Chapter 1

THE CONTEXTUAL FRAMEWORK OF OLDUVAI

History of the research

En 1911, Kattwinkel found fossils of *Hipparion* in the Olduvai Gorge which he took to Berlin. These discoveries generated a great deal of interest in Germany, so in 1913, Reck studied the palaeontology and geology of the gorge (Reck 1914). He discovered a human skeleton (OH1), which he ascribed to what was then thought to be the Middle Pleistocene of Bed II. Later this skeleton was proved to be intrusive and much more recent (L. Leakey 1931).

The First World War prevented further work being undertaken, and it was Louis Leakey who resumed the expeditions in 1931; the discovery of a primitive lithic industry in Bed I was published for the first time in *Nature* in December of that year. Although the term Oldowan was not yet being employed, it seemed evident that some of the oldest evidence of human culture was being found in Olduvai.

A little later the Oldowan was clearly defined, and it was assumed that "*the Oldowan culture comprises a series of artefacts which are made either from worn pebbles or from lumps of rock. The piece of material to be made into a tool was then trimmed very roughly by striking off flakes in two directions so that the line of intersection of these flake scars gave a jagged cutting edge along one side of the pebble or lump of rock*" (L. Leakey 1936:40). Louis Leakey said that the Oldowan "typical site" was Bed I of what at the time was called Oldoway, where the supposedly alluvial deposits contained an association between that lithic industry and archaic fauna ascribed to the first part of the Middle Pleistocene.

Work in Olduvai was sporadic until 1959. The appearance of the *Zinjanthropus boisei* cranium that year was the first physical evidence of hominids outside South Africa, and in fact its discovery was considered so important that it enabled investigation to be started on a large scale. In 1960, Mary Leakey began a programme of systematic excavations in Beds I and II. The work ended in 1963, after more than 10 archaeological sites had been excavated, providing the material for a detailed monograph (Leakey 1971). Together with the discovery of *Zinjanthropus*, the monograph of the excavations in Beds I and II was the great landmark of African archaeology in these years (Isaac 1984). The publication of Volume 3 of the work in Olduvai implied the assumption of various unprecedented paradigms: the first was the documentation of lithic industries 1.8 my ago. Moreover, that industry appeared in dense concentrations close to bone remains. The first known lithic technology was characterised by cores and flakes, with a few retouched pieces. In addition, Acheulean industries were documented that coexisted with the so-called Developed Oldowan. In short, Leakey's monograph (1971) provided a prodigious compendium of empirical information, and served to structure the entire archaeological sequence of East Africa, comparing the other African sites with the cultural stratigraphy established in Olduvai Beds I and II.

From 1968 to 1971 Mary Leakey excavated in Beds III, IV and Masek Beds. The scientific impact of these excavations was not as great as that of Beds I and II: in the later sequence the fauna is poorly preserved, the remains of hominids are scarce and assemblages are usually found in a secondary position. Furthermore, the monographic publication of these excavations is considerably later (Leakey & Roe 1994), although it is as rigorous and detailed as that of Beds I and II (Leakey 1971).

Despite isolated works by Stiles *et al.* (1974) on Bed II and Kleindienst (1973) on Bed III, no further excavations were undertaken on Bed III until the 1980s. The first of these was directed by Johanson, and in 1986 a partial skeleton of *Homo habilis* was discovered (Johanson *et al.* 1987) just below Tuff IC. By 1974 forty-six human fossils had been found (Leakey 1978), and with OH-62, the total number of hominids discovered in Olduvai came to more than 60.

In 1988, Blumenschine and Masao (1991) began excavations, and these are still in progress. While Leakey's excavations (1971, 1994) concentrated on large areas with conspicuous concentrations, Blumenschine and Masao have approached the task from a landscape archaeology perspective, making pits in the basal part of Bed II. To date preliminary studies on their excavations have been published (Blumenschine & Masao 1991; Deocampo *et al.* 2002), the models generated (Blumenschine & Peters 1998; Peters & Blumenschine 1995), and new remains of *Homo habilis*, which bring the number of hominids recovered in Olduvai to 65 (Blumenschine *et al.* 2003).

