THE LUKENYAN INDUSTRY: A DEFINITION

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A THESIS

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DECLARATION

This thesis is my original work and has not been presented for any degree at another University

Mulu Muia

Signature

This thesis has been submitted for examination with my approval as University Supervisor

Dr. E W. Wahome

Signature

DEDICATION

To my late Grandfather, Kamongo Ngunyu
who saw in me the hope of having a learned member in the family
and to my parents, Mr Muia Kamongo and Mrs. Rachel Wayua Muia
who made that hope a reality albeit through a lot of sacrifices

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ABSTRACT

This work analyses lithic assemblages from five Pastoral Neolithic (PN) sites at Lukenya Hill, Machakos District. It defines a new archaeological industry for the PN in East Africa. The definition is based on typological, technological and attribute analysis of flaked stone artefacts. This industry (the Lukenyan Industry) is compared to with the Elmenteitan, the only other well defined archaeological industry for the PN. These two industries constitute an Industrial Complex.

Chapter One is introduction where the basic concepts dealt with in the thesis have been introduced and discussed. A brief review of the literature from the earliest times of research in East African prehistory up to the point where the term Pastoral Neolithic was introduced has been given. Then a definition of the term itself is given and a discussion of the problem addressed in the thesis follows. It is also in this chapter that the methodology used in the study is presented. Finally, a definition of terms and technical concepts is given at the end of the chapter.

In Chapter Two, the field survey carried out in the Athi-Kapiti Plains is reported. The chapter starts by reviewing the models which informed the hypotheses tested in the field survey. Then the sampling strategy used to choose the areas surveyed is reviewed. This is followed by a presentation of survey results by area, after which a discussion of the implication of the results follows and various speculations are offered. Finally, suggestions for the survey work are made.

Chapter Three gives a description of the sites which have been studied for the thesis. It starts by giving the environmental setting of Lukenya Hill. This is followed by review of the sampling strategy used in the excavation of the sites. A description of each

site paying attention to site layout, size, stratigraphy and where applicable, the date of the site is presented.

Chapter Four presents the descriptive analysis of the artefacts. Here, a scope of analysis, typological system used, definition of tool types and reduction sequence are discussed.

In Chapter Five, a comparison of Lukenya Industry with the Elmenteitan Industry of the southwest Kenya paying attention to the similarities in the topology, technology and tool sizes is made leading to the conclusion that the two industries are similar. It was concluded that these two industries are similar and we suggested that they constitute an Industrial Complex.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

A Neolithic stage in East African prehistory was recognised by L.S.B. Leakey in the early 1920s (Leakey, 1931). The work by Mary Leakey at Hyrax Hill, Nakuru in the late 1930s provided the first comprehensive definition for the stage (Leakey 1945).The term "Stone Bowls" was introduced to denote a formal Neolithic entity which had variants (Leakey 1945; Leakey and Leakey 1950, Cole 1963) Later research on East African Neolithic sought to determine the nature of Stone Bowl Cultures (e.g. Cohen 1970, Odner 1972, Bower 1973, Merrick 1973). However, by the mid 1970s, the taxonomic importance of stone bowls was declining and attention was being directed towards other aspects of Stone Bowl sites, especially fauna (e.g. Gramly 1975, Onyango-Abuje 1977a and b). It was also at about this time that the concept of pastoralism in East African Neolithic was introduced (Odner 1972: 77-79; Gramly 1975).

Work by the University of Massachusetts, Boston group in the mid 1970s (Bower *et al.* 1977) should be viewed in the light of this shifting emphasis. As a result of extensive field survey and test excavations of sites in the central Rift Valley and its environs, the term Pastoral Neolithic (PN) was proposed which replaced Stone Bowl Cultures.

1.2 The Pastoral Neolithic Defined

The term Pastoral Neolithic (PN) was coined in the mid 1970s to refer to prehistoric communities that had a pastoral economic base relying heavily on cattle and/or ovicaprids, and a Later Stone Age (LSA) technology (Bower *et.al* 1977:119). The definition was later modified to accommodate emerging research findings showing a wide variety of subsistence regimes within the PN (Bower 1988:97). The PN was meant to be a regional developmental stage intermediate between the LSA and the Pastoral Iron Age (PIA) (Bower 1988:94).

Table 1.1: Radiometric Dates for the Pastoral Neolithic

	SASES NO	SITE	DATE	LAB REF NO	REFERENCES
1	GaJi4	Dongodien	3405±130	GX 4642-IA	Barthelme, 1984
1	GaJi4	Dongodien	4580±170	GX 4642IIA	Barthelme, 1984
2	FwJj5	Ileret SB Site	4000±140	GX 4643-A	Barthelme, 1984
3	NONE	Lopoy	1080±80	UCLA2124G	Lynch and Robins, 1979
3	NONE	Lopoy	980±80	UCLA2124J	Lynch and Robins, 1979
3	NONE	Lopoy	1100±80	UCLA2124H	Lynch and Robins, 1979
3	NONE	Lopoy	1375±125	GX5041	Lynch and Robins, 1979
4	NONE	Apeget 1	1800±300	UCLA2124K	Lynch and Robins, 1979
9	NONE	Namoratunga	2285±165	GX5042	Lynch and Robins, 1979
11	NONE	Turkwell Scheme	1500±100	N-909	Robins, 1972
10	BB-14	Kangatotha	5020±220	N-814	Robins, 1972
12	NONE	North Horr I	4405±130	GX3705	Maggs, 1977
12	NONE	North Horr I	3330±130	GX3706	Maggs, 1977
12	NONE	North Horr II	1525±155	GX3707	Maggs, 1977
12	NONE	North Horr II	748±140	GX3708	Maggs, 1977
13	NONE	Prospect Farm	2690±80	UCLA1234	Cohen, 1970
13	NONE	Prospect Farm	2910±110	N-651	Cohen, 1970
14	GrJi60	Lion Hill Cave	1850±130	GX4715	Bower and Nelson, 1978
15	GsJh1	Remnant Site	1355±145	GX4634	Bower et al., 1977
15	GsJh1	Remnant Site	2315±150	GX4324	Bower et al., 1977
16	GsJi2	Nderit Drift	1370±140	GX4320	Bower et al., 1977
16	GsJi2	Nderit Drift	1925±160	GX4318I-C	Bower et al., 1977
16	GsJi23	Nderit Drift	2360±155	GX4503-A	Bower et al., 1977
17	GrJi22	Elmenteita	1830±130	GX4216	Ambrose, 1984a
18	GsJj25	Masai Gorge RS	1545±135	GX4312	Ambrose, 1984a
18	GsJj25	Masai Gorge RS	1560±135	GX4311-C	Ambrose, 1984a
18	GsJj25	Masai Gorge RS	2325±145	GX5344	Ambrose, 1984a
18	GsJj25	Masai Gorge RS	2495±150	GX4345-A	Ambrose, 1982
18	GsJj25	Masai Gorge RS	2515±140	GX4471-A	Ambrose, 1984a
18	GsJj25	Masai Gorge RS	2595±135	GX5346	Ambrose, 1984a
18	GsJj25	Masai Gorge RS	2865±150	GX4462-A	Ambrose, 1984a
19	GsJj44	Gilgil	2200±130	GX4323-C	Bower et al., 1977
19	GsJj44	Gilgil	2040±155	GX4323-A	Bower et al., 1977
18	GtJ13	Ndabibi	1665±145	GX4463-A	Bower et al., 1977
18	GtJ13	Ndabibi	1815±120	GX4465-A	Bower et al., 1977
18	GtJ13	Ndabibi	1415±150	GX4464-G	Bower et al., 1977
18	GtJ13	Ndabibi	2225±155	GX4465-G	Bower et al., 1977
18	GtJ13	Ndabibi	1255±125	GX4463-G	Bower et al., 1977
20	NONE	Keringet Caves	2430±110	N-654	Cohen, 1970
20	NONE	Keringet Caves	2055±110	N-655	Cohen, 1970
20	NONE	Keringet Caves	2910±115	N-635	Cohen, 1970
21	GtJi10	Enkapune ya Sauli	595±130	GX9949	Ambrose, 1984a
21	GtJi10	Enkapune ya Sauli	1408±160	GX9950	Ambrose, 1984a
21	GtJi10	Enkapune ya Sauli	2040±160	GX9951	Ambrose, 1984a
22	GuJj2	Akira	1965±140	GX4386-G	Bower et al., 1977
22	GuJj2	Akira	1255±140	GX4384	Bower et al., 1977
22	GuJj2	Akira	1775±115	GX4385-G	Bower et al., 1977
22	GuJj2	Akira	1440±120	GX4386-A	Bower et al., 1977
22	GuJj2	Akira	1090±150	GX4383-A	Bower et al., 1977
23	GuJj13	Salasun	1315±135	GX4421-G	Bower et al., 1977
23	GuJj13	Salasun	2990±170	GX4468-A	Bower et al., 1977
23	GuJj13	Salasun	1110±115	GX4468-G	Bower et al., 1977
23	GuJj13	Salasun	2680±150	GX4421-A	Bower et al., 1977
24	GuJh4	Rotian	2155±140	GX5135-G	Ambrose, 1982
24	GuJh4	Rotian	1965±150	GX5135-A	Ambrose, 1982
23	GuJi14	Pickford's Site	2025±135	GX8027-G	Ambrose, 1984a
23	GuJi14	Pickford's Site	1815±120	GX8027-A	Ambrose, 1984a
25	GqJi6	Maringishu	1695±105	GX4466-A	Bower et al., 1977

Table 1.1 continued.

26	GnJh	Ngenyn, Baringo	2080±130	UCLA1322-C	Hivernel,
27	GtJj 2	Crescent Island	2660±120	GX4585-A	Onyango-Abuje, 1977
27	GtJj 2	Crescent Island	2405±150	GX4588-A	Onyango-Abuje, 1977
27	GtJj 2	Crescent Island	2660±160	GX4589-G	Onyango-Abuje, 1977
27	GtJj 2	Crescent Island	2535±140	GX4586-G	Onyango-Abuje, 1977
28	GtJj3	Causeway	895±105	GX4319-C	Bower and Nelson, 1978
28	GtJj3	Causeway	2380±140	GX5639-A	Bower and Nelson, 1978
28	GtJj3	Causeway	2045±125	GX4319-A	Bower and Nelson, 1978
28	GtJk21	Naivasha Railway RS	2000±135	GX4583-G	Onyango-Abuje, 1977
29	GrJh4	Njoro River Cave	2920±80	Y-91	Cole, 1963
30	GrJi25	Hyrax Hill	1295±105	GX4582-A	Leakey, 1945
30	GrJi25	Hyrax Hill	1955±125	GX4582-G	Leakey, 1945
16	GrJi1	Prolonged Drift	2315±150	GX5735-A	Gifford et al., 1980
16	GrJi1	Prolonged Drift	2530±160	GX5735-G	Gifford et al., 1980
31	GqJf4	Tunnel RS	2050±60	Y-1397	Sutton, 1966
31	GqJf4	Tunnel RS	2730±60	Y-1398	Sutton, 1966
32	KFR-A4	Terrace RS	2100±110	HEL-531	Siiriainen, 1977
32	KFR-A4	Terrace RS	1900±90	HEL-533	Siiriainen, 1977
32	KFR-A5	Porcupine Cave	2320±160	HEL-852	Siiriainen, 1977
32	KFR-A5	Porcupine Cave	2830±120	HEL-871	Siiriainen, 1977
32	KFR-A5	Porcupine Cave	2490±110	HEL-851	Siiriainen, 1977
32	KFR-A12	River RS	1100±120	HEL-534	Siiriainen, 1977
32	KFR-C4	Kisima Farm	760±90	HEL-853	Siiriainen, 1977
33	GwJh2	Narosura	2640±115	N-703	Odner, 1972
33	GwJh2	Narosura	2660±115	N-701	Odner, 1972
33	GwJh2	Narosura	2360±110	N-700	Odner, 1972
33	GwJh2	Narosura	2760±115	N-702	Odner, 1972
34	GvJm3	Lukenya Hill	1804±119	GX3539	Gramly, 1975
34	GvJm3	Lukenya Hill	1501±170	N-1827	Gramly, 1975
34	GvJm14	Lukenya Hill	1991± 13	N-1884	Gramly, 1975
34	GvJm22	Lukenya Hill	1490±131	UCLA1709D	Gramly, 1975
34	GvJm22	Lukenya Hill	2311±127	UCLA1709C	Gramly, 1975
34	GvJm22	Lukenya Hill	1307±122	N-1076	Gramly, 1975
34	GvJm44	Lukenya Hill	2085±135	GX4160-A	Bower and Nelson, 1978
34	GvJm44	Lukenya Hill	1710±135	GX4160-C	Bower and Nelson, 1978
34	GvJm44	Lukenya Hill	2030±125	GX4507-A	Bower and Nelson, 1978
34	GvJm44	Lukenya Hill	2070±155	GX5638-G	Ambrose, 1984a
34	GvJm44	Lukenya Hill	1775±150	GX4507-G	Bower and Nelson, 1978
34	GvJm44	Lukenya Hill	2415±155	GX5138	Ambrose, 1984a
34	GvJm44	Lukenya Hill	3290±145	GX5348	Ambrose, 1984a
34	GvJm44	Lukenya Hill	1820±200	GX5638-A	Ambrose, 1984a
34	GvJm47	Lukenya Hill	1340±145	GX4161-A	Bower and Nelson, 1978
34	GvJm47	Lukenya Hill	970±130	GX4161-G	Bower and Nelson, 1978
34	GvJm48	Lukenya Hill	1810±135	GX5347-G	Ambrose, 1984a
34	GvJm48	Lukenya Hill	1600±130	GX5347-A	Ambrose, 1984a
34	GvJm52	Lukenya Hill	1855±180	GX5692-A	Ambrose, 1984a
34	GvJm52	Lukenya Hill	2050±115	GX5692-G	Ambrose, 1984a
34	GvJm184	Lukenya Hill	2115±130	GX5774-G	Nelson, pers. comm.
34	GvJm202	Lukenya Hill	2295±135	GX7414-G	Nelson, pers. comm.
34	GvJm202	Lukenya Hill	2045±125	GX7414-A	Nelson, pers. comm.
35	NONE	Ngorongoro	2260±180	GX1243	Sassoon, 1968
36	HbJd3	Serengeti	3000±140	GX5640	Ambrose, 1984a
36	SE-3	Seronera	2020±115	N-1067	Bower, 1973
37	NONE	Nasera	2060±100	ISGS438	King and Bada, 1979
37	NONE	Nasera	2180±200	ISGS438	King and Bada, 1979
38	GuJf13	Lemek N-E	2225±140	GX8532	Robertshaw, 1990
38	GuJf6	Ngamuriak	2135±140	GX8533	Robertshaw, 1990
38	GuJf6	Ngamuriak	1940±140	GX8534	Robertshaw, 1990
38	GuJf12	New Mara Bridge	1390±150	GX8535-G	Robertshaw, 1990

Table 1.1continued.

38	GuJf12	New Mara Bridge	1315±145	GX8535-A	Robertshaw, 1990
38	GwJg8	Olopilikunya	2325±70	GX13186	Robertshaw, 1990
21	GtJi12	Enkapune ya Muto	2355±170	GX9937	Marean, 1992
21	GtJi12	Enkapune ya Muto	2595±175	GX9938	Marean, 1992
21	GtJi12	Enkapune ya Muto	2570±175	GX9939	Marean, 1992
21	GtJi12	Enkapune ya Muto	2610±70	ISGS1756	Marean, 1992
21	GtJi12	Enkapune ya Muto	2820±70	ISGS1757	Marean, 1992
21	GtJi12	Enkapune ya Muto	2330±235	GX9398	Marean, 1992
21	GtJi12	Enkapune ya Muto	2560±70	ISGS1735	Marean, 1992
21	GtJi12	Enkapune ya Muto	2860±70	ISGS1733	Marean, 1992
21	GtJi12	Enkapune ya Muto	2710±80	ISGS1746	Marean, 1992
21	GtJi12	Enkapune ya Muto	3280±190	GX9940	Marean, 1992
21	GtJi12	Enkapune ya Muto	3125±185	GX9941	Marean, 1992
21	GtJi12	Enkapune ya Muto	3030±70	ISGS1946	Marean, 1992
21	GtJi12	Enkapune ya Muto	3110±70	ISGS2040	Marean, 1992
21	GtJi12	Enkapune ya Muto	3990±70	ISGS2308	Marean, 1992
21	GtJi12	Enkapune ya Muto	4475±210	GX9942	Marean, 1992
21	GtJi12	Enkapune ya Muto	4535±170	GX9943	Marean, 1992
21	GtJi12	Enkapune ya Muto	4860±70	ISGS1742	Marean, 1992
39	NONE	Maua Farm	4140±200	GX3346	Mturi, 1986
39	NONE	Maua Farm	2160±190	GX3347	Mturi, 1986
39	NONE	Maua Farm	1545±140	GX3348	Mturi, 1986
39	NONE	Wasendo	1885±120	GX3910	Mturi, 1986
39	NONE	Wasendo	3225±140	GX3911	Mturi, 1986
39	NONE	Wasendo	3145±160	GX3912	Mturi, 1986
39	NONE	Wasendo	2170±165	GX3913	Mturi, 1986
39	NONE	Wasendo	3200±180	GX3914	Mturi, 1986
39	NONE	Wasendo	1895±120	GX3915	Mturi, 1986
39	NONE	Wasendo	1420±135	GX3916	Mturi, 1986
39	NONE	Simba I	4930±180	GX3917	Mturi, 1986
39	NONE	Simba I	5020±165	GX3918	Mturi, 1986

PN sites have a wide spatial and temporal distribution (Table 1.1; Map 1.1). They stretch from northern Tanzania, through most of Kenya upto north eastern Uganda. They contain ceramic, lithic and faunal assemblages which are highly heterogeneous from site to site. This aspect of the PN, coupled with the wide separation of sites with similar characteristics (e.g., the sites of Crescent Island and Narosura (Onyango-Abuje 1977a:158)) has made it difficult to identify and define archaeological cultures for the Neolithic Era in East Africa.

1.3 Literature Review and The Problem Statement

The PN lacks a well-defined culture-historical framework. The one proposed by Bower *et al.* (1977:119-143) was severely criticized by various scholars who in turn proposed other schemes which have nevertheless been unsatisfactory (e.g. Ambrose 1984a, 1984b, Collett and Robertshaw 1983; Robertshaw and Collett 1983, see also Bower 1988:92-108 for a fuller discussion). Simply put, our understanding of the PN stage has been hampered by inability to define archaeological cultures as a result of the heterogeneity of materials found in PN sites.

The concept of archaeological cultures has a long history, but it found its first explicit expression in the literature only in the mid nineteenth century. At this time, European archaeologists began labeling geographically and temporally restricted assemblages of prehistoric materials as the remains of ethnic groups (Trigger 1989:148-206). An "archaeological culture" refers to similar assemblages of artefacts found at several sites defined in a precise context of time and space representing the surviving remains of a human society. Clarke (1968:407) defined an archaeological culture as "a polythetic set of specific and comprehensive artefact-types which consistently recur together within a limited geographical area", partially representing the whole spectrum of sociocultural roles and activities. An archaeological culture is comparable to an industry (*cf.* Close 1977:2; Bishop and Clark 1967:893, Nelson 1977:138-9). Therefore, the consistent recurrence of similar assemblages which are geographically contiguous and temporally restricted may be taken to constitute an archaeological culture. A well-defined industry may be used in the identification of an archaeological culture.

The assemblages which are similar are as a result of manufacture by a single self-conscious social group and represent an archaeological culture (Clarke 1968:407). We can recognise archaeological cultures by identifying artefact styles and by showing their distribution in time and space (Close 1977:2). Flaked stone tools and ceramics are particularly useful in this respect because they are the most abundant in the archaeological record. There are certain technological features characterizing a certain industry which act as distinctive markers of cultural groups.

The argument being advanced in this thesis is twofold. First, lithic and ceramic production is a learned process. As a result, a certain social group evolves its own manner (that is technology) of producing flaked stone tools and ceramics. Like language, a peoples' technology is unique to them. Therefore, social groups can be recognized in the archaeological record by analyzing and understanding the technology behind the production of both stone tools and ceramics. Second, the subsistence, economic organisation, trade and burial tradition of prehistoric social groups can only be understood in the context of well-defined archaeological cultures. In the PN, an archaeological culture can be defined by identifying a ceramic ware which co-varies with a distinct flaked stone tool technology. The PN has different ceramic wares which occupy overlapping positions in time and space (Bower 1988:93,97; see also Wandibba 1977). Individual wares are associated with different flaked stone tool technologies at different sites, making it difficult to identify archaeological cultures. If and when archaeological cultures have been identified, the detailed study of the other aspects of these prehistoric societies (economic organisation, subsistence and trade among others) becomes possible. The Elmenteitan culture is a case in point.

The original definition of the Elmenteitan lithic industry , given by Louis Leakey (1931: 172-5), was based on topology of flaked stone tools although the pottery associated with it (Elmenteitan

Ware, nee Remnant Ware, see Wandibba 1977; also Bower *et al.* 1977:134-140) was incorporated. A technological definition was offered in 1977 by Nelson (1980:275-278). Ambrose (1984a: 220-1) proposed a definition for the Elmenteitan culture which incorporated mortuary tradition, geographic distribution and economy, in addition to a lithic industry and pottery type. Robertshaw (1988, 1990) documented a stone artefact assemblage in the Lemek-Mara region of south-western Kenya which differed from those of the central Rift Valley, but which is associated with Elmenteitan pottery. On this basis, it was interpreted as a functional variant of the Elmenteitan Industry. It was also shown that, while the average size of larger artefacts, such as *outils ecailles,* may decrease with distance from the central Rift Valley, the size of the geometric microliths and curved backed blades, which are quite small, remain constant (Robertshaw 1988:58-9).

The Elmenteitan is the only securely defined archaeological culture within the PN in terms of both the ceramic and lithic technology. A fair amount is known about subsistence, settlement pattern and technology of the Elmenteitan culture. The same cannot be said for other societies living in East Africa during the PN period. The most obvious associations between PN sites are based on the similarity of pottery assemblages. Since pottery assemblages alone cannot constitute an archaeological culture, most PN sites have been left without proper assignation to specific cultural entities (e.g., the site of Prolonged Drift, Gifford *et al.* 1980:64). As a result, it has been difficult to analyze specific cultural adaptations of the prehistoric peoples living in East Africa during the PN period. For example, faunal studies have revealed a wide variety of subsistence strategies within the PN stage. Some PN sites have their faunal remains dominated by wild species (e.g., the site of Naivasha Railway Rock shelter, Gifford-Gonzalez and Kimengich 1984:451-471); others have a mix of a wild and domestic taxa (e.g., the site of Prolonged Drift, Gifford *et al.* 1980:57-108) while others have domestic stock dominating (e.g., the site of Crescent Island, Onyango-Abuje 1977:147-159). Equally varied is the structure of the settlements and the settlement pattern (Bower 1984a, b). If then we are to begin to understand this important phase in East African prehistory, we need to subdivide it into appropriate divisions for study. The need to identify and define another archaeological culture for the PN cannot, therefore, be gainsaid.

The research reported here defines a new PN lithic industry to help us in the identification of an archaeological culture. It is based on the analysis of lithic assemblages recovered from GvJm47 (Wambua's), GvJm48 (Makongoni), GvJm52 (Silanga), GvJm184 (Brown's) and GvJm299 (Daystar University) at Lukenya Hill. Materials from these sites reveal a distinct lithic industry which is associated with a unique pottery ware. The faunal remains from these sites are almost wholly dominated by domestic stock and cattle bones account for upto 98% of the bone assemblages (Nelson and Kimengich 1984:497). These sites are not only geographically contiguous, but also have dates which overlap very well (ranging between 2300 and 1600 BP, Table 1.1): they are the type sites for the Lukenyan Industry.

The Lukenyan Industry sites are very large and open with areas of up to 50,000 square metres. They often have more than one ash heap which it now appears, from Wambua's and Daystar sites, may be on the periphery. They are located on the well-drained gentle slopes of the hill: GvJm48 and GvJm52 are on the eastern side while GvJm47, GvJm184 and GvJm299 are on the western side. They are found between 40 and 350 metres from the base of the hill. The sites can be recognized by observing a scatter of artefacts exposed by erosion or by burrowing animals and by presence of ash heaps.

Assemblages recovered from these sites comprise bones, stone artefacts and ceramics. The faunal remains are almost a hundred percent domestic cattle and ovicaprids. A stone bowl fragment, exposed by erosion, was recovered from GvJm184 during the reconnaissance survey, the first such find from the open sites (Nelson, pers. comm.). Three more stone bowl fragments were later recovered from GvJm47. Due to the nature of the problem investigated here and the time and resources at our disposal it was not possible to deal with all the materials recovered from these sites.

It is the analysis of the lithic and ceramic assemblages from GvJm47, GvJm48, GvJm52, GvJm184 and GvJm299 which forms the basis for the definition of a new industry for the PN. The focus of the research reported here is the lithics (the ceramics were analysed by Mr. Were).

1.4 Theoretical Framework and Research Hypotheses

The theoretical framework used in this study is the Systems Theory. Culture is viewed as a function of the environment in which it is found. The unique features of any culture are as result of adaptive response to the challenges the environment poses. In this scheme of things, it follows that cultures in similar environments will have the same features.

The working hypothesis in this thesis is that the Athi-Kapiti Plains will have archaeological cultures which are similar in terms of topology and technology and that the lithics found in the sites have similar topology, were made using the same technology and that they have the same size.

1.5 The Research Design

The research reported here was done in several phases.

1) A preliminary analysis of lithic assemblages from three of the sites studied and reported here, stored at the Archaeology Laboratory of the National Museums of Kenya, was done. This material was recovered during a series of field surveys between 1975 and 1981 (Nelson, pers. comm., see also Bower *et al.* 1977:140-1). The aim of this analysis was to determine the feasibility of the study and how to recognise the industry in the field. The analysis was threefold.

a) the various typological categories were identified to make calculation of percentages of tool types possible. (b) a qualitative analysis of the reduction sequence was attempted with a view to understanding the technology used in the production of the tools. (c) attributes for formal description of the tools were recorded. These attributes were tool sizes (length, width and thickness).

2) The sites at Lukenya Hill were visited to determine their characteristics and to map their

features.

3) An archaeological survey was done based on one and two above to attempt to extend the geographic range and number of assemblages available for analysis. The focus of this survey was the Athi-Kapiti Plains. Stratified probability sampling techniques, though not in the strict sense of the term, were used. Given the nature of the research conducted and the time and resources at our disposal, only the hills were sampled for survey. Localities were selected using elevation, slope of the land, distance from the base of the hills, size of the hills and soil type. Other special features like springs and gullies were also taken into consideration Each of the localities so defined was subjected to foot survey. The northern end of Lukenya Hill, which up to the time of our survey had not been surveyed, was also surveyed. Identified sites were marked on topographic maps and given SASES numbers (Chapter Two).

4) Selected sites were targeted for test excavations to obtain new assemblages for analysis. Since no sites comparable to those of Lukenya Hill were found in the Athi-Kapiti Plains, two sites at Lukenya Hill were chosen for excavation These were Wambua's (GvJm47) and Daystar (GvJm299) (Chapter Three)

5) Laboratory analysis of the assemblages was done followed by the description of the Industry (Chapter Four). The analysis was the same as that described in one above

6) A comparative analysis of these materials with Elmenteitan assemblages from sites in Lemek-Mara in south-western Kenya was done. The aim was to establish the range of variation of materials within the two industries against which the similarities and differences among other PN sites may be assessed This comparison is necessary because Lukenya Hill and Lemek-Mara have the same spatial distribution (relatively far from their obsidian sources in the central Rift Valley) and have the same temporal distribution.

1.6 Summary and Conclusion

As pointed out in section 1.3 above, the assemblages from the five PN sites at Lukenya meet the basic requirements of a lithic industry. However, it is important to point out that material from some of the sites have been proposed to belong to the provisionally-named Savanna Pastoral Neolithic (SPN) (Ambrose 1984a; 1984b). It is hoped that if a new lithic industry can be defined from the assemblages from these sites, then a basis will have been established for evaluating the validity of the SPN

Pottery and probably lithic assemblages from the upper levels of GvJm44 were observed to be similar to the assemblages from the sites under study. They were not included in the present study because we did not think that their non-inclusion will significantly affect the outcome of this study. There are also three pottery traditions represented in this site and we were unable to determine the boundaries between them. It is hoped that an evaluation of the nature of lithics at this site will help verify whether or not the relationship between lithics and pottery observed for the five PN sites at Lukenya Hill is fortuitous.

1.7 Definition of Terms and Technical Concepts Used in the Thesis

Industry - Is comparable to an archaeological culture. Refers to similar assemblages of artefacts found at various sites defined in a precise context of time and space representing the surviving remains of a human society (Bishop and Clark 1967:893; Close 1977:2; Nelson 1976:138-9).

Industrial Complex - refers to a grouping of industries considered to represent the same whole (Bishop and Clark 1967:892)

Assemblage - refers to any collection of artefacts and ecofacts which have been recovered from an archaeological site

Culture - refers to a peoples way of life; all that is nonbiological and socially transmitted in a society, including artistic, social, ideological, and religious patterns of behaviour and the techniques of mastering the environment. Usually used to indicate a social grouping that is smaller than a civilization but larger than an industry

Archaeological Culture - Is comparable to an industry. It refers to similar assemblages of artefacts found at several sites defined in a precise context of time and space representing the surviving remains of a human society (Bishop and Clark 1967:893; Close 1977:2; Nelson 1976:138-9).

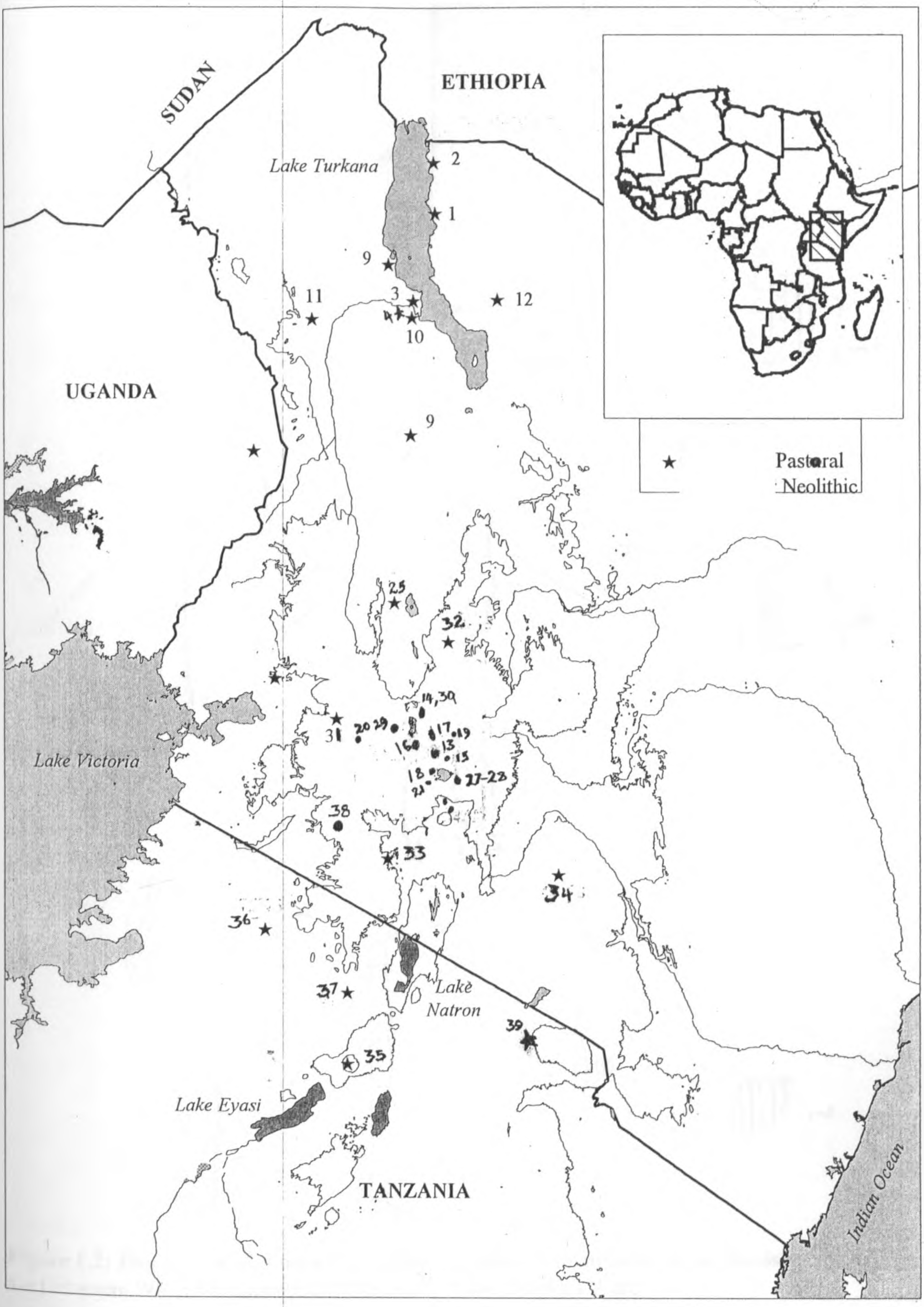

Figure 1.1: Map showing sites mentioned in Table 1.1 (adapted from Ambrose 1984a).

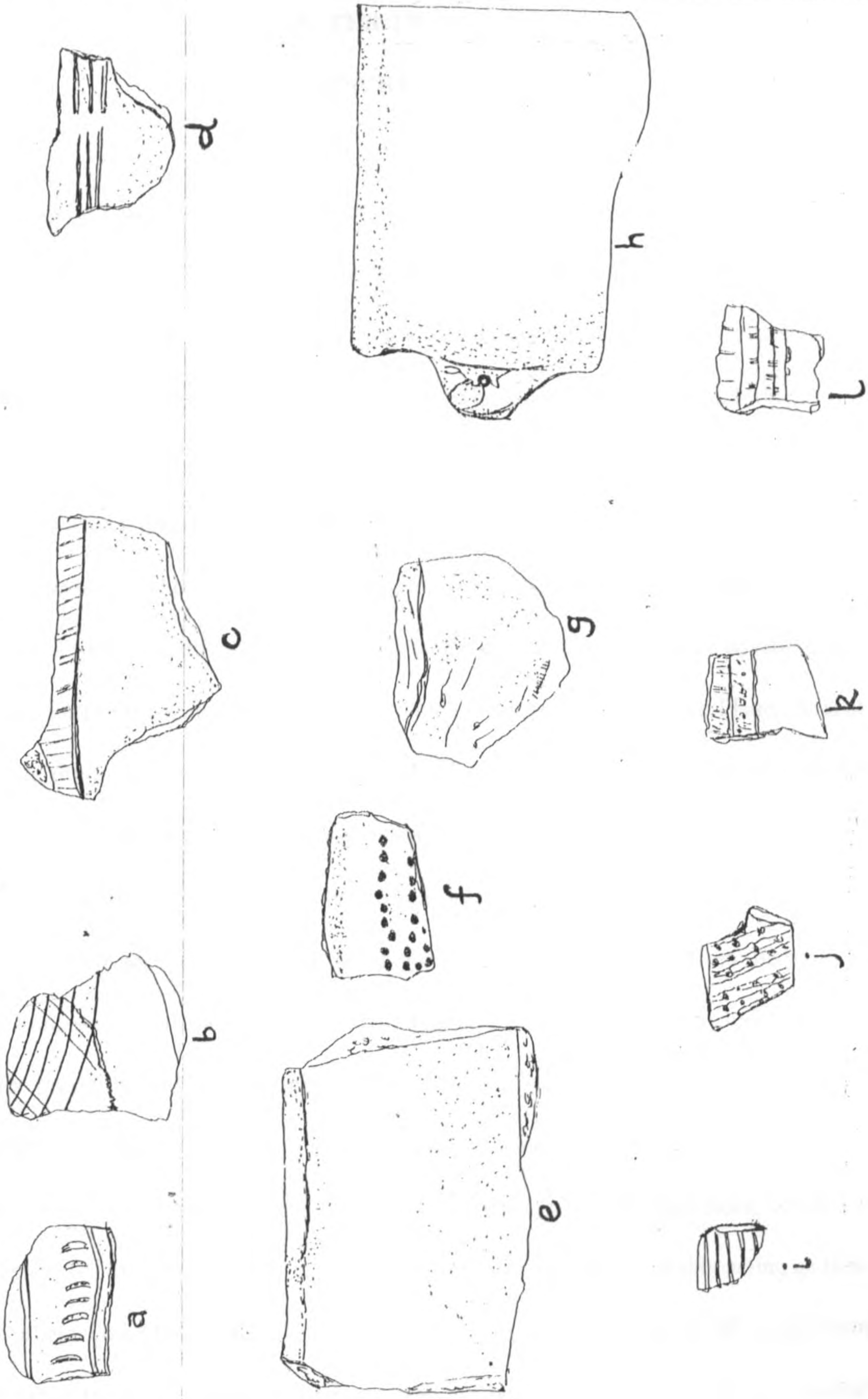

Figure 1.2: Illustration of some of the pottery traditions mentioned in the thesis
a-e Lukenyan Ware; f-h Elmenteitan (Remnant) Ware, i-l Akira Ware

CHAPTER TWO

FIELD SURVEY

2.1 Introduction

Our hypotheses for this field survey were anchored by two models which viewed Lukenya Hill as part of a wider pastoral ecology. Pastoralists are known to be wide ranging and to occupy a heterogeneity of ecological zones often encompassing lowlands and highlands to take advantage of seasonal variation in the distribution of pasture and water. The lowlands usually have little pasture and water in the dry seasons to support large stocks associated with pastoralists, they would therefore, be suitable for habitation during the rainy season when new pastures grow and water collects in seasonal streams. The highlands, which receive better rains due to their elevation would have enough pastures and water during the dry seasons which pastoralists would take advantage of. The hill is therefore part of the wider ecological zone which includes the Athi-Kapiti Plains. It is at the middle of the territory of a pastoral group that moved with their livestock to the plains during the rain season to take advantage of pastures and water in the lowlands during these times. They would then use the pastures in the highlands during the dry seasons

The first model envisages such a pastoral group moving with their livestock from the foothills of the Aberdare Ranges during the wet seasons and settling on the lowlands which include the Athi-Kapiti Plains; the reverse would be true during the dry seasons. The second model envisages such a group originating from the Mt. Kenya region, following the same pattern as above, Lukenya Hill would, be at the middle of such movements. The sites at Lukenya Hill would, therefore, constitute part of the settlements of the pastoral group during their stint in the lowlands, probably acting as their home base; the others would be on the Athi-Kapiti Plains. Alternatively, Lukenya Hill would form the southern fringes of the group's territory. In such a case, we would not expect to find sites similar to those of Lukenya Hill on the Athi-Kapiti Plains.

The working hypothesis for this study therefore, is that the assemblages from Wambua's

(GvJm47), Makongoni (GvJm48), Silanga (GvJm52), Brown's (GvJm184) and Daystar (GvJm299) sites at Lukenya Hill represent one lithic industry and that it is replicated in the Athi-Kapiti Plains. That is, the sites in the Athi-Kapiti Plains with the lithic industry and the Ware of the sites at Lukenya Hill represent the same adaptations as those of the Hill. Therefore, the technology used in the manufacture of stone tools represented in those sites and the range of types should be the same as those of Lukenya Hill sites.

