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Notwithstanding all the help, I bear the final responsibility for the findings and conclusions.

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DECLARATION

I declare that this dissertation is my own, unaided work. It is being submitted for the degree Master of Arts in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.

R. Engela

14 day of February, 1995.

is further analysed through the calculation of food utility & density indices.

The recognition of the simultaneous nature of adaptive strategies and cultural form enables this study to detect previously unrecognised features of the material culture record and advance our understanding of the Pleistocene / Holocene boundary.

A paleo-environmental reconstruction, based on the macro-mammalian fauna, indicates that the Basutolian ecozone with a dominance of grass-land species existed around Rose Cottage during the late Pleistocene and Holocene. During the mid Holocene a slightly drier environment prevailed. The grassland quality improved (possibly changing to sweetveld) and attracted new and different migratory species; this change, coupled with the extinction of the large grazers at the end of the Late Pleistocene, led to the ancient grazing succession being irrevocably transformed causing, for example, the extinction of *Antidorcas bondi*. Within the parameters set by the changing environment, deliberate human choices in the exploitation of the faunal environment are detected through the analysis of community structure and Mean Ungulate Biomass values.

I present a detailed analysis of the archaeological evidence of human occupation from four levels. A spatially distinct location for the first stage of stone knapping is recognised; and in addition there is a separate and discrete co-occurrence of formal tools and bladelets. Spatial differentiation is also noted for the occurrence of opaline material as opposed to material other-than-opaline. The articulation of various occupation features (such as hearths, pits, 'empty areas' etc.) within a level, and between levels, is analysed in terms of a deliberate spatial dialogue. Through diversity indices, the richness and evenness structure of the stone assemblage and reconstructed faunal community is investigated and correspondences detected. The faunal exploitation at Rose Cottage

This study, based on material excavated at Rose Cottage Cave, presents a new theoretical perspective for our understanding of the southern African archaeological record dated to the Pleistocene/ Holocene boundary. Over the past twenty years, two contesting models for interpreting the Pleistocene/ Holocene boundary have been proposed — it has been described as a period of cultural stasis, on the one hand, or, as exhibiting continuous change, on the other hand. This study departs from the position that this debate is at a theoretical impasse.

Through the assumption of a theoretical framework that deals concurrently with cultural representation and social strategy, previously unrecognised aspects of the archaeological record are investigated. I explore the active constitutive role of material culture and thus remove the false dichotomy between cultural form and functional expediency. In allowing for the active role of human agency, a model for the interpretation of spatial use is developed through the incorporation of the informative and constraining role of previous spatial patternings. I recognise that meaning is actively created, and examine the spatially and chronologically contingent nature of meaning through the unique perspective that deep sequence archaeological deposit offers.

SPACE, MATERIAL CULTURE AND MEANING IN THE
LATE PLEISTOCENE AND EARLY HOLOCENE
AT ROSE COTTAGE CAVE.

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A dissertation submitted to the Faculty of Arts, University of the
Witwatersrand, Johannesburg, in fulfilment of the requirements for
the degree of Master of Arts

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The Later Stone Age was divided into Wilton and Smithfield 'cultures'. The Smithfield was seen as an internal South African development. Within the Smithfield culture three variants, based on scraper morphology and size, were recognised. Their temporal relation was not clear, and to avoid any implication of a chronological relationship they were named A, B and C. It was, however, generally accepted that A was the oldest culture, B the youngest, and C a cave variant. No Later Stone Age industry before the Smithfield was recognised at this stage.

Smithfield A was confined to the South African inland plateau. Its distribution was linked to lydianite (also called hornfels or indurated shale) and thought to be associated with rock engravings. The tools were seen as the result of "cruder" (Goodwin and Van Riet Lowe 1929:172) workmanship and considered generally to be larger than the tools from other industries. Concavo-convex and large circular scrapers were deemed 'marker' tools. In the years following Goodwin and Van Riet Lowe's publication, a number of assemblages were analysed and, based on the cultural-historical methodology, several variants of the Smithfield culture were proposed. For the Smithfield A, Smithfield P was proposed as the "Umgazana variant". It was classified as distinct from A on the basis of the presence of an abundance of wood, bone and shell artifacts, and an absence of endscrapers (Chubb *et al* 1934; Van Riet Lowe 1936).

CHAPTER ONE

HISTORICAL CONTEXT

Historical survey

This chapter outlines the archaeological debates pertaining to the late Pleistocene and early Holocene in southern Africa, and situates my research in the wider context of southern African Stone Age archaeology. I illustrate how these debates revolve around and are informed by renewed and improved bodies of knowledge on the one hand, and, crucially, by basic conceptual inferences on the other hand.

For the first half of this century archaeologists concentrated on establishing wide-ranging cultural-historical sequences. This was not an easy task as there was a dearth of excavated deposits containing long sequences, as well as no absolute dating technique. A research methodology was developed whereby assemblages were classified on the basis of their core and formal tool components (Deacon, J 1984a) and Early, Middle and Later Stone Ages were identified (Goodwin and Van Riet Lowe 1929). Within these technological stages, archaeological 'cultures' were recognised based on the presence and absence of certain marker items ('type specimens'). The theoretical assumption was that the chronological and spatial distribution of these 'cultures' was best explained by migration or diffusion hypotheses and/or adaptation to locally suitable raw materials (Goodwin and Van Riet Lowe 1929:150).

SECTION I

CONTEXT

"We cannot understand the character of the life world unless we understand the social systems that shape it, and we cannot understand social systems unless we see how they arise out of activities of social agents" (Bernstein 1985:22 on Habermas).

"There are ... some alternative concepts of culture to the systemic one, and alternative concepts of the relation between style and the social group. For example, there is the view of culture as a constitutive process, as a 'series of productive and individual acts aimed towards the construction of meaning' (Dougherty and Fernandez 1981:415). Social action is constitutive (eg. Giddens 1979), just as culture is always 'in production'. ... 'cultures do not exist but are always in the process of formation' (Drummond 1981:638). From this, it follows that material culture itself is an active, productive, social force (Csikszentmihalyi and Rochberg-Halton 1981; Williams 1985; Wolff 1981)" (as quoted by Conkey 1989:129).

within which faunal exploitation could be made by the communities under study.

I then move on to a Third Section where I present the data pertinent to this study. I discuss the human behavioural patterns that can be deduced from the material remains. My theoretical concern with the space and time dichotomy in society, dictates that I discuss successive levels and their concomitant cultural material as units. Chapters Six to Nine thus deal with the artifactual material and its spatial articulation in each level. I discuss, for each level, specific features such as hearths, pits etc., as well as the excavated artifactual material like stone material, bone residue, worked bone and ostrich egg shell. Special attention is given to the spatial configuration of these residues of human behaviour.

The Fourth and last Section (Chapters Ten and Eleven) presents the conclusions of the dissertation. I provide a chronological perspective on the successive levels and thus address the issue of change over time (Chapter Ten). I also assess the usefulness of my approach and propose some further avenues of research in Chapter Eleven.

PREFACE

This dissertation forms part of a broader research project into Pleistocene and Holocene human habitation in the eastern Orange Free State (Wadley 1991). I focus on patterns of human occupation at Rose Cottage Cave during the late Pleistocene and early Holocene.

This dissertation is divided into four sections. The First Section, Chapters One to Three, provides the historical, theoretical and physical context of this study. In Chapter One I describe the debates and paradigmatic developments in southern African Stone Age research as they relate to the study of assemblages dating to the late Pleistocene and early Holocene. I thus situate this dissertation in a broader historical context. My specific theoretical approach developed in response to what I perceive as a lacuna in present research orientations. In Chapter Two I outline my theoretical approach and propose a model for the study of time related technological shifts. By describing the site and excavations in Chapter Three, I delineate the physical framework within which this dissertation operates.

In Section Two, I establish the parameters within which, on the one hand this dissertation functions (Chapter Four) and, on the other hand, the societies under study functioned (Chapter Five). I describe and assess the methods used in the analysis of the material from Rose Cottage Cave in Chapter Four. In Chapter Five the faunal material from Rose Cottage is used to reconstruct the paleo-environment and thus establishes the environmental parameters

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CHAPTER TWO

THEORETICAL APPROACH

The primary aim of this dissertation is to explain assemblages dating to the late Pleistocene and early Holocene. The untangling of the extremely complex stratigraphy of a large site such as Rose Cottage Cave (excavated over a number of field seasons), demanded a rigorous engagement with the spatial configurations. Grappling with these issues over a long period brought about an heightened sensitivity to spatiality and led me to consider the usefulness of various theoretical perspectives outside of the normal ambit of archaeology. I have found some concepts used in literary theory especially insightful. By thinking of archaeological remains as analogous to text, it becomes possible to approach the study of past behaviour (and present research methodology) in terms of "reading" (Bapty and Yates 1990:15). By using concepts suggested by literary theory, I attempt to construct an analytical framework that deals concurrently with cultural representation (meaning) as well as production (social strategy). Because it provides insight into the simultaneous nature of meaning and social strategy, this approach is thus well-suited to the study of human society.

The derivation of meaning through the study of the articulation of material culture in space and time lies at the core of archaeological research, and I will pursue my theoretical discussion in terms of these central tenets of archaeology.

Notwithstanding the new approach I propose to follow, I recognise that as useful as new concepts are in revising the way we conceptualize old issues and in opening up new arenas of inquiry, no body of work functions in a vacuum.

"The scholarly enterprise is by its very nature a collective enterprise. ... All theories, analyses, interpretations, can be evaluated only against their specific background. This means ... that the merit of analytical concepts are determined by ... the value they add to the already existing body of scholarship. Concepts become useful to the extent that they allow us to explore new avenues of investigations, offer innovative and exciting insights and shed fresh light on old problems." (Greenstein 1994:9)

Although not taking on board all the implications of the new paradigm, the impact of this debate was felt early on in South Africa. In 1985, Lewis-Williams appealed to southern African archaeologists to adopt a new theoretical framework that would include the investigation of both techno-economic as well as the socio-ideological aspects of prehistoric society (Lewis-Williams 1985). A number of southern African Stone Age and Rock Art research projects of the 1980s can be considered to fall under the rubric of 'social archaeology' (Campbell 1986; Deacon, J 1986, 1988; Wadley 1987, 1989; Mazel 1988, 1989a, 1989b; Solomon 1989; Hall 1990). Though not dealing with assemblages dated to the late Pleistocene/ early Holocene boundary, these works sought new approaches and had an impact on how we can view this period.

In this dissertation I respond to the challenge to link the archaeological record to the internal workings (socio-ideological aspects) of prehistoric society. I employ a post-processual analytical approach, and draw upon principles and concepts that are derived from the ambit of critical theory, that is a body of theory informed by critical engagement with the central tenets of post-modernism and post-structuralism.

new databases are in furthering our understanding of the prehistoric record, significant advances in our comprehension of past life ways are brought about by paradigm shifts. By changing paradigmatic allegiances, archaeologists assume new premises and new aims. These 'changing viewpoints' open up many fruitful research strategies in the discipline.

For the past ten years, the international archaeological community has been engaged in intense review of the basic tenets of archaeology. Emanating mainly from the Cambridge 'school' of archaeologists, a paradigmatic and epistemological challenge has been mounted against the positivist nature of archaeology-as-science. Archaeology functions within a double hermeneutic — on the one hand, Western science with its concomitant emphasis on hypothesis testing, generation of general laws and a belief in the independence of data and theory, and, on the other hand, the humanities and social sciences with an emphasis on historical and cultural specificity in the creation of symbolic meaning (Hodder 1992:11-12). The post-structuralist school criticised archaeological practice *inter alia* for emphasising the establishment of deterministic links from the material world to the non-material world, and pointed to the fact that a positivist approach could not adequately deal with the arbitrary nature of signs (and the coupled creation of meaning) in human society (Hodder 1992:83). By using theoretical insights derived mainly from continental theorists, new conceptual frameworks and new arenas of debates were explored (Bapty and Yates 1990:1-2).

The debate between the Deacons and Parkington raises crucial questions:

- Can material culture be viewed as containing information other than functionally-related activities?
- If this is the case, as is implicitly suggested in the Deacon's work, the question still remains, how do we gain access to this socially determined information?
- In interpreting change, does it always occur as an adaptive response?
- How does the nature of deep sequence cave deposits determine what we recognise?

At bottom level, the shared epistemology and theoretical framework of the Deacons and Parkington, inhibits the posing of these kinds of questions in relation to their debate.

While the data presented in this study contribute material pertinent to the debate over continuous change as opposed to homeostatic plateau, this dissertation seeks to open up avenues to the latter questions.

New evidence of assemblages dated to this period is important to augment existing knowledge. However, I would suggest that scholarship on the late Pleistocene/ early Holocene cannot be advanced within present parameters. The debate has reached an impasse and only by changing the accepted conventions of how we view the archaeological record, do we have the possibility of advancing the state of our knowledge of this period. As valuable as

expressions (Parkington 1972). The Robberg technology was 'practised' when groups, whose main focus of settlement was the interior plateau, moved into areas without the familiar interior hornfels raw material. With the onset of the Holocene, climatic conditions on the inland plateau worsened and settlement focus shifted to the (at the time) more attractive mountainous regions. The Albany technological industry then evolved through an adaptation to locally available raw material, as well as an adaptation to the change in the hunting pattern from large, migratory grazers to smaller and territorial *bovidae* (Parkington 1984:131).

Several studies of assemblages dating to the late Pleistocene/ early Holocene boundary have also made valuable contribution to our knowledge base of this period: for example in the eastern, northern and central Transvaal (Beaumont 1973, 1978; Louw 1969; Mason and Steele 1988; Plug 1978, 1981; Wadley 1986, 1987, 1991, 1992, 1993), Swaziland (Barham 1989), Natal/Kwa-Zulu (Kaplan 1989, 1990), Orange Free State and Lesotho (Carter *et al* 1988; Mitchell 1994), Karoo (Sampson 1985, Bousman 1989) the Cape Drakensberg (Opperman 1978; 1984) and the Northern Cape (Humphreys and Thackeray, A 1983; Thackeray 1981). We now know that assemblages dated to the late Pleistocene/ early Holocene boundary occurred over most of southern Africa and are 'characterised', on quick visual inspection, by the occurrence of 'large' tools, especially side-struck flakes. But the central debate of whether the occupations dated to this period exhibit a 'plateau of adaptation' or 'continuous change *par excellence*', has not been resolved.

potentials brought about by environmental and demographic conditions (In Mazel 1989b; 1987). Parkington proposed activity variation as the essential factor in assemblage formation. Artefact variation, he argued, could be accounted for by investigating the seasonal mobility of Late Stone Age hunter-gatherers through the study of the resource possibilities of different ecological zones (Parkington 1979, 1980, 1989).

A major thrust of Parkington's criticism centred around the proposed Albany 'plateau' in the late Pleistocene and/or early Holocene. By pointing to the disjointed nature of cave deposits and thus dates, changes in raw material and stone tool frequencies, as well as the changing environmental conditions in this period, he suggested this occupation in this period reflected continuous change *par excellence* (Parkington 1980:81-82).

In a 1984 publication, Parkington suggested that the (at that stage) open-air and therefore undated, Lockshoek assemblages should be viewed as contemporaneous with the ephemeral Robberg assemblages of the mountains. He pointed to the scarce, but widespread occurrence of naturally-backed knives (previously called D-shaped scrapers) in assemblages classified as Robberg and Albany. Although not denying the evidence for "... evolution of new and better toolmaking practices ..." (1984:80), he favoured an explanation that suggested that the Robberg technology was the result of expedient tool manufacturing — a point underpinned by his thesis that stone assemblages should be viewed as local adaptive

Post-innovative changes were seen as the results of social and demographic adjustments to regional environmental change. Through their research in the eastern Cape the Deacons (HJ Deacon 1972, 1976; J Deacon 1978) and Richard Klein (1984), had recognised the existence of a Later Stone Age technology pre-dating the Oakhurst. This industry was characterised by bladelet manufacturing and was termed the Robberg. As evidence for the occurrence of this industry accumulated (Beaumont 1981; Schweitzer and Wilson 1978, 1982), it became clear that the Robberg had a very limited geographical distribution, with the assemblages confined to the mountainous and coastal ecotones.

Although their research was primarily focused on the eastern Cape, by the early 1980s, the work of the Deacons and associated researchers resulted in the emergence of a model of the South African Late Stone Age. This perspective held that Late Stone Age technological changes could best be explained in terms of three successive homeostatic plateaus of adaptation — the Robberg (late Pleistocene), the Albany (Pleistocene-Holocene boundary) and the Wilton (Holocene).

This model was criticised by Parkington (1980, 1984; in Mazel 1989b) who felt that the recognition of cultural units was more of a hindrance than a help in the study of prehistoric human life ways (1984:132). Parkington questioned the punctuated equilibrium model and considered the Later Stone Age record to exhibited more or less continuous change as people responded to changing resource

groups with large territorial ranges, low population density and the absence of fixed boundaries (Deacon, HJ 1976:163).

By incorporating research work from other sites, a number of successive stone Industries dating to the late Pleistocene and Holocene were recognised. Their occurrence was explained in terms of a biological systems model called punctuated equilibrium. Periods of relative economic stability (stasis) were displaced by intervals of accelerated change; these periods of quickened change reflected adaptive responses to a changing environment and resulted in new technological industries (Deacon, HJ 1976; 1979; Deacon, HJ and Brooker 1976).

In her analysis of Nelson Bay Cave, Kangara and Boomplaas, J Deacon combined a model developed earlier of cultural ontogeny (1972), with the model of punctuated equilibrium. She extended the evolutionary biological concepts 'adaptation' and 'selection' to the archaeological record and, emphasising the significance of development through time, introduced the explanatory principles of innovative and post-innovative change (Deacon J 1978; 1984b). Innovative change was seen as the introduction of new items — or the new combinations of old items — into the archaeological record; post-innovative change described adjustments in artefact style and frequency. Although she initially proposed that innovative changes were caused by major environmental shifts (1978), she later favoured an explanation in which innovative changes were understood to have an evolutionary momentum of their own (1984b).

important, but only a first step in increasing our knowledge of past behaviour. In an attempt to establish causal relationships between prehistoric environment and life ways, many archaeologists shifted their research focus from stone-tool technology to other components of the archaeological record. An intellectual climate in which archaeology was viewed as a science in the Popperian hypothetico-deductive model (derived from Hempel), became the norm (Mazel 1989b). Archaeological research interest shifted to studies and concepts relating to adaptive strategies such as, the prehistoric environment, settlement patterns, systems theory etc. Culture was viewed as a set of adaptive strategies and, given the positivist nature of the Popperian model, adaptive strategies were often seen as determinant of human behavior (Trigger 1980).

Working within this paradigmatic framework, the study of Quaternary environments and human adaptation in a temporal framework, was the central focus of the influential research done by HJ Deacon and J Deacon in the eastern Cape.

In his research project "The prehistory of the Eastern Cape region", HJ Deacon gave special attention to the extraction and analysis of plant and animal remains. Excavations at Melkhoutboom and Boomplaas caves revealed deep and well-preserved deposits. Occupations dated to the upper and terminal Pleistocene were ascribed to life ways that were adapted to the hunting of large herd animals. The concomitant social organisation entailed large local

concavo-convex scrapers (now called circular scrapers), naturally-backed knives and large, broad platform side-struck flakes, three distinct but related industries were identified within the Oakhurst Industrial Complex:

- a southern Cape coastal industry named Oakhurst;
- an industry on the central plateau (primarily open-site), as well as in the south-eastern and northern inland, named Lockshoek; and
- the Pomongwe industry in Zimbabwe and north-eastern Botswana.

The old Smithfield A culture was now subsumed under the Lockshoek industry. Only industries that were considered to post-date the Wilton (that is Smithfield B,C and a Natal variant, N) were classified under the Smithfield Industrial Complex.

The above schema was a significant improvement in southern African Stone Age nomenclature and incorporated the important diachronic implications of J Deacon's work at Wilton Cave (1972). It answered the called-for need (Inskeep 1967) to define and circumscribe the use of terms, and provided a broad cultural-historical classification schema. But, although it expanded our understanding of the prehistoric past, it remained mainly descriptive.

It was becoming clear to archaeologists that the development of better and more refined cultural-historical sequences, was an

The chronological relationship between the Smithfield variants and the Smithfield and Wilton remained unclear. Although excavations at Oakhurst (Goodwin 1938; Schrire 1962), Matjesriver (Louw 1960) and Glentyre (excavated by Goodwin in the 1930s; published by Fagan 1960) provided evidence for a chronological relationship between the Smithfield variants and the Smithfield and Wilton cultures, this avenue of research was not fully explored until the late 1960s.

Armed with the radio-carbon dating technique, as well as nomenclature standards from the Burg Wartenstein Conference of 1965, Sampson set about establishing the temporal relationship of assemblages in the Middle Orange River basin of the Northern Cape (Clark, JD *et al* 1968; Sampson 1967a; 1967b; 1967c; 1970; 1972). This work culminated in his 1974 publication *The Stone Age Archaeology of Southern Africa*. In this publication Sampson proposed a new classification schema for the Southern African Stone Age based on the research of the previous fifty years. He divided the Later Stone Age into four Industrial Complexes: Oakhurst, Wilton, Smithfield and a miscellaneous category, Strandloper for "any non-Wilton assemblage from a coastal shell midden that postdates the Oakhurst complex" (Sampson 1974:405).

The Oakhurst was seen as the oldest Later Stone Age Industrial Complex and dated to the terminal Pleistocene and early Holocene (Sampson 1974:275-277). Based on a shared technology of

the densest concentration of bone, over 9kg of bone was recovered from only nine squares. Dates of $8\ 614 \pm 40$ BP and 9250 ± 70 BP have been obtained from charcoal samples in H. The H floor was divided, on the horizontal plane, by a big block of sandstone.

Although the deposit on the eastern side of the sandstone block, was a slightly different colour and produced a slightly older date than the deposit on the western side, the stone material is similar to the rest of the H level. The bone preservation, though, was of a poorer quality in the eastern area.

Above the H level was level CM which varied in colour from a lighter grey to orange-brown. This level was especially rich in stone material but the bone preservation was only moderate (see Figure 21).

Above CM, the Ph deposit was black in colour with interspersed calcrete washes. It had a soft texture — the consistency of dried and decomposed cork, and was rich in charcoal and bone. In the section drawings a clear slant over 4m is apparent; the width of Ph varies from approximately 100mm at its thinnest to over 210mm in some areas (for section drawing see Figure 4 and plan drawing Figure 26).

The Ja level was an orange colour and was, in patches, extremely hard. The bone preservation in Ja was not good, and a calcrete growth is visible on a number of the stone material. The Ja level appeared to have been leached (alternatively moistened and dried a

deposit and further complicated stratigraphical relationships between deposit on the eastern and western side of the excavation. Within the natural stratigraphy, levels were subdivided into spits of known volume. Figure 7 presents the volume counts for the squares of each level. As can be seen in the figure, the volume of deposit between levels, as well as between squares within a level, varies considerably. Deposit was generated differentially across space during occupation. Post-depositional factors also affected different areas at different rates.

The recent dates available from Rose Cottage were published by Wadley and Vogel in 1991 (Table 1). The sequence of dates from the new excavations follows the stratigraphical sequence. The dates cluster in related units with some clear hiatuses between units.

Levels LB, DB and DCM contained a Later Stone Age Industry related to the Robberg of the Cape (Wadley 1993). Two dates of $12\ 690 \pm 120$ BP and $13\ 360 \pm 160$ BP have been obtained for DB. DCM was a dark grey-brown level, and is undated.

Levels H, CM, Ph and Ja contained Oakhurst Industry assemblages. Level H did not extend over the whole excavation, but was restricted to the northern section of the excavation (see Figure 10). It was a dark black level with soft deposit and occurs at a depth of 700mm below surface in the Q4 square and 850mm in square N4. The thickness of the level varies between 100 – 150mm and slopes from east to west. H is the level at Rose Cottage Cave with

restricted to entrances on the west and the east. Although there is only a skylight that provides illumination, the cave is north-facing and receives extensive sunlight in the winter.

Given the deep sequence of deposit, the cave has attracted a number of researchers. The present excavation programme by Wadley (1991; 1992; 1993; Wadley and Harper 1989) follows two previous excavations at Rose Cottage (Malan 1952, Beaumont 1978).

Time depth

At present, a number of industries have been identified from the Rose Cottage deposits (Wadley 1991; Harper 1994) and I shall briefly discuss the stratigraphical relationship and associated dates of the levels.

Figures 3, 4, 5, and 6 illustrates the location of the section drawings as well as the north, south, and square L5 section drawings. As can be seen from the drawings, the stratigraphical inter-relationship is complex. Some levels vary internally from a width of 500mm to less than 50mm. In some areas it is clear that in the process of depositing of some of the levels, deposit from previous levels was removed; the stratigraphical sequence would not have been understood if the levels were not excavated on a broad spatial basis. A big sandstone block that fell into the deposit at the H level boundary with the LB and DB levels, depressed the

CHAPTER THREE

"THE ARCHAEOLOGICAL TEXT": OUTLINE OF SITE AND EXCAVATION

Spatial location

Rose Cottage Cave is situated in the foothills of the Drakensberg about 3km east of Ladybrand, Orange Free State, and 10km southwest of Maseru, Lesotho, on a range called Platberg (coordinate: 29.13S, 27.28E; altitude: 1 676m) (Figure 1). It is an extensive single cave, approximately 20m by 8m. It was formed in the Clarens sandstone matrix through the dislodging, by differential erosion, of a large boulder along a master joint or joint-intersection (Butzer and Vogel 1979) (Figure 2). A paleo-springbed is situated some 400m from the cave and would have been generated during rainy periods. The Caledon river is approximately 6km away and would have provided a perennial water source. The Caledon river valley has also functioned as a receptacle for materials that were eroded out of the surrounding foothills and mountains; opaline and tuffaceous material have a common origin in the basalt lavas of the surrounding Drakensberg mountains.

The large boulder that resulted in the formation of the cave, now encloses the front of the cave. It has acted as a bank in shoring up the deposit with the result that Rose Cottage provides a deposit of nearly 7m. The presence of the boulder has prevented the development of a large talus slope, but some eroded talus deposit is visible in front of the eastern entrance. Access to the cave is

arbitrary (Hodder 1992:14-15; 161-162). The meaning invoked in one context refers to meanings invoked in other contexts. By a close, recursive study of the context we are able to analyse the meaning as well as the strategic intentions of the social actors. In this process we move back and forth from broad generalisations to narrow non-arbitrary contexts.

Archaeology has, of all the social sciences, a special perspective on the time depth of human society. We are in a unique position to provide insight into the historical development of meaning.

Archaeological deposits can be analysed to provide "snapshots" of the various developmental stages of meaning — the consecutive nature of archaeological deposits must not be confused with continuity. The chronological sequence of occupation provides insight into the historical aspect of context and, by excavating on a broad spatial scale, consideration is given to the articulation of space, material culture and meaning. The key to such an analysis lies in the recognition that space and time function in tandem. The one informs the other and their functioning in the creation of meaning can therefore not be understood in isolation (Massey 1992:83).

By approaching the archaeological material through the theoretical approach outlined above, I hope to achieve the stated primary aim of this dissertation: an explanation of the temporal and spatial patterning in the late Pleistocene and early Holocene at Rose Cottage Cave.

operating in that society and is always temporarily and spatially contingent.

Meaning is thus not singular and immutable and can be seen to be in a continual state of flux^a, that is, changing over time. It can be said that the hegemony of meaning is continually undermined through internal contestation by social, economic, gender and other power relations. Not only is there always a host of alternative actions available, but the meaning of a specific action is often contested. The recognition of these contestations of meaning is not simple as power relations do not and cannot exist "outside" or "behind" the dominant ideology (Moore 1986:194-196)^b — social existence is very seldom self conscious. To investigate the contestation of meaning we need to develop a theoretical understanding of the relationship between cultural values and beliefs (meanings), and their forms of representation (Bourdieu 1977; Moore 1986:75-77).

In the section on material culture I outlined some of the archaeological routes that can be followed. It is, however, important to realise that a further key to the formulation of this theory lies in the contingent nature of meaning. Because meaning is chronologically and spatially contingent, it is not completely

^aIn some instances the parameters within which meaning fluctuates can be so narrow that, for all practical purposes, no difference in meaning can be identified. However, I consider it important not to lose sight of the theoretical implications of viewing meaning as constantly shifting.

^bThere is no existence outside of the 'lived' conditions of social reality which is in turn constituted by the dominant ideology (Giddens 1979:187).

The notion of a base spatial text allows a working model to be developed in which the spatial configurations of a level can be analysed as though they are contemporaneous. Moving through space creates a continual dialogue between any group of occupiers and the physical and human text with which they interact, and — in line with the metaphor model — this dialogue then in turn informs and creates a new text, and change is affected.

Time

In the above view of space, the crucial role of social agency in the production of meaning in society is allowed for. This applies equally to the third tenet, that of time. Social practices are not the mechanistical following of rules (Bourdieu 1977:72) but the result of applying a 'system of meaning' to a particular situation. Meaning is only achieved through practice, by the active movement in and through space. At the same time at which a particular meaning is actualised, an emergent meaning is also conferred (Moore 1986:84). Hodder (1992:14-15) uses the equation of: $T = T-1$, where T = meaning at the time of and spatial point T , and 1 = previous meanings*. The meaning of an object (and/or action) is always partly dependent on previous uses and meaning. This results in the context simultaneously conferring and deriving meaning from action. The specific system of meaning of a society (the cognitive and motivating structures) is visible in the social classifications

*Following more correct algebraic principles the equation can be written as: $T_1 = T_0 \cdot A$; where T_0 = meaning at time of and spatial point T_0 , and A = previous meaning.

The archaeological 'text' (that is, the material remains and their spatial patterning as excavated by the archaeologist) was produced through a three-way interplay between physical environment, the visible spatial arrangements set up by previous occupation and the contingent decisions of the successive groups occupying the space. The geological and morphological conditions of a site are an important part of the archaeological record (see also Deacon, J 1988; Parkington 1989). In a cave, the restraints of the physical cave conditions such as limited space, availability of sunlight, dry areas, boulders, sloping walls and so), should not only be viewed as negative physical impositions on the occupation of the cave. These conditions provided a 'base' spatial text onto which the occupants of the cave could elaborate and write their own spatial text. It is important to understand the cultural utilisation and values around these very tangible elements in the archaeological deposit. Most of these elements remain physically unchanged for long periods and can thus provide a stable point of reference in long sequence occupation.

In long sequence occupation caves* the 'base' spatial text was further informed by previous occupation. The remains of previous occupation would have been visible at each renewed occupation. The 'visibility' of previous material and spatial arrangements such as hearths, pits, dumping areas and other activity areas, would have influenced and constrained the spatial organisation and creation of meaning.

*This argument can be applied to all archaeological sites.

reproduction of the social order" (1986:89). She uses the functioning of metaphor in language as an analogue to illustrate the functioning of space in society. By using a metaphorical model Moore is able to draw together, in a single analytical framework, the study of both the affective, meaning component of space, as well as the active, processual aspect of space^a. Space can then be viewed as being simultaneously the product of activities (history) as well as determinant of activities (future). Space is thus not seen as static and only reflective of underlying societal cognitive concepts, but as an active participant in shaping the day-to-day choices made by individuals — individuals that ultimately constitute society.

Archaeology has not yet developed the methodological principles for correlating the formation of archaeological layers to length, intensity, extent, and so on, of occupation periods. The identification of separate depositional layers is standard archaeological excavation practice, but do we understand the meaning of these levels in terms of active human strategy? At the most basic level, we do not know whether an archaeologically-identified level represents a single occupation episode, a number of repeated visits or a natural occurrence.

^aThe creative aspect of metaphor rests on an internal tension between predictive potential and constraining reference. Past meanings set the constraining parameters within which a metaphor functions, and, in the act of employing a metaphor, the future is determined and given shape by these selective meanings (Hamilton 1993:87). The historical reference of a metaphor results in it having, simultaneously, a predictive and a constraining role.

are considered simultaneously and the trap of considering functional expediency and cultural form in a dichotomised way is avoided. Similarly, when hunting and slaughtering decisions are assessed, socio-ideological considerations cannot be divorced from the apparent 'technical' or utilitarian decisions.

The above discussion is limited to a few examples, but the approach can be extended to all archaeological material that was deposited through human intervention. While it is important to consider the techno-economic role of material culture, the full complexity of past life will only be understood when the role of material culture within social relationships is developed more fully. Only then will we begin to comprehend the complex constitutive role of material culture.

Space

Like material culture, the second major tenet of archaeology — space — can be analysed as the result of activities (reflecting socially-determined behaviour), and it can be viewed as an active participant in creating and informing social activities. To arrive at a better understanding of the complexity of spatial behaviour in society, the concepts of spatial dialogue and metaphor prove to be a stimulus for the development of new approaches.

In her study of the utilisation of space by the Marakwet, Moore views space as an "active instrument in the production and

we can begin to look for explanation in archaeological patterning beyond purely utilitarian, economic practices.

For example, stone tools can be viewed as having been manufactured to fulfil certain economic tasks. But, while not detracting from the techno-economic function of these tools, tools can also be seen to take on the role of material culture signifiers of certain social relationships (Conkey 1980:609-630; Wadley 1987, 1989:42-53; Hall & Binneman 1987:140-152). By analysing the features of stone tool assemblages as not only related to the technical reduction strategies of manufacturing or the extractive functions of the tools, one can come to understand the intentions and meanings pertaining to the more socio-ideological aspects of society. Traditionally features that function in the socio-ideological realm have been viewed as functioning completely separately from the more techno-economic (ie. manufacturing or extractive considerations); features such as choice of type or colour and translucency of the raw material, or the choice of specific tooltypes to be manufactured on older stone tools. However, in most instances, features that function on the socio-ideological level cannot be separated from the techno-economic; the colour of stone material could be altered through heating, but the knapping ability was also enhanced. The choice of specific tool types for utilisation was a technical decision, but could also carry social considerations. When summary statistics provide assessments of the structure of stone assemblages in terms of richness and evenness composition, the technical and social considerations that effected the assemblage

Material culture

In our study of past societies, the configuration of material culture in space and time has been viewed as reflective of underlying societal concepts. While acknowledging the reflective aspect of material culture, I seek also to consider the active, constitutive role of material culture.

Material culture is one of the constitutive forces of society — those acts aimed at the construction of meaning in society. Put in more individualistic terms, "the self is inseparable from the sign^a process that constitute(s) consciousness" (Csikszentmihalyi and Rochenberg-Halton 1981:15). Material culture needs to be studied not only as reflecting cultural values and norms but also as actively participating in the creation of these values and norms. A framework of analysis that views archaeological patterning as simply reflective of societal norms and actions, resulted in an erroneous dichotomy between cultural form and functional expediency^b and has placed the emphasis in archaeological explanation on the adaptive and technical aspects of material culture (re unresolved debates over isochrestic and iconic style (Wobst 1977; Wiessner 1984, 1985, 1989; Sackett 1982, 1985, 1986a, 1986b; Binford 1986). By accepting that material culture plays an important role in the construction of meaning in a society,

^aThe word 'sign' is used here in a broader sense than the semiotic meaning of representation. It is used in this instance for any information that has enough coherency to evoke a consistent image or label. It thus includes objects.

^bHodder links this dichotomy to a Western philosophical distinction between materialism and idealism (1982: 83-85, 147-148).

premise that when choices concerning the transport of butchered elements have to be made, skeletal elements with a high GUI value will have a greater chance of being chosen. This regularity should be archaeologically visible.

However, butchering seldom reduces the skeleton to discrete skeletal parts. In practice, animals are butchered into sets of elements, such as fore shoulder or hind limb etc. In such units, elements with a low GUI values (for example, carpals and tarsals) are close physically to elements with a high GUI value. The probability of these elements being transported is therefore linked to their relative position within the skeleton. To take this skeletal complexity into consideration, the Modified General Utility Index (MGUI) was developed.

Meat Utility Index	→ Modified Utility Index	→ Modified <u>General</u> Utility Index
Marrow Index		
White Grease Index		

The above index provided archaeozoologists with a quantifiable framework in their analyses of animal butchering practices. By plotting the relative frequencies of the skeletal elements against their MGUI values on an XY frequency plot, a number of curves can be observed (Figure 8). The shape of these curves can then be interpreted as indicative of different human utilisation strategies. I

Fire-affected bones

The parameters for the identification of fire-affected bones were established by Brain and Sillen in their 1988 article. A sample of bone identified as fire affected was taken to the Transvaal Museum and its identification as fire-affected confirmed by Plug. The Brain and Sillen parameters were strictly followed and the margin of error would lie on the conservative side.

Food utility and density values

In order to exploit the interpretive value of skeletal material fully, it was decided to calculate bone density and food utility values for all the material from Rose Cottage Cave. By using this technique we can study some of the decisions around butchering practices. This can contribute to a better understanding of hunting strategies, and, ultimately some of the social strategies during site occupation. As advocated in chapters One and Two, the false separation between adaptive and social strategies is thus avoided.

In his work on the Nunamuit, Binford proposed three behavioural strategies in relation to the butchering, transport and disposal of *artiodactyla* skeletons (1978:81,111).

To arrive at this model, Binford attributed to each skeletal part a value expressing its potential economic yield (food value). This 'food' value is calculated on the meat, fat and marrow contained around and/or within each identifiable skeletal part and is known as the General Utility Index (GUI). The model was developed on the

reconstruction of paleo-environments. The mere presence of these animals is indicative of specific environmental conditions or social practices.

It is not, however, adequate to note only the presence or absence of species or combination of species when one is trying to reconstruct paleo-environments. Valuable information on animal community structure can be gleaned by studying species abundance. The quantification of faunal samples from archaeological sites has become standard practice^{*}. I calculated the Number of Identified Species (NISP) and Minimum Number of Individuals (MNI) on procedures as laid down by the archaeozoology department at the Transvaal Museum (outlined in Plug 1988). I also calculated percentage Minimal Animal Units (%MAU) as proposed by Binford (1978). This calculation is the same as the Quantifiable Skeletal Parts (QSP) method described by De Wet (1993:19).

It is, of course, incorrect to assume a direct relationship between the faunal record and the paleo-environment. Klein cautions us not to assume that the species composition or frequency of species occurrence in the archaeological faunal deposit, directly reflects the once living faunal community (Klein 1979b:7). Although it will not be possible to reconstruct the exact nature of the paleo-environment, by using analysis such as the Mean Ungulate Biomass, some broad ecological inferences can be made.

^{*}Unfortunately, the quantification of archaeological faunal samples is fraught with problems (Casteel 1977, Turner 1983, Grayson 1984, Klein and Cruz-Uribe 1984, Plug 1988).

Heat-altered stone

The occurrence of heat-altered stone was also noted. As for the categories of utilised and re-worked, the frequency of specific tool types chosen for heat alteration and the spatial location of this material was seen as possibly indicative of social and technological strategies not accessible through an analysis of reductive strategy.

When highly siliceous stone is heated slowly, and at relatively low temperatures, it is easier to knap. Heat removes the interstitial water and thus the microcrystal structure of the stone is more closely aligned. The material is now "more like glass" and the generation of sharper edges is possible (Gregg and Grybush 1976:189). Heat-altered stone is recognised (through visual inspection) by an opaque change in the colour of the stone's surface. In some cases small concentric white circles mark the surface of the stone material. In cases where the heating was extreme or quick, small circular pieces of stone detach from the surface and leave cracked and scraggy negative depressions.

Bone material

Environmental reconstruction

When looking at a varying species composition over time, a quantitative as well as qualitative approach should be used. The change in occurrence of specific species (or combination of species), with distinct habitat requirements, is useful in the

of tiny chips, and these scars had to be spaced in a regular fashion. To avoid, as far as possible, the categorisation of trampling damage into utilisation, the above criteria were strictly enforced. The margin of error is thus on the conservative side. There could have been more stone material that was utilised and not recognised as such by me, but I am sure that the stone material I have classified as utilised, does indeed represent the 'minimum number' of utilised stone material.

Re-worked stone

Note was also taken of the frequencies of stone material at Rose Cottage Cave that displayed two distinct episodes of negative flake scarring. On this material, some of the flake scars were of a smoothed nature and had a different patina from the rest of the visibly 'fresh' scars. Technologically, the 'fresh' scars were also always manufactured over the older scars. Due to previous occupation at Rose Cottage or in the vicinity of the cave, older stone material was available*. This material was periodically picked up and re-worked. Stone material displaying these episodes of flake scarring were noted and classified as re-worked. Material that was of a visibly older technology, but not re-worked was classified as antique.

*At present, there is a considerable amount of Middle Stone Age artifacts that is being eroded out of the dongas and erosion platters in the vicinity of Rose Cottage Cave.

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categories with each other, and other aspects of the archaeological record, will receive special attention.

Raw material

Four categories of raw material were recognised: opaline, hornfels, tuffaceous rock and a category for rock that did not fall into any of the above classes. I decided that the difference between translucent and non-translucent opaline could be an emic category and decided to analyse for this category as well. During the classification of stone material, I subdivided the category of opaline material into translucent opaline and non-translucent opaline. This was a subjective division based on the amount of light shining through the edge of the stone material and would not pass any geological test! Although there is no difference in the structural properties of naturally differently coloured opaline material (Dr G. Cawthorn, Geological Survey, pers. comm.), there was, however, a clear visual difference in the appearance of these stone materials (see also discussion below of colour changes in heat-altered stone).

Utilisation

During the classification of stone material, note was taken of material that displayed utilisation. After identifying stone material with possible utilisation by visual inspection, material was checked under the microscope. Material was only considered to have been utilised if the 'damage' was of an extensive and regular^a nature. There had to be more than three negative scars from the dislodging

^aCareful consideration was given not to confuse this with retouch!

Stone material

Typology

The stone assemblage was classified using the typology developed by J Deacon (1982). Using the concept of a reduction sequence, this typology was developed to understand broad technological changes over time. For the purposes of the Rose Cottage programme, the reduction sequence categories were followed but adapted. The amendments are reflected in Appendix 1. I realise this technologically informed typology might not be the most appropriate classification schema and, given the social intent of this dissertation, might be seen to be contrary to my stated aims. However, the development of a whole new classification schema falls outside the ambit of a dissertation of this nature and I have decided to retain the present standard typology. A number of additional categories that do not necessarily pertain to reductive strategies, were added (see discussion below on heat altered, re-worked etc. stone material).