Stratigraphical, chronological and paleoecological contexts of Beds I & II

The Olduvai basin was created 2 my ago by the lifting of volcanic highlands to the east and south. Today, the Olduvai gorge, which bisects the Serengeti Plain, begins in lakes Masek and Ndutu and flows eastwards into the Olbalbal Depression. To the south and east of the Olduvai valley are volcanic highlands, and to the north an area of metamorphic mountains. According to Hay (1976), the Olduvai sedimentary deposits are nearly 100 metres deep. This sequence was deposited in a basin 25 kilometres in diameter, and 7 different formations have been distinguished: Beds I, II, III, IV, Masek, Ndutu and Naisiusiu, which cover a time span of between 2.1 my and 15,000 BP.

Bed I, the oldest in the sequence, is no more than 60 metres thick. The oldest deposits, with an age of 2.1 – 2 my, are found only on the western side of the Gorge. In Bed I there are 6 main tuffs, which from bottom to top are referred to as Tuffs IA, IB, IC, ID, IE and IF. All the archaeological sites of Bed I are located in the Upper Member, above Tuff IA and below Tuff IF. According to Hay (1976), during the deposition of Bed I the Olduvai lake was shallow, and its area fluctuated seasonally a great deal. The lake-margin terrains were deposited at levels that were intermittently flooded by the lake, although fresh water flowed through the floodplain of the southeast of the basin, where most of the sites are located (Hay 1976). Deocampo *et al.* (2002) calculate that the lacustrine plain in which the sites in Bed I and the basal part of Bed II are found was some 3 kilometres wide from the shore of the perennial lake to the alluvial fan and that, given the lake's alkalinity and salinity, it would have been covered by open grassland tolerant to salt. The lava flows and alluvial fan deposits are located solely on the eastern margin of the paleolake, while the alluvial plain deposits have only been identified on the western side of the gorge (Hay 1976).

In its 20-30 metres thickness Bed II is extremely variable. Tuff IF, on which the entire sequence of Bed II rests, and Tuffs IIA, IIB, IIC and IID, the latter at the top of the formation, stand out as stratigraphic markers. These tuffs serve to divide Bed II into three different members, along which there are different archaeological remains. The Lower Member of Bed II is formed by sediments deposited between Tuff IF and IIA, the Middle Member by the deposits between Tuff IIA and IIC, and the Upper Member by the deposits between Tuff IIC and the sediments which make up the base of Bed III (Hay 1971, 1976). This author distinguished a greater variety of lithofacies than in Bed I, such as the alluvial fan, alluvial plain, the perennial lake, the lake margin, the aeolian deposits and the stream deposits, which are much more abundant than in Bed I. The basal part of Bed II, well studied in recent years (Deocampo *et al.* 2002; Ashley & Driese 2000; Ashley & Hay 2002), was very similar to that of the previous period: until the deposition of Tuff IIA, there was an alluvial plain and a river delta in the Olduvai basin on the western and northern margins of the lake, and an alluvial fan complex in the eastern and southern parts (Ashley & Hay 2002). In the period represented by Tuffs IIB and IID the Olduvai lake was constantly shrinking and the open and fluvial areas were extending; the deposits on the bottom of the lake were progressively contracting and its floodplain gradually covered a larger area.

Hay (1976) says that, of the 63 archaeological sites so far discovered in Beds I and II, 46 are located in the fluvio-lacustrine deposits on the eastern margin of the lake, while only 16 were on the western shore. Hay (1976) related the concentration of sites on the eastern shore of the lake with the greater abundance of fresh water in this area, associated with a permanent river flowing from the Crater Highlands. He concluded that all the archaeological sites were associated with constant sources of fresh water and vegetation, no evidence of human life being documented in the aeolian tuffs deposited on dry savannas or alluvial plains (Hay 1976:180). Recent studies support this conclusion, and in fact in the random trenches throughout the whole of the territory there would seem to be a correlation between the presence of fresh water and the appearance of artefacts (Deocampo *et al.* 2002).