2.2 Objectives

The primary objective of our survey in the Athi-Kapiti Plains was to locate sites comparable to those at Lukenya Hill. This was aimed at extending the known geographic distribution of such sites with a view to understanding the settlement pattern of the people who left them. Second, we sought to increase the number of assemblages from comparable sites to make the definition of the industry represented at them more comprehensive.

Taking into consideration the time and resources at our disposal, we targeted areas similar to those where the sites at Lukenya Hill are situated. Therefore, we used the situation and characteristics of the sites at Lukenya Hill as the model for our field survey. At Lukenya, most late PN open sites are found situated between 40 metres (Makongoni, GvJm48) and 350 metres (Wambua's, GvJm47) from the base of the hill at altitudes ranging from about 1600 to 1700 metres above sea level and on well-drained soils with slope ranging from 4.0 degrees to 8.5 degrees. These sites are also found at an average distance of six kilometres from permanent water sources (the Athi River) which are suitable for sustaining large herds of stock. They also have clear structural characteristics with large ash heaps, sometimes two, which, from evidence from Wambua's and Daystar, may be at the periphery of the site. The sites range in size from about 5400 square metres (Makongoni, GvJm48) to over 60,000 square metres (Wambua's, GvJm47) and are easily recognised

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In this regard, localities were targeted for foot survey on the basis of the slope of the land, distance from the base of the hill, elevation, soil type and proximity to water sources. These variables overlap in a limited number of places in the Athi-Kapiti Plains. This strategy, while not exhaustive in any way, was adopted in view of the time and resources at our disposal and the desire to cover a large area as far south of Lukenya Hill as possible. On the basis of map analysis and a drive-by of locations identified in this analysis, three minor and two major localities were chosen for survey. These are Kyumbi, Kyamutheke, Kavani, Sultan Hamud and Ilbisil.

Kyumbi and Kyamutheke Hills are inselbergs to the south east south and east south east of Lukenya Hill respectively. Kyumbi is about six kilometres from Lukenya Hill while Kyamutheke is about eight kilometres away.

Kavani is a single inselberg situated within the Konza Ranch in the Athi-Kapiti Plains which rises up to an altitude of 1776 metres above sea level.

At the Sultan Hamud area (about 70 kilometres from Lukenya Hill) several localities were subjected to foot survey. These included Soysambu, Oloonkai, Lolondo, Matui, Bwanakala, Iltorot and Kekorook which are to the east of the East Africa Portland Cement's Quarry and Factory at Kibini (or Nkama) and Embolioi, Kiasa and Emukishoe hills to the west. The former are within easy reach of a marshland which nowadays has several wells dug into it while the latter are within easy reach of Elsenkei River and the wells at Selengei, Ngongu and Olorika

At Ilbisil, which is about 70 kilometres from Lukenya Hill and about 30 kilometres south of Kajiado town along the Nairobi-Namanga Road, we surveyed a section of Emisinga, Lemeiopoti and Ilemelepo hills and a section of the Ilbisil River. All these areas are within easy reach of Ilbisil River and Olkejuado River into which it drains.

These areas were chosen for survey to see if the inhabitants of Lukenya Hill ranged that far south, putting such areas to the same use as Lukenya Hill.

2.3 Survey strategy

The strategy used in this survey was a mix of strategies used by Peter Robertshaw in the Lemek-Mara region and John Bower in the Serengeti Plains. Taking into consideration the slope of the land, distance from the base of the hill and elevation among other factors, we placed ourselves ten metres apart. That means that everybody had about five metres to survey between us (the overlap), with up to ten metres to survey on the area away from the overlap. We would converge on areas with burrows and which have been eroded for thorough inspection. Depending on the nature of the slope, areas further downslope were examined. This way we covered the entire range of possibilities on which sites would be found based on the Lukenya Hill model

2.4 Survey Results by Area

2.4.1. Lukenya Hill: The northern end of the hill was surveyed as part of an exercise to develop survey techniques for application in the Athi-Kapiti Plains. A total of nine new sites was found: one Acheulean, one site with MSA and LSA horizons, three LSA, two PN and two Iron Age

a) Daystar University (GvJm299): This is a Late PN site of the Lukenyan Industry and has two ash heaps both of which have bone, pottery and obsidian flakes exposed by rodents and ant bears. It also has small erosional surfaces some of which have materials eroding from them. It is on the western side of Lukenya Hill, near Daystar University. Part of the site is on the University's land, hence the name

b) GvJm300: This is an LSA site. A scatter of obsidian, silica and quartz was observed eroding out of the deposits.

c) GvJm301: This is an Iron Age site found between GvJm47 (Wambua's) and GvJm184 (Brown's). Slag and pottery (a tuyere?) were observed

d) GvJm302: This is an Acheulean site with a quartz-based industry. We observed a hand axe, several heavy-duty scrapers, polyhedrons and hammer stones. It appears the site has been destroyed by erosion with very little left undisturbed.

e) GvJm303: This is an LSA site which may have an overlying PN and/or PIA layer A dense scatter of quartz tools and obsidian and silica in smaller quantities was observed. Bone and two undecorated potsherds were exposed some distance away from the main LSA scatter. One of the potsherds is very thick (the base of a vessel?) while the other one is only slightly thinner

f) GvJm304: This is also an LSA site A dense scatter of quartz was observed while obsidian and silica were in lesser quantities Bones were exposed by ant bear some distance away from the main scatter A potsherd with cross-hatching decoration may indicate low level PN utilisation

g) GvJm305: This is a PN site of the Akira period. It is found to the east of Daystar site (GvJm299) near a deep gully. This site was virtually destroyed by erosion The potsherds observed were heavily weathered Very few lithic artefacts were observed

h) GvJm306: This is probably an Iron Age site found adjacent to GvJm305 (the Akira site). This site too was virtually destroyed by erosion We observed undecorated weathered potsherds

i) GvJm307: This is possibly a late MSA or early LSA site found on a small inselberg to the north east corner of the Daystar University compound This is where they have the water tanks supplying the University constructed It is possible that part of the site was destroyed by the construction of the tanks. Obsidian, silica and quartz artefacts were observed in light scatters.

2.4.2 Kavani: We made a one day trip to Kavani, a small inselberg to the south east south of the Ministry of Public Work's (MOPW's) Road Mantainance camp at Konza on the Mombasa highway.

The inselberg is to the east of the road, about 4.3 kilometres from the camp. An LSA and a PN site were found.

a) GwJm7: This is an LSA site found mainly on the northern and north western end of the inselberg, based mostly on quartz, some silica and a little bit of obsidian. A scatter of obsidian, maybe of PN age, was observed on the top of the inselberg. An unusually high density of obsidian scatter on the northern face of the larger rock outcrop may date from either the LSA or PN.

b) GwJm8: This is a PN site found further downslope on the south west side of the hill, 90 metres upslope from the only bedrock in the vicinity. Artefacts, mostly made on quartz with a few obsidian and silica tools, bones and a single potsherd were observed in three closely spaced ant bear exposures. The potsherd (which has comb-impressed decoration) has affinities to Suswa Ware (Nelson, pers. comm.).

2.4.3 Kyumbi: This is an inselberg about 5 kilometres to the south east south of Lukenya Hill. It is found to the west of the Nairobi-Mombasa highway directly opposite the junction with the Machakos road. It has the same structural formation as the Lukenya Hill.

A one day trip was made to this hill. The entire foothill and outlying areas were surveyed. Except for stray artefacts observed on the surface, no sites were found. A small scatter of undecorated pottery observed on a road side on the southern end of the hill was modern. The absence of sites can possibly be explained by the steep slope of the hill which made deposition difficult or which encouraged the washing away of any sites which may have formed there.

2.4.4 Kyamutheke: This is also an inselberg about eight kilometres to the east south east of Lukenya Hill and about three kilometres from Kyumbi. It is found to the east of the Nairobi-Mombasa highway.

The whole hill side was surveyed. Mostly obsidian artefacts were observed on the eastern and western sides of the hill, but none were in appreciable concentrations to warrant recording as sites. On the western side of the hill, the obsidian was observed on the road leading up to Mr Mwambi's home and it is thought that they come from a site that may have been destroyed by the road cutting or a small quarry near the foot of the hill. On the eastern side of the hill, the artefacts were observed in several erosional surfaces, especially on the north-east and some of them were weathered. None were found in a continuos scatter to merit recording as a site. It is suspected that the sites had been destroyed by erosion.

2.4.5 Sultan Hamud: Two major localities were surveyed in this area. These included the hills of Soysambu, Oloonkai and Lolondo, Matui, Bwanakala, Iltoroto and Kekorook which lie to the east of East Africa Portland Cement Quarry at Kibini and Embolioi, Kiasa and Emukishoe hills to the west.

There were numerous erosion surfaces on the slopes of these hills, but no sites were found. However, a thin scatter of obsidian and quartz flakes was found on the landscape at various places through out the survey area, though never in enough densities to merit recording any sites. Numerous potsherds, which had no decorations were observed. They are thought to be modern because none were found eroding from the numerous erosion faces.

2.4.6 Ilbisil: In this area, we wished to survey the Maparasha, Lemeipoti, Emisinga and Ilemelepo hills. However, certain areas were inaccessible due to dense vegetation and ticks, especially Maparasha and Ilemelepo Hills. There was also the danger of wild animals, especially buffaloes. Nevertheless, we managed to survey a section of Emisinga Hills, the whole of Lemeipoti Hill and a section of Ilemelepo Hills in addition to a number of nearby small hills.

Over most of the areas, we observed stray obsidian flakes on the landscape, but none in quantities enough to make a site. In addition, a total of five sites was found.

a) HaJl1: This is a PN site found about 200 metres downstream from the bridge across the Ilbisil River on Namanga road. An ashy bone deposit was observed filling a shallow depression about one metre from the ground surface in an old river terrace. Some of the bones were collected for possible dating. Two potsherds (which were *in situ*) were also collected and have affinities to Akira Ware.

b) HaJl2: This is a Rock shelter with Maasai shield paintings. It has quartz and silica artefacts eroding out at the drip line.

c) HaJl3: An LSA site which covers most of the foot of the small inselberg stretching from the eastern side across the western side and a part of the southern end On the southwest, there is LSA with bone and possible MSA (several discoids were observed).

d) HaJl4: A possible early PN site located to the west of Ilbisil Market on the road to Torosei It has moderate quantities of obsidian and undecorated potsherds. No bone is preserved

e) HaJl5: This is an Iron Age site about a kilometre and a half before the Market on the eastern side of Namanga Road near the water tank that supplies the market, the Health Centre and the school It has metal slag which maybe associated with remelting of iron Undecorated potsherds were also observed

2.5 Addendum

In February 1996, about two years after our survey in the Athi-Kapiti Plains to the south of Lukenya Hill, a site was found in the Nairobi National Park about fifteen kilometres to the west of the hill. It is found on the margin of a ridge where it starts a gradual drop towards a stream The soil is well drained and the degree of slope on which it is found is within that of the Lukenya Hill sites even without the benefit of an inselberg. The setting for this site is the same as the one recorded for

Maasai settlements in the Amboseli area by Western and Dunne (1979) and the Ngamuriak site in southwest Kenya (Robertshaw 1991).

This site has the ceramic ware associated with the Lukenyan Industry and is the first site away from the hill to contain that ware. The lithics are made of obsidian, silica and quartz. Preliminary examination shows that their technology is basically the same as that represented by the Lukenya Hill assemblages. Distribution of material in and around the quarry shows that the site is smaller than any of those at Lukenya. No evidence of an ash heap survives. About 70 per cent of the site has been destroyed by quarrying for murram to gravel the roads inside the park. This site was designated GvJl1.

2.6 The Lukenyan Settlement System

The new site in the Nairobi National Park (GvJl1) has several implications for the kind of settlement system we can expect for the Lukenyan populations in the Athi-Kapiti Plains. Its small size and lack of ash heaps would suggest a system of stock herding where only small numbers of stock were kept in the sites away from Lukenya Hill. This would be related to availability of permanent sources of water, which are very few in the Athi-Kapiti Plains. In this case, sites in the Athi-Kapiti Plains would be expected to be smaller. Considering the location of the Nairobi National Park site on well-drained soils on the flank of a stream, sites in the Athi-Kapiti Plains would be expected to occur in similar environments. This settlement pattern has been documented for the Elmenteitan in the Lemek-Mara region (Robertshaw 1988, 1990, see also Western and Dunne 1979).

2.7 Implications of the Survey Data

As pointed out elsewhere, we not only did not find sites comparable to those of Lukenya Hill in the Sultan Hamud area, but no sites at all. Going by the amount of obsidian observed on the landscape, it is inconceivable that sites are altogether absent. Either the sampling technique used did not cover the areas with exposed sites or the numerous erosional faces did not expose any sites. However, this is not possible because the sites at Lukenya Hill are not buried deep enough to fail to be exposed by either erosion or burrowing. It is also possible that the area was infested with tsetse flies in prehistoric times which made pastoralism impossible.

The other implication is that the pastoralists who left the Lukenya Hill sites did not go this far south, making the hill the southern limit of their territory. This is unlikely though considering that pottery similar to that found at Lukenya Hill sites was found at PN sites on the western slopes of Mt Kilimanjaro (Mturi 1986). The Athi-Kapiti Plains would be the only corridor between the two localities and the area of contact between the Kilimanjaro populations and the Lukenya Hill populations would be somewhere in the Sultan Hamud area and the environs. This implies that the Lukenya Hill populations may have used these areas in a different manner, possibly because the area does not have permanent water sources capable of supporting large herds

The presence of Akira-like ceramics at Ilbisil and at Lukenya Hill also has specific implications for our study. At Lukenya Hill, Akira Ware is slightly older than the pottery we are trying to define. If the Lukenyan populations replaced the Akira populations, then we should have sites in the Ilbisil area that were left behind by these same people which is not so far the case. The Akira-like ceramics at Ilbisil were found in an old river terrace (about one meter from the ground surface) exposed by the erosion of the present river channel to about six metres. Because so far there is no evidence to show that Lukenyan settlement pattern includes floodplain occupation, it might be argued that the spate of erosion mentioned above may have destroyed any Lukenyan sites in other environments. The fact that we do not have sites similar to those at Lukenya Hill may mean that the Akira populations defended their territory against encroachment by the Lukenyan people. The third possibility is that both populations occupied different parts of the landscape.

It is important to note that LSA sites occur in very low frequencies in the areas we surveyed.

The implication here is that some factors created low densities of hunter-gatherers in the area, the most important perhaps being the amount of water during the dry season.

It is also important to note that, in the Lemek-Mara region very few LSA sites were found in contrast to the Serengeti Plains to the south, yet they are in the same ecosystem (Robertshaw 1990). In Serengeti, LSA sites were found in or near rock shelters which are not common in Lemek-Mara In our area of study only one rock shelter site was found This is probably because no systematic effort was made to survey rock faces

The Nairobi National Park site has specific implications for the models anchoring our hypotheses. While it is too early to make any conclusions about the territorial range of the Lukenyan pastoralists, one can not help noting that the new site would seem to be in the general direction of the Central Rift and would lie in the route through which obsidian found its way to Lukenya Hill; the temptation to consider Lukenya Hill as being within the southern fringes of their territory is very strong

2.8 A Strategy for Future Survey Work

The strategy we used during our survey ignored the plains because experience elsewhere had shown that these environments have few sites (Robertshaw 1990) The new site in the Nairobi National Park voids this approach and a reconsideration of the strategy for future survey work in the plains is necessary. The specific location of this site on a well drained ridge would suggest that all such micro-environments in the Athi-Kapiti Plains be the focus of future survey effort Other micro-environments like river terraces and low-lying hills, which were not surveyed in the Sultan Hamud area and other low-lying areas not liable to erosion, especially those next to permanent water sources should be surveyed in future.

Meanwhile, other areas to the south of the Athi-Kapiti Plains need further attention These would include the area between Sultan Hamud and Kilungu Hills. The region lying between Ilbisil and Mount Kilimanjaro, including the foothills of Oldonyo Orok and Mount Meru are particularly wanting in view of the sites on West Kilimanjaro which have a pottery Ware which has been described as Narosura-like (Mturi 1986), but which we consider to be similar to the one found at Lukenya Hill. The exact nature of the West Kilimanjaro material should be determined.

Other areas which need attention are those to the west and north of Lukenya Hill. The corridor between Lukenya Hill, the Kikuyu Escarpment, the Aberdare Ranges, Mount Kenya and Oldonyo Sabuk need to be surveyed. The new site at the Nairobi National Park strongly suggests that the corridor between the Ngong Hills and the Kikuyu Escarpment, moving northwards towards the Aberdares should receive priority.

As already pointed out, our survey results may have been compromised by the survey strategy we adopted. We also did our survey during the rainy season when vegetation was dense in certain areas hindering accessibility. It is suggested that future survey in the area should be done in a broadly defined research framework, for example one aimed at reconstructing the culture history of the area.

To understand the LSA settlement pattern in the Sultan Hamud-Kajiado area and their environs, a stratified survey is recommended. In this sort of study, one would seek to understand the effect distribution of water sources and rainfall patterns had on distribution of such sites and to compare these results to better watered uplands to the north.

2.9 Summary and Conclusion

In this chapter, we reviewed the objectives, the strategy and the results of our field survey in the Athi-Kapiti Plains. We also discussed the implications of our results for the prehistory of this area and offered suggestions for future survey work in the Athi-Kapiti Plains.

From the foregoing, it is clear that a lot of questions have been raised than answered and that there is more that needs to be done. The nature of the lithics associated with the Lukenya-like pottery at the PN sites on Mt. Kilimanjaro needs to be assessed. Most of the discussion in section 2.6 is highly speculative in the absence of more data. Akira Ware is found in a number of sites on Lukenya Hill and at GvJm44, it is stratified below Lukenya Ware. While Akira Ware is found in the Ilbisil area, Lukenya Ware is lacking. Why this should be the case needs to be addressed as a matter of priority in future surveys.

The lithics at the upper levels of GvJm44 are suspected to be similar to those of the Lukenyan lithic industry. Their true nature need to be analysed and compared with that of the Lukenyan Industry. This is necessary so that we can understand whether the technology of the lithics associated with the Akira Ware is different from that associated with the Lukenyan Ware. This will be important as a first step towards understanding the role of pottery traditions in the definition of lithic industries and whether or not distinct pottery traditions (as defined for the PN in East Africa) represent social groups or cultural entities.

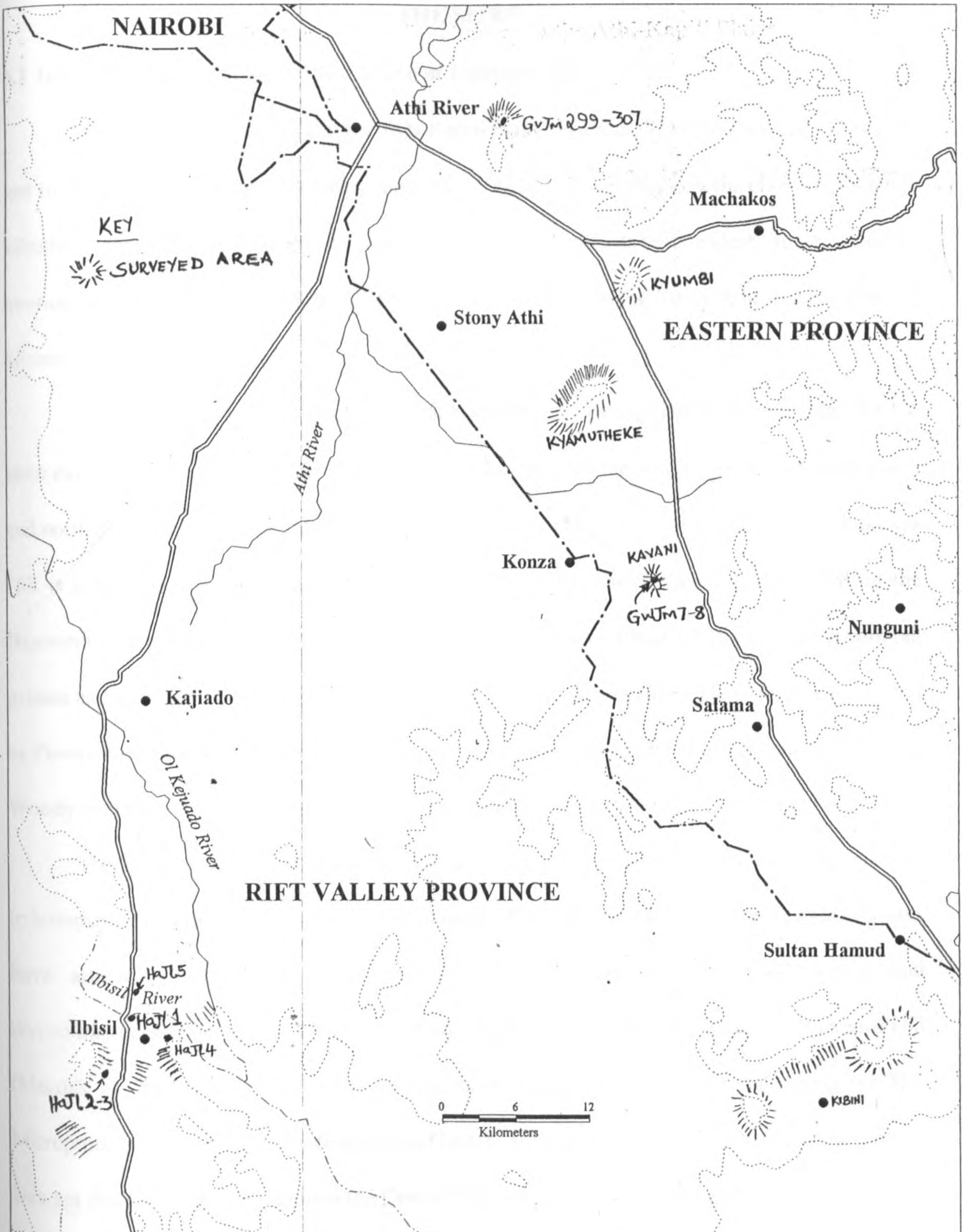


Figure 2.1: Map showing the area of Field Survey in the Athi-Kapiti Plains

CHAPTER THREE

THE SITES

3.1 Introduction: The Geographic Setting of Lukenya Hill

Lukenya Hill, an inselberg in the Athi-Kapiti Plains, is about 40 kilometres east of Nairobi, just to the north of the Nairobi-Mombasa highway. It rises 200 metres above the plains, is about 11 kilometres long in a north-south orientation and about 5 kilometres at its widest. It is situated an average of 5 kilometres from Athi River to its north-west while the Stony Athi River is about 3 kilometres to its west (Figure 3.1)

Situated at the northern fringe of the Athi-Kapiti Plains, Lukenya Hill is in the middle of what once must have been a major wildlife migration corridor between the Athi-Kapiti Plains to the south and north-west and Ol Doinyo Sabuk to the north (Marean 1992:240-1). The vegetation at Lukenya Hill is mainly acacia-cammiphora bushland on well-drained sandy clay soils derived from the Basement rock of the hill while that of the surrounding Athi-Kapiti Plains is typical savanna with tall grasses and scattered acacia trees suitable for plain game. The grasses of the plains are predominated by *Pennisetum mezianum*, *Bothriochloa insulpta*, *Themada triandra* and *Digitaria macroblephara*. Woody vegetation is predominated by *Acacia drepanolobium* (Foster and Coe, 1968).

The hill has a wealth of archaeological sites stretching in age from the Early Stone Age (ESA) to historical times (the latter both Kamba and Maasai). The ESA and Middle Stone Age (MSA) sites have artefacts made almost exclusively of local raw material viz. vein quartz and crypto/microcrystalline silica. During the MSA, imported obsidian found its way to Lukenya Hill (Merrick *et. al* 1994), eventually dominating as the preferred raw material during the PN. Microprobe analysis of obsidian artefacts from GvJm47 at Lukenya Hill showed that the raw material was got from Mt. Eburru region in the Central Rift, about 130 kilometres away.

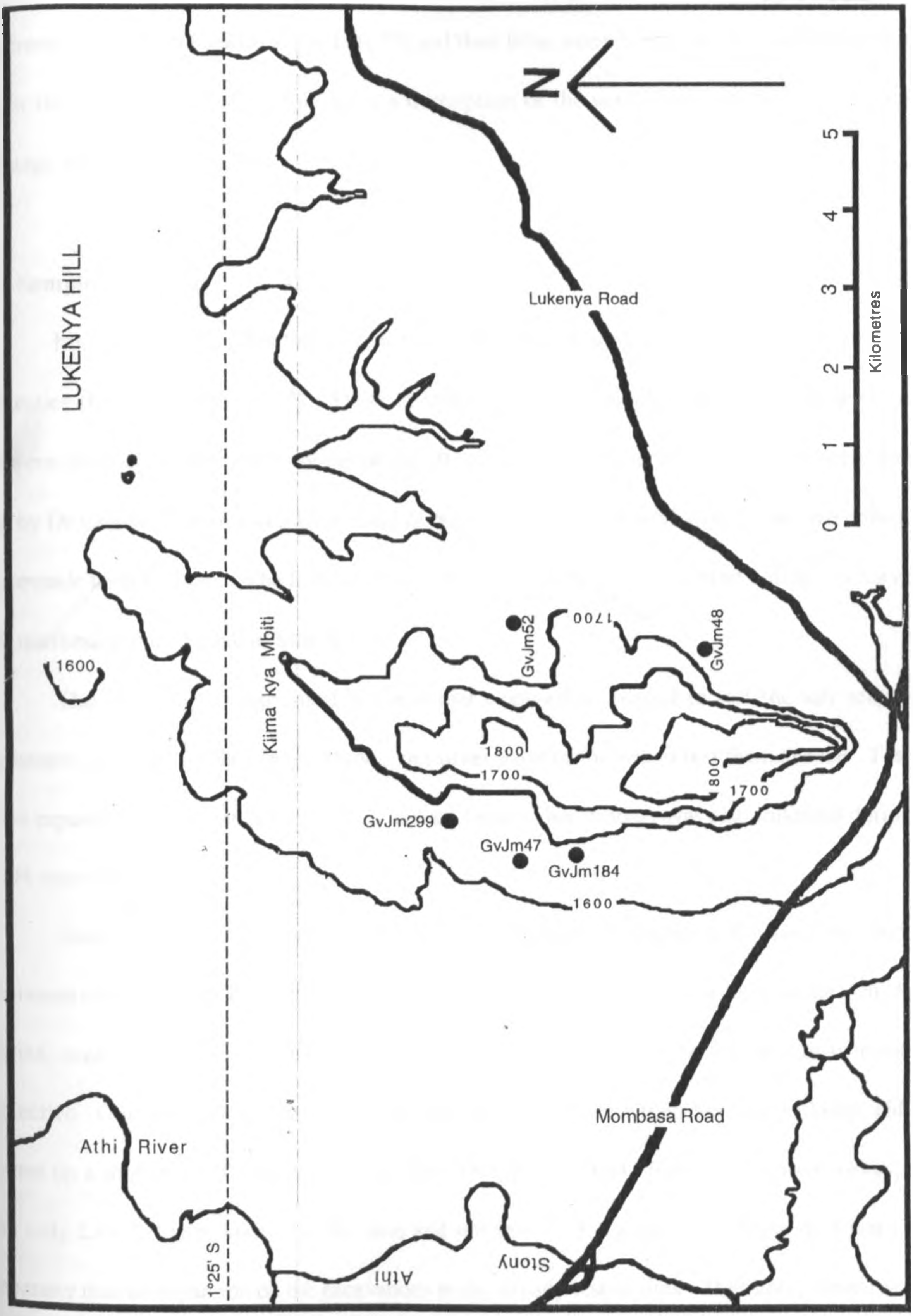


Figure 3.1: Map of Lukenya Hill showing the sites under study

The five sites under study in this report are all found on the foot of the hill in similar environments. They all belong to the Late PN and their lithic assemblages are dominated by obsidian from the Central Rift What follows is a description of the sites, their general layout, sampling strategy and the stratigraphy.

3.2 Sampling Strategy

Four of the five sites featured in this report have a long history going back to the mid seventies (Bower *et. al* 1977). Three of them (GvJm48, GvJm52 and GvJm184) were tested between the mid seventies and early eighties by a team from the University of Massachusetts, Boston led by Dr Charles Nelson and a University of Nairobi field school (GvJm184) Surface collections were made from GvJm47 The fifth site (GvJm299) is new, it was discovered during our survey of the northern end of the hill in March 1994.

The sampling strategy used in the earlier excavations tended to test the ash heaps with systematic dispersion of the test pits throughout other parts of the site to test them as well Test pits were expanded in areas with a lot of bones and artefacts This strategy was also followed during our 1994 excavations

Since our objective was to provide a comprehensive definition for the lithic industry represented in the Late PN sites at Lukenya Hill and in any other similar sites in the Athi-Kapiti Plains, excavation of more sites was thought necessary to expand the assemblage to meet that objective. Our survey in the Athi-Kapiti Plains failed to replicate the sites from Lukenya Hill, but turned up a similar site (GvJm299) on the Hill This, plus GvJm47 from the previous survey, were the only Late PN sites known at the time and not tested Excavations on these sites were more necessary than an expansion on the excavations in the already tested sites. Therefore, these two sites (GvJm47 and GvJm299) were targeted for excavation.

Our objective to excavate at the two sites was twofold. Both these sites have a lot of material exposed away from the ash heaps which seems to imply specialised functional locales around a central livestock enclosure. Each also has a number of ash heaps of different sizes and density of materials.

Our second objective was to recover samples large enough for comparison. This determined the location of the test pits. Trenches were put at the various locales we wished to test. The number of test pits per trench was determined by the richness of the locale so that we could be meet our objective But owing to the time and resources we had at our disposal and the enormous size of each site, we did not test the sites as extensively as we would have wished.

One by one metre square test pits were used at all the sites. They were oriented to the surface to control the stratigraphy. Excavations proceeded by arbitrary ten centimetre spits. Spits were excavated to the base of natural levels where these existed. Excavation was ended at very low density of finds During excavations, materials were separated into bones, lithics (obsidian, silica and quartz) and pottery. Each of these was given a separate catalogue number. Trowels were commonly used, but at GvJm299, where some undisturbed parts of the sites had highly compact sediments, we used rock hammer as a pick All the dirt was sieved using the 5mm screen, although a 1mm screen appears to have been used at GvJm48 so that a rescreening of the assemblages was necessary to ensure compatibility of the assemblages.

3.3 Wambua's Site (GvJm47)

This site is situated on the western side of the hill, about 350 metres from its base. It is to the east of the road leading to Daystar University at the point where it makes a sharp bend towards north and there is a junction with the road leading to Wambua's home. To the west, the site is bordered by the road leading to Wambua's home and in fact artifacts and bones are visible on the eastern side of the road cutting and on the road surface for a distance of about 144 metres. The southern part of the site, where we have what appears to be remains of habitation, is in Brown's farm

The site has a surface area of more than 60,000 square metres, extending for about 220 metres in the north-south axis and about 300 metres in the east-west axis It has two large ash heaps and numerous small erosional exposures scattered throughout the site; these contain artefacts and bones. We thought that these exposures may represent different functional locales around a central cattle enclosure.

The site has been dated to 1340+/-145 BP on apatite (970+/-130 BP on collagen) Though possible, these dates are suspiciously recent The bone on which it was done was collected from the road cutting and may have been contaminated If the C14 value is correct, this may be the oldest Pastoral Iron Age date from the site

There are at least three discernible ashy areas in the site Two of these ash heaps are to the upper end (the eastern part) of the site The first ash heap is to the southern end of the site, the second to the northern end and the third, which is less ashy than the other two, is upslope of the first one towards the east All these ash areas were tested Ash heap one was designated test trench one, ash heap two test trench two and ash heap three test trench four

A total of 18 one by one metre test pits was excavated These test pits were excavated in five trenches scattered through out the site to test the possibility that there might be functional facies The average depth in trenches three, four and five was 20 centimetres. Pits in trenches one and two, which were in the ash heaps, had up to 60 centimetres of deposit

The stratigraphy in the ash heaps is usually characterised by a fine-grained ashy soil, apparently mixed with ash from the levels below by burrowing rodents. This is followed by the ash layer itself which averaged 25 centimetres. In the second ash heap to the north of the site (Trench two), there is no discernible ash layer as in the first ash heap to the south of the site (Trench one) In the western end of the sites, the material bearing horizon is only about 20 centimetres at its deepest, with an average of 15 centimetres in most places. There is no ash in this part of the site and material density is relatively high, especially from about 5 centimetres to about 15 centimetres below the surface The break between the material-bearing horizon and the sterile layers below is very abrupt Probes failed to turn up deeper horizons

A total of 2005 specimens, mostly obsidian and silica artefacts, was analysed from this site. Out of these, 30 specimens were excluded from further analysis because they were either pieces of bone, quartz or felsite included erroneously with the silica, or were weathered specimens, smooth pebbles and rolled pebbles

3.4 Daystar Site (GvJm299)

Daystar site (GvJm299) is on the western side of Lukenya Hill and borders Daystar University to the southeast It is a new site that was discovered during our survey of the northern end of the hill. It has not been dated It is a large open site of more than fifty thousand square metres and has at least three discernible ash heaps and various exposures A fourth ash concentration was exposed in test trench six at about 35 centimetres below the surface

A total of 16 one by one metre test pits was excavated scattered in five trenches throughout the site. The deepest test pit was 60 cm with the majority averaging 20 cm

The stratigraphy in the ash heaps is characterised by an ashy soil, mixed with the ash layer below by burrowing animals. The soil was mostly brownish in areas away from the ash heaps, mostly highly compacted, especially in test trench five. Test trench four, in the ash heap, has highly loose ashy soil and a lot of rodent activity.

A total of 1651 specimens, mostly silica and obsidian artefacts, were initially analysed. Out of these, 80 specimens were excluded from further analysis because they were either bone fragments (13 pieces) or quartz artefacts (13 specimens) erroneously included together with the silica artefacts. Others were weathered silica and obsidian artefacts, rolled pebbles(mostly silica) and smooth pebbles.

3.5 Makongoni Site (GvJm48)

Makongoni Site (GvJm48, 1°28'10"S, 37° 4'31"E) is on the eastern side of Lukenya Hill about 250 metres past Lukenya Academy (Figure 3.1). The site is on colluvial slope at the base of the hill, about 40 metres away from exposed rocks. The vegetation is mostly *Commiphora-Themeda triandra* savanna.

The site has a surface area of about 5400 square metres (approximately 60 metres in upslope-downslope direction and about 90 metres on lateral contour). It has two ash heaps.

A date of 1600+/-130 on apatite (1830+/-135 on collagen) was obtained for the site. There were other dates obtained from earlier components in upslope portion of this site a date of 12,770+/-650 on bone apatite from the 30-50 cm level and a date of 23,170+/-920, also on bone apatite from the 90-110 cm level The assemblages from these levels and their stratigraphic relationships show that these were LSA components

Only assemblages from test trenches one and six were included in the analysis A total of 30 one by one metre test pits was excavated in these two trenches. The test pits were systematically placed throughout the site to explore the various areas. Sometimes they were regularly spaced Test pits were expanded in areas with high concentration of bones and artefacts (Figure 3 2)

The stratigraphy is a simple one having reddish sandy silt with local concentrations of ash which may be up to one metre thick Other areas of the site have ash deposits of 40-50 centimetres maximum thickness. There are two major ash concentrations in this site. To the west of the north ash heap, there are very thin (1-3 centimetres), densely compacted ash lenses at the base of the midden which are not clearly "floors". Ash areas have rodent burrows and krotovina. They are also the areas with the deepest cultural deposits of up to one metre as opposed to an average of 40-50 centimetres over most of the site.

Materials recovered from the site included lithics (made of obsidian, silica, quartz and lava), pottery and bones of cattle and ovicaprids. Other significant finds included shells (which are not cowries) from the Indian Ocean, ground stone implements and ground bone tools.

Out of the thirty test pits excavated test trenches one and six in this site, ten of them were excluded from the analysis. Test pits 14 to 20 from test trench one, which are towards the foot of the hill, were excluded because they were mixed up with an LSA horizon; almost half of the artefacts were weathered Artefacts from test pits 1C and 1D were not found and test 1E had some spits missing In test trench six, test pit two was not found. Test trenches two, three, four and five were excluded because their assemblages were too small

A total of 6303 specimens, mostly silica and obsidian artefacts, was initially analysed Out of these, 1655 were excluded from further analysis Out of the 1655, 1579 were fine fraction excluded by rescreening using a 5 mm screen The others were either weathered, or were rolled or smooth pebbles, or other raw materials (like quartz, feldspar, lava or rhyolite) or bone fragments erroneously included together with silica.

3.6 Silanga Site (GvJm52)

Silanga Site (GvJm52, 1^0 26'58"S, 37^0 04'50"E) is a large open site on the eastern side of Lukenya Hill where a modern reservoir (from which the site gets its name) collects water seasonally from a local stream. It is located about 250 metres from the talus slope of the inselberg outcrop It is basically in the same setting as the rest of the sites of the same age at Lukenya Hill

The site has two discernible ash heaps with a tree line dividing them. There are two C-14 dates from this site: 1855+/-110 on apatite (2050+/-115, gelatin) and 1840+/-140 (apatite).

A total of 34 one by one metre test pits was excavated (Figure 3.2). 24 of these test pits were in the first grid (N56-S10/E05-W36), out of which seven are contiguous units in the center of the ash heap. The ash dump in this first grid is about 5 x 10 m in area.

