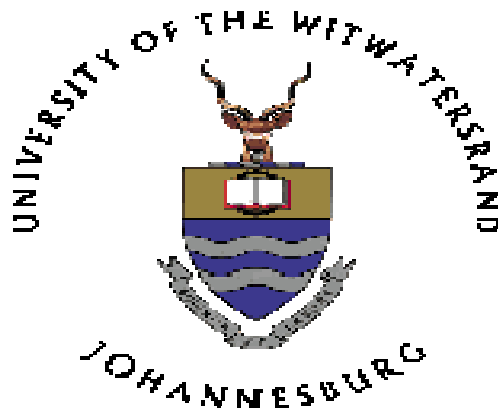


A NEW ANGLE ON MIDDLE STONE AGE HUNTING TECHNOLOGY IN SOUTH AFRICA



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A thesis submitted to the Faculty of Science, University of the Witwatersrand, Johannesburg, in
fulfilment of the requirements for the degree of Doctor of Philosophy.

Johannesburg, July, 2008.

DECLARATION

I declare that this thesis is my own unaided work. It is submitted for the degree of Doctor of Philosophy in the Faculty of Science of the University of the Witwatersrand, Johannesburg. It has not been submitted before for any other degree or examination in any other university.

.....

Moleboheng Mohapi

15th day of July, 2008.

ABSTRACT

Lithic points have always been assumed to have been spears and they occur in Middle Stone Age (MSA) assemblages in great numbers before the Howiesons Poort. They disappear or occur only very rarely in the Howiesons Poort Industry (when segments appear to replace them). After the Howiesons Poort, points become common again. Segments, which are part of some Later Stone Age (LSA), as well as MSA assemblages, have, like points, been associated with hunting weapons. This study reports on the results of a technological analysis of South African points and segments. The points come from two MSA sites in KwaZulu-Natal: Sibudu Cave and Umhlatuzana Rock Shelter. MSA segments are from the Howiesons Poort assemblages of Sibudu and Umhlatuzana, while LSA segments are from Jubilee Shelter in the Magaliesberg. Changing hunting strategies are examined through time by investigating the changing technologies used for points and segments. This is a new contribution because no-one has ever used the same methodology to compare segments and points.

Sibudu and Umhlatuzana points cover a long span of time. Sibudu points come from layers that have optically stimulated luminescence ages of between ~73,000 – ~35,000 years ago and they include specimens from the Still Bay up to the final MSA. Radiocarbon ages from Umhlatuzana may be unreliable because they are likely to be minimum ages and because of rotational slippage of some of the sediments. MSA segments from Sibudu have an age of approximately 70,000 – 60,000 years ago while LSA segments from Jubilee have an age of about 6,000 years ago.

There is overwhelming evidence that points from Sibudu and Umhlatuzana were used as hafted spearheads. Results of morphometric analyses, tip cross-sectional area (TCSA) and tip penetrating angles support Marlize Lombard's suggestion (based on use-trace analyses) that post-Howiesons Poort points from Sibudu were used as hafted hand-held spears while Still Bay points served several purposes which included hunting. Similar results were obtained from the analysis of Umhlatuzana points. Changes in the use of points over time are not as evident at Umhlatuzana as at Sibudu, but the morphologies of their bases suggest that final MSA points

were hafted differently from points in the older MSA phases. Rock types appear not to have played any role in the form and function of points from the two sites.

Sibudu and Umhlatuzana segments are likely to have been used to tip different types of hunting weapons. Their size attributes, TCSA and tip penetrating angles are within the range of attributes of other MSA segments (from other South African contexts), some of which have been suggested to have been used as hunting weapons. When hafted vertically, transversely or diagonally, they are likely to have been used as arrowheads and when hafted in pairs (back-to-back), they could have been used as darts, or even spearheads in the case of large segments. Results of the Sibudu and Umhlatuzana technological analyses of segments confirm results of residue analysis and experimental work. These indicate that segments could have been hafted in various configurations, but that they were used mainly to tip hunting weapons. Jubilee Shelter LSA segments are, however, probably too small to have been used effectively as hunting tools (especially if hafted vertically and diagonally) and micro-wear analysis by Wadley and Binneman suggests that they were used as compound parts of knives rather than as projectiles.

Rock types seem to have played an important role in the form and function of segments at Sibudu because segments form three populations based on rock types. The small quartz tools might have been hafted transversely while larger, elongated hornfels and dolerite segments might have been hafted diagonally or back-to-back. Rock types seem not to have influenced the forms and functions of Umhlatuzana and Jubilee Shelter segments.

Jubilee segments (LSA) are as equally un-standardized as Sibudu and Umhlatuzana segments (MSA). There is, however, some standardization amongst the length/breadth ratios of Howiesons Poort quartz segments from Sibudu.

DEDICATION

This thesis is dedicated to my late parents, Seabata and `Mampho Mohapi. `Ma, thanks for being my rock even long after you are gone.

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CHAPTER ONE

INTRODUCTION

Past technological studies have suggested that tip angles and tip cross-section areas of stone tools, such as points, can be used to distinguish spears, darts and arrowheads and this literature is discussed shortly. Spears can either be thrusting spears or throwing spears thrown with the aid of a spearthrower (Hughes 1998). Thrusting spears are handheld while throwing spears are considered to be projectile weapons. In this study, **spears** refer to handheld thrusting spears unless otherwise stated. **Darts** are projectiles dispatched with atlatls (spearthrowers) and **arrows** are projectiles used with bows (Cattelain 1997; Shott 1993, 1997). Each of these weapons is supposedly associated with a preferred range of tip widths, angles and/or tip cross-sectional areas and these details will be discussed later. My own previous research at Rose Cottage Cave, Eastern Free State (Mohapi 2005, 2007), supports the metric distinction between spearheads and arrows because sets of points differed temporally in size and tip-angle, but not in their triangular shapes.

Both points and segments have been considered parts of hunting weaponry by other researchers (for example, Volman 1984; H.J. Deacon 1989, 1995; Wurz 1999) and the general expectation has been that points were the stone tips of spearheads, while segments were either barbs on weapons or were tips of arrows (Deacon 1995). Desmond Clark's (1977) study of last century Kalahari San arrows that were used with bows challenges these interpretations because the San arrows, comprising compound inserts, have penetrating angles that fall within the spearhead range. The inserts are not points, but segments or small blades. It has, therefore, become clear that other attributes, to be discussed shortly, might play an important role in determining the functions of points and segments. Hafting position is certainly one of these attributes.

In this new study, I shall analyse: 1. all points from all of the Middle Stone Age (MSA) layers at Sibudu Cave, KwaZulu-Natal, 2. a selection of points from Umhlatuzana Cave, KwaZulu-Natal, 3. all segments from Sibudu and a selection of segments from the Howiesons Poort layers at

Umhlatuzana and, 4. all segments from the Later Stone Age (LSA) layers of Jubilee Shelter in the Magaliesberg, Gauteng. Details of each site and the contexts for their points and segments are provided in Chapter Three.

Aims

I aim to look at technological change through time in both points and segments. If the assumption that points and segments are indeed hunting weapons is correct, then the results of the technological study will enable me to assess whether hunting strategies changed through time within the MSA and between the MSA and the LSA. The main emphasis in the study will be on the MSA. To achieve my aim, I shall be examining temporal changes in the attributes of points and segments, for example, length, breadth, thickness, penetrating angle, tip cross-sectional area, mass and rock type. Finally, I shall attempt to determine what role was played by the temporally distinct points and also by the segments which appear for about 10,000 years (~70 - ~60 ka) in the MSA and then re-appear at about 6 ka in the LSA. I aim to explore, through a comparison of their technological features, the possibility that points and segments were temporal variants of hunting weapons in the MSA. I also aim to investigate the possibility that MSA segments and LSA segments served different functions in their respective industries. Lastly, I aim to test whether MSA tools were less standardized than LSA tools as has been suggested by some scholars (Thackeray 1992; also see Mellars 1989a).

The Sibudu Cave MSA sequence includes morphologically diverse points belonging to the Still Bay Industry, near the base of the sequence, and the final MSA layers at the top of the sequence. Some of the morphological change that is intuitively apparent may be due to different hafting strategies and this is one possibility that will be investigated. Points from Umhlatuzana Rock Shelter also encompass a long period. All the point collections listed here will be subjected to a technological analysis.

The metric study of segments from the MSA layers at Sibudu will be compared with both MSA segments from Umhlatuzana Rock Shelter and LSA segments from Jubilee Shelter. This comparison is intended to see whether LSA and MSA segments were technologically related and could therefore have been used for the same purposes. Unlike points, segments have the potential

to be hafted at different angles and in different directions (see Clark *et al.* 1974; Phillipson 1976; Clark 1977; Nuzhnyj 2000; Lombard 2007b, 2008) and, as Rots (2002) points out, the greatest advantage that hafting provides is the flexible angle at which a tool can be mounted to its shaft. Thus, hafting strategies may also be an important part of segment selection and use and this will also be investigated.

Rationale

In South Africa, before 70 ka, points are found in large numbers. However, during the Howiesons Poort, that is, somewhere between 70 and 55 ka, backed tools (including segments) are most common and points are absent or very rare. Between ~55 ka and ~30 ka, points become common again and only rare segments are found until the LSA at about 6 ka.

Previous studies, for example, Lombard's (2004, 2005a) residue and micro-wear analyses on Sibudu points, technological studies (Villa *et al.* 2005; Mohapi 2005, 2007; Villa and Lenoir 2006) and replication studies (Shea 1988, 1989, 1995, 2006) have shown that wide-angled points are most likely to have been used as spearheads while narrow-angled points, especially in the final stages on the MSA, in assemblages younger than about 35 ka, were more likely to have been used to tip arrows (for example, Mohapi 2005, 2007). It is, therefore, possible that segments replace points as weapons in the Howiesons Poort. This suggestion is supported by massive quantities of bone that have been discovered in pre- Howiesons Poort, Howiesons Poort and post-Howiesons Poort assemblages, indicating that hunting took place in all these industrial phases. However, the idea that segments replaced points as tips of hunting weapons still needs testing.

Studying the whole Sibudu point sequence, which includes points from the Still Bay up to the most recent MSA level (~73 – ~35 ka), is a new contribution to the study of points. Lastly, no one in southern Africa has done a comparative technological analysis of MSA and LSA segments to determine their possible uses as spearheads or arrowheads, even though many researchers have speculated about this possibility. The recent use-wear studies of segments (and points) by Lombard provide valuable cross-references for my study. Comparing tools from

Umhlatuzana with Sibudu tools should be particularly fruitful because Umhlatuzana is about 90 km from Sibudu and therefore, I am dealing with the same rock types and environment.

Theoretical Framework

Since the middle of the last century, archaeologists have contemplated the correlation between forms of artefacts and their functions and have debated the usefulness of lithic typologies. One group of scholars (for example, Krieger 1944; Spaulding 1953, 1954; Rouse 1960; Thomas 1986) suggests that, in the deep past, artisans had specific mental templates when manufacturing tool types. This means that the artisans associated a particular form with a particular function and that the resulting tool types can be recognized by archaeologists, who in turn can reconstruct the activities of the toolmakers. Another theoretical faction, for example, Ford (1954 a, b), doubts that ‘real’ types existed in the past. In other words, the types that archaeologists use exist only in the heads of archaeologists. Definitions of tool types have changed a great deal through time and, to a great extent, it is chance that determines the form of typological structures used for stone tools (Ford 1954 a, b). Some ‘types’ of retouched tools are the result of tool rejuvenation, and sometimes even constraints imposed by raw material characteristics, and they may no longer (at the stage of their excavation) resemble the intended end-products of their makers (Dibble 1987, 1988). Therefore, variability observed in some tool classes is not due to intentional design, but is a result of prolonged use or tool recycling (Flenniken & Raymond 1986; Flenniken & Wilke 1989; Rolland & Dibble 1990; Dibble 1991; Dibble & Rolland 1992). Dibble demonstrates that scrapers can be re-sharpened many times after they are first manufactured, thus the discarded scraper, which the archaeologist measures, may bear no resemblance to the scraper in its first stage of manufacture and use. Convergent scrapers and double scrapers can, for example, result from re-sharpening single-edged scrapers (Dibble 1987) and some types called points by archaeologists might really be categories of convergent scrapers (Dibble 1988). Hafted tools add another dimension to the analysis because they are usually thrown away only after re-sharpening and subsequent use, whereas hand-held, unhafted tools are usually discarded after very minimal secondary retouch or re-sharpening (Keeley 1982). This practice can lead to the same tools being discarded in different morphological forms that may subsequently be interpreted by archaeologists to mean different functions and types (also see Shott & Weedman 2007).

Since the early debates, there have been many more about the usefulness of lithic typologies and the issue has not reached closure. Far more archaeologists seem agreed on the usefulness of technological as opposed to typological studies. *Chaîne opératoire*, as its name suggests, was introduced by French archaeologists and it remains the approach most favoured in Europe. It was intended to explain the life-history of a stone tool through manufacturing process from beginning to end (Karlin & Julien 1994; Schlanger 1994; Dobres 2000). *Chaîne opératoire* takes into consideration both the physical and cognitive components of artifact knapping. Physical components are the mechanical processes involved in creating an artifact while the cognitive components have to do with decisions that artifact makers have to make when planning and making artefacts (Karlin & Julien 1994). In southern Africa, *chaîne opératoire* has been used by a number of scholars for several decades. One of the first to use the *chaîne opératoire* was Janette Deacon (1982) in the analyses of LSA material from three sites in South Africa: Nelson Bay Cave (on the west coast), Kangkara (about 45 km north-west of Nelson Bay Cave) and Boomplaas Cave (70-80 km from the west coast). Peter Mitchell (1988) also used the *chaîne opératoire* method in the analyses of microlithic assemblages of southern Africa such as Sehonghong (in Lesotho) (see also Carter *et al.* 1988), Rose Cottage Cave, Boomplaas and Nelson Bay Cave. Sarah Wurz used the approach in the study of backed tools from Klasies River Mouth (Wurz 1997, 1999). Villa and colleagues (2005) used the *chaîne opératoire* in their study of stone tools from post-Howiesons Poort layers at Sibudu Cave. Villa and Lenoir (2006) also used the *chaîne opératoire* approach in the study of lithic points from Sibudu, Rose Cottage Cave and Bouheben (in France). Delagnes and colleagues (2006) have also used the *chaîne opératoire* approach in the analysis of crystal quartz backed tools from the Howiesons Poort layers at Sibudu. Since I shall not be conducting a full analysis of all stages of the industries at the three sites, my approach is not a full *chaîne opératoire*. Instead, I shall be examining *end products* in the sense of *chaîne opératoire* and I adopt the type of methodology used by archaeologists who conduct full *chaîne opératoire* analyses.

Although technological studies appear highly effective, they also have their flaws. The observation that tools may change their shapes and sizes through use is just as applicable to technological as to typological studies. It means that users of the technological approach must

take into account the possibility that some end products of the knapping process (such as blades or formal tools like points and segments) have undergone repeated reworking and alteration. Length and breadth measurements, amongst others, must be viewed in this light.

Notwithstanding the caveat that researchers such as Dibble and Keeley introduce, I believe that it is still possible to make a cautious link between tools and functions, at least in the case of points and segments that will be examined here, but probably also in the case of some other tool classes. Although both points and segments might have been resharpened in the past, it should be possible, by examining large samples of tools through time, to get the full range of lightly used and heavily used tools. If each of the periods examined has such a range of tools, then it should still be possible to see temporally characteristic features in each of the assemblages if, indeed, there is real technological variability between the assemblages. In any case, not all dimensions of tools need change due to resharpening. For instance, the study of Gamo hidescrapers from Ethiopia has shown that resharpening of these tools reduces length while the distal thickness increases, yet, width and thickness (maximum) are not changed by tool re-sharpening (Shott & Weedman 2007). Some attributes of microliths such as thickness and direction of striking platform are unlikely to change due to resharpening (Eerkens 1998). Moreover, some tool types such as microliths are unlikely to change due to resharpening, there is little difference in average measurements between microliths lost during use and those recovered from general site contexts which most likely represent discarded items (*ibid*: 45).

Technological approaches to the study of point and segment functions have another advantage in that they offer potential for reaching empirical conclusions that can be statistically tested. One of the calculations that I shall use, coefficient of variation (CV), is designed to reveal standardization, or lack of standardization, among tool attributes. According to Marks *et al.* (2001: 20), “a technological product is said to be standardized when the produced items tend to exhibit a common set of characteristics which vary little, if at all, from each other”. The issue of standardization has its origin in the rather simplistic notion that tools should become more standardized through time. For instance, in southern Africa, it has been suggested that Howiesons Poort backed tools are more standardized than the same class of tools in the LSA (Thackeray 1992). However, Wurz (1999) has reported that there is no significant difference in

the CVs of Howiesons Poort backed tools at Klasies River Mouth and backed tools from the LSA of other sites. Crystal quartz backed tools from Sibudu have also been shown to lack standardization like the LSA crystal quartz segments from Jubilee Shelter (Delagnes *et al.* 2006). European Upper Palaeolithic tools have, in addition, been said to be more standardized than those from the Middle Palaeolithic and this has been used as an argument that anatomically modern humans were cognitively different from Neanderthals (Mellars 1989a, 1996a). Marks *et al.* (2001) have, however, shown through a study comparing Middle Palaeolithic burins (from Rosh Ein Mor in Israel) with Upper Palaeolithic ones (from Cabeco and Tobas in Portugal) that they are equally standardized.

Technological analysis is simply one strand of evidence for archaeological interpretation. I am aware of the importance of the use of multi-stranded evidence; thus, Marlize Lombard's findings from residue and use-wear analyses on Sibudu and Umhlatuzana points and segments will be taken into consideration when drawing conclusions about tool functions. I shall also use evidence from hunting and hafting experiments (for example, Odell & Cowan 1986; Frison 1989; Lombard *et al.* 2004; Pargeter 2007). The next section of the chapter states hypotheses that this study is based on.

Hypotheses

Points

- (i) Broad points with large or broad tip angles (for example, equal or greater than 54.8 degrees) (see Peterkin 1997) and a wide range of lengths and weights represent hand-delivered spears. Similarly, points with large tip cross-sectional areas (TCSAs) (for example, $168 \pm 89 \text{ mm}^2$) should be spearheads, while points with smaller TCSAs (for example, $58 \pm 18 \text{ mm}^2$) may be darts, while even smaller TCSAs (for example, $33 \pm 20 \text{ mm}^2$) (Shea 2006) may be arrowheads. The overlap in TCSAs between darts and arrows means that other attributes need to be implicated in the separation of these two weapon categories.
- (ii) Small points that are light and have narrow tip angles and small TCSAs represent arrowheads.
- (iii) Changes in platform width and thickness or in width and thickness of retouched bases of points might indicate different hafting strategies through time.

Segments

- (i) Segments used as spearheads might be hafted diagonally, transversely or in pairs, so that their penetrating angles fall within the range of tip angles of spearheads (for example, equal or greater than 54.8 degrees).
- (ii) Segments used as arrowheads might have small penetrating angles (for example, 48.8 degrees) (see Mohapi 2007) and TCSAs which fall within the range of known arrowheads (for example, $33 \pm 20 \text{ mm}^2$). Segments thus used may have had reversible tips. Where two segments were used as part of an arrowhead, or where one small segment was used transversely, the tip-angle might be wide like that of a spearhead, but mass would be small.

Contents of the thesis

Chapter Two summarises the literature related to points and segments, and spears and arrows, as well as the technological issues that will be explored at Sibudu, Umhlatuzana and Jubilee. The literature survey contextualizes points and segments and examines their role within hunting and hafting research carried out both in South Africa and internationally. Chapter Three provides background to the three sites, Sibudu, Umhlatuzana and Jubilee. Sibudu is a MSA site in KwaZulu-Natal containing a long sequence with MSA points from a range of ages, and segments from the Howiesons Poort Industry (pre-60 ka at this site). Umhlatuzana is also in KwaZulu-Natal and it has yielded a similar sequence to that at Sibudu, in addition to a LSA sequence. Jubilee has LSA segments from the Wilton Industry, which has ages between 6 ka and 3 ka at this site. Chapter Four describes the methods of analysis used in this study for points and segments. Methods include measurements such as length, breadth and thickness of points and segments, and calculations include length/breadth ratios, coefficients of variation, tip penetrating angles and tip cross-sectional areas. T-tests are used to assess the significance of differences that are observed in attributes through time and between rock types used for the two tool types. Chapter Five gives results of the technological study of points and Chapter Six gives results of the technological study of segments. Chapter Seven provides an interpretation and discussion of these results and Chapter Eight summarizes and concludes the study. This thesis is the first

attempt in South Africa to compare the technological features of points and segments with the aim of including both as variants within the hunting technology of both MSA and LSA assemblages.

CHAPTER TWO

PREVIOUS STUDIES OF POINTS AND SEGMENTS, SPEARS AND ARROWS

Lithic points are generally assumed to have been used to tip spears while segments were used as arrowheads or barbs of spearheads (Clark *et al.* 1974; Clark 1977; Volman 1984; Deacon 1989; Deacon & Deacon 1999; McBrearty & Brooks 2000). A number of archaeologists have used different approaches in their study of these tools in an attempt to test the validity of this assumption. One of these approaches is the technological approach which usually encompasses morphometric analyses. Scholars who use this approach have looked at a number of variables including: the maximum breadth (Shott 1997), tip cross-sectional area (TCSA) (Hughes 1998; Shea 2006), tip penetrating angle (Villa *et al.* 2005; Villa & Lenoir 2006, Mohapi 2007), mass and maximum length and thickness (Brooks *et al.* 2006). Macro-fracture and micro-wear analyses (always used in conjunction with experimental archaeology) have also become an important part of the technological approach and have proved very useful in providing evidence for the use of both segments and points as hunting tools (Ahler 1971, Lombard 2004, 2005a & b, 2006a & b, 2007a & b; Lombard *et al.* 2004; Phillipson 2007a & b; Wurz & Lombard 2007). This chapter contains a review of literature on points and segments and the way that these have been demonstrated to have been part of the prehistoric hunting apparatus.