The first radiometric evidence of Olduvai coincided with the need to establish a chronological framework for the remains of *Zinjanthropus* and *Homo habilis,* which appeared in 1959-1960. Various K-Ar dates were carried out in various tuffs of Bed I and these oscillated between 1.57 and 1.89 my, a date of 1.75 my being suggested for FLK Zinj (L. Leakey *et al.* 1961). When Leakey's monograph (1971) was published, a chronology for the Basal Member of Bed I of around 2-1.8 my was estimated, and Tuff IF was dated at 1.7 my (Hay 1971). The same author warned that there were no satisfactory dates for Bed II, calculating that its top would be between 1-0.7 my.

In recent years new radiometric dates have been obtained. Walter *et al.* (1991, 1992) have used the 40Ar/39Ar laser-fusion method: according to their studies, Tuff IB is between 1.859±0.007 and 1.798±0.004 my, and Tuff IC 1.761±0.028 my, Tuff ID (1,764±0,014 my), Tuff IE (1,75±0,020 my) and Tuff IF (1,749±0,007 my), the upper part of which closes Bed I. Manega (1993) calibrates the dates of Walter *et al.* (1991) and offers new 40Ar/39Ar dates for Beds II and III. Manega (1993) puts Tuff IB at 1.8±0.01 my, Tuff IC in 1,76±0,01 my, Tuff ID in 1,76±0,02 my, Tuff IE in 1,75±0,02 my and Tuff IF in 1,75±0,01ma. He also offers reliable dates for Bed II, situating Tuff IIA at 1.66±0.01 my and IID at 1.48±0.05 my, when it was thought that the top of Bed II would be about 1.2 my (Hay 1976). Manega (1993) dates Tuff IIIA (the bottom of Bed III) at 1.33±0.06 my, which reinforces the greater anti-

Bed	Tuff	Dates (my)
Naisiusiu	Loc. 45	0,04-0,013
Ndutu	Lower Ndutu	>0,40
Masek	-	>0,78**
IV	-	>0,78**
III	IIIA	1,33±0,06
II	IID	1,48±0,05
	IIA	1,66±0,01
	IF	1,75±0,01
	IE	1,75±0,02
	ID	1,76±0,02
I	IC	1,83±0,00*
	IB	1,84±0,00*
	Bed I Lavas	1,87±0,05
	IA	1,98±0,03
Pre-Bed I	Naabi Ignimbrite	2,03±0,01

Table 1.1. 40Ar/39Ar ages by Manega (1993:110). (*) 40Ar/39Ar dates by Blumenschine *et al.* (2003); (**) Paleomagnetism dates (Tamrat *et al.* 1995).

quity of the final part of Bed II. The most recent 40Ar/39Ar dates put Tuff IC of Bed I at 1.839±0.005 my and Tuff IB at 1.845±0.002 my (Blumenschine *et al.* 2003), so Tuff IF and the top of Bed I are probably over 1.75 my old (tabl. 1.1).

The general evolution of the paleoenvironments has been sketched out above, indicating the gradual process of desertification that affected the Olduvai lake. The isotopic study of the carbonates (Cerling & Hay 1986) indicates that during the sedimentation phase of Bed I and the basal part of Bed II, the average temperature of the Olduvai basin was 13°-16°. During the formation of the Lemuta Member, the basin would have been subject to drier and warmer conditions, with temperatures of 22°-25° and a substantial drop in rainfall, giving way later to periods with more humid conditions similar to those of Bed I. According to Cerling and Hay (1986), from the upper part of Bed II to the end of Bed IV conditions would have been stable, with a temperature of 15°-18°. According to Sikes's (1994, 1996) isotopic analyses the climate in the basal part of Bed II was similar to that of present-day lake Nakuru, with an average temperature of 18° and rainfall of 900 mm. Sikes's interpretations (1994, 1996), which assume the presence of gallery forests with which the archaeological sites would be associated, are complemented with the reconstruction by Deocampo *et al.* (2002) based on the geochemistry of the soils; these authors describe a great lacustrine floodplain of open vegetation in which the hominids would not have moved about much, restricting themselves to areas close to sources of fresh water.