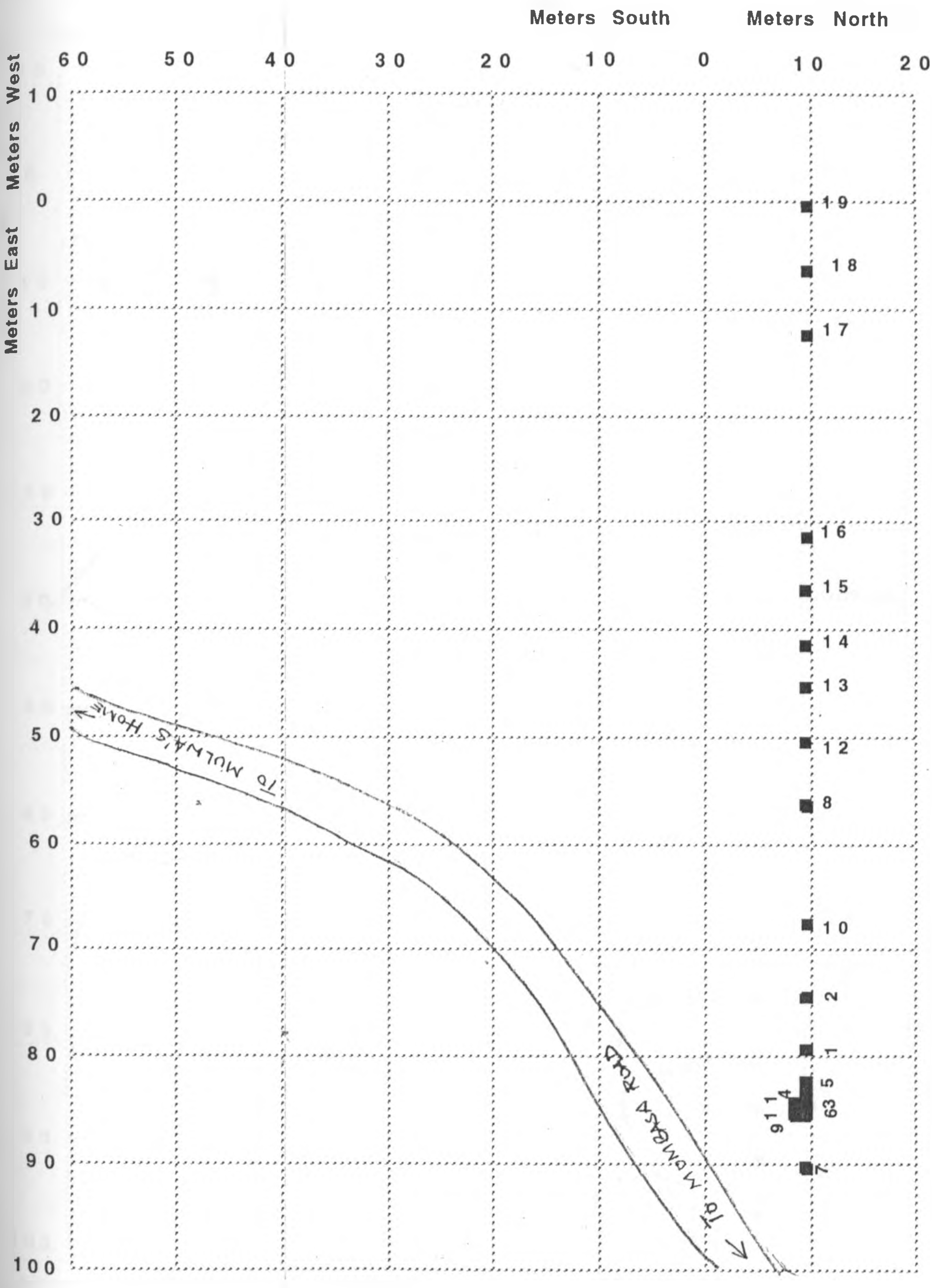


Figure 3.2: The Site Map of Makongoni (GvJm48)

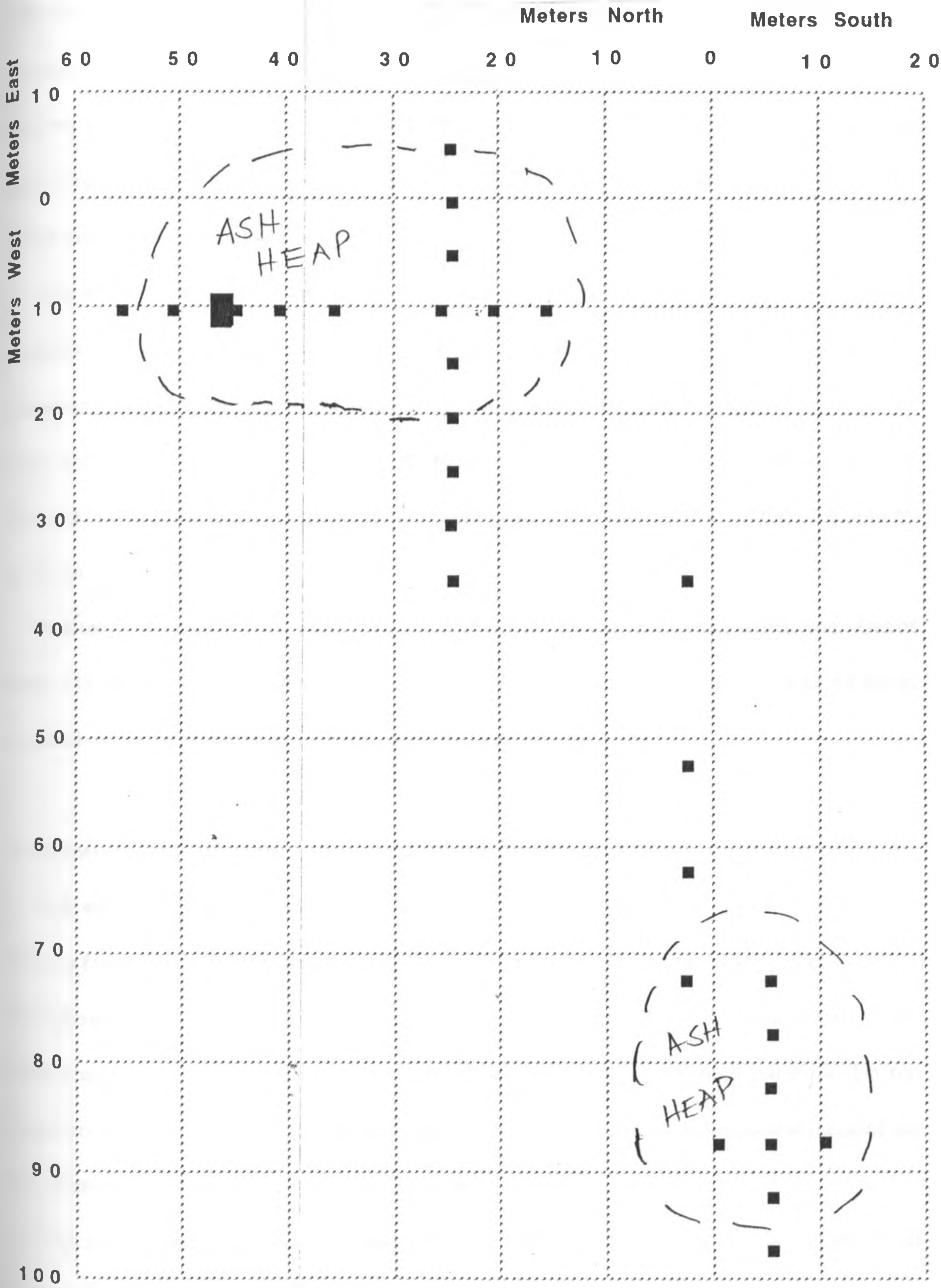


Figure 3.3: The Site Map of Silanga (GvJm52

The thickness is variable, but it averages from surface to 40 cm (maximum 60 cm) in depth. The lowest levels of some units have a reddish (iron-enriched) zone at the base, suggesting burning on the land surface in some spots. As at GvJm48, there are zones (both within the ash heap and elsewhere adjacent to it) of thin, compacted, cracked whitish deposit. Sometimes this is vertically penetrated by what looks like rodent burrows.

The other ten test pits are in the second grid (N2-S16/W72-W99). This area has less ashy deposits with a lot of bone, about 5 cm thick. The cultural sediments overlie alluvial "apron" sediments, which contain very low densities of bone and other materials. This horizon has a grayer color and different texture from the natural sediments. This is overlain by a thick bone horizon, followed by more gray ashy material right up to the surface. The ash layer is from the surface to 40 to 50 cm.

A total of 4003 specimens, mostly silica and obsidian artefacts, were initially analysed. Out of these, 242 specimens were excluded from further analysis because they were either weathered pieces or rolled or smooth pebbles or bone fragments or other raw materials.

3.7 Brown's Site (GvJm184)

This site is on the western side of the hill. It can be approached from the Small World Country Club by taking the first left turning off the Nairobi-Mombasa highway immediately after the Club, then take the next left turning and proceed uphill. The site is about 120 metres from the base of the hill and has a slope of about eight degrees. It is bounded by a gully to the south and euphorbia and acacia trees to the west. It has two ash heaps, the larger of the two found to the southern end of the site where the gully removes part of it (Figure 3.4).

This site was tested between 1980 and 1982, first by Dr Charles Nelson, then by students from University of Nairobi (1981). The University of Nairobi pits were completed and backfilled in 1982 by Dr Charles Nelson. A total of 19 test pits was excavated. All the test pits were in the southern

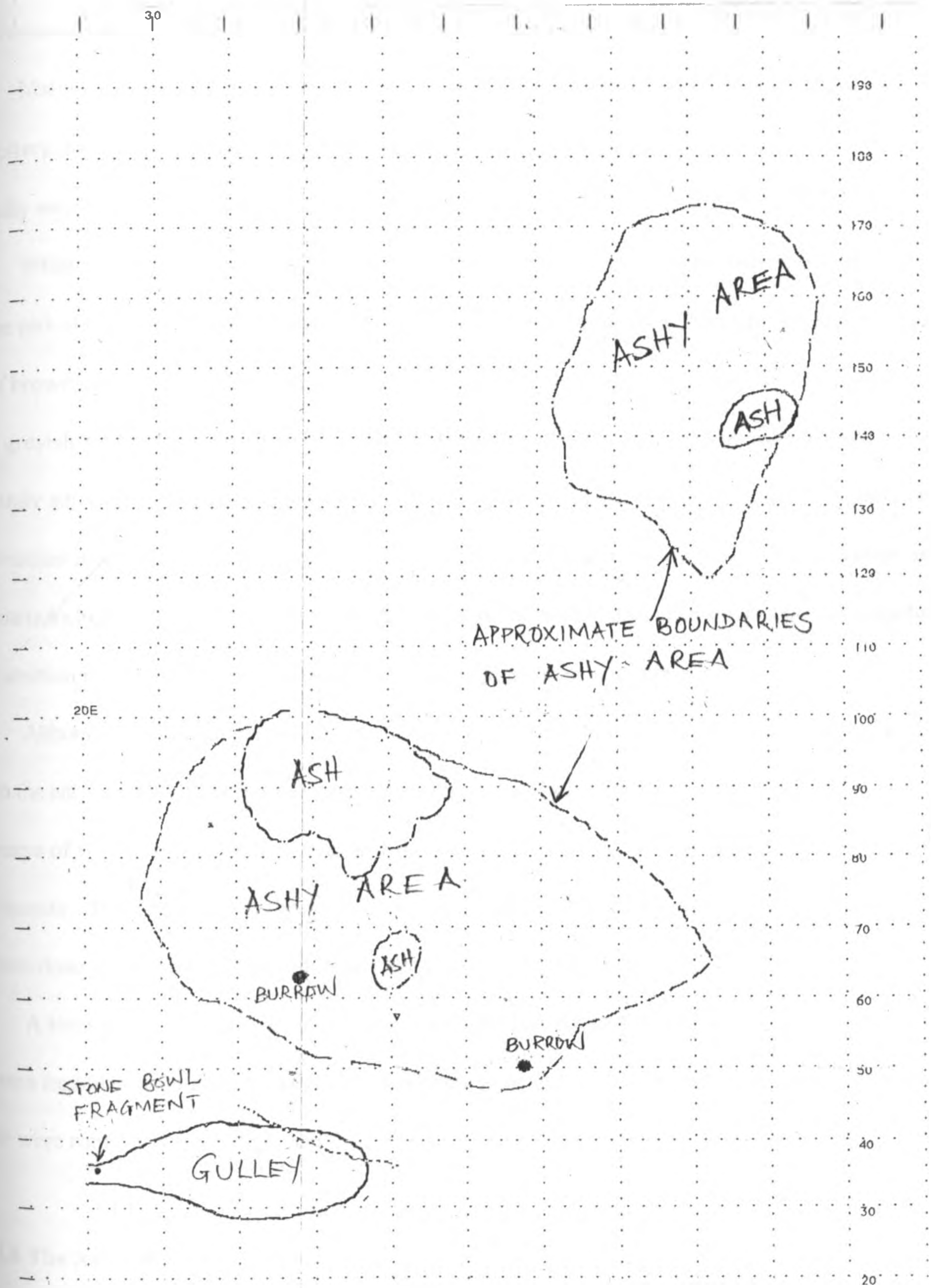


Figure 3.4: The Site Map of Brown's (GvJm184)

ash heap which was excavated to a depth of 130 centimetres. The site has been dated to 2115 +/- 130 (on gelatin)

Materials recovered included lithics of obsidian, silica, quartz and lava to a limited extend, pottery, highly comminuted bones and smooth pebbles. A stone bowl fragment eroding out of the gully was also collected

While the stratigraphy in the ash heap is not much different from the one observed in other sites, the part of the site exposed by the gully shows a slightly different profile The topmost layer is made of brown-greyish sandy silty particles, with massive to slight blocky structure This is followed by a greyish brown sand with massive quartz pieces gradually changing in to an ashy greyish brown sandy silt with a structure similar to the one above it This layer has abundant bone, quartz and obsidian inclusions There is a gradual transition to the ash layer below which also has bone and quartz inclusions This layer also has ashy brown sandy silt with blocky inclusions There is a gradual transition to a light brownish layer which has blocky, angular structure

Although only a small portion of this site is visible, it may turn out to be the largest of all the sites on the hill Large parts of the site are buried Recent ant bear exposures away from the known ash heaps of the early eighties have exposed the site in areas previously not thought to have cultural deposits. The actual size of this site will not be known until extensive excavations of the site have been done, but the area of the ash heaps alone covers 14,000 square metres

A total of 4411 specimens, mostly silica and obsidian artefacts was analysed. Out of these, 64 were excluded from further analysis because they were either bone fragments, other raw materials or were rolled and smooth pebbles

3.8 The Assemblages

The analysis reported in this thesis is based on three sets of assemblages The first set comprise Museum collection from three sites (GvJm48, GvJm52 and GvJm184) at Lukenya Hill which were recovered in a series of excavations undertaken in the mid seventies and early eighties by a University of Massachusetts, Boston team led by Dr Charles Nelson and a University of Nairobi field school. These assemblages are housed at the Division of Archaeology Laboratories at the National Museums of Kenya.

The second set of assemblages was recovered by our excavations at Lukenya Hill in May 1994. Two sites, Wambua's (GvJm47) and Daystar (GvJm299) both on the western side of the hill, were excavated. These, plus the first set of assemblages form the core of this research project.

The third set of assemblages is from excavations conducted in the early eighties by a team led by Dr Peter Robertshaw, then of the British Institute in Eastern Africa, in the Lemek-Mara region of Narok District. They are also housed at the National Museums. This set, as described by Robertshaw (1990), was used for comparison with the first two sets as is explained below.

A total of 16,301 silica and obsidian artefacts was analysed from the first two sets of assemblages. These form the core of this thesis. Out of these, silica accounts for 14.6% of the artefacts. The third set of assemblages is from the Elmenteitan occurrences at Ngamuriak in the Lemek Valley. This site alone has an assemblage of 22,738 silica and obsidian artefacts, more than the Lukenya Hill assemblages put together. Silica accounts for only 1.7% of the artefacts.

3.9 Summary and Conclusion

In this chapter, we gave the environmental setting of Lukenya Hill and the surrounding Athi-Kapiti Plains. We also gave a description of the sites paying attention to their general layout, the sampling strategy used in their excavation and their stratigraphy. All the sites are in almost similar environments and their stratigraphy is, to a large extend, the same. The sampling strategy used in the excavation is also the same.

It emerges that some of the sites (e.g. GvJm184 and 299) are too large and the number of test pits put in each is not enough to do justice to understanding the structural patterning of such sites. Future research efforts should be geared to getting more samples from these sites. The analysis of assemblages from these sites is described in the following chapter.

CHAPTER FOUR

DESCRIPTIVE ANALYSIS

4.1 Introduction: The Scope of Analysis

The analysis is threefold. The first is typological, where the various tool types are identified. The second is technological in which the reduction sequence is discribed with a view to understanding the production of the tools. The third is metrical, where selected tools are measured (length, width and thickness) to understand the preferred tool size. These analyses were carried out in conjunction with each other because each one on it own is not sufficient to delineate a lithic industry. Nelson (1973), using typology and attribute analysis in analysing twenty nine LSA occurrences from East Africa, was not able to isolate regional groupings except for sites within close proximity of each other which showed resemblance in tool type frequencies (Nelson 1973, 1976). Ambrose (1984b:228) has argued that differences in the frequencies of tool types are not good cultural markers because they may reflect differences in the performance of various activities rather than indicators of cultural affiliation. He therefore advocates a tripartite approach in differentiating lithic industries viz.: technological (core preparation and core reduction), morphological (size and shape of tools) and typological (tool types and the relative frequencies of the types). It is this approach which has been used in this report.

4.2 Typological Analysis

The aim of the typological analysis is to use a well defined typology to assess the similarities and/or differences between the occurrences under study by comparing the relative frequencies of various tool classes. Using this approach, it has been shown that possible activity facies can be identified in at least one of the sites. It has also been possible to study the reduction sequence on the basis of the typology defined here

4.2.1 The Typological System

The typology used in the analysis is basically the one developed for East Africa by Nelson (1973, 1980) with some slight modifications. Artefacts were divided into three broad groups viz. cores, tools and waste. The tools were in turn divided between shaped, unshaped modified blades. Shaped tools included all the microliths, scrapers, burins, borers, gravers, combination tools and transformed tools. Unshaped tools are any flaked stone artefacts characterised by retouch confined to a natural spur or the intersection of two edges. Only one tool type was recognised under this category: becs.

Waste include all unmodified blades and bladelets, flakes (including utilised flakes) and debris. Debris included angular waste, burin spalls, Krukowski microburins, microburins, platform removal flakes, derived segments, split pebbles and burned obsidian.

The definitions for the typology are given below. Most of the definitions by Nelson (1973, 1980) have been adopted.

4.2.1.I Shaped tools: A shaped tool was defined as any artefact that has been modified by retouch, or trimming. Shaped tools constitute between 6.8% and 11.6% of all the artefacts at the Lukenya Hill PN sites (Table 4.2)

4.2.1.I.a Microliths: These are defined as any backed stone tool, other than burins. They include crescents, triangles, trapezes, curved-backed and truncated flakes, straight-backed flakes and micropercoirs and points.

4.2.1.I.a.i) Crescents: These are flakes having biterminal truncations and crescentic blunted edge intersecting with an unblunted one (Nelson 1973:148). They are highly standardised in shape, all being symmetrical (except one asymmetrical specimen at Brown's). The crescents are the most frequent complete microlith (Table 4.2).

4.2.1.I.a.**ii) Trapezes:** These are biterminally truncated flakes whose truncations produce a microlith of trapezoidal or trapeziform outline, with the edge opposite the truncation usually unmodified (Nelson 1973:157). There is a tendency towards intergradation with crescents.

4.2.1.I.a.iii) Triangles: These are also biterminally truncated flakes whose truncations produce a triangular or subtriangular outline (Nelson 1973:156). There is also a tendency towards intergradation with the crescents as is the case with the trapezes

4.2.1.I.a iv) Curved-backed flakes: These are flakes having uniterminal, convex truncation (Nelson 1973: 160). Most of the truncations were proximal.

4.2.1.I.a.v) Straight-backed: These are flakes with backing running parallel to the opposite edge without truncating it. This category is very rare in East Africa (Nelson, pers. comm.; 1973).

4.2.1.I.a.iv) Oblique truncations: These are microliths with uniterminal truncations. The truncation may be straight or concave, but the angle between the truncation and the opposite edge should be greater than 15 degrees.

4.2.1.I.a.v) Orthogonal truncations: These are microliths with either concave or straight truncations, which may be proximal or distal and an angle exceeding 85 degrees between the truncation and the opposite edge. No convex truncations were observed, but this could be as a result of sample size. There is tendency to intergrade with obliquely truncated microliths

4.2.1.I.a.vi) Micropercoirs: These are tools with sharp pointed working edge formed by two lines of abrupt retouch or steep trimming, intersecting at less than 90 degrees (Nelson 1973:206).

4.2.1.I.a.vii) Points: These are convergent flakes trimmed or retouched to a sharp point (Nelson 1973:227). One specimen has been constricted by backing at the end opposite the point as if it was used for hafting.

4.2.1.I.b.Scrapers: These are tools with unifacially flaked, planoclinal edges (Nelson 1973:175). The scrapers were divided into combined, concave, convex, denticulate, end, nosed, notched, side, others and fragments.

4.2.1.I.b.i) Combined scraper: A specimen having a concave scraper edge, the concave and the notch differentiated on account of the degree and extent of concavity (Nelson 1973:199).

4.2.1.I.b.ii) Concave: Scrapers having one or more concave scraping edges which are longer than one centimetre long (Nelson 1973:199).

4.2.1.I.b.iii) Convex: These are scrapers having a pronounced convex edge which truncates at least one edge of the specimen and occupies more than 40% of periphery of the finished tool in a single, continuously modified arc of retouch, shallow trimming or steep trimming (Nelson 1973:194).

4.2.1.I.b.iv) Denticulate: These are scrapers with abrupt retouched edges.

4.2.1.I.b.v) End scrapers: These are specimens whose major working edges truncate the distal or the proximal ends of the piece and account for less than 40 percent of the periphery of the finished tool (Nelson 1973:182). There is tendency for this class to intergrade with convex and side scrapers.

4.2.1.I.b.vi) Nosed scrapers: These are scrapers with narrow, constricted, convex or sub-rectangular edges produced by extensive lateral retouch or trimming along one or both adjacent edges (Nelson 1973:192). This class is highly variable in morphology and the next most numerous class after the end scrapers.

4.2.1.I.b.vii) Notched scrapers: These are specimens with one or more concave scraping edges which are shorter than one centimetre. This class intergrades with the concave scrapers.

4.2.1.I.b.viii) Side scrapers: These are pieces with one or both of their lateral margins partially or wholly modified by retouch or trimming, but lacking other definitive characteristics to be classified as other tool types (Nelson 1973:197). This class intergrades with modified segmentary blades and utilised flakes. In fact their rarity may be explained on their assignation to other tool classes.

4.2.1.I.b.ix) Miscellaneous scrapers: These are combination scrapers and other specimens which do not necessarily fall within the other formal classes.

4.2.1.I.b.x) Fragments: These are specimens from scrapers which have been broken either by segmentation or otherwise and are not big enough to be considered complete tools.

4.2.1.I.c ***Outils écaillés*** These are artefacts with scalene flake scars on one or more edges which in turn have crushing and/or shattering along them. It is felt that such flaking is not as a result of deliberate modification, but occurs in the process of using such tools. Although this is the position, *outils écaillés* have nevertheless, been treated as shaped tools in line with other classifications in East Africa to make comparison possible.

4.2.1.I.d Burins: These are specimens whose main working edges are in the thickness of the piece. They were divided into angle, dihedral, transverse, on truncation and technical or other burins.

4.2.1.I.d.i) Angle burins: These are burins whose bit is formed by the intersection of a facet with a snap or segmentation, the platform remnant at the distal end of a platform removal flake, or a sub-vertical dorsal flake scar at the distal end of a flake. The platform from which the burin spall is struck must truncate the distal end of the flake, but it may be oblique to the flake axis (Nelson 1973:239). Angle burins are the most numerous of all classes of burins.

4.2.1.I.d.ii) Dihedral burins: These are burins whose bits are formed by two sets of intersecting facets and which may be symmetrical or asymmetrical to the flake axis (Nelson 1973:237)

4.2.1.I.d.iii) Burins on truncation: These are burins other than transverse having bits formed by the intersection of a set of burin facets and a blunted edge, which may be convex, concave or straight and may truncate either the proximal or the distal end of the flake (Nelson 1973:239). Burins on truncation are very rare and are found in only two sites; at Daystar and at Makongoni.

4.2.1.I.d.iv) Transverse burins: These are burins whose bits have been formed by a single set of facets which originate from the lateral margin of the of a flake and partially or completely truncate its distal or proximal end (Nelson 1973: 237). These are also rare and are represented by one specimen each at Silanga, Brown's and Makongoni.

4.2.1.I.d.v) Informal burins: These are burins having bits which may be due to accidental flaking. They are represented by one piece each at Wambua's and at Silanga.

4.2.1.I.e Borers: These are rod-like implements which have retouch towards the end and which may have grinding-like utilisation at the tip. They may have been used for the making of ostrich eggshell beads.

4.2.1.I.f Gravers: These are implements which have their main working edges on a corner of a piece of waste and which may also be thinned by flaking. This category is represented by two specimens in only one site (Silanga) where they constitute only 0.1% of the assemblage.

4.2.1.I.g Combinations and Transformations: These are implements which exhibit the characteristics of two or more major classes within the shaped stone tools (Nelson 1973:241). The most common forms of combinations involve burins, scrapers and *outils écaillés*.

4.2.1.II Unshaped tools: These are flaked stone artefacts characterised by retouch confined to a natural spur or the intersection of two edge (Nelson 1973:242). Only one class was identified under this category. This is anomalous and probably means that most pieces which would fall under this category have been identified with other categories, especially modified blades and bladelets.

4.2.1.II.a) Becs: These are pointed implements formed by retouching a natural spur on a piece of waste (Nelson 1973:242). Such spurs may be formed by very small notches adjacent to snaps, step fractures, hinge fractures or sub-vertical dorsal flake scars. Most of the end and nosed scrapers have marginal becs.

4.2.1.III Modified blades and bladelets: Blades are defined as flakes which are twice as long as they are wide and having at least a planoclinal edge. The bladelets were differentiated from blades on the basis of width. A blade had to have a minimum width of 11.5 millimetres and at least 30 millimetres long. Any flake with a width below this was classified as a bladelet.

All blades and bladelets were divided between whole and segmentary pieces and further subdivided into modified and unmodified specimens. All the unmodified blades and bladelets are placed under special categories of waste

4.2.1.III.a) Modified blades: These are blades which have been modified either by retouch or utilisation. The difference between retouch and utilisation is tenuous at best though. There was tendency to regard all such specimens as utilised unless the extend of the edge modification could be shown to be by flaking not consistent with utilisation. For this reason therefore, all retouched and utilised specimens were grouped together.

4.2.1.III.b) Modified segmentary blades:

These are flakes which have been broken by segmentation or snapping and whose length is at least half as long as it is wide. These pieces tend to intergrade with derived segments

4.2.1.III.c) Modified bladelets: These are flakes with a maximum width of less than 11.5 millimetres and minimum length of at least 30 millimetres

4.2.1.III.d) Modified segmentary bladelets: These are flakes which have been broken by either segmentation or snapping and whose length is at least half as long as it is wide. This class tends to intergrade with derived segments.

4.2.1.IV Cores: These are flaked stone artefacts with flake scars running at least a half way through the length of the specimen. The flake scars may be scalene or not, but the platforms should not have any crushing. Cores interact with *Outils ècaillès* to a great extend

Cores made out of obsidian are very few in all the assemblages as opposed to those made of silica. This contrasts with the fact that obsidian was the preferred raw material and artefacts made from it predominate in all the assemblages. Since most of the obsidian used at the PN sites at Lukenya was imported from the central Rift Valley (more than 130 kilometres away), their rarity can only be as a result of exhaustion and conversion into other tools, for example *Outils ècaillès*. Cores made on silica predominate through out the assemblage, though the majority are not well developed and were at best attempts at cores.

4.2.1.V Special Categories of Waste: Any artefact that does not fall within the aforementioned categories was classified as waste. These included cores, all flakes and unmodified blades, split pebbles, burned obsidian and all debris produced in the manufacture of tools (Krukowski microburins, microburins, burin spalls and derived segments).

4.2.1.V.a) Blades and bladelets: All the blades and bladelets which were not modified were grouped under this category

4.2.1.V.b) Flakes: These are defined by the presence of an identifiable positive bulb of percussion. Flakes are by far the most predominant in the assemblages

4.2.1.V.c) Platform removal flakes: These are flakes which remove platforms from cores in the process of their preparation or from backed artefacts in the process of their modification. While most platform removal flakes were from cores, there was a good representation from the modification of tools.

4.2.1.V.d) Burin spalls: These are produced in the process of making burins. Their flake release surfaces are in the thickness of the piece

4.2.1.V.e) Krukowski microburins: These are produced accidentally in the backing process of the manufacture of microliths. They are characterised by a prominent bulb of percussion originating from the backed edge

4.2.1.V.f) Microburin: A flaked artefact which may have backing or trimming and is a by-product of the manufacture of microliths. A blade is notched, and snapped off where the chipping has narrowed and weakened it. One piece becomes the microlith tool, while the residue (the microburin) still shows traces of the original notch and fracture (Bray and Tramp 1970). They are very rare and are found at only two sites, at Brown's and Wambua's, where they constitute 0.1% of the assemblage.

4.2.1.V.g) Derived segments: These are by-products in the process of segmentation. This category intergrades with segmentary blades. Any specimen which was rectangular was classified as a derived segment if its width was at least twice the length. Other derived segments are wedge- and trapeze-shaped. Most of them had utilisation on either one or both sides.

4.2.1.V.h) Angular waste: These are specimens which don't have any identifiable bulb of percussion for them to be flakes or cannot be identified to any of the other artefact classes

4.2.1.V.i) Split pebbles: Most of the pieces within this category are from silica. They are mostly pebbles which have been split in the process of making cores. Split pebbles are absent from Wambua's and Silanga and account for between 0.1% and 0.2% of the assemblage in all the other sites

4.2.1.V.j) Burned obsidian: This category was identified because of the likelihood of using such specimens for dating purposes and not necessarily because of they have technological information. They account for between 0.1% and 0.2% of the assemblages

4.2.2 Raw Materials used in Manufacturing tools

Figure 4.1 below presents the proportions of the raw materials used in the manufacture of tools at the five sites under review here. The figure gives the impression that quartz was the most preferred raw material. The dorminance of quartz has to do with the excavation procedures. At the sites showing the highest proportion of quartz (that is at GvJm48 and GvJm52), even very small pieces, which could not even be flaked, were kept and counted. This is in contrast to the other sites where only flaked or flakable pieces were kept.

The pattern of raw material utilisation is broadly similar. In all the sites, obsidian is the preferred raw material for the manufacture of tools. Quartz, a locally available raw material, constitutes less than 1% of tools as observed elsewhere. This has to do with the difficult nature of this raw material.

It is worthwhile to note that, all the sites with low utilisation of silica are found on the western side of the hill and nearer the known silica raw material source at Stony Athi River (Barut, 1996). This raises some questions on the nature in which obsidian was imported into the hill and the possible implications this may have on the settlement patterns and movement of the pastoralists associated with the Lukenya Hill sites. There is also question of the temporal factor in the trade network involved in the acquisition of obsidian.

Sites	Obsidian	Silica	Quartz
GvJm47 (Wambua's)	1,871	104	647
GvJm52 (Silanga)	3,024	737	63,959
GvJm184 (Brown's)	3,988	359	5,267
GvJm299 (Daystar)	1,303	267	2,506
GvJm48 (Makongoni)	3,733	915	69,997

Figure 4.1: Raw material proportion for all the sites

Turning to the first question, what emerges is a model in which the sites on the western side of the hill acted as the entry points of obsidian. The pastoralists moved to Lukenya Hill with new stocks of obsidian and therefore needed to use less of the silica. It is also noteworthy that two of the sites on this side of the hill have two of the largest cores so far observed, one at Daystar and the other at Brown's. In this model therefore, by the time the pastoralists made it to the sites on the eastern side, they had less of the obsidian and needed to use more of silica, even though they had longer distances to walk to get it. This may also explain the fact that the highest concentration of silica cores, albeit poorly formed ones, is found at Silanga site, the furthest of all the sites and where the obsidian waste tends to be small in size. This question will need further consideration when more sites with the Lukenya Hill lithic industry turns up.

The other question is about trade relations through time. It is possible that the sites on the western side of the hill were occupied at the height of the trade relations between the Lukenya Hill pastoralists. They therefore had plenty and steady supply of obsidian and needed to use less of silica. In this model therefore, the sites on the eastern side of the hill were occupied during the earlier times when trade relations were just beginning or in the later times when such trade links were breaking up. This is unlikely though because Wambua's site has the youngest date of all the Lukenya Hill PN sites, although the date is done on a bone from the surface which may have been contaminated. Also, Makongoni site has some very large unutilised obsidian pieces especially from trench one which is unusual for these sites. This does not indicate "scarcity" of obsidian. More and secure dates will be needed to clarify this issue.

4.2.3 Gross category frequencies

A summary of the typology is given in Table 4.1. There is a wide range of variability in the frequency of certain artefact categories. The range of variation for the shaped tools is 4.8 percentage points. The site with the highest proportion (Silanga, 11.6%) and the site with the lowest proportion (Makongoni, 6.8%) also have the lowest (86.2%)and the highest (91.6%) proportion of waste respectively, thus showing an inverse relationship between the frequency of shaped tools and waste. Although the main controlling factor in the shaped tools is the frequency of *outils ecaillės*, they are also capable of producing a lot of waste. Silanga site, which has the highest proportion of *outils ecaillės* also has the lowest frequency of waste. However, this can possibly be explained by the morphology of the *outils ecaillės*, most of which were made from segmentary blades and flakes, some having very little modification. Therefore, they did not produce as much waste as they would have done under other circumstances, for example if bipolar cores had been used to make them. Two very large cores show that large chunks of obsidian were brought to the sites, but the majority of cores

Table 4.1: Gross frequency of artefact types

Typology	Wambua's (GvJm47)				Silanga (GvJm52)				Brown's (GvJm184)				Daystar (GvJm299)				Makongoni (GvJm48)			
	Obs.	Silica	Total		Obs.	Silica	Total		Obs.	Silica	Total		Obs.	Silica	Total		Obs.	Silica	Total	
	n	n	n	%	n	n	n	%	n	n	n	%	n	n	n	%	n	n	n	%
Crescent	5	0	5	0.3	8	1	9	0.2	14	0	14	0.3	4	0	4	0.3	12	0	12	0.3
Trapeze	2	0	2	0.1	0	0	0	0.0	2	0	2	0.0	0	1	1	0.1	1	0	1	0.0
Triangle	0	0	0	0.0	1	0	1	0.0	1	0	1	0.0	1	0	1	0.1	0	0	0	0.0
Curved-backed	4	0	4	0.2	3	0	3	0.1	11	0	11	0.3	7	0	7	0.4	6	1	7	0.2
Oblique truncation	0	0	0	0.0	1	2	3	0.1	8	0	8	0.2	1	1	2	0.1	2	1	3	0.1
Ortho truncation	4	0	4	0.2	0	0	0	0.0	2	0	2	0.0	0	0	0	0.0	0	0	0	0.0
Micropercoir	0	0	0	0.0	0	1	1	0.0	1	0	1	0.0	0	0	0	0.0	1	0	1	0.0
Point	0	0	0	0.0	1	2	3	0.1	1	0	1	0.0	1	0	1	0.1	1	0	1	0.0
Straight backed	0	0	0	0.0	1	0	1	0.0	0	0	0	0.0	0	0	0	0.0	1	1	2	0.0
Microlith fragments	9	1	10	0.5	28	6	34	0.9	25	1	26	0.6	12	1	13	0.8	24	5	29	0.6
Outils ecailles	63	2	65	3.3	211	25	236	6.3	188	8	196	4.5	55	8	63	4.0	128	16	144	3.1
Outil ecaille fragments	9	0	9	0.5	49	4	53	1.4	68	5	73	1.7	13	0	13	0.8	34	2	36	0.8
Combination	0	0	0	0.0	1	0	1	0.0	0	0	0	0.0	0	0	0	0.0	0	1	1	0.0
Concave scrapers	1	0	1	0.1	0	3	3	0.1	1	0	1	0.0	0	0	0	0.0	1	2	3	0.1
Convex scrapers	2	0	2	0.1	1	0	1	0.0	1	2	3	0.1	1	1	2	0.1	0	1	1	0.0
Denticulate	0	0	0	0.0	0	1	1	0.0	1	0	1	0.0	0	0	0	0.0	1	1	2	0.0
End scrapers	7	2	9	0.5	12	13	25	0.7	14	5	19	0.4	2	2	4	0.3	8	11	19	0.4
Nosed scrapers	6	1	7	0.4	5	4	9	0.2	13	4	17	0.4	2	3	5	0.3	4	6	10	0.2
Notched scrapers	0	0	0	0.0	2	3	5	0.1	1	0	1	0.0	0	1	1	0.1	0	2	2	0.0
Side scrapers	1	0	1	0.1	1	3	4	0.1	1	0	1	0.0	1	0	1	0.1	1	4	5	0.1
Other	1	0	1	0.1	0	1	1	0.0	1	0	1	0.0	0	0	0	0.0	0	1	1	0.0
Scraper fragments	0	0	0	0.0	3	2	5	0.1	0	0	0	0.0	0	0	0	0.0	0	1	1	0.0
Borers	2	0	2	0.1	0	4	4	0.1	3	1	4	0.1	2	3	5	0.3	0	2	2	0.0
Reamer	0	0	0	0.0	0	1	1	0.0	1	0	1	0.0	0	0	0	0.0	0	0	0	0.0
Angle burin	10	1	11	0.6	16	3	19	0.5	41	8	49	1.1	8	3	11	0.7	21	2	23	0.5
Dihedral	0	0	0	0.0	2	3	5	0.1	2	1	3	0.1	0	0	0	0.0	1	2	3	0.1
On truncation	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	1	1	0.1	1	1	2	0.0
Transverse	0	0	0	0.0	1	0	1	0.0	1	0	1	0.0	0	0	0	0.0	1	0	1	0.0
Informal	1	0	1	0.1	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0
Graver	0	0	0	0.0	1	1	2	0.1	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0
Combination tools	0	0	0	0.0	2	3	5	0.1	0	2	2	0.0	2	0	2	0.1	2	0	2	0.0
Transformed tools	3	0	3	0.2	2	0	2	0.1	2	0	2	0.0	0	0	0	0.0	0	2	2	0.0
Becs	2	0	2	0.1	3	4	7	0.2	1	4	5	0.1	2	0	2	0.1	1	0	1	0.0
Modified Blades																				
Whole blades	7	4	11	0.6	5	0	5	0.1	5	1	6	0.1	1	0	1	0.1	6	0	6	0.1
Segmentary blades	15	0	15	0.8	16	3	19	0.5	9	2	11	0.3	5	0	5	0.3	4	2	6	0.1

Table 4.1 continued.

Modified bladelets						
Whole bladelets	0	0	0	0.0	0	1
Segmentary bladelets	2	0	2	0.1	3	0
Cores	3	3	6	0.3	3	42
Special categories of waste						
Bladelets	1	0	1	0.1	4	2
Segmentary bladelets	26	0	26	1.3	40	11
Blades	3	1	4	0.2	2	2
Segmentary blades	42	3	45	2.3	88	20
Flakes	705	40	745	37.7	1136	213
Utilised flakes	4	1	5	0.3	15	14
Angular waste	727	35	762	38.6	659	272
Burin spalls	63	2	65	3.3	112	6
Technical burin	0	0	0	0.0	1	0
Derived segments	121	5	126	6.4	492	47
Krukowski microburins	4	0	4	0.2	2	0
Microburin	2	0	2	0.1	0	0
Platform removal flakes	13	3	16	0.8	85	14
Split pebbles	0	0	0	0.0	0	0
Burned obsidian	1	0	1	0.1	6	0
Totals	1871	104	1975	100.0	3024	737
Summary						
Microliths	24	1	25	1.3	43	12
Outils ecailles	72	2	74	3.7	260	29
Scrapers	18	3	21	1.1	25	30
Borers	2	0	2	0.1	0	4
Reamers	0	0	0	0.0	0	1
Burins	11	1	12	0.6	19	6
Gravers	0	0	0	0.0	1	1
Combined/transformed	3	0	3	0.2	4	3
Becs	2	0	2	0.1	3	4
Modified blades	20	4	24	1.2	21	3
Modified bladelets	0	0	0	0.0	3	1
Cores	3	3	6	0.3	3	42
Waste	1716	90	1806	91.4	2642	601

1	0.0	0	0	0	0.0	1	0	1	0.1	3	4	7	0.2
3	0.1	4	0	4	0.1	0	0	0	0.0	1	2	3	0.1
45	1.2	15	23	38	0.9	5	11	16	1.0	11	40	51	1.1
6	0.2	18	0	18	0.4	3	0	3	0.2	48	2	50	1.1
51	1.4	66	3	69	1.6	21	0	21	1.3	87	7	94	2.0
4	0.1	19	0	19	0.4	3	0	3	0.2	33	5	38	0.8
108	2.9	148	8	156	3.6	29	1	30	1.9	133	21	154	3.3
1349	35.9	1486	120	1606	36.9	426	79	505	32.2	1712	354	2066	44.4
29	0.8	12	2	14	0.3	4	1	5	0.3	7	11	18	0.4
931	24.8	791	117	908	20.9	453	136	589	37.5	711	323	1034	22.2
118	3.1	106	4	110	2.5	41	6	47	3.0	88	2	90	1.9
1	0.0	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0
539	14.3	818	26	844	19.4	169	1	170	10.8	577	56	633	13.6
2	0.1	1	0	1	0.0	4	1	5	0.3	2	0	2	0.0
0	0.0	1	1	2	0.0	0	0	0	0.0	0	0	0	0.0
99	2.6	77	8	85	2.0	21	5	26	1.7	47	13	60	1.3
0	0.0	0	3	3	0.1	1	1	2	0.1	1	8	9	0.2
6	0.2	7	0	7	0.2	2	0	2	0.1	10	0	10	0.2
3761	100.0	3988	359	4347	100.0	1303	267	1570	100.0	3733	915	4648	100.0

55	1.5	65	1	66	1.5	26	3	29	1.8	48	8	56	1.2
289	7.7	256	13	269	6.2	68	8	76	4.8	162	18	180	3.9
55	1.5	33	11	44	1.0	6	7	13	0.8	15	30	45	1.0
4	0.1	3	1	4	0.1	2	3	5	0.3	0	2	2	0.0
1	0.0	1	0	1	0.0	0	0	0	0.0	0	0	0	0.0
25	0.7	44	9	53	1.2	8	4	12	0.8	24	5	29	0.6
2	0.1	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0
7	0.2	2	0	2	0.0	2	0	2	0.1	2	2	4	0.1
7	0.2	1	4	5	0.1	2	0	2	0.1	1	0	1	0.0
24	0.6	14	3	17	0.4	6	0	6	0.4	10	2	12	0.3
4	0.1	4	0	4	0.1	0	0	0	0.0	1	2	3	0.1
45	1.2	15	23	38	0.9	5	11	16	1.0	11	40	51	1.1
3243	86.2	3550	292	3842	88.4	1177	231	1408	89.7	3456	802	4258	91.6

which survive are very small. There is a lot of reduction of cores going on as is explained elsewhere and this process must have produced a lot of waste. This observation is borne out by the fact that Makongoni, which has a high proportion of cores made of obsidian, also has the highest proportion of waste.