Points

A point is “any blade or flake for which an extremity was made pointed by bilateral retouching” (Debenáth & Dibble 1994: 58). Here I discuss two variants of points, **unifacial points** and **bifacial points**.

Unifacial points have been defined morphologically as “triangular, sub-triangular, sometimes lozenge-shaped, more or less elongated, with a pointed end produced by significant retouching and made on a flake which is either Levallois or not” (Debenáth & Dibble 1994: 61). These

types of points must be flat and straight though they can also be skewed (and are then sometimes called *dejetées*). A unifacial point may also be thin, either on the proximal or distal end. The distal extremity of the point in particular must form a sharp angle (*ibid*: 62).

Bifacial points are retouched on both faces, often invasively and there are also many variations within this category. At Sibudu, many bifacial points occur in the final MSA (with an age of about 35 ka) where they range between long and short points in an array of shapes, some with bulbar reductions and some without (Wadley 2005c). Umhlatuzana, which is only about 90 km from Sibudu, has a similar range of bifacial points in its final MSA, but its sequence is dated only by radiocarbon (Kaplan 1990) and cannot therefore be securely linked to that at Sibudu.

In the Still Bay of Sibudu, bifacial points are particularly common although most of the points are fragmentary. The Still Bay occurs immediately below the Howiesons Poort layers, and it has an age of about 73 ka (Wadley 2007). Still Bay points are said to be generally “narrowly elliptic or lanceolate shaped tools, with two sharply pointed apices” (Henshilwood *et al.* 2001a: 444). These points are also characterized by shallow invasive retouch and are usually produced from good quality rocks such as chert, quartzite and silcrete (Goodwin 1929; Goodwin & van Riet Lowe 1929; McBrearty & Brooks 2000; Brooks *et al.* 2006). Still Bay points mostly occur in coastal sites in the Western Cape (South Africa), for example at Blombos Cave (Henshilwood & Sealy 1997; Henshilwood *et al.* 2001a; Soressi & Henshilwood 2004; Henshilwood 2005), Hollow Rock Shelter (Evans 1994), Peers Cave (Volman 1981) Diepkloof (Parkington *et al.* 2005; Rigaud *et al.* in press), Blombos Sands and Cape Hangklip (Minichillo 2005).

At Blombos, Still Bay points appear in two MSA phases: M2 (approximately 78 ka) and M1 (about 75 ka) (Henshilwood 2005). There is a low frequency of bifacial points in M2, which may be an early Still Bay phase (Henshilwood & Sealy 1997; Henshilwood *et al.* 2001a & b; Soressi & Henshilwood 2004; Henshilwood 2005). However, M1 is characterized by high densities (more than 300) of elongated, bifacial points, some with two opposed points to give them a lanceolate or narrowly elliptic leaf shape (Henshilwood & Sealy 1997; Henshilwood *et al.* 2001a; Soressi & Henshilwood 2004; Henshilwood 2005). These layers also contain high densities of bifacial point tips (Henshilwood & Sealy 1997; Henshilwood *et al.* 2001a; Soressi &

Henshilwood 2004; Henshilwood 2005). Bifacial point tips also occur in densities higher than those of whole points in the Still Bay at Sibudu.

Studies of weaponry in the past

Projectiles and hand-held spears

According to Knecht (1997: 3), “projectile technology refers to launched weapons”. Such weapons include javelins and darts. A dart refers to a small spear propelled with the aid of a spearthrower (Knecht 1997; Ellis 1997; Shott 1997; Hughes 1998). Thrusting spears (often referred to as lances), on the other hand, are not projectile weapons because they never leave the hand of the hunter during use (Ellis 1997; Knecht 1997).

Functions of points can be explained by technology because of desirable properties of these tools (Hughes 1998; Villa *et al.* 2005; Shea 2006; Villa & Lenoir 2006; Mohapi 2007). Functions are also explained by experiments involving the use of points (Odell & Cowan 1986; Shea 1988, 1989, 1995; Lombard *et al.* 2004), residue and micro-wear analysis (Lombard 2003, 2004, 2005a & b, 2006a, 2007b, 2008; Hardy *et al.* 2001). These are going to be discussed in the sub-sections that will follow.

Technological studies of points

As has been the case with other formal tool types, research into lithic points focused, initially, mostly on morphological variation/typology and geographical distribution (Odell 1988; Knecht 1997). However, the study of points has shifted to a greater emphasis on morphometric analysis. The essence of this kind of study is to identify, statistically, patterns in metric and geometric variables (Thomas 1986: 7). One reason for this shift is that technological analyses of points are believed to be a good basis for the interpretation of archaeological hunting strategies. Variables related to base shape, overall size (breadth, length, width, mass etc) and edge/tip penetrating angle have been part of this type of technological study (Knecht 1997). The tip penetrating angle is the angle at which lateral edges of the point converge, forming a tip (Shea 2006). The penetrating angle, seen in plan view, is measured in degrees and can be calculated for complete points and distal fragments of points (Villa *et al.* 2005). The penetrating angle has been

suggested as an indicator of point functions because there is an optimal tip size for every type of weapon armature (Shea *et al.* 2001; Shea *et al.* 2002; Villa *et al.* 2005; Shea 2006; Villa & Lenoir 2006).

Another important part of the technological study of weapon armatures is the tip cross-sectional area (TCSA). TCSA is defined as a maximum cross-sectional area, that is, the part of the weapon that cuts the animal's hide, creating the hole for the shaft to enter (Hughes 1998). The TCSA is considered one of the best means to distinguish between different lithic weapon armatures, that is, arrows, spear-thrower darts and hand-held spears (Hughes 1998; Villa *et al.* 2005; Villa & Lenoir 2006; Shea 1988; 2006). The TCSA (see Chapter Four for the formula) is said to be one of the variables that influences penetration of a low velocity weapon, for example, for deep and effective penetration, a small TCSA is required. According to Hughes (1998), 15 cm is considered a minimal depth to cause damage in human organs and significant bleeding and 20 cm for large ungulates. Shea (2006) claims that North American hafted arrowheads have a TCSA of $33 \pm 20 \text{ mm}^2$ and hafted dart tips have a TCSA of $58 \pm 18 \text{ mm}^2$, while experimental and ethnographic thrusting spears have a TCSA of $168 \pm 89 \text{ mm}^2$. North American hafted arrowheads have a TCSA of $33 \pm 20 \text{ mm}^2$ and hafted dart tips have a TCSA of $58 \pm 18 \text{ mm}^2$, while experimental and ethnographic thrusting spears have a TCSA of $168 \pm 89 \text{ mm}^2$ (Shea 2006).

Projectile width at the tip influences sharpness, penetration of the point into the animal's body and the size of the wound (Shea 1997; Nelson 1997). The overall size of the point correlates with the potential for extended use-life through resharpening and is also related to the distance and the speed of the projectile (Nelson 1997). The size and shape of the point's base is probably influenced by the type of haft design (Shea 1988).

Patterson (1985) carried out a functional analysis of stemmed projectile points from site 41 HR182 in Harris County, Upper Texas. He looked at the weights, lengths, widths and neck thicknesses of the points to determine whether they are arrow points or spears. He found that thickness, neck width and weight are the key attributes for use in classification. It was also

discovered that on the Upper Texas coast, arrow points generally weigh less than 2 grams while spear points generally weigh over 3 grams (*ibid*: 89).

Selected stone points from some post-Howiesons Poort layers in Sibudu Cave (Villa *et al.* 2005), Rose Cottage Cave and Middle Paleolithic layers from Bouheben in France (Villa & Lenoir 2006) were technologically examined to determine their functions. Examination of the maximum width, penetrating angle and the tip cross-sectional area of these points has indicated that they were most likely to have been used as hand-held spearheads (Villa *et al.* 2005; Villa & Lenoir 2006).

Points from various post-Howiesons Poort layers at Rose Cottage Cave (dating between 50 000 and 29 000 years ago) and from a final MSA layer, Dc (between 31 000 and 29 000) were also technologically analysed to determine their functions (Mohapi 2005, 2007). The post-Howiesons Poort points were interpreted as spearheads and they have an average length of 39.6 ± 10.9 mm, an average breadth of 21.6 ± 3.9 mm, an average thickness of 7.4 ± 2.1 mm, an average penetrating angle of $74.1 \pm 12.6^\circ$ and TCSA of 81.0 ± 33 mm² (Mohapi 2005, 2007). The Dc points were interpreted as arrowheads and they have an average length of 15.6 ± 4.0 mm, an average breadth of 6.9 ± 1.7 mm, an average thickness of 1.8 ± 0.5 mm, an average penetrating angle of $48.8 \pm 8.3^\circ$ and a TCSA of 6.4 ± 2.6 mm² (Mohapi 2005, 2007).

Small points from Aduma in Ethiopia are thought to be darts propelled by atlatls (Brooks *et al.* 2006) because of their small size (average length = 74 mm) in comparison with Mousterian points. Rose Cottage points interpreted as spearheads by Mohapi (2005, 2007) fit into the category that Brooks *et al.* (2006) call darts. Brooks *et al.* (2006) and Patterson (1985) suggest that weight is perhaps the most important attribute in the development of a projectile technology. In my examination of points and segments, I have used mass (weight) in addition to the usual length, breadth and thickness measurements and calculations of length/breadth ratios, tip penetrating angles and TCSAs.

The issue of standardization of tool kits is another aspect of technology that I shall be examining. Standardization of stone tools refers to the consistency of, for example, shape and size within a given tool class (Marks *et al.* 2001, also see Monnier 2006). It is measured using the coefficient of variation (CV) which is defined as “the ratio of the standard deviation to the mean” (Marks *et al.* 2001: 21). Variance in lithic tools can, however, be affected by a number of natural and cultural factors including: rock type properties, availability of rocks, the number of knappers responsible for the manufacture of the tools, motor coordination of the knapper, knapping technology, intended function and stylistic properties (Eerkens 1998), therefore, these factors should be considered when assessing standardization. Changes in variance of some microliths from Early Mesolithic to Later Mesolithic assemblages in England are thought to have been largely due to changes in hunting techniques. Early Mesolithic microliths were part of a ‘reliable tool kit’ used to hunt large migrating herds of red deer (*Cervus elaphus*) and they were therefore standardized and produced ahead of the hunt. Later Mesolithic microliths were part of a ‘maintainable tool kit’ used in encounter-based hunting in which hunters would take animals individually as they were encountered and therefore microliths used to tip their hunting weapons were not produced ahead of time and were less standardized than Early Mesolithic ones (Eerkens 1998, also see Bleed 1986).

It is thus clear that it is important to assess standardization of tools when looking at changing hunting technologies through time. In this study, coefficients of variation of attributes (for example, breadth, length, thickness, length/breadth ratio and mass) have therefore been calculated to assess standardization of points and segments.

Residue and micro-wear studies of points

Residue analysis involves observing, with the aid of a microscope, traces left on tools in an attempt to determine what they were used for and how (or if) they were hafted (Semenov 1964; Dockall 1997; Gibson *et al.* 2004; Williamson 2004, 2005; Lombard 2006a & b, 2007b, 2008; Lombard & Wadley 2007). Use-wear analysis involves observing patterns of damage that occur on the edges and surfaces of stone tools due to use (Odell 1988). Though many fractures found in archaeological tools can be post-depositional, there are some fractures which experiments have

proven result from use (Barton & Bergman 1982; Bergman & Newcomer 1983; Fischer *et al.* 1984; Lombard *et al.* 2004; Lombard 2005b). The following are the four diagnostic impact fractures associated with hunting:

- (1) Step terminating bending fracture, which is “a bending initiation fracture which before meeting the opposite surface of the specimen runs parallel to this surface, and which thereafter makes a sharp 90° step to meet the surface at a right angle” (Lombard 2005b: 115; also see Fischer *et al.* 1984).
- (2) Spin-off fracture > 6 mm: this is a cone or other fracture type that initiates from a bending fracture such as a snap fracture that removes parts longer than 6mm from the original surface of a tool (Lombard 2005b; also see Fischer *et al.* 1984).
- (3) Bifacial spin-off fractures: “cone or other fracture types that initiate from the same bending fracture removing parts of both surfaces irrespective of the dimensions of the spin-off fracture” (Lombard 2005b: 115; also see Fischer *et al.* 1984).
- (4) Impact burination is a fracture resembling a burin blow occurring along one of the lateral edges but lacking the negative bulb of percussion found in deliberate burination (Barton & Bergman 1982; Bergman & Newcomer 1983; Lombard *et al.* 2004; Lombard 2005b)

Micro-wear analyses of polish, edge damage and impact striations on experimental Clovis points from Colby have shown consistent use of these tools as hafted spear points and butchering tools (Kay 1996). Residue and use-wear analyses of Middle Paleolithic points from Starosele in southwestern Crimea (Ukraine) and Buran Kaya III in eastern Crimea show evidence that, among other functions, these points were hafted and may have served as thrusting spears or projectile points (Hardy *et al.* 2001). Residues of starch and other plant materials which may be remnants of hafts were found to be confined to the proximal portions of these points and this suggests hafting. Impact scars suggest that many of the points were subjected to strong forces during use; they were possibly thrown or thrust forcefully into an object and one point even had feather barbs from a raptor and this provides evidence of their use as hunting weapons (Hardy *et al.* 2001).

Use-wear analyses of stone artefacts from Middle Paleolithic occupations of Kebara Cave Levels IX-XII in Mount Carmel, Tabun Cave I, II, and IX, Hayonim Cave Level E, Qafzeh Cave Levels

XV-XXIV, and Tor Faraj Rockshelter Level C (all in Israel) demonstrate that Levallois points were used as hafted projectile points. Residues on these tools are identical to those found on replicas of the same tools which were thrown and thrust at animal carcasses in experiments (Shea 1988, 1989, 1993, 1994, 1995).

Such findings have also been made in Africa, where they have been supported by residue and other use trace studies. Lombard (2004, 2005) found residues on points from Sibudu Cave (South Africa) that suggest that the points were hafted spearheads. The points have ochre on their thin bases and wear patterns that suggest hafting. In addition, animal remains are most often present on the distal portions of the points, but are absent on the proximal and medial portions (Lombard 2004, 2005). This is interpreted to be a result of using these tools for hunting and/or processing animal products (Lombard 2004, 2005). These conclusions are supported by results of replicated experimental tools which were hafted using fibrous plant twine, bark, hide and sinew and were then used to stab or throw at a forequarter of a dead *Connochaetes taurinus* (blue wildebeest) (Lombard *et al.* 2004).

Residue and use-trace/wear analyses of some triangular, Still Bay bifacial points from Sibudu that are morphologically similar to post-Howiesons Poort points, suggest that these points were used as pointed hunting weapons (Lombard 2006b). However, use-trace/wear analyses of Still Bay bifacial points with pointed, asymmetrical bases from the same site, suggest that these points were hafted and used as butchery tools or knives (Lombard 2006b). Lombard (2006b) suggests that the pointed, asymmetrical bases of the points were an adaptation to improve the hafting technology for specialised butchery knives or butchery implements. According to Wadley (2007), this suggestion is consistent with experimental work by Shea and colleagues (2001) showing that long, thin points (such as the Still Bay ones) are better suited for use as knives rather than spearheads because they are fragile and vulnerable to breakage. Furthermore, other archaeological analyses of South African Still Bay points have yielded results indicating that there are few Still Bay points with impact fractures typical of hunting weapons (Minichillo 2005). For this reason Minichillo (2005: 126-7), too, argues that the Still Bay points were used as knives because “...a robust hafting element, large proportion of the point inside the haft, and

consistent evidence for resharpening all support the primary interpretation of Still Bay points as bifacial knives”.

In addition, the following fractures diagnostic of the hunting function were found on post-Howiesons Poort points from Sibudu: step terminating fractures, spin-off fractures >6 mm, impact burination and bifacial spin-off fractures (Lombard 2005a). Macro-fracture analysis has also provided evidence for the use of Umhlatuzana points as hafted spearheads (Lombard 2007c). Of these points a good proportion has diagnostic impact fractures (36.5 % for post-Howiesons Poort and 12% for pre-Howiesons Poort points) indicative of their use as hunting spears (Lombard 2007c).

Lombard’s suggestions for the use of some Sibudu points as hunting weapons are supported by faunal evidence. The bovid and zebra remains in the MSA assemblages at Sibudu Cave imply that the people of this site were skillful hunters (Plug 2004). Age profiles of bones at Sibudu show high proportions of adults and sub-adults and low proportions of juveniles or very old animals (Plug 2004). Bones with carnivore modifications are rare relative to sample size and all these factors have been regarded as indicative of active hunting (rather than scavenging) by people who targeted large animals in their prime (Plug 2004).

Macro-fracture analysis of points (from the M1 phase) and convergent flakes (from the M3 phase) from Blombos Cave has led to the conclusion that some of these tools were used as hunting weapons (Lombard 2007a). Seventeen per cent of points from M1 and 21% of the convergent flakes from M3 have all four types of diagnostic impact fractures (Lombard 2007a). However, only one convergent flake fragment from the M2 phase has a step terminating fracture, therefore it has been suggested that M2 convergent flakes were not primarily used for hunting (*ibid*: 63).

Micro-wear analyses of some MSA points from Rhino Shelter and White Paintings Rock Shelter in Tsodilo Hills, Botswana, has led to the suggestion that they were used as hafted, thrusting spearheads (Phillipson 2007a). These points have use-wear which consists primarily of dorsal, ventral and edge damage to their distal halves; this damage might have resulted from repeatedly

stabbing an animal carcass (*ibid*: 22). The way these points were broken suggests that they were attached in order to be held, not thrown because:

an animal running away with a spear in its side might cause a stone point to snap when the spear shaft banged against or became wedged in a tree or bush; however, it is the wrenching motion as someone tried to recover a thrust spear that would most likely have imparted a twist to the fracture (Phillipson 2007a: 22)

Experimental studies of points

“The best way to evaluate the plausibility of points as spear points” is to use them in feasibility experiments (Shea 1995: 285). Odell and Cowan (1986) conducted experiments with 80 spears and arrows on animal targets. They found that the objects used to tip spears were larger in general than those used to tip arrows. They also discovered that if a wide tip angle is used for projectiles this correlates negatively with penetration in that “the wider the angle, the greater is the tendency for the point to bounce off its mark” (Odell and Cowan 1986: 203). They therefore concluded that wide-angled points would have placed the hunter at a disadvantage if they were used as projectiles rather than as stabbing spears.

In another experiment, replicas of prehistoric points were used to shoot or stab dead animals and their fractures were studied in an attempt to determine how reliable macro- and micro-fractures are in yielding information on prehistoric point functions (Fischer *et al.* 1984). It was discovered that equal proportions of macro-fractures (all diagnostic impact fractures discussed above were present) and micro wear traces (linear polishes and striations), that is, 40% and 60% respectively, were present on both prehistoric and experimental points (Fischer *et al.* 1984). This was regarded as evidence that macro and micro wear traces can be effective as determinants of prehistoric point functions and also as evidence that points were indeed used as spearheads and arrow tips (*ibid*: 1984: 43).

About ninety experiments were conducted with replicas of Levallois points hafted on wooden spears that were thrown and thrust at carcasses of goats, gazelle, deer and horse (Shea 1995). These experiments added to the evidence that Levallois points are very effective spear points and that whether thrown like a javelin or thrust like a bayonet, they have little difficulty penetrating the hide, abdominal wall and viscera of an animal carcass. Shea (1995: 286) has, therefore, suggested that “Levallois points would have had considerable ‘stopping power’, an ability to quickly and decisively immobilize large animals” The passage of these sharp, broad points through the skin and muscle of animals creates long slashing wounds that leave a blood trail for hunters to follow to the injured animal (*ibid*: 286). Most of the Levallois points which were shot at carcasses were able to penetrate to the depth of at least 20 cm and the wounds they created were massive. Points which could achieve only partial penetration (less than 20 cm) still created gaping wounds and fractured ribs (Shea *et al.* 2001). The experiments demonstrate that Levallois points resist breakage because they are short and broad and were therefore probably manufactured with the intention of being used as armatures for thrusting spears (*ibid*: 812).

Damage observed on experimental points included lateral snapping (which occurred on 41% of the points used as hunting weapons), distal breakage (which occurred on 46% of the points used as hunting weapons) and edge damage (Shea *et al.* 2002). Lateral snapping refers to “a fracture that propagates between dorsal and ventral surfaces, roughly perpendicular to the long axis of the point, splitting the tool into distal and proximal fragments” (Shea *et al.* 2002: 59). Distal breakage refers to “one or more relatively large fractures originating at or near the distal end of the point” and these fractures can spread beneath the dorsal or ventral surface or the lateral edges (Shea *et al.* 2002: 59). Edge damage refers to “microfracturing damage on the edge of a stone tool” (*ibid*: 59). These breakage patterns are not restricted to hunting only because they also occur when points are used to perform other functions; however, the experimental Levallois points were effective in their use as spearheads (Shea *et al.* 2002).

Extensive culling of elephants in Hwange National Park in Zimbabwe provided an opportunity to test replicas of Clovis tools and weaponry (Frison 1989, 1991). The experiments left no doubt that Clovis projectile points can inflict lethal wounds on African elephants and also that simple tools can be used to perform the necessary butchering. The most common damage observed on

the points was crushing. Reshaping of the distal end with an antler flaking tool while still mounted in the foreshaft easily repaired snapping of the tips (Frison 1989, 1991). Such studies have highlighted the importance of technological studies of points, in conjunction with replication and experimentation.