Numerous paleoclimatic reconstructions through the fauna exist (for example Potts 1988; Kappelman 1984; Kappelman *et al.* 1997; Andrews 1983; Fernández-Jalvo *et al.* 1998; Plummer & Bishop 1994; Stewart 1994), pollen (Bonnefille 1984), soil analysis (Ashley & Hay 2002; Ashley & Driese 2000; Cerling & Hay 1986; Hay 1976; Deocampo *et al.* 2002; Sikes 1994, 1996) and landscape models (Blumenschine & Peters 1998; Peters & Blumenschine 1995). According to the general synthesis by Potts (1988), in the oldest sites of Bed I (those below Tuff IB) there was a period of humid savanna, with closed vegetation, meadows and pools and an average rainfall of 1000 mm. In the interval between Tuff IB and Tuff IC the vegetation became more open and the climate drier, with a mosaic of meadows, closed savannas and gallery forests. In the basal part of Bed II, Peters and Blumenschine (1996) propose that that there were seasonally exposed lacustrine plains around the perennial lake dominated by grasses that would sustain enormous herds of herbivores (in contradiction with Sikes 1994). Although there would have been some small clumps of trees in this floodplain (where sites such as DK or FLK Zinj were located in Bed I), trees would have been more abundant in the middle and higher part of the lacustrine plain (Peters & Blumenschine 1996). The climate would become progressively more arid and open, and the gradual increase of equids in the sites throughout Bed II would indicate that the hominids were adapting to savanna lands with less and less closed vegetation.

Archaeological sites in Beds I & II

The primary source for studying Olduvai Beds I and II is Leakey's monograph (1971). The historiographic importance of this work has already been mentioned, since it established the foundations on which subsequent archaeological research in East Africa was based. This monograph became the principal point of reference of all archaeological works in two respects, the empirical and also the methodological. Beginning with the latter, it has to be emphasised that until the publication of Leakey's monograph, there was no standardised terminology for discussing the most ancient archaeological assemblages of East Africa. Thanks to Leakey's work a detailed, orderly and comprehensible study appeared which situated different lithic artefacts in a stratigraphic sequence and made it possible to advocate typological evolution.

Since there were no other African assemblages that had been subjected to radiometric dating in the same way as the sites of Beds I and II, the establishment of a sequence of typological development in Olduvai was a key point of reference from which to structure an evolution of lithic artefacts. Thus, to a greater or lesser extent all the studies after Leakey's monograph (1971), particularly in the 1970s (for example Bower 1977; Chavaillon *et al.* 1979; Clark & Kleindienst 1974; Isaac 1976, 1977; Harris & Isaac 1976; Kurashina 1978) but also in the 1980s (Davis 1980; Roche 1980; Stiles 1980; Gowlett 1986; Harris *et al.* 1987; Potts 1988; Willoughby 1987; Toth 1982) and in recent years (Jones 1994; Isaac *et al.* 1997; Kyara 1999; Ludwig 1999; Kimura 1999, 2002; Schick & Toth 1993; de la Torre & Mora 2004) have adopted Leakey's typology to dispute or support her classifications.

The historiographic importance of Leakey's formal methodology and typology was accompanied by a prodigious empirical record: her monograph describes 13 sites that cover the whole of the first part of the early Pleistocene. In these sites Leakey (1971) observed a cultural evolution from the Oldowan typical of Bed I and the basal part of Bed II, up to the Acheulean which emerged after Tuff IIB (Middle Member of Bed II), together with a development of the Oldowan (which she called Developed Oldowan A and B). It was not just of typological, but also contextual, significance since Leakey (1971) underlined the excellent conditions of preservation of most of the sites. This author spoke of authentic living floors and butchering sites in different levels of DK, FLK NN, FLK I, FLK North, HWK, EF-HR, FC West, SHK and TK, and said that the assemblages in a secondary position were few and restricted (with the exception of BK) to not very significant strata.