To resolve this issue, the waste should be classified on the basis of pieces which can be ascribed to manufacture of *outils écaillés* and those which are as a result of core reduction

There is also elevated frequencies of angular waste at Wambua's and Daystar sites and flakes at Makongoni site. The former is probably related to the fact that the highest density of materials in these sites was found away from the ash heaps The ash heaps are thought of as refuse disposal dumps and the materials represented in them would reflect the activities performed in the areas were such refuse came from On the other hand, the areas away from the ash heaps, at least some of them, may have been the tool manufacturing areas. Another possibility is that the angular waste may be due to trampling, the implication here being that the ash heaps provide protection against trampling A third possibility would be foibles of classification as a result of which more derived segments were identified in the other sites than at these two sites where they are far much lower To test whether this may have been the case, derived segments and angular waste were added together and the percentages calculated This revealed that these two sites still had the highest figure for the combined categories, with 12 percentage points between the lowest (Makongoni, 35.9%) and the highest (Daystar, 48.3%). Thus, the variation in the classification of derived segments could not account for the variation in the frequencies for angular waste.

Although Makongoni has a low proportion of derived segments and angular waste, it has the highest frequency of flakes (48.5%), which seem to control its proportion of waste Since this site also has a high proportion of cores made of obsidian and the waste made of obsidian dominates, the high proportion of flakes can be explained by the reduction of cores. However, this is contradicted by the fact that the site with the highest proportion of obsidian cores (Silanga) also has the second lowest proportion of flakes (41.6%) which is seven percentage points below Makongoni. This can, however, be explained by the fact that Silanga has the highest proportion of shaped tools which is five percentage points above that of Makongoni.

The greater reliance on silica or lack of it does not seem to affect the overall frequency of artefacts. In fact, the site that has the greater reliance on silica (Makongoni, 19.7%) also has the lowest proportion of shaped tools (6.8%), while the site with the least reliance (Wambua's, 5.3%) has the second lowest (6.9%). As observed elsewhere, the use of other raw materials for making tools is very minimal as was shown by an analysis of material from upper levels of GvJm44 (Nelson, pers. comm). As a result, it was not felt that the grouping of silica and obsidian artefacts would affect the relative proportions of artefact classes in any great way.

4.2.4 Relative proportions of tools, cores and waste

Table 4.2 summarises the relative proportion of tools, cores and waste. The same variation in the proportion of artefact categories observed for the gross categories is still evident and more striking when variation is measured within each of these categories. The *outils écaillés* dominate the shaped tools, they account for more than a half of all the tools and their abundance controls the proportion of all the other classes. The variation between the site with the lowest (Wambua's, 54%) and the highest (Silanga, 66%) proportion of *outils écaillés* is 12 percentage points. Microliths are the next most abundant, accounting for between 12.6% and 21.2% of the shaped tools, the variation being 8 percentage points. This variation can probably be accounted for by the differences in sample sizes.

Waste is dominated by flakes, including the modified ones. The variation between the site with the lowest proportion (Daystar, 36.3%) and the one with the highest proportion (Makongoni, 48.9%) is 12 percentage points. Issues which may account for this variation are discussed in the section

Table 4.2: Relative frequency of artefact types

	GvJm47				GvJm52				GvJm184				GvJm299				GvJm48			
	Obs.	Silica	Total		Obs.	Silica	Total		Obs.	Silica	Total		Obs	Silica	Total		Obs.	Silica	Total	
	n	n	n	%	n	n	n	%	n	n	n	%	n	n	n	%	n	n	n	%
Shaped tools (n)	130	7	137		352	86	438		404	37	441		112	25	137		251	65	316	
Crescent	5	0	5	3.6	8	1	9	2.1	14	0	14	3.2	4	0	4	2.9	12	0	12	3.8
Trapeze	2	0	2	1.5	0	0	0	0.0	2	0	2	0.5	0	1	1	0.7	1	0	1	0.3
Triangle	0	0	0	0.0	1	0	1	0.2	1	0	1	0.2	1	0	1	0.7	0	0	0	0.0
Curved-backed	4	0	4	2.9	3	0	3	0.7	11	0	11	2.5	7	0	7	5.1	6	1	7	2.2
Oblique truncation	0	0	0	0.0	1	2	3	0.7	8	0	8	1.8	1	1	2	1.5	2	1	3	0.9
Ortho truncation	4	0	4	2.9	0	0	0	0.0	2	0	2	0.5	0	0	0	0.0	0	0	0	0.0
Micropercoir	0	0	0	0.0	0	1	1	0.2	1	0	1	0.2	0	0	0	0.0	1	0	1	0.3
Point	0	0	0	0.0	1	2	3	0.7	1	0	1	0.2	1	0	1	0.7	1	0	1	0.3
Straight backed	0	0	0	0.0	1	0	1	0.2	0	0	0	0.0	0	0	0	0.0	1	1	2	0.6
Microlith fragments	9	1	10	7.3	28	6	34	7.8	25	1	26	5.9	12	1	13	9.5	24	5	29	9.2
Total Microliths (n)			25				21				66				29				56	
Outils ecailles	63	2	65		211	25	236		188	8	196		55	8	63		128	16	144	
Outil ecaille fragments	9	0	9		49	4	53		68	5	73		13	0	13		34	2	36	
Total outils ecailles (n)			74				289				269				76				180	
Combination	0	0	0		1	0	1		0	0	0		0	0	0		0	1	0	
Concave scrapers	1	0	1		0	3	3		1	0	1		0	0	0		1	2	3	
Convex scrapers	2	0	2		1	0	1		1	2	3		1	1	2		0	1	1	
Denticulate	0	0	0		0	1	1		1	0	1		0	0	0		1	1	2	
End scrapers	7	2	9		12	13	25		14	5	19		2	2	4		8	11	19	
Nosed scrapers	6	1	7		5	4	9		13	4	17		2	3	5		4	6	10	
Notched scrapers	0	0	0		2	3	5		1	0	1		0	1	1		0	2	2	
Side scrapers	1	0	1		1	3	4		1	0	1		1	0	1		1	4	5	
Other	1	0	1		0	1	1		1	0	1		0	0	0		0	1	0	
Scraper fragments	0	0	0		3	2	5		0	0	0		0	0	0		0	1	1	
Total scrapers (n)			21				55				44				13				43	
Angle burin	10	1	11		16	3	19		41	8	49		8	3	11		21	2	23	
Dihedral	0	0	0		2	3	5		2	1	3		0	0	0		1	2	3	
On truncation	0	0	0		0	0	0		0	0	0		0	1	1		1	1	2	
Transverse	0	0	0		1	0	1		1	0	1		0	0	0		1	0	1	
Informal burin	1	0	1		0	0	0		0	0	0		0	0	0		0	0	0	
Total burins (n)			12				25				53				12				29	

Borers	2	0	2		0	4	4		3	1	4		2	3	5		0	2	2	
Reamer	0	0	0		0	1	1		1	0	1		0	0	0		0	0	0	
Graver	0	0	0		1	1	2		0	0	0		0	0	0		0	0	0	
Combination tools	0	0	0		2	3	5		0	2	2		2	0	2		2	0	2	
Transformed tools	3	0	3		2	0	2		2	0	2		0	0	0		0	2	2	
Unshaped tools																				
Becs	2	0	2	100.0	3	4	7	100.0	1	4	5	100.0	2	0	2	100.0	1	0	1	100.0
Modified blades/bladelets(n)	24	4	28		24	4	28		18	3	21		7	0	7		14	8	22	
Whole blades	7	4	11		5	0	5	39.3	5	1	6	17.9	1	0	1	28.6	6	0	6	14.3
Segmentary blades	15	0	15		16	3	19	53.6	9	2	11	67.9	5	0	5	52.4	4	2	6	71.4
Whole bladelets	0	0	0		0	1	1	0.0	0	0	0	3.6	1	0	1	0.0	3	4	7	14.3
Segmentary bladelets	2	0	2		3	0	3	7.1	4	0	4	10.7	0	0	0	19.0	1	2	3	0.0
Cores	3	3	6		3	42	45		15	23	38		5	11	16		11	40	51	
Special categories of waste (n)	1711	90	1801		2642	601	3243		3550	292	3842		1177	231	1408		3456	802	4258	
Bladelets	1	0	1	0.1	4	2	6	0.2	18	0	18	0.5	3	0	3	0.2	48	2	50	1.2
Segmentary bladelets	26	0	26	1.4	40	11	51	1.6	66	3	69	1.8	21	0	21	1.5	87	7	94	2.2
Blades	3	1	4	0.2	2	2	4	0.1	19	0	19	0.5	3	0	3	0.2	33	5	38	0.9
Segmentary blades	42	3	45	2.5	88	20	108	3.3	148	8	156	4.1	29	1	30	2.1	133	21	154	3.6
Flakes	705	40	745	41.4	1136	213	1349	41.6	1486	120	1606	41.8	426	79	505	35.9	1712	354	2066	48.5
Utilised flakes	4	1	5	0.3	15	14	29	0.9	12	2	14	0.4	4	1	5	0.4	7	11	18	0.4
Angular waste	727	35	762	42.3	659	272	931	28.7	791	117	908	23.6	453	136	589	41.8	711	323	1034	24.3
Burin spalls	63	2	65	3.6	112	6	118	3.6	106	4	110	2.9	41	6	47	3.3	88	2	90	2.1
Technical burin	0	0	0	0.0	1	0	1	0.0	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0
Derived segments	121	5	126	7.0	492	47	539	16.6	818	26	844	22.0	169	1	170	12.1	577	56	633	14.9
Krukowski microburins	4	0	4	0.2	2	0	2	0.1	1	0	1	0.0	4	1	5	0.4	2	0	2	0.0
Microburin	2	0	2	0.1	0	0	0	0.0	1	1	2	0.1	0	0	0	0.0	0	0	0	0.0
Platform removal flakes	13	3	16	0.9	85	14	99	3.1	77	8	85	2.2	21	5	26	1.8	47	13	60	1.4
Split pebbles	0	0	0	0.0	0	0	0	0.0	0	3	3	0.1	1	1	2	0.1	1	8	9	0.2
Burned obsidian	1	0	1	0.1	6	0	6	0.2	7	0	7	0.2	2	0	2	0.1	10	0	10	0.2
Summary (% of assemblages at each site)																				
Shaped tools				6.9				11.6				10.1				8.7				8.8
Unshaped tools				0.1				0.2				0.1				0.1				0.1
Modified blades				1.2				0.7				0.5				0.4				0.7
Cores				0.3				1.2				0.9				1.0				0.9
Waste				91.4				88.3				88.4				89.7				89.9

above Angular waste is the next most dominant. The variation between the site with the lowest (Brown's, 23.6%) and the highest (42.2%) proportion of angular waste is 18 percentage points This variation is unusually large and may be misleading in view of the fact that the material from Brown's site appears to have been selected during sieving, especially the material excavated by the University of Nairobi Field School There is nothing in the field notes about this and we have not been able to get the people in charge of the excavation to clarify the issue On the other hand, when this figure is viewed against the next lowest proportion of angular waste at Makongoni site, the difference between them is small This may be related to the fact that most of the test pits excavated in these two sites were in the ash heaps which may have provided protection against trampling as noted elsewhere Trampling seems to be the most viable explanation for the higher frequency of angular waste in the other sites, especially at Wambua's and Daystar where most of the test pits were excavated away from the ash heaps

Derived segments are the next most abundant with a variation of 15 percentage points between the sites with the lowest (Wambua's, 7.0%) and highest (Brown's, 22%) proportion Issues which may be related to this variation were discussed in the section above

The modified blades and bladelets are dominated by segmentary blades The range of variation between the sites with the lowest (Makongoni, 27.3%) and the highest (Daystar, 71.4%) proportion of segmentary blades is 44 percentage points, the highest variation so far This appears to be a matter of sample size The proportion of segmentary blades at Daystar, when calculated against the assemblage from that site, is the same as that of Makongoni and Brown's, the sites with the biggest samples. To better reflect the variation, the proportions of these classes were calculated against one total for the category. The variation was 13 percentage points with Daystar having the lowest proportion (4.7%); Silanga had the highest proportion (17.9%).

4.2.5 Shaped tools

Table 4.3 summarises the proportion of the shaped tools as percentage of total shaped tools and the assemblage for each site. The variation between the sites, when viewed against the assemblage is very small (only 3 percentage points), but this is due to the proportion of waste in each of the sites which account for more than 80% of the assemblages. When this variation is viewed for every class against total shaped tools in each site, the variation still seems small (8 percentage points). This is because the *outils écaillés* control the proportion of all other tool classes. Elsewhere, it was remarked that *outils écaillés* are not strictly considered as shaped tools, but where included here to make comparison with other sites possible. If they are taken out of the shaped tools, the picture is changed substantially.

Table 4.3: The frequency of the various classes of shaped tools as percentage of the total shaped tools and the assemblage for each site. T= Shaped tools; A= Assemblage.

	GvJm4 7			GvJm5 2			GvJ m184			GvJm299			GvJm48		
	n	%(T)	%(A)	n	%(T)	%(A)	n	%(T)	%(A)	n	%(T)	%(A)	n	%(T)	%(A)
n		137	19 75		438	3761		441	4347		137	1570		316	4648
Microliths	25	18.2	1. 3	55	12.6	1.5	66	15	1.5	29	21.2	1.8	56	17.7	1.2
O/Es	74	54	3 7	289	66	7.7	269	61	6.2	76	55.5	4.8	180	57	3.9
Scrapers	21	15.3	1. 1	55	12.6	1.5	44	10	1	13	9.5	0.8	45	14.2	1
Borers	2	1.5	0. 1	4	0.9	0.1	4	0.9	0.1	5	3.6	0.3	2	0.6	0
Reamers	0	0	0. 0	1	0.2	0	1	0.2	0	0	0	0	0	0	0
Burins	12	8.8	0. 6	26	5.9	0.7	53	12	1.2	12	8.8	0.8	29	9.2	0.6
Gravers	0	0	0. 0	2	0.5	0.1	0	0	0	0	0	0	0	0	0
Combined	0	0	0. 0	5	1.1	0.1	2	0.5	0	2	1.5	0.1	2	0.6	0
Transformed	3	2.2	0. 2	2	0.5	0.1	2	0.5	0	0	0	0	2	0.6	0

Table 4.4: The proportion of the various classes of microliths calculated against the total for each site

	GvJm47		GvJm52		GvJm184		GvJm299		GvJm48		Mean	All Sites	
	n	%	n	%	n	%	n	%	n	%	%	n	%
Crescents	5	20.0	9	16.4	14	21.2	4	13.8	12	7.1	15.7	44	19.0
Trapezes	2	8.0	0	0.0	2	3.0	1	3.4	1	1.8	3.3	6	2.6
Triangles	0	0.0	1	1.8	1	1.5	1	3.4	0	1.8	1.7	3	1.3
Curved backed	4	16.0	3	5.5	11	16.7	7	24.1	7	12.5	15.0	32	13.9
Oblique truncations	0	0.0	3	5.5	8	12.1	2	6.9	3	3.6	5.6	16	6.9
Ortho truncations	4	16.0	0	0.0	2	3.0	0	0	0	0.0	3.8	6	2.6
Straight backed	0	0.0	1	1.8	0	0.0	0	0	2	0.0	0.4	3	1.3
Micropercoirs	0	0.0	1	1.8	1	1.5	0	0	1	0.0	0.7	3	1.3
Points	0	0.0	3	5.5	1	1.5	1	3.4	1	1.8	2.4	6	2.6
Microlith fragments	10	40.0	34	61.8	26	39.4	13	44.8	29	23.2	41.9	112	48.5
Total	25	100.0	55	100.0	66	100.0	29	100.0	56	51.8		231	100

A summary of the frequency of various classes of microliths is given in Table 4.4. Complete microliths are dominated by crescents with a variation of seven percentage points between the site with the highest frequency (Brown's, 21.2%) and the one with the lowest (Daystar, 13.8%). This is followed by the curved-backed flakes which show a big variation of 18 percentage points between the site with the highest frequency (Daystar, 24.1%) and the one with the lowest frequency (Silanga, 5.5%). This variation appears to be controlled by the frequency of microliths themselves at each site. The burins are dominated by angle burins, although there is a wide variation between the sites for this class. There was a tendency to make burins out of segmentary blades and there is a relationship between the proportion of segmentary blades and angle burins; their dominance is not unexpected.

4.2.6 Unshaped Stone Tools

Only one category of unshaped stone tools (becs) was identified. This is in marked contrast with the other sites from this time period. Since no serious effort was made to record attributes from modified segmentary blades and bladelets, it is possible that most specimens in these two categories would fall under this category. A proper assessment of the importance of the unshaped tools in these assemblages can only be done after the attributes for the modified blades and bladelets has been done.

As noted elsewhere, the wide variation in the morphology (size and shape) of *outils écaillés* does not suggest to me that this category should be considered as shaped tools, but rather as unshaped. Traditionally, *outils écaillés* have been considered as shaped tools. Since a reassessment of the typological system used for other sites in East Africa lies outside the reference of this thesis and to ease comparison, the traditional approach has been followed here and *outils écaillés* placed together with the shaped tools. If they were to be included with the unshaped tools, this would have a far reaching implication in the assessment of lithic industries in East Africa. One of them would be that unshaped tools would dominate in most Later PN industries in East Africa

4.2.7 Modified blades and bladelets

As noted elsewhere, modified blades and bladelets are dominated by segmentary blades. This is probably related to the fact that the initial flake targeted by the makers of this industry appears to have been a long one which could then be put to other uses. This would also account for the important role segmentation plays in this industry. The long flakes would probably also be explained by the nature of the raw material that found its way to the sites, which appears to have been long blade cores among other forms. Thus, considering the important role of segmentation, the abundance of segmented flakes is not unexpected. It should also be noted that most of the segmented blanks were converted into other tool types.

The issue of the segmentary blades is a little more complicated than this. While the segmentation on some of the specimens is without doubt, some of them appear to have been broken by trampling or snapping. The characteristic bulb of percussion associated with segmentation is missing in some of these pieces. They are also very few in the assemblages, so no qualitative statements can be made about them.

The modification observed on most of the segmentary blades is utilisation. There was tendency towards utilising the segmented corners of these specimens. Others had utilisation on the edge formed by the segmentation and the flake release surface. Inverse retouch was not a very common form of modification.

4.2.8 Cores

The cores from these assemblages are very small and, those made of silica, highly informal. They are also very few and where their proportion is relatively high, they are dominated by silica. The silica cores have only a few flakes taken off them. Most of the obsidian cores have more than one platform and tend to be bipolar. There are some of them which have the morphology of tabular cores, but lack the characteristic facetting on the platform associated with such cores from elsewhere in East Africa. While the rarity of cores from these assemblages can be explained by their reduction till exhaustion, it is also related to their conversion to other artefacts. There is evidence that some of the *outils écaillés* were initially cores.

Table 4.5 below compares the relative frequency of cores and waste. The proportion of waste is far much higher than that of cores. This supports the idea that the number of cores, especially obsidian cores, was much higher than has survived in the archaeological record.

4.2.9 Special Categories of Waste

A summary of the special categories of waste relative to the assemblages on the one hand is given in Table 4.1 and relative to other categories on the other is given in Table 4.2. Most of the issues related to the variation observed for some categories of waste, especially flakes, derived segments, angular waste and segmentary blades and bladelets have been discussed in other sections above. What follows is a discussion of issues related to other categories of waste.

Table 4.5: Relative frequency of cores and special categories of waste

	GvJm47		GvJm52		GvJm184		GvJm299		GvJm48	
	n	%	n	%	n	%	n	%	n	%
Cores	6	0.3	45	1.4	38	0.3	16	1.1	51	1.2
Bladelets	1	0.1	6	0.2	18	0.1	3	0.2	50	1.2
Segmentary bladelets	26	1.4	51	1.6	69	1.4	21	1.5	94	2.2
Blades	4	0.2	4	0.1	19	0.2	3	0.2	38	0.9
Segmentary blades	45	2.5	108	3.3	156	2.5	30	2.1	154	3.6
Flakes	745	41.2	1349	41.0	1606	41.2	505	35.5	2066	47.9
Utilised flakes	5	0.3	29	0.9	14	0.3	5	0.4	18	0.4
Angular waste	762	42.1	931	28.3	908	42.1	589	41.4	1034	24.0
Burin spalls	65	3.6	118	3.6	110	3.6	47	3.3	90	2.1
Technical burins	0	0.0	1	0.0	0	0.0	0	0.0	0	0.0
Derived segments	126	7.0	539	16.4	844	7.0	170	11.9	633	14.7
Krukowski microburins	4	0.2	2	0.1	1	0.2	5	0.4	2	0.0
Microburins	2	0.1	0	0.0	2	0.1	0	0.0	0	0.0
Platform removal flakes	16	0.9	99	3.0	85	0.9	26	1.8	60	1.4
Split pebbles	0	0.0	0	0.0	3	0.0	2	0.1	9	0.2
Burned obsidian	1	0.1	6	0.2	7	0.1	2	0.1	10	0.2
Total	1808	100.0	3288	100.0	3880	100.0	1424	100.0	4309	100.0

What emerges from Table 4.1 is that the frequency of burins is much below that of burin spalls. Since burin spalls are thought to be by-products of burin manufacture, this anomaly is striking. Possible explanation for this is that a lot of burin spalls get produced in the process of using *outils ècaillės*. Most of the *outils ècaillės* from the assemblages under study here were observed to have numerous burin-like facets, most of which did not appear to be intentional. Others had been altered by further modification of the *outils ècaillės* such that the pieces could not be classified as combined or transformed tools. However, the relative proportion of *outils ècaillės* does not seem to correspond with the proportion of burin spalls. This may imply that more burins than survive in the archaeological record were converted to other tools. Some of the specimens identified as burin may have been produced by the cores themselves, which were also observed to have burin-like facets.

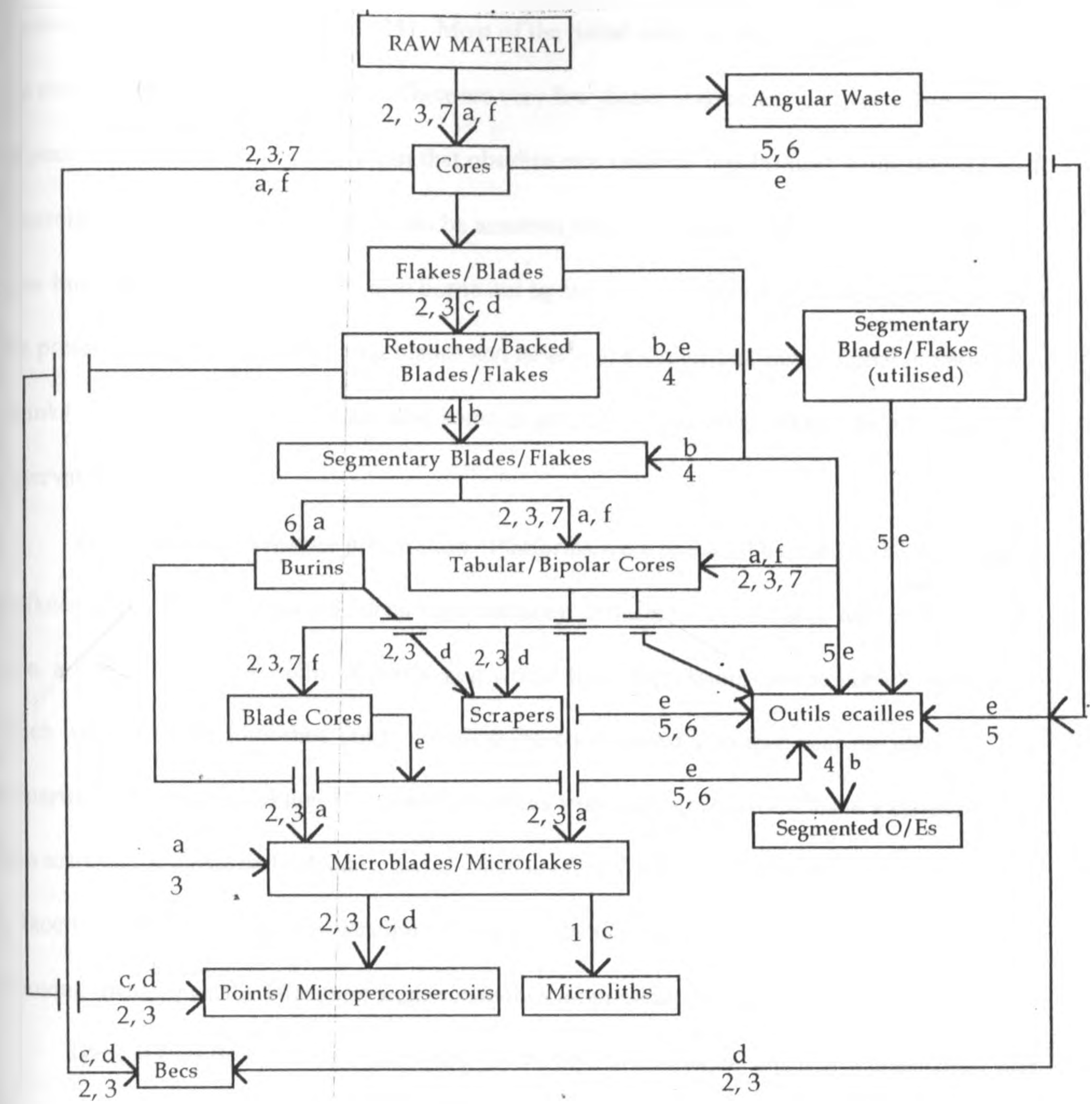
Another striking anomaly is the near absence of Krukowski microburins in relation to microliths. Krukowski microburins are by-products of the manufacturing process of microliths. The most plausible explanation for their paucity is the recovery methods. Considering the small size of the microliths, especially the geometrics, most Krukowski microburins would have passed though a five millimetre screen. While this could have been the case, the situation is complicated further by the very small proportion of Krukowski microburins at the two sites with the greatest proportion of microliths (Brown's and Makongoni). As noted elsewhere, a small-sized screen was used at Makongoni and selection during sieving may have taken place at Brown's. Since the small screen used at Makongoni did not lead to the recovery of more Krukowski microburins, the paucity of this category can not be explained by inadequate recovery methods. The other most plausible explanation may be related to the sampling technique noted elsewhere. The sites with more test pits away from the ash heaps tend to have a relatively higher proportion of Krukowski microburins. This reinforces the view that the ash heaps mostly contain material from certain functional locales.

4.3 Technological Analysis

The argument advanced in this report is that a peoples' technology, like language, is unique to them. The science and art of making stone tools is a learned process which is passed on from generation to generation. As a result, people learn how to make stone tools in a particular style that articulates their membership in a particular social group (see Weissner 1983), thus making it possible to use stone tools as cultural markers.

The study of lithic technology involves all the processes related to raw material acquisition, making of cores, manufacturing of the various tools and use and discard of the tools. The study of reduction sequence as part of technology studies involves determining at what point in the production chain various products are produced, what is called the *chaine operatoire* (Inizan *et al.* 1992:12) (see Figure 4.2).

During our investigations, we sought to isolate those technological features which would most likely reflect cultural affiliation. These included core preparation, flaking techniques, morphology of the tools and their sizes.



<u>Process</u>

a- Flaking

b- Segmentation

c- Backing

d- Retouch &/or trimming

e- Utilisation

f- Core preparation

<u>By - products</u>

1- Krukowski microburins

2- Flakes

3- Angular waste

4- Derived segments

5- Scalene flakes

6- Burin spalls

7- Platform removal flakes

Figure 4.2: A representation of the reduction sequence for obsidian artefacts at the Late PN sites at Lukenya Hill

The obsidian on which most tools are made of in the Lukenya assemblages came from the Central Rift (Merrick and Brown 1984). Most of the initial core preparation took place away from the sites, most probably at the quarry. There are very few pieces with cortex on them The presence of pieces with ground aretes may mean that obsidian raw material was brought in the form of tools (especially in the form of blades). It can be assumed that such blade cores were put to other uses after they were exhausted. This is also borne out by the very small number of obsidian cores But the presence of some unusually long blades and large cores shows that raw material in fairly large chunks was brought in. There are also some large platform removal flakes which bear out this observation.

There was extensive core preparation. Platforms were prepared by flaking the flake release surfaces of the cores (the future dorsal flake surface). After a series of flakes was taken from the core, a series of negative bulbs of percussion would form depressions on the outside of the core which would then be smoothed out by grinding the core against a surface near the platform, thus preparing it for further flaking. The resultant flakes from such cores would have a series of short flake scars on the dorsal surfaces and a partial grinding of the platform. Platforms were also prepared by facetting them, although this was not a common practice. Further, platforms were modified by removing them especially after their angle made them impossible to flake.

There at least three flaking techniques. a) the bipolar technique which produces flakes with very thin platforms or the platforms are absent altogether. This is because the technique leads to sheared cone of percussion on most of the flakes. The flake release surface on most of the flakes is heavily rippled. Some of the flakes which fall within this category are also produced during the use of *outils ècaillès*. Although it is hard to draw the line between these two processes, not the least because of the overlap between cores and *outils ècaillès*, the flakes from the latter are very small and had little functional utility.

b) the punch technique was also used. There are at least two punches used: a soft punch (which did not leave any prominent mark on the platform) and a sharp-pointed punch. The soft punch appears to have been the one used for blade production. The sharp-pointed punch left evidence in the form of pot marks on platforms where it was tried and failed to detach any flakes because the core was being struck far away from the edge. Often, the technique was repeated close to the edge and a flake would be detached. Flakes produced this way have a prominent pot mark on the platform and may also have sheared cones of percussion. The technique was also tried in segmentation. Pot marks were observed on the dorsal surfaces of blades where the technique was used to try and segment them, sometimes with success. The soft punch technique is the most common through out the assemblages studied.

c) the other technique was the direct or hard percussion. This technique appear to be confined to the large flakes which more often than not would also have one side with cortex. The large blades also appear to have been flaked by this technique. The flakes produced this way have a prominent bulb of percussion.

In the initial stages of the reduction sequence, the targeted flakes appears to have been long blades, although what actually survives in the archaeological record are short, wide flakes some of them often very small. Some of the flakes and blades were used and then discarded at this stage. A few were segmented without further modification. The majority were utilised and then segmented by placing them on an anvil and striking them on the arris. These processes produced, in addition to segmentary blades and flakes, what are collectively called derived segments. These consist of wedge-shaped debris, trapeziform pieces with one side sometimes utilised and rectangular pieces with utilisation either on one side or both sides or none. The derived segments were further used to make other tools especially *outils écaillés*, various kinds of scrapers, burins among others.

The segmented blades were used to make other tools like becs, burins, scrapers and *outils écaillés*. Some of these were also used as tabular and bladelet cores. Others had their corners (especially the proximal end) utilised and then discarded.

Other categories of waste were also used to make tools. For example we have a burin made from a burin spall and an *outil écaillé* made from a platform removal flake.

4.4 Metrical Analysis

Ambrose (1984b:225) has argued that shape and size of shaped stone tools made on obsidian (especially backed microliths and scrapers) are better indicators of cultural affiliation. This is because backed microliths and end scrapers are not only easily recognised, discrete classes of shaped tools, they are also found in sufficiently large numbers in LSA/PN assemblages through out East Africa. He further argues that, since microliths are extensively modified and that obsidian is a raw material that places few mechanical constraints on artifact form, their final form is likely to be controlled by cultural factors (Ambrose 1984b:225)

In this report, attributes were recorded from artifacts made of both obsidian and silica. Attributes were recorded from microliths and *outils écaillés*. End scrapers were very few and highly unstandardised and were not measured.

Attributes were recorded to serve two purposes: 1) to compare assemblages from the five sites under study for the formal description of the industry and 2) to use the data in comparative study of these assemblages from the study area with Elmenteitan assemblages from the Lemek-Mara region. The attributes recorded were the size of the tools (length, width and thickness).

A summary of the metric data for microliths from the Lukenya Hill sites is given in Table 4.7. The pooled mean for the sites overlaps very well with the individual mean for each of the sites. Although the truncations tend to be longer than the other microliths in all the sites, this does not seem to have affected the mean length at Brown's were they were predominant. A case can be made for standardised microliths at Lukenya Hill.

Table 4.6: A summary of metric data for a pooled sample of all the microliths from the sites

Miroliths for all the sites	N	Mean	SD	Min.	Max.
Length	111	18.89	5.39	8.32	45.1
Width	111	8.94	2.35	4.8	17.55
Thickness	111	2.59	0.77	1.21	4.85
W/L Ratio	111	0.49	0.12	0.24	0.9

Table 4.7: A summary of the microliths from all the sites

All Microliths GvJm47	N	Mean	SD	Min.	Max.
Length	17	17.96	4.68	10.36	26.86
Width	17	9.63	2.43	8.14	13.44
Thickness	17	2.47	0.64	1.54	3.4
W/L	17	0.56	0.16	0.36	0.9
All Microliths GvJm52	N	Mean	SD	Min.	Max.
Length	20	19.57	3.53	13.42	26.5
Width	20	8.88	2.55	5.27	14.5
Thickness	20	2.76	0.86	1.21	4.19
W/L	20	0.47	0.1	0.27	0.67
All Microliths GvJm184	N	Mean	SD	Min.	Max.
Length	35	19.24	5.83	11.27	32.9
Width	35	9.04	2.52	6.22	17.6
Thickness	35	2.56	0.73	1.58	4.26
W/L	35	0.49	0.13	0.3	0.85
All Microliths GvJm299	N	Mean	SD	Min.	Max.
Length	16	18.97	8.25	8.32	45.1
Width	16	8.35	2.45	4.8	13.77
Thickness	16	2.49	0.95	1.31	3.73
W/L	16	0.47	0.09	0.24	0.62
All Microliths GvJm48	N	Mean	SD	Min.	Max.
Length	23	17.87	3.06	11.05	22.81
Width	23	8.1	1.54	5.1	11.39
Thickness	23	2.59	0.71	1.49	4.15
W/L	23	0.47	0.11	0.27	0.77

The crescents from this sites are highly standardised in their shape. Only Makongoni site had some crescents which tended to be shallow than the other sites. Deep crescents were very few.

These observations are borne out by the data presented in Table 4.9. The mean width/length ratio of 0.4 compares favourably with that of the other microliths which shows that the variation between the length of the truncations noted above is not that great.

A summary of the metric data for *outils ècaillès* is given in Table 4.10. The *outils ècaillès* show an unusually high degree of uniformity in their mean width/length. The reason for this is probably related to the fact that some *outils ècaillès* are wider than they are long. Another possibility is raw material economics, and especially the fact that most of the *outils ècaillès* were made from segmentary blades. There is also a tendency towards some specimens being thick which is probably related to the fact that some *outils ècaillès* are made from exhausted cores

Table 4.8: A summary of the metric data for all the crescents from the PN sites

All crescents from the sites					
	N	Mean	SD	Min.	Max.
Length	43	18.28	2.69	13.23	25.05
Width	43	8.07	1.61	5.1	13.98
Thickness	43	2.61	0.68	1.77	4.26
W/L	43	0.44	0.07	0.31	0.57

4.5 The Definition of the Lukenyan Industry

It has been demonstrated above that a wide degree of variation is possible within an industry, even for sites within close proximity to each other and having almost equal access to the raw materials. The degree of variation observed in typology for the Lukenyan Industry from all its representative sites is, in general, much smaller than the variation observed for the Elmenteitan, especially the sites in the Rift Valley which have a greater variation. In none of the sites at Lukenya Hill do we have a variation in relative frequency of tool types as varied as that observed for the Elmenteitan sites. Although the highest degrees of variation in relative proportion of tools between sites is observed for the Lukenyan Industry sites, these can probably be explained by other than cultural differentiation, especially considering that it occurs in only two artefact classes (modified whole blades with a variation of 37 percentage points and modified segmentary blades with a variation of 27.7 percentage

Table 4.9: A summary of the metric data for the *outils écaillés*

Outils écaillés- GvJm47	N	Mean	SD	Min.	Max.
Length	55	20.08	5.89	9.05	37.6
Width	55	14.92	4.53	6.1	26.19
Thickness	55	4.94	1.66	2.36	10.96
W/L	55	0.77	0.25	0.36	1.37
Outils écaillés - GvJm52					
	N	Mean	SD	Min.	Max.
Length	218	19.41	7.3	9.3	59.4
Width	218	15.07	5.79	5.44	46.49
Thickness	218	5.37	2.48	1.9	15.33
W/L	218	0.8	0.25	0.26	1.94
Outils écaillés- GvJm184					
	N	Mean	SD	Min.	Max.
Length	189	20.2	6.1	9.65	48.84
Width	189	15.35	5.41	5.47	38.07
Thickness	189	5.33	1.75	1.99	11.56
W/L	189	0.79	0.27	0.31	2.01
Outils écaillés - GvJm299					
	N	Mean	SD	Min.	Max.
Length	57	19.15	5.56	7.72	41.84
Width	57	14.86	4.79	7.52	29.78
Thickness	57	4.94	1.76	2.72	13.46
W/L	57	0.82	0.31	0.42	2.18
Outils écaillés- GvJm48					
	N	Mean	SD	Min.	Max.
Length	134	20.99	6.69	8.4	51.56
Width	134	15.68	5.91	5.42	41.31
Thickness	134	5.91	2.44	1.87	14.63
W/L	134	0.76	0.25	0.33	1.8
All outils écaillés					
	N	Mean	SD	Min.	Max.
Length	653	20	6.6	7.27	59.4
Width	653	15.25	5.52	5.42	46.49
Thickness	653	5.33	2.16	1.87	15.33
W/L	653	0.76	0.26	0.26	2.18

points. The variation in the other artefact types ranges from 0.1 percentage points to 8.6 percentage points, a much smaller range than that observed for the Elmenteitan sites where variation ranges from 0.3 percentage points to 42.1 percentage points. The pattern of variation shows that the Lukenya Hill sites were functionally similar and may broadly reflect cultural affiliation.