Evidence in bones

The appearance of lithic points in association with bones in archaeological sites has also served as undisputed evidence of the use of points as hunting weapons. A mesial fragment of a Levallois point was found embedded in the third cervical vertebra of a wild ass (*Equus africanus*) at a Middle Palaeolithic site called Umm el Tlel in Syria (Boëda *et al.* 1999). This fragment must have been hafted because in order for it to penetrate into the vertebrae, a strong force was necessary, thus requiring a very strong grip which could not be achieved by holding the object directly. It is possible that this hafted weapon was thrown to achieve great penetration (*ibid*: 401), in other words, the Levallois point was used as part of a projectile weapon.

At a Mesolithic site called Bloksbjerg in Klampenborg, north of Copenhagen in Denmark, a tip of a stone point was found embedded in bone (Friis-Hansen 1990). Friis-Hansen (1990) suggested that this tip could have been used as an arrowhead because it is well suited for an 8.5 mm diameter arrow-shaft with a long binding.

Milo (1998) found a stone point tip embedded in an extinct buffalo cervical vertebra from Klasies River Main, South Africa. This has been used as evidence to suggest that at Klasies River Main lithic points were used as hafted spear tips for hunting (Milo 1998).

Segments and Arrows

Segments (sometimes called crescents or lunates) have been described as geometric forms with steep retouch intended to blunt and shape the tool along an arc while the other lateral is straight and sharp (J. Deacon 1984, 1995; Thackeray & Humphreys 1983; Walker 1994; Gibson *et al.* 2004). They are shaped like the segment of an orange, with pointed tips, a curved backed edge and a sharp, straight cutting edge (J. Deacon 1984, 1995). MSA segments are predominantly

found in the Howiesons Poort, but some are also found in the final MSA of Sibudu (Wadley 2005c). However, the earliest appearance of segments in the MSA is in the Lupemban Industry (between 230-300 ka years ago) in central Africa at Kalambo Falls and Twin Rivers (both in Zambia) (Clark 1988; Barham *et al.* 2000; Barham 2002). These segments are large, thick and they occur only infrequently (Barham *et al.* 2000; Barham 2002). LSA segments are found in Wilton Industries throughout southern Africa (Mitchell 2002) and the ages for Wilton assemblages (defined by a substantial presence of segments) range between close to 7 ka and just a few hundred years ago (Wadley 2000). LSA segments are generally smaller than MSA ones (Deacon 1989, 1995).

It has long been assumed that backed artefacts such as segments were hafted and used as arrowheads or as barbs on spears for hunting or human conflict (for example, Bocquentin & Bar-Yosef 2004; Clark 1975; Clark *et al.* 1974; Crombé *et al.* 2001; H.J. Deacon 1966, 1976, 1989, 1995; J. Deacon 1984; Deacon & Deacon 1999; Fischer *et al.* 1984; Mitchell 2002; Nuzhnyj 2000; Phillipson 1976; Wadley & Binneman 1995). The morphology of segments, especially their backed convex edge, has been regarded as indicative of their use as hafted tools. Their backed edge is said to facilitate hafting by creating a rough surface on which mastic can adhere to the tool (Clark 1977; Phillipson 1976; Nuzhnyj 2000; Gibson *et al.* 2004; Lombard 2005a; 2007c; Pargeter 2006; Wurz & Lombard 2007). There are indeed instances where backed artefacts found in historical, ethnographic and archaeological contexts have been parts of hunting weapons (Clark *et al.* 1974). Clark and colleagues (1974) studied a variety of ancient Egyptian bows and arrows which are replicas of arrowheads recovered from the epi-Palaeolithic and later contexts in Africa. These arrows have heads made of various materials such as bone, worked stone and fish mandibles which are hafted onto wooden hafts in different positions (Clark *et al.* 1974). Historic bows and arrows of the San of southern Africa also contain microlithic stone inserts (Clark 1977).

Hilary Deacon (1989, 1995) has suggested that southern African Howiesons Poort segments may have been hafted for use as barbs on spears or as spearheads, while Later Stone Age (LSA) segments were used for arrows. His argument is partly based on the fact that MSA segments are two or three times the size of their LSA equivalents. McBrearty and Brooks (2000) suggest that

Howiesons Poort segments were parts of composite projectiles, but they believe that projectiles occurred before the Howiesons Poort (Brooks *et al.* 2006).

Backed tools from the Howiesons Poort and more recent LSA industries may have had multiple uses, including cutting (Clark 1970; Clark & Prince 1974; J. Deacon 1995; Wadley & Binneman 1995). Experiments (Wallis & O'Connor 1998) and archaeologically recovered composite weapons show that segments and even small blades or flakes were parts of weapons (Clark 1975; Clark *et al.* 1974; Myers 1989; Binneman 1994). In Europe, Châtelperronian backed points with burin-like impact fractures from Arcy-sur-Cure seem to have been used as weapon tips (Plisson & Schmider 1988) and Gravettian straight, pointed backed blades are also projectile points. Some Magdalenian and Solutrean backed bladelets were used as side barbs on weapons: reindeer antler points with double grooves were found in the Solutrean of Combe Saunière (Plisson & Geneste 1989) and a grooved antler point with backed blades still in place was found at Pincevent (Leroi-Gourhan, 1983). Hafted microliths have been found in Loshult in Sweden and skeletons of aurochs were found embedded with microlith fragments in Prejlerup (Crombé *et al.* 2001). A hundred flint arrows were found (some hafted to wooden arrowshafts) in Ahrensburg in Germany (Rozoy 1985). Backed tools have been found embedded in bones of prey in the Upper Palaeolithic Talitskij settlement in the north-eastern part of the Russian Plains (Wurz 1999).

Technological studies of segments

LSA backed tools have been said to be more standardized than MSA ones (J. Deacon 1972; Thackeray 1992). CVs of length, breadth and length/breadth ratio of Wilton segments analysed by Deacon (1972) are high when all the segments are combined (length = 25.7; breadth = 25.4 and length/breadth ratio = 31.9). However, lengths and breadths of silcrete segments from layer 3F, an LSA layer from Wilton Rock Shelter, are highly standardized (CV for length = 5.6 and breadth = 5.4). Thus, it seems that, when variables are reduced (for example, calculating CVs from one rock type only), there is a greater chance of standardization within a single tool class. However, Wurz (1997, 1999) reported that there is no significant difference in the CVs of Howiesons Poort backed tools at Klasies River Mouth and backed tools from LSA sites and that both show a lack of standardization. Crystal quartz backed tools from Sibudu have also been shown to lack standardization like that of the LSA crystal quartz segments from Jubilee Shelter

(Delagnes et al. 2006). Wurz (1977, 1999) has suggested that the lack of standardization of both MSA and LSA backed tools implies similar behaviour in these chronologically separate industries. She interprets both as products of cognitively modern people.

Upper Palaeolithic tools, like LSA tools, have been said to be more standardized than those from the Middle Palaeolithic of Europe (which can be equated to MSA tools in Africa) and this has been used as an argument that anatomically modern humans were cognitively different from Neanderthals (Mellars 1989, 1996). Marks *et al.* (2001) have, however, shown through a study comparing Middle Palaeolithic burins (from Rosh Ein Mor in Israel) with Upper Palaeolithic ones (from Cabeco and Tobas in Portugal) that they are equally standardized. In England, Early Mesolithic microliths have been found to be more standardized than Later Mesolithic ones (Eerkens 1998).

As mentioned earlier, Shea (2006) uses tip cross-sectional area (TCSA) to distinguish small arrowheads from large thrusting spear tips and medium-sized darts, but he used points for the calculations and he suggests that TCSA may not be useful for use on segments, which can be hafted in a variety of positions. However, the TCSA can be used for segments hafted vertically and back-to-back (hafting positions of segments will be discussed in detail later) because points are hafted vertically too.

Tip penetrating angle is another commonly-used attribute for distinguishing arrows and spears (Shea 2006; Villa & Lenoir 2006). Again, this attribute can be problematic when applied to segments; for example, Clark (1977) illustrates San arrows with opposed segments that create angles of 85 and 99 degrees, which would normally be associated with spearheads. Another “double-pointed” arrow tipped with two glass points resembling crescents/backed blades was described by Goodwin (1945) (also see Rudner 1979) and this angle would also be associated with a spearhead, yet the weapons described by both Clark and Goodwin were clearly arrows.

Shott (1997) considers that shoulder-width (maximum width on the proximal end of a point) is an effective and simple means to discriminate between darts and arrowheads and shoulder-width

can easily be adapted for use with segments. Arrows are said to have a mean shoulder-width of 14.7 mm while darts have a mean shoulder-width of 23.1 mm (Shott 1997).

Residue and micro-wear studies of segments

Backed pieces from LSA layers at Enkapune Ya Muto (Kenya) have traces of red ochre opposite the unmodified edge and Ambrose (1998) suggests that the ochre could indicate hafting parallel to the long axis of the backed pieces.

At Melkhoutboom Cave, in the Eastern Cape, South Africa, LSA segments have traces of mastic on their arcs and this has been regarded as evidence of their use in composite tools (Deacon 1976). Phillipson (1976) examined mastic-encrusted backed tools, including segments, from the LSA site of Makwe in Zambia and was able to reconstruct a variety of hafting methods based on mastic distributions. For example, deep segments may have been mounted as transverse arrowheads, while narrow, pointed segments functioned as barbs or back-to-back inserts to form a point. Transverse arrowheads were widely used in the past, for example, in ancient Egypt (Clark *et al.* 1974), the European Mesolithic (Friis-Hansen 1990) and in the Near East (Anderson-Gerfaud 1983).

Wurz's (1999, 2000) analysis of MSA backed artefacts from Klasies River indicated that the damage on these backed pieces was the same kind as that observed on Harper's (1997) Rose Cottage Cave collection and on Clark's (1977) ethnographic examples of lithic inserts on arrows. Their cutting edges showed "fine nibbling and retouch" which Clark (1977) associates with the use of these backed pieces as tips of projectile weapons (Wurz 1999, 2000).

Residue and macro-fracture analyses of segments from Sibudu have shown that segments were used and hafted differently on this site (Lombard 2006b, 2007b, 2008). Ochre residues (80%) and resin residues (87%) are concentrated on the backed portions of tools which are usually associated with hafting (Lombard 2006b). It has previously been suggested that ochre was a component in the hafting technology (Ambrose 1998; Rots 2002; Lombard 2004, 2005a; Gibson *et al.* 2004; Wadley *et al.* 2004; Wadley 2005a & b, also see Hodgskiss 2006).

Quartz backed tools from Sibudu could have been hafted as multiple or single barbs on hunting weapons because resin is only observed on one tip of the backed tool suggesting that only one tip of the segment was glued to the shaft (Lombard 2008).

Bone hafting (hafting of segments in bone) seems to have been used in the early Howiesons Poort phase (Lombard 2008). Use-wear analysis suggests that 50% of these same segments could have been hafted diagonally (Lombard 2008). More than half of segments in the most recent Howiesons Poort phase at Sibudu appear to have been hafted to wood and about half of these segments appear to have been hafted diagonally (Lombard 2008). The adhesive recipe used to attach these segments to hafts included ochre and resin/gum (Lombard 2007b). Most of the animal residues on the Howiesons Poort segments from Sibudu and Umhlatuzana are concentrated on the blade or cutting portions of the segments in the following proportions: animal tissue (84%), collagen (67%), blood residue (84%) and hair fragments (89%) (Lombard 2007b). This suggests that the Howiesons Poort segments might have been used mostly for the processing (either butchering or hunting) of animal material (Lombard 2007b). However, use-wear traces on these segments show little evidence of their use as cutting, sawing or scraping implements (*ibid*: 8) and this implies that the main function of Sibudu and Umhlatuzana segments was as inserts of composite hunting weapons (Lombard 2007b).

Twenty-one per cent of Klasies River Mouth segments analysed by Wurz & Lombard (2007) for macro-fractures have impact scars that are indicative of their use as hunting weapons. This percentage is in accordance with percentages of diagnostic impact fractures found on Sibudu (22%) and Umhlatuzana (24%) Howiesons Poort segments studied by Lombard (2007c).

Experimental studies of segments

A recent experimental study conducted by Justin Pargeter (2006) has explored the hafting strategies suggested by Nuzhnyj (2000) using 33 replicated MSA segments. Pargeter's (2006) experiments have shown that segments function very well when used as projectile tips and that they are effective when hafted in a variety of positions. Pargeter (2006) hafted his segments to wooden shafts in four configurations: vertically, horizontally, diagonally and back-to-back and shot them into an impala carcass using a projectile machine. All hafting configurations were

successful (84% effective), even though not equally so (Pargeter 2006, 2007). Segments hafted vertically, diagonally and back-to-back were highly successful in penetrating the carcass and created deep wounds and great bleeding which could lead to death if the animal was alive. However, those hafted horizontally caused lacerations rather than deep wounds and would not necessarily have caused death if the animal was alive. These lacerations would, however, have caused a blood spoor which would lead the hunter to the wounded animal in a genuine hunting experience (Pargeter 2006, 2007).

Evidence in bones

In Kongemose, Denmark, a flint arrowhead was found deeply embedded in an unhealed lesion in a limb bone of red deer (Friis-Hansen 1990). Lastly, at a site northeast of Hamburg, Stellmoor, two broken proximal ends of tanged arrowheads were discovered in position in foreparts of arrow-shafts. There were also two points of arrowheads which were embedded in reindeer vertebrae (*ibid*: 502).

Backed pieces have also been found in association with, and sometimes embedded in, human bones in Nubian cemeteries dating to around 12,500 BC (Clark *et al.* 1974). These backed pieces may have formed parts of heads of arrows (Clark *et al.* 1974).

Summary

This review of the literature has shown that technological studies have a great deal to offer; they are able to help discriminate between weapon types and their uses and, together with use trace analyses, they can provide information on hafting types. Points appear to have received more attention than segments, particularly in the form of experimental work. Points are better understood than segments which may have a complex history because of their potential for being hafted in several directions. The literature suggests that technological studies of South African MSA points and MSA and LSA segments will yield profitable and novel results and I hope to be able to examine technological change through time in both categories of tool.

The next chapter describes contexts (for example, location and cultural) in which points and segments appear in the three sites which will be the focus of this study: Sibudu, Umhlatuzana and Jubilee.

CHAPTER THREE

BACKGROUND TO SIBUDU, UMHLATUZANA AND JUBILEE

This chapter gives descriptions of the sites whose material is studied in this project: Sibudu Cave, Umhlatuzana Rock Shelter and Jubilee Shelter. It includes site locations as well as the background research, especially regarding lithics.

Sibudu Cave

Location and description

Sibudu Cave is located about 40 km north of Durban, on a steep cliff overlooking the Tongati River (Wadley 2005c, Wadley & Jacobs 2006). The site is about 15 km inland from the KwaZulu-Natal Indian Ocean (Fig. 3.1) and the cliff on which it is situated is partially covered by a forest. The site is 55 m long and about 18 m wide and it was formed as a result of long term erosion of the sandstone and shale cliff by the Tongati River during a marine regression (Fig. 3.2) (Wadley 2001; 2005c, Wadley & Jacobs 2006).

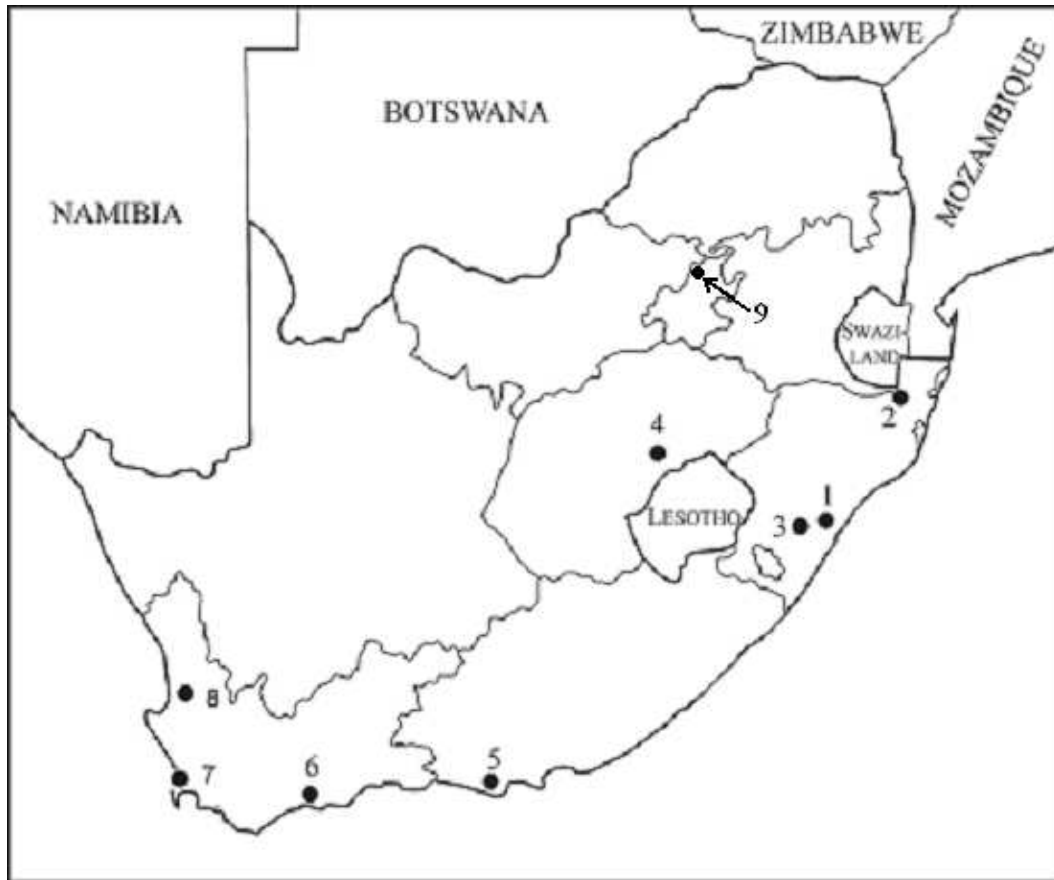


Fig. 3.1 Map of Southern Africa showing Sibudu, Umhlatuzana, Jubilee and some sites which will be discussed later. Sites are numbered in the following manner: 1. Sibudu Cave , 2 Border Cave, 3. Umhlatuzana Rock Shelter, 4. Rose Cottage Cave, 5. Klasies River Mouth, 6. Blombos Cave, 7. Peers Cave, 8. Diepkloof, 9. Jubilee Shelter (Courtesy Lyn Wadley).



Fig. 3.2 A picture of Sibudu Cave (courtesy Lyn Wadley).

Excavations

Excavations on this site were initiated by Aron Mazel of the Natal Museum in 1983 (Wadley 2001; 2005c; Wadley & Jacobs 2006). Mazel dug a small trial trench of about a metre deep but stopped excavating when he realized that the site is MSA because his focus is on the Iron Age. Lyn Wadley of the University of the Witwatersrand started work on this shelter in 1998 and 21 m² of Middle Stone Age (MSA) deposit have been excavated so far. Wadley started excavating a 2 m² trial trench comprising two squares, B5 and B6, in 1998 and this trench reached a depth of three metres after being excavated for almost a decade (Wadley & Jacobs 2006). Squares A4, A5 and A6 were excavated between 2003 and 2005 and have reached layer RSp, which is approximately 70 cm below the surface (Wadley & Jacobs 2006). The remaining squares have been excavated to varying depths since 1998; squares C2, C3, D2, D3, E2, and E3, in the eastern part of the excavation grid, were excavated between 1999 and 2003 to a depth of about one metre (at the base of layer BSp 2, exposing layer SPCA) (Wadley & Jacobs 2006: 4) (Fig. 3.3).