The antiquity, quantity and quality of the record excavated by Leakey has led many archaeologists to examine the materials of Beds I and II. With regard to the scholars who have personally reviewed the lithic materials, it is curious to observe that those who studied artefacts in the 1970s were not interested in the analysis of complete sites but of specific artefacts, such as Dies and Dies (1980), Bower (1977) and Roche (1980), who studied examples of choppers in different parts of the sequence. This typological approach can still be seen in some studies conducted in the 1980s, such as those of Wynn (1981), Willoughby (1987) and Sahnouni (1991). The latter analysed certain specific artefacts – polyhedrons, subspheroids and spheroids – throughout the whole of the Oldowan sequence. Although they incorporate a great number of analytical variables, both Sahnouni (1991) and in particular Willoughby (1987) respect Leakey's original ascriptions (1971), only adding new attributes to a study that is still typological. Wynn (1981) also opted for interpreting some objects in isolation without analysing their relationships with other categories of tools within each site, but he adopted a more innovative approach, structuring his hypothesis on the craftsmen's spatial, geometric and mental skills.

There are also comprehensive reviews of the Oldowan lithic collections restricted to specific aspects. Of note is the contribution by Kroll (Kroll & Isaac 1984; Bunn & Kroll, 1986), who concentrates on the spatial analysis of FLK Zinj through the study of lithic refits. This work has never been systematically published and only preliminary information exists. Kyara's investigation (1999) also concentrates on a specific aspect of the lithic industry, with a monographic study of the raw materials of Bed II. One of our objections to this study is its rigid adherence to the categories created by Leakey, which, as we shall see in the following chapters, can be questioned. The major problem is the emphasis on a diachronic comparison of the different categories throughout the whole of the sequence, instead of a synchronic reconstruction of the contribution of raw materials in each site. By failing to do this, it is only possible to monitor the changing frequencies of different raw materials in each category of artefacts, when in fact the classification of the categories is in itself questionable.

The same problem, which we could call a "diachronic fixation" affects other supposedly technological modern reviews such as those of Ludwig (1999) and Kimura (1997, 1999, 2002). The merit of Ludwig (1999) is that he reviewed most of the lithic collections of Beds I and II. However, instead of analysing the relationships between the artefacts from each site, this author concentrates on comparing each category over half a million years. From this perspective, Ludwig (1999) never presents a reconstruction of each site's technology, but restricts himself to a formal comparison of attributes outside their contexts (cortex, length, number of scars, etc.) which provides little technological information. This is also the problem with Kimura (1997, 1999, 2002), who explicitly states her interest in what she calls "time trends" (Kimura 2002) or diachronic variations between Beds I and II. Like Ludwig (1999), Kimura concentrates on comparing analytical attributes without seeking a deeper understanding of the technical parameters they generate, and with no examination of knapping methods. However, the studies by Kimura (particularly 1997 and 1999) do explore the dynamics of importing and exporting artefacts in each site and the role of the availability of raw material so (despite the fact that her conclusions are sometimes at variance with those that will presented in the following chapters), her work has relevance.

The first complete review of the lithic collections of whole sites was that conducted by Stiles (1977), who analysed various assemblages from Bed II in order to demonstrate the typological similarities between the Developed Oldowan B and the Early Acheulean. The next complete study was that of Potts (1988), who reviewed various assemblages from Bed I from an innovative standpoint. The main problem is that Potts (1988) was faithful to Leakey's original classification (1971), only modifying the classifications in small details. Since Leakey's classification was basically typological, this prevented Potts (1988) making a technological reconstruction of the activities of each site, far less the knapping methods. Despite these objections, not just the study of the industry but in fact the whole of Potts' study (1988) benefits from an integrated conception of the sites, and from an interest in reconstructing the processes of formation and the paleoecological environment. In this way, Potts (1988) adopted a synchronic perspective in order to ask himself what strategies for obtaining raw materials would be adopted in each site, why certain raw materials were chosen and others were not, and what the dynamics of importing and exporting objects would have been. In short, despite the fact that it was a strictly typological study, the perspective adopted by Potts is fundamental for understanding the strategies adopted for managing lithic resources in Bed I.