For the purposes of this dissertation, stone artifacts are defined as all stone material that was deposited in the cave through human intervention. The stone assemblage is broadly divided into the material produced in the first stage of knapping (from now on referred to as non-formal material), that is, debris (chips and chunks), cores, flake-blades and flakes; and the second stage of knapping that is, material with secondary knapping (from now on referred to as formal material). The articulation of these two broad

CHAPTER FOUR

METHODOLOGY

As is well known, one of the most essential instruments in the excavation of archaeological material is a sieve, and the size of the sieve mesh determines an excavation yield. During the analysis of the material excavated from Rose Cottage Cave I was struck by the image of 'sifting' data through 'sieves' of different mesh sizes. Every conceptual framework, analytical technique and statistical calculation can be seen as a mesh onto which one places the 'deposit', or data. One 'shakes' and manipulates these techniques in an effort to detect some of the human behaviour that lies in the 'deposited' data. Sometimes one recognises the network of past human action in one's 'sieves'. But quite often, one wonders if one is not just staring at an aureole created by the overlay of the various meshes.

Before I discuss the artifactual material excavated from Rose Cottage Cave, I will outline a few methodological principles. The principles and procedures outlined here apply to material from all the levels.

SECTION II

PARAMETERS

The uppermost level, Mn, consisted of a hard, compacted deposit. Bone preservation was good and a few seeds were also recovered. Pottery was present.

Soft surface material was removed at the top of the cave floor. It contained Stone Age and European material (Behrens 1992).

number of times). A sublevel JaG, dated to $8\,380 \pm 70$ BP, was identified, but seems to be of limited distribution. It was decided that this level is the same deposit as the Ja level, but had not been subjected to as much leaching (see Figure 31 for plandrawing).

Above the Ja level was a very dark and humus-like level — Pt. The deposit was soft, powdery and greasy. Pt was dated 5970 ± 70 BP and contained a classic Wilton assemblage (Wadley 1991).

The youngest levels A2, A and Mn contained post-classic Wilton assemblages. Levels A2 and A consisted of a softer reddish-brown deposit with excellent bone preservation. Approximately 15,5 kg of bone was excavated with over a thousand identifiable macro-mammalian fragments. A large number of amphibian and fish bones were also recovered. Level A, contains pottery as well as domesticated animal bone, and was dated to 680 ± 80 BP (Wadley 1992; Wadley and Vogel 1991). Level A2 also had pottery and domesticated animal bone but is not dated at present (there is no pottery in any of the levels below A2). Extensive rodent activity in level A, initially complicated the interpretation of the stratigraphy (see squares K3 and Q4).

altitudes with sweetveld at the end of the rainy season. These migrations would also have occurred in warmer, drier situations (Ellery *et al*, in prep).

Grassland ecosystems are characterised by the seasonally predictable variations in rainfall, nutrient availability, associated grazing availabilities, and fires (Ellery *et al*, in prep). These variations produce pulses of primary production* and hence food resources that are potentially rich but spatially and temporally variable. Intermittent rainfall and the concomitant pulses of nutrient flows produce the best quality grass. Areas in the grassland ecosystem with a low dry season temperature and high rainfall — such as Rose Cottage Cave at present — typically produce a short grass sward (McNaughton 1985:261).

Highly mobile, nomadic grazers are the most effective in exploiting the constantly shifting resource base. Studies done on grassland ecosystems have pointed to the interrelationship between moisture availability, forage quality dynamics, grassland carrying capacity, and the grazing behaviour of ungulates (McNaughton 1985:281-283).

The different energy requirements and different digestive strategies of each species constrains their feeding behaviour (Smithers 1983:578 and as discussed in Brink 1987:78-80). Large ruminants are better at extracting their energy and protein requirements from

*Primary production = dry plant biomass expressed in terms of kilogram per hectare.

Table 3 lists Minimum Number of Individuals (MNI) per species and the basis on which the MNI's were calculated.

I shall now describe the modern ecosystem and habitat requirements of the archaeologically observed faunal community at Rose Cottage Cave (as based on Smithers 1983, Lynch 1983, Leuthold 1977). Thereafter I shall discuss the implications of their varying presence on the reconstruction of the paleo-environment at Rose Cottage Cave.

Habitat requirements

(i) Grassland ecosystems

Rose Cottage Cave is situated in a low quality *Cymbopogon-Themedra* grassland (Acocks's Veld Type 48) which is considered to be reasonably sour grassland type (Acocks 1988:100-101). The distinction between sweetveld, mixed veld and sourveld is based on the ability of vegetation to sustain animal production over an annual cycle. Sweetveld sustains animal production for close to twelve months of the year, mixed veld between six and eleven months, and sourveld for less than six months (Tainton 1981). However, in the early part of the rainy season, sourveld is more productive than sweetveld, and then decreases sharply in productivity towards the end of the season. Sweetveld is not as productive as sourveld at the beginning of the rainy season but retains its productivity for longer. Historically this seasonal change in forage quality would have caused animal migrations onto sourveld in the early part of the rainy season and migration away from the sourveld to lower

ENVIRONMENTAL RECONSTRUCTION, BASED ON FAUNAL ANALYSIS

Introduction

Any attempt to explain the patterning in the faunal remains from Rose Cottage Cave, demands the untangling of the social decisions concerning faunal exploitation from the changing ecological parameters within which these decisions were based. The challenge lies in detecting deliberate human selection within the wider set of alternatives offered by changing environmental conditions.

The first step in the analysis will be the reconstruction of the paleo-environment. To understand the temporal variability brought about by environmental change, it is necessary to view the late Pleistocene and Holocene periods. The impact of the changing environment on the composition of ecological zones and the associated change in macromammalian diversity and abundance in the Rose Cottage area, will be analysed.

Environmental reconstruction

Fauna identified archaeologically

Table 2 lists the Number of Identified Skeletal Parts (NISP) of macromammals, birds and tortoises that were identified in each of the Late Pleistocene and Holocene levels at Rose Cottage Cave.

I have outlined the parameters within which the data from Rose Cottage will be analysed and now move on to a chapter discussing the environmental parameters within which the society under study functioned.

are contemporaneous, or if they were produced by repeated occupations. Archaeologists are, unfortunately, not yet able to provide a conclusive answer to this question. But, given my theoretical approach as outlined in Chapter Two, I will treat the archaeological patterning, within the parameters set by the identification of a level, as concurrent.

Much of the data is analysed spatially and appropriate statistical procedures had to be observed.

Following the work of Simek (1989:61) it was decided to look not only at the raw material frequencies of artifacts as they occur per square, but to calculate the difference between observed and expected frequencies. This is done by calculating an average frequency per square. If there is no patterning of artifacts all squares should, hypothetically, have the same number of artifacts. The difference between the archaeological occurrence (observed frequency) and the average occurrence (expected) is then calculated. For ease of visual inspection, I have calculated percentage values based on the positive values of the difference between observed and expected. Although all of the calculations done on a spatial basis were also calculated taking volume of deposit into account, it was decided that the differential volume of deposit is part of the spatial patterning and should therefore not be factored out.

comparison — between sites, and between levels — problematic. A small sample might, on visual inspection of frequency of classes, look like a less rich assemblage. However, when the sample size is factored into the equation, a totally different picture might emerge. To circumvent the above problem a number of richness indices have been developed (Bobrowsky and Ball 1989:5).

Evenness provides an assessment of the relative frequency of items in each class independent of sample size. The apportionment (equitability) of individuals amongst the classes can then be established. One can thus verify whether some classes contain more individual items (that is were more emphasised) than others.

Following the calculation of the above two indices the composite General Diversity Index (GDI) can be calculated taking into account both the number of classes present (richness) as well as the relative frequency of items within each class (evenness). One thus arrives at a single value that expresses the heterogeneity of the population or sample under study. Appendix Three explains the procedure followed in calculating the indices at Rose Cottage.

Spatial analysis

The detection of spatial patterns was an important objective of the research effort, and excavations were conducted on a broad spatial scale. It is impossible to determine whether the spatial configurations of a single level are the result of a single visit that is,

population (or sample), and the implicit claim is made that the analytically created classification units had 'real' meaning to the society under study (Jones and Leonard 1989:2; Rindos 1989:14). These indices are used to describe the archaeological phenomena, while at the same time characterising the socio-cultural situation that brought the phenomena about (Conkey 1989:126). As for all archaeological data, a clear understanding of the sample formation process is essential when diversity indices are employed.

The use of indices such as richness and evenness to assess diversity and community structure, has long been standard practice in ecological studies (Odum 1971:148-154). These techniques were first used in archaeology by archaeozoologists (Wing 1975:302-308, Grayson 1984; Avery, M 1982:183-374) but have also recently been expanded to the arena of lithic analysis (Leonard and Jones 1989).

In this dissertation I calculated richness, evenness and general diversity indices for both the lithic assemblages and faunal samples. Diversity is a composite value and it must be understood in terms of its two primary determinants — richness and evenness.

The richness index provides an insight into the number of classes under study; it expresses a value for the 'variety' aspect of the population (or sample of population). A simple measure of richness is a direct count of the different classes. As is well understood, class richness is linked to sample size and a direct tally thus makes

Stone and Bone

Diversity Indices

In order better to describe and assess the complexity of the patterning of cultural material, we have to use quantitative as well as qualitative appraisals. The calculation of indices should be seen as an empirical tool that can provide one with a clearer assessment of the role of material culture in constituting society.

These indices are used as referents for the structural properties of a population (or sample from a population) that was made up of distinct categories. One thus moves away from a qualitative and intuitive notion of the structure of the archaeological sample to a clearer understanding of the processes that govern the representation of different classes of phenomena in the archaeological record (Jones and Leonard 1989:2; Bobrowsky and Ball 1989:4). The classes into which the archaeological phenomena are arrayed, are of course — to a degree — arbitrary classification units created by the archaeologist (for example, pottery types, lithic classification systems, species of animals and so on). While the arbitrary nature of the classification systems are not disputed, the archaeological patterning we detect through these classification systems enables us to state that our categories do, to some extent, overlap with the categories as used and understood by the societies under study.

Thus, although the diversity indices use archaeologically determined classes, these indices are seen to characterise the structure of the

The FUI and density values are only available for North American species (Lyman 1984:276-279; Binford 1978 as reworked by Metcalfe and Jones 1988:492). It is recognised that applying these food and density values in an analysis of African *bovidae* could be problematic*. Unfortunately data for African *bovidae* are not available, and their calculation should become a matter of priority for African archaeozoologists. However, Grayson (1989:648) argued that, given the similar skeletal construction of terrestrial quadruped mammals he could apply the Binford MGUI values calculated on sheep to marmots! Klein (1989:377-379) and Klein and Cruz-Uribe also demonstrated (1989:87) the applicability of the American data to the African faunal material excavated at Klasies River mouth and Kasteelberg.

It was decided to apply the above techniques to the faunal material from Rose Cottage Cave. Following the work of Klein and Cruz-Uribe (1989) only the skeletal elements from *bovidae* were included in the analysis. Appendix Two details the procedure followed at Rose Cottage.

*See Lee Ann Kreutzer (1992) for discussion of the difference between bison and deer bone densities, due to differences in body size, distribution of weight and the resultant locomotion pattern. Given the different weight distribution in African *bovidae* (Sachs and Grzimek 1967), there could be differences in bone density between the African species.

statistical method for differentiating between assemblages that are (primarily) the result of transport decisions as opposed to assemblages that are (primarily) the result of bone destruction factors. Given that both differential bone density and differential human transport decisions produce negative hyperbolic relationships when plotted against skeletal abundance (see Figure 8 3b), Spearman rank order correlation coefficient tests can be used.

- In assemblages primarily produced by bone attritional factors the Spearman rank order correlation between skeletal abundance and density values should be significant and positive, while the correlation between skeletal abundance and FUI values should be not significant.
- In assemblages in which the occurrence of bone is primarily due to human transport decisions, the correlation between skeletal abundance and density should be not significant, while the correlation between skeletal abundance and FUI should then be significant and negative (see schematic representation below).

BONE DESTRUCTION		HUMAN TRANSPORT	
skeletal abundance	significant and positive	skeletal abundance	not significant
density		density	
skeletal abundance	not significant	skeletal abundance	significant and negative
food (FUI)		food (FUI)	

Following on the pioneering work by Brain in 1967, Lyman (1984 and 1985) published important data pertaining to differential bone density. He demonstrated that the probability of a bone's survival in archaeological deposit is strongly linked to the specific density of such bone. The least dense skeletal elements are often those elements with the highest food value (also see Brain 1981). An inverse utility curve can thus be produced due to bone attritional factors. Attributing human behavioural meaning (for example transport decisions) to such a curve, could therefore be misleading.

Metcalf and Jones (1988) proposed a simplified method of calculating the Modified General Utility Index (MGUI) and renamed it the Food Utility Index (FUI). They also pointed to the problems with individual and species variation in the calculation and application of the FUI. A further problem of applying the utility curves at multiple kill sites was thus discerned. The Binford model was developed based on data observed in the Nunamut society, people living in Arctic conditions. It became clear that the geographical location of a society (eg. arctic/alpine as opposed to desert/savannah) could have a determining influence on the evaluation of transport costs and manner, and thus ultimately on the production of the archaeological sample. It became evident that the archaeological application of the behavioral strategy model, as proposed by Binford, needed to be refined.

While not proposing solutions for all the problems associated with the density and food utility curves, Grayson in 1989 suggested a

now discuss unbiased, bulk and gourmet, as well as the inverse of bulk and gourmet utilisation strategies.

Hypothesised ideal model

a) Unbiased utilisation: each skeletal element is present in direct relationship to its food value (linear model $Y = a + bX$).

At consumption sites

a) Bulk utilisation: elements with moderate and high food values are present, elements with low food values are not present

($Y = a + b \log X$).

b) Gourmet utilisation: elements with high food values are present, elements with moderate or low food values are not present

($Y = aX^b$).

At kill/butchering sites

a) Inverse bulk utilisation: elements with moderate and high food values are absent, elements with low food values are present.

b) Inverse gourmet utilisation: elements with high food values are absent, elements with moderate or low food values are present.

By taking seasonal variation and sexual dimorphism into consideration the explanatory value of the above model was enlarged by Speth (1983). Thomas and Mayer (1983:353-389) applied the model to their analysis of the faunal remains of Gatecliff, Horizon Two and illustrated the importance of the monitoring perspective (that is the site under analysis, a consumption site or a kill/butchering site (see Figure 8 again)).

otter and water mongoose as well as the conclusions, based on the charcoal analysis, of a relatively dry climate during the occupation of these levels. A possible explanation may lie in the development of hunting strategies around waterbodies in relatively dry periods. There would be less freestanding water available during a dry period and water dependent species will be more concentrated around the few perennial waterbodies, thus being easy prey.

Ostrich has a wide environmental tolerance (Plug, pers. comm.) and their occurrence at Rose Cottage Cave cannot be used for the reconstruction of paleo-environments.

Quantitative data

In addition to the above qualitative data, information can also be gleaned from considering quantitative data.

(i) Community structure

In order to determine the extent of similarity in species community structure over time, pairwise Spearman rank-order correlation coefficients were calculated on the NISP of species identified per level (Table 6). With the exception of the Mn and Ph levels in the ungulate sample, the correlations for all the levels were significant and thus statistically valid. A pattern emerges of strong internal correlation between levels similarly dated. This was especially clear in the sample containing only ungulates. For example, the Mn level correlated 74 per cent, 65 per cent and 65 per cent with levels A, A2 and Pt respectively. In contrast with these strong correlations,

The presence of kudu, leopard and vervet monkey in the early-Holocene levels can be seen as indicative of an environment with greater woody cover. This is supported by the charcoal analysis from these levels indicating thicket taxa (Wadley *et al* 1992).

Both water mongoose and cape clawless otter occur in levels dated to the early and late Holocene and can be considered as indicative of relatively wet circumstances in these periods. There is at present a spring at the bottom of the Rose Cottage Cave hill that is only activated in a high rainfall year. To provide the habitat needed by water mongoose and cape clawless otter this spring must have been more substantial in the past. The perennial water-dependent otter could, of course, also have been procured in the nearby Caledon river.

As a further indication of wet and dry climatic fluctuations, Table 5 is provided. I distinguished between water-dependent and water-independent species. Some species live near water and/or need water regularly as opposed to species that live in dry areas and receive enough water from their food so as not to need a regular supply of water.

The dominant component is clearly species that can function in a dry environment, a reflection of the general Basutolian ecozone conditions. There is, however a relatively strong presence of species dependent on water in both the late-Pleistocene and mid-Holocene levels. This is in contradiction to the above mentioned presence of

As discussed above, the appearance of both *Hippotragus equinus* and *Connochaetes gnou* is linked to the relatively drier conditions in the mid Holocene. It is suggested that *Antidorcas bondi* and *Hippotragus leucopheus* preferred wetter conditions. Even though the grasslands could have been of a better quality (ie. sweetveld or mixed sweetveld and sourveld), drier conditions prevailed. In addition to the drier conditions, the new growth material that would have been preferred by *Antidorcas bondi* (Brink 1987:81), was now grazed by the migrating blue wildebeest.

As stated in Plug and Engela (1992:17), the majority of the extant fauna identified from the excavations at Rose Cottage Cave, survived in the Ladybrand region till recent historical times. There are, however a few species present in the archaeological deposit whose present-day distribution ranges do not include the south-eastern Free State (Du Plessis 1969; Lynch 1983; Smithers 1983). It is these species, with their very specific habitat preferences, that provide the most valuable information in reconstructing the paleo-environment.

Phacochoerus aethiopicus (warthog) was identified in most of the levels at Rose Cottage Cave. Although they did not historically occur in the Free State grasslands, Du Plessis (1968:62) mentions a reference to them in the south eastern Free State and their archaeological occurrence can be linked to optimal environmental conditions.

Of these, quagga and bluebuck are recent extinctions, whereas, at Rose Cottage Cave, the giant cape horse and giant hartebeest became extinct during the Pleistocene/Holocene boundary (Plug and Engela 1992:18). A date of 7 570 BP has been noted for Bond's springbuck in the southern Transvaal at Kruger Cave (Brown and Verhagen 1985).

An ecological interdependent grazing succession has been proposed for the extinct grassland fauna (Brink 1987:78-82). At Rose Cottage Cave the extinct grazing succession could have been as follows: *Equus capensis* (giant cape horse) as a coarse bulk feeder, which prepares the grassland for the intermediate feeder *Megalotragus priscus* (giant hartebeest) whose feeding and trampling in turn opened the way for the fresh grass grazers *Antidorcas bondi* (bond's springbuck) and possibly *Hippotragus leucophaeus* (bluebuck).

The compelling proposal by Brink that *Antidorcas bondi* was an exclusive grazer, can therefore be supported at Rose Cottage Cave (Brink 1987:78-80). *Antidorcas bondi* continued to exist after the extinction of the other species in the ancient grazing succession, and it must have slotted in to the grazing succession of the extant animals.

Hippotragus niger (roan antelope) and *Connochaetes taurinus* (blue wildebeest) appear in the faunal record at Rose Cottage Cave after the disappearance of *Antidorcas bondi* and *Hippotragus leucophaeus*.

species [black wildebeest] passes by itself into the Colony." (as quoted in Du Plessis 1969:232).

(See also migration pattern discussion in Von Richter 1971:38)

In the faunal record at Rose Cottage Cave black and blue wildebeest do not occur together until the uppermost level of the early Holocene, Ja (dating to $8\,380 \pm 70$ BP). The appearance of blue wildebeest is sudden and thereafter constant. Charcoal analysis has indicated that the mid-Holocene levels were formed during relatively warmer and drier conditions (Esterhuysen in prep) which would tend to favour the expansion of sweetveld grasslands (Ellery *et al*, in prep). The presence of blue wildebeest as well as other species discussed below, can be seen as evidence for the improved quality of grass.

The tentative identification of *Hippotragus cf. equinus* (roan antelope) in the mid-Holocene level, Pt, corresponds, likewise, to the indication from the charcoal analysis, of a warmer environment. Given their sensitive habitat selection (roan favour an open woodland), their presence in the mid Holocene can be seen as a further indication of better quality grass and/or expanding savannah vegetation.

Five extinct species were identified at Rose Cottage Cave, *Equus quagga* (quagga), *Hippotragus leucophaeus* (bluebuck), *Equus capensis* (giant cape horse), *Megalotragus priscus* (giant hartebeest) and *Antidorcas bondi* (Bond's springbuck).

highest carrying capacities of all southern African biomes (Rutherford and Westfall 1986).

When the prevalence of species occurring on grasslands as opposed to species that prefer a more bushy and/or shrubby environment is compared, there is a dominance (with the exception of the mid-Holocene Pt level) of species belonging to a grassland environment (Table 4). This dominance is even more evident in the list containing only ungulates. It is obvious that despite fluctuations in the environmental conditions, the main contributors to the ungulate component at Rose Cottage Cave were grazers.

The co-occurrence of *Connochaetes gnou* (black wildebeest) and *Connochaetes taurinus* (blue wildebeest) in the levels above Ph, is very interesting. Though Klein notes their presence in his discussion of the Basutolian ecozone, they do not co-occur in any of the Orange Free State and north-central Cape sites he analysed (Klein 1979a:114; 1979b:45). They typically occupy the same feeding niche and are presently spatially separated (Brink personal communication). A traveller to the Interior of South Africa noted in 1848 that:

"Both species of Gnu inhabit, during a certain period of the year, the extensive grassy plains which exist some considerable distance to the northwards of the Vaal River, and at another period a portion of each at least, advances to the southward to feed upon the vegetation which occurs in that direction after the fall of the summer rains. Both species advance simultaneously as far as the southern branches of the Orange River, but on reaching those, the species here figured [the blue wildebeest] ceases to advance, and the common

that ostrich occurred in the area of Rose Cottage Cave. Presently ostrich is limited to the bushveld areas of southern Africa (Roberts 1985:1).

Environmental implications

Qualitative data

The variability in the species and groups of species discussed above, can be used to some extent as indicators of changing environmental conditions at a site. As already stated in the methodology chapter, one cannot assume that the frequency of occurrence of the animals in the archaeological record reflects the actual (biocoenoses) species frequency or exact composition of the faunal communities. Given the changes in the faunal record over time at a single site one is, however, able to arrive at a general picture of the paleo-environment at the different periods of site occupation (Klein 1979b:7).

With one exception, *Cercopithecus aethiops* (vervet monkey), the species composition at Rose Cottage Cave falls within the range of species that constitutes the Basutolian ecozone as reconstructed by Klein (1984:109-116). Historically this ecozone was characterized by a vegetational homogeneity that resulted in a relatively low species diversity in the large mammal communities. Despite the low species diversity, the Basutolian ecozone supported the highest large mammal biomass in southern Africa (Klein 1984:118). Modern-day studies also point out that the grasslands have the

movement in the early summer onto the sour grassveld of the Drakensberg, has been reported previously (Vinnicombe 1976).

Sylvicapra grimmia (common duiker), *Oreotragus oreotragus* (klipspringer) and *Tragelaphus strepsiceros* (kudu) are exclusive browsers and will therefore avoid grasslands where woody plants are absent. The common duiker will only occur in areas that have adequate low bushy shelter. They do sometimes feed on lower forbs in stands of high grass. Klipspringer only live on suitable rocky terrain.

Grassland habitat is avoided by *Cercopithecus aethiopicus* (vervet monkey); and the habitat preferences of *Panthera pardus* (leopard) and *Tragelaphus strepsiceros* (greater kudu) also exclude grasslands. Vervet monkeys will penetrate grasslands along river courses that provide enough tree cover. Leopard also penetrate normally unfavourable terrain, provided that there is some adequate sheltering available in the form of big trees or rocky hills. Greater kudu have a preference for broken terrain with bush cover.

Atilax paludinosus (water mongoose) feed mainly on amphibians and crustacea and therefore only occur near adequate water bodies. The cape clawless otter, *Aonyx capensis*, requires open water and will move away when the water dries up.

Although no bone material of *Struthio camelus* (ostrich) was identified, the presence of ostrich egg shell in the deposit indicates

Alcelaphus buselaphus (hartebeest) and *Redunca fulvorufula* (mountain reedbuck) favour grasslands near small patches of bushes and forest trees that afford shelter. Mountain reedbuck are exclusive grazers and will eat higher quantities of grass in the late season to balance the lower forage quality of the grass. Hartebeest prefer grass, but will also browse (stomach contents with as high as a 40 per cent leaf component have been analysed).

Pelea capreolus (grey rhebuck) have always been associated with open mountainous grasslands, but recent faecal analyses have indicated a browsing diet. More research is needed before a decisive answer about their habitat preferences can be reached, but preliminary research indicates that they have a strong tolerance for cold conditions, which could be indicative of sourveld specialisation.

Antidorcas marsupialis (springbuck) are intermediate feeders. Their feeding selections are seasonal; fresh green grass and herbs from around October to March, moving over to leaf and pod material from around June to August (Bigalke 1972:351).

Though *Raphicerus campestris* (steenbok) are intermediate feeders, they cannot exist without the forbs in the lower grass levels and are easily affected by drought.

Taurotragus oryx (eland) are predominantly browsers but will feed on fresh grass in the beginning of the wet season. Their historical

Hippotragus cf. equinus (roan antelope) are very particular in their habitat selection, especially in respect to the tree-to-grass ratio. They are restricted to savannahs where trees and grasses are the co-dominant plant forms; they only occur in open savannah with extensive open areas of long grass (Smithers 1983). Roan antelope are sensitive to environmental changes that affect the cover of trees.

Connochaetes gnou and *Connochaetes taurinus* (the black and blue wildebeest) prefer to graze on short green grasses. When the availability of these grasses declines with the onset of the dry season, black wildebeest will feed on Karoo shrubs. Blue wildebeest will continue feeding exclusively on grass, albeit of a lower quality.

Damaliscus dorcas (blesbok) are exclusively grazers, preferring short grass of an intermediate quality. They only occur on open grasslands.

Phacochoerus aethiopicus (warthog) feed on perennial grasses and their roots, rhizomes and stolans^a, but prefer feeding on fresh green grass shoots, whether it is in burnt veld, near water, or veld in early spring.

^a rhizomes: a creeping (more or less horizontal) underground stem which send up new leaves and stems each season.

stolans: (=runner) a stem which grows along the ground and roots from the nodes (Van Wyk *et al* 1988: 343-344).

from the ground. Through their feeding and trampling behaviour, they open-up the grass for grazers of intermediate quality grasses (for example black and blue wildebeest, roan antelope) who then proceed to feed on grass sheaths and leaves below 100-150mm. This in turn reduces the vegetation so that the availability of new leaf material is enhanced, and ungulates with high protein requirements can move in (Gwynne and Bell 1968; Bell 1969).

(ii) Species-specific habitat requirements

The species *Hippotragus equinus* (roan), *Connochaetes gnou* (black wildebeest), *Equus burchelli* (zebra), *Damaliscus dorcas* (blesbok), *Equus quagga* (quagga), *Equus capensis* (extinct giant cape horse), *Megalotragus priscus* (extinct giant hartebeest) and *Antidorcas bondi* (extinct Bond's springbuck), are all grazers endemic to grassland environments. There are, however, important differences in their respective grazing strategies that can be used as habitat indicators.

As already discussed, the non-ruminant *Equus burchelli* (zebra) has a high tolerance of low quality grass. Given their similar physiology, it can be assumed that *Equus quagga* (quagga) and *Equus capensis* (extinct giant cape horse) had the same grazing preferences.

Although equids, like most grazers, will select for fresh leaf material of higher forage quality, they can exist on lower quality diets. *Equus burchelli* (zebra) prefers an open grassland habitat.

fodder, and hence do not require forage of very high quality. However, their overall fodder requirements are higher. Smaller ruminants need higher quality forage but have an overall lower energy and protein requirement.

Non-ruminant digestive systems process food more rapidly and they are therefore able to extract their energy requirements from lower quality grass (Bell 1969:119). Zebra are non-ruminants with a big body size and therefore have high energy requirements. Smithers (1983) and McNaughton (1985:277) note that zebra supplement their low quality high bulk diet by eating a lot of grass seeds.

The ability (and morphological constraint) to utilise discriminately only certain components of the grass by different ungulate species leads to an interdependency of species in a seasonal grazing succession on grasslands (Gwynne and Bell 1968; Bell 1969; Bell 1971; Leuthold 1977:21-27; McNaughton 1985). When the sward starts to lose its quality through prolonged growth or at the end of the wet season, large animals are normally the first to move into areas of taller grass. They graze, trample and recycle nutrients (in the form of urine and dung) in areas where the forage quality is low. Their behaviour results in new growths that then provide protein-rich grass for smaller ungulates.

Zebra, with their high tolerance of low quality food (Brink 1987:78) are normally the first to move into grass of low forage value. Their diet at this stage consists primarily of grass stems 100-150mm

determine a preference for utilising certain stone material, their frequency of occurrence in the utilised assemblage should be compared to their frequency of occurrence in the general assemblage. Flake-blades occur 5,71 times more frequently and flakes nearly twice as frequently in the utilised assemblage than in the general assemblage. Formal tools also occurred 3,8 times more in the utilised inventory than the general inventory. Ninety per cent of the stone material chosen for utilization was manufactured on opaline.

Table 11 lists all the stone material that displayed previous episodes of flake scarring. Fifty-five artifacts were identified as having been manufactured on older stone artifacts (1,88 per cent of total assemblage), and were classified as re-worked. In the formal category, two scrapers and one miscellaneous tool were identified as having been produced on antiques. The combined category of chips and chunks is the most abundant category in the re-worked assemblage (56,36 per cent) with flakes the second most abundant category (20 per cent). In the H level, cores and flake-blades occur in higher percentages in the re-worked assemblage than their frequency in the general assemblage; flake-blades occur 1,6 times more frequently, cores 2,15 times more frequently and formal tools 3,60 times more frequently in the re-worked assemblage than the general assemblage. Only older stone artifacts produced on opaline, were chosen for re-working; there is also a preference for translucent opaline (61,82 per cent).

66,78 per cent). Cores contributed 4,21 per cent of the stone material. Within the core category, 41,46 per cent of these were bladelet cores that is, cores that are generated during the manufacturing of bladelets. Flake-blades contribute 5,03 per cent of the stone material. When broken flakes are excluded, 93,93 per cent of the flake-blades are bladelets. The broken flake-blades were of such small dimensions that a second calculation, categorising them as bladelets, was done. Bladelets (broken and complete) then constitutes 97,28 per cent of the flake-blade category. Flakes contributed 22 per cent of the stone material and, excluding core rejuvenation and broken flakes, 56,13 per cent of all flakes were produced by side-struck technology.

Only 1,51 per cent of the stone material from H could be classified as formal. The various categories of scrapers constitute 20,45 per cent of the formal material; scrapers form the biggest single category of formal tools in the H level. A number of tools with clear secondary retouch were broken or of such an unstandardised nature that they had to be classified as miscellaneous (broken and miscellaneous, 34,09 per cent). A number of tools (seven) that have not been reworked but are clearly of Middle Stone Age technology, were also excavated.

A small percentage (2,98 per cent) of stone artifacts in the H level displayed clearly visible utilisation damage (Table 10). The most abundant category of utilised material was flakes (40,22 per cent) with flake-blades being the second most abundant. In order to

Three hearths in squares Q4, O4 and L5 were exposed in the H level. These features contained high concentrations of charcoal and dark ash-like material. The hearth in square O4 had a number of small, blackened boulders packed around the perimeter of the ashy concentration. In L5 a big, flat rock was centered in the hearth and a number of small, heat-splintered stones were spread outside the perimeter of the ash-like material.

Between squares O4 and P4, a stratigraphically complex feature was noted. A clearly defined pit, containing over 6kg of small fragments of broken long bone capped by a layer of stones, was present. This pit was so densely packed with small fragments of long bone, that at points in the excavation, it was like excavating a stratum of bone with no other deposit in between. This refuse pit appears to be located on the remains of an older pit that, stratigraphically, belongs to the DB level below H.

A second smaller pit-like feature was noted in Q4 but, apart from dark soft soil, contained no recognisable material.

Stone material

Level as a unit

The inventory of stone material from H is provided in Table 9. The majority of the worked stone falls into the non-formal category (98.49 per cent). The biggest contribution to the stone material is the combined category of chips and chunks (a combined total of

depressed the deposit underneath it into a nearly step like formation (see Figure 6, L5 section drawing). The block landed in a slanted position with the highest section of the rock on the western side. Because of the rock, the link of continuous deposit between the eastern and western areas of the excavation, was complicated. After the fall of this block, human occupation of the cave was resumed and deposit formed over and around the sandstone block and by the end of the Ja occupation, deposit completely covered the rock.

Although the H deposit is not the first level that was formed after the sandstone block had fallen, it is the first level of deposit that started to cover a portion of the rock. Deposits that formed after the fall of the sandstone block do not display a visible link. In the instance of the H level, the discontinuity around the sandstone block is further complicated by a cut-away trench of (subsequent) CM deposit dug into what would have been H deposit in squares N4, N3, and sections of M5. The H deposit on the eastern side of the sandstone block is of a slightly different colour and has produced a date of $9\ 250 \pm 70$ BP. This is older than the H date for the deposit on the western side of the sandstone block ($8\ 614 \pm 40$ BP). However, no technological difference could be detected between the samples from the two areas and, in order to increase the sample size, the material from the two areas has been combined.

CHAPTER SIX

H LEVEL

Features

The lowermost Oakhurst level — H — is only present in the northern part of the excavation in squares Q4, P4, O4, N4, M5, L5, L4, K5, and J5 (Figure 10). The absence of this occupation level in the southern part of the excavation can be attributed to a number of factors such as the removal of deposit by successive occupiers, the scouring away of deposit by subsequent water action, or the limited spatial extent of H occupation.

The younger CM level cuts into the H level in two places. As can be seen in the section drawing, in squares P4 and N4 the CM level deposit cuts abruptly into the H deposit (Figure 4). This cut-away is so abrupt, and the sides at a distinct 90° degrees angle, that it seems that the H deposit was deliberately removed by the generators of the CM deposit. The H deposit does therefore not form a continuous level and would not have been understood if the site was not excavated on a broad spatial scale.

Probably at the end of the Last Glacial Maximum a large single block of sandstone was dislodged from the roof of Rose Cottage Cave. This dislodging occurred during a hiatus in occupation and landed in the intersection of levels dated to $20\,600 \pm 250$ BP and $13\,360 \pm 150$ BP. It covered an area of approximately 3m^2 and weighed several tons. The impact of this block of sandstone

SECTION III

MATERIAL REMAINS

MUB graph displays a large difference between the MUB values for the late Pleistocene and Holocene.

A strong preference for hunting large ungulates (as opposed to medium and smaller ungulates) could be at the basis for the strong representation of the large ungulates. As referred to previously, the social decisions and control over hunting patterns can be detected at Rose Cottage Cave. This occurrence will be discussed in more detail in the final chapter.

Given the aim of this dissertation, it is important to remember that the ultimate endeavour of the faunal analysis is to understand the utilization of "the meat around the bones", that is, the inferring of human behaviour in the exploitation of animals. The next step in the development of this dissertation is a discussion of the patterning in the archaeological material primarily caused by human actions and decisions.

and can therefore recover more easily from environmental perturbations than larger species.

The lower temperatures during the late Pleistocene at Rose Cottage Cave (as indicated by the charcoal analysis (Esterhuysen in prep)) would have led to a decrease of primary production of the grassland (JF Thackeray 1980:223). This would have reduced the carrying capacity of the grassland. *Equus capensis* and *Megalotragus priscus* are large ungulates with a postulated slow reproductive rate (JF Thackeray 1980:222) as well as an overall high energy need (Brink 1987:80). Their extinction can thus be attributed to the progressive decrease of the grassland carrying capacity during the late Pleistocene.

The relationship between the expected biomass (MUBe) and corrected (MUBk) biomass, provides further evidence for a high biomass in the late Pleistocene. Given the significant relationship between expected and archaeological biomass in the late Pleistocene, we can assume that it is not preservational bias that is the reason for the large ungulate presence in these levels*. Although the model does not suggest that there is an over-representation of large ungulates in the late Pleistocene, the plotted

*As part of the calculation of the corrected biomass, the equation proposed by Behrens-mayer et al (1979) as a correction for the preservational bias against small animals, was calculated. A two sample t-test showed that the archaeological MNI and the corrected abundance estimate is highly correlated ($r = -0.066$; $P = 0.95$; d.f. = 6). This supports the above evidence that there is no undue preservational bias against the smaller ungulates (except, of course, in the late-Holocene levels) (see forthcoming publication Engela and Grant).

animals with a low bodyweight (MUBk), were calculated for Rose Cottage Cave (see again Table 7; Figure 9). The hypothesis that there would be no difference between the expected biomass (MUBe), the corrected biomass (MUBk) and the archaeological biomass (MUBa) was tested by Students T-tests^a. The relationships between expected and corrected, and expected and archaeological were statistically significant in the late-Pleistocene and early-Holocene levels (Table 8). There was thus no over-representation of large ungulates nor a preservational bias against small animals in these levels.

As can be expected, the biomass values calculated on both the archaeological and corrected formulas, are the highest in the late Pleistocene. The decrease in biomass in the Holocene is linked to an increase in the relative abundance of small and medium ungulates and concomitant decrease in large ungulates. JF Thackeray (1980:222) suggests that the increase in the relative abundance of smaller ungulates as well as extinction of larger species, can be linked to their respective reproductive strategies and thus population recovery potential. Smaller species have a higher reproductive rate

* H(1)0 : MUBa/MUBk = 1
 Ha : MUBa/MUBk $\neq$ 1

H(2)0 : MUBe/MUBa = 1
 Ha : MUBe/MUBa $\neq$ 1

Although neither the Rose Cottage data nor the published data is normally distributed, I have decided to continue using the student's T test in order to compare my results with the results obtained by Thackeray (see forthcoming publication discussing statistical problems with this technique, Engela and Grant).

biomass (MUBe)^a can be used to understand selective predation as well as preservational biases at the site.

The model postulates that when there is a significant relationship between expected (MUBe) and corrected (MUBk) values, it is an indication that there is no preservational bias against small ungulates as well as no selective predation. When the relationship between expected (MUBe) and archaeological (MUBa) biomass is significant, there is no over representation of large ungulates.

Samples	Student t-test	Implications
MUBe and MUBk	significant	no preservational bias against small animals (ie. taphonomical biases factored out)
MUBe and MUBa	significant	no over representation of large ungulates

The archaeological MUB values (MUBa), the expected MUB values (MUBe), and the values as corrected for preservational bias against

^aExpected Mean Ungulate Biomass

$$(MUB) = 10^{(0.123N) + 0.66}$$

where

N = number of species in community.

(log (MUB)e = (0.123 x N) + 0.66; as determined by F. Thackeray 1980:218. This equation was developed by using non-linear regression on data collected in Namibia. It is recognised that this equation applies primarily to Namibian ecological conditions (F.Thackeray 1980: 218) but, given the lack of similar data for South Africa, it was decided to apply it to species identified at Rose Cottage. F.Thackeray also applies this data to species identified in Pleistocene and Holocene levels at the South African sites of Klasies River Mouth, Nelson Bay Cave, Boomplaas, Elands Bay Cave, as well as, Apollo 11 and eleven other Namibian sites).

(II) Mean Ungulate Biomass

As a further indication of environmental conditions during the occupation at Rose Cottage Cave, the Mean Ungulate Biomass* (MUB) has been calculated for each level (Table 7; Figure 9).

Thackeray (1980:216-223; 1981) established that the statistical relationship between the biomass calculated on the species observed in the archaeological sample (MUBa), biomass corrected for preservational bias against small species (MUBk)^b and expected

*Mean Ungulate Biomass

$$MUB = \sum \frac{(Bi ni)}{N}$$

where

- Bi = mean adult mass of each species
- ni = no of individuals of each species
- N = total number of animals in community.

^bCorrected Mean Ungulate Biomass

$$(MUB) k = \sum \frac{(Bi Fe)}{N}$$

where

- Bi = mean adult mass of each species
- N = total number of animals in each community

$$Fe = \frac{Fs}{(0.59 \log(\text{bodyweight}) - 1.2)}$$

(Fe as determined by Behrensmeyer *et al* 1979 and correctly published by F. Thackeray 1980; where Fs = frequency of occurrence of species).

the correlation between Mn and any of the other levels were in the lower 40 percentage and upper 30 percentage range. The internal correlation of faunal species composition in contemporaneous levels, was well defined and showed a stepped pattern of reduced correlation over time.

The above evidence is seen as an indication that the faunal selection at the site, though always confined by the parameters set by the environment, was under a strong degree of social control. If the hunting pattern of the communities occupying Rose Cottage Cave was based purely on environmental availability, it could be expected that the reconstructed faunal community structure would be as highly variable as the fluctuating environment (Esterhuysen in prep)*. The reconstructed faunal communities displayed a marked degree of uniformity within levels closely dated, and corresponded to broad technological periods.

*A similar pairwise Spearman rank correlation coefficient was calculated on the plant species preliminary identified through the charcoal analysis. In contrast with the strong correlations between the faunal communities of grouped levels, a highly variable picture emerges for the plant species. A large proportion of the correlations are not significant. Some of the levels are so highly negatively correlated that it cannot be, statistically, by chance alone (M. Grant personal communication). Although it is known that there are preferred species during the collection of firewood (Archer 1990), it is still assumed that charcoal analysis reflects environmental changes more accurately than faunal evidence. It is thus assumed that the high degree of plant species variability between the levels reflects the changing environment more accurately. Unfortunately, these calculations are preliminary and conclusive interpretations awaits final identification work (see Esterhuysen in prep).

The area of L5 and M5 contained the highest frequency of formal tools. Most of the bladelets as well as broken flake-blades were also excavated in these squares. The three backed tools excavated in H were also found in this area. It thus seems that in contrast to the cores, chips, chunks and flakes (material of the first stage of knapping) stone that was more elaborately processed, occur in a separate area. This is a relatively secluded area that is located between the big sandstone block and the sandstone boulder that resulted in the formation of the cave and shored up the deposit (see Figures 2 and 10). On excavation, square L5 also contained a big hearth with a number of heat splintered stones as well as a flat block of stone that could have functioned ideally as an anvil.