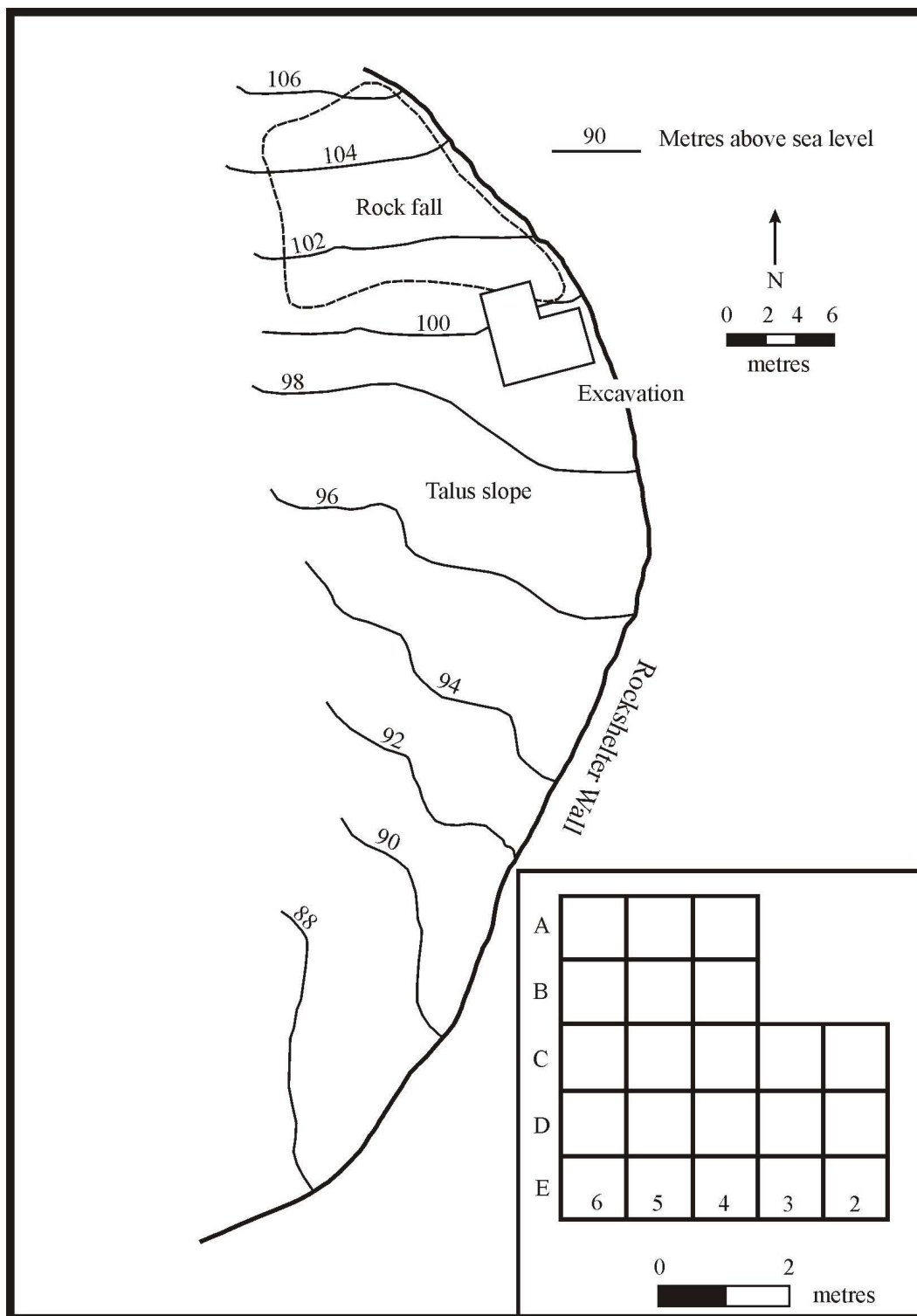


Fig. 3.3 Plan of Sibudu Cave (courtesy Lyn Wadley).

Cultural sequence

Sibudu Cave has an Iron Age (IA) occupation directly overlying MSA deposits and does not have Later Stone Age (LSA) deposits. The MSA sequence is long and comprises: a pre-Still Bay phase, a Still Bay Industry, a Howiesons Poort Industry, a post-Howiesons Poort phase, a late MSA and final MSA phases (Wadley 2005c, Wadley 2006b; Wadley & Jacobs 2006).

Assemblages with ages between ~80 ka and ~60 ka

Assemblages designated as pre-Still Bay are from layers LBG, LBG 2, LBG 3, LBG 4 and BS (Wadley & Jacobs 2006). These layers are below the Still Bay Industry and seem to be unrelated to it (Fig. 3.4). BS, the basal layer, with an age of ~80 ka (Wadley *et al.* in prep.) has some unifacial points, however, the lithic sample is small because of the rock encroachment which has reduced the size of the trial trench (Wadley & Jacobs 2006). Lithics from the pre-Still Bay have not been analysed yet (Wadley & Jacobs 2006).

The Still Bay has an age of ~73 ka (Wadley *et al.* in prep). The *fossile directeur* of the Still Bay is the lanceolate point, which appears in layers RGS and RGS 2 (most of these points are broken though) (Wadley 2007; Wadley & Jacobs 2006). According to Wadley & Jacobs (2006: 15), “this breakage pattern is typical of Still Bay points, which tend to be longer and thinner, and therefore more vulnerable to breakage, than points from other MSA industries.” These lanceolate points and bifacial points from the Still Bay at Sibudu are included in the present study. Prior to my study, Wadley (2007) described these points and Marlize Lombard (2006b) carried out a functional analysis of them using residue analysis. Lombard (2006b) and Wadley (2007) have concluded that the two pointed ends of these Still Bay points were not intended to be used reversibly. Minichillo (2005) has made the same suggestion based on a study of Still Bay points from a number of sites in South Africa. In this study, I am comparing distal and proximal angles of Still Bay points to see whether they are similar statistically or not.

Overlying Still Bay layers is a Howiesons Poort Industry which occurs in layers PGS, GS2, GS, GR2, GR and DRG (Fig. 3.4). The majority of the backed pieces in these layers are segments manufactured on hornfels, dolerite and other raw materials such as quartz, especially in GS and

in PGS (Delagnes *et al.* 2006; Wadley & Jacobs 2006). Some of these segments form part of the present study while others have been examined by Lombard (2006a) for residue and use-wear. Moreover, Delagnes and colleagues (2006) have carried out a typological and technological study of a few quartz backed tools (backed blades, trapezes and segments). Other tools found in this industry are blades (found in high proportions) and sandstone flakes (Wadley & Jacobs 2006). A broken bone point has also been recovered and it is being examined by Lucinda Backwell (*ibid*: 15).

Assemblages ~ 60 ka, the post-Howiesons Poort

Post-Howiesons Poort is an informal lithic designation given to assemblages that are found in layers whose ages cluster around 60 ka. These layers are: Br under YA2, YA1, BOr, Ymix, BL2, BL3, B/Gmix, B/Gmix2, Y1, Ch2, G1, P1, Su, Su2, Ch, BM, Iv, BP, OP, P, BO, Ma, MY, Che, Eb, SS, Mi, BL, Or, SPCA, BSp2 and BSp (layers listed from the bottom up) (Fig. 3.4; Table 3.1) (Villa *et al.* 2005; Wadley & Jacobs 2006). Retouched artefacts in this phase are mainly points and scrapers and the stone tools appear to be the product of various flaking strategies that include tool-maintenance (Cochrane 2006). Some points from layers in this phase form part of the present study and will be technologically examined in an attempt to check whether there is change in the way they were used or hafted and to check what type of weapons they were used as. Previous technological and typological studies of lithics from this phase were made by Villa & Lenoir (2006) (who analysed a large sample of points from layers YA2 to MOD) and Cochrane (2006) who analysed artefacts from post-Howiesons Poort layers dated to ~ 60 ka. Villa & Lenoir (2006) concluded on the basis of results of morphometric (e.g. tip cross-sectional area [TCSA]) and impact fracture analyses that these points were used as tips of hand-delivered spears. Cochrane (2006) found out that there was a brief shift of rock preference at Sibudu in the post-Howiesons Poort. Layers immediately above the Howiesons Poort were dominated by lithics made on quartz and quartzite while lithics in the upper layers of the post-Howiesons Poort were predominantly made on hornfels and dolerite. A notched bone was also found in the uppermost layer BSp (dating to 61.3 ± 2.0 ka) (Wadley & Jacobs 2006).

Assemblages ~50 ka, the late MSA

The late MSA is an informal lithic designation given to assemblages from layers in the northern excavation grid whose ages cluster around 50 ka. These are found in layers: YSp, RSp, GMod, BMod, OMod2BL, OMod2, OModBL, OMod, Mod, Cad, Pu, RD, RSp, Ore, Ore2 and PB (Fig. 3.4) (layers listed from the bottom up) (Wadley & Jacobs 2006). These assemblages have a high frequency of unifacial points, especially in layers RSp, OMod and Mod (Villa *et al.* 2005, Wadley & Jacobs 2006). Bifacial points are also found here even though in low quantities (Wadley & Jacobs 2006). Some of the points examined in the present study come from this phase. Villa and colleagues (2005) and Villa & Lenoir (2006) have also studied some points from the late MSA. Points studied by Villa and colleagues (2005) have also been interpreted as tips of hand-delivered spears based on results of morphometric analysis.

Assemblages ~ 37 ka, the final MSA

These assemblages are found in layers in the eastern excavation grid whose ages cluster around 37 ka. These layers are: Mou, D Mou, Es, MC (hearth), LBMod, Bu, Co (Fig. 3.5; Table 3.1) (Wadley & Jacobs 2006). Bifacial points are found in higher frequencies than unifacial points in layers Mou, DMou, LMou, Es, MC, LBMD, Bu and Co (Wadley 2005c). In addition, these assemblages have a rare form of points; hollow-based, some rare small bifaces and some wide segments. Hollow-based points seem to be a local variant of points at both Sibudu and Umhlatuzana because they are found in the MSA/LSA transition layers (final MSA layers) at Umhlatuzana too and seem to be unique to KwaZulu-Natal (Kaplan 1990, Wadley 2005c). The hollow base may have been designed to fit a specific haft used during the final MSA. There is evidence that these tools were hafted; Marlize Lombard (2007c) found ochre residues (ochre is associated with hafting, especially when found on proximal ends of tools [see Wadley *et al.* 2004; Hodgskiss 2006; Lombard 2006a, Wadley 2006a]) on the proximal end of one of these points from Sibudu. Besides lithics, a polished bone pin was found in layer Co (Cain 2004).

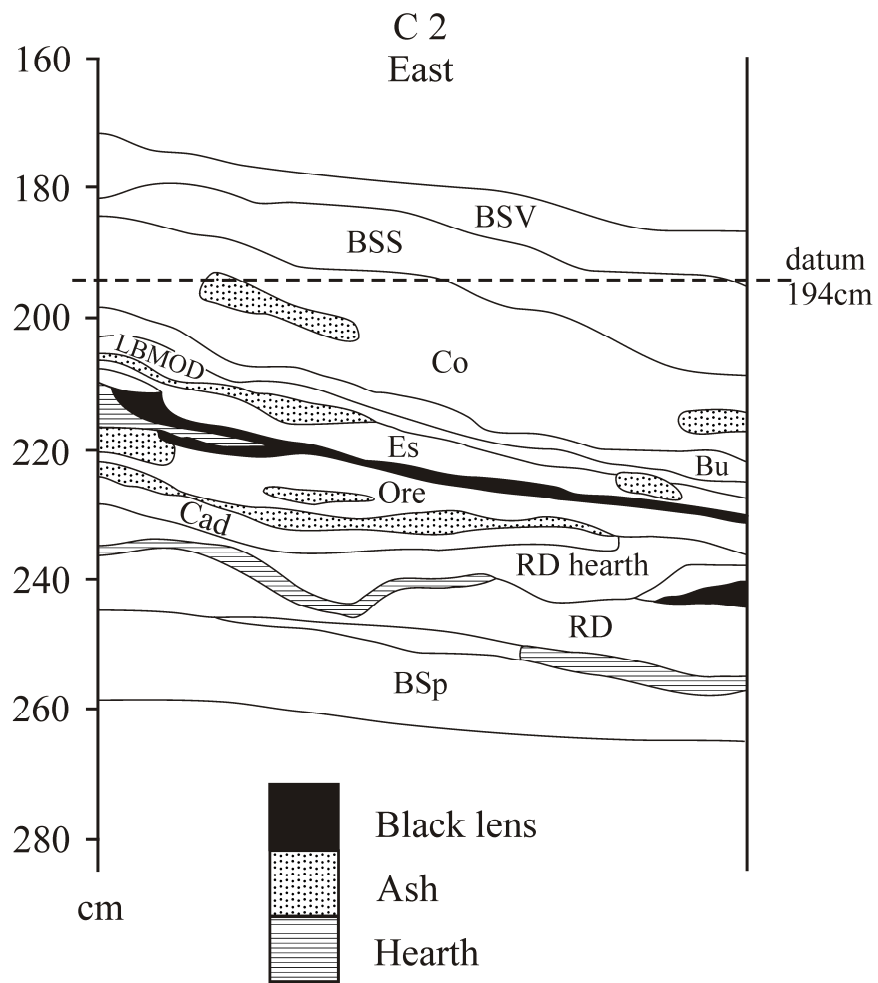


Fig. 3.5 The stratigraphy of square C2 in the eastern grid (courtesy Lyn Wadley).

Table 3.1
The chronology of final MSA, late MSA, post-Howiesons Poort and Still Bay layers of points and segments from Sibudu Cave (from Wadley & Jacobs 2006).

Layer	Age in ka
Final MSA	
LB MOD	50.4 ± 1.8
Coffee	37.1 ± 1.5
Buff	36.7 ± 1.7
late MSA	
O MOD (and related hearths)	50.3 ± 2.1
MOD (and related hearths)	49.7 ± 1.8
RSp	48.4 ± 1.7
Grey MOD	
Ysp	
Oreo (and related hearths)	
BMBF	
BY	
HC in RD	
RD 2	
post-Howiesons Poort	
Orange	
SPCA	
BSP	61.3 ± 2.0
Chestnut	
Ebony	
BL (and related layers)	
SS (and related layers and hearths)	56.2 ± 1.9
Ivory	
Ma	
Hearth in Midnight	
White Ash	
Howiesons Poort	
GR (and related layers)	
GS (and related layers)	
PGS (and related layers)	
Still Bay	
RGS (and related hearths and layers)	
Pre-Still Bay	
LBG and related layers	

Umhlatuzana Rock Shelter

Location and description

Umhlatuzana Rock Shelter is located about 35 km west of Durban, KwaZulu-Natal (Fig. 3.1), on the farm called Kerkmans 915 (Kaplan 1990). The site is named after the Umhlatuzana River that runs through a steep gorge some 100 m below the site (*ibid*: 3). According to Maud (pers. comm. cited in Kaplan 1990), the site is located geologically in the ortho-quartzite horizon of the Natal Super group and was formed by long-term erosion of softer basal sandstones and shales of the Natal group below the hard and resistant ortho-quartzite horizon. The rock shelter is 43 m long, reaches a depth of 6.5 m and has a maximum roof height of 17 m. It is surrounded by coastal forest and thornveld.

Excavations

Umhlatuzana Rock Shelter was discovered in 1982 by Dr R.R. Maud during a survey of the proposed N3 toll road and was excavated between May and July, 1985 (Kaplan 1990). The main objectives of excavating this site were: to rescue any cultural material which could have been endangered by the building of the new road between Durban and Pietermaritzburg and to investigate hunter-gatherer/farmer relationships in the area (*ibid*: 1).

Six one-metre squares were excavated, namely J2, K2, J3, K3, J4 and K4. The first four squares were excavated to the depth of over 2.5 m while squares J4 and K4 were excavated to a depth of 1.5 m below the surface (Kaplan 1990). All in all, 28 layers were excavated at Umhlatuzana (*ibid*: 7) and these will be looked at in detail in the next section.

Cultural sequence

The cultural sequence at Umhlatuzana is long and encompasses the MSA and LSA. Layers 28-22 belong to the pre-Howiesons Poort and Howiesons Poort (with a radiocarbon minimum age of 45 000 BP); layers 21-19 to the late MSA (has a radiocarbon date of 40 000-35 000 BP); layers 18-14 to the MSA/LSA transition phase (dated between 35 300 and 27 800 BP) (Table 3.2); layers 13-4 to Robberg and layers 3-1 to the Holocene (Kaplan 1990). It should be noted that the radiocarbon ages provided here are likely to be minimum ages except for the final (MSA/LSA

transition) MSA layers ones. The MSA sequence will be described shortly while the LSA one will not be described because it is not the subject of the present study.

The pre-Howiesons Poort and Howiesons Poort (layers 28-22)

These assemblages are dominated by chips, flakes and chunks which make up 99% of the whole assemblage. Blades, bladelets, cores, grindstones, and utilised pieces also form part of these assemblages (Kaplan 1990). Formal tools comprise unifacial and bifacial/denticulate points, scrapers, and backed pieces which include segments, trapezoids and backed blades/bladelets (*ibid*: 12). The bifacial points may be from an industry like the Still Bay, especially because there is one double-pointed point and these types of points are only found in the Still Bay. The Howiesons Poort does not usually have points, so admixture between Still Bay and Howiesons Poort is possible because there was no clear stratigraphy at the site and the deposit was slumped. Some of the points and segments from this phase of the MSA are the subject of the present study. For purposes of this study points will be treated as pre-Howiesons Poort material and segments as Howiesons Poort material and this is based on the fact that points are not found in the Howiesons Poort Industry and segments do not usually appear in the pre-Howiesons Poort in southern Africa. Marlize Lombard has done residue and use-wear analyses of points and segments from these assemblages (Lombard 2005b, 2007b). As noted in Chapter Two, a good proportion of these points have diagnostic impact fractures indicative of their use as hunting tools. In addition, animal residues on the segments' blade or cutting portions as well as use-wear suggest the segments were predominantly used as inserts of composite hunting weapons (Lombard 2007b). In this study, I will be examining these points and segments technologically to check whether there are any indications of what part of hunting weapons they were.

The late MSA (layers 21-19)

As was the case with layers 28-22, late MSA assemblages comprise mostly chips, chunks and flakes. The remaining lithics are similar to those found in pre-Howiesons Poort and Howiesons Poort layers, except that one adze was found in these assemblages (Kaplan 1990). Points from this phase also form part of the present study.

The MSA/LSA transition (layers 18-14)

This phase has both LSA and MSA artefacts and these include scrapers, bladelet cores and bladelets and MSA points including hollow-based points as well as large and small segments (*ibid*: 33). It should be noted, however, that there is a possibility of mixing of deposits due to rotational slipping in this phase. Flakes, chips and chunks form a big part of this assemblage while formal tools only make 0.4% of the total assemblage (Kaplan 1990).

Table 3.2
The chronology of MSA layers at Umhlatuzana Rock Shelter (From Kaplan 1990).

Layer	Excavated Units	Radiocarbon date (BP)
MSA/LSA transition		
14	RBS X; PBS II	
15	RBS XI; PBS III	27 800 ± 780 (Pta – 4 389)
16	RBS XII; PBS IV	
17	RBS XIII; PBS V	30 100 ± 1 800 (Pta – 4 228)
18	RBS XIV; PBS VI	35 100 ± 830 (Pta – 4 331)
Late MSA		
19	RBS XV; PBS VII	
20	RBS XVI; PBSVIII	34 400 ± 1 000 (Pta – 4 288) 35 000 ± 1000 (Pta – 4 235) 37 100 ± 1 100 (Pta – 4 366) 38 200 ± 1 100 (Pta – 4 665) 40 600 ± 1 500 (Pta – 4 333)
21		37 100 ± 860 (Pta – 4 666)
	RBS XVII; PBS IX	
Pre-Howiesons Poort/Howiesons Poort		
22	RBS XVIII; PBS X	
23	RBS XIX; PBS XI	45 200 ± 3 200 (Pta 4 234)
24	RBS XX; PBS XII	
25	RBS XXI; PBS XIII	
26	RBS XXII; PBS XIV	
27	RBS XXIII; PBS XV	
28	RBS XXIV	

Jubilee Shelter

Location and description

Jubilee Shelter is a bushveld site at the base of a kloof in the northern slope of the Magaliesberg, North West Province (Wadley 1987) (Fig. 3.1).

Excavations

Jubilee Shelter has been extensively excavated and rich deposits of MSA and LSA occupations have been found (Wadley 1987). The following section will describe the LSA assemblages only. The MSA ones will not be described because they are not of concern in this study.

The LSA at Jubilee consists of the following industries/phases: The Early Later Stone Age (ELSA), Oakhurst, Wilton, Post-Wilton (without pottery), Post-Wilton (with Bambata pottery) and Post-Wilton (with undiagnostic pottery). The ELSA is undated and has tools that are unstandardized in form, shape and extent of retouch with the exception of a few pieces (Wadley 1987). The dominant tool type in this phase is miscellaneous retouch (these include minimally retouched tools, irregular pieces and broken retouch). Other tools found in the ELSA are some chunky borers with thick, blunted points; blades and some irregularly backed and broken, backed bladelets (blades and bladelets appear in low quantities) (*ibid*: 48-49). Scrapers are also found in low quantities while cores are found in high quantities, suggesting that there was extensive stone knapping during this phase.

The Oakhurst in Jubilee Shelter is dated 8 500 B.P. and is found in layer R. This industry is characterized by low proportions of retouched tools. Tools found in this industry include: 'boot-shaped' flakes, side-struck scrapers, large D-shaped scrapers, concavo-convex scrapers and some naturally backed tools which have been included in miscellaneous retouch because Deacon's typology does not recognize the naturally backed tool category (Wadley 1987: 50).

The Oakhurst has high densities of miscellaneous retouch, but not as many as those in the ELSA. Backed pieces are rare in this industry and segments are absent (Wadley 1987). Cores, core

reduced pieces and flakes appear frequently but blades and retouched tools have low proportions (*ibid*: 50).

The Wilton dates to between 6490-3100 B.P. and has segments, some of which are exceptionally small but are still within the range of variation of Wilton segments illustrated at the type site by Deacon (Wadley 1987). Segments used in this study come from this industry. Segments from the early phase of this industry (between 6490-5250 B.P.) are the longest of the Wilton segments. Backed bladelets also occur in the Wilton together with scrapers, borers and miscellaneous retouch (*ibid*: 51). The scraper category includes what Wadley (1987: 51) calls 'duckbill' endscrapers which are frequently made on hornfels and sometimes have stepflaking on one or both laterals. These scrapers have the appearance of combined adzing and scraping tools and occur in different sizes: small, medium and large (*ibid*: 51). Small scrapers found here are mostly made on fine-grained raw materials and are the most frequent tool type.

The Post-Wilton (without pottery) is undated and contains few segments, backed bladelets or end-of-blade scrapers. Scraper frequencies are very high; many tiny scrapers are 'thumbnail'-like and they are more standardized than scrapers from previous levels (Wadley 1987). Proportions of scrapers dominate relative to backed tools because microlithic scrapers have high proportions. This phase has low densities of flakes but has the highest retouch frequency in the whole site (*ibid*: 52).

The Post-Wilton (with Bambata pottery) is dated 1840-1550 B.P. and is distinguished from the previous phase because it is associated with Bambata pottery. Scraper frequencies remain high and backed tools are still rare (Wadley 1987). Cores are rare while retouched tools appear in high proportions.