Apart from the use-wear study of a few pieces carried out by Sussman (1987), we know of no other studies that involve a first-hand review of the Oldowan lithic materials. However, there are numerous contributions that had been based on the data contained in Leakey's original monograph. The most interesting are those of Jones (1979, 1980, 1981, 1994), who through the use of experimental replicas has proposed various explanations for the diversity and functionality of Acheulean bifaces. Also relevant at a methodological level are the works of Brantingham (1998) and McNabb (1998), who used the frequencies of objects in sites of Beds I and II to propose the hypotheses about mobility through the landscape and the dynamics of importing and exporting artefacts. However, at an empirical level, their conclusions are not very functional, since these authors base themselves directly on the same percentages as Leakey (1971) which, as we shall see in the following chapters, are questionable.

This is the problem with the studies on the differences between the Oldowan and Acheulean of Olduvai (Davis 1980; Stiles 1979, 1980; Callow 1994; Roe 1994, etc.). All these authors have based themselves on the data provided by Leakey (1971) and have used it for conducting statistical analyses. By not examining the artefacts themselves, these scholars have attributed cultural connotations to questionable objects, and based their interpretations on metrics and percentages that can be disproved. Although we shall expand on this problem in chapter 9, we would say here that we consider it dangerous to base models of behaviour on second-hand data, and that the artefacts should be examined personally in order to understand the technical dynamics implicit in their manufacture. This reflection leads us to set out which sites we shall be studying in the coming chapters and why they have been chosen.

The sites analysed in this study

From the assemblages excavated by Leakey (1971) in Beds I and II, seven sites have been chosen (fig. 1.1). A number of criteria were adopted in order to select the assemblages shown in table 1.2: the first and most important was to select collections that Leakey considered to be in primary position, since our major interest is the synchronic reconstruction of the technology and operational sequences employed in each site. For this reason FLK Zinj and the two levels of TK (Lower Floor and Upper Floor) were selected, classified by Leakey (1971) as living floors.

Another of the selection criteria was our interest in the earliest technological strategies found in Olduvai, which led us to study DK, situated at the beginning of the archaeological sequence of Bed I. The contextual integrity of this site is not as well preserved as those already cited, but it does contain a numerous lithic collection that makes it possible to reconstruct knapping methods. Moreover, various authors (Gowlett 1986; Davidson 2002; Davidson & Noble 1993; de la Torre & Mora 2004) had referred to possible technical similarities between DK and the technological strategies documented in the Middle Palaeolithic on the basis of the Leakey's original publication (1971), but without having studied the lithic collection at first hand, so it was interesting to test this hypothesis. While DK was chosen for being the earliest Olduvai site, BK was studied for precisely the opposite reason, since it is the site of the most recent assemblages of Bed II, the limit of this study. Given that here, too, attention had been drawn to the similarities with the discoid cores of the Middle Palaeolithic, BK was included in this study, despite its serious contextual problems. Leakey (1971) warned of the secondary position of some of the levels of FLK North. Nevertheless, it

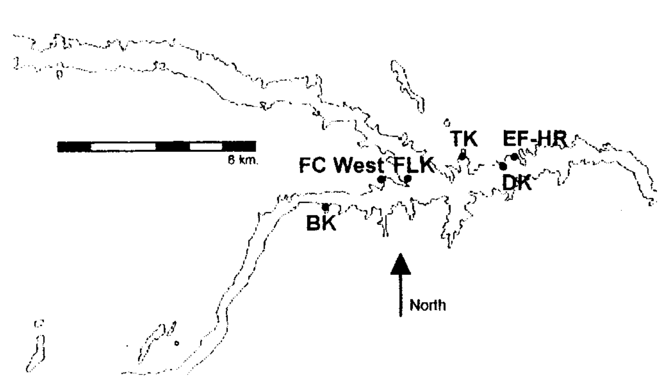

Figure 1.1. Olduvai Gorge with the sites analysed in this study.

Bed II	Upper	II D (1,48 my)	BK TK (Lower & Upper Floors)
		II C (~1,5 my)	
	Middle	II B (~1,6 my)	FC West EF-HR FLK North Sandy Conglomerate
		II A (1,66 my)	
	Lower		FLK North, *Deinotherium* Level
		I F (1,75 my)	
Bed I (Upper Member)	Upper		FLK North, Levels 6-1
		I D (1,76 my)	
	Middle		FLK *Zinjanthropus*
		I B (1,84 my)	
	Lower		DK

Table 1.2. Olduvai sites studied in this work.

was decided to carry out a study of nearly all its levels, in order to discern any possible diachronic differences in the use of the same point in the landscape. In addition, with the aim of understanding the differences proposed by Leakey (1971) between the Developed Oldowan and the Acheulean, FC West and EF-HR respectively were selected, both in primary position.