As can be expected from this discussion, when the evenness and richness indices are considered spatially, the non-formal assemblage has the lowest richness and lowest evenness indices in the area of squares O4 and P4 — the typical pattern expected in a knapping area. The sample size for the spatial distribution of formal tools is very small (and ignoring those square where the sample size is less than three), an indication of a high richness index for formal material can be found in square L5. The spatial differentiation of the formal and non-formal material is thus born out by the diversity indices.

It is of interest to note that the highest concentration of ostrich egg shell is in squares M5 and N4. This area contains a low frequency of non-formal stone tools, but a high frequency of formal stone. It

at Rose Cottage. It can also be seen as an indication that meat was a valuable resource and that the option of gourmet utilization of only the choicest parts of the hunt, was not exercised.

Spatial configurations

The spatial scope of the H level was limited and it is recognized that the archaeological excavation does not correspond to the complete occupation area of the inhabitants of the cave at the H period. The spatial patterns detected are therefore painfully incomplete. None the less, I will discuss some indications of the spatial articulation of material culture.

The high concentration of cores in square P4 coupled with a high concentration of chips and chunks in the two adjacent squares of Q4 and O4, clearly points to a confined area of knapping. The spill area of refuse around the knapping of cores, has been well documented (Toth and Shick 1986:27-28; 55) and it is interesting to note that squares Q4 and O4 both contain small hearths. Given the high presence of flake-blades in the H assemblage it is interesting to note that end-struck flakes appear in a spatially more concentrated area than side-struck flakes. Although the highest occurrence of flake-blades is in L5, the highest occurrence of utilised bladelets is in P4. It thus seems that, some of the production process of bladelets, as well as their eventual use was spatially concentrated in the area where the first stage of knapping also occurred.

As discussed in the methodology chapter (Chapter Four), the diversity indices provide a 'shorthand' assessment of the structural properties of a sample. The H level does not display a strong difference between the structure for the non-formal and formal stone assemblages. Although aiming at different end-results, the knapping procedures for the non-formal and formal assemblages seem to be closely related. It is proposed that the producers of the stone artifacts in the H level were not making an effort to establish the formal tools as a distinct category (See Chapter Ten for further discussion of diversity indices).

When discussing the food and density values for the skeletal parts identified in H, they need to be considered separately for each *bovidae* size category. In the *bovidae* size category 1 the bone assemblage is due to human transport decisions and not bone attritional factors. This utility curve indicates that nearly complete carcasses of animals in this size category were brought back to the site. In the *bovidae* size categories 2 and 3, the dominant driving factor in the construction of the bone assemblage, is the specific density of the bone. A bulk consumption strategy is a visible, but subordinate factor. None the less, it is reasonable to suggest that for size categories 1, 2 and 3 most of the animal was carried back to the home base. In turn, this could be seen as an indication that the hunting parties had to be a relatively large size to be able to carry such a large percentage of the killed animal back to the site. Hunting was probably also carried out close to the site but the main focus of settlement did not move to the killed animal and remained

general occurrence (3,8 times more). Thus, although utilitarian activities were primarily performed by flake-blades and flakes, in the H level formal tools were also used extensively. The high incidence of opaline material in the utilised assemblage could be indicative of a preference for material that produces high-quality cutting edges and provides a greater degree of control over the knapping technology. It could also, however, be a factor of ease of identification. An anomaly is the presence of a number of chunks and chips with utilisation damage. Although this could be attributed to erroneous identification of utilization (but see discussion in Chapter Four), the preliminary residue analyses at Rose Cottage Cave indicate that there are organic residue on chunks and points to the fact that they have indeed been utilised (personal comment B. Williamson). It is not clear, however, whether the utilised chunks (and chips) were used in their present morphology or whether they are the result of utilised edge of stone artifacts being 'cleaned'.

In the re-worked assemblage there is a preference for opaline material, with a strong selection for translucent opaline. When the preference for opaline is seen in conjunction with the high proportion of cores, it can be proposed that the stone material from previous occupation levels was primarily seen as a source of raw material. The selection for translucent opaline could, however, be indicative of a non-technical consideration. The H level stone assemblage also contained a number of unworked Middle Stone Age pieces (7). The H level was occupied after a hiatus and clearly material from previous occupations was picked up and re-used.

Discussion

Level as a unit

As can be expected at an occupation site, the stone assemblage of the H level contains a high number of chips and chunks. This indicates that stone knapping took place in this level. Typical of an industry dated to this period ($8\ 614 \pm 40$ BP and $9\ 250 \pm 70$ BP), the majority of the flakes are side-struck. Many flakes had a broad striking platform and many large macro-lithic flakes were present. There is quite a sizeable contribution of bladelets, which can be seen as a technological carry-over from the bladelet-dominated industries in the levels below H.

The formal assemblage in H contained a number of miscellaneous and broken tools. Coupled with the low percentage of formal tools (relative to other levels at Rose Cottage Cave) this must be seen as indicative of the 'informal' nature of the retouched assemblage in the H level.

When the frequency with which certain types of artifacts appear in the utilised category is compared with their frequency of occurrence in the general assemblage, it becomes clear that certain stone material categories were preferentially utilised. As noted above (Table 10), flake-blades occur at 5,71 times and flakes at twice the frequency in the utilised category than their occurrence in the general assemblage would lead one to predict. There is also a preference for utilising specifically end-struck flakes. Formal tools also have a higher occurrence in the utilised assemblage than their

In order to establish which of the two patterns is dominant, Spearman rank-order correlation coefficients were calculated (pair-wise). For the *bovidae* size category 1 the relationship between percentage occurrence and percentage density is not significant, while the relationship between percentage occurrence and percentage food value is significant, positive and moderately strong.

•bov 1: %MAU & %den $p = .0573$

%MAU & %FUI $p = .0404$, $r = .6482$

Bovidae size categories 2 and 3 have significant relationships between percentage occurrence and percentage density. The coefficient level for the relationship of percentage density and percentage occurrence is however, higher than the coefficient levels for percentage occurrence and percentage food value. In size category 2, the correlation coefficient for percentage occurrence and percentage density is high whereas the correlation coefficient for percentage occurrence and percentage food value, while not unimportant, is far lower. In size category 3 the correlation coefficients for percentage occurrence and percentage density as well as percentage occurrence and percentage food value are comparable:

•bov 2: %MAU & %den $p = .0005$, $r = .9687$

%MAU & %FUI $p = .0105$, $r = .7101$

•bov 3: %MAU & %den $p = .0385$, $r = .9255$

%MAU & %FUI $p = .0414$, $r = .9122$

and O4. It was densely filled with small fragments of mostly long bone pieces. This pit could have been purposely dug for the burying of refuse bone; or it could have been constructed for another function that became obsolete, and it then was recycled as a bone refuse pit.

The skeletal parts identified to *bovidae* were grouped into the four size categories and the density and food values were calculated (see Appendix Two). XY-scatter plots were produced (Figure 20). The sample size for *bovidae* size category 4 was too small to warrant calculation.

For *bovidae* size category 1, 2 and 3 the percentage occurrence plotted against the percentage food, display, by visual inspection, consumption site bulk utility curves. The plots for percentage occurrence and percentage density demonstrated a straight linear relationship. The plotted relationship between food value and occurrence indicates that a bulk utilization strategy was followed during the occupation of H level; skeletal parts with moderate and high food values are present at the site and it is thus clear that only skeletal parts with low food values were not brought back to the site. On the other hand, the linear relationship between percentage occurrence and percentage density indicates that the survival potential of a bone in the H level is directly related to its specific density.

remnants of some burnt organic matter. Significantly, the two squares that contained some of the lowest density of stone material and no features, squares M5 and N4, contained the highest concentration of ostrich egg shell. One very small ostrich egg shell bead (4.85mm in diameter) was excavated in square P4, while four half-finished beads were excavated in squares O4, P4 and Q4 (Figure 17).

Worked bone

Two pieces of polished long bone were excavated in square P4 (Figure 18). Although the one piece is not complete, both have a triangular morphology as well as smoothed edges, and this leads one to interpret them as awls.

Bone material

The H level produced one of the richest bone assemblages in Rose Cottage Cave — over 9kg of bone was excavated from the nine squares that constitute H. Most of this bone (7.9kg) came from squares on the western side of the block of sandstone (Figure 19). In this area, the bone was exceptionally well preserved but in small fragments. Bone on the eastern side of the block of sandstone was not as well preserved.

As already discussed in the section dealing with the features excavated in H, a bone-filled pit was situated between squares P4

O4 are also the squares with the highest occurrence of quartz. Raw material 'other-than-opaline', have the highest frequency in squares Q4 and O4 (Figure 15).

When the diversity indices for the stone material are calculated for each square (Figure 16), the highest richness (that is, the widest variety of artefact types) for the formal material is in square L5, and for the non-formal material in squares K5 and J5. The lowest richness for the non-formal material is in squares Q4 and O4; these two squares also have the lowest evenness indices for non-formal material.

Three very clear hollows were visible in the block of sandstone in square L5 and M5. These depressions were small, round and about 100mm deep, with smoothed edges. It seems plausible that these hollows were used for grinding some material. The two pieces of groundstone that were found, were in the square adjacent to these hollows.

Ostrich egg shell

In the H level 95.69g of ostrich egg shell was excavated (Figure 17). The ostrich egg shell was very soft, decomposed and fragmentary and I am thus not able to compare its weight with the weight of a fresh ostrich egg shell ($\pm 250g$). A few pieces in squares L4, N4, O4 and P4 displayed a black substance on the surface. It was not clear if this was from manganese staining or the

Figure 11 lists the stone material from H in a diagrammatic spatial basis. The highest occurrence of cores is in square P4 with the highest percentage of chips and chunks in the two adjacent squares of Q4 and O4. This area also has a high concentration of end-struck flakes (squares P4 and O4), in contrast with side-struck flakes which are spatially more evenly spread across the H level. The highest concentration of bladelets is in square L5 whilst broken bladelets occur in high frequency in squares M5 as well as P4.

The sample of formal tools is small and spatial patterning should be approached with caution. What is of interest though is the high occurrence of backed tools in squares L5 and M5 - the area with the highest frequency of broken bladelets.

Figure 12 presents the spatial occurrence of utilised stone artifacts. The highest concentration of utilised stone material is in squares P4 and O4 which is the same area where the general highest concentration of stone artifacts occur.

The highest occurrence of re-worked material is in square M5. The spatial distribution of heat-altered material corresponds to areas where hearths occur (Figure 13 and 14).

The spatial distribution of raw materials for H is schematically represented in Figure 15. For the non-formal assemblage, the highest occurrence of opaline is in squares P4 and O4, with a sizeable component of opaline in squares M5, L5. Squares P4 and

The diversity indices (richness, evenness and diversity) for the total H stone assemblage, were calculated separately on the formal and non-formal material, as well as on the combined totals for formal and non-formal material (Table 15). As discussed in Chapter Four (Methodology) and Appendix Three, the usefulness of these indices lies not in their absolute values but in their values relative to each other. For the H level, the indices calculated on non-formal material are lower than the indices calculated for the formal tools. This indicates that the non-formal assemblage is less variable than the formal tool assemblage (lower richness), and characterised by a less even spread of items per tool category (lower evenness) indicating a greater degree of emphasis on certain tool types. In the first stage of knapping, a number of chips and chunks are produced resulting in a non-formal assemblage with a restricted and standardised range of stone artifacts (tool types).

Spatial configurations

Although the spatial extent of the H level was not extensive, distinct features were excavated and it is valuable to consider the spatial distribution of material. As already stated, the greatest part of the stone artifacts assemblage in the H level is constituted by non-formal material; it is thus no surprise that the spatial distribution of the non-formal material is the dominant force in the spatial patterning of the combined stone material.

A number of stone artifacts in H displayed signs of having been affected by high temperatures (Table 12). The frequency occurrence of artifacts in the heat-affected assemblage, is not much different to their frequency of occurrence in the general assemblage - for example chips and chunks occur at 66,78 per cent in the general assemblage and occur at 36,25 per cent in the heat-affected assemblage. Similarly, cores constitute 4,21 per cent in the general assemblage and 4,37 per cent of the heat affected assemblage.

In square L4 three groundstone pieces were found - a fragment of a palette and two pieces of an upper grindstone. The groundstone pieces were so fragmentary that one was not able to tell if they were from a single grindstone or from two separate grindstones. Small fragments of ochre and haematite were also found in squares P4, O4 and M5 (Table 13).

The raw materials used for stone material in the H level are given in Table 14. Opaline is the material of choice; 61,2 per cent of all non-formal material is produced on opaline and 90,9 per cent of all formal tools are manufactured on opaline. There is also a preference for the production of artifacts on translucent opaline. When the stone material manufactured on opaline is considered, it is clear that 52,18 per cent of the non-formal material are translucent opaline, and 80 per cent of the formal tools are produced on translucent opaline. Not-with-standing the preference for opaline, a size-able component of stone material was also manufactured on hornfels, tuffaceous rock, quartz and other material.

analysed. When combined, the broken and 'unstandardised' miscellaneous formal tools form the biggest category of formal tools in CM.

In the utilised assemblage the preference for utilizing flakes and blades is quite clear. There are only three utilised formal tools in the CM assemblage. It thus seems that blades and flakes were primarily used in economic activities, whereas secondary retouched tools probably fulfilled some other purpose. Once again, the preference for opaline material is obvious and this has already been discussed in the H level chapter.

As for the H level, there is a strong preference for opaline in the re-worked category. Within the re-worked category a strong emphasis was placed on the manufacturing of formal tools. The choice of only opaline material, coupled with the high incidence of cores point to the fact that previous occupation material served as a ready source of raw material.

Compared with the H level, in the CM level there is a greater polarity between the richness and evenness indices calculated on the non-formal material and the richness and evenness indices calculated on the formal material (see Table 22). This indicates that in the CM level, more emphasis was placed on creating a difference between the formal and non-formal, stone assemblages than in the H level.

assemblages that are primarily produced due to bone destruction factors and it would be wrong to try to deduce any human transport decisions in such an assemblage.

The sample of skeletal parts in the *bovidae* size category 4 is so small that the statistical relationships were not significant.

Discussion

The broad area of deep CM deposit in squares N3 and N4 (next to the block of sandstone), contained no conventional features and could be designated as a relatively 'empty' space. Although no plant material was excavated in this area, it would have been ideal as a bedding hollow. The feature is adjunct to the highest section of the block of sandstone and, at the time of the CM occupation, this could have functioned as a natural wind barrier. Although a substantial amount of ostrich egg shell was excavated in square N4, the occurrence of ostrich egg shell in bedding material is not unknown (see similar occurrence in Elephant Shelter, Wadley 1979).

As can be expected at an occupation site, the high number of chips and chunks as well as the presence of cores indicate that stone knapping took place in the CM level. Unfortunately, CM has a low number of cores. This small percentage of cores could possibly be due to a sampling bias. As can be seen in the discussion of inventories for more complete levels, cores tend to cluster spatially and, for the stone assemblage, not all the squares in CM were

density, as well as percentage occurrence and percentage food value are all significant, positive and strong:

•bov 1: %MAU & %den $p = .0022$, $r = .9679$

%MAU & %FUI $p = .0098$, $r = .8165$

•bov 2: %MAU & %den $p = .0004$, $r = .7868$

%MAU & %FUI $p = .0003$, $r = .8063$

Since all the relationships are statistically significant, it is important to look at the degree of correlation. In the *bovidae* size 1 category the strongest correlation is between percentage occurrence and percentage density (96,79 per cent), indicating that the primary generative factor was the factor of bone density. In *bovidae* size category 2 the correlation between percentage occurrence and percentage food value is marginally stronger (80,63 per cent) than the correlation between percentage occurrence and percentage density (78,68 per cent). This indicates that the food value of each skeletal part (processed in a bulk utility strategy) was the dominant causal factor in the formation of the assemblage.

In *bovidae* size category 3 the relationship between percentage occurrence and percentage density is significant, positive and strong, whereas the relationship between percentage occurrence and percentage food value is not significant:

•bov 3: %MAU & %den $p = .0183$, $r = .9630$

%MAU & %FUI $p = .1304$

According to the skeletal part model proposed by Grayson (as discussed in Chapter Four), the above relationships are indicative of

concentration of bone in the area to the west of the big block of sandstone.

As for the other levels at Rose Cottage Cave, the skeletal part food values were calculated for *bovidae* grouped into four size categories. XY-scatter plots were generated for the skeletal part percentage occurrence against percentage food values. For all four of the *bovidae* size categories, a bulk utility strategy became apparent (Figure 25).

When the density and food values for skeletal parts in similarly grouped *bovidae* size categories were calculated, *bovidae* size categories 1, 3 and 4 displayed a similar curve between percentage occurrence and percentage density as the above-calculated relationship between percentage occurrence and percentage food value. The plot of the percentage density calculations for *bovidae* size category 2, exhibited a straight linear relationship between percentage occurrence and percentage density, that is, the preservation potential of a CM bone in *bovidae* size category 2 is in direct relationship to its density.

In an effort to determine whether the food value or the density value of the bone was the primary factor in the generation of the archaeological assemblage, paired Spearman rank-correlation tests were done. In the *bovidae* size categories 1 and 2, the relationships between percentage occurrence and percentage density, as well as

Worked bone

A large number of worked bone pieces were excavated in CM (Figure 23). Four separate pieces of broken link shafts were excavated with one piece still angular and unfinished. An interesting piece of bone material with a number of clear negative flake scars is illustrated in Figure 23. These flake scars could have been caused by crushing during marrow extraction, but given the regular nature of the negative flake scars, it is suggested that this piece is the result of controlled bone working activity. A piece that can be described as an awl as well as a piece of highly polished bone flake indicates that bone material was used in a number of activities. Figure 23 shows the root of a polished and smoothed tooth. The tooth was so highly polished that the direction of the striation marks could not be detected.

Bone material

Based on the weight of the bone it can be said that bone was well preserved in the CM level; over 11kg of bone fragments were excavated (Figure 24) of which 204 fragments were identifiable. Unfortunately the *in situ* bone was extensively fractured due to unknown post-depositional factors, and thus crumbled on excavation. In the level above CM — Ph — 12kg of bone was excavated, but 418 fragments were identifiable to either species, genus or size category. Although the refuse bone weight is relatively well spread over most of the excavation, there is a higher

As for all the other levels, diversity indices (richness, evenness and standardised diversity) were calculated (Table 22). These indices were calculated on the combined assemblage, non-formal material and formal material. When the indices calculated on the non-formal material are compared with the indices calculated for the formal material, the expected pattern of lower richness and far lower evenness for the non-formal material emerges. In the first stage of knapping (non-formal) a limited variety of artefact types were produced (lower richness); within the restricted range of artifacts that were produced, certain types were emphasised (lower evenness). A wider variety of tool types were produced in the formal categories (higher richness) with a far better apportionment of tools across these categories (higher evenness).

Ostrich egg shell

The CM level produced quite a sizeable mass of ostrich egg shell -- 157,4 gram (Figure 22). The highest concentration is in square N4 (60,7g) with the two adjacent squares O4 and M5 producing 37,8g and 33,8g, respectively. There is a distinct non-occurrence of ostrich egg shell in squares of the south-western part of the excavation. Three separate ostrich egg shell beads in various stages of manufacturing, were also found in squares P4, O4, and N4 (Figure 22).

occurs eight times more frequently in the re-worked assemblage than in the general assemblage. Except for one artefact, all the reworked stone material was manufactured on opaline antiques.

A number of stone artifacts (279) also displayed signs of heat alteration (Table 19). As can be seen from the table, the proportions of heat-altered stone artifacts within various classes do not differ greatly from their proportions in the general assemblage.

A large number (15) of miscellaneous groundstone work were present in the sample, but were unfortunately so fragmented that they could not be classified any further. One complete palette, as well as, (possibly associated) minute pieces of ochre, specularite and haematite were found in squares M3 and O4 (Table 20).

Table 21 lists the raw material used in the production of stone artifacts in the CM level. Opaline is clearly the preferred material (60,6 per cent), particularly in the formal categories where 77,60 per cent of the stone material is manufactured on opaline. Despite the preference for opaline as a raw material, other raw materials such as hornfels, tuffaceous rock and relatively fine-grained sandstone, were also used. The presence of a small amount (5,3 per cent) of chips, chunks and manuports manufactured on quartz material conforms to a pattern of quartz presence in levels dated to $8\ 380 \pm 70$ BP and $9\ 250 \pm 70$ BP.

in the utilised assemblage than in the general assemblage (5,05 per cent), indicates that flake-blades are nearly four times more likely to occur in the utilised assemblage. Although it is impossible to state categorically, the broken bladelets were of such a small morphology that it seems likely that they were derived from bladelets (see discussion in conclusion on stone classification system). Flake-blades, and in particular, bladelets, were specifically selected for utilisation. The percentage occurrence of chips and chunks in the utilised assemblage is only 21,34 per cent - far less than their occurrence in the general assemblage (64,67 per cent). Opaline is the preferred raw material of stone material chosen for utilisation (91,95 per cent; 1,5 times more than the occurrence of opaline in the general assemblage).

There are 53 (1.33 percent) stone artifacts that could be identified as having been re-worked, that is, displaying some previous flake scarring older than the present flaking (Table 18). The majority of re-worked material are flakes and chunks (29,16 per cent; 30,19 per cent, respectively); this is more than their occurrence in the general assemblage, where chunks occur at 19,79 per cent and flakes at 25,39 per cent. Cores contributed 24,52 per cent of the re-worked assemblage. When the percentage occurrence of the categories of stone artifacts in the re-worked assemblage are compared with their percentage occurrence in the general assemblage, it is clear that cores occur eight times more frequently in the re-worked category. Similarly, formal tools constitute 9,43 per cent of the re-worked assemblage and, as a combined category,

category (25,39 per cent). Side-struck flakes are, by a small margin, in the majority.

The CM sample did not produce a large number of formal tools — 47 (1,19 per cent) — but within this small sample a wide variety of tool types occur (see Table 16). A sizeable portion of these formal tools were scrapers (21,27 per cent of the formal tool assemblage) that ranged in size categories from small to large. Knives (10,63 per cent), backed tools (8,51 per cent), a ventrally retouched bladelet, adzes (8,51 per cent), spokeshave (4,25 per cent) and an awl were also found. Eight tools were so broken that they could not be classified, and 10 tools were unclassifiable and were called 'miscellaneously retouched pieces'. Combined, the two categories of broken and miscellaneous, form the biggest group of formal tools (38,29 per cent).

A number of stone artifacts displayed utilisation (2, 24 per cent). The majority of the utilised stone material (Table 17) are side-struck and end-struck flakes (39,32 per cent); compared to the percentage occurrence of flakes in the general assemblage (25,39 per cent) it is clear that flakes occur 1,5 times more in the utilised assemblage than in the general assemblage. The occurrence of utilised flakes is thus not just a reflection of their presence in the general assemblage but indicates that flakes were specifically selected for utilisation. There seems to be no specific preference for either side- or end-struck flakes, but flakes of smaller than 30mm dominate. A similar much higher percentage occurrence of flake-blades (20,22 per cent)

pits, their well-defined edges as well as the 90° angle of their walls. It is suggested that they were deliberately excavated by the occupants of the cave.

On the western side of the excavation, in square Q4 a small concentration of charcoal and ash was designated as a hearth. On the eastern side, a large concentration of ash and charcoal was evidence of a hearth that was built on the surface of the big block of sandstone; a smaller concentration of ash and charcoal indicated a second hearth (in square K3). In the immediate vicinity of the smaller hearth in K3, an area of dense concentration of bone fragments was noted.

Stone material

The CM deposit occurred in 16 squares and a representative sample of the stone material from a random sample 10 squares was analysed (Q3, Q4, M3, M4, M5, L3, K3, K4, J3, K4, J3, J4). Table 16 provides the inventory of the 3 957 stone artifacts. As can be expected, chips and chunks constitute the majority of artifacts, namely 64,57 per cent. Eight manuports were also noted. Cores contributed only 3,1 per cent of the assemblage with the majority — 78 (54,54 per cent) — being irregular. Like the H level, CM has a sizeable assemblage of flake-blades (5,05 per cent). Once again, like the H level, the majority (83,80 per cent) of flake-blades are smaller than 26mm (that is bladelets). After the combined categories of chips and chunks, flakes constitute the next largest

CHAPTER SEVEN

CM LEVEL

Features

The CM level is an orange-brown deposit that, at a depth of about 500mm below surface, occurred over most of the excavation. In the north-eastern corner of the excavation (squares J5, K5, L5 and a section of M5) CM deposit was absent - possibly due to erosion. A stratigraphically interesting feature occurs between squares N3, N4 and the big block of sandstone in the eastern part of the excavation. It appears that over an extensive area (see Figure 21) *in situ* deposit of the H and LB levels were removed and CM deposit subsequently formed (See Figure 4). Once again, the angle at which the CM deposit cuts into the lower deposits is so distinct and at such a well defined 90° angle, that it is proposed that this was a deliberate action and not the result of animal disturbances or natural erosion of the H and LB deposit before CM occupation.

In CM, the conventional features of hearths and pits occur on the eastern and western side of this cut-away trench. On the plan drawing of CM two large pits and one smaller pit can be clearly seen in square P4 (Figure 21). The edges of these pits were well defined and they were stone lined (see Figure 4). Unfortunately these pits did not contain any material and were filled with deposit of a slightly different colour from the rest of the level. In square Q4, the top of CM deposit was removed by a similar cutting of the Ph deposit into CM (see Figure 4). Given the restricted scale of these

seems that the ostrich egg shells (used as water containers, and in bead production etc.) were being processed, used or discarded away from the first stage of stone knapping.

The three pieces of groundstone work occur in L4, a square that also does not contain high frequencies of other artifacts. At the beginning of H occupation, square L4 must have been bare rock and the H occupation debris was the first material to cover part of this rock. In the adjacent square, K4, there are three hollows in the big block of sandstone. The portable groundstone work thus occurs next to these permanent grinding hollows. This does not correspond to the spatial occurrence of ochre and one can thus safely assume that the material that was ground was not colouring material.

JA LEVEL

Features

Level Ja occurs at a depth of approximately 250mm below surface in the Q4 square, it varies in thickness from between 100mm and 200mm and extends across the full 20 squares (Figure 31). Like the other levels, Ja slopes from west to east.

There were two large, readily identifiable hearths in Ja and three smaller ashy concentrations. The two big features, one in square L3 and the other one extending across squares P3 and P*, were designated as hearths based on the density of charcoal. The western hearth was approximately 85mm by 400mm and the eastern hearth was approximately 600mm by 400mm. There were also three ashy features in squares O4, K5 and K3. These features were considerably smaller than the readily identifiable hearths and consisted of ashy areas of distinctly darker and softer deposit but did not contain particularly high concentrations of charcoal.

On the eastern side of the excavation three features were labelled as pits. These features had clearly distinguishable edges and continued beyond the depth of Ja deposit into the next level, Ph. The two larger pits in J5/K5 and K3 were capped with a layer of large stones and the smaller pit (in K5) had three relatively large stones lying at the side of the pit. The deposit in the three pits in Ja, though of a slightly different colour, was no different from the rest

The size-able occurrence of worked and un-worked ostrich egg shell, as well as, the well preserved diagnostic and undiagnostic bone material leads one to suggest that the absence of worked bone is not a preservation problem but a deliberate social choice of the community. The hearth area of square M5 contains both the highest mass of ostrich eggshell and undiagnostic bone and this area was probably a focal point of activity.

The food utility and density calculations done on the skeletal parts of the species identified in the Ph level, indicates that the presence of the bone can be mainly attributed to preservational factors. In *bovidae* size categories 1 and 3 the dormant pattern of bulk utility is still visible, and, especially in the case of *bovidae* size category 3, can be seen as a strong contributing factor to the bone assemblage. A utility strategy for the bone of *bovidae* size category 2 could not be detected, and for the *bovidae* size category 4 the correlation coefficient calculations pointed out that the detection of utility strategies would be erroneous. The formation of the bone assemblage for size category 4 should thus be attributed to bone preservational factors.

Given the, by now established, spatial clustering of tool types, the limited spatial extent of the small stone material sample could be problematic and the results should be approached with caution. The dominance of chips and chunks (55,24 per cent) is the pattern as expected at an occupation site where knapping occurred. It is of interest to note that this is the lowest percentage of chips and chunks of all the levels analysed so far and, as for the occurrence of certain tooltype frequencies in the CM level, can be seen as an indication of the spatially distinct location for tool working activities. Similarly, the high percentage of flakes in the Ph level could be due to the spatially constrained nature of the sample.

As already stated, the sample of stone material that has been utilised, re-worked or heat altered is too small to allow comparison with the general assemblage. It is, however interesting to note that even in this small and spatially confined sample, the trends as detected in the analysis of stone material from other levels, are broadly visible.

Compared to the previous the previous level — CM — the Ph level displays less of a difference between the richness indices for formal and non-formal material, and the evenness indices for formal and non-formal material. In the case of the richness indices differences, this is the start of a trend that will continue into the late Holocene (see Chapter 10).

significant. According to the Grayson proposals, this indicates an assemblage that is generated by bone destruction factors and no human decision-making strategies can be inferred.

Discussion

The occurrence of nine pits in the Ph level warrants further attention. It is a high concentration of these features in one level, but not out of the ordinary given the occurrence of these features in all the levels under study. Unfortunately, most of these pits were 'empty' on excavation — as is also the case in the Ph level — and one is thus not able to elaborate on the possibilities of storage, delayed delivery, territoriality etc. and the implication that this could have for change in social organisation in hunter gatherer societies (Hall 1990). The two sets of neatly constructed double pits (in squares N3, N4) are spatially distinct from the cluster of five, less well constructed pits (in squares P3 and O3) and could be an indication of the different functions and/or values attached to these pits.

The enormous hearth excavated in square M5 occurs to the north of the big block of sandstone. This location is similar to the position of a big hearth excavated in level H, square L5 and leads one to consider the opportune usefulness of the naturally occurring big block of sandstone and the development of ensuing social meanings.

•bov 1: %MAU & %den $p = .0006$, $r = .9156$

%MAU & %FUI $p = .0070$, $r = .7211$

•bov 2: %MAU & %den $p = .0000$, $r = .9189$

%MAU & %FUI $p = .0010$, $r = .6878$

Although all the relationships are significant for bov 1 and bov 2, the degree of correlation between %MAU and %density is the highest and should therefore be seen as the most important correlation. The bone of *bovidae* size categories 1 and 2 present in this level, is due, primarily, to preservation factors. The model does however provide a second level of explanation. The bulk utilisation strategy of the occupant of the Ph level, though muted by dominant preservation aspects, is still visible.

The correlation between %MAU and %den as well as %MAU and %FUI for the *bovidae* size category 3 is very interesting:

•bov 3: %MAU & %den $p = .0004$, $r = .8883$

%MAU & %FUI $p = .0013$, $r = .8063$

The correlation between %MAU and %density is the strongest, with a lesser, though relatively quite strong correlation between %MAU and %FUI. When a plot of the %MAU against %density is inspected, a curve that could be seen as indicative of bulk utilisation is visible. Once again, although the primary reason for bone in the level is attributable to preservation factors, bulk utilisation was definitely a co-contributing factor.

In the *bovidae* size category 4 the correlation between %MAU and %density was significant but between %MAU and %FUI not

concentration of bone occurs in the middle section of N3, N4 and M4, M5. Although a large number of skeletal parts (and concomitant species) could be identified (NISP = 418), most of the bone was heavily fragmented. Given the good preservation in this level, it is reasonable to assume that the bone was not fragmented due to post-depositional damage, but in a deliberate effort to extract marrow.

The skeletal parts of the four size categories for *bovidae* were grouped and Food Utility Indices (FUI) calculated. The percentage FUI values were plotted against the percentage Minimal Animal Units (%MAU) on XY scatter plot (Figure 30). A visual examination of these plots shows that for *bovidae* size categories one, three and four a bulk utility strategy is evident — skeletal parts with moderate and high food value were brought back to the site. Size category two displays a linear relationship between %FUI and %MAU and the model of utility strategy does not apply.

As discussed previously, these visual plots can be misleading as density values can produce similar curves. The density values for these grouped skeletal parts were then calculated and Spearman rank-order correlation tests done on the %FUI and %MAU as well as the %density values and %MAU. Except for a not significant correlation between %FUI and %MAU in the *bovidae* size category 4, all the correlations were significant:

than in the formal assemblage (lower evenness index for non-formal assemblage compared to formal assemblage).

Ostrich egg shell

Over 200g of ostrich egg shell was excavated in the Ph level (Figure 27). The state of preservation of the ostrich egg shell was quite good and a number of worked ostrich egg shell pieces were also found. The biggest mass of ostrich egg shell was in squares M5, N4 and L4. Figure 27 shows the worked pieces of ostrich eggshell. Three separate pieces of unfinished beads were found in square M5. In squares N4 and P4 two separate pieces that could have been water bottle plugholes were also found.

Worked bone

Although the general bone preservation in Ph was good, only two pieces of worked bone were found (Figure 28). In square J4 a broken linkshaft was excavated and in square M5 a fragment of polished bone was found.

Bone material

The bone in the Ph level was exceptionally well preserved (Figure 29). Over 12kg of bone was excavated in 19 squares; this is an average of 600g per square. Spatially, the bone is evenly spread across most of the excavation but a slightly higher than average

A number of stone material exhibits evidence of heat alteration (Table 26). The category of chips and chunks constitute 59,32 per cent and flakes (including broken flakes) 23,72 per cent of the heat altered material. Although the sample of stone material from Ph is small and comparison with the general assemblage thus problematic, it is interesting to note that cores occur in double the frequency in the heat-altered assemblage as opposed to their occurrence in the general assemblage.

Four pieces of miscellaneous groundstone work and two palettes were excavated in the Ph level. A minute piece of ochre was also found in square M3 (Table 27).

With the exception of one tool, all the formal stone tools in the Ph sample were manufactured on opaline. Opaline is also the dominant raw material in the non-formal categories (51.46) with an indication of preference for translucent opaline material (Table 28).

When the Ph level formal and non-formal richness and evenness indices are compared, the difference in strategy between the knapping stages becomes obvious (Table 29). In the first knapping stage less of a variety of stone categories were produced compared to the variety produced in the formal assemblage (non-formal material lower richness relative to formal material); the apportionment of the frequency of stone material across the categories were also less equitable in the non-formal assemblage.

dominant component of the stone assemblage (55,44 per cent). Cores constitute 4,48 per cent of the assemblage; most of the cores could be classified as either irregular (45 per cent) or the result of bladelet manufacturing (41,54 per cent). A size-able component of flake-blades, forming 5,49 per cent of the assemblage was recognised; when broken flake-blades are combined with bladelets, 84,61 per cent of the flake-blade category can be classified as smaller than 26mm. Flakes is the second biggest category of stone material with the majority of flakes being side-struck (55,07 per cent).

The small sample of formal tools presented 7 scrapers, 5 adzes and a number of broken tools as well as tools that were retouched in such a irregular way as to be classified as miscellaneous. A single tool displaying technological characteristics associated with the Middle Stone Age and a ventrally retouched bladelet were also noted.

Within the small sample of Ph stone material, thirteen pieces show utilisation damage (Table 24). Bladelets and broken bladelets form the majority of the material and, with the exception of one piece, all the utilised stone material occur in opaline. Note was also taken of the material that display previous episodes of flake-scarring and sixteen such pieces were identified (Table 25). The majority of the material that is re-worked resulted in flake-blades and the material of choice is opaline. Unfortunately, these samples are too small to allow comparison with the general assemblage.

nine pits. These pits were clearly defined by 90° edges containing, relative to the surrounding level, softer and slightly darker deposit. These pit deposits did not contain any material different from the rest of the level deposit, and the pits have been designated as empty. In most instances, the pits continued beyond the depth of the Ph deposit into the underlying CM deposit. The four smaller pits in the western cluster as well as the two pits in square N4 were clearly stone lined. In square P3 there appears to have been a pit dug on top of a previous pit. In squares N3 and N4 the double pits are so neatly constructed and, in the case of N4, stone lined, that it seems it is a deliberate attempt to pair the sets of pits.

A concentration of teeth fragments was visible in M3. When the plan drawing for the Ph level is compared with the plan drawing for the CM level, the gradual build-up of deposit around the big block of sandstone in squares M3, M4, M5, L3, L4 and L5 can be seen. By the end of the Ph occupation the rock was nearly completely covered. To the north of the big rock, in square M5 a big hearth rich in charcoal and bone was excavated. A section of a hearth was also excavated in the southern edge of N3; unfortunately most of this hearth would be in square N2 and this square was not excavated.

Stone material

Due to time constraints, the stone material from a sample of four squares was analysed for the Ph level (Table 23). As for all the other levels, the combined category of chips and chunks is the

CHAPTER EIGHT

PH LEVEL

Features

After the formation of the CM deposit, Rose Cottage Cave was unoccupied for a period of time. As can be seen in the south section drawing, a number of calcrete washes were deposited in and on top of the CM level. These are the residue of intermittent spring activity that must have originated at the back of the cave at times of high rainfall. The next occupation level, Ph, was then formed on top of the calcrete washes and remaining CM deposit. The Ph level was a thick black level, well preserved, and rich in archaeological material.

It can be seen in the section drawing that some of the underlying CM deposit was removed in square Q4, and Ph occupation material deposited in its place. The western-most edge of this feature is clearly visible in the section drawing, and it seems that the cut-away extends across the whole of square Q4 until about 150mm from the Q4 — F4 boundary. Given the sharp angle of the one edge of the feature, it is considered to have been deliberately caused by human action. It is interesting to note that it is in the same position as a similar feature in the CM deposit.

The Ph level extends over most of the excavation, with only sections of squares J5 and J4 not containing Ph deposit (Figure 26). An interesting feature of the Ph level is the occurrence of

Unfortunately spatial information for stone material in the CM level is incomplete and it was decided that determination of spatial patterning would be premature at this stage. The spatial extent of the ostrich egg shell and the (sizeable) worked bone sample is known. Although there was no preservation problem in the southern most squares, no ostrich egg shell occurs in that area. The highest occurrence of ostrich egg shell is in square N4 - the area in which the CM deposit pits through the H deposit. The high occurrence of ostrich egg shell in an area that could possibly have contained bedding material, leads one to suggest that ostrich egg shell water bottle containers could have been stored in the bedding material (see similar occurrence in Elephant Shelter, Wadley 1979). A large number of worked bone occur square N3 — adjacent to the high ostrich egg shell occurrence in N4.

In *bovidae* size categories 1 and 3, the calculations done on bone occurrence, density and food values points out that the bone assemblages were primarily formed through differential bone preservation. The dormant pattern of bulk utility strategy is visible in the *bovidae* size category 1 assemblage. In *bovidae* size category 3 the assemblage conforms to the predicted Grayson model for bone attritional factors producing the assemblage. In *bovidae* size category 2 there is a stronger correlation between occurrence and food values than occurrence and density values and, although density obviously played a role, the excavated archaeological assemblage is primarily the result of human transport decisions (bulk utility).

potential of bone in the Ja level is thus directly related to the bone's specific density.

Following the suggestions of Grayson for differentiating between archaeological assemblages produced by bone attritional factors or archaeological assemblages produced by human decision mechanisms, Spearman rank-order correlation tests were calculated.

In *bovidae* size category 1, the relationship between percentage occurrence and percentage density is significant and positive:

•bov 1: %MAU & %den $p = .0038$, $r = .8728$

whereas the percentage occurrence and percentage food value relationship is not significant:

•bov 1: %MAU & %FUI $p = .0725$

Within the Grayson model, such a constellation of relationships occur only in assemblages that are produced (primarily) through poor bone preservation factors.

In *bovidae* size category 2 the relationship between percentage occurrence and percentage density, as well as percentage occurrence and percentage food value is significant and positive:

•bov 2: %MAU & %den $p = .0001$, $r = .8513$

%MAU & %FUI $p = .0014$, $r = .7163$

Similarly, in size category 3 the Spearman rank-order correlations are significant and positive for both the percentage occurrence and percentage density and percentage occurrence and percentage food value relationships:

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vertebra in the western side of the excavation. The high percentage of enamel in P3 is an anomaly, especially when viewed against the spatial distribution for skull material.

Most of the bone in Ja was burnt, but it was not clustered around the areas where hearths occur. This raises interesting implications for the understanding of bone dumping behaviour, and will be discussed later in more detail. A small percentage of bone displayed cut marks (see Potts and Shipman 1981 for a discussion of cut marks on bone). Most of this bone occurred in square M5, an area outside of the general distribution of bone.

After calculating the food value (%Food Utility Index) of each skeletal part of the *bovidae* in Ja (as grouped into the four size categories), XY scatter plots were produced (Figure 41). The first step in the analysis is the visual inspection of the plots, and it is clear that the plots of the food values against their relative frequency of occurrence (%Minimal Animal Unit) produces consumption site bulk utility curves. This means that skeletal elements with moderate and high food values were chosen, while elements with low food values were selected against.

But, as Lyman (1984, 1985) and Grayson (1989) pointed out, bone attritional factors could produce similar curves. The values for percentage bone density (%den) were then calculated on similarly grouped data. In Ja, the XY plots for the percentage density and percentage occurrence display a linear relationship. The preservation

table, the majority of the refuse bone (56,52 per cent) consists of long bone fragments. Only 24,57 per cent of the refuse bone could not be identified to skeletal parts and was classified as miscellaneous.

Confirming the above pattern of long bone dominance, the ratio of identifiable bone to mass of refuse bone is calculated at one piece of identifiable bone to every 15.5g of refuse bone. The similar ratio for long bone was one piece of identifiable bone to 8.77g of long bone.

Most of the refuse bone material was burnt (74,47 per cent) as can be expected at a human occupation site. A small percentage showed gnaw marks (carnivore and porcupine) and could be indicative of cave utilisation by non-humans (Thackeray, JF 1990).

The main interpretive value of refuse bone skeletal identification does, however, lie in the spatial distribution. Like the stone, the bone in Ja occurs in the same eastern and western blocks of distribution. Square L5 has the highest concentration of bone with most of the rest of the bone occurring in the eastern area of the level. The long bone pieces, rib and skull all have their highest occurrence in L5. The squares adjacent to L5 also contain high percentages of these skeletal parts and very little long bone, rib and skull occur in the western part of the excavation. Although most of the vertebra material also occur in L5, relative to the spatial distribution for other skeletal parts, there is a high percentage of

material of the wall of long bone and none of the items was decorated. Except for one complete point and a snapped shaft piece, all the items were fragmented. On the piece of snapped shaft there are two chop marks and on the one end of this piece the manufacturing process of sawing half-way through the bone and then snapping the object, can be seen.