The Post-Wilton (with undiagnostic pottery) is dated 1350 B.P. and has a few formal tools of which scrapers are dominant (Wadley 1987). There are a few flakes and cores as well as large pieces of grindstones and soap stone bowls. Also found in this phase is pottery associated with Late Iron Age. According to Wadley (1987: 53), it is not clear whether there is a true association between this pottery and the stone artefacts found in this phase.

The next chapter will describe the methods used in the analyses of points and segments which form part of this study.

CHAPTER FOUR

METHODOLOGY

This Chapter describes the methodology used in the analyses of points and segments from two Middle Stone Age (MSA) sites, that is, Sibudu Cave and Umhlatuzana (both in KwaZulu Natal, South Africa) and Later Stone Age (LSA) segments from Jubilee Shelter in the Magaliesberg (South Africa).

For the purposes of this study, a point is a lithic artifact with a pointed tip. In most instances the point has been deliberately shaped by retouch on one or both laterals. Thus, all the points examined here are retouched tools; unretouched levallois flakes or unretouched triangular flakes (such as those used by Wurz at Klasies River 1997, 2000) have been excluded.

Segments (sometimes called crescents or lunates elsewhere) are defined by Deacon (1984) as a portion of a circle with a curved back shaped by abrupt retouch and a straight, sharp cord. Each end of a segment is pointed. Trapezes are related forms of segments (Wurz 1997), yet trapezes are not included in this study.

Sample size

The sample size includes 278 points (whole and broken) from different layers in Sibudu (see Table 4.1) and 175 points (whole and broken) from different Umhlatuzana layers (Table 4.2). Pre-Howiesons/Howiesons Poort layers from Umhlatuzana are layers 22-28; late MSA layers 19-21 and MSA/LSA layers 16-18. There are 65 segments (broken and whole) from Sibudu (60 from Howiesons Poort layers; three from post-Howiesons Poort; one from late MSA and one from Still Bay layers). Segments from Umhlatuzana are 93 (broken and whole) and they are all from Howiesons Poort layers. Lastly, there are 41 whole LSA segments from various layers from Jubilee Shelter (Table 4.3).

Table 4.1

The sample size of points (whole and broken) from Sibudu.

Phase	n	%
final MSA	26	9.4
late MSA	166	59.7
post-Howiesons Poort	56	20.1
Still Bay	30	10.8
Total	278	100.0

Table 4.2

The sample size of points (whole and broken) from Umhlatuzana.

Phase	n	%
MSA/LSA transition	64	36.6
late MSA	21	12.0
Pre-Howiesons Poort	90	51.4
Total	175	100.0

Table 4.3

Sample size of Sibudu, Umhlatuzana and Jubilee segments.

Site	n
Sibudu	65
Umhlatuzana	93
Jubilee	41

Technological analysis

Points

The Sibudu and Umhlatuzana points were analysed for a number of variables that include type of raw material, type of blank from which they were produced, location of retouch, type of retouch and base types. Whole points or points with tiny fragments broken from them were weighed. In the Chapters Five and Six it will be seen that point totals vary according to the attributes being studied. This is because recording of measurements such as length depends on an unbroken specimen, but base type attributes can be documented from proximal ends of broken points, and some other measurements can also be made on broken points.

In addition, the points were measured using digital calipers for length, maximum breadth, breadth at 10 mm and at 5 mm from the tip as well as maximum thickness, and thickness at 10 mm from the tip (lengths and breadths were measured only on tools with unbroken lengths and breadths, respectively). Points' platform/base breadth and base thickness were also measured (regardless of whether or not these were reduced through retouch) to see whether any patterns can be observed throughout the sequence that might imply change in hafting methods. These measurements were then used in calculations of means, standard deviations and coefficients of variation (CV) of different variables of the points. Length/breadth ratios, tip penetrating angles and tip cross-sectional area (TCSA) were also calculated.

Length/breadth ratios

Length/breadth ratios can only be calculated from measurements taken from tools that have unbroken lengths and breadths. Length/breadth ratios were calculated using the formula: length divided by breadth = L/B ratio. Length/breadth ratios provide an indicator of the shape of an artifact. The larger the ratio, the more elongated the piece, the smaller the ratio, the shorter the piece relative to its breadth (the cut-off point is 2.0).

Tip penetrating angles

It is possible to measure penetrating angles not only on whole points, but also on distal fragments and on tips that have broken from points. The point tips are measured at 10 mm from the tip for the calculation of penetrating angles, so any tip longer than 10 mm can be used. The formula used is the solution of right angles in which $B = 90^\circ - A$ (see Fig. 4.1 for the illustration). The detailed trigonometric formula for the solution of angle B is to be found in Dibble & Bernard (1980). This formula was also used by Carter *et al.* (1988) to calculate edge angles of bladelets from Sehonghong, a rock shelter in Lesotho.

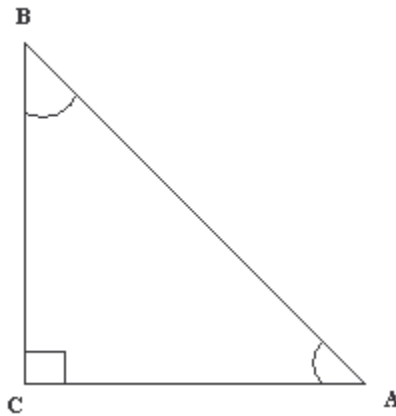


Fig. 4.1 Right-angle triangle illustrating the calculation of the tip angle.

Note: The triangle represents half of a point tip and B is half of the tip angle. Therefore, after calculating the value of B by subtracting A from C (which equals 90°), B is multiplied by two to get the full tip angle.

Tip cross-sectional area (TCSA)

In addition, tip cross-sectional area (TCSA) of the points was calculated using the formula: $\frac{1}{2}$ maximum breadth x maximum thickness (Shea 2006). The TCSA can also be calculated on broken points provided they still retain their maximum breadth and thickness.

Coefficients of variation

These were calculated using the following formula: Standard Deviation (SD) divided by mean, multiplied by 100 = CV. Coefficient of variation provides a more reliable indicator of the degree

of standardization of an attribute than the SD. The cut-off point in this study is 10.0, the smaller the CV, the more standardized a trait is; the bigger the CV, the less standardized it is.

T-tests

T-tests for continuous variables were run on Excel using the two-tailed distribution (where the test assumes that the variances of the two populations are equal). The sample must comprise at least three measurements for this test. A significant difference between samples is considered proven when p (the probability of a significant difference occurring) is less or equal to 0.05.

Point types

Point types are illustrated in Fig. 4.2 and the types include: 1. unifacial (retouched on one face only, usually the dorsal face), 2. unifacial distal fragment (a broken unifacial point that retains most of the distal portion), 3. unifacial tip (a broken unifacial tip), 4. bifacial (retouched on both dorsal and ventral faces), 5. bifacial distal (broken bifacial that retains most of the distal portion), 6. bifacial tip (a broken bifacial tip), 7. partly bifacial (retouched on the dorsal and partly on the ventral), 8. partly bifacial distal (broken partly bifacial that retains most of the distal portion), 9. partly bifacial tip (a broken partly bifacial tip) and 10. trilateral (a three sided point with retouch on all the faces).

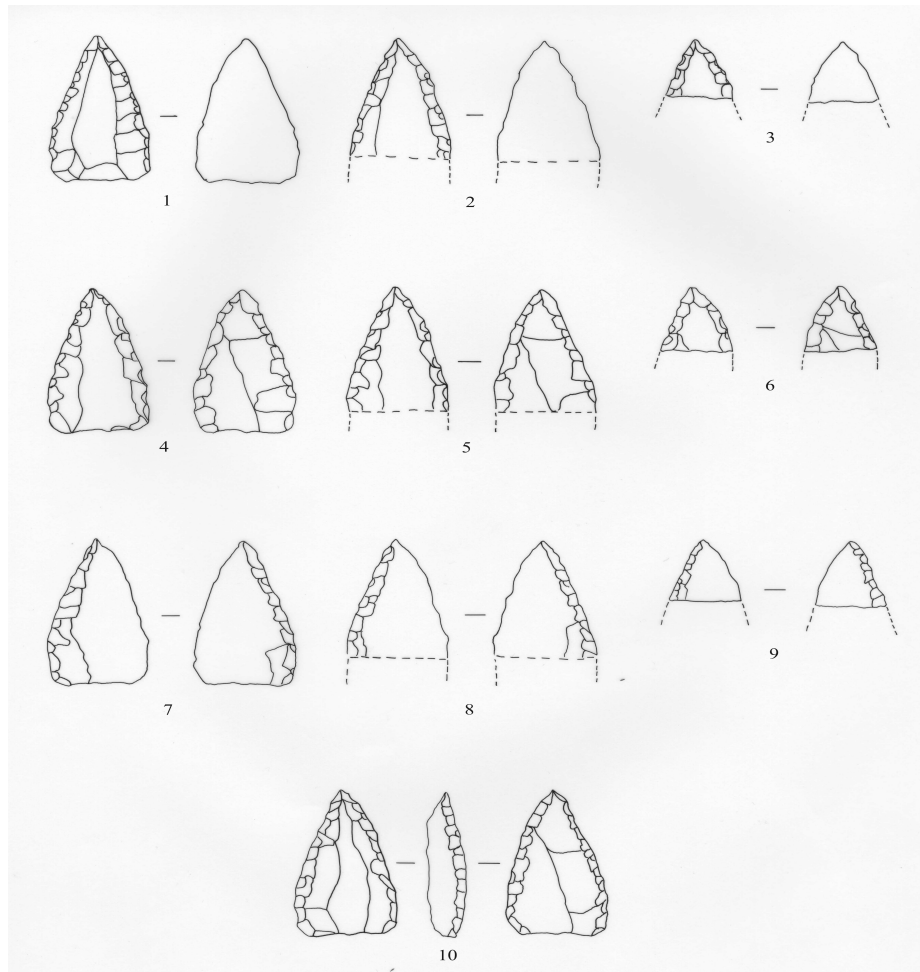


Fig. 4.2 Point types: 1. a unifacial point, 2. a unifacial distal fragment, 3. a unifacial point tip, 4. a bifacial point, 5. bifacial point distal fragment, 6. a bifacial point tip, 7. a partly bifacial point, 8. a partly bifacial point distal fragment, 9. a partly bifacial point tip and 10. a trilateral point.

Retouch locations

Retouch locations are illustrated in Fig. 4.3. and some of the locations are: 1. Total retouch (retouch is all over the point either on the dorsal or both the dorsal and ventral faces), 2. right (retouch is on the right lateral edge, either on the dorsal or ventral), 3. right partial (retouch partial on the right lateral), 4. left (on the left lateral edge), 5. left partial (retouch partial on the right lateral), 6. distal (retouch is restricted to the distal end of the point), 7. proximal (retouch is restricted to the proximal end of the point). There are instances where retouch is found on different locations in a point and these are also illustrated in Fig. 4.3. Unless stated otherwise, retouch is always on the dorsal face of the point.

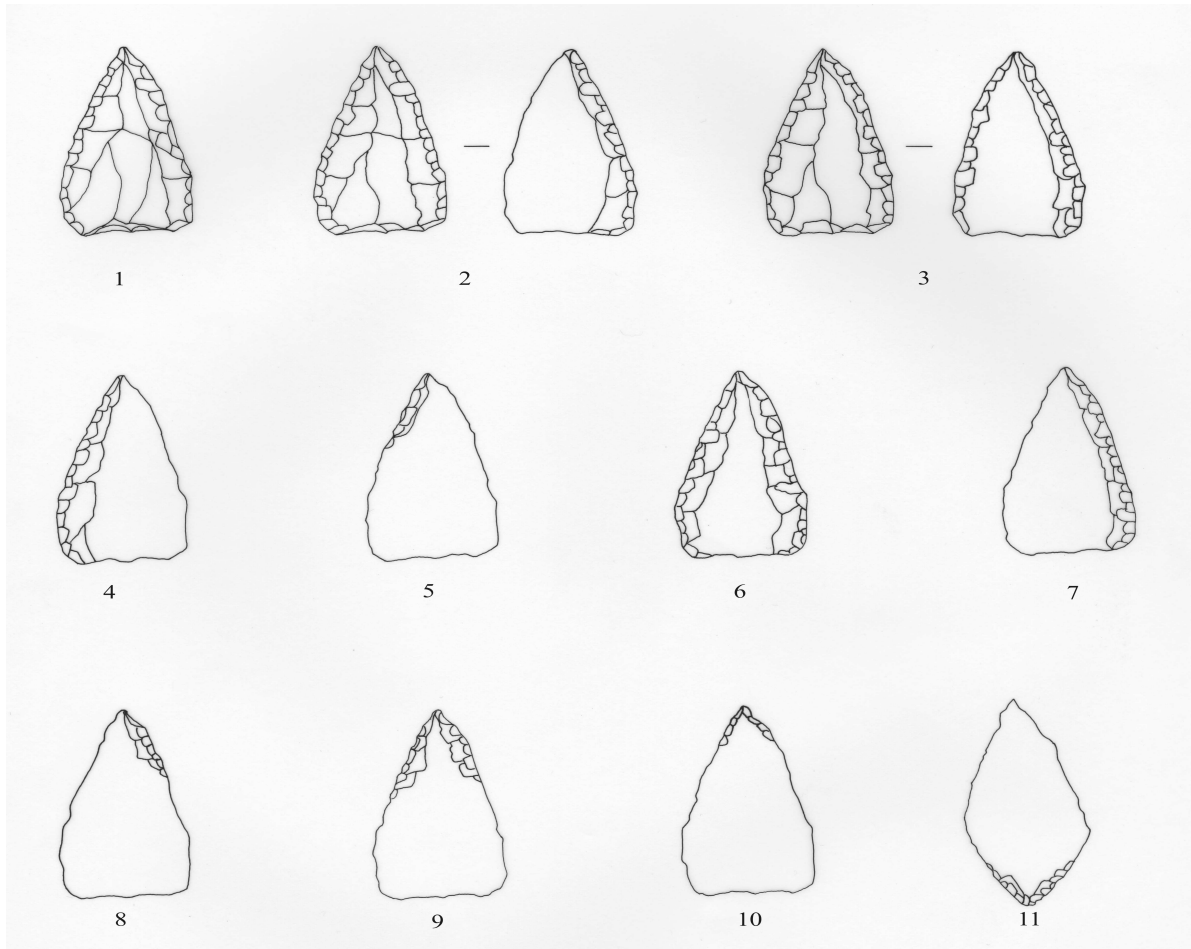


Fig. 4.3 Retouch locations: 1 total retouch on a point, 2 total retouch (dorsal) and retouch on the right lateral (ventral), 3, total retouch (dorsal) and left-right retouch (ventral), 4, retouch on the left lateral, 5, left partial retouch, 6, retouch on the left and right laterals, 7, retouch on the right lateral, 8, right partial retouch, 9, left partial and right partial, 10, distal retouch and 11, proximal retouch.

Retouch types

Retouch types are illustrated in Fig. 4.4. The types are: 1. invasive (starts on the lateral edges and extends into the middle of the point), 2. marginal (moderate and does not extend to the middle of point like invasive), 3. short (is slightly shorter than marginal) and 4. abrupt (restricted to the edge of the point, whether the lateral edges or any other edge, very abrupt). There are instances where these types are found in one point as is illustrated in Fig. 4.4.

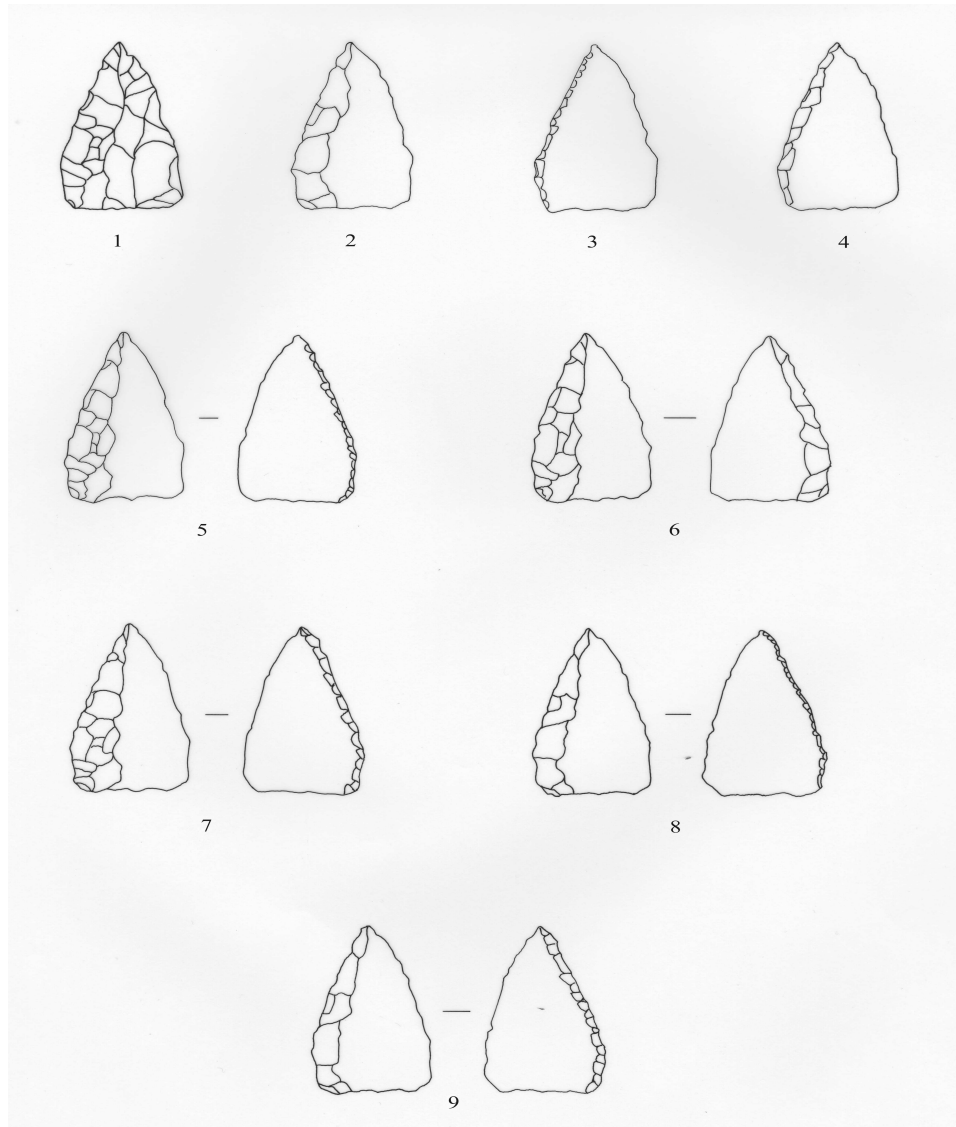


Fig. 4.4 Retouch types: 1. invasive retouch on a point, 2. marginal retouch, 3. abrupt retouch, 4. short retouch, 5. invasive (dorsal) and abrupt (ventral), 6. invasive (dorsal) and marginal, 7. invasive and short, 8. marginal and abrupt and 9. marginal and short.

Base types

Base types are based on Paola Villa's categories (personal communication) and they are illustrated in Fig. 4.5 and are: 1. pointed (striking platform removed and base pointed), 2. broad and curved (platform removed by retouch and base broad, round/ curved), 3. straight (striking platform removed by retouch and base straight), 4. reduced (striking platform removed by retouch and base thin but not necessarily round), 5. platform plain, 6-7. platform faceted (striking platform has two or more facets resulting from platform preparation), 8. hollow (striking

platform removed by retouch resulting in a hollow base (these were treated as reduced platforms in the analysis) and 9. platform punctiform (striking platform tiny and hardly noticeable).

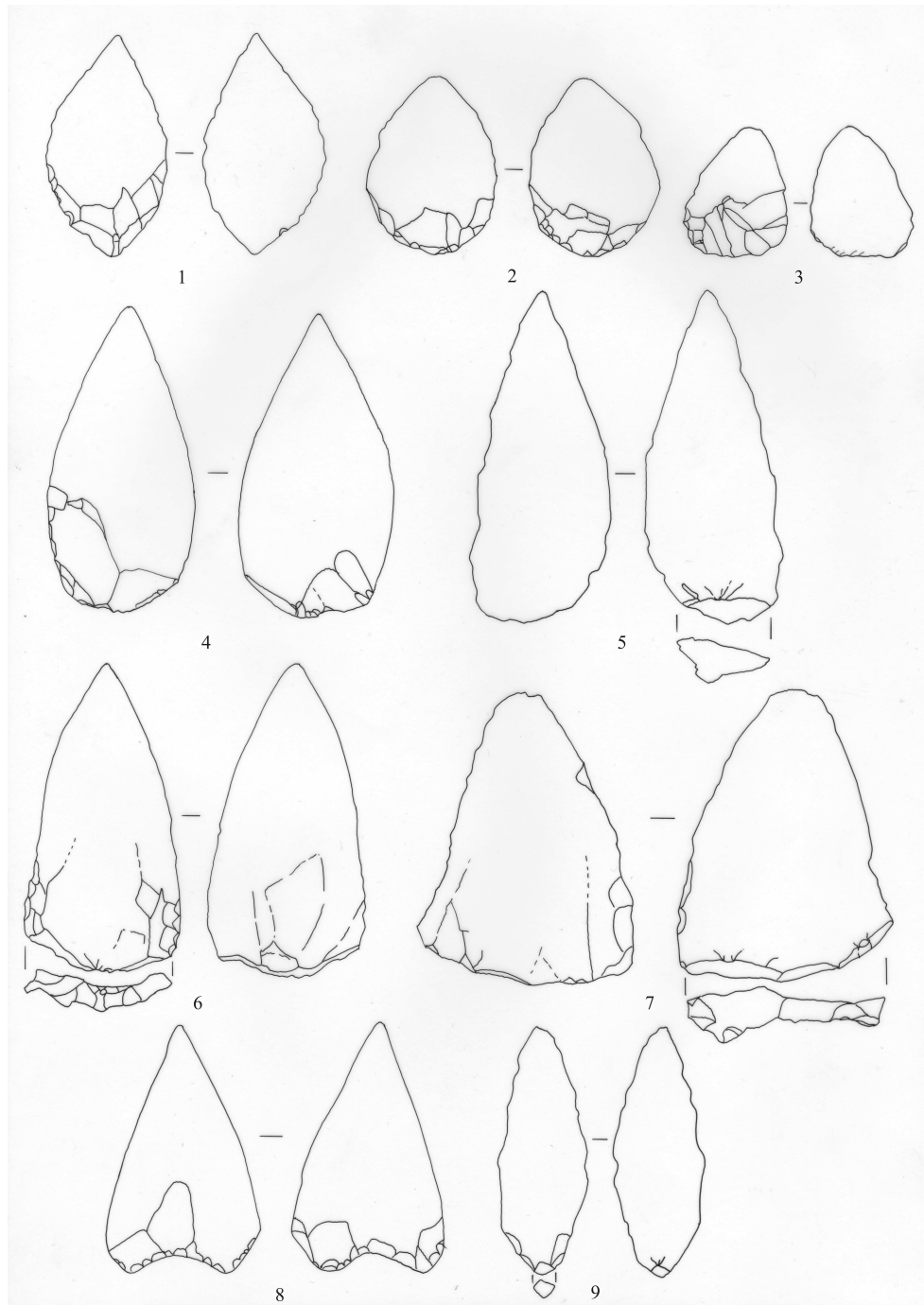


Fig. 4.5 Point base types: 1. a pointed base, 2. a broad and curved base, 3. a straight base, 4. a reduced base, 5. a plain platform, 6-7. faceted platforms, 8. a hollow base and 9. a punctiform platform (striking platform tiny and hardly noticeable).