In short, the selection criteria have led us to study a representative sample of the archaeological evidence of Olduvai Beds I and II. In the following chapters we will attempt to present an orderly and coherent description of their technical features in order to reconstruct the knapping methods, operational sequences and, in general, the underlying technological strategies in each assemblage. The methodology of the lithic analysis will be described in the next section, and it should be emphasised that our classification will not be subordinated to the one proposed by Leakey (1971), arguing and justifying the disagreements that arise. This study will always be approached from a synchronic standpoint, that is, trying to discern the relationships between the different categories which make up an assemblage, and the behavioural response that these imply within specific contextual and temporal parameters. Then, once each assemblage has been characterised, we can go on to evaluate the synchronic and diachronic relationships between different settlements. We hope that the 885 kilograms of stones that have passed through our hands in the Museum of Nairobi will enable original and comprehensible conclusions to be

Leakey (1971)	Isaac *et al*. (1997)	De la Torre & Mora (2004)	This work
Tools	**Flaked pieces**		**Flaked pieces**
Choppers	Choppers	Choppers	Cores
Polyhedrons	Polyhedrons	Polyhedrons	
Discoids	Discoids, regular	Cores	
	Discoids partial		
Proto-bifaces	Discoids, elongate		
Heavy Duty scrapers	Scrapers, core		
Light Duty Scrapers	Scrapers, flake	Retouched flakes	Small retouched pieces
Burins	Other and misc.		
Awls			
Outils écaillés			
Laterally trimmed flakes			
Sundry tools			
Bifaces	Acheulean forms		Large Cutting Tools
Spheroids/ subspheroids	**Pounded pieces**		**Pounded pieces**
Modified battered			
Utilised materials			
Hammerstones	Hammerstones	Hammerstones	Knapping Hammerstones
Utilized cobbles	Battered cobbles		Hammerstones fract. angles
Utilised flakes			Spheroids / subspheroids
Anvils	Anvils		Anvils
Debitage	**Detached pieces**		**Detached pieces**
Flakes	Whole flakes	Whole flakes	Whole flakes
Others	Broken flake	Flake fragments	Flake fragments
	Angular fragments	Angular fragments	Angular fragments
		Chips	Chips
	Core fragments		
Manuports	**Unmodified**	**Manuports**	**Unmodified material**

***Table.** 1.3.* Different classifications of the lithic collections in the East African Lower Pleistocene.

offered on the technological strategies of the Olduvai sequence, which even today remains a fundamental point of reference for studying the hominids of the Early Pleistocene in East Africa.

Methodology for describing the industry

Isaac's desire to simplify (1984, 1986), by trying to synthesise the variety of categories defined by Leakey (1971), has also been our aim in this and previous studies (de la Torre & Mora 2004). However, given that the number of sites and chronological range are very much greater than those we studied previously in Peninj, the number of categories identified has been considerably increased (tabl. 1.3).

Precisely because of this broad temporal and contextual range, describing in this section the different types of objects would not be very elucidating; in Olduvai, many of the classes of artefacts require a contextual discussion of each site. For this reason, we have decided to describe each type of object as it appears in the sequence, since the diachronic structure has also been used to organise the index of this monograph. In this way, idiosyncratic objects such as the hammerstones with fracture angles, anvils, etc, will be described at the point where they are relevant.

The same is true of the methods of exploitation; in previous studies (de la Torre & Mora 2004; de la Torre *et al.* 2003, 2004) the systems of reduction identified could be discussed in advance, since the sample was small and well located geographically and stratigraphically. It was emphasised in those studies that the classification was valid exclusively for the sample being analysed at the time, and that the extrapolation *en bloc* of those systems to other archaeological assemblages was not recommended. A more meaningful approach would be to systematise them as they appeared in the archaeological sequence, rather than start with a long list of alternative forms of exploitation, technical options that would not be understood without studying each site first.