Of special interest are two warthog tusks, which were excavated separately and in an extremely fragmented state. I was able to refit the pieces and it emerged that each set of fragments constitute one half of a tusk split lengthwise; they are not from the same tusk. There are clear, unidirectional striation marks on the inside of each tusk.

Bone material

Over 6kg of bone was excavated in the Ja level but, as for most archaeological sites, only a small fraction of this bone was identifiable to species, genus or family size level. The bulk of the bone material is not identifiable to the above categories and is classified as undiagnostic refuse.

The analytical value of refuse bone has always been underestimated. It is, however, possible to identify the skeletal part ancestry of most of the refuse bone. Unfortunately, it is very time consuming and, at Rose Cottage Cave, this data was collected only for the Ja level (Table 37, Figure 40). As can be seen from the

The abraded stone in Ja occurs on a wide-spread spatial scale. Once again, there is a (weak) pattern of clustering in the eastern and western area.

The richness and evenness indices were calculated on the stone assemblages in each square (Figure 37). Within the non-formal category, K4 had the lowest richness. The sample sizes of the formal tools per square was very small and I decided to ignore the calculations in squares with small sample sizes as well as those calculation resulting in non-fractional indices. Square L then exhibits the highest richness index.

Ostrich egg shell

Ja level produced over a 100g of ostrich egg shell (Figure 38), but not a single piece of decorated shell nor any beads. The state of ostrich egg shell preservation was not good — the material was quite friable and soft. When the spatial distribution of ostrich egg shell in Ja is considered, the ostrich egg shell is concentrated in the two eastern and western areas of artefact build-up, with squares L5 and Q4 having the highest concentration of ostrich egg shell.

Worked bone

A number of worked bone pieces was found in Ja (Figure 39). The bone objects appear to have been manufactured from the dense

As can be expected, heat-altered stone seem to cluster in the vicinity of hearths. The highest frequencies of heat-altered stone occur in squares Q3 and Q4, next to the big hearth that spans squares P3 and P4. The second highest number of heat-altered stone is in square K5, the square that contains the small ashy feature (Figure 35).

Figure 36 provides the raw material utilised for stone artefact production from Ja per square. The opaline material occurs in high percentages in squares K4 and L3, reflecting the high percentage of stone material in those squares. There is an emphasis of hornfels material in square M3 that is not a direct reflection of the amount of material that occur in that square, and could be indicative of an area of preference for working in hornfels. Square Q4 displays a similar emphasis on tuffaceous material.

When the spread of raw material used for the manufacturing of formal tools is considered, the preference for translucent opaline in the manufacturing of formal tools is once again evident. The western area of activity contains a total of 38,56 per cent of the translucent opaline material; this is more than could be expected if the raw material choices are just an unbiased reflection of the frequencies of formal tools produced in that area. An interesting anomaly is the high percentage of tuffaceous rock in the western area. As for the translucent opaline, this indicates a selection for working in tuffaceous rock in a specific area.

material occurs in the eastern side, in squares K4 and L3. Square L3 also contained a big hearth, and K4 is next to a small, but distinct, ashy concentration in K5.

The spatial distribution of the non-formal material follows the same pattern as the combined stone material. The categories of chips and chunks, cores, as well as flakes, are clearly concentrated in the two identified eastern and western areas of stone concentration. It is of interest to note that a moderately high percentage of side-struck flakes occur in the western concentration.

The distribution of formal tools also follows the broad east-west distribution. Unlike the non-formal categories that have a low percentage of occurrence in the western side, the formal stone has a moderately high (33,51 (positive) per cent) occurrence on the western side.

Figure 33 is a diagrammatic presentation of spatial occurrence of some of the utilised material. Unlike the non-utilised material no clear east-west division is visible. There is a slight indication of material being preferentially used in two squares at the back of the cave.

With the exception of one square (N3), the re-worked material is spatially divided between the east and west, with most of the material occurring on the eastern side (Figure 34).

consists of hornfels, tuffaceous material or relatively fine-grained sandstones. Like the other Oakhurst levels, Ja had a small percentage of quartz material (4 per cent of general assemblage).

In the Ja level richness, evenness and diversity indices were calculated for the stone assemblage. As in the previous levels, the indices for the non-formal stone are lower than the indices calculated for the formal stone tools (Table 36). This indicates that the structure of the non-formal assemblage is, compared with the formal material, far less diverse (of a lower richness). The lower evenness is indicative of an uneven division of tools in the non-formal category — as can be expected in an assemblage that has a high number of chips and chunks.

When indices for the formal categories are calculated, a pattern of high richness and high evenness (relative to the non-formal material) emerges. A great variety of formal tools were produced, but the production of no one type of formal tool was particularly emphasised.

Spatial configuration

The spatial distribution of stone material in Ja was also analysed (Figure 32). When the combined categories of formal and non-formal stone are considered, it is clear that the stone material from Ja is spatially concentrated in two blocks in the eastern and western areas of the excavation. There is an area of 'empty space' between the concentrations. The highest concentration of stone

chosen for re-working was opaline, while only 5 per cent was antiquities of 'other-than-opaline' material.

Table 33 lists the stone from Ja that has been identified as heat altered. The relative frequencies of heat-altered stone tool material do not differ significantly from their relative frequencies in the general assemblage. The majority of stone artifacts that display signs of heat treatment are artifacts manufactured on opaline (95 per cent).

Abraded stone and groundstone work are not included in the stone inventory discussed above. Table 34 provides the inventory of such stone in the Ja level. A total of 16 abraded stones occur in Ja. Unfortunately most of the abraded stones were in the form of small to minute pieces. There are two upper grinders and four palettes, the rest of the abraded stone is classified as miscellaneous ground stone work. A single piece of unworked rock crystal was found in Q4. Small pieces of ochre, specularite, haematite and other iron bearing stones were also found.

The preferred raw material in the Ja level is opaline (57 per cent) (Table 35). The preference for opaline is especially evident when the raw material choices in the formal tool categories are considered. Here, 85 per cent of the formal tools are made on opaline; 44,3 per cent on translucent opaline and 40,2 per cent on non-translucent opaline. Despite this obvious preference for opaline a sizeable component, especially of the non-formal material,

11,34 per cent (11) (see Table 30). A few broken and miscellaneous tools as well as knives and an awl complete the formal tool categories.

Table 31 displays the inventory for the utilised stone material from Ja. It is interesting to note that only three formal tools were identified as having been utilised. The most abundant categories of utilised artifacts are chunks (30 per cent) and flakes (32,85 per cent). These percentages reflect the abundance of chunks and flakes in the general assemblage. The flake-blade category (including blades, bladelets and broken blades) is nearly nine times more abundant in the utilised collection than in the general assemblage (utilised assemblage 27,14 per cent; general assemblage 3,08 per cent). There is also a strong preference for utilising opaline material, 91,42 per cent of utilised material occur in opaline material, whereas the occurrence of opaline in the general assemblage is only 57,77 per cent.

Table 32 provides an inventory of artifacts that have been manufactured on older stone artifacts. It is interesting to note that formal tools occur in five times the frequency in the category of re-worked stone material assemblage than in the general assemblage. A similar preference for choosing older stone material to use as cores, is displayed in the high frequency of cores in this category; cores are five times more likely to occur in the re-worked category than in the general assemblage. Once again there is a strong preference for opaline: 95 per cent (83) of the material that were

of the Ja deposit. The pits have therefore been designated as empty.

The two large hearths were approximately 3.6m apart. The area between the hearths did not contain any conventional features. This 'empty space' is seen as a component in the organisation of space in the Ja level. Further evidence for the recognition of 'empty space' will be provided in the discussion below.

Stone material

Level as a unit

Out of 4 870 pieces of stone, only 2,02 per cent were formal (Table 30). The categories of chips and chunks, combined, contribute 61,42 per cent of the stone present in the level. Cores contribute 4,2 per cent and within the core category, nearly half (49,75 per cent) of the cores fall in the irregular category. Flake-blades are 3,08 per cent of the stone assemblage; within the flake-blade category 40,6 per cent of all flake-blades are broken and 51,3 per cent are classified as bladelets that is smaller than 26mm. After chips and chunks the next most abundant category is flakes; 29,21 per cent of the stone collection in Ja consists of flakes. Excluding core rejuvenation flakes and broken flakes, most of the flakes (54,97 percent) were manufactured by side-struck technology.

Of the 97 formal tools the most abundant categories are: scrapers 39,17 per cent (38), backed tools 26,80 per cent (26) and adzes

more widely and evenly distributed across the occupation floor. This may be linked to the high percentage of side-struck flakes produced in material other-than-opaline.

The spatial organization described above establishes, within the parameters of the proposed model, the integrity of each level in the cave. Significantly, the model of previous occupation features which actively participates in the spatial dialogue of the next occupation, can also be applied to successive levels. When successive levels are considered, the constraining and informative nature of space is visible.

In the CM level an area of deep deposit was formed next to the big block of sandstone. As suggested in the CM chapter, this area is right next to the highest section of the big sandstone block, and contains relatively low frequencies of occupation debris. I proposed that it would have functioned ideally as a sleeping hollow. In the next level, Ph, this is the area in which two sets of neatly constructed double pits, were located. Although these pits were empty on excavation, they are of such a careful and neat construction, that it seems reasonable to assume that whatever was stored in these pits was of value to the occupiers of the cave. The pits were placed in an area of deposit that is relatively clear of previous occupation debris, and/or possibly containing decomposed bedding material. Within this model, it is understood that the choice of emplacement for these pits was simultaneously constrained by functional considerations on the one

1992:55). The more private areas, prepared for sleeping shelters, will also typically display a low frequency of occupation debris (Yellen 1977; Gould & Yellen 1987). I suggest that these archaeologically observed 'empty' areas formed part of deliberate spatial organisation during occupation at Rose Cottage Cave and can be seen as part of intentional spatial arrangement.

In both the H and Ja level there is a clear spatial location for the first stage of knapping. The highest occurrence of cores, chips and chunks are in the same area. The highest occurrence of end-struck flakes co-occur with the cores, chips and chunks. Side-struck flakes do not have as confined a clustering pattern as end-struck flakes, and are more widely distributed across the occupation floor. In both the H and Ja level, there is also a sizeable component of un-utilised side-struck flakes in the area where the strongest clusters of formal tools, bladelets and re-worked material co-occur. In both levels this material (formal tools, bladelets, re-worked material and un-utilised side-struck flakes), co-occur in spatially distinct clusters and is apart from the clusters of cores, chips and chunks.

The raw material distribution displays a spatial differentiation for working in opaline material as opposed to working in material 'other-than-opaline'. The highest frequencies of raw material other-than-opaline (tuffaceous in the H level; hornfels in the Ja level) co-occur with the highest frequencies for opaline material. However, unlike the opaline material, the clustering for other-than-opaline material is not as tight — the other-than-opaline material appears

CHAPTER TEN

THE DEVELOPMENT OF A CHRONOLOGICAL NARRATIVE

In the preceding chapters, I delineated the archaeological occurrences of the late Pleistocene and early Holocene at Rose Cottage Cave. I now review this material, with the purpose of developing a chronological perspective.

Space - Time

Four levels at Rose Cottage date to this period. A single level could be the product of a once-off occupation, or the result of repeated visits over a relatively short term. In either case, the spatial configuration of each occupation is informed and constrained by the previous spatial text. In each level a well-defined spatial patterning is visible. The articulation of occupation features (hearths, pits, empty spaces), material culture remains (stone material, ostrich egg shell, worked bone and other bone residue), and the physical cave conditions, present arrangements that had meanings to the society under study.

As discussed in the specific chapters dealing with each level, in the CM, Ph and Ja levels there were 'empty' areas, containing no conventional occupation features (hearths or pits) as well as low frequencies of occupation debris. (The limited spatial extent of the H excavation could be the reason no such area was recognised in that level). An open public space can be considered a feature of hunter-gatherer campsites (Fisher and Strickland 1991; Reeler

SECTION IV

DISCUSSION and CONCLUSION

stone is the same as their frequency of occurrence in the general assemblage, and one is thus not able to point to any preferential choice of stone material for heat treatment.

Like the formal tools, ostrich egg shell follows the broad east-west distribution, but has a more balanced spread between the two areas.

The spatial distribution of refuse bone largely conforms to the east-west distribution of artifacts in Ja. The anomalous high occurrence of enamel material in square P3 (outside the area of high occurrence for skull) should perhaps be seen in conjunction with the presence of formal tool activity in square Q3. Although not noted ethnographically, it is reasonable to assume that mandible and maxilla, with their ready cutting edges, can be used as tools.

Although there are two readily identifiable hearths and three areas of ashy concentration, it is interesting to note that the burnt refuse bone in Ja does not cluster around these hearths. Burnt bone seem to have been dumped in squares M4, L4 and L5. The highest occurrence of long bone fragments is also in these squares. It is thus suggested that after roasting the meat, the bone, especially long bone, was removed from the fire and marrow processing was done in this area. The big, flat block of sandstone that occurs on the boundary of squares K4 and K5 could have functioned as an anvil.

Like the burnt refuse bone, heat-altered stone does not cluster around the two big hearths. There is, however, a reasonably high number of heat-altered stone around the ashy concentration in square K5. Unfortunately, the frequencies of types of heat-altered

When the spatial configuration of material that constitute the final stage of knapping is analysed, a better balance between the western and eastern distribution areas, is visible: compared to an occurrence of only 6,79 per cent for non-formal tools in the western area, 31,51 per cent of formal tools occur in the western area.

If we assume that the spatial distribution of formal tools is more closely linked to their area of usage than their area of production, we have an interesting situation in the Ja level in which the stone knapping seems to have taken place (primarily) in the eastern area while the use of formal tools was more linked to the western area. This tentative suggestion is further supported when the spatial data on utilised tools are considered. Utilised tools appear to be widely spread and do not cluster in either the eastern or western areas. Unlike the H level, bladelets do not cluster around the primary formal tool area.

A further exception to the above distribution into eastern and western areas, is the relatively high occurrence of adzes in the otherwise 'empty' area. This is an interesting phenomenon and could be indicative of the type of activity associated with adzes and spokeshaves, that is the manufacturing of digging sticks and the working of skins (Parkington and Mazel 1978) took place in a space not associated with other activities. Given the small sample size (11), this pattern can not be seen as conclusive. It should rather be viewed as an interesting possibility to be further researched.

reasonable to suggest that the bone assemblage in the Ja level is primarily due to bone attritional factors. However, for the *bovidae* size categories 2 and 3 an indication of a consumption site bulk utility as an underlying factor in the creation of the assemblage, can be suggested. This implies that for animals of these size ranges (from springbuck to roan antelope) most of the skeleton was brought back to the site.

Spatial configurations

The distribution of stone material in the Ja level is clearly clustered in two areas with an area of empty space between them. A similar area of open space was noted at the Duineveld excavation (Reeler 1992:55).

In the eastern side of the excavation a big charcoal-filled hearth, two ashy concentrations, as well as three stone-capped pits are visible. The highest frequency of stone (especially chips and chunks, and flakes) occurs in square K4, a relatively open space between these features. A big flat block of sandstone was excavated between squares K4 and K5. K5 also has a high frequency of heat-altered stone, as well as a charcoal-less ashy feature; while square L3 has the highest number of cores. Square K3 is also the square with the lowest formal richness index. It is thus tempting to suggest that the first stage of stone reduction took place in the eastern area.

tools (second stage of knapping) the following pattern emerges. The knapping methodology of the first stage produced in a limited variety of artifacts with an uneven spread of the number of artifacts in each category (low richness, low evenness). In contrast to the non-formal material, the formal stone knapping strategy is less 'standardised' — it has high richness, but more control was exercised over the number of tools produced in each category (high evenness).

The two striated warthog tusks bears a tantalising resemblance to the ivory "dagger" excavated at Border Cave (Beaumont 1978:Figure 25, opposite p.38). Although only the outer 'husk' of the warthog tusks were excavated at Rose Cottage Cave, it seems reasonable to assume that the complete tusks were used.

The refuse bone in Ja is dominated by long bone. This can be attributed to a number of factors. Long bone is extremely durable and can withstand severe post-depositional impact (Behrensmeyer 1978; Behrensmeyer *et al* 1979); in addition, long bone is relatively easy to identify, even when broken up into small pieces. It is also important to consider that since other bone material (ribs, vertebra, skull) are more friable, it would have been more easily destroyed in the consumption of the meat around these parts.

When the skeletal part food and density values are considered it is clear that, although not conforming absolutely to the proposed pattern of destruction driven assemblages (Grayson 1989), it is

a morphology of small and flat was noted in the broken flake-blade category.

Not only do the bladelets display a remarkable degree of standardisation, but there is also evidence for the extensive utilisation of bladelets. As noted above (Table 31), bladelets occur in a seven times higher frequency in the utilised category than in the general assemblage. This is coupled with the remarkably low occurrence of utilised formal tools (3), and indicates that bladelets were the tools that were primarily utilised. The high incidence of opaline material in the utilised assemblage could be indicative of a preference for material that produces high-quality cutting edges as well as providing a greater degree of control over the knapping technology. It could also, however, be a factor of ease of identification. An anomaly is the presence of a number of chunks and chips with utilisation damage. Although this could be attributed to erroneous identification of utilisation (but see Chapter Four), it could also be the result of the utilised edge of artifacts being 'cleaned'.

In the re-worked assemblage there is a clear preference for opaline material. When this is seen in conjunction with the high proportion of cores it can be proposed that the stone material from previous occupation levels was seen as a resource base to be 'quarried'.

When the richness and evenness indices for the non-formal material (first stage of knapping) is compared with the indices for the formal

Discussion

Level as a unit

Most of the stone material from Ja was classified as non-formal. The majority of stone material are chips and chunks; the 'waste product' that is produced during the manufacturing of tools. This high percentage of waste, coupled with the sizeable component of cores in Ja, is an indication that stone knapping took place at the site.

It was noted during the classification of the non-formal material in Ja that there is a regularity in the size and morphology of the flakes that cannot be expressed in the traditional classification scheme. This is a qualitative judgement, and unfortunately no quantifiable data is as yet available^a. This high degree of standardisation in the flake category must be seen in conjunction with the insight provided by the diversity indices, as will be discussed below.

Flake-blades constitute a small part of the non-formal material in Ja. Like flakes, flake-blades (and specifically bladelets) showed a marked degree of standardisation. The majority of the flake-blades could be classified as bladelets, and whether they were parallel-sided, thick triangular or small irregular, the overriding morphology was a bladelet of small and flat dimensions. As for the other levels,

^aA project measuring the width, breadth and height of individual flakes and flake-blades from Rose Cottage is in process. These quantification techniques are, unfortunately very time-consuming, and it is suggested that future research give attention to developing a finer grained classification schema for flakes when dealing with assemblages dated to the late Pleistocene — early Holocene boundary.

•bov 3: %MAU & %den $p = .0013$, $r = .8943$

%MAU & % FUI $p = .0169$, $r = .6382$

The Grayson model does not provide explanations for both percentage food value and percentage density relationships to the percentage occurrence being significant and positive. The relationship of percentage density and percentage occurrence is highly correlated in both size categories 2 and 3, while the correlations between percentage food value and percentage occurrence is of a lower order. On the first level of explanation the dominant causal factor in the production of the archaeological assemblage is bone destruction. However, the bulk consumption strategy of the producers of the archaeological assemblage is also still visible as a 'shadow' (or second level explanation) underlying the bone destruction driven assemblages.

In *bovidae* size category 4, both the percentage occurrence and the percentage density as well as the percentage occurrence and percentage food value rank order correlations are not significant:

•bov 4: %MAU & %den $p = .01513$, $r = .9747$

%MAU & %FUI $p = .18230$, $r = .6669$

The relationship between percentage occurrence and percentage density is only by a small margin not significant and, if this small margin is ignored, the *bovidae* size category 4 bone assemblage can be ascribed to bone destruction.

CHAPTER ELEVEN

CONCLUSIONS

"We should not be depressed that the hypotheses ... tell such radically different stories, for a large amount of agreement about ascertainable issues ... underlies the ordering of information into these contrary tales; and the tales themselves, like all fruitful theories, [serve] as marvelous devices for suggesting further questions and avenues of future research" (Gould 1994:26).

This study set out to explain the temporal and spatial patterning dating to the late Pleistocene / Holocene boundary at Rose Cottage Cave. In Chapter One I detailed the present debates pertaining to this period and expressed concern with the parameters within which these debates have proceeded. I suggested that our comprehension of the Pleistocene / Holocene boundary period is unlikely to advance unless we extend our terms of inquiry.

I specifically suggested that we need to develop avenues of understanding the intentional role of material culture beyond the confines of a techno-economic explanation. This understanding of material culture will enable us to study change as behaviour that is informed by meaning and affected by human agency (putting the woman and the man 'back' into the societies we study). I further suggested that we need to develop a sensitive awareness of how the character of deep sequence archaeological deposits has shaped our understanding of archaeological patterns.

over time, these fluctuations do not (strictly) correspond with the technological periods. However it would, in my view, be simplistic and erroneous to assume a direct utilitarian link. The production of a specific tool type cannot be simplistically linked to the hunting of a specific animal.

Based on the data presently available in this dissertation, I proposed an explanation for the richness and evenness indices patterning as displayed by the bone and stone. I recognise that issues such as the range of other more 'economic' activities performed at site (especially activities not related to hunting like plant food processing, preparation of other tools), discard and use patterns, groups size and group configuration etc. need to be considered. However, I reiterate that I consider this only possible once more comparative work within the paradigm proposed in this dissertation is available.

The inferences derived from the above chronological perspective are tentative suggestions. I now move on to a discussion where I evaluate their contribution and make suggestions of further research.

that an increase in the distinctiveness of the formal tools from the non-formal stone material could be linked to an intensified need to signal their distinctive character — thus emphasising their potential social role. At times when the variety of stone material produced increases, there is a parallel 'standardisation' of the hunting procedure. The advancement of social bonds through the distribution of specific elements of the spoils of the hunt, is a well established principle in hunter-gatherer societies (Cashdan 1985).

It is interesting to note that, at Rose Cottage Cave, in periods when the hunting just produced 'more of the same type of animal' (high evenness) and the enhancement of social bonds through the distribution of specific and distinctive skeletal parts would not have been possible, there is a concomitant increase in the variety component of the formal stone material. I thus propose that the stone material and bone material functioned in a closely linked, but alternate manner, in the establishment of social ties*. The conventional position of associating stone industries and types of animals hunted, is thus not unreasonable. As previously discussed in Chapter Five, the stepped nature, and strong internal correlation of the coefficient correlations calculated for the species community structure of each level, corresponds with related technological stone industries. Although there were changes in environmental conditions

*Unfortunately the extremely time consuming calculation of Food Utility strategies for the ungulate community of all the levels, did not provide conclusive support for the above proposal. This can possibly be ascribed the methodology of collating all identifiable ungulate bone material into archaeozoologically established four size categories — categories that might not have been of any value to the societies under study. Future research will need to calculate Food Utility Values on a variety of differently grouped categories.

Figure 46, when the richness index for stone is plotted against the richness index calculated on all macromammalian species (as well as against the ungulates only), a mirror image of increased richness in stone linked to a concomitant decreased richness in species, is revealed for all the levels up to A2 (a similar plot for evenness calculations does not display any clear patterning; Figure 47).

An increase in stone assemblage richness is related to an increase in the variety component of the assemblage, that is a wider range of tool types were being produced; while a decrease in the richness of animals hunted indicates that a smaller variety of animals was hunted. A decrease in the variety of animals hunted could be linked either to the hunting of fewer bigger animals, or the hunting of more of the same types of animals. When the graph of species evenness and stone assemblage richness (Figure 48) per level is considered, it is clear that the evenness index for species shows a similar trend to the richness index for stone assemblages, in all the levels except Ph and the levels above A2. Thus, for most levels, concomitant with an increase in the variety component of the stone assemblages, there is an 'increase' in the specialised hunting of more of the same type of animal.

The question arises as to what the social strategy behind this patterning could be? If we accept that stone tools, simultaneous to their techno-economic function, also play a role in social relations, the increase in the variety of tools manufactured could indicate a change in some aspect of social relations. I have already argued

non-formal components of successive stone assemblages. The marked difference between the diversity indices for the formal and non-formal stone material demands consideration in its own right. We need to entertain the possibility that it can be seen as indicative of different 'intentionalities' during these two stages of knapping. If the meaning carried by the two categories was the same to the producers, one would expect these two knapping processes to display the same characteristics. This is, however, not the case. In some levels, the structure and control of the section of the 'text' consisting of the first stage of knapping is broken and reversed during the second stage of knapping. Although the production of formal tools can only proceed within the parameters set by the initial stage, the producers seem to make a special effort to indicate the distinctiveness and special character of formal knapping. The boundaries established by the initial knapping text seems to be 'twisted and turned' in an effort to signify the different and special qualities of formal tools. When formal tools were expected to play an important role in signifying social relations, distinctions between formal and non-formal tools were likely to be emphasised (Figure 45b). In the same way that a methodology sensitive to spatiality reveals clear patternings, here a methodology informed by a social-intent perspective allows potentially significant patterns to come into view.

By viewing the structural properties of the stone assemblages in relation to the community of faunal species identified in the respective levels, a clear association emerges. As can be seen in

of analysis that takes the social meaning of material culture into consideration.

In an effort to understand the internal composition of stone assemblages better, I have applied an analytical technique (the calculation of diversity indices) that evaluates the structure of these assemblages. In the chapters dealing with each of the levels under study, I have already discussed some of the constitutive inferences that can be derived from these indices. I realise that other considerations such as group size, length of occupation, range of activities and activity variation, as well as time spent on specific activities, affect the material culture assemblage and should therefore be reflected in these indices. However, the development of a model taking these issues into consideration entails a theoretical perspective that views material culture primarily as reflective of social behaviour. In this dissertation I have chosen to privilege a viewpoint that emphasises the constitutive role of material culture and have analysed the results of the diversity indices calculations from this perspective. I shall now look at their significance for understanding change over time.

In Table 38 (and Figure 45) the results of the richness and evenness calculations of the stone material from nine Rose Cottage Cave levels are displayed. As can be seen from the first graph, the richness and evenness indices of stone tool assemblages have a linked relationship over time. What is of interest though, is the trend displayed when calculating the difference between the formal and

blades were specifically selected for utilisation. In all the levels, flake blades occur in far greater frequencies in the utilised assemblages than they do in the general assemblages. It is thus suggested that flake blades were produced for further reduction into backed tools, on the one hand, but primarily, to be utilised in the format of their original morphology (ie. un-retouched). Although not a clear pattern, there also seems to be a spatial differentiation for utilised flake blades as opposed to unutilised flake blades (see especially H level).

My use of a spatially sensitive analysis has allowed me to detect the above described patterns; this was done through a methodology informed by a new theoretical perspective. However, it is recognised that new methodological principles, revealing new types of data, are only the first step of a new theoretical orientation. The linking of the above described cluster patterns to specific social relations awaits, *inter alia*, more comparative work on the association of meanings and values to their form of representation as well as a better understanding of generative processes.

Time - Space

The use of a theoretical framework and methodological approach that foregrounds the detection of deliberate human intent and control over the construction of meaning, makes a reconsideration of previous classification systems imperative. I have already discussed some inadequacies of the present stone tool typology, and would like to make a call for the development of a framework

technological considerations. The high incidence of using raw material other-than-opaline in the production of side-struck flakes cannot be linked to a change in the availability of opaline*. The shift of raw material choice can be seen, as in the above instances, as indicative of deliberate choices that are informed by considerations beyond the purely technological. A possible route of explanation lies in considering that side-struck flakes co-functioned with formal tools in signalling stylistic management (and the concomitant social relations management) in the societies dated to the late Pleistocene and early Holocene.

An interesting feature of the stone assemblage at Rose Cottage Cave (in the levels under study) is the high frequency of utilisation of flake blades (see Figure 44 for illustration of utilised non formal tools). Once again, as is the case for the flakes, there is a standardisation in the flake blades that cannot be expressed in the present stone tool typology. Regular, small and flat pieces, with parallel sides, was used for bladelets as well as for broken flake blades. There is a high frequency of broken flake blades in all the levels under study; the bulk of these broken flake blades were so small and so regular in morphology, that they can be considered broken bladelets. Given the small numbers of backed tools in these assemblages, the production of these flake blades cannot be primarily linked to the production of backed tools. When the assemblages of utilised tools is considered, it is clear that flake-

*Opaline and tuffaceous material have a common point of origin in the basalt lavas of the surrounding Drakensberg mountains and their availability would have been equatable.

'thick description"', we can arrive at insights that previously eluded us.

The dominance of side-struck flakes, and the occurrence of broad striking platforms on these flakes, have been considered characteristic of assemblages dated to the late Pleistocene and early Holocene and ascribed to the Oakhurst Industrial Complex. We need to arrive at an explanation that can link their occurrence to deliberate human strategies outside of the purely techno-economic terrain. As alluded to in the discussion of the Ja level, there is a standardisation in the size and morphology of flakes that is not expressed in the present stone typology; this standardisation is especially evident in side-struck flakes larger than 30mm (see Figure 4.3). Side-struck flakes, like formal tools, were utilised, but to a far lesser degree than their occurrence in the general assemblage would lead one to expect. It is thus clear that when specific stone tools were chosen for utilisation, side-struck flakes were not chosen. The absence of cores that can be linked to the production of side-struck flakes indicates that the (majority) of large side-struck flakes were not manufactured at the site and are therefore not simply discards. The regularity of side-struck flakes, their spatial co-occurrence with formal tools and bladelet material, and their 'non-utilisation' is indicative of careful and deliberate decision making processes around these 'tools' that cannot be ascribed to narrow

*The Geertzian term of 'thick description' advocates the use of the internal logic of a historically contingent social situation to arrive at an understanding. Following Hodder (1982:14), I am suggesting that the 'internal logic' of a level provides us with the parameters within which we can develop explanation.

technological considerations, but informed by meanings attached to antecedent occupations (see Figure 42 for an illustration of re-worked material).

As alluded to in the earlier discussion of spatial arrangements of stone material, non-formal stone material should not be considered only as the superfluous debris of a process whose ultimate aim lies in the production of formal tools. If (as I believe we should), we ascribe to formal tools, functions beyond the purely techno-economic, it follows that the polarised distinction between symbolic and technological attributes of material culture is a false distinction (Sackett 1982, 1985, 1986a, 1986b; Wiessner 1984, 1985, 1989). When viewing non-formal stone material, we can extend this approach and look for meanings 'other-than-technological' in the non-formal component of the assemblages as well. By placing our focus on investigating the intent and rationale behind the manufacturing of stone assemblages, we might be able to access meanings beyond the techno-economic in the stone material. Given the paucity of ethnographic information on stone tool use and manufacturing, we have to look to other lines of information in developing our understanding of deliberate human strategies. If we can arrive at a clearer understanding of the principles involved in the manufacturing of stone tools, these precepts can then be compared with evidence of concomitant social behavior, and, *en route* of

corresponding taboo behavior) as the original hearth, and ashy concentrations thus functioned on a different plane of meaning (see Douglas 1966). In a similar vein, the meaning carried by refuse storage pit (see square Q4, H level) as opposed to the meaning carried by pits of a very neat construction (squares N4 and N3, Ph level) could have been different and therefore influenced the spatial text in radically different ways. Due to the limitations of a study of this nature, I am unfortunately not able to propose any specific interpretation as to the meaning of such articulations, but hope that further research will throw more light onto the social implications of such features.

Heat altered stone material clusters in the vicinity of hearths. However, contrary to the expectation at the start of this study, there is no indication of preferential heat treatment for specific stone material and the clustering of such material around the hearths can be ascribed to the unintentional heat-alteration of material that happened to be close to fires. In this instance, the spatial distribution of material will not be understood if it is not viewed in conjunction with other lines of evidence such as the frequency of occurrence in general assemblage.

There is a clear indication of preferential choice of raw material type. Opaline material was the raw material of choice for the manufacturing of formal tools. The high frequency of translucent opaline as a raw material in the category of re-worked stone can, once again, be seen as a choice not governed solely by

hand, and on the other hand, by the social significance/s² attached to areas previously containing bedding material and/or being relatively empty. In the successive Ja level, the area that contained the pits in Ph is an area of low occupation concentration. No occupation features are visible in this area and very low frequencies of material culture debris were noticed. In reverse to the Ph spatial arrangements, the main features of the Ja occupation are to the east and west of this area. The regularity in the above described spatial locations points to an alternate emplacement in successive levels between areas of intense occupation debris and 'empty' areas.

This model is however, not as clearly defined as one would have hoped. The spatial extent of the excavation was limited; the unambiguous recognition of areas of public space as opposed to private space, and the linking of specific features to such areas, was thus not possible. In the levels under study, the alternation of areas of high and low occupation densities between successive levels are visible. This archaeological occurrence can, however, not yet be linked to a social explanation such as, for example, a public space — private space inversion. We also need to consider that all the different spatial features of occupation (hearths, pits, ashy concentrations, boulders etc.) did not carry the same meaning and did not signal the same cultural behavior. For example, re-dumped ash from an hearth might not have the same social value (and

²These values of social significance are not stagnant and are, in turn, continually transformed by previous social behavior and functional considerations.

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presentation of chronology. By viewing previous spatial organisation (the archaeological remains as well as the physical cave conditions) as informing successive occupations, I was theoretically empowered to analyse the material from any one level as if it was contemporaneous. On a conceptual level, archaeologists have long been aware of the problems of viewing the prehistoric past as a purely diachronic sequence (a problem typical of the cultural historical approach). Recently, the erroneous nature of splitting the diachronic sequence into synchronically functioning phases (problems associated with functionalist-adaptive approach) have become the topic of debate. One of the keys to the conceptual advancement in archaeology lies in theorizing on the intersection of the diachronic and synchronic, and I present this model as a possible departure point for debates. Indeed, the responsibility of writing a truly narrative precolonial history for southern Africa requires us to span the theoretical gap between chronology and diachrony (Parkington 1993:96).

The main contribution of this dissertation lies in the construction of a theoretical approach and the development of ensuing methodological principles. Further studies, employing similar methods and principles, are necessary to test the full interpretive potential of the theoretical perspectives advanced in this dissertation.

preferential utilisation of specific tool types, and their spatially distinctive occurrence; the distinct choice of older material of translucent-opaline for re-working, and the high preference for manufacturing formal tools on this material; a standardisation and regularity in the morphology of (especially) side-struck flakes that can be linked to the spatial distribution of formal material; choices in the hunting strategies that cannot be directly linked to environmental aspects.

These features point to deliberate human decision-making processes in ascribing meaning. However, accessing the specific social strategies behind these choices remains difficult. I explored the use of diversity indices in an effort to arrive at a clearer assessment of the constitutive role and transformative power that material culture has in human society. By looking at the structure of the non-formal stone material in relation to the formal stone material in each level (as well as over time), I presented an interpretation of the social cultural situation involved. The linkage of stone and bone diversity indices threw a sharper light onto these issues, and I proposed an explanation of bone material and stone material alternating in the strengthening of social relation bonds.

Through the consideration of the informative and constraining role of space, I was able to arrive at a model for the interpretation of deep sequence cave deposits^a, and to move beyond the mere

^aThis actually applies to all archaeological sites, and may contribute to resolving the daunting problem of contemporaneity at any archaeological site.

In Chapter Two I presented a theoretical approach that allowed these issues to be foregrounded. By grappling with some of the conceptual concerns around the nature of material culture, space and time in relation to archaeology, new interpretive frameworks are posited. The suggestion of new interpretive frameworks necessitated the development of appropriate research methodologies. This in turn demanded that I outline the procedures I followed at Rose Cottage Cave (Chapter Four). After detailing the paleo-environmental conditions around Rose Cottage I discussed, as units, all the archaeological material occurring in each of the levels pertinent to this study.

In the Chapter immediately preceding this one (Chapter 10) I presented a chronological overview of the archaeological material at Rose Cottage Cave in the levels under study. Previously unknown patterns were detected and tentative interpretations were presented in that chapter. This proceeded under the imperative of developing the proposed extended terms of inquiry.

I will now examine these interpretations and propose further avenues of research.

In examining whether material culture can contain information other than functionally related activities, this study detected patterns of stone material use and faunal exploitation that suggest deliberate decision making not fully explicable by techno-economic considerations. These included features such as, *inter alia*, the

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APPENDIX ONE

STONE TYPOLOGY

The stone material classification used in this dissertation is based on the reduction sequence and formal tool classification schema as developed by J Deacon (1982, 1984a). The Rose Cottage programme has adapted the broad categories and expanded expanded some of the sub-categories. I will now discuss the classification standards as used by the Rose Cottage programme.

I did not distinguish between chips of irregular or bladelet dimension, but classified all material smaller than 10mm as chip.

Under the broad category of cores, bladelet cores displaying one or two, platforms were distinguished. Similarly, for core reduced pieces, I distinguished between cores reduced pieces with one or two (chisel-like) striking platforms.

In the category of blade and bladelet (flakes that have a length measurement of double or more of their maximum width measurement) different morphologies were distinguished. Flat blade/bladelets with uniform parallel sides dimensions were distinguished from those whose edges converged in a point. Some of the flakes were of blade/bladelet proportions but displayed a cross-section morphology of being triangular, and were noted separately. Those blade/bladelets that could not be classified into either of these categories, were deemed irregular. In the text the

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TABLE 1: C-14 dates Rose Cottage Cave

DATE (BP)	LAB NO	LEVEL	SQUARE
680 ±50	Pta 5622	A	N4
5 970 ±70	Pta 5943	Pt	N3
8 380 ±70	Pta 5600	Ja	L5
8 614 ±40	Pta 5560	H	Q4
9 250 ±70	Pta 5599	H	L5
12 690 ±120	Pta 5593	DB	L5, L3
13 360 ±150	Pta 5601	DB2	K3
20 600 ±250	Pta 5598	G	L4
27 200 ±350	Pta 5596	Dc	L5
31 300 ±90	Pta 5592	Ge	L5

(after Wadley and Vogel 1991: 605 and Wadley pers. comm.)

TABLES

**SPACE, MATERIAL CULTURE AND MEANING IN THE
LATE PLEISTOCENE AND EARLY HOLOCENE
AT ROSE COTTAGE CAVE.**

Volume II

TABLES

FIGURES

could, however, be said that one is comparing two very dissimilar samples and are thus, in effect, comparing 'apples and oranges'. The argument could be made that the archaeologically observed differences merely reflect the analytical construction of the samples. In an effort to address the problem of dissimilarity, I have, for each level, calculated the diversity indices for informal, formal and combined stone material on observations of equal frequency. The archaeologically observed indice values were then divided by the 'ideal' indice values and a 'standardised' index could then be calculated (A. Samson and G. Manas: pers. comm.). Table 46 shows the calculation of each level.

A note of caution: due to the use of log values in the calculations, a number of the values are expressed in fractional negative terms. When comparing the relative values (larger-than or smaller-than), it crucial to take the negative nature of the value into consideration.

diversity index. On reproducing all the published diversity indices it became clear that most authors have used $\log_e$ with the exception of Cruz-Urbe who used $\log_e$ in the 1988 article, but possibly $\log_2$ in her 1991 article. For comparative purposes I have thus decided to use $\log_e$.

stone material

diversity $H = \sum(n_i/N)\log(n_i/N)$ (Shannon diversity index)

richness $d = (S-1)/\log N$

evenness $e = (H)/\log N$

where:

S = number of stone categories;

N = total number of stone;

n_i = number of stones per category.

I have calculated the above indices on the stone material classified at Rose Cottage Cave for all the levels dated to between $13\,360 \pm 150$ BP and 680 ± 50 BP. The calculations were done on the combined stone material assemblage as well as on the separate samples of non-formal and formal material. In the H and Ja levels these calculations were also done on the samples for each square.

The use of diversity indices for stone tools have previously been restricted to formal tools only (Simek 1989). I have extended the application of these indices to non-formal material and consider the relative values of formal and non-formal material very informative. It

APPENDIX THREE

DIVERSITY, RICHNESS AND EVENNESS INDICES

For purposes of comparison, I have calculated my data on indices that have been used in the southern African archaeological literature (Avery, M 1982; Cruz-Uribe 1988, 1991). I used the same index formula for the faunal material and stone assemblages.

faunal material

diversity $H = \sum (ni/N) \log(ni/N)$ (Shannon diversity index)

richness $d = (S-1)/\log N$

evenness $e = (H)/\log N$

where:

S = number of species

N = total MNI or N = total NISP

ni = species MNI or ni = species NISP.

At Rose Cottage Cave calculation procedure followed, resulted in low MNI totals (Plug and Engela: 1992). Although I am satisfied that the MNI calculation procedure is correct, the low MNI totals made comparison with other southern African sites difficult. I have thus calculated the indices on MNI and NISP per level (Table 44). Following Cruz-Uribe's recommendation, only material identified to specific species was used and not material identified to size categories (Cruz-Uribe 1988). Similar calculations were done on the samples of all ungulates per level (Table 45). Odum (1971) recommends that logs be used when calculating the Shannon

The data was prepared in the spreadsheet package, Lotus 123 and then imported to the statistical package Statsgraphics. In order to optimise the number of data points for which there were values available for both FUI and density, the Spearman rank-order correlation coefficients were done pairwise and not listwise. The results are listed in Table 43.

distal articulation of a skeletal element was not possible, I used an average between the proximal and distal value (eg. FUI value for proximal humerus = 2 295g; distal humerus = 1 891g; humerus not identified to proximal or distal = 2 093g). The values as determined by them for skull, mandible and pelvis were used, divided by the number of separate fragments per skeletal part used in the identification (see again Table 40). When skull material was present, it could be assumed that the maxilla and hyoid was brought along. I have thus calculated an FUI value for skull material based on the FUI of hyoid and maxilla. In order to be statistically consistent, both the FUI and density values were also calculated as percentages against the maximum FUI and density value respectively (M. Grant personal comment).

The visual inspection of the XY plotted values was an important step in the process, and the data were then plotted (Figure 49). Most of the XY plots display a either a unbiased utility curve (linear relation) or a consumption site bulk utilisation curve ($Y = a + b \log X$). Since, as we know from the work of Grayson, these curves can be produced either by human transport decisions or by bone attritional factors, the next step in the analysis was the calculation of Spearman rank-order correlation coefficients.