The Lukenyan Industry microliths have a pooled Mean length of 18.72 mm. Crescents are much more standardised than the other microliths as was demonstrated in Chapter Four above. They have a Mean length of 18.25 mm, a Mean width of 8.07 mm and a Mean width/length ratio of 0.44 mm. The standard deviation of 0.07 shows a very small degree of variation. It should be noted, however, that the samples on which these figures are based are small and not statistically significant for the individual sites. So, these patterns of variation may change considerably when more samples become available.

The *outils ècaillés* are, however more abundant. They vary widely in their sizes with a range of between 7.27 mm and 59.40 mm. Their shapes are also varied and an examination of the width /length ratio shows that they are much wider. In fact, some of them are much wider than they are long. Their Mean lengths range from 19.15 mm to 20.99 mm, while their Mean widths range from 14.86 mm to 15.68 mm.

Technologically, the Lukenyan Industry is characterised by extensive core preparation, remnants of which are left on the dorsal flake surfaces of flakes and blades. This also results in platform removal flakes. Platforms are also prepared for flaking by grinding the outer surfaces of cores to remove depressions formed by negative bulbs of percussion. This process results in flakes and blades with evidence of grinding on dorsal surfaces near the platform. The preferred flaking technique is the use of punch, although other techniques are also represented. There were two kinds of punch which were used, a soft punch and a sharp-pointed one. The sharp-pointed punch leaves pockmarks on the platform. It is also used for segmentation. The targeted flake was a long one which was then segmented to make other tools such as burins, end scrapers, etc.. Segmentation was also used in the resharpening of tools like burins.

4.6 Summary and Conclusion

In this chapter, we have presented the descriptive analysis of the lithics which included the typological analysis, metric analysis and the reduction sequence. The scope of analysis and the typological system used were also reviewed. We have also presented the metric data for microliths and outil ecailles. All these provided the basis for the definition of the Lukenyan Industry, which is presented in this chapter.

The main conclusion was that there was an overlap in the main features of the lithic industry present at the five PN sites at Lukenya Hill to warrant considering it as a distinct lithic industry. In the following chapter, we have offered a comparison of this industry with another well known PN industry, the Elmenteitan.

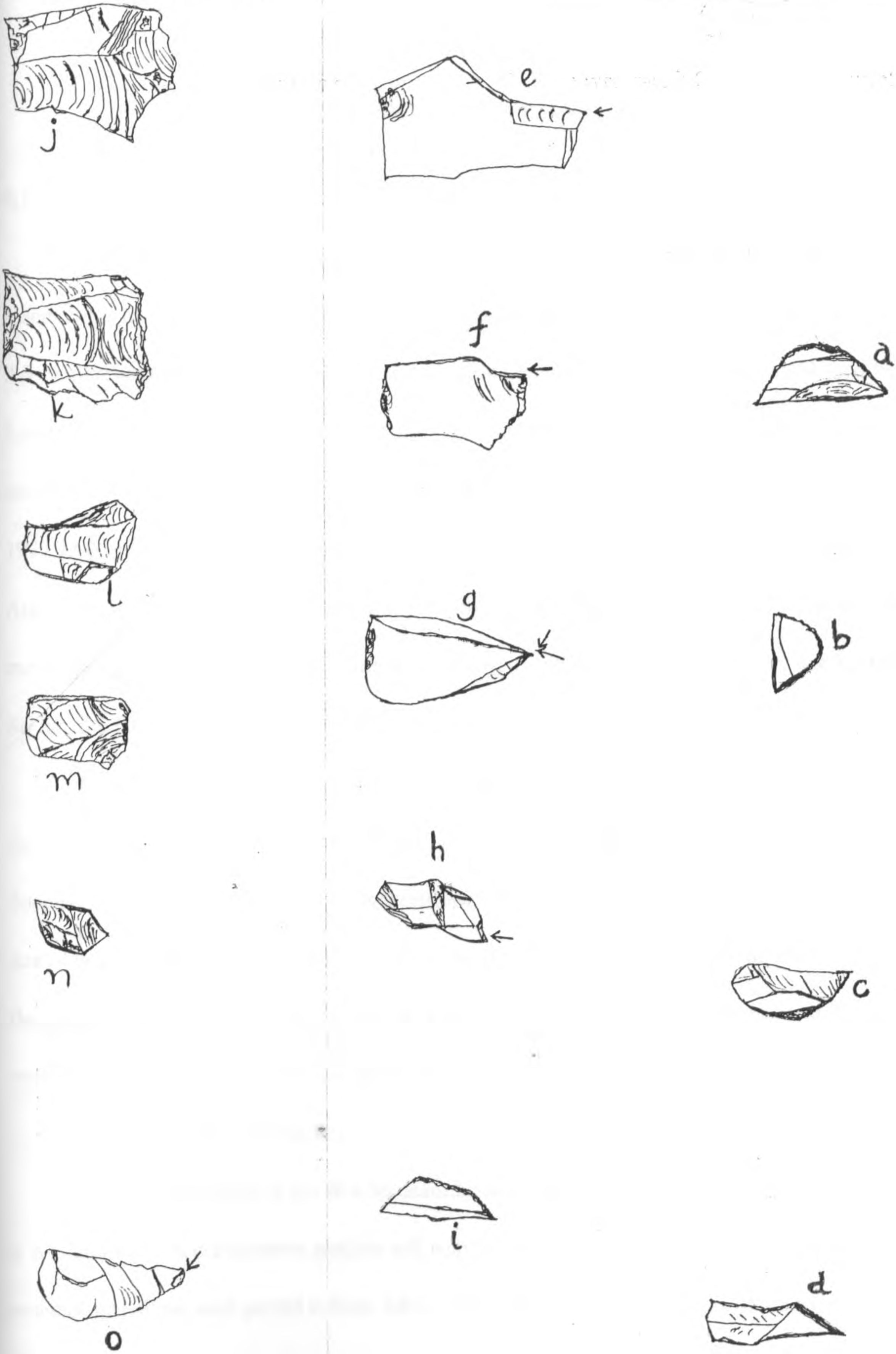


Figure 4.3: Illustration of some of the tools described above a-c, i: Crescents; d: truncation; e-h, o: burins; j-n: *outils ecailles*

CHAPTER FIVE

THE COMPARATIVE ANALYSIS

5.1 The Comparative Problem

A comparative analysis was undertaken of the Lukenya Hill assemblages with Elmenteitan assemblages from sites in south-western Kenya. The Elmenteitan Industry has a long history in East African archeological lore. The original definition of this lithic industry was established by Louis Leakey (1931: 172-5) and was based on typology of flaked stone tools although the pottery associated with it (the Elmenteitan Ware, nee Remnant Ware, see Wandibba 1977; also Bower *et al.* 1977:134-140) was noted. A technological definition was offered in 1977 by Nelson (1980:275-278). Ambrose (1984a: 220-1) proposed a definition for the Elmenteitan culture which incorporated mortuary tradition, geographic distribution, economy, in addition to a lithic industry and pottery type. So far, the Elmenteitan remains the only securely defined archaeological culture in the PN.

Between the early and mid-eighties, a stone artefact assemblage, which was associated with the Elmenteitan Ware, but which differed with the Elmenteitan Industry of the Central Rift was documented in south-western Kenya (Robertshaw 1988, 1990) It was shown that, while the average size of larger artefacts, such as *outils ècaillès,* decreased with distance from the Central Rift Valley, the size of the microliths remains constant (Robertshaw 1988:58-9). On the basis of its association with the Elmenteitan Ware and the uniform size of the microliths, it was interpreted as a functional variant of the Elmenteitan Industry.

This present study is the first to describe the Lukenya Hill assemblages in formal terms and it is hoped that this comparative analysis will help put them in a proper perspective in relation to other assemblages of the same period in East Africa The Elmenteitan assemblages of south-western Kenya were chosen for this purpose for a variety of reasons. Both localities have the same geographic setting in areas with almost similar rainfall patterns, flora and fauna They are also situated almost the same distance from their known obsidian sources in the Central Rift (Merrick and Brown 1984; Merrick *et al.* 1990) and it can be assumed that the technological constraints imposed by the cost of obtaining the raw material was the same in both regions (*cf.* Childe 1956:137). Lastly, both localities have the same temporal distribution and are the only PN entities in East Africa with distinct lithic technologies co-existing with specific pottery wares. These assemblages are also different from others known from the surrounding areas. It has been shown that the Lemek-Mara Elmenteitan assemblages are different from those of the Serengeti Plains which has the same ecology (Robertshaw 1990:293). There are no ceramics close to what we have at Lukenya anywhere else on the east side of the Rift, except at West Kilimanjaro (Mturi 1986), more than 170 kilometres to the south. Finally, the Elmenteitan and Lukenya Industries share to a great extend the same typological classes and techniques of tool manufacture.

The aim of this comparative study is to establish the range of variation of materials within the two industries against which the similarities and differences among other PN sites may be assesed. A lesser aim is to see whether the industry represented by the Lukenya Hill assemblages can be separated from others with similar characteristics.

5.2 The Comparison

The comparative study reported here was largely limited to the sites of Ngamuriak in Lemek Valley and those Lukenya Hill in the Athi-Kapiti Plains. However, the data presented in Table 5.1, includes those of two other Elmenteitan sites on the fringes of the Mau Escarpment near the known obsidian sources of the Central Rift. The purpose of including these data was to show the range of variation possible within the Elmenteitan Industry, against which to judge the variation observed for the Lukenya Hill assemblages.

Table 5.1: Relative proportion of artefact types from Elmenteitan and Lukenya Hill sites

	Elmenteitan sites				Lukenyan sites					
	GsJh1	GsJj25	GuJf6	Mean	GvJm47	GvJm52	GvJm184	GvJm299	GvJm48	Mean
Tools and modified blades	10.1	11.1	13.6	11.6	8.3	12.6	10.7	9.3	7.3	9.6
Cores	0.4	0.4	0.8	0.5	0.3	1.2	0.9	1.0	0.9	0.9
Waste	89.5	88.4	85.5	87.8	91.4	88.3	88.4	89.7	91.4	89.8
Sample size (n)	6367	4544	22738		1975	3761	4347	1570	4648	
Shaped tools (n)	220	172	1360		137	438	441	137	316	
Crescent	20.9	11.6	8.8	13.8	3.6	2.1	3.2	2.9	3.8	3.1
Triangle	5.5	1.7	0.7	2.6	0.0	0.2	0.2	0.7	0.0	0.2
Trapeze	0.9	1.2	0.3	0.8	1.5	0.0	0.5	0.7	0.3	0.6
Curved backed	0.9	2.9	6.4	3.4	2.9	0.7	2.5	5.1	2.2	2.7
Oblique truncation	2.3	5.2	9.1	5.5	0.0	0.7	1.8	1.5	0.9	1.0
Ortho truncation	0.0	0.6	1.4	0.7	2.9	0.0	0.5	0.0	0.0	0.7
Misc. Truncations	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Straaight backed	0.0	0.6	1.5	0.7	0.0	0.2	0.0	0.0	0.6	0.2
Micropercoir	0.0	0.6	0.0	0.2	0.0	0.2	0.2	0.0	0.3	0.1
Point	0.0	0.0	0.0	0.0	0.0	0.7	0.2	0.7	0.3	0.4
Others (pot perf.& misc. micr.)	0.9	1.2	2.2	1.4	0.0	0.0	0.0	0.0	0.0	0.0
Microlith fragment	29.1	9.9	12.4	17.1	7.3	7.8	5.9	9.5	9.2	7.9
	60.5	35.5	43.1	46.4	18.2	12.6	15.0	21.1	17.6	16.9
End scrapers	10.4	6.4	9.9	8.9	6.6	5.7	4.3	2.9	6.0	5.1
Convex scapers	0.5	1.2	0.9	0.9	0.7	0.7	0.2	0.0	0.9	0.5
Nosed scrapers	4.1	7.6	0.6	4.1	5.1	2.1	3.9	3.6	3.2	3.6
Side scrapers	0.5	8.7	1.5	3.6	0.7	0.9	0.2	0.7	1.6	0.8
Others	1.9	2.9	2.6	2.5	1.4	2.2	0.6	0.7	2.1	1.4
Scraper fragments	3.2	12.8	2.4	6.1	0.0	1.1	0.0	0.0	0.3	0.3
	20.6	39.6	17.9	26.0	14.5	12.7	9.2	7.9	14.1	11.7
Percoir	0.5	0.0	1.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Reamer	0.5	0.0	0.1	0.2	0.0	0.2	0.2	0.0	0.0	0.1
Borer	0.0	0.0	0.0	0.0	1.5	0.9	0.9	3.6	0.6	1.5
Graver	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.1
Burins	14.5	14.5	14.0	14.3	8.8	5.7	12.0	8.8	9.2	8.9
Outils ecailles	2.7	7.6	18.7	9.7	18.2	12.6	15.0	21.2	17.7	16.9
Flakes with inverse retouch	0.0	1.7	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.0
Combination tools	0.9	1.2	3.4	1.8	0.0	1.1	0.5	1.5	0.6	0.7
Transformed tools	0.0	0.0	0.9	0.3	2.2	0.5	0.5	0.0	0.6	0.8

Table 5.1 continued.

Unshaped tools(n)	15	104	271		2	7	5	2	1	
Casual retouch	53.5	26.9	69.0	49.8	0.0	0.0	0.0	0.0	0.0	0.0
Casually trimmed	20.0	8.7	1.1	9.9	0.0	0.0	0.0	0.0	0.0	0.0
casual inverse retouch	0.0	0.0	13.7	4.6	0.0	0.0	0.0	0.0	0.0	0.0
Becs	0.0	26.9	14.0	13.6	100.0	100.0	100.0	100.0	100.0	100.0
Kasoga flakes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Retouched snap	0.0	8.7	2.2	3.6	0.0	0.0	0.0	0.0	0.0	0.0
Edge-worn flakes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Edge-battered flakes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Modified blades (n)	406	228	1466		28	28	21	7	22	
Whole blades	41.3	42.1	65.3	49.6	39.3	21.5	28.6	28.6	59.1	35.4
Segmentary blades	58.6	57.9	34.7	51.4	60.1	78.6	71.4	71.4	50.9	66.5
Tools and modified blades (n)	641	486	3097		167	473	146	146	339	
Shaped tools	34.3	35.4	43.9	37.9	82.0	92.6	93.8	93.8	93.2	91.2
Unshaped tools	2.3	22.6	8.8	11.2	1.2	1.5	1.4	1.4	0.3	1.1
Modified blades	63.3	42.0	47.3	50.9	16.8	5.9	4.8	4.8	6.5	7.7
Waste (n)	5700	3387	19448		1801	3243	1408	1408	4258	
Cores (n)	26	18	193		6	45	16	16	51	

The site of Ngamuriak was chosen for the comparative study for various reasons. It is not only the most extensively excavated Elmenteitan site in the Lemek-Mara, but also well-reported in the literature (Marshall 1986, 1990, Robertshaw 1990). It lies about 110 Kilometres from the Central Rift obsidian sources, just about the same distance as Lukenya Hill. Ngamuriak is therefore, the most suitable choice for helping us to understand the possible forces in operation which might explain some of the variation which observed.

Although the typological systems used in both analyses are basically the same, relying heavily on the typology developed for East African LSA and PN by Nelson (1973, 1980), there are some differences in the definition of tool classes. For example, the system used for the classification of burins is slightly different. For this reason, all the burins from all the sites are considered as a monolithic group in both assemblages. Within the microliths, we did not have pot perforators or miscellaneous microliths. These were subsumed under "others" in the Ngamuriak and the Rift assemblages. For the scrapers, "others" includes notched, concave and informal scrapers. Other groups which were classed together were modified blades and bladelets, because Robertshaw (1990) does not recognise bladelets, while Nelson's (1980) small blades are much bigger than the bladelets we identified at Lukenya Hill. Also, in the Central Rift and Ngamuriak assemblages, attributes were recorded for the blades, something we did not do with our assemblage. In Figure 5.1, all the special categories of waste are grouped together under "waste" because the data for the Remnant and Maasai Gorge sites do not have such categories separated, except for burin spalls and derived segments. Other categories in waste are flakes, angular waste, and unmodified blades.

5.2.1 The Elmenteitan Industry

Within the Elmenteitan, there is wide variation in the relative frequency of certain shaped tool classes. For the sites in the Central Rift, the variation in shaped stone tools and modified blades as a proportion of the assemblage is small (only one percentage point). Cores are equally represented, while the variation in waste is only one percentage point (Figure 5.1). However, when the variation is viewed within the categories themselves, differences become more discernible. Modified blades dominate in the tools and modified blades category with a variation of 21 percentage points for the sites in the Central Rift (Remnant , 63.3% and Maasai Gorge, 42%). The proportion of shaped tools is almost the same with a variation of one percentage points, while unshaped tools have a variation of 20 percentage point.

Within the shaped stone tools, the variation is even greater. Microliths dominate with a variation of 25 percentage points between the site with the highest frequency in Remnant (60.5%) and the lowest frequency in the Maasai Gorge (35.5%%). There are more scrapers at Maasai Gorge (39.6%) than there are at Remnant site (20.6%) with a variation of 19 percentage points between them. Burins are the next most abundant class and are equally represented at both sites. *outils écaillés* have a variation of five percentage points between the sites. The relative proportion of the modified blades (whole and segmentary) is almost the same for these sites, with a variation of two percentage points for the segmentary blades.

These variations for sites within close proximity of each other, albeit one at a higher altitude than the other, are striking. Both these sites are situated close to known obsidian sources, so the differences between them cannot easily be explained by unequal access to raw materials. This is borne out by the equal proportion of tools, modified blades, cores and waste in the two assemblages. The variation probably reflects different adaptations to exploitation of resources, which may be related to seasonal movements of the pastoralists during the rainy and dry seasons between the high elevation and the low elevation sites.

When the site of Ngamuriak is brought into the picture, other patterns of variation begin to emerge. The proportion of tools, modified blades, cores and waste at Ngamuriak as a percentage of the assemblages compares favourably with that of the sites at the Central Rift. But the Ngamuriak site has slightly more tools and modified blades than the sites at the Rift (variation of 3.5 percentage points). The variation of shaped stone tools alone as a proportion of the assemblage is greater between Ngamuriak (6%) and the sites of the Rift (3.5% at Remnant and 3.8% at Maasai Gorge). Modified blades are the same at Ngamuriak and Remnant (6.4%) and are more than at Maasai Gorge (5%). There more unshaped tools at Maasai Gorge (2.3%) than at both Remnant (0.2%) and Ngamuriak (1.2%). Within tools and modified blades, the proportion of shaped tools is higher at Ngamuriak (43.9%) than at the sites of the Rift which have only a variation of two percentage points between them. The variation between them and Ngamuriak is nine percentage points.

When we examine the proportion of the various classes of shaped stone tools from all three sites, what emerges is that microliths dominate and that Remnant has the highest proportion (60.5%), followed by Ngamuriak (43.1%) and Maasai Gorge which has 35.5%. Scrapers are the next most abundant class. They are more at Maasai Gorge (39.6%) followed by Remnant site (20.6%) and lastly Ngamuriak (17.9%). The burins are the same at all the three sites with 0.5 percentage points between the Rift sites and Ngamuriak (14%). *Outils écaillés* are more abundant at Ngamuriak than at the sites of the Rift, with a variation of seven percentage points. Ngamuriak has more modified whole blades (65.3%) than the other sites (Remnant, 41.3%; Maasai Gorge, 42.1%), the variation between them is 24 percentage points

From the above observations, the degree of variation which emerges for the sites of the Rift and Ngamuriak (in the Lemek-Mara) does not show any pattern which would completely set the two regions apart Any large degree of variation observed for the sites in the Rift, for example the 25 percentage points of variation for the microliths between Remnant site (60.5%) and Maasai Gorge (35.5%), subsumes the other sites within it (in this case Ngamuriak site has 43.1%). One thing that seems to set Ngamuriak apart from the sites of the Central Rift is the proportion of *outils écaillés* which, at 18.7%, is higher by 11 percentage points from the next site with the next highest proportion

(Maasai Gorge, 7.6%; the variation is 16 percentage points with Remnant which has the lowest proportion of 2.7%). Ngamuriak also has more modified blades than the Rift sites with a variation of 24 percentage points between it and the Remnant site (41.3%) and 23.2 percentage points with the Maasai Gorge site (42.1%). Ngamuriak also has the greater variety of unshaped tools with pieces having casual retouch dominating, but the lower frequency in the other sites may be a question of sample size.

In broad terms, the Ngamuriak assemblages are similar to the Elmenteitan assemblages of the Central Rift, although strictly speaking, their typology is different in ways which would make them a distinct industry from the Elmenteitan of the Central Rift as defined by Nelson (1980). Issues related to its assignation to the Elmenteitan Industry were discussed elsewhere (Robertshaw 1988) and will be dealt with below.

5.2.2 The Elmenteitan and the Lukenya Hill Sites

a) Typological Comparison

The proportion of tools and modified blades, cores and waste is broadly similar between the Elmenteitan sites and Lukenya Hill sites, although the sites at Lukenya Hill tend to have more waste (Mean of 89.8%) than the Elementeitan sites (Mean of 87.8%). Ngamuriak has less waste (85.5%) than the site with the lowest proportion at Lukenya (Silanga, 88.3). Brown's site at Lukenya has proportion of waste much closer to the Elmenteitan sites (88.4%). Lukenya Hill sites also have slightly more cores (Mean 0.9%) than the Elmenteitan sites (Mean 0.5%), although Ngamuriak has a proportion (0.8%) which overlaps with that of the Lukenya Hill sites (0.3% to 1.2%). Wambua's site has the lowest proportion of cores (0.3%) which is lower than the that of the sites at the Rift (0.4%).

The shaped tools in the Elmenteitan sites are dominated by microliths (Mean 46.4%) while at the Lukenya Hill sites, the microliths and *outils ècaillès* dominate in equal proportions (Mean

16.9%). The proportion of *outils écaillés* is lower at the Rift sites (Remnant, 2.7% and Maasai Gorge 7.6%) while at Ngamuriak (18.7%) it is comparable to that of Lukenya sites. There are more scrapers at the Elmenteitan sites (Mean of 26%) than at the Lukenya sites (Mean 11.7%), although individually, Ngamuriak is closer to Lukenya Hill sites. The same is also true of burins, although, in this case, Ngamuriak has the same proportion as the Rift sites (variation between them is 0.5%). The Elmenteitan sites have Mean proportion of 14.3% of burins compared to Lukenya Hill sites Mean of 8.9%.

Within the modified blades, the proportion of blades for the Lukenya Hill sites is lower (Mean 35.4%) than the Elmenteitan sites. Here again, Ngamuriak is closer to the Lukenya sites than it is to the Rift sites. But the segmentary blades are far more numerous at Lukenya Hill sites (Mean 66.5%) than at the Elmenteitan sites (Mean 51.4%).

When the proportion of shaped tools is viewed within tools and modified blades, then Lukenya Hill has a Mean of 91.2%, more than 40 percentage points over the Elmenteitan sites. The unshaped tools are only 1.1% compared to Elmenteita's, 11.2% while modified blades are 50.9% at the Elmenteitan sites and 7.7% at Lukenya sites. These figures may be misleading because only becs were identified as the unshaped tools at Lukenya Hill. When the attributes for modified blades are recorded, perhaps more unshaped tools may turn up at the Lukenya Hill sites and the picture will change. What this Means is that modified blades may be much lower for the Lukenya Hill sites than they are for the Elmenteitan sites. However, the proportion of shaped tools is not expected to change that much and will probably still be higher at Lukenya Hill than at the Elmenteitan sites. Individually, Ngamuriak again is closer to Lukenya Hill than to the Rift sites, further confirming the view that the same forces were in operation in these areas.

For the waste, the only data available for the Rift sites are for burin spalls and derived segments. Although the Rift sites and Ngamuriak sites have the greater proportion of burins, they have very low proportions of burin spalls. Since burin spalls are a by-product of burin manufacture, this is surprising. As pointed out in Chapter Four, the abundance of burin spalls at Lukenya Hill sites may be related to the abundance of *outils ècaillès* most of which have burin-like facets. But it should also be pointed out that, as a proportion of the assemblage, the *outils ècaillès* at Ngamuriak are far much fewer than they are at Lukenya Hill. This would probably explain why Ngamuriak and the Rift sites have less burin spalls.

Another issue is that of derived segments. The Lukenya Hill sites have far much higher proportions of derived segments than any of the Elmenteitan sites. This issue was addressed in Chapter Four where it was shown that, at least for the Lukenya Hill sites, the discrepancy in the frequency of this category between the sites was not related to foibles of classification. At Ngamuriak, derived segments are far much fewer than at the other Elmenteitan sites and Lukenya Hill sites. Although it is hard to say with any certainty why this is the case, it may be related to technology: that there was less segmentation at Ngamuriak than at the other sites reviewed here. This is supported by the fact that Ngamuriak has more modified blades than any other site, although, without the figures for the unmodified blades from Ngamuriak and the sites of the Rift, it is hard to say how significant this may be.

Typologically, therefore, the Ngamuriak assemblages are broadly more similar to those of Lukenya Hill than they are to those of the Rift. In the Elmenteitan assemblages of the Rift and Lemek-Mara and Lukenya Hill, microliths are dominated by crescents while scrapers are dominated by end scrapers followed by nosed scrapers. Burins are the next dominant and angle burins tend to dominate at the Elmenteitan sites of the Rift. At Ngamuriak and Lukenya Hill, *outils ècaillès* are the next dominant class followed by burins. On average, Ngamuriak and Lukenya Hill sites have more shaped tools than the Rift sites. In the strict sense therefore, the Ngamuriak assemblages should not be considered Elmenteitan.

Table 5.2: A summary of the matric data for the crescents and *outils écaillés* from Lukenya Hill and Ngamuriak

All crescents from Lukenya sites					
	N	Mean	SD	Min.	M ax.
Length	44	18.28	2.69	13.23	25. 05
Width	44	8.07	1.61	5.10	13. 98
Thickness	44	2.61	0.68	1.77	4.2 6
W/L	44	0.44	0.12	0.31	0.5 7
All crescents from Ngamuriak					
	N	Mean	SD	Min.	M ax.
Length	33	19.43	5.37	12.70	44. 40
Width	33	7.12	2.01	4.00	15. 70
Thickness	33	2.69	0.83	1.50	5.20
W/L	33	0.37	0.70	0.29	0.66

All outils écaillés from Lukenya sites					
	N	Mean	SD	Min	Max
Length	653	20.00	6.60	7.27	59.40
Width	653	15.25	5.52	5.42	46.49
Thickness	653	5.33	2.16	1.87	15.33
W/L	653	0.76	0.26	0.26	2.18
All outils écaillés from Ngamuriak					
	N	Mean	SD	Min	Max
Length	191	21.19	8.09	7.40	50.60
Width	191	17.25	7.28	3.90	50.50
Thickness	191	5.03	2.16	1.50	13.90
W/L	191	0.84	0.27	0.35	2.00

b) Metric Analysis

Table 5.2 summarises the metric data for the crescents and *outils écaillés* from Ngamuriak and Lukenya Hill sites. The Lukenya Hill crescents are, on average, smaller than their Ngamuriak counterparts, although they tend to be wider. The *outils écaillés* are on average bigger at Ngamuriak, but they tend to be wider. However, these differences may be due to sample size. The Ngamuriak crescents tend to be larger than the ones from the Rift Elmenteitan sites which have Mean lengths of 15.1 to 17.9 mm, the range of variation here is 4.3 mm. The Ngamuriak crescents are much closer to the Lukenya crescents in their Mean lengths, with only a variation of 1.15 mm. For the *outils écaillés*, the variation in Mean length is only 1.19 mm while that of the Mean width is 2 mm. This, again is a pointer to similar forces in operation at Lemek-Mara region and at Lukenya Hill for this similarity to have emerged and it can be argued that the Ngamuriak assemblages are, in the strict sense, different from those of the Central Rift.

c) Technology

The technology at the Rift Valley sites, Ngamuriak and Lukenya Hill is broadly similar. Cores were probably brought to the sites in the form of prepared blade cores. Evidence from all the sites reviewed here shows that the initial core preparation took place away from the sites because the debitage recovered from the excavation of habitations sites does not reflect this initial core preparation (Nelson 1980:274; Robertshaw 1990). The targeted blade form was usually a long one. These blades were then segmented and used for making specialised tools such as burins, segmentary blades and end scrapers among others. These tools were then repeatedly segmented to sharpen them (Nelson 1980). Segmented burins, for example, are not uncommon at Lukenya Hill and flakes which undoubtedly come from further trimming of end scrapers are numerous. Other blades were used and then discarded without further modification. Segmentation is an important part of all these industries and a majority of all the other tools are, in one way or the other, related to the segmented pieces.

Few cores have survived which probably means that they were used to exhaustion. This means that smaller blades were produced which would appear to have been used for making geometric microliths. The small size of microliths from these industries suggests this, although cultural preferences are probably the main reason. These small blades were also used and then discarded while a few were also segmented. The segmentation processes produce segmentary blades and derived segments. The high incidence of burin plans in these industries is also probably related to these segmentation processes.

Although no detailed reduction analysis is reported for the Ngamuriak site, an examination of the assemblages shows that it is similar to the one exhibited by the Lukenya Hill assemblages. It has also been shown that, typologically and technologically, Ngamuriak is divergent from other Rift sites (Robertshaw, 1988:58-9). This raises the question: Is it really part of the Elmenteitan Industry?.

5.3 A Summary of the Main Research Findings

The aim of this thesis is to define of a new industry for the PN in East Africa based on assemblages from five PN sites at Lukenya Hill in the Athi-Kapiti Plains. In this chapter, a comparative study has been done which demonstrates the similarity of the Lukenya Hill assemblages with those of the Elmenteitan site of Ngamuriak in the Lemek Valley on the western side of the Rift Valley. But this similarity does not mean that these two assemblages belong to the same industry.

5.3.1 A Case for Lukenyan Industry

From the comparative study above, it emerges that the Lukenya Hill assemblages are similar to those of the Ngamuriak site in the Lemek Valley. In fact, these two assemblages are more similar than the Ngamuriak assemblages are to the Elmenteitan assemblages of the Rift, an industry to which they belong. They not only share the same technology, they also have a typology which is basically the same and tool sizes which overlap very well. Their temporal distribution also overlaps. These similarities give rise to a strong temptation to assign these assemblages to the same industry. Two questions which arise and need answers therefore, are: Do these assemblages belong to the same industry?. Can a case be made for a distinct lithic industry for the Lukenya Hill assemblages?.

As argued above, the Ngamuriak and by extension other Elmenteitan assemblages from Lemek-Mara should not be considered Elmenteitan if the strict definition of this industry were applied. Their assignation to the Elmenteitan culture is based solely on the presence of the Elmenteitan Ware with them. The reasons for doing this have been discussed by Robertshaw (1988) and we need not repeat them here. The basic argument advanced in this thesis is that, at least for the PN in East Africa, any definition of a lithic industry and by extension an archaeological culture, **should consider the pottery associated with that industry** because lithics are only a small representative subsystem of all the possible social-cultural roles within a culture system. Since the pottery found at the Ngamuriak site is the same as that associated with the Elmenteitan Industry (Elmenteitan Ware), its assignation to that industry is not disputed here. Rather, we need to emphasise that, as argued by Childe (1956:137), "the same culture **should not** be expected to be represented by an identical assemblage of types in two contrasted environments" (emphasis mine). Since the pottery associated with the industry represented by the Lukenya Hill assemblages is different from the Elmenteitan Ware, we cannot, therefore, validly make a claim for the Lukenya Hill material being Elmenteitan without jeopardising our basic argument.

The fact that the lithic assemblages from Ngamuriak share the same/or similar technological features with the Lukenya Hill assemblages while the ceramics are different has several possible explanations. 1) that the people responsible for these lithics may have had a common ancestry but that they both went separate ways thus developing different ceramic styles. A ceramic ware with the same technological features from a site that acted as a dispersal point is likely. However, such a ceramic ware and/or a site have not so far been found.

2) that ceramic production was the domain of women. Men from both communities, who moved with the cattle from one place to the other, learned lithic technology from each other, hence the similarity in technological features. This way, these peoples had access to the Central Rift Valley obsidian source areas.

3) that although these peoples intermarried and that ceramic production was the domain of women in both communities, cultural constraints forbade replication of other peoples' ceramics. So, the newcomers were forced to seek acceptance in their new homes by learning the local technique of making pottery, hence no overlap in technology.

4) Linguists have reconstructed the sequence of events about the population movements during the first millenium AD. They have proposed that Southern Cushitic-speaking pastoralists were the first in highland Kenya and that they were replaced by Southern Nilotic-speaking pastoralists in the western highlands as far south as Mt. Hanag, west of Lake Eyasi, Tanzania in the first millenium AD. If Southern Nilotic-speaking people with the Elmenteitan pottery replaced Southern Cushitic-speaking populations with the Lukenyan Industry on the Loita-Mara-Serengeti Plains during the Neolithic, then the first aspect of material culture to change may have been the pottery, with lithic reduction sequences changing later during their conversion.

While the first and the fourth models can easily be tested archaeologically, the other two cannot. Therefore, other models are necessary to explain this similarity in the lithics between the two localities.

There are two specific arguments in this thesis which have guided this research. The first is that lithic and ceramic production are processes learned in a cultural context. The other argument, although not explicitly expressed, is that culture is an adaptation to environmental conditions. It follows from this that cultures in similar environments can be expected to exhibit the same traits (*cf.* Childe 1956:137) and taken together, they would constitute a bigger whole, which has variously been called "technocomplex" (Clarke 1968:357), "techno-territory" (a territory "which shared substantial elements in technology", Clark 1975:14) or an "industrial complex" ("grouping of industries considered to represent parts of the same whole", Bishop and Clark 1967:892). Clarke defines a technocomplex as "a group of cultures characterised by assemblages sharing a polythetic range but **differing** specific types of the same general families of artefact types, shared as a widely diffused and interlinked **response** to common factors in environment, economy and technology" (1968:357) (emphasis mine). An industrial complex can be defined on both spatial and temporal terms. On this basis and taking into consideration the noted similarities between the Lukenya Hill assemblages and the Elmenteitan assemblages at Ngamuriak, a *prima facie* case has been established for an industrial complex for the Later PN in East Africa. As result, Lukenya Hill assemblages constitute a distinct lithic industry within this industrial complex and which we have proposed to call the Lukenyan Industry.

5.3.2 Summary and Conclusion

1. From the analysis of the Lukenya Hill assemblages from the five PN sites and the comparative study with the Elmenteitan assemblages from Ngamuriak site, it is concluded that a Lukenyan Industry

exists in the Athi-Kapiti Plains which is distinct from the other industries from the same time period. Its similarity with the Elmenteitan Industry of the Lemek-Mara has been noted and the differences in pottery postulated to be as a result of cultural differentiation. The similarity in lithics is due to similar strategies to deal with similar constraints imposed upon the two peoples by environment, accessibility to raw material and economy. The high cost of obtaining the preferred raw material (obsidian) imposed the same technological constraints, hence similarity in technological features in the two industries.

2. An industrial complex exists during the Later PN (*ca.* 2400 BP to *ca.* 1300 BP) in East Africa. The industries in this industrial complex have different pottery wares associated with them. It has been demonstrated that these wares can be used as the starting point for the definition of other lithic industries in this industrial complex.

5.4 Recommendations

Recommendations about a future survey strategy have been given in Section 2.8 above and will not be repeated here. What is suggested here relates to the bigger question of the Later Prehistory of East Africa.

1. A long term detailed and systematic study of the lithics from the Later Prehistory of East Africa in terms of technology, metric analysis, reduction sequence and typology is recommended. This will make it possible to compare lithics from various sites and assess their relationship.

2. Once this body of data from the lithics becomes available, an evaluation of the relationship of lithics and pottery should be undertaken. Pottery traditions, in East Africa at least, have been assumed to constitute cultural entities. This may not be the case as the comparative study based on lithics reported here shows.

REFERENCES

Ambrose, S.H. 1980: Elmenteitan and other Late Pastoral Neolithic adaptations in central Highlands of East Africa. In *Proceedings of the Eighth Panafrican Congress of Prehistory and Quaternary Studies (*eds. R.E Leakey and B.A. Ogot): 279-282. Nairobi, TILLMIAP.

Ambrose, S.H. 1982: Archaeological and Linguistic Reconstruction of History in East Africa. In *The Archaeological and Linguistic Reconstruction of African History* (eds. C. Ehret and M. Posnansky): 104-157. Berkeley: University of California Press.

Ambrose, S. H. 1984a: The Introduction of Pastoral Adaptations in the Highlands of East Africa. In *From Hunters to Farmers: The Causes and Consequences of Food Production in Africa* (eds. J.D. Clark and S.A. Brandt): 212-239. Berkeley: University of California Press.

Ambrose, S. H. 1984b: *Holocene Environments and Human Adaptation in the Central Rift Valley, Kenya.* (Ph.D. dissertation, University of California, Berkeley).

Ambrose, S.H., F.M.M. Hivernel and C.M. Nelson 1980: The Taxonomic Status of the Kenya Caspian. In *Proceedings of the Eighth Panafrican Congress of Prehistory and Quaternary Studies* (eds. R.E. Leakey and B.A, Ogot). Nairobi, TILLMIAP.

Barthelme, J.W. 1984: Early Evidence for Animal Domestication in Eastern Africa. In *From Hunters to Farmers: The Causes and Consequences of Food Production in Africa* (eds. J.D. Clark and S.A. Brandt): 200-205. Berkeley, University of California Press.

Barut, S. 1996: *Later Stone Age Raw Material Use at Lukenya Hill, Kenya.* (PhD dissertation, University of Illinois at Urbana-Champaign).

Bishop, W.W. and J. D. Clark 1967: *Background to Evolution in Africa.* Chicago and London: The University of Chicago Press.

Bower, J. R. F. 1984a: Settlement Behavior of Pastoral Cultures in East Africa. In *From Hunters to Farmers: The Causes and Consequences of Food Production in Africa* (eds. J.D. Clark and S.A. Brandt): 252-260. Berkeley: University of California Press.

Bower, J. R. F. 1984b: Subsistence-Settlement Systems of the Pastoral Neolithic in East Africa. In *Origin and Early Development of Food-Producing Cultures in North-Eastern Africa* (eds. L. Krazyzaniak and M. Kobusiewicz): pp. 473-480. Poznan Academy of Sciences and Poznan Archaeological Museum.

Bower J. R. F. 1988: Evolution of Stone Age Food-Producing Cultures in East Africa. In *Prehistoric Cultures and Environments in the Late Quaternary of Africa.* B.A.R. International Series 405, Cambridge.

Bower, J. R. F., Nelson, C. M., Waibel, A. F. and Wandibba, S. 1977: The University of Massachusetts' Later Stone Age/Pastoral Neolithic Comparative Study in the Central Kenya: an overview. *Azania 12*: 119-146.

Bray, W. and D. Tramp 1970: *The Penguin Dictionary of Archaeology.* Middlesex: Penguin Books.

Childe, V.G. 1956: *Piecing Together the Past: the Interpretation of Archaeological Data*, London.

Clark, J.G.D. 1975: *The Earlier Stone Age Settlements of Scandinavia.* Cambridge, Cambridge University Press.