We are aware that postponing the definition of each type of object or method of exploitation until it first appears in the archaeological record requires the line of reasoning to be followed continuously. This drawback, which makes it impossible to avoid other descriptions or to skip from one part of the study to another, has been carefully considered; each technological phenomenon we describe reflects a specific technical structure that does not allow the various definitions to be taken out of context. Thus, the classification of the various percussion objects could not be understood if we were to restrict ourselves to mentioning the groups identified without offering any technological explanation. This has happened with other examples such as the polyhedrons or choppers, which were rapidly (and superficially) interpreted in another study (de la Torre & Mora 2004), but which in reality present

Dorsal face	Striking platform	
	Cortical	Non-cortical
Cortical Cortex > 50% Cortex < 50% Non-cortical		

Table 1.4. Cortex in the whole flakes.

a more complex set of problems than we had initially realised. Furthermore, we shall not restrict ourselves to describing the typical Oldowan processes of *débitage*, but will also discuss operational sequences of Acheulean *façonnage*, which require a preliminary contextualisation impossible to synthesise in advance. For all these reasons, we trust that the reader will forgive the absence of the traditional description of each category in this section on methodology, and wait for them to appear in the discussion that begins in the next chapter.

That decision affects the systematisation of the cores, the different types of hammerstones and retouched pieces but fortunately it is unnecessary to delay the description of knapping products, which can be categorised analytically irrespective of their characteristics in each site. The percentages of corticality in the flakes have been calculated by combining the presence of cortex in the striking platform and on the dorsal face of the products (tabl. 1.4), although in this study they will only be applied to complete flakes. Combining the cortical character of the striking platform and the dorsal face is very useful, since it enables combined inferences to be made on the exploitation phase of the core and its processes of rotation. Toth's types (1982) are redundant with respect to the characters of table 1.4, since the latter includes all the possibilities contemplated by Toth and is in fact more detailed. However, since Toth's method of classifying the cortex (and not the flake technology, as many mistakenly believe) is so widespread, this attribute will also be included in the analysis of the flakes.

The calculation of the number of dorsal scars of the flakes is a common practice in lithic technology, and has been carried out systematically in African archaeology in recent decades (for example Isaac 1977; Noll 2000; Kimura 1997, Ludwig 1999; Texier 1995; etc.). This variable provides information on the recurrence of knapping on the actual *débitage* surfaces, and is, together with the direction of the preliminary detachments, a basic attribute for deducing the methods of exploitation by which flakes are obtained. These diacritical structures have been very commonly used in European archaeology since their definition (Dauvois 1976), but have received little attention in Africa, which must surely be due to the poor quality of the raw materials available, since it is well known how difficult it is to identify the direction of preliminary detachments in materials other than chert. Most of the material in Olduvai is quartz, in which the ripples are not well preserved and it is usually impossible to reliably reconstruct the direction of the blows preserved on the dorsal faces. For this reason it has sometimes been impossible to determine the direction of the previous scars. In fact, the diacritical outlines of the flakes included in each chapter should be regarded as minimum variations that must be greater than we have been able to identify.

In Olduvai, there is a wide variety of rocks, with metamorphic rocks including quartzes, quartzites and gneisses, and the lavas including basalts, phonolites and trachyandesites. Given the petrological similarity between the Olduvai's quartzes and quartzites (Hay 1976), both will be referred to by the generic term quartzes, most frequently employed in the literature. With regard to the lavas, the differences between the basalts and phonolites are conspicuous, but are not so marked in the case of the trachyandesites. For this reason, and also with a desire to synthesise, in the description of each site they will all be included in the general category of lavas, although in chapter 9 they will be treated separately in order to analyse the sources of supply of each raw material.

We hope that on the basis of the rigorous study of the various lithic collections, we shall be able to offer a systematic picture of the techniques employed in each site. From this starting point, the specific conclusions on each assemblage will be integrated within a broader contextual framework. Our aims are to understand how these craftsmen adapted to their environment and to reconstruct the technological strategies developed by the hominids of the Plio-Pleistocene in Olduvai.