APPENDIX TWO

FOOD UTILITY AND BONE DENSITY CALCULATIONS

The identification of skeletal parts was done with the help of the extensive osteological collection at the Transvaal museum under the guidance of Dr. J. Plug. After determining the Number of Identifiable Skeletal Parts (NISP) to species, genus or size group, the NISP for *bovidae* was collated into the four size groups as defined by Brain (1974). Table 39 shows the species as grouped for Rose Cottage Cave.

In order to compare my work with the published Food Utility (FU) and density data, the Binford formula of minimal animal units (MAU, also known as fractional MNI) was calculated (Binford 1978). This was done by dividing the NISP calculated for each skeletal part by the number of such skeletal parts in an individual (Table 40) (Chaplin 1971; Schmid 1972; Van den Driessche 1976). The percentage minimal animal unit (%MAU) was then calculated as fractions of the highest MAU.

The food and density value for the skeletal parts present in each size group was then calculated by multiplying the skeletal abundance (%MAU) with the food and density value for each skeletal element (Table 41 and Table 42). The FU and density values were based on the published work of Metcalfe and Jones (1988) and Lyman (1985). I have used their data for the clearly identified skeletal parts. Where the identification of proximal or

A number of tools with clear **Middle Stone Age** technological attributes were also excavated in the levels dated to the Later Stone Age.

A number of scrapers also have a combination of secondary retouch ('scraper retouch') as well as adze damage. On some scrapers the edge opposite to the working edge is abruptly blunt — sometimes through deliberate knapping, and in other cases the working edge have been positioned in such a way that the 'natural' morphology of the scraper provided a blunted edge — these scrapers were classified as backed. A few scrapers were of such high dimensions (measured opposite to the flat ventral surfaces) that a category of high backed was introduced.

Tools with secondary retouch along one or more straight edges were classified as knives.

In the category of backed tools, we distinguished between two size classes and various sub-classes based on the backed margin and planform of the tool. Flakes of blade proportions with backing; segments; tools in which the backing is on an edge that is at an oblique angle to the rest of the tool; tools with backing that cannot be classified into either of the above categories as well as broken tools with backing were recognised.

A category of bladelets with flat, invasive retouch on the ventral side was introduced.

The categories of adze, spokeshave, awl, borer and miscellaneous retouched pieces, were recognised following the criteria as established by J. Deacon 1982.

term flake-blades was used when referring to the combined category of blades and bladelets.

In an effort to detect knapping strategies, we noted flakes that still have cortical material, as well as the two sizes classes of bigger and smaller than 30mm. To distinguish between end-struck and side-struck flakes, we used the bulb of percussion as a point of reference. Two measurements were taken: i) the 'long axis' — in direct line with the striking platform and bulb of percussion up, to the edge of the flake, and ii) the maximum 'width' of the flake at right angle to the first measurement. Side-struck flakes are those flakes that have longer 'width' measurements than 'long axis' measurements, and end-struck *vice versa*. For broken flakes the specific section of origin — proximal, medial or distal — was also noted.

In the scraper category (i.e. tools with secondary retouch on a convex edge), three size classes were distinguish: larger than 30mm, between 20-30mm and smaller than 20mm. Within these size classes, sub-classes based on the placement of secondary retouch and the planform of the tools, were distinguished. As for the flakes, the bulb of percussion was used as a reference point and the placement of secondary retouch could then occur on:

- the end,
- one or both sides,
- both on the end and on one side or,
- on the end and two sides.

TABLE 4: (cont.)
Ungulates only

Species	Late Holocene		Holocene		Early Holocene		Pleistocene		TOTAL	
Bushy										
<i>Sylvicapra grimmia</i>	5	10.20%			13	16.77%			18	12.33%
<i>Oreotragus oreotragus</i>	1	2.04%	1	8.70%	12	15.48%			14	9.59%
<i>Aspicerus malampus</i>	1	2.04%							1	0.66%
<i>Tragelaphus streptoceros</i>					2	2.61%	1	12.50%	3	2.05%
? <i>Taurotragus oryx</i>	31	63.27%	6	69.57%	49	63.23%	4	78.00%	94	64.38%
<i>Redunca fulvorufula-lives</i>	11	22.48%	2.5	21.74%	1.5	1.94%	1	12.50%	16	10.66%
Subtotal	49	100.00%	11.5	100.00%	77.5	100.00%	6	100.00%	146	100.00%
Grass										
<i>Connochaetes gnou</i>	41	8.44%	9	12.05%	29	12.42%	8	20.51%	88	10.38%
<i>Alcelaphus buselaphus</i>	19	3.91%	2	4.92%	21	8.69%	8	20.51%	50	6.25%
<i>Damaelacus dorcas</i>	69	14.20%	10	24.10%	43	18.42%	6	15.38%	128	16.00%
<i>Antidorcas marsupialis</i>	304	62.65%	18	43.37%	103	44.11%	15	38.46%	440	55.00%
<i>Ourebia ourebia</i>	1	0.21%							1	0.13%
<i>Raphicerus campestris</i>	12	2.47%	1	2.41%	13	5.57%			26	3.25%
<i>Pelea capreolus</i>	29	6.97%	3	7.23%	23	9.55%	1	2.56%	56	7.00%
<i>Redunca fulvorufula-eats</i>	11	2.26%	2.5	6.02%	1.5	0.64%	1	2.56%	16	2.00%
Subtotal	496	100.00%	41.5	100.00%	294	100.00%	39	100.00%	800	100%
Savanna Grass										
<i>Equus burchelli/quagga</i>	1	1.49%	1	3.70%	5	6.67%	5	41.67%	12	6.05%
<i>Phaenoceros aethiopicus</i>	35	82.09%	23	85.19%	63	84.00%	6	50.00%	147	81.22%
<i>Connochaetes taurinus</i>	11	16.42%	1	3.70%	3	4.00%			15	8.29%
<i>Hippotragus equinus</i>			2	7.41%					2	1.10%
<i>Hippotragus niger</i>					2	2.67%			2	1.10%
<i>Hippotragini</i>					2	2.67%	1	8.33%	3	1.66%
Subtotal	67	100.00%	27	100.00%	76	100.00%	12	100.00%	181	100.00%
Bushy	49	8.14%	11.5	14.38%	77.5	20.08%	6	13.56%	146	12.05%
Grass	553	91.86%	68.5	85.63%	309	79.92%	51	86.44%	981	87.95%
TOTAL	602	100.00%	80	100.00%	386	100.00%	59	100.00%	1127	100.00%

TABLE 4: Animal habitat preference, grasslands - bush/shrub
All species

Species	Late Holocene		Holocene		Early Holocene		Pleistocene		TOTAL	
Bushy										
<i>Cercopithecus aethiops</i>					2	1.14%			2	0.41%
<i>Hyena brunnea</i>	2	0.82%							2	0.41%
<i>Panthera pardus</i>	9	3.69%			2	1.14%			11	2.27%
<i>Felis caracal</i>	1	0.41%			1	0.57%			2	0.41%
<i>Procavia capensis</i>	183	75.00%	45	78.65%	93	52.99%	1	11.11%	322	65.39%
<i>Sylvicapra grimmia</i>	5	2.08%			13	7.41%			18	3.71%
<i>Oreotragus oreotragus</i>	1	0.41%	1	1.77%	12	6.84%			14	2.89%
<i>Aepyceros melampus</i>	1	0.41%							1	0.21%
<i>Tragelaphus stropsiceus</i>					2	1.14%	1	11.11%	3	0.62%
<i>Taurotragus oryx</i>	31	12.70%	8	14.18%	49	27.82%	6	66.67%	94	19.38%
<i>Redunca fulvorufula-lives</i>	11	4.51%	2.5	4.42%	1.5	0.85%	1	11.11%	16	3.30%
Subtotal	244	100.00%	56.5	100.00%	178	100.00%	9	100.00%	485	100.00%
Shrub										
<i>Canis mesomelas</i>	12	3.77%	1	1.69%	12	6.02%			25	4.89%
<i>Suricata suricatta</i>					2	1.50%			2	0.39%
<i>Hyena brunnea</i>	2	0.63%							2	0.39%
<i>Panthera pardus</i>	9	2.83%			2	1.50%			11	2.15%
<i>Felis caracal</i>	1	0.31%			1	0.75%			2	0.39%
<i>Procavia capensis</i>	183	57.55%	45	76.27%	93	69.92%	1	100.00%	322	69.01%
<i>Lepus/Procapra</i>	111	34.91%	13	22.03%	23	17.29%			147	28.77%
Subtotal	318	100.00%	59	100.00%	133	100.00%	1	100.00%	511	100.00%
Grass										
<i>Canis mesomelas</i>	12	2.31%	1	2.55%	12	4.70%			25	2.92%
<i>Cynictis penicillata</i>	1	0.19%							1	0.12%
<i>Felis caracal</i>	1	0.19%			1	0.69%			2	0.23%
<i>Xerus inauris</i>	2	1.73%							2	0.23%
<i>Pedotia capensis</i>	10	1.93%			9	3.52%	1	2.50%	20	2.33%
<i>Connochaetes g u</i>	41	7.90%	5	11.76%	29	11.35%	8	20.00%	83	9.05%
<i>Alcelaphus buselaphus</i>	19	3.66%	2	4.71%	21	8.22%	8	20.00%	50	5.83%
<i>Gemaliscus dorcas</i>	99	15.29%	10	23.53%	49	18.83%	0	16.00%	128	14.94%
<i>Antidorcas marsupialis</i>	304	58.57%	18	42.55%	103	40.31%	18	37.50%	440	51.34%
<i>Ourebia ourebia</i>	1	0.19%							1	0.12%
<i>Raphicerus campestris</i>	12	2.31%	1	2.55%	13	5.09%			26	3.03%
<i>Polia capensis</i>	29	5.59%	3	7.06%	23	9.00%	1	2.50%	56	6.53%
<i>Redunca fulvorufula-cats</i>	11	2.12%	2.5	5.88%	1.5	0.59%	1	2.50%	16	1.87%
Subtotal	519	100.00%	42.5	100.00%	250	100.00%	40	100.00%	857	100.00%
Savanna Grass										
<i>Equus burchelli/quagga</i>	1	1.49%	1	3.70%	5	6.87%	5	41.87%	12	8.63%
<i>Phacochorpus aethiopicus</i>	55	52.09%	23	55.19%	63	64.00%	6	50.00%	147	81.22%
<i>Connochaetes taurinus</i>	11	16.42%	1	3.70%	3	4.00%			15	8.29%
<i>Hippotragus equinus</i>			2	7.41%					2	1.10%
<i>Hippotragus niger</i>					2	2.67%			2	1.10%
<i>Hippotragini</i>					2	2.67%	1	5.33%	3	1.66%
Subtotal	67	100.00%	27	100.00%	78	100.00%	12	100.00%	181	100.00%
Bushy/Shrub										
	802	48.85%	116	82.43%	309	48.28%	10	16.13%	996	48.97%
Grass										
	555	51.05%	59.5	97.57%	531	51.72%	52	89.87%	1038	51.03%
TOTAL	1148	100.00%	185	100.00%	839	100.00%	62	100.00%	2034	100.00%

TABLE 3: MNI basis

LB LEVEL	NISP	MNI	REASON
Equus sp	1	1	1 molar lower
Bov 2 non dom	5		
Bov 3 non dom	2		
Alcelaphus buselaphus	1	1	metacarpal prox
Alcelaphus/Connochaetes	1		
Antidorcas marsupialis	6	1	1 m3L
Pelea capreolus	1	1	3 phalanx
Bird	1		
TOTAL	18	4	
DB LEVEL	NISP	MNI	REASON
Papio ursinus	1	1	canine frag
Equus burchelli/quagga	5	1	1 mand p2
Equus capensis	1	1	r p3U frag
Equus sp	3		
Procavia capensis	1	1	humerus dist
Phacochoerus aethiopicus	1	1	mand teeth fragmented
Bov 1	1		
Bov 2 non dom	10		
Bov 3 non dom	17		
Bov 4	2		
Connochaetes gnou	6	2	1 m3L
Alcelaphus buselaphus	7	2	age differences
Alcelaphus/Connochaetes	13		
Megalotragus priscus	5	1	
Damalisca dorcas	5	1	1 m2L
Antidorcas marsupialis	5	1	1 m1L
Antidorcas bondi	1	1	m2L
Hippotragini	1		
Taurotragus oryx	2	1	1 m3L frag
Pedetes capensis	1	1	molar
TOTAL	88	15	

TABLE 3: MNI basis

H LEVEL	NISP	MNI	REASON
Carnivore	1		
<i>Equus burchelli/quagga</i>	1	1	l m3L
<i>Procavia capensis</i>	10	1	humerus dist frag
<i>Phacochoerus aethiopicus</i>	7	1	m3L frag
Bov 1	16		
Bov 2 non dom	27		
Bov 3 non dom	9		
Bov 4	1		
<i>Connochaetes gnou</i>	2	1	l m3L
<i>Alcelaphus buselaphus</i>	1	1	m2U
<i>Alcelaphus/Connochaetes</i>	2		
<i>Damaliscus dorcas</i>	6	2	age difference
<i>Sylvicapra grimmia</i>	1	1	lateral malleolus
<i>Antidorcas marsupialis</i>	3	1	molar lower frag
<i>Oreotragus oreotragus</i>	3	1	2 phalanx
<i>Raphicerus campestris</i>	1	1	calcaneum
<i>Pelea capreolus</i>	1	1	l m3L
<i>Taurotragus oryx</i>	4	1	p4L buc frag
<i>Pedetes capensis</i>	1	1	metatarsal
<i>Hystrix africaeaustralis</i>	1	1	metatarsal dist
<i>Lepus/Pronolagus</i>	4	1	radius
Tortoise	9	1	carapace
Bird			
TOTAL	111	17	
DOM LEVEL	NISP	MNI	REASON
<i>Equus capensis</i>	1	1	r m1L
<i>Equus sp</i>	1		
<i>Phacochoerus aethiopicus</i>	5	1	molar frags
Bov 2 non dom	7		
Bov 3 non dom	4		
<i>Connochaetes gnou</i>	2	1	m1U
<i>Alcelaphus/Connochaetes</i>	13		
<i>Damaliscus dorcas</i>	1	1	tooth frag
<i>Antidorcas marsupialis</i>	4	2	age differences
<i>Antidorcas bondi</i>	2	1	m2U
<i>Tragelaphus strepsiceros</i>	1	1	m1L
<i>Taurotragus oryx</i>	4	1	r m1U
<i>Redunca fulvorufula</i>	2	1	p4U
TOTAL	47	10	

TABLE 3: MNI basis

CM LEVEL	NISP	MNI	REASON
Papio ursinus	4	2	age differences
Cercopithecus aethiops	1	1	carpal
Suricata suricatta	1	1	ulna
Panthera pardus	1	1	13U
Carnivore	6		
Equus burchelli/quagga	3	1	teeth frags
Procavia capensis	16	2	3x radius
Phacochoerus aethiopicus	13	2	molar
Bov 1	19		
Bov 2 non dom	36		
Bov 3 non dom	18		
Bov 4	2		
Connochaetes gnou	9	1	1 m3L
Alcelaphus buselaphus	5	2	age differences
Alcelaphus/Connochaetes	4		
Damaliscus dorcas	6	1	1 m3L
Sylvicapra grimmia	1	1	2 phalanx
Antidorcas marsupialis	6	2	age differences
Oreotragus oreotragus	4	1	3 phalanx
Raphicerus campestris	7	1	2 phalanx
Pelea capreolus	3	1	1 phalanx
Hippotragini	2		
Taurotragus oryx	17	1	1 p4U
Pedetes capensis	3	1	3 phalanx
Hystrix africaeaustralis	1	1	tooth frag
Lepus/Pronolagus	3	1	humerus dist
Tortoise	9	1	carapace frag
Bird	4		
TOTAL	204	25	

TABLE 3: MNI basis

PH LEVEL	NISP	MNI	REASON
<i>Papio ursinus</i>	2	1	incisor lower
<i>Canis mesomelas</i>	9	1	l m2L
<i>Suricata suricatta</i>	1	1	metapodial, dist
<i>Atilax paludinosus</i>	3	2	age differences
<i>Felis caracal</i>	1	1	phalanx prox frag
Carnivore	2		
<i>Procavia capensis</i>	37	8	15x humerus dist
<i>Phacochoerus aethiopicus</i>	25	2	age differences
Bov 1	26		
Bov 2 non dom	86		
Bov 3 non dom	36		
Bov 4	2		
<i>Connochaetes gnou</i>	10	2	age differences
<i>Alcelaphus buselaphus</i>	4	1	l m2U
<i>Alcelaphus/Connochaetes</i>	1		
<i>Damaliscus dorcas</i>	25	2	l m3L
<i>Sylvicapra grimmia</i>	7	1	1 phalanx
<i>Antidorcas marsupialis</i>	48	6	l m1L
<i>Antidorcas bondi</i>	4	1	l m2L
<i>Oreotragus oreotragus</i>	5	2	age differences
<i>Raphicerus campestris</i>	5	1	r m1L
<i>Pelea capreolus</i>	12	2	2&3 tarsal
<i>Hippotragus leucophaeus</i>	1	1	
<i>Tragelaphus strepsiceros</i>	2	1	l p3L
<i>Taurotragus oryx</i>	16	1	l m2L
<i>Redunca fulvorufula</i>	3	1	m1U ling frag
<i>Pedetes capensis</i>	2	1	phalanx
<i>Hystrix africaeaustralis</i>	1	1	molar
<i>Lepus/Pronolagus</i>	10	2	4x humerus dist
Tortoise	30	2	pelvic girdle
Bird	2		
TOTAL	418	44	

TABLE 3: MNI basis

JA LEVEL	NISP	MNI	REASON
<i>Cercopithecus aethiops</i>	1	1	1 humerus dist frag
<i>Canis mesomelas</i>	3	1	1 phalanx
<i>Aonyx capensis</i>	1	1	humerus dist frag
<i>Atilax paludinosus</i>	1	1	phalanx prox
Mongoose	1		
<i>Panthera pardus</i>	1	1	p2U frag
<i>Felis lybica</i>	1	1	3 phalanx
Carnivore	7		
<i>Equus burchelli/quagga</i>	1	1	1 p3U
<i>Equus sp</i>	1		
<i>Procavia capensis</i>	30	3	5x humerus dist
<i>Phacochoerus aethiopicus</i>	18	2	age differences
Bov 1	19		
Bov 2 non dom	48		
Bov 3 non dom	34		
Bov 4	4		
<i>Connochaetes gnou</i>	8	3	age differences
<i>Connochaetes taurinus</i>	3	1	1 m2L
<i>Alcelaphus buselaphus</i>	11	2	1 m2L
<i>Alcelaphus/Connochaetes</i>	7		
<i>Damaliscus dorcas</i>	6	2	1 m2L
<i>Sylvicapra grimmia</i>	4	2	age differences
<i>Antidorcas marsupialis</i>	46	4	age differences
<i>Antidorcas bondi</i>	4	1	1 m2L
<i>Antidorcas sp.</i>	4		
<i>Pelea capreolus</i>	7	2	1 m2U
<i>Hippotragus leucophaeus</i>	1		
<i>Taurotragus oryx</i>	12	1	1 m2L buc frag
<i>Pedetes capensis</i>	3	1	molar upper frag
<i>Hystrix africaeaustralis</i>	6	2	age differences
<i>Lepus/Pronolagus</i>	6	1	1 ulna prox
Tortoise	12	1	carapace
Bird	8		
TOTAL	319	35	

TABLE 3: MNI basis

PT LEVEL	NISP	MNI	REASON
<i>Papio ursinus</i>	4	1	m3L frag
<i>Canis mesomelas</i>	1	1	tarsal
Mongoose	2		
Carnivore	3		
<i>Equus burchelli/quagga</i>	1	1	l m2U
<i>Procavia capensis</i>	45	6	humerus distal
<i>Phacochoerus aethiopicus</i>	23	1	m2L frag
Bov 1	40		
Bov 2	8		
Bov 2 non dom	71		
Bov 3	2		
Bov 3 non dom	27		
<i>Connochaetes gnou</i>	5	1	l m3U
<i>Connochaetes taurinus</i>	1	1	l p4U
<i>Alcelaphus buselaphus</i>	2	1	m2L ling frag
<i>Alcelaphus/Connochaetes</i>	11		
<i>Damaliscus dorcas</i>	10	2	age differences
<i>Antidorcas marsupialis</i>	18	3	age differences
<i>Oreotragus oreotragus</i>	1	1	1 phalanx
<i>Raphicerus campestris</i>	1	1	3 phalanx
<i>Pelea capreolus</i>	3	1	l dp4U
<i>Hippotragus equinus</i>	2	1	r m2L
<i>Taurotragus oryx</i>	8	2	age differences
<i>Redunca fulvorufula</i>	5	1	l m1L
<i>Hystrix africaeaustralis</i>	2	1	2 phalanx
<i>Lepus/Pronolagus</i>	13	1	max frag
Tortoise	17	1	carapace frag
Bird	4		
TOTAL	330	28	

TABLE 3: MNI basis

A2 LEVEL	NISP	MNI	REASON
<i>Papio ursinus</i>	7	1	canine frag
<i>Canis mesomelas</i>	8	2	age differences
<i>Atilax paludinosus</i>	1	1	fibula frag
Mongoose	8		
<i>Panthera pardus</i>	7	2	age differences
<i>Felis lybica</i>	1	1	p4L, frag
Carnivore	11		
<i>Equus</i> sp	2		
<i>Procavia capensis</i>	90	4	1 p2U
<i>Phacochoerus aethiopicus</i>	26	1	molar frag
<i>Ovis/Capra</i>	1		
<i>Ovis aries</i>	6	1	r max dp3-m1
<i>Capra hircus</i>	28	3	age differences
Bov 1	49		
Bov 2	39		
Bov 2 non dom	243		
Bov 3	8		
Bov 3 non dom	150		
Bov 4	4		
<i>Connochaetes gnou</i>	15	3	r m3U
<i>Connochaetes taurinus</i>	5	1	r mand m1
<i>Alcelaphus buselaphus</i>	7	2	r m2L
<i>Alcelaphus/Connochaetes</i>	27		
<i>Damaliscus dorcas</i>	32	2	m2L frag
<i>Sylvicapra grimmia</i>	1	1	m2L unerupted frag
<i>Antidorcas marsupialis</i>	130	5	age differences
<i>Raphicerus campestris</i>	5	3	age differences
<i>Pelea capreolus</i>	17	3	age differences
<i>Taurotragus oryx</i>	16	3	age differences
<i>Redunca fulvorufula</i>	14	1	1 m3U
<i>Xerus inauris</i>	3	1	r humerus prox frag unfused
<i>Pedetes capensis</i>	5	1	molar frag
<i>Hystrix africaeaustralis</i>	3	1	molar frag
<i>Lepus/Pronolagus</i>	54	4	8x femur shaft
Tortoise	4	1	carapace frag
Bird	17		
TOTAL	1044	48	

TABLE 3: MNI basis

A LEVEL	NISP	MNI	REASON
<i>Papio ursinus</i>	8	1	m3L, frag
<i>Canis mesomelas</i>	3	1	l l3 frag
<i>Attilax paludinosus</i>	1	1	r scapula blade & glenoid
Mongoose	6		
<i>Panthera pardus</i>	2	1	2 phalanx
<i>Felis lybica</i>	2	1	r mand, p3-m1
<i>Felis caracal</i>	1	1	metatarsal prox frag
Carnivore	4		
<i>Equus</i> sp	3		
<i>Procavia capensis</i>	66	4	r m1U
<i>Phacochoerus aethiopicus</i>	24	2	age differences
<i>Bos taurus</i>	4	1	2 phalanx dist frag
<i>Ovis/Capra</i>	1		
<i>Ovis aries</i>	1	1	r mand alveoli p2 & p3
Bov 1	28		
Bov 2	31		
Bov 2 non dom	134		
Bov 3	6		
Bov 3 non dom	138		
Bov 4	1		
<i>Connochaetes gnou</i>	15	2	r m3U
<i>Connochaetes taurinus</i>	4	2	age differences
<i>Alcelaphus buselaphus</i>	6	2	age differences
<i>Alcelaphus/Connochaetes</i>	12		
<i>Damaliscus dorcas</i>	31	2	r m2L
<i>Sylvicapra grimmia</i>	4	1	l mand p4-m1
<i>Antidorcas marsupialis</i>	135	5	age differences
<i>Raphicerus campestris</i>	6	1	2 phalanx prox frag
<i>Aepyceros melampus</i>	1	1	l l4
<i>Pelea capreolus</i>	10	1	l m3U
<i>Taurotragus oryx</i>	12	2	age differences
<i>Redunca fulvorufula</i>	7	2	age differences
<i>Xerus inauris</i>	5	1	l mand
<i>Pedetes capensis</i>	5	1	femur shaft frag
<i>Hystrix africaeaustralis</i>	4	1	molar unerupted
<i>Lepus/Pronolagus</i>	41	3	pelvis acetabulum
Tortoise	2	1	carapace, frag
Bird	7	1	radius dist frag
TOTAL	770	43	

TABLE 3: MNI basis

MN LEVEL	NISP	MNI	REASON
<i>Papio ursinus</i>	2	1	canine
<i>Canis mesomelas</i>	1	1	metapodial, dist
<i>Cynictis penicillata</i>	1	1	ulna prox
Mongoose	3		
<i>Hyaena brunnea</i>	2	1	incisor
<i>Felis lybica</i>	2	1	ulna
<i>Equus burchelli/quagga</i>	1	1	sesamoid
<i>Equus sp</i>	1		
<i>Procavia capensis</i>	27	5	r m2L
<i>Phacochoerus aethiopicus</i>	5	1	l m3L
<i>Bos taurus</i>	17	5	age differences
<i>Ovis/Capra</i>	14		
<i>Ovis aries</i>	5	1	astragalus
Bov 1	5		
Bov 2	30		
Bov 2 non dom	29		
Bov 3	8		
Bov 3 non dom	68		
<i>Connochaetes gnou</i>	11	2	r scapula
<i>Connochaetes taurinus</i>	2	1	l m3L
<i>Alcelaphus buselaphus</i>	7	2	age differences
<i>Alcelaphus/Connochaetes</i>	16		
<i>Damaliscus dorcas</i>	6	1	r m2U
<i>Antidorcas marsupialis</i>	39	3	age differences
<i>Oreotragus oreotragus</i>	1	1	l p3U
<i>Ourebia ourebia</i>	1	1	metapodial, dist
<i>Raphicerus campestris</i>	1	1	3 phalanx
<i>Pelea capreolus</i>	2	1	m1L
<i>Taurotragus oryx</i>	3	1	m1L
<i>Redunca fulvorufula</i>	1	1	m1U
<i>Xerus inauris</i>	1	1	pelvis
<i>Hystrix africaeaustralis</i>	4	1	mand frag
<i>Lepus/Pronolagus</i>	16	2	r mand
Bird	1		
TOTAL	333	37	

TABLE 2: Species identified late Pleistocene and Holocene levels (NISP)

Species	Levels											TOTAL
	Min	A	A2	Pl	Ja	Ph	CM	H	DCM	LB	DB	
<i>Papio ursinus</i>	2	8	7	4		2	4				1	28
<i>Cercopithecus aethiops</i>					1		1					2
<i>Canis mesomelas</i>	1	3	8	1	3	9						25
<i>Aonyx capensis</i>					1							1
<i>Suricata suricatta</i>						1	1					2
<i>Cynictis penicillata</i>	1											1
<i>Attilax paludinosus</i>		1	1		1	3						6
Mongoose	3	6	8	2	1							20
<i>Hyaena brunnea</i>	2											2
<i>Panthera pardus</i>		2	7		1		1					11
<i>Felis lybica</i>	2	2	1		1							6
<i>Felis caracal</i>		1				1						2
Carnivore		4	11	3	7	2	6	1				34
<i>Equus burchelli/quagga</i>	1			1	1		3	1			5	12
<i>Equus capensis</i>									1		1	2
<i>Equus sp</i>	1	3	2		1				1	1	3	12
<i>Procapra capensis</i>	27	66	90	45	30	37	16	10			1	322
<i>Phaocochoerus aethiops</i>	5	24	26	23	18	25	13	7	5		1	147
<i>Bos taurus</i>	17	4										21
<i>Ovis/Capra</i>	14	1	1									16
<i>Ovis aries</i>	5	1	6									12
<i>Capra hircus</i>			28									28
Bov 1	5	28	49	40	19	26	19	16			1	203
Bov 2	30	31	39	8								108
Bov 2 non dom	29	134	243	71	48	66	36	27	7	5	10	696
Bov 3	8	6	8	2								24
Bov 3 non dom	68	138	150	27	34	38	18	9	4	2	17	503
Bov 4		1	4		4	2	2	1			2	16
<i>Connochaetes gnou</i>	11	15	15	5	8	10	9	2	2		6	83
<i>Connochaetes taurinus</i>	2	4	5	1	3							15
<i>Alcelaphus buselaphus</i>	7	5	7	2	11	4	5	1		1	7	50
<i>Alcelaphus/Connochaetes</i>	16	12	27	11	7	1	4	2	13	1	13	107
<i>Megalotragus prisca</i>												5
<i>Damaliscus dorcas</i>	6	31	32	10	6	25	6	6	1		5	128
<i>Sylviscapre grimmia</i>		4	1		4	7	1	1				18
<i>Antidorcas marsupialis</i>	39	135	130	18	46	48	6	3	4	6	5	440
<i>Antidorcas bondi</i>					4	4			2		1	11
<i>Antidorcas sp</i>					4							4
<i>Oreotragus oreotragus</i>	1			1		5	4	3				14
<i>Ourebia ourebia</i>	1											1
<i>Raphicerus campestris</i>	1	6	5	1		6	7	1				26
<i>Aepyceros melampus</i>		1										1
<i>Pelea capreolus</i>	2	10	17	3	7	12	3	1		1		56
<i>Hippotragus equinus</i>				2								2
<i>Hippotragus leucophaeus</i>					1	1						2
<i>Hippotragini</i>							2				1	3
<i>Tragelaphus streptaceros</i>						2			1			3
<i>Taurotragus oryx</i>	3	12	16	8	12	16	17	4	4		2	94
<i>Redunca fulvorufula</i>	1	7	14	5		3			2			32
<i>Xerus in. xris</i>	1	5	3									9
<i>Pedetes capensis</i>		5	6		3	2	3	1			1	20
<i>Hystrix africaeaustralis</i>	4	4	3	2	6	1	1	1				22
<i>Lepus/Procapra</i>	18	41	64	13	6	10	3	4				147
Tortoise		2	4	17	12	30	9	9				83
Bird	1	7	17	4	8	2	4			1		44
TOTAL	333	770	1044	330	319	418	204	111	47	18	88	3682

TABLE 10: (cont.)
Raw material

Combined	TOTAL	Q4	P4	C4	N4	M5	L4	L5	K5	J5
(Opaline translucent)	42 48.28%	1 50.00%	9 47.37%	16 68.18%	3 37.50%	4 50.00%	5 55.56%	3 30.00%	2 33.33%	
(Opaline not translucent)	37 42.53%	1 50.00%	10 52.63%	6 27.27%	5 62.50%	4 50.00%	3 33.33%	3 30.00%	3 50.00%	2 66.67%
Subtotal opalines	83 95.40%	2 100.00%	19 100.00%	21 95.45%	8 100.00%	8 100.00%	8 88.89%	10 100.00%	5 83.33%	2 66.67%
Hornfels	1 1.18%									1 33.33%
Tuffaceous rock	3 3.45%			1 4.55%			1 11.11%		1 16.67%	
Quartz										
Other										
TOTAL	87 100.00%	2 100.00%	19 100.00%	22 100.00%	8 100.00%	8 100.00%	9 100.00%	10 100.00%	6 100.00%	3 100.00%
Non-formal		Q4	P4	C4	N4	M5	L4	L5	K5	J5
(Opaline translucent)	38 48.34%	1 50.00%	9 47.37%	16 68.18%	3 37.50%	1 25.00%	5 55.56%	3 30.00%	1 20.00%	
(Opaline not translucent)	40 48.76%	1 50.00%	10 52.63%	6 27.27%	5 62.50%	3 75.00%	3 33.33%	7 30.00%	3 60.00%	2 66.67%
Subtotal opalines	78 98.12%	2 100.00%	19 100.00%	21 95.45%	8 100.00%	4 100.00%	8 88.89%	10 100.00%	4 80.00%	2 66.67%
Hornfels	1 1.22%									1 33.33%
Tuffaceous rock	3 3.66%			1 4.55%			1 11.11%		1 20.00%	
Quartz										
Other										
Total	82 100.00%	2 100.00%	19 100.00%	22 100.00%	8 100.00%	4 100.00%	9 100.00%	10 100.00%	5 100.00%	3 100.00%
Formal		Q4	P4	C4	N4	M5	L4	L5	K5	J5
(Opaline translucent)	4 80.00%					3 75.00%			1 100.00%	
(Opaline not translucent)	1 20.00%					1 25.00%				
Subtotal opalines	5 100.00%					4 100.00%			1 100.00%	
Hornfels										
Tuffaceous rock										
Quartz										
Other										
Total	5 100.00%					4 100.00%			1 100.00%	

TABLE 10: H level, utilised stone inventory

Non-formal	TOTAL	Q4	P4	O4	N4	M5	L4	L5	K5	J5
chunk	21 24.14%	2 100.00%	5 26.32%	6 27.27%	1 12.50%			6 60.00%	1 16.67%	
chip	1 1.15%						1 11.11%			
manuport/module										
CORE										
irregular										
bladelet 1 plat										
bladelet 2 plat										
flat bladelet										
blade										
cere rectus 1 plat										
cere rectus 2 plat										
flat plat bld cere										
other										
BLADE										
parallel sided	2 2.30%				1 12.50%		1 11.11%			
pointed										
thick triangular										
irregular	1 1.15%			1 4.55%						
BLADELET (<25mm)										
parallel sided	1 1.15%								1 16.67%	
pointed										
thick triangular	2 2.30%		1 5.26%					1 10.00%		
irregular	3 3.45%		2 10.53%						1 16.67%	
BROKEN BLADE										
distal	5 9.80%		3 15.79%			2 25.00%	3 33.33%			
medial	3 3.45%		1 5.26%	1 4.55%		1 12.50%				
proximal	6 6.78%		1 5.26%	1 4.55%		1 12.50%	1 11.11%			1 33.33%
FLAKES										
cere ra. flake										
Cortical Flakes										
undisturbed >50mm					1 12.50%		1 11.11%			
undisturbed <50mm										
undisturbed >50mm										
undisturbed <50mm	1 1.15%							1 10.00%		
Non-Cortical Flakes										
undisturbed >50mm	1 1.15%									1 33.33%
undisturbed <50mm	13 14.84%		6 15.79%	3 13.64%	3 37.50%		2 22.22%	1 10.00%	1 16.67%	
undisturbed >50mm										
undisturbed <50mm	4 10.34%		1 5.26%	6 27.27%			1 10.00%	1 16.67%		
Broken Flakes										
distal	5 5.78%			2 9.09%	2 25.00%					1 33.33%
medial										
proximal	4 4.60%		2 10.53%	2 9.09%						
Subtotal	62 94.25%	2 100.00%	19 100.00%	22 100.00%	6 100.00%	4 50.00%	9 100.00%	10 100.00%	5 83.33%	3 100.00%

TABLE 9: (cont.)

Formal	TOTAL	Q4	P4	Q4	N4	M6	L4	L5	K5	J6
SCRAPER Large > 30mm end side										
end & side	2 0.07%	1 0.24%			1 0.03%					
end & 2 sides										
end & adding										
high backed										
large backed										
naturally backed										
SCRAPER Medium 20-30 end side										
end & side	1 0.03%					1 0.20%				
end & 2 sides	1 0.03%	1 0.24%								
end & adding	1 0.03%									1 0.75%
high backed										
medium backed	1 0.03%			1 0.10%						
naturally backed										
SCRAPER Small < 20mm end side										
end & side	1 0.03%	1 0.24%								
end & 2 sides	1 0.03%					1 0.20%				
end & adding										
high backed	1 0.03%							1 0.20%		
small backed										
knife										
not back knife	2 0.07%		1 0.23%						1 0.04%	
BACKED TOOL > 30mm backed blade segment										
obliquely backed										
irregularly backed										
broken backed										
BACKED TOOL < 30mm backed bladelet segment	1 0.03%							1 0.03%		
obliquely backed										
irregularly backed	2 0.07%					1 0.20%		1 0.20%		
broken backed										
ventrally backed	2 0.07%		2 0.48%							
not back										
spoke-like	4 0.14%		1 0.23%		1 0.03%			2 0.02%		
not										
blade	1 0.03%			1 0.10%						
broken tool	0 0.01%	1 0.24%			2 0.71%	1 0.20%	1 0.44%	1 0.20%		
irregularly backed	10 0.31%		2 0.48%	1 0.10%	1 0.03%	4 1.03%		1 0.03%		1 0.70%
MSA tool	7 0.24%	3 0.73%				2 0.52%		2 0.02%		
Subtotal	14 1.51%	7 1.70%	0 1.32%	0 0.03%	0 1.70%	10 2.02%	1 0.44%	0 0.03%	1 0.04%	2 1.00%
TOTAL	2017	411 100.00%	444 100.00%	544 100.00%	281 100.00%	881 100.00%	228 100.00%	581 100.00%	110 100.00%	128 100.00%

TABLE 9: H level, stone inventory

Non-format	TOTAL		Q4	P4	O4	N4	M6	L4	L5	K5	J5
chunk	666 20.08%		70 19.95%	90 21.62%	112 20.69%	69 24.20%	70 18.37%	46 19.74%	76 19.95%	20 19.81%	21 16.41%
chip	1362 46.99%		243 69.12%	162 38.49%	275 50.55%	112 39.86%	177 49.46%	103 45.18%	153 44.09%	56 47.06%	66 51.58%
manipul	13 0.45%		3 0.73%	2 0.45%	1 0.18%		4 1.05%		1 0.28%	1 0.84%	1 0.78%
CORE											
irregular	44 1.51%		2 0.49%	7 1.55%	5 0.92%	6 2.14%	9 2.56%	3 1.32%	9 2.10%	3 2.52%	1 0.78%
bladelet 1 plat	15 0.51%		2 0.49%	8 1.80%		3 1.07%			1 0.28%	1 0.84%	
bladelet 2 plat	4 0.14%			1 0.23%			2 0.52%		1 0.28%		
flat bladelet	15 0.51%		2 0.49%	3 0.68%	4 0.74%	3 1.07%	2 0.52%		1 0.28%		
blade											
core redio 1 plat	16 0.55%		1 0.24%	5 1.13%	3 0.65%	1 0.36%	2 0.52%	1 0.44%	2 0.52%	1 0.84%	
core redio 2 plat	12 0.41%			1 0.23%		1 0.36%	3 0.79%	1 0.44%	5 1.31%		1 0.78%
flat plat bid core	17 0.58%		2 0.49%	4 0.90%	2 0.37%	2 0.71%	3 0.76%			3 2.52%	1 0.78%
other											
BLADE											
parallel sided											
pointed											
thick triangular											
irregular	4 0.14%		1 0.24%		2 0.37%		1 0.28%				
BLADELET (<25mm)											
parallel sided	7 0.24%					2 0.71%	1 0.28%	1 0.44%	1 0.28%	2 1.68%	
pointed											
thick triangular	5 0.17%			1 0.23%			2 0.52%		2 0.52%		
irregular	60 1.71%		4 0.97%	8 1.80%	7 1.29%	6 2.14%	5 1.31%	6 2.63%	9 2.10%	5 4.20%	1 0.78%
BROKEN BLADE											
distal	22 0.75%		2 0.49%	5 1.35%		1 0.36%	5 1.31%	5 2.19%	2 0.52%	1 0.84%	
medial	15 0.55%		2 0.49%	1 0.23%	4 0.74%		1 0.28%	2 0.88%	4 1.05%	1 0.84%	1 0.78%
proximal	43 1.47%		5 1.29%	5 1.13%	5 1.10%	4 1.42%	12 3.15%	4 1.75%	5 1.31%	1 0.84%	1 0.78%
FLAKES											
core rd flake	10 0.34%		1 0.24%	3 0.68%	2 0.37%		3 0.78%	1 0.44%			
Cortical Flakes											
bladelet <30mm	5 0.17%				1 0.10%	2 0.71%		1 0.44%	1 0.28%		
bladelet <30mm	30 1.03%			10 2.25%	8 1.47%	2 0.71%	3 0.79%	2 0.88%	4 1.05%		1 0.78%
bladelet <30mm	2 0.07%				1 0.18%						1 0.78%
bladelet <30mm	21 0.72%		1 0.24%	5 1.13%	4 0.74%	4 1.42%		2 0.88%	4 1.05%		1 0.78%
Non-Cortical Flakes											
bladelet <30mm	14 0.46%			2 0.45%	4 0.74%		1 0.28%		2 0.52%	1 0.84%	4 3.13%
bladelet <30mm	162 5.55%		10 4.30%	42 9.49%	25 4.60%	12 4.27%	14 3.67%	19 8.33%	17 4.40%	6 4.72%	7 5.47%
bladelet <30mm	10 0.32%		4 0.97%	1 0.23%	5 0.92%	1 0.36%	3 0.79%	1 0.44%	3 0.79%		
bladelet <30mm	220 7.65%		22 5.35%	37 8.33%	45 8.27%	27 9.51%	20 7.51%	19 7.99%	33 8.00%	5 4.04%	12 9.38%
Broken Flakes											
distal	45 1.54%		2 0.49%	8 1.80%	3 0.55%	3 1.07%	4 1.05%	6 2.63%	11 2.69%	5 4.20%	3 2.34%
medial	31 1.05%		2 0.49%	8 2.03%	6 1.10%	3 1.07%	3 0.79%	3 1.32%	5 1.31%		
proximal	75 2.57%		7 1.70%	11 2.40%	15 2.64%	13 4.63%	12 3.15%	3 1.32%	7 1.84%	3 2.52%	3 2.34%
Subtotal	2975 98.48%		404 99.80%	435 99.65%	541 98.45%	279 99.22%	371 97.98%	227 99.56%	372 97.64%	110 99.16%	129 99.44%

TABLE 8: Mean Ungulate Biomass, statistical relationship

	MUBa	MUBe	MUBk	MUBe/MUBa	MUBe/MUBk
MN	138.55	240.99	228.48	1.7394	1.0548
A	128.62	240.99	238.78	1.8737	1.0093
A2	127.32	240.99	261.27	1.8928	0.9224
PT	173.14	77.62	383.29	0.4483	0.2025
JA	119.81	136.77	198.43	1.1416	0.6893
PH	94.445	240.99	153.01	2.5516	1.5750
CM	125.91	103.04	234.41	0.8184	0.4396
H	131.99	103.04	258.39	0.7807	0.3988
DCM	220.66	58.48	577.3	0.2650	0.1013
LB	200.71	14.19	464.91	0.0707	0.0305
DB	299.43	77.52	809.11	0.2592	0.0969

TABLE 7: (cont.)