Segments

Segments were measured for maximum length, breadth and thickness and they were also weighed. Length/breadth ratios and tip cross-sectional area were calculated. Tip penetrating angles for both tips were measured and rock types were recorded.

Tip penetrating angles

A trigonometric formula cannot be used with segments to calculate their tip angles because their tips are not triangular and so a mathematical protractor was used. Both tips of segments were measured and treated as two separate samples on the assumption that they could represent reversible arrow or spear tips. Tip penetrating angles of single segments were multiplied by two to get angles of double-segments because it is possible that two segments were hafted together to form the tip of a spearhead (see Clark 1977).

Tip cross-sectional area (TCSA)

Tip cross-sectional area (TCSA) was calculated in the same way as that for points. However, a second set of TCSA calculations was performed using the segment lengths in place of breadths. This was done to see what the TCSAs of the segments would be if they were hafted transversely instead of longitudinally.

Length/breadth ratios, CVs and t-tests were calculated as for points.

I move now, in Chapter Five, to the metric analysis of points from Sibudu and Umhlatuzana. Chapter Six contains the analyses of segments from Sibudu, Umhlatuzana and Jubilee.

CHAPTER FIVE

ANALYSIS OF POINTS FROM SIBUDU AND UMHLATUZANA

This chapter presents results of technological analyses of Middle Stone Age (MSA) lithic points, distal and proximal point tips from Sibudu Cave and Umhlatuzana Rock Shelter. Metric (in mm) measurements taken on the points, namely breadth, thickness, length, base thickness and base breadth are reported, together with tip cross-sectional area (TCSA) and penetrating (tip) angle calculations. Other morphological variables, such as rock types, retouch types and their locations and point base types will be dealt with. Also included in this chapter are coefficient of variation calculations and t-tests for different measurements taken on the points. The chapter is divided into two sections that give results from each site. Ultimately, the analyses will promote characterisations of the point assemblages of both sites through time.

Sibudu points

Two hundred and seventy eight points (whole and broken) from Sibudu were analysed in this study (see Figs 5.1-5.3 for drawings of these points). Thirty of these (10.8%) points are from the Still Bay; 56 (20.1%) from the post-Howiesons Poort; 166 (59.7%) from the late MSA and 26 (9.4%) from the final MSA (Table 5.1). One hundred and ninety two (69.1%) of these points are made from hornfels; 71 (25.5%) from dolerite; ten (3.6%) from quartzite; three (1.1%) from quartz while one (0.4%) is made from chert and cryptocrystalline silica (CCS) (Figure 5.7). Still Bay points are from two squares only (B5 and B6), whereas the other points are from about 18 square metres, except for the final MSA points which are from 6 squares only. In each description of the analysis, I shall start with the oldest phase in the sequence and end with the youngest.

Table 5.1

Point and point fragment frequencies and percentages from all MSA phases at Sibudu.

Points	final MSA		late MSA		post-Howiesons Poort		Still Bay	
	n	%	n	%	n	%	n	%
Whole	15	57.7	85	51.2	42	75.0	6	20.0
Almost complete (tip broken)	3	11.5	17	10.2	4	7.1	0	0
Medial-distal fragment	0	0	4	2.4	1	1.8	0	0
Distal fragment	1	3.8	26	15.7	5	8.9	0	0
Distal tip	7	26.9	34	20.5	4	7.1	16	53.3
Proximal tip	0	0	0	0	0	0	8	26.7
n	26	99.9	166	100	56	99.9	30	100

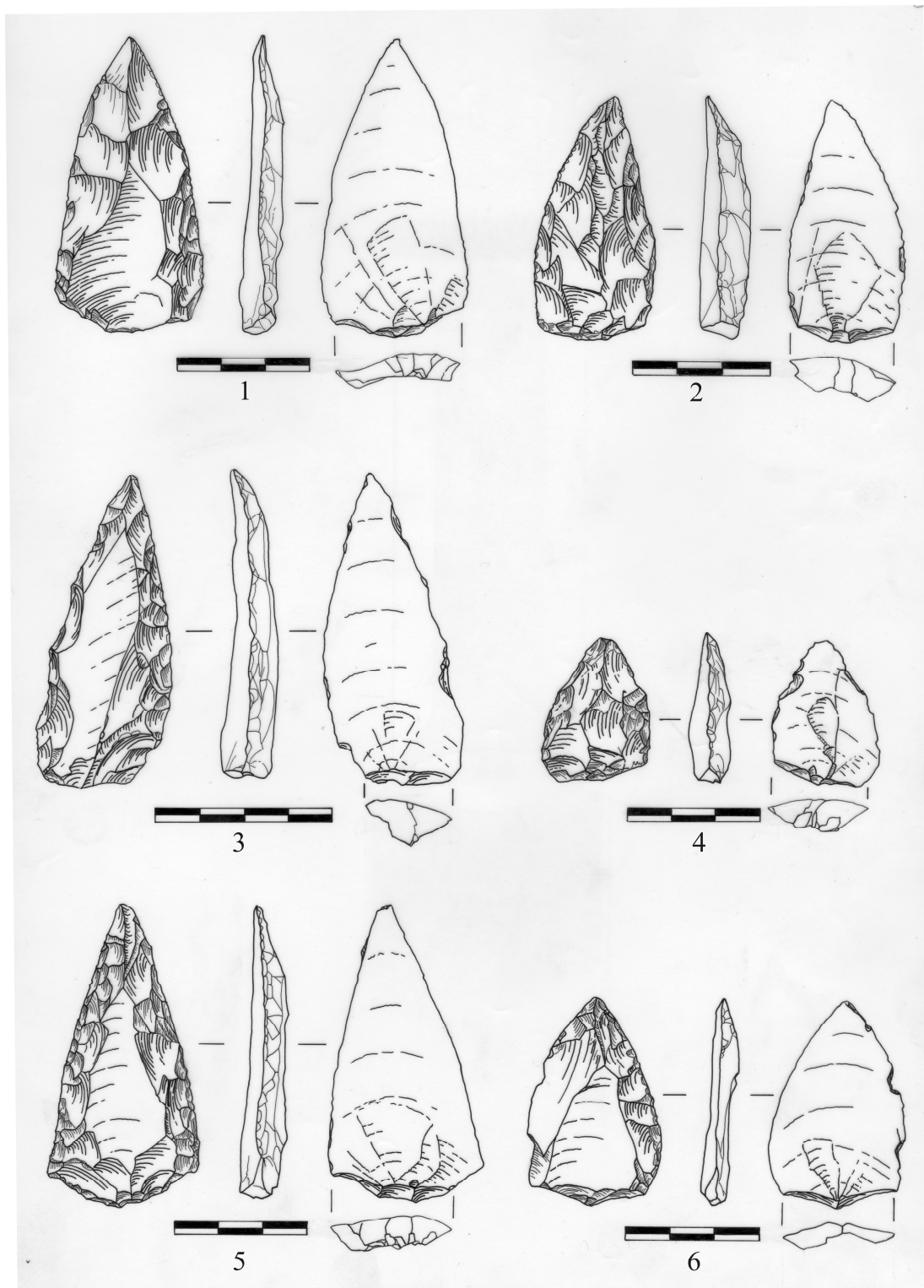


Fig. 5.1 Sibudu points illustrating variability in size throughout the MSA: 1-5 are hornfels unifacial points from layers BL2A (post-Howiesons Poort), OMOD (late MSA), BL in SS (post-Howiesons Poort), Hearth in OMOD (late MSA) and RSp (late MSA) , respectively, 6 is a dolerite unifacial point from Hearth above OMOD (late MSA). Note the variability in sizes of the points.

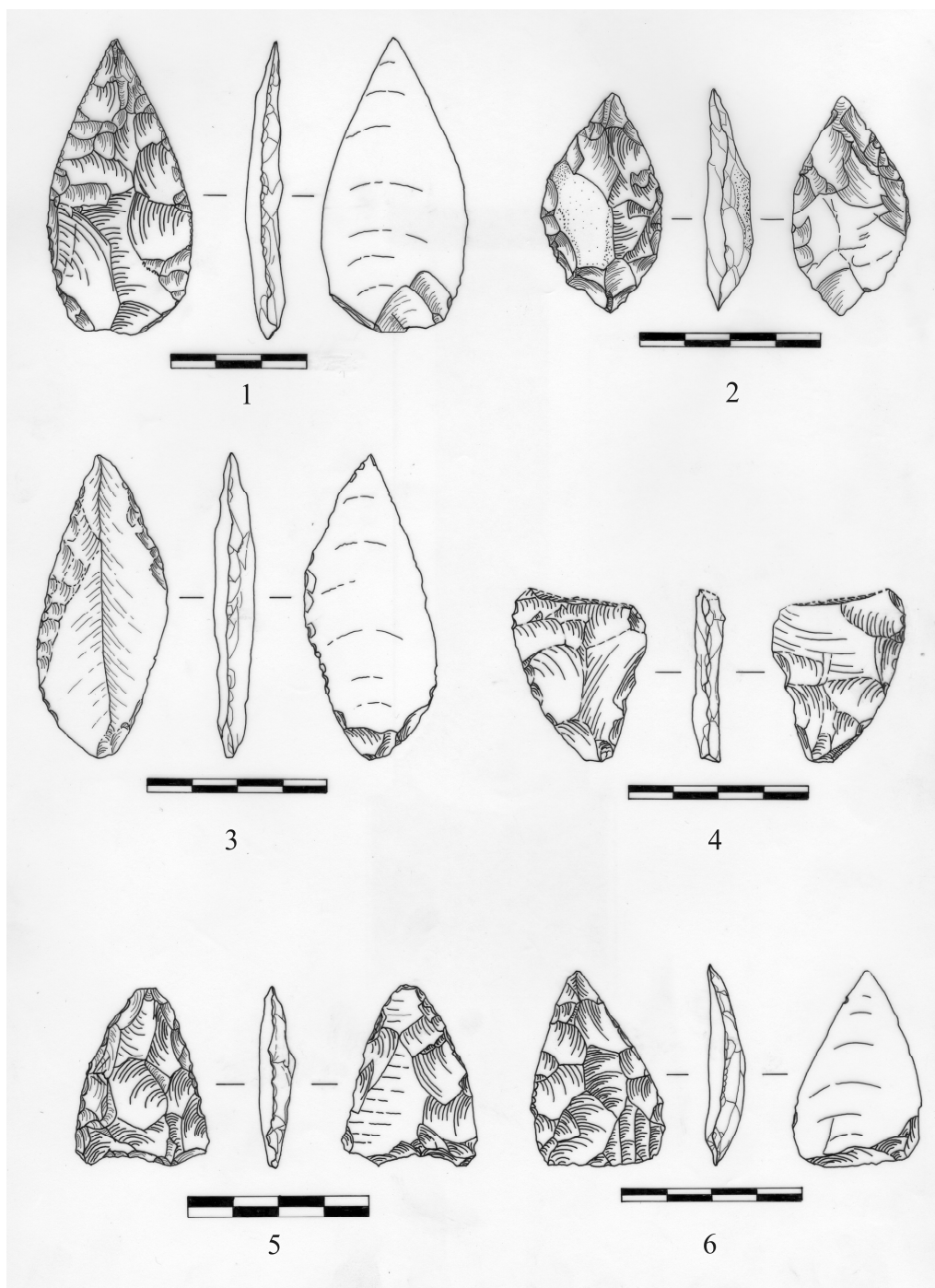


Fig. 5.2 Sibudu points illustrating variability in base types throughout the MSA sequence: 1 is a hornfels unifacial point with a reduced platform and is from lower OMOD (late MSA), 2 is a hornfels double-pointed bifacial point from RGS (Still Bay), 3 is a dolerite partly bifacial point from layer RGS (double-pointed points are only found in the Still Bay), 4 is a quartzite bifacial point proximal tip from RGS (proximal bifacial fragments are only found in the Still Bay layers), 5 is a bifacial hollow-based point (hollow-based points only occur in the final MSA layers at Sibudu) and 6 a unifacial point in hornfels (final MSA). Note the variability in base types throughout the MSA sequence.

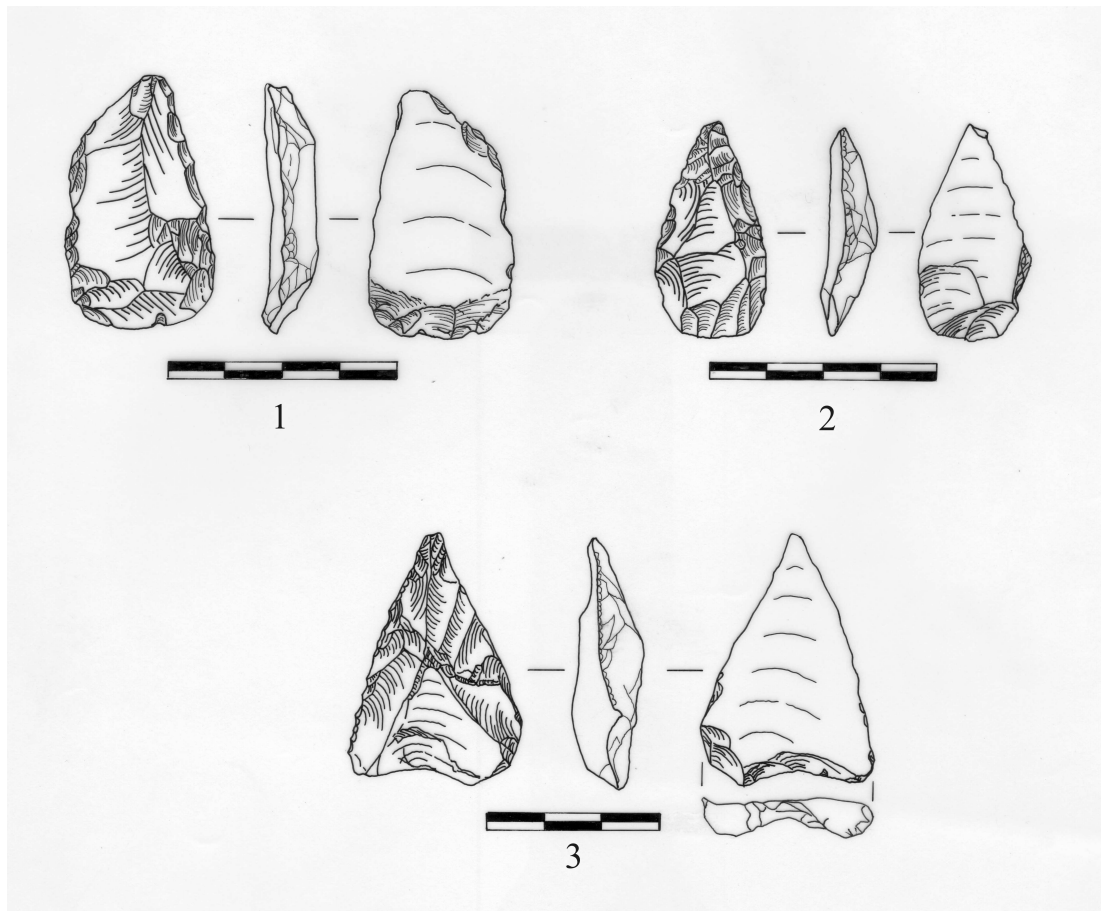


Fig. 5.3 Unifacial points from Sibudu: 1-2 are unifacial points from layers RSp and YSp (both late MSA), respectively and 3 is a unifacial hollow-based point from layer MC (final MSA) (all points are in hornfels).

Breadth, thickness and length of the points

The range of breadths of the Still Bay points is 7 – 30 mm and the mean breadth is 20.7 ± 6.8 mm. The range of thicknesses of these points is 3 – 13 mm and their mean thickness is 6.9 ± 3 mm. The lengths of Still Bay points range from 25 to 66 mm and the mean length of these points is 43.9 ± 16 mm (Tables 5.2, 5.3 & 5.4). The small size of sample ($n = 7$) and the wide range of lengths of Still Bay points makes the mean length rather meaningless. Fig. 5.2:2, for example, illustrates a Still Bay point that has been considerably re-sharpened and recycled, presumably after the tip broke.

The post-Howiesons Poort points have breadths that range from 14 - 49 mm and the mean breadth of these points is 29.2 ± 8 mm. They have thicknesses that range between 5 – 23 mm and

their mean thickness is 10.2 ± 3.3 mm. They vary in length from 32 - 114 mm and have a mean length of 50.7 ± 14.7 mm (Tables 5.2, 5.3 & 5.4).

Late MSA points range in breadth from 7 - 52 mm and they have a mean breadth of 26.9 ± 7.1 mm. They range in thickness from 2 - 17 mm and have a mean thickness of 8.4 ± 2.9 mm. Their lengths range from 20 - 98 mm and they have a mean length of 42.7 ± 14.7 mm (Tables 5.2, 5.3 & 5.4).

Final MSA point breadths range from 16 - 41 mm and they have a mean breadth of 27.9 ± 9 mm. The points' thicknesses range from 2 - 13 mm with a mean of 7.6 ± 3 mm. The range of lengths is 21 - 55 mm and the mean is 38.4 ± 9.8 mm (Tables 5.2, 5.3 & 5.4).

Table 5.2

Breadth (in mm) of points (including some distal/proximal fragments, but excluding tips) from different MSA phases at Sibudu.

	final MSA	late MSA	post-Howiesons Poort	Still Bay
Mean	27.9	26.9	29.2	20.7
SD	9.0	7.1	8.0	6.8
Min	16.0	7.0	14.0	7.0
Max	41.0	52.0	49.0	30.0
n	13	101	46	15

Table 5.3

Thickness (in mm) of points (including some distal/proximal fragments, but excluding tips)
from different MSA phases at Sibudu.

	final MSA	late MSA	post-Howiesons Poort	Still Bay
Mean	7.6	8.4	10.2	6.9
SD	3.0	2.9	3.3	3.0
Min	2.0	2.0	5.0	3.0
Max	13.0	17.0	23.0	13.0
n	14	102	47	16

Table 5.4

Length (in mm) of whole and side-broken points from different MSA phases at Sibudu.

	final MSA	late MSA	post-Howiesons Poort	Still Bay
Mean	38.4	42.7	50.7	43.9
SD	9.8	12.9	14.7	16.0
Min	21.0	20.0	32.0	25.0
Max	55.0	98.0	114.0	66.0
n	13	92	41	7

Base measurements of points

The Still Bay points have base thicknesses that range between 1.0 – 10.0 mm with a mean of 2.9 ± 2.7 mm and base breadths that range from 2.0 – 23.0 mm, with a mean of 7.1 ± 6.4 mm (Tables 5.5 & 5.6).

The range of base thicknesses of post-Howiesons Poort points is 1.0 – 14.0 mm, with a mean of 6.7 ± 3.3 mm. The range of base breadths is 3 – 37 mm, with a mean of 22.1 ± 8.9 mm (Tables 5.5 & 5.6).

The late MSA points have bases with thicknesses of 7.3 ± 3.8 mm and breadths of 22.3 ± 9.4 mm (Tables 5.5 & 5.6).

Final MSA points have a mean base thickness of 5.0 ± 1.9 mm and a mean base breadth of 19.2 ± 4.4 mm (Tables 5.5 & 5.6).