Clarke, D. L. 1968: *Analytical Archaeology.* London, Methuen.

Close, A. E. 1977: *The Identification of Style in Lithic Artefacts from North East Africa.* Cairo, S.O.P Press.

Cohen, M.N. 1970: A Reassessment of the Stone Bowl Cultures of the Rift Valley, Kenya. *Azania 5*: 27-38.

Cole, S. 1963: *The Prehistory of East Africa.* New York, MacMillan.

Collett, D. P. and P. T. Robertshaw 1983: Pottery Traditions of Early Pastoral Communities in Kenya. *Azania 18*: 107-126.

Foster, J.B. and M.J. Coe 1968: The Biomass of Game Animals in Nairobi National Park. *Journal of Zoology (London)* 155: 413-425.

Gramly, R.M. 1975: *Pastoralists and Hunters: Recent Prehistory in southern Kenya and northern Tanzania.* PhD Dissertation, Havard University.

Gifford, D. P; G. L. Isaac and C. M. Nelson 1980: Evidence for Predation and Pastoralism at Prolonged Drift: A Pastoral Neolithic Site in Kenya. *Azania 15:* 57-64.

Gifford-Gonzalez, D. P. and J. Kimengich 1984: Faunal Evidence for Early Stock-Keeping in the Central Rift of Kenya: Preliminary Findings. In *Origin and Consequences of Food-Producing Cultures in North-Eastern Africa* (eds. I. Krazyzaniak and M. Kobusiewicz): 457-471. Poznan. Ploish Academy of Sciences and Poznan Archaeological Museum.

Hivernel, F.M.M. 1978: *An Ethnoarchaeological Study of Environmental Use in the Kenya Highlands.* (PhD Dissertation, University of London).

Hivernel, F. 1983: Excavations at Ngenyn (Baringo District, Kenya). *Azania* 18: 45-79.

Inizan, M.L., H. Roche and J. Tixier 1992: *The Technology of Knapped Stone.* Meudon: CNRS.

King K. Jr and J.L. Bada, 1979: Effects of *in situ* leaching on amino acid racemization rates in fossil bone. *Nature 281:*135-137.

Leakey, L.S.B. 1931: *The Stone Age Cultures of Kenya Colony.* Cambridge: Cambridge University Press.

Leakey M.D. 1945: Report on the Excavations of Hyrax Hill, Nakuru, Kenya Colony 1937-38. *Transactions of the Royal Society of South Africa* 30(4):271-409.

Leakey M.D. and L.S.B. Leakey 1950: *Excavations at Njoro River Cave*. Oxford: Oxford University Press.

Lynch, B.M. and L.H. Robbins, 1979: Cushitic and Nilotic Prehistory: New Archaeological Evidence from northwest Kenya. *Journal of African History 20*:319-328.

Maggs, T.M.O'c. 1977: Some Recent Radiocarbon Dates from the Eastern and Southern Africa. *Journal of African History 18*: 161-191.

Marean C.W. 1992: Implications of Late Quaternary Mammalian Fauna from Lukenya Hill (South-Central Kenya) for Paleoenvironmental Change and Faunal Extinctions. *Quaternary Research 37*: 139-255.

Marean, C.W. 1992: Hunter to Herder: Large Mammal Remains from the Hunter-Gatherer Occupation at Enkapune Ya Muto Rockshelter, Central Rift, Kenya. *African Archaeological Review* 10: 65-127.

Marshall, F.B. 1986: *Aspects of the Advent of Pastoral Economies in East Africa*. (PhD dissertation, Department of Anthropology, University of California, Berkeley).

Marshall F.B. 1990: Cattle Herds and Caprine Flocks: Early Pastoral Strategies in Southwestern Kenya. In *Early Pastoralists of South-western Kenya..* (ed. P. Robertshaw) Nairobi: British Institute in Eastern Africa.

Merrick, H.V. and F.H. Brown: 1984: Obsidian Sources and Patterns of Source Utilization in Kenya and northern Tanzania. *African Archaeological Review 2*: 129-52.

Merrick, H.V., F.H. Brown and W.P. Nash 1994: Use and Movement of Obsidian in the Early and Middle Stone Ages of Kenya and northern Tanzania. *MASCA Research Papers in Science and Archaeology* 11:29-44.

Mturi, A.A. 1986: The Pastoral Neolithic of West Kilimanjaro. *Azania* 21: 53-63.

Nelson, C.M. 1973: *A Comparative Analysis of Twenty-Nine Later Stone Age Occurrences from East Africa* (PhD dissertation, University of California, Berkeley).

Nelson, C.M. 1976: Flaked Tool Variation in the Later Stone Age of Eastern and Southern Africa. In *The Proceedings of the 7th Pan-African Congress for Prehistory and Quaternary Studies.* Addis Ababa 1971. (eds. A. Berhanon, J. Chavaillon and J.E.G. Sutton). Addis Ababa: Ministry of Culture.

Nelson, C. M. 1980: The Elmenteitan Lithic Industry. In *The Proceedings of the 8th Pan-African Congress for Prehistory and Quaternary studies.* Nairobi, 1977. The International Louis Leakey Memorial Institute of African Prehistory.

Nelson, C.M. and J. Kimengich 1984: Early Phases of Pastoral Adaptation in Central Highlands of Kenya. In *Origin and Consequences of Food-Producing Cultures in North-Eastern Africa* (eds.I Krazyzaniak and M. Kobusiewicz): 481-487. Poznan. Polish Academy of Sciences and

Poznan Archaeological Museum

Odner, K. 1972: Excavations at Narosura, a Stone Bowl Site in the southern Kenya Highlands. *Azania 7:* 25-92.

Onyango-Abuje, J.C. 1977a: Crescent Island: A Preliminary Report on Excavations at an East African Neolithic site. *Azania 12:*. 147-159.

Onyango-Abuje, J.C. 1977b: *A Contribution to the Study of the Neolithic in East Africa with Particular Reference to the Naivasha-Nakuru Basin.* PhD Dissertation, University of California, Berkeley.

Robertshaw, P. T. 1988: The Elmenteitan: An Early Food-Producing Culture in East Africa. *World Archaeology 20:1 Archaeology in Africa.* London, Routledge.

Robertshaw, P. T. 1990: *The Early Pastoralists of Southwestern Kenya.* Nairobi, The British Institute in Eastern Africa.

Robertshaw, P. T. and D. P. Collett 1983: A New Framework for the Study of Early Pastoral Communities in East Africa. *Journal of African History 24:* 289-301.

Robbins, L.H. 1972: Archaeology in Turkana District, Kenya. *Science 176:* 359-366.

Sassoon, H. 1968: Excavation of a Burial Mound in Ngorongoro Crater, Tanzania. In *Tanzania Notes and Records 69:*15-32.

Sutton, J.E.G. 1966: The Archaeology and Early History of Peoples of the Highlands of Kenya and Southern Tanzania. *Azania 1:*37-58.

Trigger, B. 1989: *A History of Archaeological Thought*. Cambridge, Cambridge University Press.

Wandibba, S. 1977: *An Attribute Analysis of the Ceramics of the Early Pastoralist Period from the Southern Rift Valley, Kenya.* (M.A. Thesis, University of Nairobi).

Weissner P. 1983: Style and Social Information in Kalahari San Projectile Points. *American Antiquity* 48: 253-276.

FACTORS AFFECTING THE EQUITY ALLOCATION DECISIONS MADE BY TRUSTEES AND FUND MANAGERS OF PENSION SCHEME PORTFOLIOS IN KENYA

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A MANAGEMENT PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION (MBA)

UNIVERSITY OF NAIROBI

DECLARATION

THIS RESEARCH PROJECT IS MY ORIGINAL WORK AND HAS NOT BEEN PRESENTED FOR A DEGREE IN ANY OTHER UNIVERSITY

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DEDICATION

To my parents, Cecilia and Bethuel Gitu.

ABSTRACT

This study sought to investigate factors influencing investments in equities by pension schemes in Kenya, from the perspective of trustees and fund managers, these being the two main groups responsible for the formulation and implementation of pension scheme investment policies.

A survey of trustees and CEOs in fund management organizations was carried out with a view to determining, in the first place, their general attitudes towards equities as an asset category. Specifically, the survey sought the cognitive, emotional and behavioural reactions of the said respondents, as the three main attitudinal elements in psychology. Secondly, the study sought the main factor considerations shaping the attitudes of the trustees and fund managers in Kenya towards equity. A third objective was the determination of the past performance of pension scheme equity investments, in terms of risks and returns, as a likely determinant of current equity investment policies of pension schemes. For this objective, the returns and risks on selected stocks quoted on the Nairobi Stock Exchange for a period of seven years (1996 – 2002) were analyzed as a proxy.

The respondents were overly concerned with the perceived excessive risks in equity relative to other alternative investments including Government securities, corporate bonds and real estate.

The most important corporate considerations made in contemplating equity investments were given as company profitability and the historical dividend payout ratio. The least important factors were found to be the level of industrial maturity and the size of the industry in which the investee company operates.

The annual average gains on the individual selected stocks over the period studied were actually -2.03%.The average risk per stock (computed as the standard deviation of returns) was quite high, 44.89% .This finding was consistent with the respondents' belief that equity investments are highly risky relative to their returns.

This is an area on which there are few studies, making this a further contribution to studies on pension scheme portfolios in Kenya.

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LIST OF ABBREVIATIONS

AIMS	Alternative Investment Market Segment
CMA	Capital Markets Authority
C&S	Commercial and Services Segment
EADB	East African Development Bank
ERISA	Employee Retirement Income Security Act
F&I	Finance and Investment Segment
I&A	Industrial and Allied Segment
MIMS	Main Investment Market Segment
MRM	Mabati Rolling Mills
NAV	Net Asset Value
NSE	Nairobi Stock Exchange
NSSF	National Social Security Fund
OECD	Organization for Economic Cooperation and Development
PAYGO	Pay - As - You - Go
RBA	Retirement Benefits Authority

1.0 CHAPTER 1:INTRODUCTION

1.1 Pension Shemes : A Background :

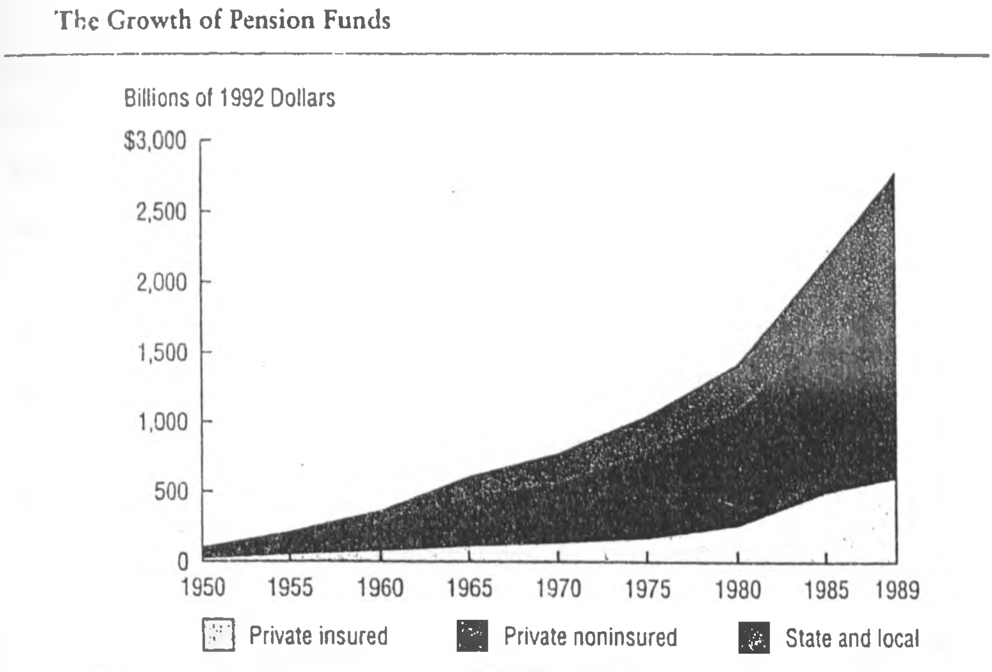
Pension schemes are in today's world primary vehicles for retirement savings for billions of people internationally. They serve several main purposes, *inter alia,* to compensate the beneficiaries (workers) for the loss of regular income; as benefits for service given during working life; and, in addition, as general social security.

The establishment of pension schemes by employers, both public and private, mainly seeks to address a triple requirement: firstly, the need to retire employees in due time while continuing to motivate those who remain in service, which is what is known as *the retirement problem*; secondly, there is the need to attract and retain staff in those employment categories which community practice treats as occupationally pensionable; finally, employers use pensions as a way of rewarding loyalty (Escolme, et al. 1990).

As a concept, pensions date back many centuries to the days of the Roman Empire where retired soldiers (legionnaires) would be granted freehold land to live off in their old age (Kohn, 1994). Formal pension schemes though, both public and private, were mooted in the latter half of the nineteenth century. Prussian Chancellor Bismarck devised the earliest public pension scheme in the 1880s for retired civil servants. The earliest private (corporate) pension scheme was set up by the American Express Company, whose business was rail transportation, in 1875. For these pioneer schemes, benefits due were paid from the resources of the scheme sponsor. As time went by and the number of retirees went up, pension payments increased, and sponsors found it financially prudent to appropriate, in advance, funds earmarked specifically for the payment of retirement benefits when these fell due. This marked the advent of pension funds as known today.

In the United States, for instance, pension funds collectively owned assets worth less than \$500M in 1929 (Kohn, 1994). Since then, the assets of pension funds have continued to grow rapidly. By the year 2001, the collective assets held by pension schemes in the US were estimated at $4.6 Trillion (Watson Wyatt, 2001). Growth has come from increasing contributions rather than from increasing coverage. From a total asset base of about $100Bn in 1950, the assets of US pensions funds grew at an estimated annual rate of 10% over the second half of the twentieth Century to surpass the $ 4.5 Trillion mark in year 2000(Kohn, 1994). The chart below shows this trend in pension fund asset growth in the US over the latter half of the twentieth century.

Figure 1: The Growth of Pension Fund Assets in the US



Source: *Trends in Pensions, (1992)*
Adapted from Kohn, (1994)

Tremendous growth has also been recorded by pension funds in other parts of the world. Pension funds in Western Europe and Asia have expanded quite a bit over the years Vittas (1996). In terms of sheer size, however, US pension funds dominate the global scene .By the end of 2001, pension funds worldwide held assets valued at an estimated

US$8 Trillion, with more than 50% of this amount being owned by US funds (Watson Wyatt, 2003). US funds accounted, at the end of 2001,for an impressive 63% of total assets, and nearly 70% of the top 50 funds in terms of asset holdings (15 of the top 20 funds are US based). The huge growth in pension funds has been attributed to various factors, among them being the globalization of securities markets, favourable tax treatment of pension funds, stability of contributions, stability of investment returns and actuarial changes in population structure, according to Maxwell (1994)

1.2 Pension schemes in Kenya: A Historical Perspective

1.2.1 Government Pension Schemes

The earliest pension schemes in Kenya were set up by the colonial Administration when Kenya was a British Protectorate. Government schemes were then administered by the Department of Pensions under the office of the Governor, who headed the local administration of the colony.

Of the more than ten schemes currently run on behalf of the civil service by the Kenya Government, all are unfunded (i.e. no predetermined financial contributions are set aside in advance towards the payment of promised benefits), and are financed wholly from the Consolidated Fund. However, a handful of schemes set up prior to independence in 1963, and which are no longer open to new entrants, have their funds invested commercially.

The funds are invested in Government securities and unquoted equity, according to the Ministry of Finance's Department of Pensions, which handles all investment matters pertaining to these schemes. The investment is worth slightly more than Kshs.120m according to the latest valuation which was carried out on June 30, 2001. Between 1981 and 2001, the investment yielded average annual returns measured at 11% on Government securities. No reliable figures are available yet on returns from unquoted equity.

1.2.2 Corporate Pension Schemes

Pioneer corporate (occupational) schemes were set-up by corporations that began operations in Kenya during colonial times e.g. Gailey & Roberts (1925). Barclays (1916), Unilever (the 1930's) Coca-Cola (1948) etc.

Until year 2000 when regulatory requirements took effect{ in enforcement of the RBA Act (1997)}, there were no regulatory requirements for private pension schemes to report on their activities or to make returns of any sort to authorities.Consequently, there is no published data on pension scheme activities in Kenya prior to year 2001. For this reason, any historical trend analysis of the growth of scheme membership, portfolio structure and performance, or other relevant variable is heavily constrained by the lack of published data.

1.3 Classification of Pension Schemes

Pension schemes maybe classified using several bases. These include,firstly the relationship between scheme sponsors and their beneficiaries;secondly the basis upon which promised benefits accumulate, and, finally, the insurance status of the scheme. On the basis of the relationship between scheme sponsors and their beneficiaries, schemes may be classified as Public/State pension schemes, Occupational pension schemes or Individual pension schemes.

Public/State Pension Schemes are set-up and run by governments on behalf of their employees and or citizens (where they are entitled to welfare benefits). Public schemes, being unfunded (meaning no advance contributions are made toward payment of the benefits due) are usually operated on a pay-as-you-go (PAYGO) basis, meaning current benefits are paid out of current income (earned from current member contributions). Examples of public/state schemes are Social Security in the US and European countries, civil service pension scheme run by the Kenya Governments and National Social Security Fund (NSSF). *Occupational Pension Schemes* are set up by organizations in a private capacity, on behalf of their employees. Occupational schemes may be further divided into two subcategories: they may be *contributory* (i.e. where both the employer and employee make predetermined financial contributions towards the employee's retirement benefits) or *non-contributory* (where the employer alone makes the contributions). In most modern economies,occupational pension schemes dominate. *Individual Pension Schemes* are set up by eligible persons for purposes of enabling oneself to save in order to receive retirement benefits within the provisions of the scheme rules. These schemes may be used by self-employed persons or persons working in firms that do not offer occupational pension schemes.

Secondly,pension schemes can also be classified on the basis on which promised benefits accumulate. Under this basis of classification schemes maybe categorized as either *Defined Benefit* or *Defined Contribution*. *Defined Benefit Schemes* promise specified benefits as some proportion of income. The sponsor (employer) promises participants a certain level of benefits on retirement. That level typically depends on the number of years they have spent on the job and on their final salary. The objective of funding (the making, in advance, of predetermined financial contributions towards the employees' retirement benefits) under this approach is to ensure that the funds in the scheme will be adequate to meet promised benefits where these ultimately fall due. Where the accumulated funds(assets) equal the level of benefits promised(liabilities), the fund is said to be *fully funded*.On the other hand where value of the assets exceeds the present value of the estimated obligation(liabilities) less the value of future contributions, the scheme is said to be *overfunded*. The scheme is described as *underfunded* if the value of the assets falls short of the present value of the estimated obligation less the present value of future contributions.

The second category of schemes based on the manner in which the promised benefits accumulate is the *Defined Contribution Scheme*. This kind of scheme allocates participants individual accounts to which specified contributions and earnings from scheme investments are credited. The ultimate benefits due depend upon the level of contributions to the account, investment returns, operational expenses and any forfeitures made. On retirement the amount accumulated in an individual account is paid out to the beneficiary either as a lump sum, an annuity, or part lump sum and part annuity. In Kenya, defined contribution schemes are the dominant type, comprising 85% of all registered schemes, the remainder being defined benefit. Together, both types of schemes covered more than 240,000 workers at the end of year 2001(RBA Newsletter, September 2001).

In another part of the world, the US, that is, defined contribution schemes dominate there as well, these making up over 90% of all operational schemes as at 1998, covering 68.6% of all participants and owning more than 50% of all pension assets (EBRI Factsheet, Jan 2003).

The third and final basis on which schemes may be classified is the *insurance status of the scheme*. Schemes may be insured or uninsured. *Insured* schemes have their assets and liabilities under the management of insurance companies who guarantee the payment of benefits under the schemes in return for specified periodic premiums. *Uninsured* Schemes, on the other hand,are managed in-house.

1.4 The Regulation Of Pension Schemes

In Kenya, the law governing pension schemes is the Retirement Benefits Act (1997), as supplemented by the Retirement Benefits Rules and Regulations (2000).

Among its main provisions, the RBA Act (1997) put in place a time limit for the vesting of accrued benefits (5 years), an 80% minimum funding level(MFL) requirement, reporting standards, disclosure requirements and investment guidelines. The Act puts in place *draconian* rules by setting limits on the portion of a fund that can be invested in particular assets or asset classes. A 70% limit is imposed, for instance, on equity as a proportion of the overall portfolio. At this point it is worth noting that in some parts of the world some writers who claim that they(the rules, that is) have an adverse effect on overall portfolio performance have criticized such rules. Srinivas and Yermo (1999), for instance, in a study of the effect of draconian rules on the overall performance of pension funds in Latin America, found this effect to be real in the funds sampled.

On the management of pension schemes, the Act puts in place a mandatory three-tier dispensation of trustees, asset managers, and custodians. Scheme trustees are required to administer the scheme in accordance with the provisions of the Act, the regulations and the scheme rules. The duties of the trustees include setting general investment guidelines: guidelines for risk, return and asset allocation. Managers make the day-to-day decisions of buying and selling specific assets while custodians hold scheme assets (cash, ownership rights certificates, etc) on behalf of the scheme's participants.

In other parts of the world, many countries have their own laws governing pension schemes. In the USA, for instance, pension schemes (or plans, as they call them there) are regulated by the Employee Retirement Income Security Act, commonly known by its acronym, ERISA. .

1.5 The Financial Objectives of Pension Schemes

The primary goal of pension schemes is to pay accrued benefits to participants as and when they fall due. Schemes therefore need to have adequate funds with which benefit obligations may be met.

For funds to be solvent, they have to be managed prudently. The focus, therefore, is on the returns earned and risk assumed on pension scheme assets. These two variables, consequently, are the principal financial concerns of pension fund managers.

1.5.1 The Return Objective

The Return Objective pertains to the overall profitability of a pension scheme's portfolio. Performance evaluation mainly focuses on the gap, if any, positive or negative, between target returns and the actual returns realized. Performance may also be benchmarked either relative to other pension funds (peer benchmarking) or relative to various market indices (market benchmarking). Historically, real pension fund returns (and risks, as measured by the standard deviation of returns) worldwide for the period between 1966 and 1990 have been as given in table 1-1.

Table 1-1: Real Pension Fund Returns and Risks

(Standard Deviations in Brackets)

(Figures in %)

	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1966-1990
Returns	0.3	-1.0	0.6	8.9	6.5	3.1
(SD)	(5.4)	(10.0)	(5.2)	(7.9)	(8.6)	9.0

Source:Davis (1993): *(Countries included in the study were Canada, Denmark, Germany, Japan, Netherlands, Sweden, Switzerland, UK, US)*

1.5.2 The Risk Management Objective

The risk management objective entails influencing the variations between actual portfolio returns and expectations over time. In carrying out their investment function pension funds, like other investors, face the two broad risk types identified in financial management: *Unsystematic (Unique)* risk and S*ystematic (Market)* risk. As Sharp (1964) and Lintner (1965) have defined it, unsystematic risk arises from the uncertainties, which are particular to individual assets and can be eliminated through diversification. Srinivas and Yermo(1999) state that for pension funds, unsystematic risk can be split into two: *systemic* and *agency* risk. *Systemic* risk arises from asymmetric information problems that make financial systems fragile, threatening pension funds, which are part of financial systems, with bankruptcy. *Agency* risks, on the other hand, arise from the moral hazard problems such as fund mismanagement that may occur since financial market dealings involve parties with different information.

Systematic risk arises on account of economy wide uncertainties and the tendency of individual assets to move in tandem with market changes. This risk cannot be diversified away.

The particular business risks pertaining to pension schemes are several:

1.5.2.1 Actuarial/Default Risk

This is the likelihood that the value of the scheme's assets will, at any time be insufficient to meet promised benefits as they fall due, hence impairing the sponsor's ability to honour its benefits promises. This risk is ran mainly by defined benefits schemes, which are committed to paying specified benefits.

Actuarial risk is managed through regular actuarial evaluation to determine the scheme's funding status. Any prospective underfunding should be addressed immediately either through boosting contributions or delaying retirement.

1.5.2.2 Price Risk

This refers to the likelihood that unfavourable changes may occur in the market (realizable) values of a scheme's assets, hence impairing the scheme's solvency, and adversely affecting its ability to pay promised benefits as and when they fall due.

1.5.2.3 Reinvestment Risk

This is the likelihood that a scheme, in seeking to replace its realized investments, may not obtain investments offering the required yields, or yields equivalent to those earned on the assets being replaced

1.5.2.4 Liquidity Risk

Liquidity risk is the possibility that a scheme may experience cash flow difficulties impairing its capacity to meet it's benefit obligations as and when they fall due. Pension schemes are mainly concerned with long-term liquidity owing to the long-term nature of their liabilities (Olson, 2001). Since cash flows in and out of schemes are steady and predictable, long-run liquidity can be conveniently managed

1.5.2.5 Interest Rate Risk

This refers to a scheme's exposure to fluctuations in the prevailing levels of market interest rates on the pension fund's financial position and cashflow. It is managed through balance sheet restructuring or interest-rate derivatives such as swaps and futures.

1.5.2.6 Currency Risk

This refers to the vulnerability of the pension scheme to effects of fluctuations in the rate of exchange between its home (operating) currency and the foreign currencies in which part of its portfolio or obligations may be denominated. This risk pertains only to those funds that have offshore assets and/or liabilities.

1.5.2.7 Credit Risk

Credit risk is the likelihood that issuers of debt instruments (bonds, notes, commercial paper etc) acquired by the scheme will default on interest payments and/or principal repayment, hence occasioning financial loss to the scheme, and impairing its ability to honour its benefit obligations. Credit risk is managed through proper screening of potential debt investments and continuous vigilance to ensure bond issuers abide by the terms of bond indentures.

1.6 Pension Scheme Asset Structure: A Brief Overview

The nature of pension schemes assets depends on the nature of their benefits obligations. Since the greater part of pension schemes liabilities are long-term in nature, pension schemes invest largely in long-term assets. Thus the portfolios of schemes worldwide basically include equities, bonds (both Government and corporate), real estate and money market securities such as treasury bills, among others.

1.7 Equity Investments of Pension Schemes

Equity (common stock) is one of the most suitable assets used by pension schemes the world over to match long-term benefit obligations. Equity investments are essentially long term in nature while at the same time retaining their liquidity characteristic.

Pension schemes that fail to invest adequately in equity lack an appropriate vehicle through which their long-term liabilities can be matched sufficiently. By ignoring equity and opting for shorter-term investments, whose maturity durations are shorter than those of promised benefits, a clear mismatch between asset/liability profiles arises. This mismatch occasions high reinvestment risk arising by creating the need for schemes to find suitable investments with which to replace those that are realized. Reinvestment risk persists as long as the scheme's liabilities remain outstanding and hence jeopardizes the scheme's capacity to pay promised benefits as they fall due.

Pension schemes in Kenya, apparently, have largely shunned equity (RBA, 2002). The average equity holdings by pension schemes in the local market, the Nairobi Stock Exchange (NSE) are minuscule and comprise about 1.97% of the total issued equity that is available on the market. Further, equity comprised only 7.32% of the total assets owned by pension schemes as at the end of year 2002,compared to 66.63% investment in debt instruments (both Government and corporate). With the mean equity holding per company being less than 3% of issued company stock, schemes can hardly earn meaningful dividends or exercise any significant influence over the affairs of investee companies. It also means that schemes in Kenya run quite a high reinvestment risk on their asset portfolio.

Collectively, the 7% of scheme portfolios is allocated to equity is far below the legally allowed limit of 70% that is laid down in the RBA's investment guidelines. This poor utilization of allowed limits in equity allocation is far behind what it is in other comparable parts of the world: funds in Latin America allocate over 20%, South East Asian funds allocate almost 20%. As for the developed countries e.g. the U.K, allocation rates are over 70%.

1.8 Pension Fund Manager/Trustee Attitudes: A Background

Decisions by pension funds managers on whether or not to invest in equities are greatly influenced by among other factors, the ATTITUDES held by those fund managers and scheme trustees, in their capacity as investment managers, towards equities as investment vehicles. Social psychology maintains that attitudes are some of the most important determinants of human actions and this is of relevance to the field of investment owing to the fact that investment managers are, first and foremost, human beings.

An *ATTITUDE* is a characteristic and relatively permanent way of thinking, feeling and acting towards something (McConnell 1978). It is an evaluation containing *cognitive, emotional* and *behavioural* components of an idea, event, object or person {Sdorow (1993), Breckler (1984)}. Attitudes of pension fund managers and trustees, in Kenya, towards equities can thus be broken down into the aforementioned elements. The *Cognitive* component of a given attitude entails the thoughts brought to mind by the object of the attitude (equities, in this case). The cognitive component response of a pension fund manager towards equity may, for example, be, " Equities are better than real estate," or "Equities are not as good as bonds". The *emotional* component, which refers to the feelings aroused in the subject (the manager) by the object (equities), may be determined from the manager's perception of investment prospects, risks and expected performance, such as "I find equity returns quite promising in the long run", and/or "Equities are too risky" etc.

The *behavioural* component entails the action that the subject would be likely to take in regard to the object. A pension fund manager / trustee may reject or accept an equity investment opportunity when given a choice. Such rejection or acceptance constitutes the manager/ trustee's behaviour (action) towards equity as an asset class.

1.9 Problem Statement

A greater presence of pension funds in the equity market would be advantageous by helping to provide price stability for instance, as pension funds take a longer-term approach to investment and are more likely and able to absorb temporary market shocks. By purchasing more equity, pension funds would also infuse substantial capital in the market, which would go a long way in boosting the stock market, making it more vibrant. Substantial equity stakes could also give funds more influence as shareholders, enabling them to play a greater role in corporate governance.

But pension schemes in Kenya do not currently own significantly large equity holdings. This contrasts sharply with other countries including third world countries where investments in equity by pension schemes is at least three times that of Kenya's. Although equity investments may be risky, they have historically generated the highest returns when compared to other available assets. Yet, investment by pension schemes in equities remains low. . This study will attempt to describe the factors governing the level of investment in equities by pension schemes in Kenya, from the perspective of individual fund managers and trustees of those schemes. Among the main factors to be considered as being responsible for the current state of affairs, will be manager/trustee attitudes i.e., the cognitive, emotional and behavioural components of fund manager/trustee attitudes towards equities as investment vehicles. Other considerations will be the past performance of quoted equity on the local stock market, the Nairobi Stock Exchange.

1.10 Objectives of the Study

The study's overall objective was to establish the general attitudes of pension fund managers and trustees in Kenya towards equity and to determine the attributes of equity most responsible for the prevalent attitudes. Specifically, this entailed the following:

(i) To determine the general attitudes held by pension fund managers and trustees in Kenya towards local equity as an investment category.

(ii) To determine the attained levels of returns and risks on equities quoted on the Nairobi Stock Exchange.

(iii) To determine, from the perspective of fund managers and trustees, any other factors besides returns and risks governing the level of investment in equities by pension schemes.

1.11 Importance of the Study

The knowledge of manager/trustee attitudes towards equity investments can be of use to several parties. Corporate managers may use it to understand the investment expectations and requirements of pension schemes, thereby being able to align their decisions with the preferences of this class of institutional investors so as to attract the much needed capital held by the latter.

Regulators [such as The Capital Markets Authority (CMA) and The Retirement Benefits Authority (RBA)] may use the results in this study to formulate strategies that will encourage greater pension scheme involvement in the stock market, hence boosting market activity and performance.

Investment advisors and financial research institutions may use the results, of this study to better understand the needs of schemes as investors, thereby being better placed to provide more relevant and appropriate counsel to their clients.

CHAPTER 2

2.0 LITERATURE REVIEW

2.1 The Formation of Manager/Trustees Attitudes Towards Equities

How do investment managers form attitudes towards equity? Some are formed through CLASSICAL CONDITIONING by the *pairing* of desirable (good investment performance) outcomes or undesirable (poor investment performance) outcomes with equities. If equities do well on the one hand, fund managers will associate financial success with equities and develop a positive attitude towards them. On the other hand, poor performance of equity investments will create, in the managers/trustees affected, a negative attitude towards equities.

Investor attitudes may also be formed through OPERANT CONDITIONING. This refers to behavioural reinforcement in investors, who learn the association between actions (investment decisions) and their consequences (investment outcomes). Operant conditioning occurs through the provision of positive or negative reinforcement of particular investment decisions. For instance, if a pension fund manager's / trustee's equity portfolio consistently yields the expected/required rate of return over several consecutive time periods, then the manager's /trustee's decision to invest in equity would be positively reinforced by the good outcomes, creating a positive attitude towards equities in the manager concerned. Conversely, persistent underperformance of the equity portfolio (where equity returns continually fall below expectations) would negatively reinforce the manager's decision to invest in equity, hence creating a negative attitude towards equities in the manager/ trustee concerned.

A third way in which investor attitudes may be formed is through LEARNING (Sdorrow, 1993). The *(social) learning theory* argues that behaviour may be learnt through observing others being punished or rewarded for acting in a particular way. As per this theory, an investment manager may *learn* to invest, or refrain from investing, in equities by observing the experiences of fellow managers (peers) who undertake equity investments. Those peers whose equity portfolios do well (i.e which consistently meet expectations) encourage the observing manager to put his (scheme's) money in equities, while those peers who lose money in equities (i.e whose equities consistently fail to meet expectations) may discourage the observing manager from venturing into the stock market.

Investor attitudes towards any asset are mainly shaped by the expectations held by the investors on the asset's future prospects. And so it is with equities as an asset class. The expectations of fund managers/trustees derive from actual equity performance over time. Equity performance entails the levels of two main variables: RETURNS and RISKS. In this chapter, we begin by examining the literature on overall asset allocation by pension funds in selected countries around the world. We then compare equity allocation levels in the countries reviewed, followed by a look at the RETURNS and RISKS attained in the past by pension fund equity holdings internationally. These two, as mentioned earlier, are the two major influences on the attitudes held by investors (such as pension funds) regarding equities. We then examine literature on the Kenyan scenario - the performance of the equity market as compared to the competing bond market, and the implications that the findings of this comparison might have had on the level of investment in equities by pension funds as part of the wider investment community.

2.2 Asset Allocation by Pension Funds Worldwide

Although the main focus of this paper will be on the equity investments of pension schemes, it is important to put matters in the right perspective by first examining scheme investments around the world, before looking specifically at equities.

2.2.1 Overall Asset Allocation

Beginning with the US, the aggregate assets held by pension funds are estimated as being in excess of \$4.6 Trillion in market capitalization (Watson Wyatt, 2003)

Equities are the largest investment in the aggregate portfolio of US pension funds [(Watson Wyatt(ibid) ,Sarney(2000)] both public and private. They took up, by the end of year 2001, over 70% of the aggregate market capitalization of pension assets.

The asset allocation of US private and public pension funds as at the year 2000 were generally as follows:-

Table 2.2.1: US Private and Public Scheme Average Asset Distribution

Asset Class	*% in Overall Portfolio*		
	Private	*Public**	*Combined*
Equity	74	68	71
Bonds	8	26	17
Money market Investments	4	2.4	3.2
Real Estate and other	14	3.6	8.8
	100	**100**	**100**

Source: *Watson Wyatt (2003): Corporate Fund Asset Mix;*
Plans $1 - $5 billion, 2000
**Sarney(2000)*

Moving on to the UK, pension schemes invest in more or less the same basic asset classes as those in the US. Russell/Mellon (2001) give the following figures on the overall asset mix of UK pension funds.

Table 2.2.2: UK Fund Average Asset Distribution

Asset Class	*As at 31.12.2000* %	*As at 31.12.2001* %
Equities Domestic	51.0	47.4
Overseas (foreign)	22.5	25.0
	73.5	72.4
Bonds	16.5	17.7
Real Estate	1.7	1.8
Money Market Funds	5.0	5.7
Cash and other	4.3	2.4
	100	100

Source: *Russell /Mellon. CAPS (2001)*

As in the US, equity is the single largest component in the aggregate portfolio of pension schemes in the UK, with bonds coming a distant second.

In Continental European countries, the asset mix is more evenly distributed than in the UK with equity investments comprising 47% of the total assets at the end of 2002. Figures from Watson Wyatt (2003) below amply demonstrate this.

Table 2.2.3: Continental European Fund Asset Allocation as at

Asset Class	*31.12.2000* %	*31.12.2002* %
Equities : Domestic	8	7
Foreign & Euro	31	40
Total Equities	39	47
Bonds: Domestic	17	11
Foreign & Euro	32	30
	49	41
Real Estate	7	9
Money market + other	5	3
	100	**100**

Source: *Watson Wyatt (2003)*

Coming to Asia, Watson Wyatt (2003) give equity allocation for Hong Kong and Japanese funds as being 40% and 50% respectively. In a past study by Asher (1995) of the asset mix of Malaysia's occupational scheme, which may be considered as being representative of other South East Asian countries, the portfolio structure comprised 10.2% equity investments in 1994 was given as follows:

Table 2.2.4: Malaysia: Employees Provident Fund Investment Portfolio Mix(1994)

Asset Class	*Shares* %
Equity	10.2
Govt. Securities and Money	
Market securities	75.1
Bonds (see note a)	14.6
Others (see note b)	0.1
	100.0

a) Indicates promissory notes, debenture loan and corporate bonds

b) Indicates bank deposits and other securities

Source: *Asher, 1995*

2.2.2 Focus on Fund Equity Allocations World Wide

As the data presented above indicates, the levels of equity allocation by pension funds worldwide vary a great deal from one country to another but appear to be influenced by the level of economic development for example in the US and UK average equity allocation is more than 70% while in Malaysia as the level, as shown above is around 10%. By way of a recap, a summary of equity allocation percentages for specific countries worldwide now follows:

Table 2.2.5:

Region/Country	*Percentage Equity Allocation as at the end of 2001*
1. North America	
a) USA	74
b) Canada	43

2.	Europe		
	a)	UK	72
	b)	Spain*	20
	c)	Sweden*	25
	d)	Belgium	55
	e)	Germany	34
	f)	Netherlands	43
	g)	Portugal	30
	h)	Switzerland	39
	i)	Ireland*	17
3.	Australia		32
4.	Asia		
	a)	Hong Kong	40
	b)	Japan	50
5.	Africa		
	a)	Egypt	37
	b)	South Africa	53
6.	Latin America		
	a)	Peru	40
	b)	Chile	23
	c)	Argentina	17
	d)	Mexico	10

*Figure given is only for domestic equity investments

Source: Nos 1-5 : *Watson Wyatt (2003)*

No 6: *Srinivas & Yermo (1999)*

2.3 Asset Allocation by Pension Funds in Kenya

2.3.1 Overall Asset Allocation

In the survey mentioned earlier, done in 2002 by the RBA, of the asset holdings of pension schemes in Kenya, the general asset allocation details were given as stated here below: -

Table 2.3.1: Average Portfolio Structure of Pension Schemes in Kenya

Assets Class		%
Equity: Offshore	0.52	
Domestic	6.80	7.32
Bonds: Corporate	5.28	
Govt.	39.16	44.44
Real Estate		6.06
Money Market Securities: T-bills	12.36	
Corporate	9.83	22.19
Others		18.99
		100.00

Source: *RBA Newsletter: September 2002*

2.3.2 Equity Allocation by Pension Funds in Kenya

The data above shows clearly that equities are some of the least popular assets among pension schemes in Kenya with funds allocating a meagre of portion of their portfolio to equity. The most popular are T-bonds (39%), followed by money market securities (22%). As the table below shows, pension schemes own less than 2% of the local equity market, which only vindicates the unpopularity of equities among funds in Kenya.