LB level

Species	MNI	avg bodyweight	MUBa	MUBe	MUBk
Equus sp	1	603.80			
Alcelaphus buselaphus	1	135.00			
Antidorcas marsupialis	1	39.05			
Pelea capreolus	1	25.00			
Total	4	802.85	200.71	14.19	462.91
Number of species	4				

DB level

Species	MNI	avg bodyweight	MUBa	MUBe	MUBk
Equus burchelli/quagga	1	307.60			
Equus capensis	1	900.00			
Phacochoerus aethiopicus	1	68.05			
Connochaetes gnou	2	170.00			
Alcelaphus buselaphus	2	135.00			
Megalotragus priscus	1	900.00			
Damaliscus dorcas	1	63.27			
Antidorcas marsupialis	1	39.05			
Antidorcas bondi	1	35.14			
Taurotragus oryx	1	670.00			
Total	12	3288.11	299.43	77.62	809.11
Number of species	10				

TABLE 7: (cont.)

CM level

Species	MNI	avg bodyweight	MUBa	MUBe	MUBk
<i>Equus burchelli/quagga</i>	1	307.60			
<i>Phacochoerus aethiopicus</i>	2	68.05			
<i>Connochaetes gnou</i>	1	170.00			
<i>Alcelaphus buselaphus</i>	2	135.00			
<i>Damaliscus dorcas</i>	1	63.27			
<i>Sylvicapra grimmia</i>	1	19.70			
<i>Antidorcas marsupialis</i>	2	39.05			
<i>Oreotragus oreotragus</i>	1	11.90			
<i>Raphicerus campestris</i>	1	11.09			
<i>Pelea capreolus</i>	1	25.00			
<i>Taurotragus oryx</i>	1	670.00			
Total	14	1520.66	125.91	103.04	234.41
Number of species	11				

H level

Species	MNI	avg bodyweight	MUBa	MUBe	MUBk
<i>Equus burchelli/quagga</i>	1	307.60			
<i>Phacochoerus aethiopicus</i>	1	68.05			
<i>Connochaetes gnou</i>	1	170.00			
<i>Alcelaphus buselaphus</i>	1	135.00			
<i>Damaliscus dorcas</i>	2	63.27			
<i>Sylvicapra grimmia</i>	1	19.70			
<i>Antidorcas marsupialis</i>	1	39.05			
<i>Oreotragus oreotragus</i>	1	11.90			
<i>Raphicerus campestris</i>	1	11.09			
<i>Pelea capreolus</i>	1	25.00			
<i>Taurotragus oryx</i>	1	670.00			
Total	12	1520.66	131.99	103.04	258.39
Number of species	11				

DCM level

Species	MNI	avg bodyweight	MUBa	MUBe	MUBk
<i>Equus capensis</i>	1	900.00			
<i>Phacochoerus aethiopicus</i>	1	68.05			
<i>Connochaetes gnou</i>	1	170.00			
<i>Damaliscus dorcas</i>	1	63.27			
<i>Antidorcas marsupialis</i>	2	39.05			
<i>Antidorcas bondi</i>	1	35.14			
<i>Tragelaphus strepsiceros</i>	1	192.60			
<i>Taurotragus oryx</i>	1	670.00			
<i>Redunca fulvorufula</i>	1	29.40			
Total	10	2167.51	220.66	58.48	577.3
Number of species	9				

TABLE 7: (cont.)

Pi LEVEL

Species	MNI	avg bodyweight	MUBa	MUBe	MUBk
Phaechochoerus aethiopicus	1	68.05			
Connochaetes gnou	2	170.00			
Alcelaphus buselaphus	1	135.00			
Damalliscus dorcas	4	63.27			
Antidorcas marsupialis	4	39.05			
Oreotragus oreotragus	1	11.90			
Pelea capreolus	1	25.00			
Hippotragus cf. equinus	1	261.00			
Taurotragus oryx	3	670.00			
Redunca fulvorufula	1	29.40			
Total	19	1472.67	173.14	77.62	383.29
Number of species	10				

Ja level

Species	MNI	avg bodyweight	MUBa	MUBe	MUBk
Equus burchelli/qugga	1	307.60			
Phaechochoerus aethiopicus	2	68.05			
Connochaetes gnou	3	170.00			
Connochaetes taurinus	1	215.00			
Alcelaphus buselaphus	2	135.00			
Damalliscus dorcas	2	63.27			
Sylvicapra grimmia	2	19.70			
Antidorcas marsupialis	4	39.05			
Antidorcas bondi	1	35.14			
Pelea capreolus	2	25.00			
Taurotragus oryx	1	670.00			
Total	21	1747.81	119.81	136.77	198.43
Number of species	12				

Ph level

Species	MNI	avg bodyweight	MUBa	MUBe	MUBk
Phaechochoerus aethiopicus	2	68.05			
Connochaetes gnou	2	170.00			
Alcelaphus buselaphus	1	135.00			
Damalliscus dorcas	2	63.27			
Sylvicapra grimmia	1	19.70			
Antidorcas marsupialis	6	39.05			
Antidorcas bondi	1	35.14			
Oreotragus oreotragus	2	11.90			
Raphicerus campestris	1	11.09			
Pelea capreolus	2	25.00			
Hippotragus leucophaeus	1	263.00			
Tragelaphus strepsiceros	1	192.60			
Taurotragus oryx	1	670.00			
Redunca fulvorufula	1	29.40			
Total	24	1733.20	94.445	240.99	153.01
Number of species	14				

TABLE 7: Mean Ungulate Biomass - archaeological, expected, corrected

Mn LEVEL

Species	MNI	avg bodyweight	MUBa	MUBe	MUBk
<i>Equus burchelli</i>	1	307.60			
<i>Phacochoerus aethiopicus</i>	1	68.05			
<i>Bos primigenius f. taurus</i>	5	180.00			
<i>Capra hircus</i>	1	35.00			
<i>Connochaetes gnou</i>	2	170.00			
<i>Connochaetes taurinus</i>	1	215.00			
<i>Alcelaphus buselaphus</i>	2	135.00			
<i>Damaliscus dorcas</i>	1	63.27			
<i>Antidorcas marsupialis</i>	3	39.05			
<i>Oreotragus oreotragus</i>	1	11.90			
<i>Ourebia ourebia</i>	1	14.00			
<i>Raphicerus campestris</i>	1	11.09			
<i>Pelea capreolus</i>	1	25.00			
<i>Taurotragus oryx</i>	1	670.00			
Total	22	1944.96	138.55	240.99	228.48
Number of species	14				

A level

Species	MNI	avg bodyweight	MUBa	MUBe	MUBk
<i>Phacochoerus aethiopicus</i>	2	68.05			
<i>Bos primigenius f. taurus</i>	1	180.00			
<i>Capra hircus</i>	1	35.00			
<i>Connochaetes gnou</i>	2	170.00			
<i>Connochaetes taurinus</i>	2	215.00			
<i>Alcelaphus buselaphus</i>	2	135.00			
<i>Damaliscus dorcas</i>	2	63.27			
<i>Sylvicapra grimmia</i>	1	19.70			
<i>Antidorcas marsupialis</i>	5	39.05			
<i>Raphicerus campestris</i>	1	11.09			
<i>Aepyroceros melampus</i>	1	48.00			
<i>Pelea capreolus</i>	1	25.00			
<i>Taurotragus oryx</i>	2	670.00			
<i>Redunca fulvorufula</i>	2	29.40			
Total	25	1708.56	128.62	240.99	238.78
Number of species	14				

A2-level

Species	MNI	avg bodyweight	MUBa	MUBe	MUBk
<i>Phacochoerus aethiopicus</i>	1	68.05			
<i>Ovis aries</i>	1	35.00			
<i>Capra hircus</i>	3	35.00			
<i>Connochaetes gnou</i>	3	170.00			
<i>Connochaetes taurinus</i>	1	215.00			
<i>Alcelaphus buselaphus</i>	2	135.00			
<i>Damaliscus dorcas</i>	2	63.27			
<i>Sylvicapra grimmia</i>	1	19.70			
<i>Antidorcas marsupialis</i>	5	39.05			
<i>Raphicerus campestris</i>	3	11.09			
<i>Pelea capreolus</i>	3	25.00			
<i>Taurotragus oryx</i>	3	670.00			
<i>Redunca fulvorufula</i>	1	29.40			
Total	29	1516.56	127.32	240.99	261.27
Number of species	14				

TABLE 6: Species community structure. Spearman rank-order correlations

		MN	A	A2	PT	JA	PH	CM	H	DCM	LB	DB
Coefficient	MN		0.7445	0.6873	0.5853	0.3151	0.3899	0.4481	0.0324	0.4058	0.3364	
			0.0000	0.0000	0.0000	0.0206	0.0000	0.0010	0.0173	0.0029	0.0134	
Significance	A	0.7445		0.6873	0.6077	0.8217	0.6126	0.6201	0.3869	0.4371	0.3749	
		0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0045	0.0013	0.0059	
	A2	0.6873	0.6877		0.7973	0.5929	0.5918	0.5947	0.3623	0.4410	0.3493	
		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0078	0.0012	0.0100	
	PT	0.5853	0.6077	0.7973		0.6863	0.7233	0.7313	0.4058	0.3889	0.3952	
		0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0029	0.0043	0.0013	
	JA											
	PH	0.3151	0.6217	0.5929	0.5853			0.7658	0.6013	0.4386	0.3375	0.4005
		0.0063	0.0000	0.0000	0.0000			0.0000	0.0000	0.0013	0.0134	0.0033
	CM	0.3899	0.6126	0.5918	0.7233	0.7658			0.8866	0.3267	0.3714	0.5600
		0.0066	0.0000	0.0000	0.0000	0.0000			0.0000	0.0164	0.0063	0.0000
	H	0.4481	0.6201	0.5947	0.7313	0.6013	0.8866			0.3761	0.3181	0.5399
		0.0010	0.0000	0.0000	0.0000	0.0000	0.0000			0.0057	0.0194	0.0001
	DCM	0.3238	0.3869	0.3623	0.4058	0.4386	0.3267	0.8761			0.4400	0.6200
		0.0173	0.0045	0.0078	0.0029	0.0013	0.0000	0.0000			0.0000	0.0000
	LB	0.4058	0.4371	0.4410	0.3889	0.3375	0.3714	0.3181	0.4400			0.4800
		0.0029	0.0013	0.0012	0.0043	0.0013	0.0000	0.0000	0.0000			0.0000
	DB	0.3364	0.3749	0.3493	0.3952	0.4005	0.5600	0.5399	0.6200	0.4800		
		0.0134	0.0059	0.0100	0.0013	0.0033	0.0000	0.0000	0.0000	0.0000		

		MN	A	A2	PT	JA	PH	CM	H	DCM	LB	DB
Coefficient	MN		0.6071	0.5915	0.5915			0.4471	0.4726	0.4156	0.5555	0.4032
			0.0000	0.0010	0.0010			0.0611	0.0143	0.0096	0.0023	0.0272
Significance	A	0.6071		0.5915	0.5915	0.5401	0.6707	0.6915	0.5341	0.5544	0.5013	
		0.0000		0.0000	0.0000	0.0005	0.0002	0.0002	0.0034	0.0024	0.0060	
	A2	0.5915	0.5915		0.5915	0.5792	0.6153	0.6476	0.4935	0.5593	0.4842	
		0.0000	0.0000		0.0000	0.0015	0.0006	0.0001	0.0069	0.0018	0.0080	
	PT	0.5915	0.5915	0.5915		0.5612	0.7046	0.7340	0.5898	0.5808	0.5410	
		0.0000	0.0000	0.0000		0.0003	0.0001	0.0001	0.0012	0.0015	0.0030	
	JA											
	PH		0.5401	0.5792	0.5612			0.6493	0.5861	0.6091	0.5284	0.5607
		0.0611	0.0005	0.0015	0.0003			0.0000	0.0000	0.0009	0.0036	0.0021
	CM	0.4471	0.6707	0.6153	0.7046	0.6493			0.5593	0.4817	0.5336	0.6964
		0.0143	0.0002	0.0006	0.0001	0.0000			0.0000	0.0083	0.0025	0.0001
	H	0.4726	0.6915	0.6467	0.7340	0.5861	0.5593			0.5179	0.5462	0.6668
		0.0096	0.0002	0.0004	0.0001	0.0000	0.0000			0.0046	0.0028	0.0003
	DCM	0.4156	0.5341	0.4935	0.5898	0.6091	0.4817	0.5179			0.5051	0.6475
		0.0228	0.0034	0.0069	0.0012	0.0009	0.0003	0.0045			0.0006	0.0001
	LB	0.5555	0.5544	0.5693	0.5808	0.5284	0.5536	0.5462	0.5051			0.5851
		0.0023	0.0024	0.0018	0.0015	0.0038	0.0035	0.0028	0.0057			0.0014
	DB	0.4032	0.5013	0.4842	0.5410	0.5607	0.6964	0.6668	0.6475	0.5851		
		0.0272	0.0060	0.0080	0.0030	0.0021	0.0001	0.0003	0.0004	0.0014		

TABLE 5: Animal water dependency
All species

Lives near water/ needs water regularly									
Species	Late Holocene		Holocene		Early Holocene		Pleistocene		TOTAL
<i>Aonyx capensis</i>					1	1.08%			1 0.33%
<i>Antelope cervinus</i>					4	4.30%			4 2.01%
<i>Capreolus capreolus</i>	17	10.43%	4	16.00%	6	6.45%	1	5.56%	28 9.36%
<i>Connochaetes gnou</i>	41	25.15%	6	20.00%	29	31.18%	8	44.44%	83 27.76%
<i>Connochaetes taurinus</i>	11	6.75%	1	4.00%	3	3.23%			15 5.02%
<i>Dama dama</i>	69	42.33%	10	40.00%	43	46.24%	6	33.33%	128 42.81%
<i>Aspideres melampus</i>	1	0.61%							1 0.33%
<i>Hippotragus niger</i>					2	2.15%			2 0.67%
<i>Tragelaphus streptoceros</i>					2	2.15%	1	5.56%	3 1.00%
<i>Redunca fulvorufula</i>	22	13.50%	5	20.00%	3	3.23%	2	11.11%	32 10.70%
Subtotal	163	100.00%	25	100.00%	93	100.00%	18	100.00%	299 100.00%
Lives in dry areas/ does not need water regularly									
Species	Late Holocene		Holocene		Early Holocene		Pleistocene		TOTAL
<i>Cercopithecus aethiops</i>					2	0.80%			2 0.27%
<i>Canis mesomelas</i>	12	2.82%	1	2.94%	12	4.80%			25 3.38%
<i>Suricata suricatta</i>					2	0.80%			2 0.27%
<i>Myasina brunnea</i>	2	0.47%							2 0.27%
<i>Xerus inauris</i>	9	2.12%							9 1.22%
<i>Alcelaphus buselaphus</i>	19	4.47%	2	5.88%	21	8.40%	8	28.67%	50 6.77%
<i>Sylvicapra grimmia</i>	5	1.18%			13	5.20%			18 2.44%
<i>Antidorcas marsupialis</i>	304	71.53%	18	52.94%	103	41.20%	15	50.00%	440 59.54%
<i>Oreotragus oreotragus</i>	1	0.24%	1	2.94%	12	4.80%			14 1.88%
<i>Ourebia ourebia</i>	1	0.24%							1 0.14%
<i>Raphicerus campestris</i>	12	2.82%	1	2.94%	13	5.20%			26 3.52%
<i>Pelea capreolus</i>	29	6.82%	3	8.82%	23	9.20%	1	3.33%	56 7.58%
<i>Taurotragus oryx</i>	31	7.29%	8	23.53%	49	19.50%	6	20.00%	94 12.72%
Subtotal	425	100.00%	34	100.00%	250	100.00%	30	100.00%	739 100.00%
Wet	163	27.72%	25	42.37%	93	27.11%	18	37.50%	299 26.51%
Dry	425	72.28%	34	57.63%	250	72.89%	30	62.50%	739 71.19%
TOTAL	588	100.00%	59	100.00%	343	100.00%	48	100.00%	1038 100.00%

TABLE 5: (cont.)
Ungulates only

Lives near water/ needs water regularly									
Species	Late Holocene		Holocene		Early Holocene		Pleistocene		TOTAL
<i>Connochaetes gnou</i>	41	25.47%	5	23.81%	29	35.37%	8	47.06%	83 31.44%
<i>Connochaetes taurinus</i>	11	7.84%	1	4.76%	3	3.66%			15 5.88%
<i>Dama dama</i>	69	47.92%	10	47.62%	43	52.44%	6	35.29%	128 48.48%
<i>Aspideres melampus</i>	1	0.69%							1 0.38%
<i>Hippotragus niger</i>					2	2.44%			2 0.76%
<i>Tragelaphus streptoceros</i>					2	2.44%	1	5.88%	3 1.14%
<i>Redunca fulvorufula</i>	22	15.25%	5	23.81%	3	3.66%	2	11.76%	32 12.12%
Subtotal	144	100.00%	21	100.00%	82	100.00%	17	100.00%	264 100.00%
Lives in dry areas/ does not need water regularly									
Species	Late Holocene		Holocene		Early Holocene		Pleistocene		TOTAL
<i>Sylvicapra grimmia</i>	5	1.31%			13	8.10%			18 2.77%
<i>Antidorcas marsupialis</i>	304	78.37%	18	58.06%	103	48.36%	15	68.18%	440 67.80%
<i>Oreotragus oreotragus</i>	1	0.26%	1	3.23%	12	5.63%			14 2.16%
<i>Ourebia ourebia</i>	1	0.26%							1 0.16%
<i>Raphicerus campestris</i>	12	3.13%	1	3.23%	13	6.10%			26 4.01%
<i>Pelea capreolus</i>	29	7.57%	3	9.68%	23	10.80%	1	4.55%	56 8.63%
<i>Taurotragus oryx</i>	31	8.08%	8	25.81%	49	23.00%	6	27.27%	94 14.48%
Subtotal	383	100.00%	31	100.00%	213	100.00%	22	100.00%	649 100.00%
Wet	144	27.32%	21	40.38%	82	27.80%	17	43.59%	264 28.92%
Dry	383	72.68%	31	59.62%	213	72.20%	22	45.63%	649 62.52%
TOTAL	527	100.00%	52	100.00%	295	100.00%	39	100.00%	913 100.00%

TABLE 17: CM level, utilised stone inventory

Non-formal	TOTAL	G1	G2	M3	M4	M5	L3	K3	K4	J3	J4
chunk	18 20.22%	1 50.00%	1 25.00%	3 11.54%	2 22.22%	1 33.33%	2 10.10%			1 12.50%	5 41.67%
whip	1 1.12%			1 3.65%							
manup: rhinocule											
CORRE											
irregular	1 1.12%				1 11.11%						
blat 1st 1 plat	1 1.12%										1 8.33%
blat 1st 2 plat											
11 1bladplat											
blade											
corro to 1st 1 plat											
corro to 1st 2 plat											
111111 blat cora	1 1.12%			1						1 8.33%	
other											
BLADE											
p: mllel sided											
pointed											
111111 triangular	1 1.12%								1 100.00%		
irregular	1 1.12%			1 3.65%							
BLADE 1 (<20mm)											
1 mllel sided	2 2.25%							2 22.22%			
pointed											
111111 triangular	5 5.82%			1 3.65%	1 11.11%			1 11.11%		2 25.00%	
irregular											
BP KBN BLADE											
dlatel	1 1.12%							1 11.11%			
medial	3 3.37%			3 11.54%							
proximal	8 8.82%	1 10.07%	1 25.00%	2 7.69%	1 11.11%						
FLAKES											
corro to 1st 1 plat											
Corro to 1st 2 plat											
111111 30+mm											
111111 30+mm											
111111 30+mm											
111111 30+mm	1 1.12%				1 11.11%						
Net - Corro to 1st 1 plat											
111111 30+mm	3 3.37%			3 11.54%							
111111 30+mm	13 14.61%	2 33.33%		5 19.22%	1 11.11%	1 33.33%		2 22.22%		2 10.67%	
111111 30+mm	3 3.37%						1 0.00%			2 25.00%	
111111 30+mm	15 16.67%		2 50.00%	3 11.54%	2 22.22%		3 27.27%	2 22.22%		1 12.50%	2 10.67%
Broken Flakes											
dlatel	4 4.49%			1 3.65%			2 10.10%			1 12.50%	
medial	3 3.37%			1 3.65%			2 10.10%				
proximal	6 6.67%			2 7.69%			1 9.09%			1 12.50%	1 8.33%
FLAT 1st	67 67.76%	8 100.00%	4 100.00%	26 100.00%	9 100.00%	2 66.67%	11 100.00%	8 88.89%	1 100.00%	8 100.00%	12 100.00%

TABLE 16: (cont.)

Form		Q3	Q4	M3	M4	M5	L3	K3	K4	J3	J4											
SCRAPER Large >30mm																						
and side	2	0.05%	1	0.33%				1	0.28%													
and 2 sides																						
and 2 sides																						
and 2 sides																						
high backed																						
large backed																						
naturally backed	1	0.03%	1	0.33%																		
SCRAPER Medium 20-30																						
and side																						
and 2 sides																						
and 2 sides																						
and 2 sides	1	0.03%					1	0.21%														
high backed	1	0.03%			1	0.13%																
large backed																						
naturally backed																						
SCRAPER small <20mm																						
and side	1	0.03%									1	0.31%										
and 2 sides																						
and 2 sides																						
and 2 sides	1	0.03%				1	0.13%															
high backed	2	0.06%				1	0.13%															
small backed	1	0.03%						1	0.20%			1	0.31%									
knife	2	0.09%				1	0.13%			1	1.70%											
naturally backed	3	0.09%				1	0.13%					1	0.31%									
BACKED TOOL >30mm																						
backed blade	1	0.03%						1	0.20%													
segment																						
polished backed																						
miscellaneous	1	0.03%				1	0.13%															
broken backed																						
BACKED TOOL <30mm																						
backed blade	1	0.03%										1	0.31%									
segment																						
polished backed																						
miscellaneous	1	0.03%						1	0.21%													
broken backed																						
very retro blade	1	0.03%				1	0.13%															
size	4	0.10%	1	0.20%	1	0.31%																
spoke blade	2	0.05%				1	0.13%		1	0.20%		1	0.20%									
and	1	0.03%				1	0.13%															
layer																						
broken tool	8	0.20%				3	0.23%	3	0.63%	1	0.15%		1	0.27%								
miscellaneous	10	0.28%	1	0.33%		3	0.23%	4	1.11%	1	0.15%		1	0.27%								
MBA tool	2	0.05%				1	0.13%	1	0.20%													
Subtotal	47	1.10%	4	1.01%	1	0.34%	10	1.04%	2	0.20%	3	0.02%	6	1.70%	1	1.70%	3	0.07%	4	1.20%		
TOTAL	5957	100.00%	306	100.00%	293	100.00%	775	100.00%	351	100.00%	667	100.00%	485	100.00%	352	100.00%	65	100.00%	343	100.00%	390	100.00%

TABLE 16: CM level, stone inventory

Non-normal	TOTAL	G3	G4	M3	M4	M5	L3	K3	K4	J3	J4
chunk	783 10.76%	58 10.36%	44 18.02%	185 23.87%	75 21.08%	89 14.69%	141 29.07%	69 19.32%	10 17.88%	64 18.86%	41 12.81%
chip	1772 44.78%	145 47.84%	159 47.44%	324 41.81%	149 41.27%	360 59.47%	159 32.78%	149 42.33%	19 33.93%	132 38.48%	165 51.89%
monopart	0 0.20%			2 0.26%	2 0.56%	1 0.16%	2 0.41%				1 0.31%
CORE											
irregular	70 1.87%	17 5.57%	4 1.37%	14 1.91%	10 2.77%	3 0.45%	14 2.80%	8 1.42%	4 7.14%	5 1.46%	2 0.63%
bladelet 1 plat	11 0.28%	1 0.33%		3 0.39%	2 0.55%		1 0.21%	2 0.57%			2 0.63%
bladelet 2 plat	6 0.13%	1 0.33%	1 0.34%	1 0.13%			1 0.21%				1 0.31%
flat bladelet	11 0.28%		3 1.02%	2 0.26%	4 1.11%					1 0.25%	1 0.31%
blade											
core radius 1 plat	10 0.25%		3 1.02%	2 0.26%		2 0.30%	1 0.21%	1 0.29%			1 0.31%
core radius 2 plat	16 0.40%	1 0.33%	2 0.66%	2 0.26%	2 0.55%	2 0.30%	3 0.62%	3 0.65%			1 0.31%
flat plat bid core	12 0.30%	2 0.66%	3 1.02%	1 0.13%	1 0.26%		1 0.21%	1 0.29%	1 1.78%	1 0.29%	1 0.31%
other											
BLADE											
parallel sided	1 0.03%									1 0.29%	
pointed											
thick triangular	3 0.08%	1 0.33%							2 3.57%		
irregular	13 0.33%		2 0.66%	2 0.26%			1 0.21%	1 0.29%		6 2.33%	
BLADELET (<25mm)											
parallel sided	8 0.15%						1 0.21%	4 1.14%			1 0.31%
pointed	2 0.05%					2 0.30%					
thick triangular	8 0.20%	1 0.33%			2 0.55%			4 1.14%	1 1.78%		
irregular	72 1.82%	2 0.66%	9 3.07%	21 2.71%	4 1.11%	12 1.80%	7 1.44%	9 2.67%	1 1.78%	3 0.87%	5 1.58%
BROKEN BLADE											
distal	27 0.69%	1 0.33%		7 0.90%	2 0.55%	3 0.45%	4 0.82%	8 1.70%	1 1.78%	1 0.29%	2 0.63%
medial	10 0.45%		1 0.34%	0 1.03%	1 0.26%	2 0.30%	2 0.41%	1 0.29%			3 0.94%
proximal	50 1.26%	1 0.33%	3 1.02%	16 1.94%	8 1.66%	8 0.90%	7 1.44%	1 0.65%		4 1.17%	5 1.56%
FLAKE											
core ref. flake	4 0.10%				2 0.55%			2 0.57%			
Carbide Flakes											
undersize 30+mm	11 0.28%	1 0.33%	1 0.34%	1 0.13%	3 0.83%			1 0.32%		1 0.29%	3 0.94%
undersize <30mm	39 0.99%		5 1.71%	3 1.03%	7 1.94%	2 0.30%	3 0.62%	1 0.29%		7 2.04%	5 1.56%
undersize 30+mm	3 0.08%		1 0.34%				1 0.21%			1 0.29%	
undersize <30mm	30 0.76%	1 0.33%	4 1.37%	2 0.26%	5 1.39%	5 0.75%	2 0.41%	4 1.14%	2 3.57%	3 0.87%	2 0.63%
Non-Carbide Flakes											
undersize 30+mm	30 0.76%	1 0.33%	2 0.66%	10 1.29%	3 0.83%	1 0.16%	8 1.24%	3 0.85%	1 1.78%	1 0.29%	2 0.63%
undersize <30mm	321 9.11%	28 8.82%	28 9.87%	48 6.24%	29 8.03%	41 6.15%	41 8.45%	33 9.39%	5 8.93%	48 13.41%	28 8.75%
undersize 30+mm	30 0.76%	4 1.01%	2 0.66%	7 0.90%		5 0.75%	2 0.41%	4 1.14%	1 1.78%	5 1.48%	
undersize <30mm	362 9.15%	27 8.65%	29 9.90%	54 6.97%	32 8.86%	74 11.08%	54 11.13%	39 9.24%	5 8.93%	68 11.08%	20 6.25%
Broken Flakes											
distal	51 1.29%	1 0.33%	1 0.34%	0 1.03%		6 1.20%	6 1.20%	3 0.85%	2 3.57%	12 3.50%	7 2.19%
medial	39 0.99%	5 1.57%	4 1.37%	12 1.56%	4 1.11%		7 1.44%	1 0.29%			5 1.58%
proximal	95 2.15%	6 1.84%	8 1.02%	23 2.97%	7 1.94%	8 1.20%	13 2.66%	9 2.53%		5 1.78%	11 3.44%
Subtotal	3910 98.01%	301 96%	292 99.88%	760 98%	353 97.70%	385 100%	482 99.88%	340 99.90%	85 99.21%	340 99.13%	316 99.78%

TABLE 15: H level, diversity, richness and evenness indices

	STANDARD		
	Combined	Non-formal	Formal
Diversity	-3.8501	-3.3673	-2.8332
Richness	11.9476	8.3153	5.6473
Evenness	-1.0000	-1.0000	-1.0000

	ARCHAEOLOGICAL		
	Combined	Non-formal	Formal
Diversity	-1.9850	-1.8972	-2.4549
Richness	5.7656	3.5162	4.2281
Evenness	-0.5156	-0.5634	-0.8665

	ARCHAEOLOGICAL/STANDARD		
	Combined	Non-formal	Formal
Diversity	0.5156	0.5634	0.8665
Richness	0.4826	0.4229	0.7487
Evenness	0.5156	0.5634	0.8665

TABLE 14: H level, raw material

Combined	TOTAL	Q4	P4	O4	N4	M5	L4	L5	K5	J5
(Opaline translucent)	842 32.29%	105 25.53%	144 32.43%	191 35.11%	111 39.50%	134 35.17%	58 25.44%	128 33.60%	30 25.21%	41 32.03%
(Opaline not translucent)	857 29.38%	111 27.01%	148 33.33%	163 29.96%	66 23.49%	115 30.18%	79 34.65%	108 28.35%	41 34.45%	26 20.31%
Subtotal opalines	1799 61.67%	216 52.55%	292 65.77%	354 65.07%	177 62.99%	249 65.35%	137 60.09%	236 61.94%	71 59.66%	67 52.34%
Horrfels	190 6.81%	30 7.30%	25 5.63%	23 4.23%	17 6.05%	25 6.56%	18 7.89%	39 10.24%	5 4.20%	8 6.25%
Tuffaceous rock	294 10.08%	53 12.90%	33 7.43%	72 13.24%	31 11.03%	22 5.77%	30 13.16%	26 6.82%	10 8.40%	17 13.28%
Quartz	143 4.90%	29 7.06%	36 8.11%	34 6.25%	4 1.42%	13 3.41%	5 2.19%	12 3.15%	5 4.20%	5 3.91%
Other	491 16.83%	83 20.19%	59 13.06%	61 11.21%	52 18.51%	72 18.90%	38 16.87%	68 17.85%	28 23.53%	31 24.22%
TOTAL	2817 100.00%	411 100.00%	444 100.00%	544 100.00%	281 100.00%	381 100.00%	228 100.00%	381 100.00%	119 100.00%	128 100.00%
Non-formal		Q4	P4	O4	N4	M5	L4	L5	K5	J5
(Opaline translucent)	918 31.95%	103 25.50%	141 32.19%	188 34.75%	106 38.41%	131 35.31%	57 25.11%	123 33.08%	29 24.58%	40 31.75%
(Opaline not translucent)	841 29.27%	107 26.49%	146 33.33%	163 30.13%	66 23.91%	110 29.85%	79 34.80%	104 27.96%	41 34.75%	25 19.84%
Subtotal opalines	1759 61.23%	210 51.98%	287 65.53%	351 64.88%	172 62.32%	241 64.96%	136 59.91%	227 61.02%	70 59.32%	65 51.59%
Horrfels	189 6.58%	30 7.43%	25 5.71%	23 4.25%	17 6.18%	24 6.47%	18 7.93%	39 10.48%	5 4.24%	8 6.35%
Tuffaceous rock	292 10.16%	53 13.12%	32 7.31%	72 13.31%	31 11.23%	21 5.66%	30 13.22%	26 6.99%	10 8.47%	17 13.49%
Quartz	143 4.98%	29 7.18%	36 8.22%	34 6.28%	4 1.45%	13 3.50%	5 2.20%	12 3.23%	5 4.24%	5 3.97%
Other	490 17.06%	82 20.30%	58 13.24%	61 11.28%	52 18.84%	72 19.41%	38 16.74%	68 18.25%	28 23.73%	31 24.60%
Total	2878 100.00%	404 100.00%	438 100.00%	541 100.00%	276 100.00%	371 100.00%	227 100.00%	372 100.00%	118 100.00%	126 100.00%
Formal		Q4	P4	O4	N4	M5	L4	L5	K5	J5
(Opaline translucent)	24 54.55%	2 26.57%	3 50.00%	3 100.00%	5 100.00%	3 30.00%	1 100.00%	5 55.56%	1 100.00%	1 50.00%
(Opaline not translucent)	16 36.36%	4 57.14%	2 33.33%			5 50.00%		4 44.44%		1 50.00%
Subtotal opalines	40 90.91%	6 86.71%	5 83.33%	3 100.00%	5 100.00%	8 80.00%	1 100.00%	9 100.00%	1 100.00%	2 100.00%
Horrfels	1 2.27%					1 10.00%				
Tuffaceous rock	2 4.55%		1 16.67%			1 10.00%				
Quartz										
Other	1 2.27%	1 14.29%								
Total	44 100.00%	7 100.00%	6 100.00%	3 100.00%	5 100.00%	10 100.00%	1 100.00%	9 100.00%	1 100.00%	2 100.00%

TABLE 13: H level, abraded stone, rock crystal, ochre, haemitite
specularite and other iron bearing stone

	TOTAL	Q4	P4	O4	N4	M5	L4	L5	K5	J6
misc groundstone work										
upper grinder	2						2			
palette	1						1			
rock crystal										
ochre			x	x						
specularite										
haemitite				x		x				
magnetic chunk										
iron bearing stone			x	x						
pebbles	132	19	21	79	2	11				

TABLE 12: (cont.)
raw material

Combined	TOTAL	Q4	P4	O4	N4	M5	L4	L5	K5	J5
(Opaline translucent)	28 16.25%	1 9.09%	6 18.75%	6 16.67%		1 9.09%		9 27.27%	3 37.50%	
(Opaline not translucent)	121 75.63%	10 90.91%	25 78.13%	30 83.33%	9 100.00%	10 90.91%	14 93.33%	15 45.45%	5 62.50%	3 60.00%
Subtotal opalines	154 95.25%	11 100.00%	31 95.88%	36 100.00%	9 100.00%	11 100.00%	14 93.33%	31 93.94%	8 100.00%	3 60.00%
Hornfels	1 0.63%							1 3.03%		
Tuffaceous rock	4 2.50%		1 3.13%				1 6.67%	1 3.03%		1 20.00%
Quartz										
Other	1 0.63%									1 20.00%
TOTAL	160 100.00%	11 100.00%	32 100.00%	36 100.00%	9 100.00%	11 100.00%	15 100.00%	33 100.00%	8 100.00%	5 100.00%
Non-formal		Q4	P4	O4	N4	M5	L4	L5	K5	J5
(Opaline translucent)	23 14.74%	1 9.09%	5 16.13%	5 14.29%		1 9.09%		8 25.81%	3 37.50%	
(Opaline not translucent)	127 81.41%	10 90.91%	25 80.65%	30 85.71%	9 100.00%	10 90.91%	14 93.33%	21 45.18%	5 62.50%	3 60.00%
Subtotal opalines	150 96.15%	11 100.00%	30 96.77%	35 100.00%	9 100.00%	11 100.00%	14 93.33%	29 93.55%	8 100.00%	3 60.00%
Hornfels	1 0.64%							1 3.23%		
Tuffaceous rock	4 2.56%		1 3.23%				1 6.67%	1 3.23%		1 20.00%
Quartz										
Other	1 0.64%									1 20.00%
Total	156 100.00%	11 100.00%	31 100.00%	35 100.00%	9 100.00%	11 100.00%	15 100.00%	31 100.00%	8 100.00%	5 100.00%
Formal		Q4	P4	O4	N4	M5	L4	L5	K5	J5
(Opaline translucent)	3 75.00%		1 100.00%	1 100.00%				1 50.00%		
(Opaline not translucent)	1 25.00%							1 50.00%		
Subtotal opalines	4 100.00%		1 100.00%	1 100.00%				2 100.00%		
Hornfels										
Tuffaceous rock										
Quartz										
Other										
Total	4 100.00%		1 100.00%	1 100.00%				2 100.00%		

TABLE 12: H level, heat-altered stone inventory

Non-normal	TOTAL	Q4	P4	O4	N4	M5	L4	L5	K5	J5
chunk	56 35.00%	7 63.64%	11 34.38%	13 38.11%	3 33.33%		7 46.67%	12 36.36%	1 12.50%	2 40.00%
chip	50 31.25%	2 18.18%	7 21.68%	14 38.89%	3 33.33%	7 63.64%	5 33.33%	8 24.24%	4 50.00%	
manupor/nodule										
CORE										
irregular	4 2.50%							2 6.06%	1 12.50%	1 20.00%
bladelet 1 plat										
bladelet 2 plat										
flat bladelet										
blade										
core reduc 1 plat	1 0.63%			1 2.78%						
core reduc 2 plat	1 0.63%			1 2.78%						
flat plat bid core	1 0.63%								1 12.50%	
other										
BLADE										
parallel sided										
pointed										
thick triangular										
irregular										
BLADELET (<26mm)										
parallel sided										
pointed										
thick triangular	1 0.63%		1 3.13%							
irregular	1 0.63%		1 3.13%							
BROKEN BLADE										
distal	4 2.50%	1 9.09%	1 3.13%			1 9.09%	1 6.67%			
medial										
proximal	3 1.88%		1 3.13%	2 5.56%						
FLAKES										
core red flake										
Cortical Flakes										
ondetruck 30+mm										
ondetruck <30mm	1 0.63%		1 3.13%							
sideetruck 30+mm										
sideetruck <30mm	3 1.88%		2 6.25%					1 3.03%		
Non-Cortical Flakes										
ondetruck 30+mm	1 0.63%									1 20.00%
ondetruck <30mm	7 4.38%		1 3.13%	1 2.78%	1 11.11%	1 9.09%	1 6.67%	1 3.03%		1 20.00%
sideetruck 30+mm	1 0.63%		1 3.13%							
sideetruck <30mm	10 6.25%	1 9.09%	2 6.25%	2 5.56%	1 11.11%	1 9.09%		2 6.06%	1 12.50%	
Broken Flakes										
distal	3 1.88%						1 6.67%	2 6.06%		
medial	5 3.13%			1 2.78%		1 9.09%		3 9.09%		
proximal	3 1.88%		2 6.25%		1 11.11%					
Subtotal	166 97.50%	11 100.00%	31 96.80%	35 97.22%	9 100.00%	11 100%	15 100.00%	31 93.94%	8 100.00%	5 100.00%

TABLE 11: (cont.)
raw material

Combined	TOTAL	Q4	P4	O4	N4	M5	L4	L5	K5	J5
(Opaline translucent)	34 61.82%	3 75.00%	7 70.00%	6 75.00%	3 75.00%	11 52.38%	2 100.00%	2 33.33%		
(Opaline not translucent)	17 30.91%	1 25.00%	3 30.00%	2 25.00%	1 25.00%	10 47.62%				
Subtotal opalines	55 100.00%	4 100.00%	10 100.00%	8 100.00%	4 100.00%	21 100.00%	2 100.00%	6 100.00%		
Hornfels										
Tuffaceous rock										
Quartz										
Other										
TOTAL	55 100.00%	4 100.00%	10 100.00%	8 100.00%	4 100.00%	21 100.00%	2 100.00%	6 100.00%		
Non-formal										
(Opaline translucent)	32 61.54%	2 66.67%	7 77.78%	5 71.43%	3 75.00%	11 52.38%	2 100.00%	2 33.33%		
(Opaline not translucent)	20 38.46%	1 33.33%	2 22.22%	2 28.57%	1 25.00%	10 47.62%		4 66.67%		
Subtotal opalines	52 100.00%	3 100.00%	9 100.00%	7 100.00%	4 100.00%	21 100.00%	2 100.00%	6 100.00%		
Hornfels										
Tuffaceous rock										
Quartz										
Other										
Total	52 100.00%	3 100.00%	9 100.00%	7 100.00%	4 100.00%	21 100.00%	2 100.00%	6 100.00%		
Formal										
(Opaline translucent)	2 66.67%	1 100.00%		1 100.00%						
(Opaline not translucent)	1 33.33%		1 100.00%							
Subtotal opalines	3 100.00%	1 100.00%	1 100.00%	1 100.00%						
Hornfels										
Tuffaceous rock										
Quartz										
Other										
Total	3 100.00%	1 100.00%	1 100.00%	1 100.00%						

TABLE 11: (cont.)