Table 5.5

Base thickness (in mm) of points (whole, almost complete plus proximal fragments/tips) from different MSA phases at Sibudu.

	final MSA	late MSA	post-Howiesons Poort	Still Bay
Mean	5.0	7.3	6.7	2.9
SD	1.9	3.8	3.3	2.7
Min	3.0	1.0	1.0	1.0
Max	8.0	25.0	14.0	10.0
n	6	78	33	12

Table 5.6

Base breadth (in mm) of points (whole plus proximal ends) from different MSA phases at Sibudu.

	final MSA	late MSA	post-Howiesons Poort	Still Bay
Mean	19.2	22.3	22.1	7.1
SD	4.4	9.4	8.9	6.4
Min	13.0	2.0	3.0	2.0
Max	26.0	52.0	37.0	23.0
n	6	115	19	12

Mass of points

Still Bay points have a mean mass of 10.5 ± 8.3 g (Table 5.7). Masses of pre-Howiesons Poort points range from 3 - 81.1 g with a mean mass of 18.1 ± 15.8 g (Table 5.7). The late MSA points

have masses that range from 0.3-70.0 g and they have a mean mass of 11.0 ± 9.5 g (Table 5.7). Final MSA points' masses vary from 1.0-15.0 g and they have a mean mass of 7.9 ± 4.6 g (Table 5.7).

Table 5.7

Mass (in g) of points (whole plus almost complete) from different MSA phases at Sibudu.

	final MSA	late MSA	post-Howiesons Poort	Still Bay
Mean	7.9	11.0	18.1	10.5
SD	4.6	9.5	15.8	8.2
Min	1.0	0.3	3.0	1.2
Max	15.0	70.0	81.1	25.3
n	13	91	41	7

Length/breadth ratios of points

Still Bay points are elongated and were made either from blades (or pieces that were deliberately shaped to blade-like proportions) because they have a length/breadth ratio of 2.0 (Table 5.8). Note that the total number of length/breadth ratios is six instead of seven because one of the points is broken on the side.

All the other points have length/breadth ratios less than 2.0 and therefore have flake rather than blade proportions (Table 5.8).

Table 5.8

Length/breadth ratios of whole points from different MSA phases at Sibudu.

	final MSA	late MSA	post-Howiesons Poort	Still Bay
Mean	1.5	1.6	1.7	2.0
SD	0.7	0.5	0.4	0.3
Min	0.8	1.0	1.1	1.6
Max	3.4	3.3	2.8	2.5
n	13	87	41	6

Tip penetrating angles and tip cross-sections of points

Because some Still Bay points have pointed tips on both the distal and proximal ends, penetrating angles were calculated for both; 22 distal tips and 7 proximal ends were used for the calculations. The mean penetrating angle for the distal ends of these points is $73.5^\circ \pm 31.6^\circ$; this is much smaller than the figures for the points from other MSA layers (Table 5.9). The proximal ends' penetrating angles, however, have a mean of $121.8^\circ \pm 14.8^\circ$ which is larger than the angles of the distal tips of points from the other MSA layers (Table 5.9). The mean tip cross-sectional area (TCSA) is $88.7 \pm 54.5 \text{ mm}^2$ (Table 5.10) and this is again considerably smaller than the TCSAs of the more recent MSA layers.

There is a wide range of post-Howiesons Poort penetrating angles ($34.0^\circ - 151.7^\circ$) and the mean is $112.0^\circ \pm 28.5^\circ$ (Table 5.9). TCSAs have a mean of $133.7 \pm 59.9 \text{ mm}^2$ (Table 5.10).

Late MSA points from Sibudu Cave have penetrating angles with a mean of $107.3 \pm 27.5^\circ$. TCSAs have a mean of $123.2 \pm 71.9 \text{ mm}^2$ (Tables 5.9 & 5.10).

Final MSA points have penetrating angles with a mean of $97.3^\circ \pm 35.7^\circ$ (Table 5.9). These points have TCSAs that have a mean of $110.2 \pm 47.3 \text{ mm}^2$ (Table 5.10).

Table 5.9

Penetrating angles (in degrees) of points (whole plus distal/proximal tips) from different MSA phases at Sibudu.

	final MSA	late MSA	post-Howiesons Poort	Still Bay	
				Distal	Proximal
Mean	96.4	107.0	112.0	73.8	121.8
SD	36.9	27.6	25.0	31.6	14.8
Min	42.2	13.1	34.0	31.9	108.4
Max	147.2	151.6	151.7	140.2	146.5
n	19	150	49	22	7

Table 5.10

Tip cross-sectional area (TCSA) (in mm²) of points (whole, almost complete plus some distal/proximal fragments) from different MSA phases at Sibudu.

	final MSA	late MSA	post-Howiesons Poort	Still Bay
Mean	110.2	124.4	133.7	88.7
SD	47.3	71.3	59.9	54.5
Min	24.0	16.0	31.5	24.0
Max	205.0	399.5	320.0	195.0
n	16	104	41	12

Point types

Ten categories of point types and point fragment types have been used at Sibudu (Table 5.11, Figs. 5.4-5.6). Eighty per cent of all Still Bay points and point fragments are bifacially retouched while 20% are unifacially retouched. This contrasts markedly with the 7.2% bifacial retouch in the post-Howiesons Poort layers. Unifacial retouch comprises 91% in the post-Howiesons Poort (Table 5.11).

Unifacial points are most common (48.8%) in the late MSA, unifacial point distal tips comprise 19.3% and unifacial point distal fragments 15.1%, while bifacial retouch is rare (Table 5.11).

In the final MSA bifacial retouch again predominates (65.3%) (Table 5.11).

Table 5.11

Frequencies and percentages of point types found in the different MSA phases at Sibudu.

Point type	final MSA		late MSA		post-Howiesons Poort		Still Bay	
	n	%	n	%	n	%	n	%
Unifacial								
Unifacial whole	7	26.9	81	48.8	41	73.2	3	10.0
Unifacial medial-distal	0	0	3	1.8	1	1.8	0	0
Unifacial distal	0	0	25	15.1	5	8.9	0	0
Unifacial tip	2	7.7	32	19.3	4	7.1	3	10.0
Bifacial								
Bifacial whole	8	30.8	10	6.0	2	3.6	2	6.7
Bifacial medial-distal	0	0	1	0.6	0	0	0	0
Bifacial distal	0	0	1	0.6	0	0	0	0
Bifacial tip (distal)	5	19.2	2	1.2	0	0	12	40.0
Bifacial tip (proximal)	0	0	0	0	0	0	8	26.7
Partly Bifacial whole	3	11.5	9	5.4	2	3.6	1	3.3
Partly bifacial distal	1	3.8		0	0	0	0	0
Partly bifacial tip (distal)	0	0	0	0	0	0	1	3.3
Trilateral								
Trilateral whole	0	0	2	1.2	1	1.8	0	0
n	26	99.9	166	100.0	56	100.0	30	100.0

Retouch locations and retouch types of points

More than half (53.3%) of Still Bay points and fragments have retouch on the distal end while 26.7% have retouch on the proximal end. Since broken points outnumber whole points in the Still Bay sample, it is possible that the retouch was originally all over the points and that the percentages used here are meaningless. Other retouch locations are stated in Table 5.12. All points, by definition have retouch on their distal tips, thus this table (Table 5.12) is, in some instances, just a reflection of the number of distal tips and proximal fragments reflected in the

assemblage. Unless stated otherwise, retouch on all unifacial points is on the dorsal surface of the point or point tip.

The most common location of retouch on the post-Howiesons Poort points is the left and right laterals (46.4%) and distal retouch is the second common retouch location (12.5%) (see Table 5.12 for the remaining retouch locations and Fig. 4.3 for illustrations of retouch locations).

In the late MSA, most points are retouched on the distal end (37.3%). The second most common location of retouch is left and right laterals (18.7%) (for the remaining retouch positions, see Table 5.12). Distal retouch is also common in the final MSA (34.6%) and total retouch comes second (19.2%) (see Table 5.12 for other retouch locations).

Table 5.12

Frequencies and percentages of retouch locations on points (whole and broken) in the different MSA phases at Sibudu.

Retouch Location	final MSA		late MSA		post-Howiesons Poort		Still Bay	
	n	%	n	%	n	%	n	%
Total								
Total (dorsal)	5	19.2	18	10.8	4	7.1	0	0
Total (ventral)	0	0	1	0.6	0	0	0	0
Total (dorsal & ventral)	0	0	0	0	0	0	2	6.7
Total (dorsal), left (ventral)	0	0	1	0.6	0	0	0	0
Total (dorsal), right (ventral)	0	0	2	1.2	0	0	0	0
Total (dorsal), distal & right partial (ventral)	1	3.8	0	0	0	0	0	0
Total (dorsal), left & right (ventral)	0	0	0	0	0	0	1	3.1
Total (dorsal), distal (ventral)	0	0	1	0.6	0	0	0	0
Left lateral								
Left	0	0	1	0.6	3	5.4	0	0
Left (ventral)	0	0	1	0.6	0	0	0	0
Left partial	0	0	3	1.8	0	0	0	0
Right Lateral								
Right	0	0	5	3.0	0	0	0	0
Right partial	0	0	6	3.6	0	0	0	0
Right partial (dorsal), right (ventral)	0	0	1	0.6	0	0	0	0
Left & right laterals								
Left & right	4	15.4	31	18.8	26	46.4	2	6.7
Left & right (ventral)	0	0	0	0	2	3.6	0	0
Left (dorsal) , right (ventral)	0	0	0	0	1	1.8	0	0
Left & right (dorsal), left (ventral)	0	0	1	0.6	0	0	0	0
Left & right partial	3	11.5	10	6.0	4	7.1	0	0
Left partial & right	0	0	7	4.2	3	5.4	0	0
Left partial & right partial	4	15.4	12	7.2	5	8.9	1	3.3
Left partial & right partial (ventral)	0	0	1	0.6	0	0	0	0
Left partial & right (dorsal), right (ventral)	0	0	1	0.6	1	1.8	0	0
Distal								
Distal	9	34.6	62	37.3	7	12.5	16	53.3
Distal (dorsal & ventral)	0	0	1	0.6	0	0	0	0
Proximal								
Proximal	0	0	0	0	0	0	8	26.7
n	26	99.9	166	99.8	56	100.0	30	99.8

There are four types of retouch used on all Sibudu points and point tips, namely: invasive, marginal, short, and abrupt retouch (see Fig. 4.4 for illustrations). Invasive retouch is preferred (90%) for the Still Bay points and more invasive retouch occurs amongst these points than any others. The rest of the Still Bay points (10%) have marginal retouch (Table 5.13).

Invasive retouch was used on 57.1% of the post-Howiesons Poort points, marginal retouch on 25% and short retouch on 10.7% (Table 5.13). There are instances where two types of retouch were mixed, for instance, invasive and marginal, and invasive and short (Table 5.13).

Invasive retouch is again the preferred retouch type in the late MSA (68.1%) and the final MSA (73.1%). A variety of other retouch types found in these phases is listed in Table 5.13.

Table 5.13

Frequencies and percentages of retouch types found on points from different MSA phases at Sibudu

Retouch type	final MSA		late MSA		post-Howiesons Poort		Still Bay	
	n	%	n	%	n	%	n	%
Invasive								
Invasive	19	73.1	113	68.1	32	57.1	27	90.0
Marginal								
Marginal	2	7.7	13	7.8	14	25.0	3	10.0
Short								
Short	1	3.8	16	9.6	6	10.7	0	0
Abrupt								
Abrupt	0	0	2	1.2	0	0	0	0
Combinations of retouch types								
Invasive & marginal	2	7.7	6	3.6	1	1.8	0	0
Invasive & short	1	3.8	8	4.8	3	5.4	0	0
Invasive & abrupt	0	0	1	0.6	0	0	0	0
Marginal & short	1	3.8	6	3.6	0	0	0	0
Marginal & abrupt	0	0	1	0.6	0	0	0	0
n	26	99.9	166	99.9	56	100.0	30	100.0

Base types of points

Of the 13 Still Bay points and broken points with intact bases, more than half (53.8%) have pointed bases. There are no pointed bases in any of the other MSA phases at Sibudu. Bases with

plain platforms constitute 30.4% of the Still Bay points (see Table 5.14 for the remaining base types).

The preferred base in the post-Howiesons Poort is a faceted platform (43.5%) and plain platforms are the second most common base type (Table 5.14 has a list of other base types found in this phase).

As in the post-Howiesons Poort, the most common base in the late MSA is a faceted platform (35.4%). This is followed by plain platforms (24%) (see Table 5.14 for the remaining base types).

The preferred type of base in the final MSA is complete removal of the butt by retouch, creating a broad and curved base (40%). Reduced bases are also common in this phase (20%) and this is probably due to the presence of some hollow-based points which are not found anywhere else in the sequence (Table 5.14, also see Fig. 4.5 for illustrations of base types).

Table 5.14

Frequencies and percentages of base types found on points (whole and proximal fragments) from different MSA phases at Sibudu.

Base type	final MSA		late MSA		post-Howiesons Poort		Still Bay	
	n	%	n	%	n	%	n	%
Pointed	0	0		0	0	0	7	53.8
Broad, curved and removed by retouch	6	40.0	12	12.5	1	2.2	2	15.4
Platform faceted	1	6.7	34	35.4	20	43.5	0	0
Platform plain	1	6.7	23	24.0	14	30.4	4	30.8
Platform punctiform	0	0	1	1.0	0	0	0	0
Platform ridge	0	0	3	3.1	0	0	0	0
Platform broken	1	6.7	12	12.5	7	15.2	0	0
Reduced	3	20.0	4	4.2	2	2.2	0	0
Straight	0	0	1	1.0	0	0	0	0
Indeterminate	3	20.0	6	6.3	3	6.5	0	0
n	15	100.0	96	100.0	46	100.0	13	100.0

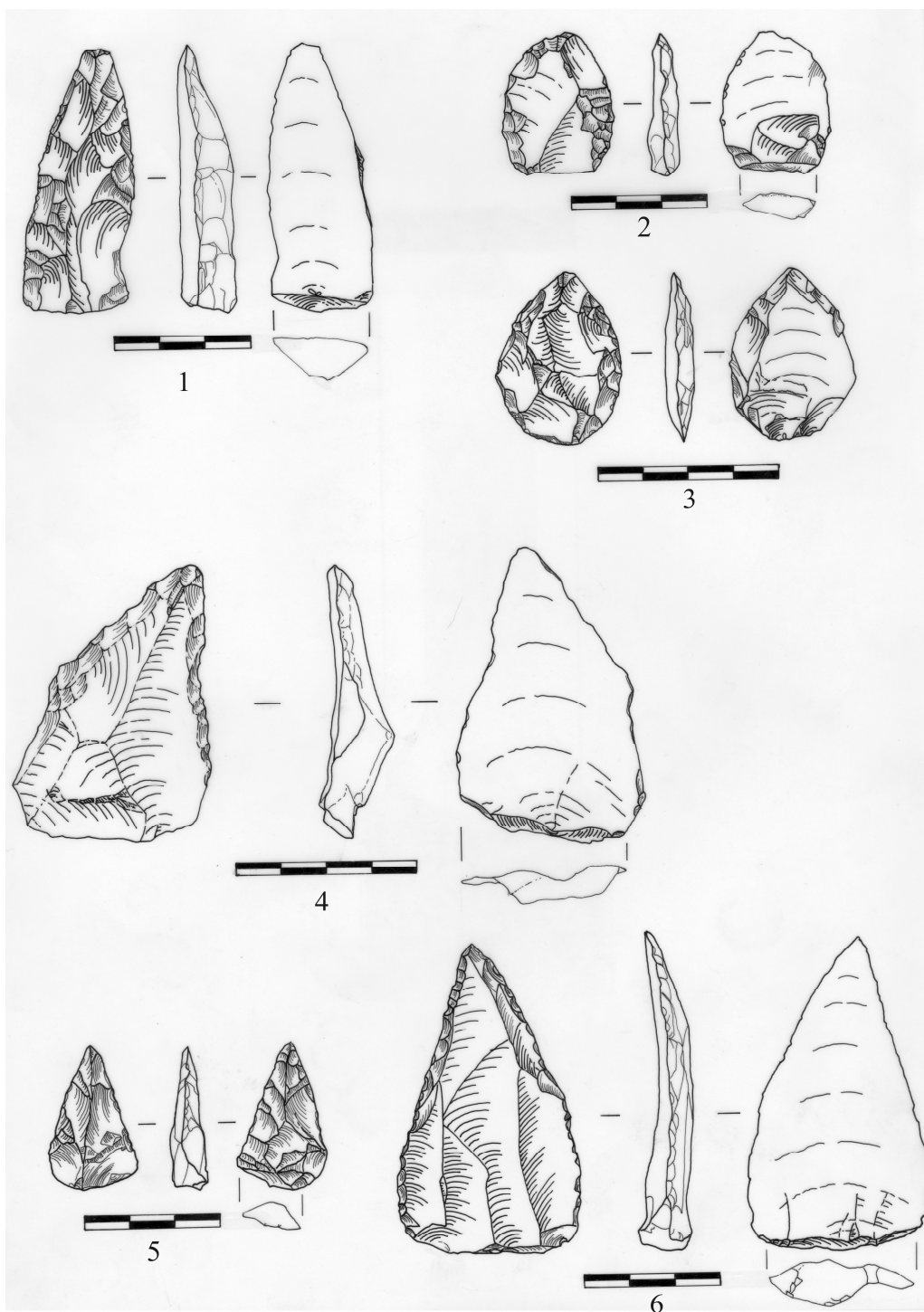


Fig. 5.4 Unifacial and bifacial points from Sibudu Cave: 1 is an almost complete unifacial point, 2 a unifacial point from RSp (late MSA) (both 1 and 2 have plain platforms), 3 a bifacial point with a reduced platform, 4 dolerite unifacial point with a plain platform from hearth in Mi (post-Howiesons Poort), 5 a hornfels bifacial point with a platform reduced by retouch (from layer RGS [Still Bay]) and 6 is a dolerite unifacial point with a faceted platform (from hearth in RSp [late MSA]).

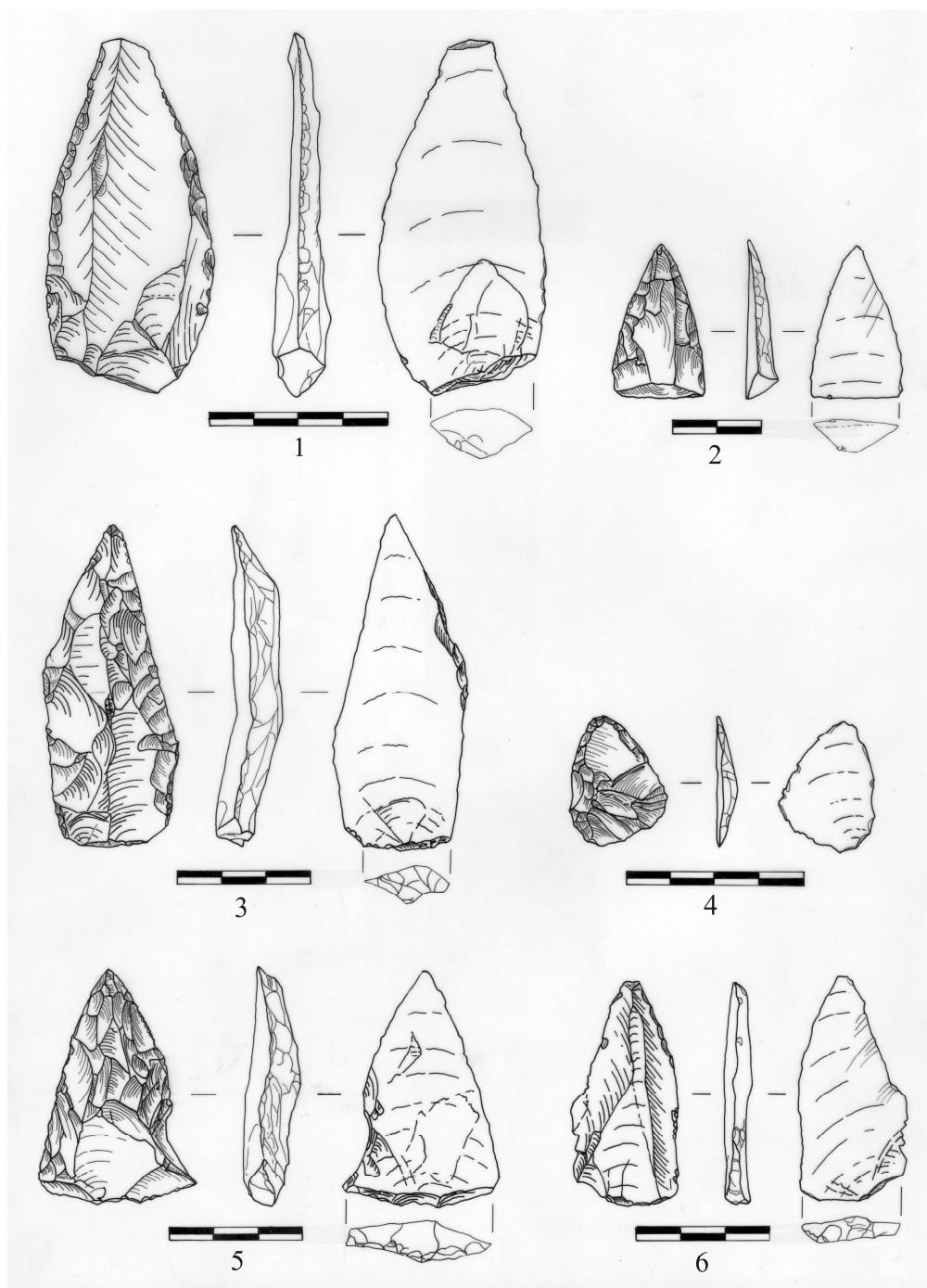


Fig. 5.5 Unifacial points from Sibudu: 1 is an almost complete unifacial point with a faceted platform from Hearth c in RD (late MSA), 2 a unifacial point with a broken platform from O MOD (late MSA), 3 a unifacial point with a faceted platform from BL2 (post-Howiesons Poort), 4 a unifacial point with a punctiform platform from black lense in OMOD (post-Howiesons Poort), 5 a unifacial point from OMOD (post-Howiesons Poort) with a faceted platform and 6 a unifacial point with a faceted platform from Top of RSp (late MSA) (all points are in hornfels). Note the predominance of faceted platforms.