Table 2.3.2: Average Equity Allocation by Pension Funds in Kenya

Market Segment	*Average Equity holding by scheme per company (% of issued capital as at 31 Dec)*	
	2002 %	*1997* %
1. Main Investment Market Segment		
(i) Agricultural Sector	1.21	1.08
(ii) Commercial & Services Sector	1.79	1.43
(iii) Finance and Investment Sector	3.24	2.79
(iv) Industrial and Allied Sector	5.55	4.21
2. Alternative Investment Market Segment	1.98	1.74
3. Percentage of equity market owned (Collectively)	1.97	1.84

Source: *Research Data*

Mugo (1999) conducted a study of the main considerations made by institutional investors in contemplating investments in equities quoted on the NSE. For retirement benefits schemes, she gives the factors considered as the caliber of management of the issuing company, trends in capital investments, safety of capital (risk?), returns on the shares, growth in sales, net profit margin, earnings per share and share price movements. Later in our analysis we examined whether, down the line, any of these factors may have changed in importance, and/ or whether there are any others that might have gained primacy lately.

2.4 The Historical Performance of Pension Fund Equity Holdings Vs Other Assets

Davis (1995), in a study of real returns and risks by asset types in various OECD countries from 1967-90, shows that equities have been the best performing but also the most volatile. The findings of the study by Davis were as summarized in the table below:

Table 2.4.1: Returns and Risks of Pension Schemes in Various OECD Countries (1967-1990) by Asset Type

	Country			
	UK	US	Germany	Japan
Equities	8.1 (20.3)	4.7 (14.4)	9.5 (20.3)	10.9 (19.4)
Bonds	-0.5(13.0)	-0.5 (14.3)	2.7(14.9)	0.2 (12.8)
Real Estate	6.7(11.4)	3.4(6.4)	4.5(2.9)	7.2(6.8)
	Canada	Switzerland		Average
Equities	4.5(16.5)	6.2(22.3)		5.93 (18.87)
Bonds	0.0 (12.1)	-2.2(17.6)		0.05 (14.12)
Real Estate	4.6 (6.2)	3.7(8.9)		5.02 (7.1)

NB: *( ) – Standard Deviations*

Source: Davis, 1995 (p.133)

Table 2.4.2: Asset Class Risks / Return Ranking for Schemes in OECD Countries

	Ranking	
Asset Class	By Returns	By Risks
Equities	1	1
Bonds	3	2
Real Estate	2	3

As can be seen from the above figures in the UK to begin with, during the period reviewed from "67-90, domestic equities yielded 8.1% returns against –0.5% for domestic bonds and 6.7% for real estate. Equity volatility (as measured by the standard deviation of returns) averaged 20.3%against 13% for domestic bonds and 11.4% for real estate. Foreign equities also did better than foreign bonds; they yielded 8.1% return while bonds yielded – 0.1%. Risk on foreign equity was 16.2% against 15.0% for foreign bonds.

In the US, domestic equities yielded 4.7% annual returns over the 1967-1990 period compared to –0.5% and 2.4% for domestic bonds and real estate respectively. The volatility of domestic equities was 14.4% against 14.3% on bonds and 6.4% on real estate. Foreign equities returned 9.9% at 17.2% volatility, which exceeded by far the 1.6% earned on foreign bonds at 11.2% volatility.

In Germany, according to the same study, domestic equities returned 9.5% annually with a 20.3% volatility. Domestic bonds yielded 2.7% with a 14.9% risk level, while real estate earned 4.5% with a 2.9% standard deviation. 10.4% return from foreign equities beat 3.4% from foreign bonds hands down.

In the Far East, Japanese pension funds earned 10.9% on domestic equities, with volatility measured at 19.4%. Domestic bonds, on the other hand, earned much less; 0.2% at a 12.8% risk level. Real estate brought in 7.2% at a 6.8% risk level. 7.8% returns from foreign equities for surpassed the 1.3% that was earned by foreign bonds.

In all countries examined in the above study, equities were shown to be the most risky of the various asset types, having the greatest yield prospects, both positive and negative.

Vittas (1996) points out that in most periods, equity returns, as compared to returns from other assets, are usually above the overall portfolio returns. As per Vittas (ibid), equities almost always contribute to average fund returns or risks (i.e. equity returns/risks are a most occasions on the higher side of average portfolio returns/risks). The study by Davis (ibid) reviewed here vindicates this observation. The following is a an analysis of deviation of asset returns and risks from those of the overall fund. Overall fund returns and risks are assigned zero value for purposes of comparison:-

Table 2.4.3: Portfolio/ Single Asset Performance Comparison for Selected Countries

Real Returns and Risks (%) (1967 - 1990)	US	UK	Japan	Switzerland
Fund (Overall)	0.0(0.0)	00(0.0)	0.0(0.0)	0.0(0.0)
Equity	+2.5(+3.7)	+2.4(+8.9)	+6.4(+12.6)	+4.8(+16.7)
Bonds	-2.7(+3.6)	-6.2(+1.6)	-4.3(-4.0)	-3.6 (+12.0)
Real Estate	+1.2(-4.3)	+1.0(0.0)	+2.7 (0.0)	+2.3(+3.3)

NB: Returns are simple weighted averages. The figures in parentheses are deviations in asset volatility from overall fund volatility.

Source: Davis (1995)

During the 1990's, in the case pension schemes in the US, fund equity returns averaged 15.5% for the ten years to September 30, 1998, according to a study conducted by Wilshire Associates in 1999. Equity risk, according to the same study, was less than 10%, which was higher than what was posted by both bonds and real estate.

The downside risk of equities arises from its changing fortunes over time. After posting positive returns over the 1990s, the year 2001 for instance was disappointing due to the negative returns that were recorded by funds equity portfolios. Russell/Mellon (2002) in reviewing pension fund performance worldwide for the year 2001, reported negative returns for most equity indices worldwide i.e. in most major markets. Russell/Mellon (ibid) remark that this experience further vindicates the long-held view of equities as being of a very volatile nature.

Table 2.4.4: Index Returns (2001) for Various Assets in Pension Fund Portfolios Worldwide

	%
Real Estate (International)	5.6
International Bonds	1.8
Equity:	
Emerging Market	0
Far East (Ex Japan)	-6.9
Japanese	-27.5
US	-10.7
UK	-13.3
Continental European	-20.3

Source: Russell / Mellon . CAPS; Pension Fund Results 2001

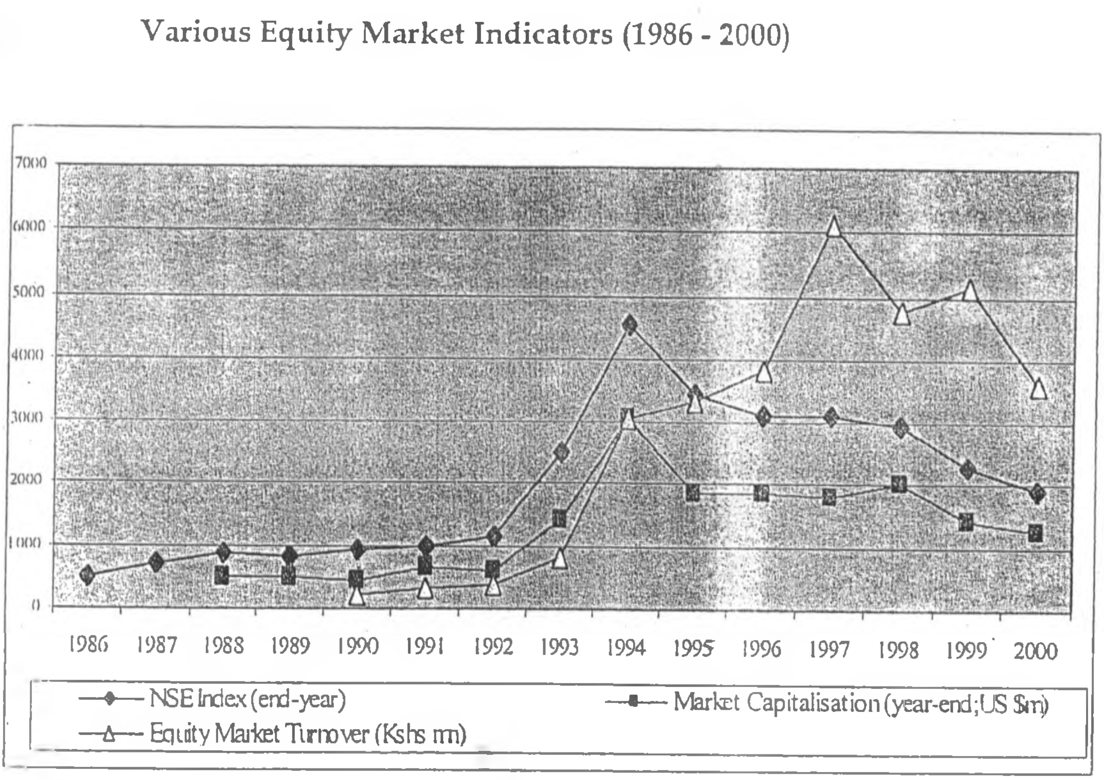
2.5 Pension Schemes and the Kenya Equity Market

As the stock market in Kenya is a relatively nascent and developing institution, and owing to the fact that there have been no reporting requirements historically for pension schemes in Kenya, the performance of scheme equity investments in the past has not been well-documented. Therefore, there is little data on the subject, making a historical analysis extremely difficult.

However, we may attempt to deduce investor experience from the general trends in the relevant equity market indicators. These indicators show that the market had its high in the early to mid-nineties from whence its been declining ever since (See Figure 2).

Equity market turnover peaked in 1997 and moved downhill till 2001 when it finally picked up. The NSE 20 index saw its highest level in 1994 and it too has been in descent to date. Equity market capitalization was at its highest point in 1994. Ever since, its been declining. The trends are illustrated in the chart below: -

Figure 2: Equity Market Indicators



Source: Kibuga Kareithi (2002)

Reproduced from the Point: Bulletin of the Institute of Economic Affairs; issue No. 52, March, 2002.

The gradual slump in the local equity market has occasioned a drastic decline in share prices leading to substantial holding losses for investors over the late 1990s. This state of affairs in the local equity market is in stark contrast to that in the competing segment, bonds.

The bond market in Kenya appears to be doing relatively better than its equity counterpart, at least as far as pension schemes are concerned. The bond market comprises two sub-segments: Corporate bonds and Government bonds (T-bonds). The T-bond market, to which pension funds allocate the largest part of their portfolio, is more liquid and thriving than the corporate bonds market. The T-bonds vary in maturities from one-year T-bonds to seven-year bonds.

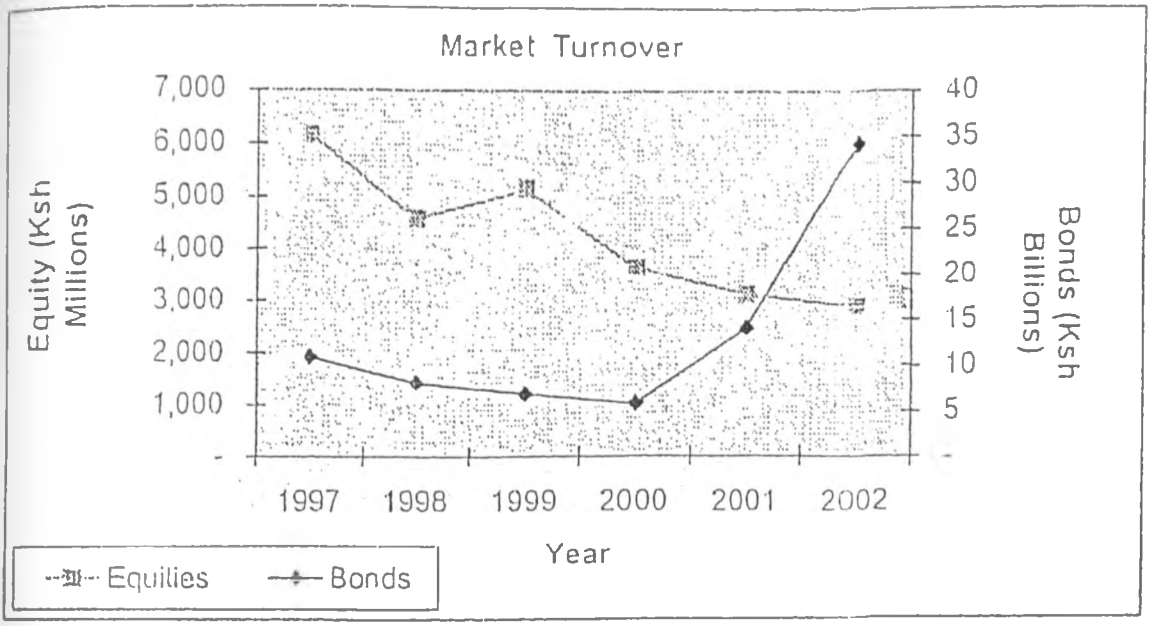
T-bonds may be more popular among pension funds owing to their lower risk as perceived by investors. With T-bonds, there is no default risk, backed as they are by the 'full faith and credit' of the Treasury. This may point to the possible risk-averse attitude of many fund managers in Kenya. The high liquidity in Government bonds also makes it easier for investors to acquire and dispose the bonds as the need arises.

Median annual returns i.e. the yields to maturity on T-bonds from 1997 to the end of 2002 were 14%, according to trading data for the period. The most liquid bond yielded a high of 27% (1997) and a low of 9% (2002) (NSE Bulletin).

The corporate bond segment comprises only four issues, with each issue having a maturity of more than 5 years. Corporate bonds, unlike Government bonds, are highly illiquid, as they do not change hands often. Therefore, yields to maturity for corporate bonds on the NSE are difficult to determine reliably. Two of the bonds, however{i.e. Mabati Rolling Mills [MRM (2007)], and East African Development Bank [EADB (2006)]}, have their interest rates pegged to the prevailing rates on T-bills.

Activity on the bond market has increased steadily (as from the year 2000) as bonds become more popular among investors in Kenya, to the extent that bond market turnover surpassed equity market turnover in year 2001 (see Figure 3). This possibly goes to show that investors expect bonds to perform better than equities in the foreseeable future, hence their greater interest in bonds making their attitudes towards bonds seem more positive than they look towards equities. Along with turnover, bond market capitalization also surpassed that of the equity market. (see Figure 4). This data has important implications on the risks and returns of both bond and equity markets as perceived by investors in general, and pension funds in particular.

Figure 3: Equity Vs Bond Market Turnover.



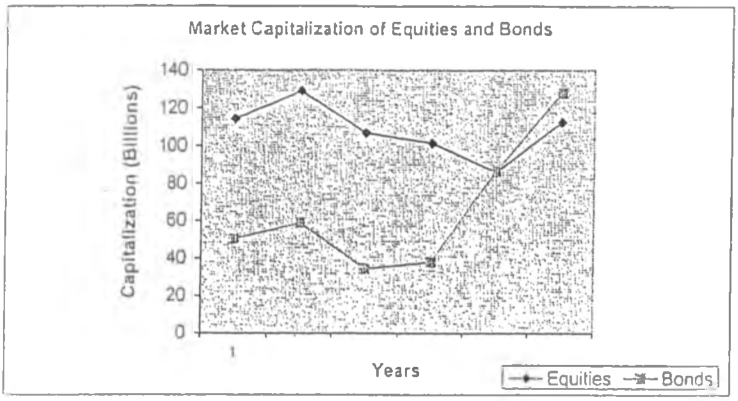
Source: NSE Bulletin: December 2002

Figure 4: Market Capitalization: Bonds Vs Equities

MARKET CAPITALIZATION

Market Capitalization of Equities at the end of December

Year	1997	1998	1999	2000	2001	2002
Equities(Shs.billion)	114.31	129.02	106.74	101.42	86 10	112.59
Bonds(Shs.billion)	50.43	58.98	34.51	38.13	86.58	128:03
GDP(Kshs'Billions')	536.20	593.43	639.03	686.18	772.89	895
Equity Mkt Cap. Ratio of GDP(%)	21.32	21.74	16.70	14.78	11.14	12.58
Bond Mkt Cap. Ratio of GDP(%)	9.41	9.94	5.40	5.56	11 20	14.31



Source: *NSE Bulletin: December 2002*

2.6 The Pros and Cons of Equity Investments from the Perspective of Pension Funds

Equities confer a multiplicity of benefits that pension schemes would be well advised to avail themselves of.

Firstly, being a variable income asset, equities offer the highest prospective returns compared to the other basic corporate securities.

Secondly, equities hold the largest potential for capital gains which, in Kenya are not taxed unlike income from bonds which is taxed (at 28% in Kenya). This means equity holdings have the potential to grow at a faster rate than can assets that are more highly taxed.

A third advantage of equities, and one very important in the case of pension schemes is that equities are a good hedge against inflation [Escolme, et al (1990), Logue & Rader (1998)]. Escolme et al (1990) argue that since pension schemes are meant to provide retirement income, in times of inflation pensioners would like to receive income which keeps up with price levels. To be able to provide such income, schemes need investments whose cashflows have the potential to grow in line with prices and with the growth in vested benefits. Escolme et al (ibid) maintain that although not offering a direct one-to-one link, a good package of equities spread across several sectors and geographical locations can yield such cashflows.

Logue & Rader (1998) argue that over long periods of time, even modest inflation rates can destroy significant real value. However, the equity risk premium associated with stocks has historically been an effective counter to inflationary effects. This however doesn't mean that stocks do well in times of unanticipated hyperinflation. They often do not (few investments do, anyway). But on the whole, the equity risk premium accrued from exposure to stocks has historically been sufficient to offset the effects of inflation and still provide a real rate of return.

A fourth advantage of equities to pension schemes is that they enable schemes to play a significant role in corporate governance.(Logue & Rader, ibid). But, this role can only be effectively played if pension schemes hold substantial shareholdings which, as per Logue & Rader (ibid) would enable the schemes to influence decisions in general meetings, influence appointments to managerial positions in the firm and also influence matters outside general meetings. The latter is a more subtle approach that tries to improve relations between shareholders and management. It is also known as relationship investing.

The main disadvantage of equities, as we've seen earlier, is their high risk, whose downside involves the likelihood that investors may lose their entire stock portfolio. For this reason pension funds need to focus on long-term rather than short-term prospects of equity investments. As noted earlier, the average duration of the benefit obligations of a traditional pension fund ranges from 10 to 15 years; scheme managers should not have to worry very much about the ups and downs in between. A pension fund, in making and evaluating its investments, should thus focus on expected performance intervals of 10 or 20 years (Olson, 2001).

A thorough evaluation of prospective equity holdings is therefore called for prior to acquisition. Goff (1971) says that a firm's financial data should be studied on a year by year basis and comparisons made between the various annual data sets. This would serve to bring out any (in)consistencies in performance over time. Goff (ibid) adds that the relevant variables to consider include pre-tax earnings, gearing levels, trends in reserves and management caliber.

Graham et al (1962) give the factors relevant in the valuation of common stocks as the expected future earnings per share, expected dividends per share and annual growth rate in those dividends, the firm's earnings capitalization rate as compared to the fund's, and the firm's net worth i.e. the net asset value(NAV) per share of the prospective investee. The NAV would be compared to the share's offer price to determine if the latter is justified or not.

Badger et al (1969) concur with Graham et al and add one more factor: the quality of the firm' earnings. They define this as the volality of earnings and the extent to which they derive from the core business of the prospective investee.

3.0 RESEARCH METHODOLOGY

3.1 The Population

The study's population originally comprised of two sub-populations. The first sub-population consisted of Trustees in the 1,300 odd occupational pension schemes registered in Kenya. The second group was made up of Chief Executive Officers (CEOs) in all eleven asset management firms registered with the RBA to manage pensions funds in Kenya as at 31st December 2002.

3.2 Method of Sample Selection

The Trustees' sample was drawn using non-probability sampling techniques. Specifically, the sample of trustees was drawn from schemes in various sectors namely education, agriculture, banking and finance, industrial / manufacturing, telecommunication and the commercial and services sectors.

A list of all registered schemes (numbering more than 1,300) was obtained from the RBA and classified as per the aforementioned sectors. Within each sector 10 schemes were selected on the basis of convenience (details on the actual membership and asset structure of individual schemes were not available, either from the RBA or the schemes themselves as they were deemed 'confidential'). Hence, convenience sampling was the only way to build up the sample. By contacting various registered schemes, I came up with a list of 10 individual trustees in each sector who were willing to fill in my questionnaire. Thus, overall, questionnaires were administered issued to 60 trustees. Of these, though, only 32. responded, making the population's response rate slightly above 50%. No response came from schemes sampled in the educational, agricultural and telecommunication sectors.

Of the 11 CEOs in fund management organizations covered, 9 responded, making this population's response rate slightly over 90%.

The individual stocks chosen for the computation of past returns and risks on listed equities were those that were quoted as from the 1st January 1994 through to the 31st December, 2002.

However, the appreciations in price, and variations in the same were computed for the years beginning 1996, owing to the fact that in the years 1994 and 1995 the Kenyan economy was recovering from hyperinflation which had begun in the year 1993. Hyperinflationary forces then pushed stock market prices upwards in the years mentioned and by so doing, most stocks more than trebled in price overnight. For this reason the years 1994 and 1995 are rendered 'abnormal' for purposes of this study, and will therefore not be considered.

3.3 Data Collection

Data was obtained using two principal approaches: Data relating to respondent attitudes was obtained by means of self-administered questionnaires issued to trustees and staff in fund management organizations. Data on the relevant prices and dividends paid on the selected stocks was obtained from records of the Nairobi Stock Exchange(NSE).

3.4 Data Analysis

Respondents' answers were collated and used to draw conclusions on objective (i) and (iii) (see chapter 1 pg 14)

Differences between the closing and opening stock prices within a given year, together with cash dividends paid on those stocks, were used to compute the annual returns earned on the selected stocks for the years under consideration. Capital gains on individual stocks were computed by obtaining the difference between the end-year price quoted on the stock in the year under consideration, and the stock's price at the beginning of that year. This was added to the cash dividends paid on the stock, the sum being divided by the year's opening price.

The simple return model used was;

$$r_t = \frac{D_t + (P_t - P_{t-1})}{P_{t-1}} \times 100$$

Where r_t = annual (percentage) rate of return on the stock in year t.

D_t = cash dividends paid on the stock in year t

P_t = the stock's market price at the end of the year t

P_{t-1} = the stock's opening market price at the start of year t.

Here, the objective was to compute the possible returns that holders of the selected stocks would have made in each of the years considered, had they acquired the stocks at the start of the year, and disposed them at the year's end.

The annual risks on individual stocks were estimated using the standard deviation of returns.

The findings made have been duly reported and most of the data tabulated for presentation purposes.

CHAPTER 4

4.0 DATA REPORTING AND ANALYSIS

4.1 Investment Preferences of Pension Funds: Perceived Returns

To most of the respondents, equities did not rank highly as far as returns are concerned. Among an asset spectrum which also included Treasury bonds, Treasury bills, Corporate bonds, Commercial paper and real estate, 78% of trustees ranked equities fifth, 13% third, 6% second and 3% fourth.

67% of respondent fund managers ranked equities third, with 11% assigning stocks of the ranks second, fourth and fifth respectively.

The order of preference is, in summary, tabulated below:

Table 4.1

Respondent Ranking of Equities among Other Asset Categories

Asset	Modal Ranking Assigned		
	Fund Managers	**Trustees**	**Combined Ranking**
T. Bonds	1	1	1
T. Bonds	5	4	5
Corporate Bonds	2	2	2
Commercial Paper	6	6	6
Real Estate	4	3	3
Equities	3	5	4

Given the above responses, the tentative deduction may be made that trustees and fund managers view equities adversely, with T-bonds, T-bills and real estate taking precedence (on the basis of return on capital)

4.2 Equity Risk Perception

78% of fund managers felt that common stocks are relatively risky securities whose use by pension schemes should by limited. 11% felt that equities, though risky, should have a place in pension scheme portfolios while a further 11% felt that stocks are actually very attractive and should occupy a dominant position in pension scheme portfolios.

As for trustees, 66% were of the opinion that common stocks are relatively risky and their use in pension scheme portfolios should be limited. 12% felt that equities ought to have a place in scheme portfolios while 22% were undecided. The details appear in summary in table 4.2 (a) below.

Table 4.2 (a)

Respondents Views on Equities and the Extent of their Use in Pension Scheme Portfolios

Response	Response Frequency (In Percentage)		
	Fund Managers	**Trustees**	**Combined**
(i) Equities are attractive and should dominate scheme portfolios	11%	0%	5.5%
(ii) Equities ought to have a place in scheme portfolios	11%	12%	11.5
(iii)Equities are relatively risky and should be limited in scheme portfolios	78%	66%	72%
(iv) Schemes should use stocks sparingly, if at all	0%	0%	0%
(v) Undecided	0%	0%	0%
	100%	**100%**	**100%**

Regarding their outlook for the local equity market over the next five years, 78% of fund managers described it as 'somewhat negative' while 22% gave theirs as 'somewhat positive'.

In the view of trustees, 81% maintained that as they saw it, market prospects were 'somewhat negative', 13% 'somewhat positive' while 3% held no particular viewpoint. [See table 4.2 (b) below]

Table 4.2 (b)

Respondent Views on Five Year Equity Market Outlook

Response	Response Frequencies (Percentage)		
	Fund Managers	**Trustees**	**Combined**
(i) Very Positive	0%	0%	0%
(ii) Somewhat Positive	22%	13%	17.5%
(iii) Neither Positive nor Negative	0%	0%	0%
(iv) Somewhat Negative	78%	87%	79.5%
(v) Very Negative	0%	0%	0%
(vi) No response	0%	6%	3%
	100%	**100%**	**100%**

The relevant surmise from the foregoing is that equities appear to evoke negative sentiments in both pension fund managers and scheme trustees. The predominant view among both groups is that since equity risk is high, its proportion in pension scheme portfolios should be limited. It may well be the reason behind the greater preference for debt over equity securities among local investors in general, and pension funds in particular.

4.3 The Equity – Allocation Preferences of Respondents

67% of fund managers stated that the highest proportion of equities they would accept in pension scheme portfolios, even under the brightest market prospects, would be 40%. 22% said they would go up to 60%. 11% did not respond.

As for the trustees, 59% gave 10% as their upper limit on equity allocation, 16% gave 20%, 9% gave 40% while the remaining 16% admitted they really didn't know. (See table 4.3(a) below)

Table 4.3(a)

Equity Allocation Preferences of Respondents (As Overall Portfolio Percentages)

	Response Frequencies (In Percentage)		
Proportional Upper Limits (%)	**Fund Managers**	**Trustees**	**Combined**
5	0%	0%	0%
10	0%	59%	29.5%
20	0%	16%	8%
40	67%	9%	38%
60	22%	0%	11%
80	0%	0%	0%
100%	0%	0%	0%
Do not Know	0%	16%	8%
No response	11%	0%	5.5%
	100%	**100%**	**100%**

The foregoing findings reveal that both fund managers and trustees maintain a strong aversion to common stocks, an aversion deductible from the low proportion of equity that's preferred especially by trustees. Among the latter, there also appears to be some ignorance regarding matters on equity allocation. Those trustees falling in this category have apparently left it all to their schemes, fund managers, hence being, if you like, 'not in the picture'. For the rest, the predominant attitude is that schemes should not heavily commit themselves in common stocks regardless of market prospects [the highest preferred cap on equities given by the trustees in this case, 40%, is far below the allowed regulatory maximum laid down in the RBA investment guidelines, 70%, leaving almost half the equity allowance unutilized]. This in all probability points to a strong aversion to equity among this group of respondents surveyed i.e. scheme trustees.

The above deduction is further reinforced by respondents' answers when asked if they would be willing to run a higher risk, by increasing the equity portion of the portfolio in a bid to increase returns. To this query 44% of fund managers answered in the affirmative, while 56% answered in the negative. 74% of trustees answered in the negative, and 26% in the affirmative.

So, in both sub-populations, majority were those unwilling to raise equity commitments even with the possibility of eg more [See Summary in Table 4.3 (b) below].

Table 4.3 (b)

Respondents Willingness to Increase Equity Proportions In Scheme Portfolios

	Response Frequencies (Percentage)		
Responses	**Fund Managers**	**Trustees**	**Combined**
Yes	44%	26	35%
No	56%	74%	65%
	100%	**100%**	**100%**

4.4 Evaluation of the Performance of Equity Holdings

4.41 The Nature of Scheme Investment Objectives

Majority of the respondents aver that the main emphasis in investing scheme funds is on capital growth but with income concerns.

78% of respondents fund managers described the investment objectives of their pension funds as 'growth with income' 22% described theirs as plainly growth (i.e. capital gains)

84% of the trustees described their scheme investments objectives as 'growth with income', 9% plain growth, and the remaining 7% giving 'income' [See Table 4.4(a)]

Going by the responses obtained, the deduction may be made that both capital gains and cash flows are of equal importance to schemes. The importance of growth is in line with the long-term investment orientation of pension schemes, while regular income is necessary to meet current scheme obligations. This way, schemes are able to honour prior commitments while maintaining the capital stock from which to generate future income

Table 4.4 (a)

The Nature of Scheme Investment Objectives

	Percentage Frequencies		
Prime Objectives	**Fund Managers**	**Trustees**	**Combined**
Growth only	22%	9%	15.5%
Growth with Income	78%	84%	81%
Income only	0%	7%	3.5%
Liquidity	0%	0%	0%
	100%	**100%**	**100%**

4.42 Target Returns on Investment

89% of respondent fund managers gave 12 – 14% return per year as their recommended range of net return that ought to be targeted in pension scheme portfolios, making this the modal class of returns. 11% recommended 10 – 11%.

56% of trustees also gave 12 – 14% as the annual range of net return sought on scheme investments. 22% gave 10 – 11.9%, a further 22% giving 8 – 9.9%.

Thus 12 – 14% annual net return was the modal response from both sub-populations, as table 4.4 (b) shows in summary

Table 4.4 (b)

Annual Target Return on Pension Scheme Portfolios

	Percentage Frequencies		
Range	**Fund Managers**	**Trustees**	**Combined**
12-14%	89%	56%	72.5%
10-11%	11%	22%	16.5%
8-9.9%	0%	22%	11%
6-7.9%	0%	0%	0%
Other	0%	0%	0%
	100%	**100%**	**100%**

4.43 Perception of Risk

Various respondents described pension fund risk variously as they saw it. 72% of trustees described risk as the possibility that the scheme may not achieve a target rate of return set beforehand, while 20% described risk as the degree of fluctuation in the value of the portfolio within a market cycle. The remaining 8% defined risk as the chance of occurrence of loss in the value of individual investments regardless of how well the overall portfolio might perform [See table 4.4 (c)].

Regarding the techniques used to measure risk, 67% of fund managers stated they used standard deviation, 22% gave variance (which is just the square of standard deviation) while 11% did not respond to this particular query. [See Table 4.4 (d)]

Table 4.4(c)

*Respondents Risk Definition**

Response	**Response Frequency**
The Possibility of	
(i) not meeting actuarial assumption	0%
(ii) not achieving target returns	72%
(iii) not equaling the inflation rate	0%
(iv) fluctuation in portfolio value	20%
(v) loss in value of individual security	8%
	100%

* *This question had only been put to trustees, hence the absence of fund manager responses.*

Table 4.4 (d)

*Techniques used by Fund Managers to Measure Portfolios Risk**

Response	**Response Frequency**
Beta	0%
Standard Deviation	67%
Variance	22%
No Response	11%
	100%

4.44 Investment Horizon

Regarding the time horizon needed for equity investment to pay off, 78% of fund managers stated that at least 10 years are needed. 22% gave their view as 5 years. They pointed out that in reality; most pension schemes evaluate their equities after barely three years. In the view of fund managers, there is need for greater patience considering that equities are long-term investments.

Indeed 91% of the trustees did give their waiting period as 3 years. The remaining 9% gave theirs as 5 years [See table 4.4 (e)]. This three-year time horizon may mainly have arisen from the RBA's requirement that schemes should undergo actuarial evaluations after every three years (though this requirement only applies to defined benefit schemes). Most schemes therefore evaluate their holdings after a similar period – which, according to fund managers, is an inadequate duration in the case of equity investments.

Table 4.4 (e)

Time Horizon used in Evaluating Equity Investments

	Response Frequencies		
Time Horizon	**Fund Managers**	**Trustees**	**Combined**
(i) Ten years or more	78%	0%	39%
(ii) Five years	22%	9%	15.5%
(iii) Three years	0%	9%	54.5%
(iv) A market cycle	0%	0%	0%
	100%	**100%**	**100%**

4.45 Evaluation of Actual Equity Performance: An Estimation of Returns and Risks

The actual returns and risks realized by pension schemes on their equity holdings in the past were estimated using the methodology explained earlier in chapter 3. The figures are as tabulated below (see appendix for full details and computations)

Table 4.4 (f)

Equity Market Returns (In Percentage) by Individual Market Segments

	Market Segment					
YEAR	**MIMS**	**C & S**	**F & I**	**I & A**	**AIMS**	**Overall Market**
1996	(3.18)	20.86	(16.21)	(18.91)	(9.92)	(10.27)
1997	9.03	2.22	7.66	(3.87)	25.14	7.53
1998	18.04	(26.21)	(1.99)	(6.14)	(8.72)	(5.88)
1999	(31.65)	(15.90)	(5.11)	(5.54)	(7.31)	(9.26)
2000	(19.20)	(24.82)	(25.79)	(6.80)	(2.77)	(13.88)
2001	(34.81)	(18.13)	(7.69)	(16.61)	64.06	2.39
2002	(30.95)	35.92	15.14	36.60	(7.35)	15.17
Mean Return	**(13.25)**	**(3.73)**	**(4.86)**	**(3.04)**	**7.59**	**(2.03)**

Key:

(i)	MIMS	:	Main Investment Market Segment
(ii)	C & S	:	Commercial and Services Segment
(iii)	F & I	:	Finance and Investment Segment
(iv)	I & S	:	Industrial and Allied Segment
(v)	AIMS	:	Alternative Investment Market Segment

Table 4.4(g)

Equity Market Risks /Standard Deviation (In Percentage by Individual Market Segments

Market Segment						
YEAR	**MIMS**	**C & S**	**F & I**	**I & A**	**AIMS**	**Overall Market**
1996	8.44	18.59	15.12	23.44	16.89	21.47
1997	47.72	18.86	19.59	25.46	58.04	35.49
1998	37.24	24.96	21.82	43.19	55.44	39.18
1999	6.58	8.35	25.82	29.51	30.85	26.02
2000	16.15	20.36	20.97	30.53	14.61	23.94
2001	15.35	20.02	20.34	32.20	241.66	116.98
2002	25.15	95.55	31.32	58.29	13.01	51.13
Mean SD per Segment/ Market	**22.34**	**29.53**	**22.14**	**34.66**	**61.50**	**44.89**

Key:

(i)	MIMS	:	Main Investment Market Segment
(ii)	C & S	:	Commercial and Services Segment
(iii)	F & I	:	Finance and Investment Segment
(iv)	I & S	:	Industrial and Allied Segment
(v)	AIMS	:	Alternative Investment Market Segment

Table 4.4 (h)

Highlights of Market Performance (By Years)

Highlight	1996	1997	1998	1999	2000	2001	2002	Overall Market '96 – 02'
i) (a) Highest Return Stock (b) Return level	Marsahlls 41.89	A. Baumaunm 144.70	W/Tea 73.84	Kapchora 57.89	Bamburi 31.43	Eagads 660.00	Bamburi 177.78	Eagads 94.90
ii) (a) Lowest Return Stock (b) Return level	EAPC 60.86	Dunlop (60.78)	Dunlop (81.50)	KCB (49.60)	Pan-African (59.26)	Total (65.45)	Marshalls (72.13)	Dunlop (32.06)
iii) (a) Highest Return Segment (b) Return level	C & S 20.86	AIMS 25.14	MIMS 18.04	F & I (5.11)	AIMS (2.77)	AIMS 64.06	I & A 36.60	AIMS 7.59
iv) (a) Least return Segment (b) Return Level	I & A (18.91)	I & A (3.87)	C & S (26.21)	MIMS (31.65)	F & I (25.79)	MIMS (34.81)	MIMS (30.95)	MIMS (13.25)
v) (a) Most Risky Segment (b) Risk Level	I & A 23.44	AIMS 58.08	AIMS 55.44	AIMS 30.85	I & A 30.53	AIMS 241.66	C & S 95.55	AIMS 61.50
vi) (a) Least Risky Segment (b) Risk Level	MIMS 8.44	C & S 18.86	F & I	MIMS 6.58	AIMS 14.61	MIMS 15.35	AIMS 13.01	F & I 22.14
vii) (a) Most Risky Stock (b) Risk Level SD								Eaagads 69.95
viii) (a) Least Risky Stock (b) Risk level								City Trust 7.53

<u>Recap:</u>

(i) Over the past seven years the, average annual return per stock, included in the study was NEGATIVE 2.03%.

(ii) Over the past seven years, the average volatility per listed stock studied here was 44.89%

(iii) Over the past seven years, the average returns for the market as a whole for different equity holding periods have as follows (See Appendix IV for the analysis of returns for individual market segments).

Table 4.4(i)

Analysis of Cumulative Percentage Returns Over Different Holding Periods.

Length of Holding Period (In Years) (Beginning 1996)	**Cumulative Percentage Returns**
1	-10%
2	- 4%
3	- 9%
4	-18%
5	- 29%
6	- 27%
7	- 16%

The picture portrayed by the above figures is of a market that is largely unrewarding and extremely volatile. What the analysis reveals is that for all the high risk involved over the seven-year period studied, investors were, in real terms, not at all compensated and, on the whole, they actually lost money. With such poor returns (losses, really) coupled with unduly high volatility, the market would indeed, be hard pressed in finding investors willing to risk scarce capital.

The average annual losses across most segments compare badly against segmental risk levels. The high risk involved demand that returns be commensurate, but for the period studied, this is far from being the case. As the data shows, 4 out of the 5 segments actually posted yearly losses over the reviewed duration, yet at the same time running double-digit volatility levels. This state of affairs would certainly deter any rational investors and, this being the reality, it should not be surprising that pension funds, as institutional investors, have largely shunned equities.

4.5 Other Determinants of Pension Scheme Equity Investments

Both the managers and trustees surveyed gave their opinions on the relative importance of various corporate and industrial factors considered in evaluating equity investments i.e. for both initial and continuing equity holdings. These factors are tabulated and analyzed in Table 4.5 below.

Table 4.5 (a)

Relative Importance of Various Factors Governing the Level of Pension Fund Equity Investments

Relative Importance & Relative Scores (R.S)

FACTORS	Very Important R.S = 3	Important R.S = 2	Unimportant R.S = 1	Total Score R.S x % Frequency
1. Fund Managers				
(i) Corporate Factors				
(a) Profitability	100%	-	-	300
(b) Size (i.e. Mkt. Capitalization	-	33%	67%	133
(c) Degree of Financial Leverage	88%	12%	-	288
(d) Age of Company (In Years)	-	-	100%	100
(e) Historical Dividend Ratio	100%	-	-	300
(ii) Industry Factors				
(a) Size	-	44%	56%	144
(b) Degree of Competition (i.e. No of Firms in Industry)	89%	11%	-	289
(c) Maturity (i.e. the rate of new entrants into the market)	67%	22%	11%	256
2. Trustees				
(i) Corporate Factors				
(a) Profitability	100%			300
(b) Size (Mkt. Capitalization)	-	45%	55%	145
(c) Degree of Financial Leverage	78%	22%	-	234
(d) Age of Company (in Years)			100%	100
(e) Historical Dividend Ratio	81%	19%	-	281
(ii) Industry Factors				
(a) Size		12%	88%	112
(b) Degree of Competition	75%	25%	-	275
(c) Maturity	84%	6%	10%	274

Table 4.5(b)

SUMMARY		
(i) Corporate Factors	Total Score	Combined Ranking
(a) Profitability	600	1
(b) Size	389	4
(c) Degree of Financial Leverage	522	3
(d) Historical Dividend Ratio	581	2
(ii)Industry Factors		
(a) Size	256	7
(b) Degree of Competition	275	5
(c) Maturity	274	6

CHAPTER 5

5.0 SUMMARY, CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH.

5.1 SUMMARY AND CONCLUSIONS

The general attitudes of the surveyed fund managers and trustees towards equities are characterized by much fear, diffidence, caution and general aversion. This attitude appears well founded going by the past experience of investors on the local equity market, at least over the period studied.