Form	TOTAL	Q4	P4	Q4	N4	M6	L4	L6	K5	J5
SCRAPER Large >30mm										
and										
side										
and 2 sides										
and 2 sides										
and 2 sides										
high backed										
large backed										
naturally backed										
SCRAPER Medium 20-30										
and										
side										
and 2 sides										
and 2 sides	1 1.82%	1 25.00%								
and 2 sides										
high backed										
medium backed	1 1.82%			1 12.50%						
naturally backed										
SCRAPER small <20mm										
and										
side										
and 2 sides										
and 2 sides										
high backed										
small backed										
knife										
not back knife										
BACKED TOOL >25mm										
backed blade										
segment										
obliquely backed										
microscopic										
broken backed										
BACKED TOOL <25mm										
backed blade										
segment										
obliquely backed										
microscopic										
broken backed										
ventral blade										
not										
spoke shave										
awl										
broken tool										
microscopic	1 1.82%		1 10.00%							
MSA tool										
SUMMARY	3 5.48%	1 25.00%	1 10.00%	1 12.50%						
TOTAL	55 100.00%	4 100.00%	10 100.00%	8 100.00%	4 100.00%	21 100.00%	2 100.00%	8 100.00%		

TABLE 11: H level, re-worked, stone inventory

Non-normal	TOTAL	Q4	P4	Q4	N4	M5	L4	L5	K5	J5
chunk	27 49.09%	3 75.00%	2 20.00%	2 25.00%	2 50.00%	13 61.90%	1 50.00%	4 66.67%		
chip	4 7.27%			1 12.50%		3 14.29%				
manuport/module										
CORE										
irregular	3 5.45%			1 12.50%	1 25.00%		1 50.00%			
bladelet 1 plat	2 3.64%		1 10.00%					1 16.67%		
bladelet 2 plat										
flat bladelet										
blade										
core reduct 1 plat										
core reduct 2 plat										
flat plat bld core										
other										
BLADE										
parallel sided										
pointed										
thick triangular										
irregular										
BLADELET (<20mm)										
parallel sided										
pointed										
thick triangular	3 5.45%		1 10.00%			1 4.76%		1 16.67%		
irregular	2 3.64%		1 10.00%			1 4.76%				
BROKEN BLADE										
distal										
medial										
proximal										
FLAKES										
core rel. flake										
Cortical Flakes										
endstruck >30mm	1 1.82%				1 25.00%					
endstruck <30mm										
sidestruck >30mm										
sidestruck <30mm	1 1.82%		1 10.00%							
Non-Cortical Flakes										
endstruck >30mm										
endstruck <30mm	3 5.45%		1 10.00%	1 12.50%		1 4.76%				
sidestruck >30mm										
sidestruck <30mm	3 5.45%		1 10.00%			2 9.52%				
Broken Flakes										
distal	1 1.82%		1 10.00%							
medial										
proximal	2 3.64%			2 25.00%						
Subtotal	62 94.65%	3 75.00%	3 90.00%	7 87.50%	4 100.00%	21 100%	2 100.00%	6 100.00%		

TABLE 23: Ph level, stone inventory

Non Formal	TOTAL	Q4	M3	M5	L3
chunk	159 13.45%	27 12.39%	65 21.52%	32 10.19%	35 10.08%
chip	494 41.79%	93 42.66%	128 42.38%	64 20.38%	209 60.06%
manuport					
CORE					
Irregular	24 2.03%	9 4.13%	3 0.99%	9 2.87%	3 0.86%
bladelet 1 plat	8 0.68%			7 2.23%	1 0.29%
bladelet 2 plat	9 0.76%	2 0.92%		7 2.23%	
flat bladelet	5 0.42%			4 1.27%	1 0.26%
blade					
core reduct 1 plat	3 0.25%			1 0.32%	2 0.67%
core reduct 2 plat	4 0.34%		1 0.33%	2 0.64%	1 0.29%
flat platform					
BLADE					
parallel sided					
pointed					
thick triangular	1 0.08%	1 0.46%			
Irregular	9 0.76%		5 1.66%	2 0.64%	2 0.57%
BLADELET (<26mm)					
parallel sided	5 0.42%	2 0.92%	1 0.33%		2 0.57%
pointed	4 0.34%	1 0.46%		3 0.96%	
thick triangular	6 0.51%			4 1.27%	2 0.57%
Irregular	17 1.44%		8 2.66%	6 1.81%	3 0.86%
BROKEN BLADE					
distal	5 0.42%			1 0.32%	4 1.15%
medial	6 0.51%	4 1.83%	1 0.33%	1 0.32%	
proximal	12 1.02%	6 2.75%	1 0.33%	4 1.27%	1 0.29%
FLAKES					
core reduct. flake	2 0.17%	1 0.46%		1 0.32%	
Cortical Flakes					
endstruck 30+mm	2 0.17%			2 0.64%	
endstruck <30mm	7 0.59%	1 0.46%		4 1.27%	2 0.57%
sidestruck 30+mm	1 0.08%		1 0.33%		
sidestruck <30mm	3 0.25%	1 0.46%		2 0.64%	
Non-Cortical Flakes					
endstruck 30+mm	14 1.18%		4 1.32%	6 1.91%	4 1.15%
endstruck <30mm	132 11.17%	27 12.39%	31 10.26%	47 14.97%	27 7.76%
sidestruck 30+mm	7 0.59%		3 0.99%	3 0.96%	1 0.29%
sidestruck <30mm	179 15.14%	37 16.97%	29 9.60%	53 16.43%	30 8.62%
Broken Flakes					
distal	11 0.93%		6 1.66%		6 1.72%
medial	18 1.52%	4 1.83%	5 1.66%	3 0.96%	6 1.72%
proximal	16 1.27%	1 0.46%	7 2.32%	2 0.64%	6 1.44%
Subtotal	1162 98.31%	217 99.54%	298 98.68%	300 96.54%	347 99.71%

TABLE 22: CM level, diversity, richness and evenness indices

	STANDARD Combined	Non-formal	Formal
Diversity	-3.9703	-3.4965	-2.9257
Richness	13.0973	9.1520	6.3424
Evenness	-1.0000	-1.0000	-1.0000

	ARCHAEOLOGICAL Combined	Non-formal	Formal
Diversity	-1.9811	-1.9110	-2.6056
Richness	6.2777	3.8686	4.9912
Evenness	-0.4990	-0.5466	-0.8698

	ARCHAEOLOGICAL/ STANDARD Combined	Non-formal	Formal
Diversity	0.4990	0.5466	0.8699
Richness	0.4793	0.4227	0.7870
Evenness	0.4990	0.5466	0.8698

TABLE 21: CM level, raw material

Combined	TOTAL		Q3		Q4		M3		M4		M5		L3		K3		K4		J3		J4	
Opaline translucent)	1291	32.63%	07	28.62%	97	33.11%	264	38.65%	136	36.23%	181	24.14%	122	25.15%	144	41.03%	18	28.67%	83	24.78%	187	49.06%
Opaline not translucent)	1106	27.94%	09	29.18%	76	26.62%	229	29.55%	119	32.06%	158	23.87%	124	25.67%	82	23.36%	21	37.60%	111	32.36%	84	29.36%
Subtotal opalines	2396	60.56%	176	57.70%	175	59.73%	513	68.18%	257	71.19%	319	47.03%	246	50.72%	226	64.39%	37	66.07%	193	57.14%	251	78.44%
Hornfels	272	6.87%	26	8.20%	26	8.58%	41	5.39%	22	6.08%	64	9.00%	39	8.04%	16	4.56%			28	8.16%	9	2.81%
Tuffaceous rock	350	8.86%	11	3.61%	41	13.99%	81	7.67%	22	6.09%	64	9.60%	42	8.66%	41	11.60%	6	10.71%	40	11.69%	22	6.89%
Quartz	210	5.31%	57	16.99%	21	7.17%	36	4.85%	6	1.39%	50	7.50%	16	3.30%	12	3.42%			9	2.32%	4	1.25%
Other	728	18.42%	36	11.80%	28	9.56%	124	16.00%	56	15.24%	170	23.48%	142	29.28%	57	16.96%	13	23.21%	70	20.41%	34	10.63%
TOTAL	3957	100.00%	305	100.00%	293	100.00%	775	100.00%	361	100.00%	607	100.00%	465	100.00%	362	100.00%	56	100.00%	343	100.00%	320	100.00%
Non Formal																						
Opaline translucent)	1273	32.36%	07	28.60%	97	33.22%	279	36.71%	133	37.68%	180	24.08%	121	25.10%	143	41.33%	15	27.27%	83	24.41%	168	49.05%
Opaline not translucent)	1067	27.00%	07	28.60%	70	26.71%	222	29.21%	117	33.14%	157	23.81%	123	25.52%	80	23.12%	21	38.16%	110	32.36%	92	29.11%
Subtotal opalines	2340	60.36%	174	57.61%	175	59.93%	501	65.92%	250	70.82%	317	47.67%	244	50.62%	223	64.45%	36	65.45%	193	58.78%	247	78.16%
Hornfels	268	6.80%	25	8.31%	27	9.28%	39	5.00%	21	5.95%	64	9.02%	39	8.09%	15	4.64%			28	8.24%	9	2.85%
Tuffaceous rock	348	8.90%	10	3.32%	41	14.04%	81	8.03%	22	6.23%	64	9.92%	42	8.71%	40	11.60%	6	10.61%	40	11.79%	22	6.88%
Quartz	210	5.57%	57	18.04%	21	7.19%	36	4.74%	6	1.42%	50	7.82%	16	3.32%	12	3.47%			9	2.35%	4	1.27%
Other	726	18.87%	35	11.63%	28	9.59%	124	16.32%	56	15.56%	170	25.50%	141	29.25%	56	16.18%	13	23.64%	70	20.59%	34	10.78%
Total	3910	100.00%	301	100.00%	292	100.00%	780	100.00%	363	100.00%	685	100.00%	482	100.00%	348	100.00%	58	100.00%	340	100.00%	319	100.00%
Formal																						
Opaline translucent)	19	38.30%					5	33.33%	5	62.50%	1	50.00%	1	30.33%	1	20.00%	1	100.00%	2	66.67%	2	60.00%
Opaline not translucent)	16	58.33%	2	50.00%			7	46.67%	2	25.00%	1	50.00%	1	30.33%	2	40.00%			1	33.33%	2	50.00%
Subtotal opalines	35	76.63%	2	50.00%			12	60.00%	7	67.50%	2	100.00%	2	66.67%	3	60.00%	1	100.00%	3	100.00%	4	100.00%
Hornfels	8	12.77%			1	100.00%	3	20.00%	1	12.50%					1	20.00%						
Tuffaceous rock	2	4.26%	1	25.00%											1	20.00%						
Quartz																						
Other	3	6.38%	1	25.00%									1	33.33%	1							
Total	47	100.00%	4	100.00%	1	100.00%	15	100.00%	8	100.00%	2	100.00%	3	100.00%	2	100.00%	1	100.00%	3	100.00%	4	100.00%

TABLE 20: CM level, abraded stone, rock crystal, ochre, haemitite, specularite and other iron bearing stone.

	TOTAL	Q3	O4	M3	M4	M5	L3	K3	K4	J3	J4
miso groundstone work	15			2	4	4	1			2	2
upper grinder					1						
palette	1										
rock crystal											
ochre			x	x							
specularite				x							
haemitite			x							x	
magnetic chunk						x					
iron bearing stone			x	x		x					
pebbles	96	7	33	15	5	20	5	4		4	3

TABLE 19: (cont.)
raw material

Combined	TOTAL	Q3	Q4	M3	M4	M5	L3	K3	K4	J3	J4
(Opaline translucent)	33 11.83%	5 29.41%	3 13.04%	9 10.11%	1 3.85%		5 12.20%	5 14.29%	2 28.57%	1 4.00%	2 18.18%
(Opaline not translucent)	205 73.48%	11 84.71%	20 86.96%	77 86.52%	21 80.77%	5 100.00%	5 12.20%	28 80.00%	5 71.43%	24 96.00%	9 81.82%
Subtotal opalines	260 93.19%	16 94.12%	23 100.00%	86 96.63%	22 84.62%	5 100.00%	32 78.05%	33 84.29%	7 100.00%	25 100.00%	11 100.00%
Hornfels	2 0.72%				2 7.69%						
Tuffaceous rock	8 2.87%	1 5.88%		2 2.26%			4 9.76%	1 2.86%			
Quartz											
Other	9 3.23%			1 1.12%	2 7.69%		5 12.20%	1 2.86%			
TOTAL	279 100.00%	17 100.00%	23 100.00%	89 100.00%	26 100.00%	5 100.00%	41 100.00%	35 100.00%	7 100.00%	25 100.00%	11 100.00%
Non-formal		Q3	Q4	M3	M4	M5	L3	K3	K4	J3	J4
(Opaline translucent)	33 12.00%	8 29.41%	3 13.04%	9 10.34%	1 3.85%		5 12.20%	5 14.71%	2 28.57%	1 4.17%	2 18.18%
(Opaline not translucent)	224 81.45%	11 84.71%	20 86.96%	75 86.21%	21 80.77%	5 100.00%	27 12.20%	28 82.35%	5 71.43%	23 96.83%	9 81.82%
Subtotal opalines	257 93.45%	16 94.12%	23 100.00%	84 96.55%	22 84.62%	5 100.00%	32 78.05%	33 97.06%	7 100.00%	24 100.00%	11 100.00%
Hornfels	2 0.73%				2 7.69%						
Tuffaceous rock	7 2.55%	1 5.88%		2 2.30%			4 9.76%				
Quartz											
Other	9 3.27%			1 1.16%	2 7.69%		5 12.20%	1 2.84%			
Total	275 100.00%	17 100.00%	23 100.00%	87 100.00%	26 100.00%	5 100.00%	41 100.00%	34 100.00%	7 100.00%	24 100.00%	11 100.00%
Formal		Q3	Q4	M3	M4	M5	L3	K3	K4	J3	J4
(Opaline translucent)											
(Opaline not translucent)	3 75.00%			2 100.00%						1 100.00%	
Subtotal opalines	3 75.00%			2 100.00%						1 100.00%	
Hornfels											
Tuffaceous rock	1 25.00%							1 100.00%			
Quartz											
Other											
Total	4 100.00%			2 100.00%				1 100.00%		1 100.00%	

TABLE 19: (cont.)

Form	TOTAL	G3	G4	M3	M4	M5	L3	K3	K4	J3	J4
SCRAPER Large > 20mm											
end											
side											
end & side											
end & 2 sides											
end & notching											
high backed											
large backed											
naturally backed											
SCRAPER Medium 20-30											
end											
side											
end & side											
end & 2 sides											
end & notching											
high backed											
medium backed											
naturally backed											
SCRAPER small < 20mm											
end											
side											
end & side											
end & 2 sides											
end & notching											
high backed											
small backed											
knife											
notched knife											
BACKED TOOL > 25mm											
backed blade											
segment											
obliquely backed											
miscellaneous											
broken backed											
BACKED TOOL < 25mm											
backed blade											
segment											
obliquely backed											
miscellaneous											
broken backed											
ventral bladelet											
size											
epoke remove											
not	1 0.00%			1 1.12%							
bracer											
broken tool	3 0.12%							1 2.00%		1 4.00%	
miscellaneous											
MSA tool	1 0.00%			1 1.12%							
Subtotal	4 1.43%			2 2.25%				1 2.00%		1 4.00%	
TOTAL	279 100.00%	17 100.00%	23 100.00%	69 100.00%	20 100.00%	5 100.00%	41 100.00%	36 100.00%	7 100.00%	25 100.00%	11 100.00%

TABLE 19: CM level, heat-altered stone inventory

Non-formal	TOTAL	Q3	Q4	M3	M4	M5	L3	K3	K4	J3	J4
chunk	66 30.62%	6 35.29%	6 28.09%	20 22.47%	7 28.62%	3 60.00%	21 51.22%	11 31.45%	2 28.57%	7 28.00%	3 27.27%
chip	78 28.32%	8 35.29%	8 28.09%	35 39.33%	5 18.23%		5 12.20%	14 40.00%		6 32.00%	
manuportundule											
CO RU											
irregular	3 1.06%							1 2.86%	1 14.29%	1 4.00%	
bladelet 1 plat	2 0.72%				1 3.05%						1 9.09%
bladelet 2 plat											
flat bladelet											
blade											
core reduce 1 plat											
core reduce 2 plat	1 0.36%							1 2.86%			
flat plat bld core	4 1.43%	1 5.88%	1 4.35%	1 1.12%					1 14.29%		
other											
BLADE											
parallel sided	1 0.36%									1 4.00%	
pointed											
thick triangular	1 0.36%								1 14.29%		
irregular	2 0.72%									2 8.00%	
BLADELET (<25mm)											
parallel sided											
pointed											
thick triangular	2 0.72%										
irregular	7 2.51%		1 4.35%	3 3.07%			1 2.44%	1 2.86%			1 9.09%
BROKEN BLADE											
distal	2 0.72%					2 7.69%					
medial	3 1.09%			3 3.37%							
proximal	7 2.51%		1 4.35%	3 3.37%			1 2.44%	1 2.86%			1 9.09%
FLAKES											
core red. flake	1 0.36%				1 3.05%						
Corriled Flakes											
ondaluck 30+mm	1 0.36%			1 1.12%							
ondaluck <30mm	4 1.43%			2 2.25%						2 8.00%	
slidestuck 30+mm											
slidestuck <30mm	3 1.06%		2 8.70%								1 9.09%
Non-Corriled Flakes											
ondaluck 30+mm	1 0.36%				1 3.05%						
ondaluck <30mm	20 7.17%	2 11.76%	3 13.04%	7 7.87%		1 20.00%	2 4.80%	1 2.86%	1 14.29%	2 8.00%	1 9.09%
slidestuck 30+mm											
slidestuck <30mm	20 7.17%	1 5.88%	3 13.04%	4 4.48%	3 11.54%		7 17.07%	1 2.86%			1 9.09%
Broken Flakes											
distal	7 2.51%			3 3.37%		1 20.00%		1 2.86%	1 14.29%	1 4.00%	
medial	3 1.09%	1 5.88%		2 2.25%	3 11.54%		2 4.80%				
proximal	10 3.60%			3 3.37%	3 11.54%		2 4.80%				2 18.18%
Subtotal	278 99.57%	17 100.00%	23 100.00%	67 67.78%	28 100.00%	5 100.00%	41 100.00%	34 87.14%	7 100.00%	24 88.00%	11 100.00%

TABLE 18: (cont.)
raw material

Combined	TOTAL	Q3	Q4	M3	M4	M5	L3	K3	K4	J3	J4
(Opaline translucent)	24 45.28%	2 28.57%	4 57.14%	2 40.00%	1 14.29%	1 100.00%	4 57.14%	1 20.00%	1 50.00%	3 60.00%	5 71.43%
(Opaline not translucent)	25 47.17%	4 57.14%	3 42.86%	3 60.00%	8 85.71%			4 80.00%	1 50.00%	2 40.00%	2 28.57%
Subtotal opalines	52 88.11%	6 85.71%	7 100.00%	5 100.00%	7 100.00%	1 100.00%	7 100.00%	5 100.00%	2 100.00%	5 100.00%	7 100.00%
Hornfels											
Tuffaceous rock	1 1.89%	1 14.29%									
Quartz											
Other											
TOTAL	53 100.00%	7 100.00%	7 100.00%	5 100.00%	7 100.00%	1 100.00%	7 100.00%	5 100.00%	2 100.00%	5 100.00%	7 100.00%
Non-formal		Q3	Q4	M3	M4	M5	L3	K3	K4	J3	J4
(Opaline translucent)	22 45.83%	2 33.33%	4 57.14%	2 40.00%	1 14.29%		4 57.14%	1 25.00%	1 50.00%	3 75.00%	4 66.67%
(Opaline not translucent)	26 54.17%	4 66.67%	3 42.86%	3 60.00%	8 85.71%		3	3 75.00%	1 50.00%	1 25.00%	2 33.33%
Subtotal opalines	48 100.00%	6 100.00%	7 100.00%	5 100.00%	7 100.00%		7 100.00%	4 100.00%	2 100.00%	4 100.00%	6 100.00%
Hornfels											
Tuffaceous rock											
Quartz											
Other											
Total	48 100.00%	6 100.00%	7 100.00%	5 100.00%	7 100.00%		7 100.00%	4 100.00%	2 100.00%	4 100.00%	6 100.00%
Non-formal		Q3	Q4	M3	M4	M5	L3	K3	K4	J3	J4
(Opaline translucent)	2 40.00%					1 100.00%					1 100.00%
(Opaline not translucent)	2 40.00%							1 100.00%		1 100.00%	
Subtotal opalines	4 80.00%					1 100.00%		1 100.00%		1 100.00%	1 100.00%
Hornfels											
Tuffaceous rock	1 20.00%	1 100.00%									
Quartz											
Other											
Total	5 100.00%	1 100.00%				1 100.00%		1 100.00%		1 100.00%	1 100.00%

TABLE 18:(cont.)

Formal	TOTAL	D3	D4	M3	M4	M6	L3	K3	K4	J3	J4
SCRAPER Large >30mm											
end											
side	1 1.03%	1 14.20%									
end & side											
end & 2 sides											
end & edging											
high backed											
large backed											
medium backed											
naturally backed											
SCRAPER Medium 20-30											
end											
side											
end & side											
end & 2 sides											
end & edging											
high backed											
medium backed											
naturally backed											
SCRAPER small <20mm											
end											
side	1 1.00%									1 14.20%	
end & side											
end & 2 sides											
end & edging											
high backed	1 1.00%							1 20.00%			
small backed											
knife											
not back/knife											
BACKED TOOL >30mm											
backed blade											
segment											
obliquely backed											
midline/region											
broken backed											
BACKED TOOL <20mm											
backed blade/et											
segment											
obliquely backed											
midline/region											
broken backed											
volute blades/et											
not											
spoke/have											
end											
bar											
broken tool	2 0.77%					1 100.00%				1 20.00%	
miscellaneous											
MSA tool											
Subtotal	5 0.43%	1 14.20%				1 100.00%		1 20.00%		1 20.00%	1 14.20%
TOTAL	63	7	2	5	7	1	7	5	2	5	7

TABLE 18:CM level, re-worked stone inventory

Non-formal	TOTAL	Q3	Q4	M3	M4	M8	L3	K3	K4	J3	J4
chunk	18 30.16%	3 42.86%	4 57.14%	1 20.00%	4 57.14%		1 14.29%			1 20.00%	2 28.57%
chip											
manuporthodule	1 1.69%				1 14.29%						
CORE											
irregular	11 20.75%	1 14.29%	2 28.57%		2 28.57%		2 28.57%	2 40.00%	1 50.00%		1 14.29%
bladelet 1 plat											
bladelet 2 plat											
flat bladelet											
blade											
core redic 1 plat											
core redic 2 plat											
flat plat bid core	2 3.77%							1 20.00%		1 20.00%	
other											
BLADE											
parallel sided											
pointed											
thick triangular											
irregular	1 1.69%			1 20.00%							
BLADELET (<20mm)											
parallel sided											
pointed											
thick triangular											
irregular	1 1.69%			1 20.00%							
BROKEN BLADE											
distal											
medial											
proximal	2 3.77%	1 14.29%		1 20.00%							
FLAKES											
core red. flake											
Cortical Flakes											
endstruck 30+mm											
endstruck <30mm	2 3.77%		1 14.29%								1 14.29%
sidestruck 30+mm											
sidestruck <30mm	1 1.69%								1 50.00%		
Non-Cortical Flakes											
endstruck 30+mm											
endstruck <30mm	4 7.55%			1 20.00%			2 28.57%				1 14.29%
sidestruck 30+mm											
sidestruck <30mm	5 9.43%	1 14.29%					1 14.29%	1 20.00%		1 20.00%	1 14.29%
Broken Flakes											
distal	1 1.69%						1 14.29%				
medial	1 1.69%									1 20.00%	
proximal											
Subtotal	48 90.57%	6 85.71%	7 100.00%	5 100.00%	7 100%		7 100.00%	4 80.00%	2 100.00%	4 80.00%	6 85.71%

TABLE 17: (cont.)
raw material

Combined	TOTAL	Q3	Q4	M3	M4	M5	L3	K3	K4	J3	J4
(Opaline translucent)	44 49.44%	3 50.00%	2 50.00%	9 34.82%	8 88.89%	2 66.67%	5 45.45%	6 66.67%	1 100.00%	3 37.50%	5 41.87%
(Opaline not translucent)	33 37.08%	3 50.00%	2 50.00%	16 61.54%	1 11.11%			2 22.22%		3 37.50%	6 50.00%
Subtotal opalines	82 92.13%	6 100.00%	4 100.00%	25 96.15%	9 100.00%	2 66.67%	10 90.91%	8 88.89%	1 100.00%	6 75.00%	11 91.67%
Hornfels	2 2.25%					1 33.33%	1 9.09%				
Tuffaceous rock	4 4.49%							1 11.11%		2 25.00%	1 8.33%
Quartz				1 3.85%							
Other	1 1.12%										
TOTAL	89 100.00%	6 100.00%	4 100.00%	26 100.00%	9 100.00%	3 100.00%	11 100.00%	9 100.00%	1 100.00%	8 100.00%	12 100.00%
Non-formal		Q3	Q4	M3	M4	M5	L3	K3	K4	J3	J4
(Opaline translucent)	43 48.43%	3 50.00%	2 50.00%	9 34.82%	8 88.89%	1 50.00%	5 45.45%	6 75.00%	1 100.00%	3 37.50%	5 41.87%
(Opaline not translucent)	37 42.53%	3 50.00%	2 50.00%	16 61.54%	1 11.11%		6	1 12.50%		3 37.50%	6 50.00%
Subtotal opalines	60 61.95%	6 100.00%	4 100.00%	25 96.15%	9 100.00%	1 50.00%	10 90.91%	7 87.50%	1 100.00%	6 75.00%	11 91.67%
Hornfels	2 2.30%					1 50.00%	1 9.09%				
Tuffaceous rock											
Quartz	4 4.60%							1 12.50%		2 25.00%	1 8.33%
Other	1 1.15%			1 3.85%							
Total	87 100.00%	6 100.00%	4 100.00%	26 100.00%	9 100.00%	2 100.00%	11 100.00%	8 100.00%	1 100.00%	8 100.00%	12 100.00%
Formal		Q3	Q4	M3	M4	M5	L3	K3	K4	J3	J4
(Opaline translucent)	1 50.00%					1 100.00%					
(Opaline not translucent)	1 50.00%							1 100.00%			
Subtotal opalines	2 100.00%					1 100.00%		1 100.00%			
Hornfels											
Tuffaceous rock											
Quartz											
Other											
Total	2 100.00%					1 100.00%		1 100.00%			

TABLE 30: (cont.)

M	M6	L3	L4	L5	K3	K4	K5	J3	J4	J5	Non-normal											
4	12.88%	1	7.89%	110	20.40%	25	12.83%	52	15.03%	53	16.26%	111	17.90%	87	17.77%	11	12.79%	81	14.75%	5	7.35%	chunk
11	50.22%	9	59.23%	221	41.15%	95	47.90%	150	45.88%	150	40.47%	258	41.42%	180	41.91%	34	39.53%	78	54.93%	34	50.00%	chip
1	0.44%					2	0.50%															manupert
7	0.06%			12	2.23%	3	1.52%	4	1.16%	8	1.54%	10	1.92%	8	2.12%	1	1.16%	1	0.70%			CORE
				1	0.19%	2	1.01%			1	0.31%	1	0.16%	1	0.27%	1	1.16%					irregular
				2	0.37%			2	0.50%	2	0.61%	2	0.32%	1	0.27%							bladelet 1 plat
	1.31%			1	0.19%			2	0.50%			1	0.16%	1	0.27%							bladelet 2 plat
																					flat bladelet	
																					blnda	
	0.44%			1	0.19%	1	0.51%	1	0.29%	3	0.92%	2	0.32%	1	0.27%							core rodia 1 plat
	0.07%			8	0.03%	1	0.51%	2	0.59%	4	1.23%	3	0.49%	2	0.63%	1	1.16%	1	0.70%			core rodia 2 plat
	0.44%			2	0.37%			3	0.67%													flat plat bid car
																					other	
																						BLADE
								1	0.29%													thick sided
								1	0.29%													rod
								1	0.29%			1	0.16%	1	0.27%							thick triangular
																						irregular
				1	0.19%					3	0.92%	3	0.49%	2	0.63%							BLADELET (<26mm)
										1	0.31%	1	0.16%	1	0.27%							parallel sided
				7	1.00%	5	2.53%	8	0.87%	8	1.04%	13	2.10%	2	0.53%			1	0.70%			pointed
																						thick triangular
																						irregular
																						BROKEN BLAD.
4	1.75%			4	0.74%			2	0.80%	1	0.31%	2	0.32%	1	0.27%					1	1.47%	distal
				1	0.19%			1	0.29%	1	0.31%						1	1.16%				medial
2	0.07%			3	0.88%			3	0.97%	4	1.23%	2	0.32%	6	1.59%	2	2.33%					proximal
																						FLAKES
1	0.44%			2	0.37%	1	0.51%	3	0.87%	2	0.61%	8	0.97%	2	0.63%			1	0.70%	1	1.47%	core rel. flake
																						Cortical Flakes
				1	0.19%	1	0.51%			1	0.31%	1	0.16%									endstruck 30+mm
1	0.44%			4	0.74%			1	0.29%	4	1.23%			1	0.27%	2	2.33%					endstruck <30mm
				1	0.19%							1	0.16%	1	0.27%							sidestruck 30+mm
1	0.44%			4	0.74%	1	0.51%	1	0.29%	1	0.31%	4	0.83%	7	1.88%							sidestruck <30mm
																						Non-Cortical Flakes
2	0.07%			7	1.30%	1	0.51%	3	0.87%	1	0.31%	17	2.75%	5	1.53%			1	0.70%			endstruck 30+mm
12	5.24%	3	23.00%	45	8.38%	18	9.09%	20	5.76%	24	7.36%	32	10.03%	28	7.99%	8	9.80%	18	11.27%	7	10.20%	endstruck <30mm
2	0.07%			8	0.53%	2	1.01%	5	1.45%	1	0.31%	10	1.62%	11	2.92%			1	1.16%			sidestruck 30+mm
19	0.50%			58	10.99%	24	12.12%	36	10.40%	33	10.12%	54	10.96%	47	12.47%	12	18.85%	8	6.34%	3	4.41%	sidestruck <30mm
																						Broken Flakes
8	2.10%			11	2.05%	1	0.51%	5	1.45%	1	0.31%	12	1.94%	7	1.88%	1	1.16%	2	1.41%	6	8.82%	distal
				9	1.80%	4	2.02%	4	1.16%	8	1.53%	4	0.88%	4	1.08%	3	0.49%	1	0.70%			medial
2	0.07%			13	2.42%	10	5.05%	20	5.76%	8	1.53%	19	3.07%	6	1.53%	2	2.33%	5	3.52%	4	5.60%	proximal
220	55.60%	13	100%	532	99.07%	185	98.48%	338	97.11%	321	98.47%	608	90.38%	371	88.41%	20	93.02%	127	95.48%	61	89.71%	Subtotal

TABLE 30: Ja level, stone inventory

Non-formal	TOTAL	Q3	Q4	P3	P4	Q3	Q4	N3	N4	M3
chunk	815 10.74%	80 17.87%	51 17.35%	23 14.94%	10 11.32%	28 14.00%	10 17.88%	61 17.52%	8 13.04%	67 18.87%
chip	2176 44.85%	133 47.00%	193 52.04%	62 40.20%	60 42.77%	70 41.49%	10 33.93%	154 44.25%	21 48.85%	172 42.79%
manipulation module	4 0.08%									1 0.25%
CORE										
irregular	102 2.09%	7 2.47%	9 3.06%	8 5.19%	1 0.63%	3 1.00%	4 7.14%	5 1.44%	3 0.82%	10 2.49%
bladelet 1 plat	10 0.31%	3 1.05%								
bladelet 2 plat	15 0.31%		1 0.34%		1 0.63%	1 0.53%		1 0.29%		2 0.50%
flat bladelet	14 0.29%			1 0.65%	1 0.63%	1 0.53%		2 0.57%		1 0.25%
blade										
core reduce 1 plat	24 0.49%	3 1.06%	2 0.60%		1 0.63%	2 1.06%		4 1.15%		2 0.50%
core reduce 2 plat	20 0.80%	1 0.35%	1 0.34%	1 0.65%	1 0.63%	1 0.53%	1 1.79%			2 0.50%
flat plat bld core	11 0.23%	1 0.35%	1 0.34%		1 0.63%					2 0.50%
other										
BLADE										
parallel sided	1 0.02%							1 0.29%		
pointed	1 0.02%									
thick triangular	7 0.14%		1 0.34%	1 0.65%		2 1.06%				
irregular	3 0.06%	1 0.35%				1 0.53%				
BLADELET (<25mm)										
parallel sided	10 0.37%	1 0.35%		1 0.65%	1 0.63%	2 1.06%		4 1.15%		
pointed										
thick triangular	4 0.08%		1 0.34%							
irregular	55 1.13%	3 1.06%	1 0.34%		4 2.52%	4 2.10%	1 1.79%	3 0.86%		2 0.50%
BROKEN BLADE										
distal	20 0.41%	1 0.35%			1 0.63%	1 0.53%		1 0.29%		1 0.25%
medial	4 0.08%									
proximal	37 0.76%	1 0.35%	3 1.02%		1 0.63%	4 2.13%		3 0.86%		3 0.75%
FLAKES										
core red. flake	24 0.49%	1 0.35%			1 0.63%			1 0.29%		2 0.50%
Cortical Flakes										
ondetuck 30+mm	5 0.12%			1 0.65%				1 0.29%		
ondetuck <30mm	31 0.64%	1 0.35%		4 2.60%	2 1.26%		1 1.79%	4 1.15%		0 1.49%
aldetuck 30+mm	8 0.16%			1 0.65%		1 0.53%				1 0.25%
aldetuck <30mm	42 0.86%	3 1.06%	1 0.34%	1 0.65%	2 1.89%	2 1.06%		1 0.29%	1 2.17%	11 2.74%
Non-Cortical Flakes										
ondetuck 30+mm	80 1.63%	1 0.35%	1 0.34%	1 0.65%		2 1.06%		2 0.57%		8 1.49%
ondetuck <30mm	420 8.62%	19 6.71%	25 8.50%	17 11.04%	11 6.92%	24 12.77%	7 12.50%	31 8.91%	0 17.38%	34 8.48%
aldetuck 30+mm	57 1.17%	2 0.71%	3 2.72%		3 1.89%	3 1.60%	1 1.79%	1 0.29%		2 0.50%
aldetuck <30mm	514 10.55%	29 10.25%	29 9.86%	22 14.29%	12 8.10%	19 9.51%	2 3.57%	51 14.80%	4 9.70%	42 10.45%
Broken Flakes										
distal	73 1.50%	2 0.71%		5 3.25%	2 1.26%		3 5.36%	4 1.15%		0 1.49%
medial	54 1.11%	4 1.41%	2 0.68%		2 1.26%	2 1.06%		5 1.44%	1 2.17%	4 1.00%
proximal	146 3.00%	10 3.53%	2 0.68%	2 1.30%	12 7.58%	5 2.60%	2 3.57%	7 2.01%		21 5.22%
Subtotal	4775 90.01%	277 97.68%	292 90.32%	151 90.05%	140 93.08%	183 97.04%	51 91.07%	347 99.71%	44 98.95%	400 99.50%

TABLE 29: Ph level, diversity, richness and evenness indices

STANDARD			
	Combined	Non Formal	Formal
Diversity	-3.6889	-3.3673	-2.3979
Richness	10.5723	8.3153	4.1703
Evenness	-1.0000	-1.0000	-1.0000
ARCHAEOLOGICAL			
	Combined	Non Formal	Formal
Diversity	-2.0672	-1.9780	-2.1775
Richness	5.5124	3.9672	3.3381
Evenness	-0.5604	-0.5874	-0.9081
ARCHAEOLOGICAL/STANDARD			
	Combined	Non Formal	Formal
Diversity	0.5604	0.5874	0.9081
Richness	0.5214	0.4771	0.8004
Evenness	0.5604	0.5874	0.9081

TABLE 28: Raw material

Combined	TOTAL	Q4	M3	M5	L3
(Opaline translucent)	359 30.37%	58 26.61%	100 33.11%	92 29.30%	108 31.32%
(Opaline not translucent)	258 21.83%	45 20.84%	54 17.88%	70 22.29%	89 25.57%
Subtotal opaline	617 52.20%	103 47.25%	154 50.99%	162 51.59%	198 56.90%
Hornfels	136 11.42%	33 15.14%	28 9.27%	46 14.66%	28 8.05%
Tuffaceous rock	93 7.87%	37 16.97%	29 9.60%		27 7.76%
Quartz	67 5.67%	3 1.38%	23 7.62%	10 3.18%	31 8.91%
Other	270 22.84%	42 19.27%	68 22.52%	96 30.57%	64 18.59%
TOTAL	1182 100.00%	218 100.00%	302 100.00%	314 100.00%	348 100.00%
Non-formal	TOTAL	Q4	M3	M5	L3
(Opaline translucent)	350 30.12%	68 26.73%	97 32.55%	86 28.67%	109 31.41%
(Opaline not translucent)	248 21.34%	44 20.28%	53 17.79%	63 21.00%	88 25.36%
Subtotal opaline	598 51.46%	102 47.00%	150 50.34%	149 49.67%	197 56.77%
Hornfels	134 11.53%	33 15.21%	28 9.40%	45 15.00%	28 8.07%
Tuffaceous rock	93 8.00%	37 17.05%	29 9.73%		27 7.78%
Quartz	67 5.77%	3 1.38%	23 7.72%	10 3.33%	31 8.93%
Other	270 23.24%	42 19.35%	68 22.82%	96 32.00%	64 18.44%
TOTAL	1162 100.00%	217 100.00%	298 100.00%	300 100.00%	347 100.00%
Formal	TOTAL	Q4	M3	M5	L3
(Opaline translucent)	9 45.00%		3 75.00%	6 42.86%	
(Opaline not translucent)	10 50.00%	1 100.00%	1 25.00%	7 50.00%	1 100.00%
Subtotal opaline	19 95.00%	1 100.00%	4 100.00%	13 92.86%	1 100.00%
Hornfels	1 5.00%			1 7.14%	
Tuffaceous rock					
Quartz					
Other					
TOTAL	20 100.00%	1 100.00%	4 100.00%	14 100.00%	1 100.00%

TABLE 27: Ph level, abraded stone, rock crystal, ochre, haemitite, specularite and other iron bearing stone

	TOTAL	Q4	M3	M5	L3
misc groundstone work	2		2		
upper grinder	2	2			
palette	2				2
rock crystal					
ochre	x		x		
specularite					
haemitite					
magnetic chunk	x		x		
iron bearing stone					
pebbles	18	5	12	1	

TABLE 26: (cont.)

raw material

Combined

	TOTAL	Q4	M3	M5	L3
(Opaline translucent)	10 16.95%	1 25.00%	4 20.00%		5 14.29%
(Opaline not translucent)	49 83.05%	3 75.00%	16 80.00%		30 85.71%
Subtotal opalines	59 100.00%	4 100.00%	20 100.00%		35 100.00%
Hornfels					
Tuffaceous rock					
Quartz					
Other					
TOTAL	59 100.00%	4 100.00%	20 100.00%		35 100.00%

Non-formal

	TOTAL	Q4	M3	M5	L3
(Opaline translucent)	10 16.95%	1 25.00%	4 20.00%		5 14.29%
(Opaline not translucent)	49 83.05%	3 75.00%	16 80.00%		30 85.71%
Subtotal opalines	59 100.00%	4 100.00%	20 100.00%		35 100.00%
Hornfels					
Tuffaceous rock					
Quartz					
Other					
Total	59 100.00%	4 100.00%	20 100.00%		35 100.00%
No heat-altered Formal tools					

TABLE 26: Ph level, heat-altered stone inventory

Non-formal	TOTAL	Q4	M3	M5	L3
chunk	6 10.17%		5 25.00%		1 2.86%
chip	29 49.15%		5 25.00%		24 68.57%
manuport/nodule					
CORE					
irregular	5 8.47%	4 100.00%	1 5.00%		
bladelet 1 plat					
bladelet 2 plat					
flat bladelet					
blade					
core reduc 1 plat					
core reduc 2 plat					
flat plat bld cor					
other					
BLADE					
parallel sided					
pointed					
thick triangular					
irregular					
BLADELET (<26mm)					
parallel sided					
pointed					
thick triangular					
irregular	4 6.78%		4 20.00%		
BROKEN BLADE					
distal					
medial	1 1.69%		1 5.00%		
proximal					
FLAKES					
core rej. flake					
Cortical Flakes					
endstruck 30+ mm					
endstruck <30mm					
sidestruck 30+ mm					
sidestruck <30mm					
Non-Cortical Flakes					
endstruck 30+ mm	1 1.69%				1 2.86%
endstruck <30mm	6 10.17%		1 5.00%		5 14.29%
sidestruck 30+ mm					
sidestruck <30mm	2 3.39%		1 5.00%		1 2.86%
Broken Flakes					
distal	1 1.69%		1 5.00%		
medial	3 5.08%				3 8.57%
proximal	1 1.69%		1 5.00%		
Subtotal	59 100.00%	4 100.00%	20 100.00%		35 100.00%

No heat-altered Formal tools

TABLE 25: (cont.) raw material

Combined (Opaline translucent) (Opaline not translucent)	TOTAL	Q4	M3	M5	L3
Subtotal opalines	14 87.50%	7 100.00%	5 83.33%		2 66.67%
Hornfels					
Tuffaceous rock					
Quartz					
Other					
TOTAL	16 100.00%	7 100.00%	6 100.00%		3 100.00%
Non-formal		Q4	M3	M5	L3
(Opaline translucent)	9 56.25%	6 85.71%	2 33.33%		1 33.33%
(Opaline not translucent)	5 31.25%	1 14.29%	3 50.00%		1 33.33%
Subtotal opalines	14 87.50%	7 100.00%	5 83.33%		2 66.67%
Hornfels					
Tuffaceous rock	1 6.25%				1 33.33%
Quartz					
Other	1 6.25%		1 16.67%		
Total	16 100.00%	7 100.00%	6 100.00%		3 100.00%
No re-worked Formal tools					

TABLE 25: Ph level, re-worked stone inventory

Non-formal	TOTAL	Q4	M3	M5	L3
chunk	3 18.75%		2 33.33%		1 33.33%
chip					
manuport/nodule					
CORE					
irregular					
bladelet 1 plat					
bladelet 2 plat					
flat bladelet					
blade					
core reduc 1 plat					
core reduc 2 plat					
flat plat bid cor					
other					
BLADE					
parallel sided					
pointed					
thick triangular					
irregular					
BLADELET (<26mm)					
parallel sided	2 12.50%	1 14.29%			1 33.33%
pointed					
thick triangular					
irregular					
BROKEN BLADE					
distal					
medial	3 18.75%	2 28.57%	1 16.67%		
proximal	4 25.00%	4 57.14%			
FLAKES					
core rej. flake					
Cortical Flakes					
endstruck 30+ mm					
endstruck <30mm					
sidestruck 30+ mm					
sidestruck <30mm					
Non-Cortical Flakes					
endstruck 30+ mm	1 6.25%				1 33.33%
endstruck <30mm	1 6.25%		1 16.67%		
sidestruck 30+ mm					
sidestruck <30mm	1 6.25%		1 16.67%		
Broken Flakes					
distal					
medial					
proximal	1 6.25%		1 16.67%		
TOTAL	16 100.00%	7 100.00%	6 100.00%		3 100.00%

No re-worked Formal tools

TABLE 24:(cont.) raw material

Combined (Opaline translucent) (Opaline not translucent)	TOTAL	Q4	M3	M5	L3
Subtotal opallines	11 84.62%	4 100.00%	5 83.33%		2 66.67%
Hornfels					
Tuffaceous rock					
Quartz					
Other					
TOTAL	13 100.00%	4 100.00%	6 100.00%		3 100.00%
Non-formal (Opaline translucent) (Opaline not translucent)	5 38.46% 6 46.15%	Q4 3 75.00% 1 25.00%	M3 1 16.67% 4 66.67%	M5	L3 1 33.33% 1 33.33%
Subtotal opallines	11 84.62%	4 100.00%	5 83.33%		2 66.67%
Hornfels					
Tuffaceous rock	1 7.69%				1 33.33%
Quartz					
Other	1 7.69%		1 16.67%		
Total	13 100.00%	4 100.00%	6 100.00%		3 100.00%
No utilised Formal tools					

TABLE 24: Ph level, utilised stone inventory

Non-formal	TOTAL	Q4	M3	M5	L3
chunk	3 23.08%		2 33.33%		1 33.33%
chip					
manuport/nodule					
CORE					
irregular					
bladelet 1 plat					
bladelet 2 plat					
flat bladelet					
blade					
core reduc 1 plat					
core reduc 2 plat					
flat plat bld cor					
other					
BLADE					
parallel sided					
pointed					
thick triangular					
irregular					
BLADELET (<25mm)					
parallel sided	2 15.38%	1 25.00%			1 33.33%
pointed					
thick triangular					
irregular					
BROKEN BLADE					
distal					
medial	2 15.38%	1 25.00%	1 16.67%		
proximal	2 15.38%	2 50.00%			
FLAKES					
core red. flake					
Cortical Flakes					
endstruck 30+mm					
endstruck <30mm					
sidestruck 30+mm					
sidestruck <30mm					
Non-Cortical Flakes					
endstruck 30+mm	1 7.69%				1 33.33%
endstruck <30mm	1 7.69%		1 16.67%		
sidestruck 30+mm					
sidestruck <30mm	1 7.69%		1 16.67%		
Broken Flakes					
distal					
medial					
proximal	1 7.69%		1 16.67%		
TOTAL	13 100.00%	4 100.00%	6 100.00%		3 100.00%

No utilised Formal tools

TABLE 23: (cont.)

Formal	TOTAL	Q4	M3	M2	L3
SCRAPER Large > 30mm					
end					
side					
end & side					
end & 2 sides					
end & adzing					
high backed					
large backed					
naturally backed					
SCRAPER Medium 20-30					
end					
side					
end & 2 sides	1 0.08%			1 0.32%	
end & adzing					
high backed					
medium backed					
naturally backed					
SCRAPER Small < 20mm					
end	1 0.08%			1 0.32%	
side	2 0.17%			2 0.64%	
end & side	1 0.08%			1 0.32%	
end & 2 sides	1 0.08%			1 0.32%	
end & adzing	1 0.08%		1 0.33%		
high backed					
small backed					
knife					
nat bok knife					
BACKED TOOL > 25mm					
backed blade					
segment					
obliquely backed					
miscellaneous					
broken backed					
BACKED TOOL < 25mm					
backed blade					
segment					
obliquely backed					
miscellaneous					
broken backed					
vent ret bladelet	1 0.08%		1 0.33%		
adze	5 0.42%		1 0.33%	4 1.27%	
spokeshave					
awl					
borer					
broken tool	4 0.34%	1 0.46%		2 0.64%	1 0.29%
miscellaneous	2 0.17%		1 0.33%	1 0.32%	
MSA tool	1 0.08%			1 0.32%	
Subtotal	20 1.69%	1 0.46%	4 1.32%	14 4.46%	1 0.29%
TOTAL	1182 100.00%	218 100.00%	302 100.00%	314 100.00%	348 100.00%

TABLE 32: Ja level, re-worked stone inventory

Non-Journal	TOTAL	Q3	Q4	P3	P4	Q3	Q4	N3	N4	M3
chunk	39 48.02%	2 26.57%			3 30.00%			0 00.00%		1 33.33%
chip										
manipulative	2 2.25%				1 10.00%					
COAE										
irregular	13 14.61%	1 14.29%	1 50.00%	2 100.00%			2 100.00%			
bladelet 1 plat	2 2.25%	2 20.57%								
bladelet 2 plat										
flat bladelet										
blade										
core rodio 1 plat										
core rodio 2 plat	3 3.37%	1 14.29%								
flat plat bld core	2 2.25%									1 33.33%
other										
BLADE										
parallel sided										
pointed										
thick triangular										
irregular										
BLADELET (<20mm)										
parallel sided										
pointed										
thick triangular										
irregular										
BROKEN BLADE										
distal										
medial										
proximal	1 1.12%									
FLAKES										
corn ref. flake										
Cortical Flakes										
endside > 30+mm										
endside < 30mm										
side > 30+mm										
side < 30mm	1 1.12%				1 10.00%					
Non-Cortical Flakes										
endside > 30+mm										
endside < 30mm	7 7.07%				2 20.00%			2 15.30%		1 33.33%
side > 30+mm	1 1.12%		1 50.00%							
side < 30mm	5 5.62%							2 15.30%		
Broken Flakes										
distal										
medial	1 1.12%									
proximal	2 2.25%	1 14.29%			1 10.00%					
Subtotal	79 84.76%	7 100.00%	2 100.00%	2 100.00%	3 30.00%		2 100.00%	13 100.00%		3 100.00%

TABLE 31: (cont.)
raw material

M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Combined
1 80.00%		3 30.00%		2 28.57%	6 75.00%	1 100.00%				1 100.00%	(Opaline translucent)
1 50.00%		6 60.00%	1 100.00%	5 71.43%	2 25.00%		1 100.00%	2 100.00%	2 100.00%		(Opaline not translucent)
2 100.00%		9 90.00%	1 100.00%	7 100.00%	3 100.00%	1 100.00%	1 100.00%	2 100.00%	2 100.00%	1 100.00%	Subtotal opalines
		1 10.00%									Hornfels
											Tuffaceous rock
											Quartz
											Other
2 100.00%		10 100.00%	1 100.00%	7 100.00%	6 100.00%	1 100.00%	1 100.00%	2 100.00%	2 100.00%	1 100.00%	TOTAL
M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Non-formal
1 80.00%		3 30.00%		2 28.57%	6 75.00%	1 100.00%				1 100.00%	(Opaline translucent)
1 50.00%		6 60.00%	1 100.00%	5 71.43%	2 25.00%		1 100.00%	2 100.00%			(Opaline not translucent)
2 100.00%		9 90.00%	1 100.00%	7 100.00%	3 100.00%	1 100.00%	1 100.00%	2 100.00%		1 100.00%	Subtotal opalines
		1 10.00%									Hornfels
											Tuffaceous rock
											Quartz
											Other
2 100.00%		10 100.00%	1 100.00%	7 100.00%	6 100.00%	1 100.00%	1 100.00%	2 100.00%		1 100.00%	Total
M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Formal
									2 100.00%		(Opaline translucent)
									2 100.00%		(Opaline not translucent)
											Subtotal opalines
											Hornfels
											Tuffaceous rock
											Quartz
									2 100.00%		Other
											Total

TABLE 31: (cont.)

Formal	TOTAL	Q3	Q4	P3	P4	O3	O4	N3	N4	M3
SCRAPER Large >30mm										
end										
side										
end & side										
end & 2 sides										
end & edging										
high backed										
large backed										
naturally backed										
SCRAPER Medium 20-30										
end										
side										
end & side										
end & 2 sides										
end & edging										
high backed										
large backed										
naturally backed										
SCRAPER small <20mm										
end										
side										
end & side										
end & 2 sides										
end & edging										
high backed										
small backed										
knife										
not backed knife										
BACKED TOOL >20mm										
backed blade										
segment										
obliquely backed										
miscellaneous	2 2.00%					1 11.11%				
broken backed										
BACKED TOOL <20mm										
backed bladelet										
segment										
obliquely backed										
miscellaneous	1 1.43%									
broken backed										
vent ret bladelet										
pale										
spokes have										
end										
bar or										
broken tool										
miscellaneous										
MSA tool										
Subtotal formal	3 4.89%					1 11.11%				
TOTAL	70 100.00%	8 100.00%		8 100.00%	8 100.00%	8 100.00%		8 100.00%		4 100.00%

TABLE 31: Ja level, utilised stone inventory

Non-formal		TOTAL	Q3	Q4	P3	P4	O3	O4	N3	N4	M3	
chunk	20	28.57%	2	25.00%	1	0.33	3	50.00%	2	22.22%	1	25.00%
chip	1	1.43%										
manuport/module												
CORE												
irregular	2	2.86%	1	12.50%								
bladelet 1 plat												
bladelet 2 plat												
flat bladelet	1	1.43%										
blade												
core reduce 1 plat												
core reduce 2 plat	1	1.43%										
flat plat bld core												
other												
BLADE												
parallel sided												
pointed	1	1.43%										
thick triangular	1	1.43%					1	11.11%				
irregular	1	1.43%	1	12.50%								
BLADELET (<28mm)												
parallel sided	7	10.00%					2	22.22%	3	60.00%		
pointed												
thick triangular												
irregular	5	7.14%					3	30.30%				
BROKEN BLADE												
distal	1	1.43%										
medial	1	1.43%										
proximal	2	2.86%										
FLAKES												
core red. flake	1	1.43%							1	20.00%		
Cortical Flakes												
endside > 30+mm												
endside < 30mm	1	1.43%										
endside > 30+mm												
endside < 30mm	1	1.43%	1	12.50%								
Non-Cortical Flakes												
endside > 30+mm	2	2.86%	1	12.50%	1	33.33%						
endside < 30mm	3	11.43%	2	25.00%			1	16.67%	1	20.00%	1	25.00%
endside > 30+mm	1	1.43%					1	16.67%				
endside < 30mm	3	8.57%									2	50.00%
Broken Flakes												
distal												
medial												
proximal	3	4.29%			1	33.33%	1	16.67%				
Subtotal	67	95.71%	8	100.00%	3	100.00%	6	66.67%	5	100.00%	4	100.00%

TABLE 32: (cont.)

[illegible]

TABLE 32: (cont.)

Formal	TOTAL	Q3	Q4	P3	P4	Q3	Q4	N3	N4	M3
SCRAPER Large >30mm										
end										
side										
end & side										
end & 2 sides										
end & edging										
high backed										
large backed										
naturally backed										
SCRAPER Medium 30-50										
end										
side										
end & side	1 1.12%									
end & 2 sides										
end & edging										
high backed										
large backed										
naturally backed										
SCRAPER small <20mm										
end	1 1.12%				1 10.00%					
side	1 1.12%									
end & side										
end & 2 sides										
end & edging										
high backed	1 1.12%									
small backed										
knife										
notched knife										
BACKED TOOL >30mm										
broken blade										
segment										
obliquely backed										
microbarbed	1 1.12%					1 100.00%				
broken backed										
BACKED TOOL <30mm										
backed blades										
segment										
obliquely backed										
microbarbed	1 1.12%									
broken backed										
ventral bladelet										
blade										
spoke-like	1 1.12%									
bar	1 1.12%									
bar										
broken tool										
microbarbed	2 2.24%				1 10.00%					
MSA tool										
Subtotal	10 11.24%				2 20.00%	1 100.00%				
TOTAL	50 100.00%	7 100.00%	8 100.00%	9 100.00%	10 100.00%	1 100.00%	2 100.00%	13 100.00%		3 100.00%

TABLE 32: (cont.)

M4	M5	L3	L4	L5	K0	K4	K6	J3	J4	J6	Non-formal
1 14.29%		8 72.73%	5 71.43%	7 77.78%			1 100.00%	1 25.00%	1 33.33%		chunk
1 14.29%											chip
2 20.57%		2 10.10%			1 50.00%	2 60.67%					manipul
											port
											COPE
											irregular
											bladedot 1 plat
											bladedot 2 plat
											flat bladedot
											blado
1 14.29%								1 25.00%			core reduc 1 plat
											core reduc 2 plat
				1 11.11%							flat plat bid core
											other
											BLADE
											parallel-sided
											pointed
											thick triangular
											irregular
											BLADBLET (<20mm)
											parallel-sided
											pointed
											thick triangular
											irregular
											BROKEN BLADE
											distal
1 14.29%											medial
											proximal
											FLAKES
											core rel. flakes
											Cortical Flakes
											ondetruck 30+mm
											ondetruck <30mm
											sideatruck 30+mm
											sideatruck <30mm
											Non-Cortical Flakes
											ondetruck 30+mm
											ondetruck <30mm
1 14.29%		1 9.09%						1 25.00%			sideatruck 30+mm
								1 25.00%			sideatruck <30mm
											Broken Flakes
											distal
									1 33.33%		medial
											proximal
7 100.00%		11 100.00%	8 85.71%	8 88.89%	1 50.00%	2 60.67%	1 100.00%	4 100.00%	2 66.67%		Subtotal

TABLE 31: (cont.)
raw material

Combined	TOTAL	Q3	Q4	P3	P4	Q3	Q4	N3	N4	M3
(Opaline translucent)	26 37.14%	2 25.00%		1 33.33%	1 16.67%	8 66.67%		2 40.00%		
(Opaline not translucent)	38 54.28%	5 62.50%		1 33.33%	5 83.33%	3 33.33%		2 40.00%		2 50.00%
Subtotal opalines	64 91.43%	7 87.50%		2 66.67%	6 100.00%	9 100.00%		4 80.00%		2 50.00%
Homfola	2 2.86%									2 50.00%
Tuffaceous rock	1 1.43%									
Quartz										
Other	3	1 12.50%		1 33.33%				1 20.00%		
TOTAL	70	8 100.00%		3 100.00%	6 100.00%	9 100.00%		3 100.00%		4 100.00%
Non-formal	TOTAL	Q3	Q4	P3	P4	Q3	Q4	N3	N4	M3
(Opaline translucent)	25 37.31%	2 25.00%		1 33.33%	1 16.67%	5		2 40.00%		
(Opaline not translucent)	36 53.73%	5 62.50%		1 33.33%	5 83.33%	3		2 40.00%		2 50.00%
Subtotal opalines	61 91.04%	7 87.50%		2 66.67%	6 100.00%	8		4 80.00%		2 50.00%
Homfola	2 2.99%									2 50.00%
Tuffaceous rock	1 1.49%									
Quartz										
Other	3 4.48%	1 12.50%		1 33.33%				1 20.00%		
Total	67 100.00%	8 100.00%		3 100.00%	6 100.00%	8		6 100.00%		4 100.00%
Formal	TOTAL	Q3	Q4	P3	P4	Q3	Q4	N3	N4	M3
(Opaline translucent)	1 33.33%					1 100.00%				
(Opaline not translucent)	2 66.67%									
Subtotal opalines	3 100.00%					1 100.00%				
Homfola										
Tuffaceous rock										
Quartz										
Other										
Total	3 100.00%					1 100.00%				

TABLE 31: (cont.)

M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Form#	
											SCRAPER Large >30mm	
											end	
											side	
											end & side	
											end & 2 sides	
											end & edging	
											high backed	
											large backed	
											naturally backed	
											SCRAPER Medium 20-30	
											end	
											side	
											end & side	
											end & 2 sides	
											end & edging	
											high backed	
											large backed	
											naturally backed	
											SCRAPER small <20mm	
											end	
											side	
											end & side	
											end & 2 sides	
											end & edging	
											high backed	
											small backed	
											knife	
											not backed life	
											BACKED TOOL >20mm	
											backed blade	
											segment	
									1	50.00%	obliquely backed	
											miscellaneous	
											broken backed	
											BACKED TOOL <25mm	
											backed blade	
											segment	
									1	50.00%	obliquely backed	
											miscellaneous	
											broken backed	
											vent rat bladelet	
											edge	
											spoke/sheave	
											awl	
											bone	
											broken tool	
											miscellaneous	
											MSA tool	
									2	100.00%	Subtotal	
2		10	100.00%	1	100.00%	7	100.00%	8	100.00%	1	100.00%	TOTAL

TABLE 31: (cont.)

M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Non-formal
		6 50.00%		2 20.57%	2 25.00%	1 100.00%		1 50.00%			chunk ohp manuport CORE irregular bladelet 1 plat bladelet 2 pint flat bladelet blade core redio 1 plat core redio 2 plat flat plat bid cor other BLADE parallel sided pointed thick triangular irregular BLADELET (<20mm) parallel sided pointed thick triangular irregular BROKEN BLADE distal medial proximal FLAKES core obj. flake Cortical Flakes ends/truck 30+mm ends/truck <30mm sides/truck 30+mm sides/truck <30mm Non-Cortical Flakes ends/truck 30+mm ends/truck <30mm sides/truck 30+mm sides/truck <30mm Broken Flakes distal medial proximal
1 50.00%				1 14.29%							
		1 10.00%									
				1 14.29%							
					2 25.00%						
			1 100.00%		1 12.50%						
1 50.00%											
		1 10.00%									
					1 12.50%		1 100.00%				
								1 50.00%			
		1 10.00%		1 14.29%	1 12.50%						
		1 10.00%		2 20.57%	1 12.50%						
2 100.00%		10 100.00%	1 100.00%	7 100.00%	3 100.00%	1 100.00%	1 100.00%	2 100.00%		1 100.00%	Subtotal

TABLE 30: (cont.)

[illegible]

TABLE 30: (cont.)

Femur	TOTAL	Q3	Q4	P3	P4	G3	Q4	N3	N4	M3
SCRAPER Large >30mm										
and										
and 1 side	1 0.03%									
and 2 sides	2 0.04%				1 0.03%					1 0.25%
and 3 sides										
high backed										
large backed										
naturally backed	2 0.04%	1 0.39%								
SCRAPER Medium 20-30										
and										
side	3 0.08%									
and 1 side	3 0.08%									
and 2 sides	2 0.04%									
and 3 sides										
high backed										
large backed										
naturally backed										
SCRAPER small <20mm										
and	13 0.27%	1 0.39%			2 1.20%	2 1.00%		1 0.29%	1 2.17%	
side	1 0.02%									
and 1 side	2 0.04%				1 0.03%					
and 2 sides	2 0.04%									
and 3 sides	3 0.07%	1 0.35%								
high backed	3 0.07%				1 0.03%					
small backed	1 0.03%			1 0.05%						
knife	7 0.14%				1 0.03%	1 0.03%				
not back knife	6 0.12%	1 0.05%	1 0.34%	1 0.05%	1 0.03%					
BACKED TOOL >25mm										
backed blade										
segment										
obliquely backed										
miscellaneous	5 0.10%					1 0.03%			1 2.17%	
broken backed										
BACKED TOOL <25mm										
backed bladelet	2 0.04%									
segment	2 0.04%		1 0.34%							
obliquely backed										
miscellaneous	2 0.04%						1 1.70%			
broken backed	3 0.06%	1 0.35%								
ventral bladelet										
edge	11 0.23%						3 5.30%			
spoke-like										
awl	1 0.02%									
bar										
broken tool	9 0.18%			1 0.05%	1 0.03%	1 0.03%				
miscellaneous	6 0.12%	1 0.35%			3 1.60%		1 1.70%			1 0.25%
MBA tool	9 0.07%									
SUBTOTAL	87 1.00%	5 2.12%	2 0.08%	3 1.00%	11 0.02%	5 2.00%	5 0.03%	1 0.29%	3 4.33%	2 0.50%
TOTAL	4870 100.00%	2153 100.00%	204 100.00%	184 100.00%	159 100.00%	185 100.00%	88 100.00%	340 100.00%	48 100.00%	402 100.00%

TABLE 33: Ja level, heat altered stone inventory

Non-formal	TOTAL	Q3	Q4	P3	P4	Q3	Q4	N3	N4	M3
chunk	42 30.66%	4 23.53%	4 25.00%	1 1.00	1 33.33%	2 66.67%		3 33.33%		3 37.50%
chip	30 27.74%	0 35.29%	5 31.25%		1 33.33%			1 11.11%		3 37.50%
manuporinodule										
CORE										
irregular	3 2.19%	1 5.88%								1 12.50%
bladelet 1 plat										
bladelet 2 plat										
flat bladelet										
blade										
core rock 1 plat	1 0.73%									
core rock 2 plat	1 0.73%									
flat plat bld core	2 1.46%	1 5.88%								
other										
BLADE										
parallel sided										
pohled										
thick triangular										
irregular										
BLADELET (<25mm)										
parallel sided										
pohled										
thick triangular										
irregular	1 0.73%	1 5.88%								
BROKEN BLADE										
distal	2 1.46%							1 11.11%		
medial	1 0.73%									
proximal	1 0.73%									
FLAKES										
core roj. flake										
Cortical Flakes										
ondetuck 30+mm										
ondetuck <30mm	1 0.73%							1 11.11%		
aldetuck 30+mm										
aldetuck <30mm	1 0.73%									
Non-Cortical Flakes										
ondetuck 30+mm										
ondetuck <30mm	13 9.49%		4 25.00%			1 33.33%		1 11.11%		
aldetuck 30+mm	3 2.19%		2 12.50%		1 33.33%					
aldetuck <30mm	5 3.65%	1 5.88%						1 11.11%		
Broken Flakes										
distal	4 2.92%									
medial	3 2.19%		1 5.25%							
proximal	7 5.11%	2 11.76%								1 12.50%
Subtotal	129 94.16%	10 94.12%	18 100.00%	1 100.00%	3 100.00%	3 100.00%		6 66.69%		3 100.00%

TABLE 36: Ja level, diversity, richness and evenness indices

STANDARD			
	Combined	Non-formal	Formal
Diversity	-4.0431	-3.4657	-3.2189
Richness	13.8509	8.9447	7.4560
Evenness	-1.0000	-1.0000	-1.0000

ARCHAEOLOGICAL			
	Combined	Non-formal	Formal
Diversity	-2.0416	-1.9241	-2.9186
Richness	6.5953	3.6597	5.2462
Evenness	-0.5050	-0.5552	-0.9067

ARCHAEOLOGICAL/STANDARD			
	Combined	Non-formal	Formal
Diversity	0.5050	0.5552	0.9067
Richness	0.4762	0.4091	0.7036
Evenness	0.5050	0.5552	0.9067

TABLE 35: (cont.)

M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Combined
60 34.68%	2 15.38%	180 29.80%	69 34.68%	107 30.92%	103 31.80%	152 34.60%	100 26.53%	27 31.40%	48 33.80%	25 36.76% (Opaline clear)	
56 24.48%	3 23.08%	133 24.77%	51 25.76%	114 32.95%	67 20.55%	141 22.82%	104 27.69%	31 36.08%	52 36.62%	27 39.71% (Opaline not clear)	
136 59.38%	5 38.46%	293 54.80%	120 60.81%	221 63.87%	170 52.15%	293 47.41%	204 54.11%	58 67.44%	100 70.42%	52 76.47% Subtotal opalines	
6 2.82%	2 15.38%	9 1.65%	7 3.54%	28 8.09%	14 4.29%	23 3.72%	27 7.16%	4 4.65%	9 4.23%	1 1.47% Hornfels	
16 7.86%	2 15.38%	44 8.19%	22 11.11%	27 7.80%	28 8.59%	32 5.18%	47 12.47%	7 8.14%	7 4.93%		Tuffaceous rock
12 5.24%	2 15.38%	17 3.17%	8 2.83%	12 3.47%	26 8.00%	19 3.07%	14 3.71%	4 4.65%	9 6.34%	2 2.84% Quartz	
57 24.80%	2 15.38%	174 32.40%	44 22.22%	58 16.76%	69 26.07%	251 40.81%	85 22.53%	13 15.12%	20 14.08%	13 18.12% Other	
228 100.00%	13 100.00%	537 100.00%	198 100.00%	338 100.00%	326 100.00%	618 100.00%	377 100.00%	86 100.00%	142 100.00%	68 100.00%	TOTAL
M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Non-formal
72 34.51%	2 15.38%	157 29.51%	69 34.67%	103 31.25%	100 31.15%	148 24.84%	99 25.68%	22 27.50%	46 33.58%	22 36.07% (Opaline clear)	
68 24.34%	3 23.08%	131 24.82%	51 25.16%	106 32.14%	68 20.55%	137 22.53%	101 27.22%	30 37.50%	49 35.77%	29 37.70% (Opaline not clear)	
182 58.85%	5 38.46%	288 54.14%	119 61.03%	213 63.39%	185 51.40%	285 46.88%	200 53.91%	62 65.00%	95 69.34%	45 73.77% Subtotal opalines	
8 2.89%	2 15.38%	9 1.60%	8 3.08%	27 8.04%	14 4.38%	22 3.62%	26 7.01%	4 5.00%	8 4.38%	1 1.64% Hornfels	
19 7.96%	2 15.38%	44 8.27%	22 11.28%	28 7.74%	28 8.72%	31 5.10%	47 12.67%	7 8.75%	7 5.11%		Tuffaceous rock
12 5.31%	2 15.38%	17 3.20%	8 2.88%	12 3.57%	29 8.03%	19 3.13%	14 3.77%	4 5.00%	9 6.57%	2 3.28% Quartz	
57 25.82%	2 15.38%	174 32.71%	48 22.65%	59 17.26%	85 26.48%	251 41.29%	84 22.64%	13 16.25%	20 14.60%	13 21.31% Other	
228 100.00%	13 100.00%	592 100.00%	196 100.00%	336 100.00%	321 100.00%	608 100.00%	371 100.00%	80 100.00%	137 100.00%	61 100.00%	Total
M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Formal
2 89.87%		3 60.00%	1 33.33%	2 20.00%	3 60.00%	4 40.00%	1 16.67%	8 83.33%	2 40.00%	3 42.86% (Opaline clear)	
1 33.33%		2 40.00%		8 80.00%	2 40.00%	4 40.00%	3 50.00%	1 16.67%	3 60.00%	4 57.14% (Opaline not clear)	
3 100.00%		5 100.00%	1 33.33%	6 80.00%	5 100.00%	8 80.00%	4 66.67%	9 100.00%	5 100.00%	7 100.00% Subtotal opalines	
			1 33.33%	1 10.00%		1 10.00%	1 16.67%				Hornfels
				1 10.00%		1 10.00%					Tuffaceous rock
											Quartz
											Other
3 100.00%		5 100.00%	1 33.33%	10 100.00%	5 100.00%	10 100.00%	8 100.00%	9 100.00%	5 100.00%	7 100.00%	Total

TABLE 35: Ja level, raw material

Combined	TOTAL	Q3	Q4	P3	P4	O3	O4	N3	N4	M3
(Opaline translucent)	1520 31.21%	106 37.46%	83 28.23%	59 38.31%	57 35.85%	71 37.77%	16 28.87%	116 33.33%	20 43.48%	119 29.60%
(Opaline not translucent)	1289 26.47%	90 31.80%	92 31.29%	35 22.73%	46 28.93%	54 28.72%	14 25.00%	75 21.55%	6 13.04%	98 24.38%
Subtotal opalinos	2809 57.68%	196 68.26%	175 59.52%	94 61.04%	103 64.78%	125 66.49%	30 53.87%	191 54.88%	26 56.52%	217 53.98%
Hornfels	224 4.60%	12 4.24%	15 5.10%	8 5.19%	9 5.66%	8 4.26%	5 8.93%	7 2.01%	1 2.17%	82 7.86%
Tuffaceous rock	411 8.44%	20 7.07%	39 13.27%	17 11.04%	14 8.81%	15 7.98%	7 12.50%	26 7.47%	2 4.35%	37 9.20%
Quartz	193 3.98%	5 1.77%	10 3.40%	5 3.25%	1 0.63%	14 7.45%	3 5.38%	10 2.87%	5 10.87%	15 3.73%
Other	1233 25.32%	50 17.67%	55 18.71%	30 19.48%	32 20.13%	26 13.83%	11 19.64%	114 32.76%	12 26.09%	101 25.12%
TOTAL	4870 100.00%	283 100.00%	294 100.00%	154 100.00%	159 100.00%	188 100.00%	56 100.00%	348 100.00%	46 100.00%	402 100.00%
Non-formal		Q3	Q4	P3	P4	O3	O4	N3	N4	M3
(Opaline translucent)	1477 30.94%	102 36.82%	81 27.74%	59 39.07%	55 37.16%	68 37.16%	12 23.53%	115 33.14%	19 43.18%	119 29.75%
(Opaline not translucent)	1250 26.19%	89 32.13%	92 31.51%	33 21.55%	40 27.03%	53 28.96%	13 25.49%	76 21.61%	6 13.04%	97 24.25%
Subtotal opalinos	2727 57.13%	191 68.95%	173 59.25%	92 60.63%	95 64.19%	121 66.12%	25 49.02%	190 54.75%	24 56.52%	216 54.00%
Hornfels	218 4.57%	11 3.97%	15 5.14%	8 5.30%	8 5.41%	8 4.37%	5 9.60%	7 2.02%	1 2.27%	32 8.00%
Tuffaceous rock	405 8.49%	20 7.22%	39 13.36%	17 11.26%	12 8.11%	14 7.65%	7 13.73%	26 7.49%	2 4.55%	38 9.00%
Quartz	193 4.04%	5 1.81%	10 3.42%	5 3.31%	1 0.68%	14 7.65%	3 5.88%	10 2.88%	5 11.36%	15 3.75%
Other	1230 25.77%	50 18.05%	55 18.54%	29 19.21%	32 21.62%	26 14.21%	11 21.57%	114 32.85%	12 27.27%	101 25.25%
Total	4773 100.00%	277 100.00%	292 100.00%	151 100.00%	148 100.00%	183 100.00%	51 100.00%	347 100.00%	44 100.00%	400 100.00%
Formal		Q3	Q4	P3	P4	O3	O4	N3	N4	M3
(Opaline translucent)	49 44.33%	4 86.67%	2 100.00%		2 18.18%	3 60.00%	4 80.00%	1 100.00%	1 50.00%	
(Opaline not translucent)	39 40.21%	1 16.67%		2 66.67%	6 54.55%	1 20.00%	1 20.00%		1 50.00%	1 50.00%
Subtotal opalinos	82 84.54%	5 83.33%	2 100.00%	2 66.67%	8 72.73%	4 80.00%	5 100.00%	1 100.00%	2 100.00%	1 50.00%
Hornfels	6 6.19%	1 16.67%			1 9.09%					
Tuffaceous rock	6 6.19%				2 18.18%	1 20.00%				1 50.00%
Quartz	3 3.09%			1 33.33%						
Other	97 100.00%	6 100.00%	2 100.00%	3 100.00%	11 100.00%	5 100.00%	5 100.00%	1 100.00%	2 100.00%	2 100.00%
TOTAL	4870	283	294	154	159	188	56	348	46	402

TABLE 34: Ja level, abraded stone, rock crystal, ochre, haemitite, specularite and other iron-bearing stone

	Q3	Q4	P3	P4	Q3	Q4	N3	N4	M3	M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	
misc groundstone work	10			3							1		1	1			1	3			misc groundstone work
upper grinder	2		1			1															upper grinder
palette	4					2											1			1	palette
rock crystal			1																		rock crystal
ochre						x							x			x	x	x		x	ochre
specularite																x					specularite
haemitite													x		x			x			haemitite
magnetite chunk																x	x	x			magnetite chunk
iron-bearing stone						x		x		x		x				x				x	iron-bearing stone
pebbles	84	6	3			4	2	2		18			10	3	2		10	2	1	1	pebbles

TABLE 33: (cont.)
raw material

M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Combined (Opaline translucent) (Opaline not translucent)
5 100.00%		9 100.00%	1 12.50% 7 87.50%	11 91.67%	3 75.00% 1 25.00%	10 90.91%	1 6.25% 13 81.25%	4 100.00%	7 100.00%	4 100.00%	
5 100.00%		9 100.00%	8 100.00%	11 91.67% 1 8.33%	4 100.00%	10 90.91% 1 9.09%	14 87.50% 2 12.50%	4 100.00%	7 100.00%	4 100.00%	Subtotal opalines Hornfels Tuffaceous rock Quartz Other
5 100.00%		9 100.00%	8 100.00%	12 100.00%	4 100.00%	11 100.00%	16 100.00%	4 100.00%	7 100.00%	4 100.00%	TOTAL
M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Non-formal (Opaline translucent) (Opaline not translucent)
5 100.00%		8 100.00%	1 12.50% 7 87.50%	9 90.00%	2 86.87% 1 33.33%	10 90.91%	1 6.67% 13 86.87%	4 100.00%	7 100.00%	3 100.00%	
5 100.00%		8 100.00%	8 100.00%	9 90.00% 1 10.00%	3 100.00%	10 90.91% 1 9.09%	14 83.33% 1 6.67%	4 100.00%	7 100.00%	3 100.00%	Subtotal opalines Hornfels Tuffaceous rock Quartz Other
5 100.00%		8 100.00%	8 100.00%	10 100.00%	3 100.00%	11 100.00%	16 100.00%	4 100.00%	7 100.00%	3 100.00%	Total
M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Formal (Opaline translucent) (Opaline not translucent)
		1 100.00%		2 100.00%	1 100.00%					1 100.00%	
		1 100.00%		2 100.00%	1 100.00%		1 100.00%			1 100.00%	Subtotal opalines Hornfels Tuffaceous rock Quartz Other
		1 100.00%		2 100.00%	1 100.00%		1 100.00%			1 100.00%	Total

TABLE 33: (cont.)
raw material

Combined			Q3	Q4	P3	P4	O3	O4	N3	N4	M3
(Opaline translucent)	18	13.14%	3 17.65%	1 6.25%		1 33.33%			1 11.11%		7 87.50%
(Opaline not translucent)	113	82.48%	14 82.35%	13 81.25%	1 100.00%	2 66.67%	3 100.00%		8 88.89%		1 12.50%
Subtotal opalines	131	95.62%	17 100.00%	14 87.50%	1 100.00%	3 100.00%	3 100.00%		9 100.00%		8 100.00%
Hornfels	5	3.65%		2 12.50%							
Tuffaceous rock	1	0.73%									
Quartz											
Other											
TOTAL	187	100.00%	17 100.00%	16 100.00%	1 100.00%	3 100.00%	3 100.00%		9 100.00%		8 100.00%
Non-formal			Q3	Q4	P3	P4	O3	O4	N3	N4	M3
(Opaline translucent)	15	11.63%	2 12.50%	1 6.25%		1 33.33%					7 87.50%
(Opaline not translucent)	109	84.50%	14 87.50%	13 81.25%	1 100.00%	2 66.67%	3 100.00%		8 100.00%		1 12.50%
Subtotal opalines	124	96.12%	16 100.00%	14 87.50%	1 100.00%	3 100.00%	3 100.00%		8 100.00%		8 100.00%
Hornfels	4	3.10%		2 12.50%							
Tuffaceous rock	1	0.78%									
Quartz											
Other											
Total	129	100.00%	16 100.00%	16 100.00%	1 100.00%	3 100.00%	3 100.00%		8 100.00%		8 100.00%
Formal			Q3	Q4	P3	P4	O3	O4	N3	N4	M3
(Opaline translucent)	3	37.50%	1 100.00%						1 100.00%		
(Opaline not translucent)	4	50.00%									
Subtotal opalines	7	87.50%	1 100.00%						1 100.00%		
Hornfels	1	12.50%									
Tuffaceous rock											
Quartz											
Other											
Total	8	100.00%	1 100.00%						1 100.00%		

TABLE 33: (cont.)

Formal	TOTAL	Q3	Q4	P3	P4	Q3	Q4	N3	N4	M3
SCRAPER Large >30mm										
and										
side										
and 1 side										
and 2 sides										
and 4 sides										
high backed										
large backed										
irregularly backed										
SCRAPER Medium 20-30										
and										
side										
and 1 side										
and 2 sides										
and 4 sides										
high backed										
large backed										
irregularly backed										
SCRAPER small <20mm										
and	3	2.10%						1	11.11%	
side										
and 1 side										
and 2 sides										
and 4 sides	1	0.73%								
high backed										
small backed										
knife										
notched knife										
BACKED TOOL >20mm										
backed blade										
sediment										
obliquely backed										
miscellaneous										
broken backed										
BACKED TOOL <20mm										
backed bladelet										
sediment										
obliquely backed	1	0.73%								
miscellaneous										
broken backed										
ventrally beveled										
edge										
apical bevel										
and	1	0.73%								
basal										
broken tool	2	1.46%	1	0.00%						
miscellaneous										
MSA tool										
Subtotal	3	0.04%	1	0.00%				1	11.11%	
TOTAL	137	100.00%	17	100.00%	10	100.00%	3	100.00%	3	100.00%

TABLE 33: (cont.)

M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Non-format
1 20.00%		4 44.44%	3 37.50%	1 6.33%	2 50.00%	2 10.10%	8 50.00%		3 42.86%		chunk
2 40.00%		1 11.11%	3 37.50%	4 35.33%		5 45.45%	4 25.00%		3 42.86%		chlp.
							1 6.25%				manuport
											CORE
											irregular
											bladelet 1 plat
											bladelet 2 plat
											flat bladelet
											blade
											core reduct 1 plat
											core reduct 2 plat
1 20.00%				1 6.33%							flat plat bld core
											other
											BLADE
											parallel sided
											pointed
											thick triangular
											irregular
											BLADELET (<25mm)
											parallel sided
											pointed
											thick triangular
											irregular
1 20.00%											BROKEN BLADE
											distal
											medial
											proximal
											FLAKES
											core rd, flake
											Cortical Flakes
											endstruck 30+mm
											endstruck <30mm
											sidestruck 30+mm
											sidestruck <30mm
											Non-Cortical Flakes
											endstruck 30+mm
											endstruck <30mm
											sidestruck 30+mm
											sidestruck <30mm
											Broken Flakes
											distal
											medial
											proximal
5 100.00%		8 88.89%	8 100.00%	10 80.33%	3 75.00%	11 100.00%	18 93.75%	4 100.00%	7 100.00%	9 75.00%	Subtotal

TABLE 32: (cont.)
raw material

M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Combined
3 42.86%		5 45.45%	2 28.57%	1 11.11%			1 100.00%	1 25.00%	1 33.33%	1 100.00%	(Opaline translucent) (Opaline not translucent)
3 42.86%		4 36.36%	5 71.43%	8 88.89%	2 100.00%	3 100.00%		3 75.00%	2 66.67%		
6 85.71%		9 81.82%	7 100.00%	9 100.00%	2 100.00%	3 100.00%	1 100.00%	4 100.00%	3 100.00%	1 100.00%	Subtotal opalines Hornfels Tuffaceous rock Quartz Other
1 14.29%		1 9.09%									
7 100.00%		11 100.00%	7 100.00%	9 100.00%	2 100.00%	3 100.00%	1 100.00%	4 100.00%	3 100.00%	1 100.00%	TOTAL
M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Non-formal
3 42.86%		5 45.45%	1 16.67%	1 12.50%			1 100.00%	1 25.00%	1 50.00%		(Opaline translucent) (Opaline not translucent)
3 42.86%		4 36.36%	6 83.33%	7 87.50%	1 100.00%	2 100.00%		3 75.00%	1 50.00%		
6 85.71%		9 81.82%	8 100.00%	8 100.00%	1 100.00%	2 100.00%	1 100.00%	4 100.00%	2 100.00%		Subtotal opalines Hornfels Tuffaceous rock Quartz Other
1 14.29%		1 9.09%									
7 100.00%		11 100.00%	8 100.00%	8 100.00%	1 100.00%	2 100.00%	1 100.00%	4 100.00%	2 100.00%		Total
M4	M5	L3	L4	L5	K3	K4	K5	J3	J4	J5	Formal
			1 100.00%							1 100.00%	(Opaline translucent) (Opaline not translucent)
				1 100.00%	1 100.00%	1 100.00%			1 100.00%		
			1 100.00%	1 100.00%	1 100.00%	1 100.00%			1 100.00%	1 100.00%	Subtotal opalines Hornfels Tuffaceous rock Quartz Other
			1 100.00%	1 100.00%	1 100.00%	1 100.00%			1 100.00%	1 100.00%	Total

TABLE 32: (cont.)
raw material

Combined			Q3	Q4	P3	P4	O3	O4	N3	N4	M3	
(Opaline translucent)	31	35.63%	4	57.14%	1	50.00%	4	44.44%	1	100.00%	1	33.33%
(Opaline not translucent)	52	59.77%	3	42.86%	2	100.00%	1	50.00%	4	44.44%	2	66.67%
Subtotal opalines	83	95.40%	7	100.00%	2	100.00%	2	100.00%	1	100.00%	2	100.00%
Hornfels	1	1.15%										
Tuffaceous rock	3	3.45%					1	11.11%				
Quartz												
Other												
TOTAL	87		7	100.00%	2	100.00%	2	100.00%	1	100.00%	2	100.00%
Non-formal			Q3	Q4	P3	P4	O3	O4	N3	N4	M3	
(Opaline translucent)	28	35.44%	4	57.14%	1	50.00%	4	50.00%	5	38.46%	1	33.33%
(Opaline not translucent)	48	60.76%	3	42.86%	2	100.00%	1	50.00%	4	44.44%	2	66.67%
Subtotal opalines	76	96.20%	7	100.00%	2	100.00%	2	100.00%	1	100.00%	2	100.00%
Hornfels	1	1.27%										
Tuffaceous rock	2	2.53%										
Quartz												
Other												
Total	79	100.00%	7	100.00%	2	100.00%	2	100.00%	1	100.00%	2	100.00%
Formal			Q3	Q4	P3	P4	O3	O4	N3	N4	M3	
(Opaline translucent)	3	37.50%					1	100.00%				
(Opaline not translucent)	4	50.00%										
Subtotal opalines	7	87.50%					1	100.00%				
Hornfels												
Tuffaceous rock	1	12.50%					1	100.00%				
Quartz												
Other												
Total	8	100.00%					1	100.00%				