Over the years 1996-2002, the average NSE return per listed stock was NEGATIVE 2.03% annually at a 44.89% volatility level. This, as compared to a modal target return of 12-14% per annum, is nothing but disastrous. The shocking reality, as pointed out in the previous chapter, is of a market that is highly risky but in which such risk is not compensated by meaningful returns.

Under such conditions, the aversive behaviour of pension funds regarding equity allocation becomes much more understandable. Given the harsh reality in this market, any prudent investor would choose to stay away from the market rather than risk scarce capital in vain.

It may well be that the market's performance over the period studied was influenced by factors beyond the market per se. Indeed, the second half of the nineties witnessed severe challenges as the Kenyan economy struggled to recover from the reeling effects of excessive money supply, withdrawal of donor support, a severe banking crisis, and so on. All these could have impacted negatively on the bourse's performance, with the consequence of keeping away would-be investors, including pension funds, from the market. But at any rate, the bourse's performance as seen here was, on its own, bad enough to bring down confidence levels and deter investors.

It may also be argued that since equities are long-term investments, returns should be higher if investors used a longer time horizon. As noted earlier, while most schemes use a three-year investment horizon (owing mainly to regulatory reasons), asset managers advise a ten-year horizon if equities are to be judged fairly.

But in the case of the local bourse, the evidence suggests otherwise [see table 4.4 (i)]. The cumulative losses appear to increase in tandem with the lengthening of the investment horizon. What the evidence really suggests is that a shorter investment horizon would have been more advisable for the period studied. This way, while the time horizon remains relevant as a determinant of equity investment levels, its role here has been reversed from that which it would ordinarily be expected to play, in theory at least.

Two factors besides investment performance, given as most important governors of pension fund equity commitments are, in summary, as follows.

Firstly, *company profitability*. It is from it's profits that a company pays dividends to its shareholders, thereby determining the level of return on members' equity holdings, hence the importance of the profit factor in influencing the equity preferences of actual and potential equity investors.

The second most important factor, as established in this survey is the company's *historical dividend payout ratio* ,which serves to indicate past variations on dividend payments, hence being an indicator of the consistency or inconsistency with which the company may be expected pay dividends in future.

The two least important factors in governing pension funds equity investments were given as, firstly, *the level of industrial maturity*, which is the rate of new entrants into the market as an indicator as to whether the industry is growing, stagnant or declining. This apparently, was thought not to impact on the fortunes of individual firms provided they are well managed, hence would not, by itself, impact heavily on equity returns and risks (although in theory, this is an influencing factor).

The second least important factor was found to be *Industrial Size*, which is the number of firms operating in a particular industry at any one time. Apparently, the respondents were of the opinion that, whether or not a given firm meets its shareholders' return expectations depends principally on how well it is managed, and not how many other firms it is competing against. Industrial size, in itself, was therefore not important according to those surveyed.

5.2 Limitations of the Study

This study was plagued by a number of difficulties, which included the following:

(i) There was a shortage of material regarding historical asset allocation by pension schemes in Kenya. This stemmed mainly from the fact that regulatory reporting requirements in Kenya are a recent phenomenon, and there hadn't been any obligation on pension schemes to report on their activities until the RBA Act was passed by Parliament in 997.This shortage greatly hampered literature review.

(ii) The respondents withheld much important information that they deemed 'confidential'. Yet, this information would have been important in bringing out patterns and relationships within the data. For instance, all respondent trustees omitted the first part of their questionnaire (see appendix III), making it impossible to study investment profiles along lines of type of scheme, age of scheme, levels of membership, etc., which was the information sought by that part of the questionnaire. This prevented the discernment of important relationships or patterns that could have been present.

(iii) Time and financial constraints meant that the survey could only be done on a limited scale, which was limited even further by the low response rate obtained from the initial sample. Consequently, generalization to the larger scheme population was impaired.

5.3 Recommendations for Further Research

This study focused on common stocks (equity) investment decisions by trustees and fund managers of pension schemes in Kenya. Other studies that could add on to material in this area include:

(i) a repetition of this same survey but on a larger scale;

(ii) a study on the factors governing trustee and fund manager investment decisions pertaining to other asset classes besides equities, and

(iii) an evaluation of the past performance of unquoted equities in pension scheme portfolios.

BIBLIOGRAPHY

Asher, Mukul. (1995) "Investing National Provident Fund Balances in Malaysia and Singapore: Practice and Issues." A background paper of the World Bank, China and Mongolia Department, Washington, D.C.

Badger, R.E, Torgerson, H.W and H.R Guthmann (1969); "Investment Principles and Practices," 6th Ed;;Prentice-Hall Inc, New York.

Breckler S.J (1984) "Empirical Validation of Affect, Behaviour and Cognition As Distinct Components of Attitude". Journal of Personality and Social Psychology. 47,1191-1205.

Davis, E.P. (1993)."The Structure, Regulation and Performance of Pension Funds in Nine Industrial Countries". Policy Research Working paper 1229, WB, Washington, D.C

Davis, E.P. (1995). "Pension Funds" Oxford: Clarendon Press

Escolme, B., Hudson, D and P. Greenwood (1990): "Hosking's Pension Schemes and Retirement Benefits". 6th Ed, Sweet & Maxwell, London.

Goff, T.C (1971) "Theory and Practice of Investment" William Heinemann Ltd, London.

Graham, B., Dodd, D.L, and S.Cottle (1962), "Security Analysis: Principles and Technique" 4th Ed, McGraw-Hill, New York.

Kohn, M (1994)"Financial Institutions and Markets" Tata McGraw-Hill, New Delhi

Logue D.E and J.S Rader (1998): "Managing Pension Plans:
A Comprehensive Guide to Improving Plan Performance"
Harvard Business School Press

Sdorrow, M.L (1993) "Psychology" 2nd Ed. 1993. Brown & Benchmark, Chicago

Mugo, W.E (1999): "A Study of Factors that Institutional Investors Consider in Making Decisions on Investments in Shares Traded on the Nairobi Stock Exchange." MBA Project (Unpublished), University of Nairobi.

McConnell. J.V (1978)"Understanding Human Behaviour" McGraw – Hill, New York.

Nairobi Stock Exchange (NSE) Bulletin; Dec. 2002

Olson, R.L (1999) "The Independent Fiduciary: Investing for Pension Funds and Endowment Funds" John Wiley & Sons, Inc., Chicago.

Russell / Mellon. CAPS "Pension Fund Returns 2001"
See http://www.caps-iis.com/download/SegPresentation 2001.ppt

RBA Act (1997). Kenya Gazette Supplement No. 63 (Acts No. 4)
Nairobi 29th August 1997

Retirement Benefits Regulations (2000). Kenya Gazette Supplement
Nairobi , Legislative Supplement No. 72.9th October 2000

Retirement Benefits Authority (RBA) Newsletters (Quarterly), Nairobi
Vol 1, No. 1 (September 2001) and Vol. 2 No. 1 (September 2002)

Sarney, M.A (2000) "State and Local Pension Plans: Equity Holdings and Returns."
Social Security Bulletin Vol. 63 No.2, New York.

Vittas, D. (1996) "Pension Funds and Capital Markets"
FSD Note No. 71, February Washington D.C:
World Bank

Watson Wyatt Inc. "Global Investment Review (2003)"
www.watsonwyatt.com

Wilshire Associates, "Private Versus Public Pension Fund Investment Performance".
(Feb. 1999). Summary of report located at
www.calpers.ca.gov/whatshap/hottopic/w-study.htm

Srinivas P.S and Yermo, J (1999). "Do Investment Regulations Compromise Pension
Fund Performance? Evidence from Latin America." (May),
World Bank, Washington D.C

APPENDIX I
LETTER OF
INTRODUCTION

UNIVERSITY OF NAIROBI
FACULTY OF COMMERCE
MBA PROGRAMME - LOWER KABETE CAMPUS

Telephone: 732160 Ext. 208
Telegrams: "Varsity", Nairobi
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P.O. Box 30197
Nairobi, Kenya

DATE: ....

TO WHOM IT MAY CONCERN

The bearer of this letter: Giiu, M. I
Registration No: D/61/P/8198/2000
is a Master of Business & Administration student of the University of Nairobi.

He/she is required to submit as part of his/her coursework assessment a research project report on some management problem. We would like the students to do their projects on real problems affecting firms in Kenya. We would, therefore, appreciate if you assist him/her by allowing him/her to collect data in your organization for the research.

Thank you.

M. B. A. OFFICE
P. O. Box 30197,
UNIVERSITY COMMERCE FACULTY

DR. MARTIN OGUTU
LECTURER & CO-ORDINATOR, MBA PROGRAMME

MO/ek

APPENDIX II

FUND MANAGERS QUESTIONNAIRE

Question 1

The following are some of the main assets available locally to investors. In considering their respective magnitudes of return on capital, per annum, how would you rank, between them, each of the assets listed below, from your experience as an investment manager? (Please rank them, numberwise, consecutively in descending order).

Treasury Bonds ______________________________

Treasury Bills ______________________________

Corporate Bonds ______________________________

Commercial Paper ______________________________

Real Estate ______________________________

Equity (Common Stocks) ______________________________

Question 2

The primary emphasis in examining the investment performance of equity holdings managed by your firm is on

a) comparing actual returns to an 'absolute' percentage return target
b) 'relative' comparison i.e. comparing the actual account returns to various market indices
c) using both 'absolute' and 'relative' measures
d) I have no real preferences

Question 3

How do you feel about investing in common stocks, by pension schemes, in general?

a) I think stocks are very attractive and should occupy a dominant position in pension scheme portfolios. ______________________

b) Common stocks should have a place in the investment portfolios. __________

c) I think stocks are relatively risky and their use by pension schemes should be limited.

d) I think pension schemes should use stocks very sparingly, if at all.

Question 4

How would you describe your outlook for local equities over the next five years?

a) Very positive

b) Somewhat positive

c) Neither positive nor negative

d) Somewhat negative

e) Very negative

f) I am undecided

Question 5

If the market generally is very optimistic on the outlook for common stocks, what is the maximum percentage of your pension scheme clients' portfolio you would advise to be invested in common stocks?

0%

5%

10%

20%

40%

60%

80%

100%

Question 6

If the market generally is very pessimistic on the outlook for common stocks, what is the minimum percentage of your pension scheme client's portfolio you would allow to be invested in common stocks?

0%

5%

10%

20%

40%

60%

80%

100%

Question 7

What average annual 'absolute' rate of return (as opposed to return 'relative' to a market index) do you consider to be a worthwhile investment objective for a pension fund, on a long-term basis? (i.e. for a period of 5 years or more).

a) 12 –14% p.a
b) 10 – 11.9% p.a
c) 8 – 9.9% p.a
d) 6 – 7.9% p.a
e) Other. If other please specify ______________________

Question 8

In your firm, what technique do you use to measure the risk of returns from quoted equity?

a) Beta ____________________

b) Standard Deviation ____________________

c) Variance ____________________

d) Other. Please specify ____________________

Question 9

What have been the average annual absolute percentage returns from equity holdings managed by your firm on behalf of pension schemes? ____________________

Question 10

In your experience as an asset manager, how would you generally categorize the investment objectives of your client pension schemes?

a) Growth – Maximum growth of capital with little or no income considerations.
b) Growth with income – Primary emphasis on capital growth of the fund with some focus on income.
c) Income – Primary emphasis on income with little or no capital considerations
d) Liquidity
e) Other (Please specify)

____

____

____

Question 11

An increase in investment return is usually associated with an increase in the acceptable level of fluctuation of the portfolio value to market cycle (i.e. risk). Would you be willing to accept a higher risk level (i.e. a wider variation in portfolio value) by increasing the equity proportion of a pension scheme portfolio in an attempt to achieve a higher return?

(Yes/No) ____

Question 12

The time period in evaluating investment return has a significant impact on the probability of realizing the stated return objective. In your experience, what investment time horizon seems most appropriate for pension schemes in as far as equity holdings are concerned?

a) Ten years or more
b) Five years
c) Three years
d) A complete market cycle
e) Other. Please specify ______________________________

Question 13

In part (i) above, what is the average time horizon actually used by your client pension schemes on their common stock holdings, in your experience?

a) Ten years or more
b) Five years
c) Three years
d) A complete market cycle
e) Other . Please specify

____

Question 14

In evaluating potential equity investments on behalf of client pension schemes, how would you describe the following corporate and industry variables pertaining to the potential investee firms, in terms of relative importance? (Please tick on either '*very important*', '*important*', or '*unimportant*' as the case may be).

	Very Important	Important	Unimportant
(i) Corporate Factors			
(a) Profitability	( )	( )	( )
(b) Size (i.e. market capitalization)	( )	( )	( )
(c) Degree of financial leverage (i.e. level of debt in capital structure)	( )	( )	( )
(d) Length of time (in years) that investee has been in operation	( )	( )	( )
(e) Historical dividend payout ratio	( )	( )	( )
(ii) Industry Factors			
(a) Size	( )	( )	( )
(b) Degree of competition (i.e. no. of firms in industry)	( )	( )	( )
(c) Maturity (i.e. number of new firms entering the market)	( )	( )	( )

APPENDIX III

TRUSTEES' QUESTIONNAIRE

Part I

1. On what date was your scheme officially set up?____________________

2. What is the type of your scheme?

   a) Fully Defined Benefit ____________________

   b) Fully Defined Contribution ____________________

   c) Part Defined Benefit and Part Defined Contribution ____________

3. Please fill in the following details regarding your scheme:

   a) Total assets held *(by latest market valuation)* ____________________

   b) Total membership:

      (i) still in employment ____________________

      (ii) retired (and receiving pensions) ____________________

PART II

Question 1

The following are some of the main assets available locally to investors. In considering the respective magnitudes of return on capital per annum from individual classes how would you rank each? (Please number them in descending order of their annual returns)

Treasury Bonds ____________________

Treasury Bills ____________________

Corporate Bonds ____________________

Commercial Paper ____________________

Real Estate ____________________

Equity (Common stocks) ____________________

Question 2

The primary emphasis in examining the investment performance for equity holdings owned by your scheme is on:

a) comparing actual returns to an 'absolute' percentage return target

b) 'relative' comparison i.e comparing the actual account returns to various market indices

c) using both 'absolute' and 'relative' measures

d) I have no real preferences

Question 3

How do you feel about investing in common stocks in general?

a) I think stocks are very attractive and should occupy a dominant position in our scheme's portfolio.

b) Common stocks should have a place in our scheme's investment portfolio

c) I think stocks are relatively risky and their use in our pension scheme should be limited.

d) I think our pension scheme should use stocks very sparingly, if at all.

Question 4

How would you describe your outlook for the local equity market over the next five years?

a) Very positive

b) Somewhat positive

c) Neither positive nor negative

d) Somewhat negative

e) Very negative

f) I am undecided

Question 5

If your fund manager is very positive on the outlook for common stocks, what is the maximum percentage of your scheme's portfolio you would allow to be invested in equities?

a) 0%

b) 5%

c) 10%

d) 20%

e) 40%

f) 60%

g) 80%

h) 100%

i) I do not Know

Question 6

If your fund manager is very negative on the outlook for common stocks, what is the minimum percentage of your schemes' portfolio you would allow to be invested in common stocks?

a) 0%

b) 20%

c) 40%

d) 60%

e) 80%

f) 100%

g) I do not know

Question 7

Please indicate what your choice of investment would be given the following options for your pension scheme's portfolio.

a) Equities Vs Bonds ____________________

b) Equities Vs Real Estate ____________________

c) Equities Vs Commercial Paper ________________

d) Equities Vs Govt. Paper ____________________

e) Equities Vs Commodities ____________________

Question 8

How would you generally categorize your scheme's investment objectives?

a) Growth – Maximum growth of capital with little or no income considerations

b) Growth with income – Primary emphasis on capital growth of the fund with some focus on income

c) Income – Primary emphasis on income with little or no capital consideration

d) Liquidity

e) Other (Please specify)

____

____

____

Question 9

What average annual 'absolute ' rate of return (as opposed to return ' relative' to a market index) do you consider as the investment objective for your fund, on a long-term basis (i.e. over 5 years or more)?

a) 12 – 14% p.a.

b) 10 –11.9% p.a

c) 8 –9.9% p.a.

d) 6 –7.9% p.a.

e) Other. Please specify ________________________________

f) I do not know.

Question 10

Scheme 'risk' can be defined in different ways. Please indicate below the single item that best describes how you, as trustee, tend to view risk.

a) The possibility of not meeting actuarial assumptions
b) The possibility of not achieving a target rate of return
c) Not at least equaling the rate of inflation
d) High degree of fluctuation in the value of the portfolio within a market cycle
e) The chance of a great loss in the value of an individual security regardless of how well the overall portfolio might perform.
f) Other.(If other, please specify in the space below)

____

____

____

Question 11

To the best of your knowledge, what actual percentage annual levels of returns and risks has your scheme recorded in both its present and past equity investments?

Returns ______________________________

Risks ______________________________

Question 12

Within what time horizon do you evaluate the performance of your scheme's equity holdings i.e. within what average duration do you usually expect your scheme's equity investments to have realized the stated return objectives?

a) Ten years or more
b) Five years
c) Three years
d) A complete market cycle
e) I do not know
f) Other. If other, please specify ______________________________

Question 13

In evaluating potential equity investments, what relative importance do you attach to the following corporate and industry variables? (Please tick either '*Very Important*', '*Important*' or '*Unimportant*' as the case may be).

	Very Important	Important	Unimportant
(i) Corporate Factors			
a) Profitability	( )	( )	( )
b) Size (i.e market capitalization)	( )	( )	( )
c) Degree of financial leverage (i.e level of debt in capital structure)	( )	( )	( )
d) Age of the potential investee (i.e how old is the firm)	( )	( )	( )
e) Historical trend in firm's share price movements (as a possible indication of future trends)	( )	( )	( )
f) Historical trend in dividend payment levels(as a possible indication of future dividend payments)	( )	( )	( )

	Very Important	Important	Unimportant
(ii) Industry Factors			
a) Size (i.e no. of firms in the industry)	( )	( )	( )
b) Degree of competition (i.e the relative market shares of individual firms in industry)	( )	( )	( )
c) Maturity (i.e rate of new entrants into the market)	( )	( )	( )

APPENDIX IV(a)

YEAR 1996

	SECURITY	Beginning Price (P(t-1) Kshs.	Ending Price P(t) Kshs.	Cash Dividends Paid/Share D(t) Kshs.	Rate of Return r(t)%	Average Return/ Segment	SD Return / Segment	Mean Return / Year(%)	SD Return / Year(%)
	MIMS								
1	Brooke Bond	190.00	168.00	1.50	(10.79)				
2	Kakuzi	94.00	97.50	2 05	5.90				
3	Sasini	64.50	59.50	2.00	(4.65)				
						(3.18)	8.443699		
	C & S								
4	Car & General	20.50	20.00	0.10	(1.95)				
5	CMC Holdings	54 00	65.00	4 00	27 78				
6	Marshalls (EA) Ltd	37.00	48.50	4.00	41.89				
7	Nation Media Group	97.00	110.00	2.25	15.72				
						20.86	18.59167		
	F & I								
8	Barclays	155.00	99.00	10.00	(29.68)				
9	Diamond Trust	52.00	32 00	1.60	(35.38)				
10	Housing Finance	26.75	18.30	1.00	(27.85)				
11	ICDC Investments	33.00	32.25	4.50	11.36				
12	Jubilee Insurance	47.25	33.50	2.50	(23.81)				
13	KCB	85.00	70 00	6.00	(10.59)				
14	NIC	49.00	40.75	3.30	(10.10)				
15	Pan Africa Insurance	62.00	50.00	-	(19.35)				
16	StanChart	53.00	47.75	5.00	(0.47)				
						(16.21)	15.12073		
	I & A								
17	Bamburi Cement	35.75	29.25	0.60	(16.50)				
18	BAT	89.00	63.00	5.50	(23.03)				
19	Carbacid	94.00	80.00	2.00	(12.77)				
20	Dunlop	253.00	255.00	21.00	9.09				
21	EA Cables	36.00	31.25	2 00	(7.64)				
22	EA Portland Cement	52.50	20.25	0.30	(60.86)				
23	EABL	57.50	50.00	1.50	(10.43)				
24	Kenya Oil Co. Ltd	60.50	50 00	-	(17.36)				
25	KPLC	175.00	140.00	-	(20.00)				
26	Total	171.00	65.00	2.50	(60.53)				
27	Unga	142.00	158.00	1.00	11.97				
						(18.91)	23.43552		
	AIMS								
28	A. Baumann	46.75	33.00	1.50	(26.20)				
29	City Trust	28.00	26.00	1.25	(2.68)				
30	Eaagads	30.00	27.25	0.70	(6.83)				
31	Express Ltd	88.00	84.50	-	(3.98)				
32	Williamson Tea	86 00	70.00	1.00	(17.44)				
33	Kapchorua	116.00	70.00	1.00	(38.79)				
34	Kenya Orchards	17 00	19.50	-	14.71				
35	Limuru Tea	1,300.00	1,300.00	24 25	1.87				
						(9.92)	16.89458	(10.27)	21.46562

APPENDIX IV(b)

YEAR 1997

	SECURITY	Beginning Price P(t-1) Kshs.	Ending Price P(t) Kshs.	Cash Dividends Paid/Share D(t) Kshs.	Rate of Return r(t)%	Average Return/ Segment	SD Return / Segment	Mean Return / Year(%)	SD Return / Year(%)
	MIMS								
1	Brooke Bond	168.00	110.00	0.80	(34.05)				
2	Kakuzi	97.60	96.00	2.40	0.82				
3	Sasini	60.50	94.00	3.00	60.33				
						9.03	47.72232		
	C & S								
4	Car & General	20.00	16.10	-	(19.50)				
5	CMC Holdings	65.00	74.00	0.50	14.62				
6	Marshalls (EA) Ltd	48.50	41.00	4.00	(7.22)				
7	Nation Media Group	110.00	130.00	3.10	21.00				
						2.22	18.86036		
	F & I								
8	Barclays	99.00	115.00	10.00	26.26				
9	Diamond Trust	32.00	22.00	-	(31.25)				
10	Housing Finance	18.30	19.00	0.75	7.92				
11	ICDC Investments	32.25	34.50	2.00	13.18				
12	Jubilee Insurance	33.50	36.75	-	9.70				
13	KCB	70.00	79.50	7.00	23.57				
14	NIC	40.75	51.00	1.75	29.45				
15	Pan Africa Insurance	50.00	41.75	1.75	(13.00)				
16	StanChart	47.75	45.50	3.75	3.14				
						7.66	19.58913		
	I & A								
17	Bamburi Cement	29.25	36.00	1.25	27.35				
18	BAT	63.00	50.00	6.00	(11.11)				
19	Carbacid	80.00	66.00	2.00	(15.00)				
20	Dunlop	255.00	100.00	-	(60.78)				
21	EA Cables	31.25	29.00	2.50	0.80				
22	EA Portland Cement	20.25	20.00	0.70	2.22				
23	EABL	50.00	48.50	6.00	9.00				
24	Kenya Oil Co. Ltd	50.00	48.25	4.00	4.50				
25	KPLC	140.00	180.00	8.00	34.29				
26	Total	65.00	52.00	2.50	(16.15)				
27	Unga	158.00	120.00	10.00	(17.72)				
						(3.87)	25.46271		
	AIMS								
28	A. Baumann	33.00	80.00	0.75	144.70				
29	City Trust	26.00	34.00	1.50	36.54				
30	Eaagads	27.25	41.50	2.00	59.63				
31	Express Ltd	84.50	59.00	4.10	(25.33)				
32	Williamson Tea	70.50	86.00	1.50	24.11				
33	Kapchorua	70.00	70.00	1.50	2.14				
34	Kenya Orchards	19.50	19.40	-	(0.51)				
35	Limuru Tea	1,300.00	750.00	27.50	(40.19)				
						25.14	58.08445	7.53	35.48903

APPENDIX IV(c)

YEAR 1998

	SECURITY	Beginning Price P(t-1) Kshs.	Ending Price P(t)% Kshs.	Cash Dividends Paid/Share D(t) Kshs.	Rate of Return (r)%	Average Return/ Segment	SD Return / Segment	Mean Return / Year (%)	SD Return / Year(%)
	MIMS								
1	Brooke Bond	110.00	140.00	1.70	28.82				
2	Kakuzi	96.00	140.00	2.75	48.70				
3	Sasini	94.00	70.00	2.00	(23.40)				
						18.04	37.24046		
	C & S								
4	Car & General	16.10	12.00	-	(25.47)				
5	CMC Holdings	74.00	36.00	0.50	(50.68)				
6	Marshalls (EA) Ltd	41.00	25.00	1.00	(36.59)				
7	Nation Media Group	130.00	138.00	2.25	7.88				
						(26.21)	24.9614		
	F & I								
8	Barclays	115.00	126.00	12.00	20.00				
9	Diamond Trust	22.00	22.00	1.00	4.55				
10	Housing Finance	19.00	16.55	1.50	(5.00)				
11	ICDC Investments	34.50	42.00	3.00	30.43				
12	Jubilee Insurance	36.75	30.00	1.75	(13.61)				
13	KCB	79.50	62.50	8.00	(11.32)				
14	NIC	51.00	37.00	1.75	(24.02)				
15	Pan Africa Insurance	41.75	25.00	1.75	(35.93)				
16	StanChart	45.50	51.50	1.75	17.03				
						(1.99)	21.8169		
	I & A								
17	Bamburi Cement	36.00	36.00	0.60	1.67				
18	BAT	50.00	76.50	6.50	66.00				
19	Carbacid	66.00	62.50	2.20	(1.97)				
20	Dunlop	100.00	18.50	-	(81.50)				
21	EA Cables	29.00	20.00	2.00	(24.14)				
22	EA Portland Cement	20.00	17.55	1.00	(7.25)				
23	EABL	48.50	67.00	6.00	50.52				
24	Kenya Oil Co. Ltd	48.25	55.00	4.00	22.28				
25	KPLC	180.00	125.00	5.00	(27.78)				
26	Total	52.00	46.50	2.60	(5.58)				
27	Unga	120.00	47.00	1.20	(59.83)				
						(6.14)	43.19238		
	AIMS								
28	A. Baumann	80.00	16.80	0.75	(78.06)				
29	City Trust	34.00	26.25	2.00	(16.91)				
30	Eaagads	41.50	43.00	4.75	15.06				
31	Express Ltd	59.00	28.75	2.20	(47.54)				
32	Williamson Tea	86.00	142.00	7.50	73.84				
33	Kapchorua	70.00	95.00	7.50	46.43				
34	Kenya Orchards	19.40	5.00	-	(74.23)				
35	Limuru Tea	750.00	750.00	87.50	11.67				
						(8.72)	55.43591	(5.88)	39.17897

APPENDIX IV(d)

YEAR 1999

	SECURITY	Beginning Price P(t-1) Kshs.	Ending Price P(t) Kshs.	Cash Dividends Paid/Share D(t) Kshs.	Rate of Return r(t)%	Average Return/ Segment	SD Return / Segment	Mean Return / Year(%)	SD Return / Year(%)
	MIMS								
1	Brooke Bond	140.00	104.00	2.30	(24.07)				
2	Kakuzi	140.00	87.00	2.75	(35 89)				
3	Sasini	70.00	45.00	0.50	(35.00)				
						(31.65)	6.582515		
	C & S								
4	Car & General	12.00	10.00	-	(16.67)				
5	CMC Holdings	36.00	30.00	0.75	(14.58)				
6	Marshalls (EA) Ltd	25.00	23.50	-	(6.00)				
7	Nation Media Group	138.00	100.00	1 65	(26.34)				
						(15.90)	8.353384		
	F & I								
8	Barclays	126.00	103.00	10.50	(9.92)				
9	Diamond Trust	22.00	26 00	0.40	20.00				
10	Housing Finance	16.55	10.55	1.25	(28.70)				
11	ICDC Investments	42.00	50.00	2 50	25.00				
12	Jubilee Insurance	30 00	25.75	0.75	(11.67)				
13	KCB	62.50	31.50	-	(49.60)				
14	NIC	37.00	27.00	1.75	(22.30)				
15	Pan Africa Insurance	25.00	27 00	0.75	11.00				
16	StanChart	51.50	56.50	5.40	20.19				
						(5.11)	25.82243		
	I & A								
17	Bamburi Cement	36.00	26.25	1.25	(23.61)				
18	BAT	76.50	77.50	7.50	11.11				
19	Carbacid	62.50	67.00	5.00	15.20				
20	Dunlop	18.50	10.00	0.40	(43.78)				
21	EA Cables	20.00	13.00	2.00	(25.00)				
22	EA Portland Cement	17.55	11.25	-	(35.90)				
23	EABL	67.00	70.00	7.00	14.93				
24	Kenya Oil Co. Ltd	55.00	67.00	-	21.82				
25	KPLC	125.00	93.50	80.00	38.80				
26	Total	46.50	48.25	3.00	10.22				
27	Unga	47.00	26 00	-	(44.68)				
						(5.54)	29.51337		
	AIMS								
28	A. Baumann	16.80	14.70	1.25	(5.06)				
29	City Trust	26.25	22.00	4.00	(0.95)				
30	Eaagads	43.00	26.00	1.25	(36.63)				
31	Express Ltd	28.75	19.00	-	(33 91)				
32	Williamson Tea	142.00	93.00	-	(34.51)				
33	Kapchorua	95.00	150.00	-	57.89				
34	Kenya Orchards	5.00	5.00	-	-				
35	Limuru Tea	750.00	650.00	60.00	(5.33)				
						(7 31)	30.84854	(9.26)	26.02083

APPENDIX IV(e)

YEAR 2000

	SECURITY	Beginning Price P(t-1) Kshs.	Ending Price P(t) Kshs.	Cash Dividends Paid/Share D(t) Kshs.	Rate of Return r(t)%	Average Return/ Segment	SD Return / Segment	Mean Return / Year(%)	SD Return / Year(%)
	MIMS								
1	Brooke Bond	104.00	97.00	4.00	(2.88)				
2	Kakuzi	87.00	55.00	1.40	(35.17)				
3	Sasini	45.00	34.00	2.20	(19.56)				
						(19.20)	16.14677		
	C & S								
4	Car & General	10.00	10.00	-	-				
5	CMC Holdings	30.00	15.25	-	(49.17)				
6	Marshalls (EA) Ltd	23.50	18.60	-	(20.85)				
7	Nation Media Group	100.00	69.00	1.75	(29.25)				
						(24.82)	20.36476		
	F & I								
8	Barclays	103.00	75.50	10.00	(16.99)				
9	Diamond Trust	26.00	14.00	0.40	(44.62)				
10	Housing Finance	10.55	5.50	0.25	(45.50)				
11	ICDC Investments	50.00	46.50	3.00	(1.00)				
12	Jubilee Insurance	25.75	18.50	1.50	(22.33)				
13	KCB	31.50	25.50	-	(19.05)				
14	NIC	27.00	17.75	1.80	(27.59)				
15	Pan Africa Insurance	27.00	11.00	-	(59.26)				
16	StanChart	56.50	49.50	9.40	4.25				
						(25.79)	20.96993		
	I & A								
17	Bamburi Cement	26.25	33.75	0.75	31.43				
18	BAT	77.50	60.50	14.25	(3.55)				
19	Carbacid	67.00	40.00	2.75	(36.19)				
20	Dunlop	10.00	6.40	0.40	(32.00)				
21	EA Cables	13.00	9.25	4.50	5.77				
22	EA Portland Cement	11.25	11.70	-	4.00				
23	EABL	70.00	74.50	7.50	17.14				
24	Kenya Oil Co. Ltd	67.00	73.00	7.50	20.15				
25	KPLC	95.50	40.00	2.00	(56.02)				
26	Total	48.25	55.00	3.40	21.04				
27	Unga	26.00	13.90	-	(46.54)				
						(6.80)	30.53178		
	AIMS								
28	A. Baumann	14.40	9.50	1.00	(27.08)				
29	City Trust	22.00	23.25	2.00	14.77				
30	Eaagads	26.00	20.50	-	(21.15)				
31	Express Ltd	19.00	17.90	-	(5.79)				
32	Williamson Tea	93.00	97.00	2.50	6.99				
33	Kapchorua	150.00	150.00	2.50	1.67				
34	Kenya Orchards	5.00	5.00	-	-				
35	Limuru Tea	650.00	650.00	55.00	8.46				
						(2.77)	14.61269	(13.88)	23.93581

APPENDIX IV(f)

YEAR 2001

	SECURITY	Beginning Price P(t-1) Kshs.	Ending Price P(t) Kshs.	Cash Dividends Paid/Share D(t) Kshs.	Rate of Return r(t)%	Average Return / Segment	SD Return / Segment	Mean Return / Year%	SD Return / Year%
	MIMS								
1	Brooke Bond	97.00	72.00	6.00	(19.59)				
2	Kakuzi	55.00	36.00	-	(34.55)				
3	Sasini	34.00	15.90	1.00	(50.29)				
						(34.81)	15.35494		
	C & S								
4	Car & General	10.00	10.00	-	-				
5	CMC Holdings	15.25	9.00	0.75	(36.07)				
6	Marshalls (EA) Ltd	18.60	18.30	-	(1.61)				
7	Nation Media Group	69.00	43.00	1.95	(34.86)				
						(18.13)	20.02435		
	F & I								
8	Barclays	75.50	73.00	10.25	10.26				
9	Diamond Trust	14.00	9.00	0.60	(31.43)				
10	Housing Finance	5.50	4.00	0.38	(20.36)				
11	ICDC Investments	46.50	38.00	2.00	(13.98)				
12	Jubilee Insurance	18.50	15.50	1.75	(6.76)				
13	KCB	25.50	16.00	-	(37.25)				
14	NIC	17.75	15.00	1.65	(6.20)				
15	Pan Africa Insurance	11.00	13.10	-	19.09				
16	StanChart	49.50	47.50	10.60	17.37				
						(7.69)	20.33671		
	I & A								
17	Bamburi Cement	33.75	16.65	0.50	(49.19)				
18	BAT	60.50	49.50	7.45	(5.87)				
19	Carbacid	40.00	34.80	2.75	(6.13)				
20	Dunlop	6.40	5.00	0.40	(15.63)				
21	EA Cables	9.25	9.50	1.10	14.59				
22	EA Portland Cement	11.70	12.70	1.00	17.09				
23	EABL	74.50	74.00	9.00	11.41				
24	Kenya Oil Co. Ltd	73.00	74.00	13.50	19.86				
25	KPLC	40.00	19.05	-	(52.38)				
26	Total	55.00	19.00	-	(65.45)				
27	Unga	13.90	6.80	-	(51.08)				
						(16.61)	32.19557		
	AIMS								
28	A. Baumann	9.50	8.05	-	(15.26)				
29	City Trust	23.25	19.20	2.00	(8.82)				
30	Eaagads	2.50	19.00	-	660.00				
31	Express Ltd	17.90	7.00	-	(60.89)				
32	Williamson Tea	97.00	66.00	5.00	(26.80)				
33	Kapchorua	150.00	137.00	2.50	(7.00)				
34	Kenya Orchards	5.00	5.30	-	6.00				
35	Limuru Tea	650.00	394.00	30.00	(34.77)				
						64.06	241.6625	2.39	116.9842

APPENDIX IV(g)

	YEAR			2002					
	SECURITY	Beginning Price P(t-1) Kshs.	Ending Price P(t) Kshs.	Cash Dividends Paid/Share D(t) Kshs.	Rate of Return r(t)%	Average Return / Segment	SD Return / Segment	Mean Return / Year(%)	SD Return / Year(%)
	MIMS								
1	Brooke Bond	72.00	54.00	2.00	(22.22)				
2	Kakuzi	36.00	14.65	-	(59.31)				
3	Sasini	15.90	13.60	0.50	(11.32)				
						(30.95)	25.15471		
	C & S								
4	Car & General	10.00	8.95	-	(10.50)				
5	CMC Holdings	9.00	21.00	0.75	141.67				
6	Marshalls (EA) Ltd	18.30	5.10	-	(72.13)				
7	Nation Media Group	43.00	77.00	2.40	84.65				
						35.92	95.54571		
	F & I								
8	Barclays	73.00	98.50	14.25	54.45				
9	Diamond Trust	9.00	10.00	0.40	15.56				
10	Housing Finance	4.00	5.20	-	30.00				
11	ICDC Investments	38.00	29.00	2.00	(18.42)				
12	Jubilee Insurance	15.50	15.50	3.00	19.35				
13	KCB	16.00	17.00	-	6.25				
14	NIC	15.00	18.55	1.60	34.33				
15	Pan Africa Insurance	13.10	7.00	-	(46.56)				
16	StanChart	47.50	58.50	8.60	41.26				
						15.14	31.32065		
	I & A								
17	Bamburi Cement	16.65	42.50	3.75	177.78				
18	BAT	49.50	54.00	8.60	26.46				
19	Carbacid	34.50	37.25	23.10	74.93				
20	Dunlop	5.00	5.00	-	-				
21	EA Cables	9.50	9.20	1.10	8.42				
22	EA Portland Cement	12.70	13.00	0.50	6.30				
23	EABL	74.00	119.00	11.50	76.35				
24	Kenya Oil Co Ltd	74.00	107.00	11.50	60.14				
25	KPLC	19.05	15.80	-	(17.06)				
26	Total	19.00	22.00	-	15.79				
27	Unga	6.80	5.00	-	(26.47)				
						36.60	58.29162		
	AIMS								
28	A. Baumann	8.05	5.30	1.00	(21.74)				
29	City Trust	19.20	18.00	2.00	4.17				
30	Eaagads	19.00	17.40	0.50	(5.79)				
31	Express Ltd	7.00	6.80	-	(2.86)				
32	Williamson Tea	66.00	43.75	0.50	(32.95)				
33	Kapchorua	137.00	137.00	0.50	0.36				
34	Kenya Orchards	5.30	5.30	-	-				
35	Limuru Tea	394.00	394.00	-	-				
						(7.35)	13.01351	15.17	51.12824

APPENDIX IV (h)

Value of Kshs. 1.00 invested in the Nairobi Stock Exchange (NSE) on 1.1.1996

Holding Period (In Years)	Market Segment					
	MIMS	C & S	F & I	I & A	AIMS	Overall Market
0	1.00	1.00	1.00	1.00	1.00	1.00
1	0.97	1.21	0.84	0.81	0.90	0.90
2	1.06	1.24	0.90	0.78	1.13	0.96
3	1.25	0.91	0.88	0.73	1.03	0.91
4	0.85	0.77	0.84	0.69	0.95	0.82
5	0.69	0.58	0.62	0.64	0.93	0.71
6	0.45	0.47	0.57	0.54	1.52	0.73
7	0.31	0.64	0.66	0.73	1.41	0.84