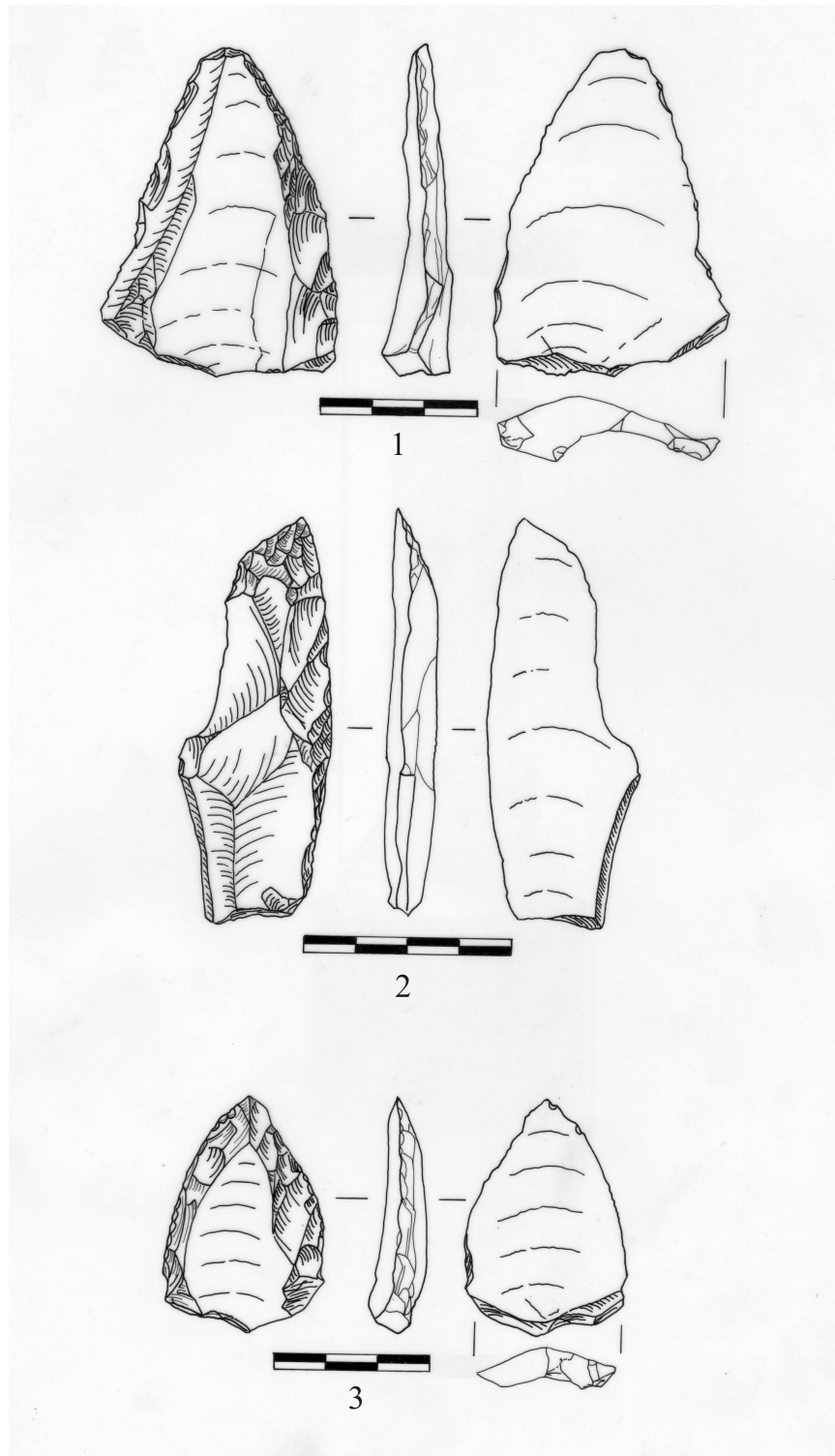


Fig. 5.6 Unifacial points from Sibudu: 1 is a dolerite unifacial point with a faceted platform from BL2E, 2 a hornfels unifacial point with a broken platform from layer Black in SPCA and 3 a dolerite unifacial point with a faceted platform from DL4 in SS (All points are from post-Howiesons Poort layers) .

Rock types of points

There are four rock types from which the Still Bay points are made: dolerite, hornfels, quartz and quartzite. Of these four, dolerite is dominant (46.7%) (Table 5.15, Fig. 5.7); it is the only time in the sequence when this is the case. The Still Bay also has the highest percentage (23.3) of quartzite points in the sequence (Table 5.15, Fig. 5.7).

Post-Howiesons Poort points are made from dolerite, hornfels and cryptocrystalline silica (CCS). Hornfels is the preferred rock (60.7%) while CCS is the least used (1.8%) (Table 5.15, Fig. 5.7).

As is the case in the post-Howiesons Poort, the preferred rock type in the late MSA is hornfels (78.3%), followed by dolerite (18.7%) (see Table 5.15 for other rock types).

In the final MSA, hornfels is again preferred (76.9%) and dolerite is less popular (19.2%) (Table 5.15, Fig. 5.7). Tables 5.16-5.21 have averages of breadth, thickness, length, base thickness, base breadth and mass (respectively) of dolerite, quartz, quartzite and hornfels points from Sibudu.

Table 5.15

Frequencies and percentages of point rock types in the different MSA phases at Sibudu.

Rock type	final MSA		late MSA		post-Howiesons Poort		Still Bay	
	n	%	n	%	n	%	n	%
Dolerite	5	19.2	31	18.7	21	37.5	14	46.7
Hornfels	20	76.9	130	78.3	34	60.7	8	26.7
Quartz	1	3.8	1	0.6	0	0	1	3.3
Quartzite	0	0	3	1.8	0	0	7	23.3
Chert	0	0	1	0.6	0	0	0	0
Crypto Crystalline Silica	0	0	0	0	1	1.8	0	0
n	26	99.9	166	100.0	56	100.0	30	100.0

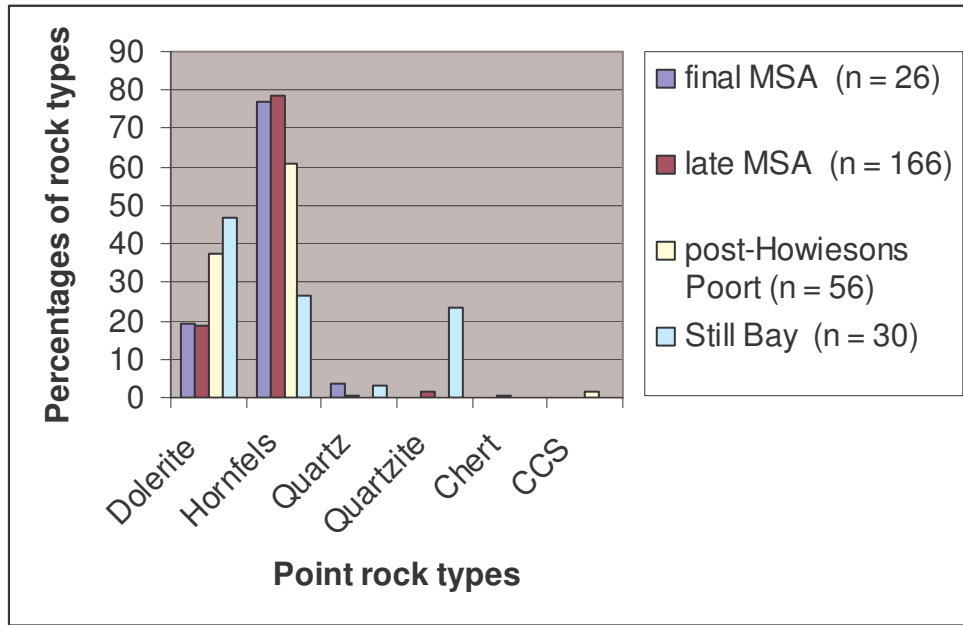


Fig 5.7 Percentages of Sibudu points rock types.

Table 5.16

Breadth (in mm) of all whole and some broken dolerite, quartz, quartzite and hornfels points from Sibudu.

	Dolerite	Quartz	Quartzite	Hornfels
Mean	28.8	21	32.3	25.7
SD	8.9	1.4	4.3	6.6
Min	7.0	20.0	28.0	7.0
Max	49.0	22.0	38.0	47.0
n	43	2	4	125

Table 5.17

Thickness (in mm) of all whole and some broken dolerite, quartz, quartzite and hornfels points from Sibudu.

	Dolerite	Quartz	Quartzite	Hornfels
Mean	9.3	8.0	9.6	8.2
SD	3.5	4.2	4.0	2.7
Min	3.0	5.0	5.0	2.0
Max	23.0	11.0	14.0	17.0
n	45	2	5	127

Table 5.18

Length (in mm) of all whole and some side broken dolerite, quartz, quartzite and hornfels points from Sibudu.

	Dolerite	Quartz	Quartzite	Hornfels
Mean	45.9	32.0	57.0	43.3
SD	11.3	9.9	9.9	12.0
Min	28.0	25.0	50.0	20.0
Max	69.0	39.0	64.0	77.0
n	35	2	2	115

Table 5.19

Base thickness (in mm) of all dolerite, quartz, quartzite and hornfels points (whole and some proximal fragments) from Sibudu.

	Dolerite	Quartz	Quartzite	Hornfels
Mean	7.9	4.5	8.3	6.3
SD	4.6	2.1	4.6	3.2
Min	1.0	3.0	4.0	1.0
Max	25.0	6.0	14.0	17.0
n	34	2	4	88

Table 5.20

Base breadth (in mm) of all dolerite, quartz, quartzite and hornfels points (whole and some proximal fragments) from Sibudu.

	Dolerite	Quartz	Quartzite	Hornfels
Mean	23.3	16.0	20.8	20.8
SD	11.4	8.5	10.0	7.8
Min	2.0	10.0	6.0	2.0
Max	52.0	22.0	27.0	41.0
n	34	2	4	88

Table 5.21

Mass (in g) of all dolerite, quartz, quartzite and hornfels points (whole and almost complete) from Sibudu.

	Dolerite	Quartz	Quartzite	Hornfels
Mean	16.2	4.0	24.6	9.9
SD	12.3	2.9	7.7	6.7
Min	1.0	2.0	16.6	0.3
Max	58.1	6.1	32.0	41.0
n	36	2	3	113

Coefficient of Variation (CV)

Length is the most standardized attribute although coefficients of variation (CV) for all attributes are high and demonstrate a lack of standardization. There is increased standardization in length through time. As a category, mass is the least standardized attribute amongst the points. The least standardization overall is shown in the Still Bay, in particular base thickness and breadth at base (Table 5.22). However, length/breadth ratios of Still Bay points are more standardized than those of points from post-Howiesons Poort, late MSA and final MSA (Table 5.22).

There is somewhat more standardization among bifacial points than unifacial points, at least, in thickness, length and mass (Table 5.23), but, in general, all the attributes show a lack of standardization through time.

Table 5.22

Coefficient of variation (CV) of measurements of points from MSA phases at Sibudu.

Measurement	final MSA	late MSA	post-Howiesons Poort	Still Bay
Breadth	32.3	26.9	28.0	32.8
Thickness	39.3	34.5	32.4	43.2
Length	25.5	30.2	29.0	36.4
Length/breadth ratio	46.6	31.2	23.5	15.0
Thickness at base	38.0	51.1	52.4	91.8
Breadth at base	22.2	42.6	41.5	91.0
Mass	57.9	87.2	90.0	78.1

Table 5.23

Coefficient of variation of measurements of unifacial and bifacial points from all MSA phases at Sibudu.

Measurement	Unifacial points	Bifacial points
Breadth	27.9	29.0
Thickness	35.6	28.9
Length	33.9	21.3
Thickness at base	46.8	63.4
Breadth at base	36.2	58.6
Mass	92.5	55.4

T-tests

The Still Bay point breadths are significantly narrower than those of both the late MSA and post-Howiesons Poort (Table 5.24). Post-Howiesons Poort points are significantly thicker than those of the final MSA, late MSA and Still Bay (Table 5.25). Post-Howiesons Poort points are also significantly longer and heavier than points from the final and late MSA, but are not significantly longer or heavier than the Still Bay points (Tables 5.26 & 5.29). This confirms the shape difference noted by the length/breadth ratios reported earlier (see Table 5.8). Still Bay points are more elongated than the others.

Late MSA points are thicker at the base than final MSA and Still Bay points, while Still Bay points are also thinner at the base than post-Howiesons Poort points (Table 5.27). The similarity of the base thicknesses of Still Bay and final MSA points may be due to the relatively high degree of bifacial working on the bases of these points. There is no significant difference in base breadth between any points (Table 5.28). The mean distal penetrating angle of Still Bay points is significantly smaller than those of points from the other MSA phases (Table 5.30). The distal penetrating angle of Still Bay points is also significantly smaller than the proximal angle of the same points (Table 5.30). The mean TCSA of Still Bay points, is smaller than those of the final and late MSA (not significantly so though) and is significantly smaller than that of the post-Howiesons Poort points (Table 5.31).

At Sibudu, hornfels points are significantly narrower, thinner and lighter (they weigh less) than dolerite points (Tables 5.32, 5.33 & 5.37). However, Sibudu points' lengths do not differ significantly between rock types (Table 5.34). Hornfels and quartz points are narrower and also weigh less than quartzite points (Tables 5.32 & 5.37). There are almost no significant differences in base measurements of points across rock types (Tables 5.35- 5.36).

Table 5.24

Differences in breadth of points (including some distal/proximal fragments but excluding tips) from various MSA phases in Sibudu.

	late MSA	post-Howiesons Poort	Still Bay
final MSA	$t = 2.0; p = 0.7$	$t = 2.0; p = 0.2$	$t = 2.0; p = 0.1$
late MSA	-	$t = 2.0; p = 0.08$	$t = 2.0; p < 0.01$
post-Howiesons Poort	-	-	$t = 2.0; p < 0.01$

Table 5.25

Differences in thickness of points (including distal/proximal fragments but excluding tips) from various MSA phases in Sibudu.

	late MSA	post-Howiesons Poort	Still Bay
final MSA	$t = 2.0; p = 0.4$	$t = 2.0; p = 0.01$	$t = 2.0; p = 0.5$
late MSA	-	$t = 2.0; p < 0.01$	$t = 2.0; p = 0.06$
post-Howiesons Poort	-	-	$t = 2.0; p < 0.01$

Table 5.26

Differences in length of points (whole and side broken) from various MSA phases in Sibudu.

	late MSA	post-Howiesons Poort	Still Bay
final MSA	$t = 2.0; p = 0.3$	$t = 2.0; p < 0.01$	$t = 2.1; p = 0.35$
late MSA	-	$t = 2.0; p < 0.01$	$t = 2.0; p = 0.8$
post-Howiesons Poort	-	-	$t = 2.0; p = 0.3$

Table 5.27

Differences in base thickness of points (whole and some proximal fragments) from various MSA phases in Sibudu.

	late MSA	post-Howiesons Poort	Still Bay
final MSA	$t = 2.0; p < 0.01$	$t = 2.0; p < 0.01$	$t = 2.0; p = 0.6$
late MSA	-	$t = 2.0; p = 0.4$	$t = 2.0; p < 0.01$
post-Howiesons Poort	-	-	$t = 2.0; p < 0.01$

Table 5.28

Differences in base breadth of points (whole and some proximal fragments) from various MSA phases in Sibudu.

	late MSA	post-Howiesons Poort	Still Bay
final MSA	$t = 2.0; p = 0.4$	$t = 2.0; p = 1.0$	-
late MSA	-	$t = 2.0; p = 1.0$	-
post-Howiesons Poort	-	-	-

Table 5.29

Differences in mass of points (whole and almost complete) from various MSA phases in Sibudu.

	late MSA	post-Howiesons Poort	Still Bay
final MSA	$t = 2.0; p = 0.25$	$t = 2.0; p = 0.02$	$t = 2.1; p = 0.4$
late MSA	-	$t = 2.0; p < 0.01$	$t = 2.0; p = 0.9$
post-Howiesons Poort	-	-	$t = 2.0; p = 0.2$

Table 5.30

Differences in penetrating angle of points (whole and tips ≥ 10 mm) from various MSA phases in Sibudu.

	late MSA	post-Howiesons Poort	Still Bay distal	Still Bay proximal
final MSA	$t = 2.0; p = 0.1$	$t = 2.0; p = 1.1$	$t = 2.0; p = 0.03$	-
late MSA	-	$t = 2.0; p = 0.5$	$t = 2.0; p < 0.01$	-
post-Howiesons Poort	-	-	$t = 2.0; p < 0.01$	-
Still Bay distal	-	-	-	$t = 2.0; p < 0.01$

Table 5.31

Differences in TCSA of points (whole and some broken) from various MSA phases in Sibudu.

	late MSA	post-Howiesons Poort	Still Bay
final MSA	$t = 2.0; p = 0.4$	$t = 2.0; p = 0.2$	$t = 2.1; p = 0.3$
late MSA	-	$t = 2.0; p = 0.5$	$t = 2.0; p = 0.09$
post-Howiesons Poort	-	-	$t = 2.0; p = 0.02$

Table 5.32

Differences in breadth of dolerite, quartz, quartzite and hornfels points (including some distal/proximal fragments but excluding tips) from Sibudu.

	Quartz	Quartzite	Hornfels
Dolerite	$t = 2.0; p = 0.2$	$t = 2.0; p = 0.5$	$t = 2.0; p = 0.01$
Quartz	-	$t = 3.0; p = 0.03$	$t = 2.0; p = 0.3$
Quartzite	-	-	$t = 2.0; p = 0.05$

Table 5.33

Differences in thickness of all whole and some broken dolerite, quartz, quartzite and hornfels points (including some distal/proximal fragments but excluding tips) from Sibudu.

	Quartz	Quartzite	Hornfels
Dolerite	$t = 2.0; p = 1.0$	$t = 2.0; p = 1.0$	$t = 2.0; p = 0.04$
Quartz	-	$t = 2.6; p = 1.0$	$t = 2.0; p = 1.0$
Quartzite	-	-	$t = 2.0; p = 0.3$
Hornfels	-	-	-

Table 5.34

Differences in length of dolerite, quartz, quartzite and hornfels points (whole and side broken) from Sibudu.

	Quartz	Quartzite	Hornfels
Dolerite	$t = 2.0; p = 0.1$	$t = 2.0; p = 0.2$	$t = 2.0; p = 0.2$
Quartz	-	$t = 2.0; p = 0.1$	$t = 2.0; p = 0.2$
Quartzite	-	-	$t = 2.0; p = 0.1$

Table 5.35

Differences in base thickness of dolerite, quartz, quartzite and hornfels points (whole and proximal fragments) from Sibudu.

	Quartz	Quartzite	Hornfels
Dolerite	$t = 2.0; p = 0.3$	$t = 2.0; p = 1.0$	$t = 2.0; p = 0.04$
Quartz	-	$t = 3.0; p = 0.4$	$t = 2.0; p = 0.4$
Quartzite	-	-	$t = 2.0; p = 0.3$

Table 5.36

Differences in base breadth of dolerite, quartz, quartzite and hornfels points (whole and proximal fragments) from Sibudu.

	Quartz	Quartzite	Hornfels
Dolerite	$t = 2.0; p = 0.4$	$t = 2.0; p = 1.0$	$t = 2.0; p = 0.2$
Quartz	-	-	$t = 2.0; p = 0.4$
Quartzite	-	-	$t = 2.0; p = 1.0$

Table 5.37

Differences in mass of dolerite, quartz, quartzite and hornfels points (whole and some almost complete).from Sibudu.

	Quartz	Quartzite	Hornfels
Dolerite	$t = 2.0; p = 0.2$	$t = 2.0; p = 0.3$	$t = 2.0; p < 0.01$
Quartz	-	$t = 3.1; p = 0.04$	$t = 2.0; p = 0.2$
Quartzite	-	-	$t = 2.0; p < 0.01$

Summary: characterisation of Sibudu points through time

Still Bay

Still Bay points are narrower and thinner than other points in the sequence and their bases are also thinner than those of points in the younger assemblages. Still Bay points are more elongated (they have blade proportions) and their penetrating angles are significantly smaller than those of other points in the sequence. Still Bay TCSAs are smaller than (but not significantly so) those of the final and Late MSA and are significantly smaller than those of the post-Howiesons Poort. Eighty per cent of Still Bay points and point fragments are bifacially worked, whereas 93% of these are unifacial in the post-Howiesons Poort assemblage. Invasive retouch is the most common type (90%) in the Still Bay, although it is also an important form of retouch in the final MSA (73%). No Still Bay points have faceted platforms (and the final MSA has only one) and it is the only assemblage to have pointed bases, although not all bases in the Still Bay are pointed.

Post-Howiesons Poort

These points are broader, thicker, longer and heavier than points elsewhere in the sequence. They have the largest TCSAs and penetrating angles of any Sibudu points. A majority of the points and point fragments are made on hornfels and almost all are unifacial, with either invasive or marginal retouch. Faceted platforms are the most common base types.

Late MSA

These points have significantly thicker bases than any other points, and the breadth at base of these points is as wide as those in the post-Howiesons Poort. However, the total mean breadth of the late MSA points is significantly narrower than those of the post-Howiesons Poort. TCSAs and penetrating angles of the late MSA points are smaller than those of the post-Howiesons Poort, but not significantly so. Although there is twice as much bifacial retouch in the late MSA as in the post-Howiesons Poort, the proportion of bifacial working is still low. There is more invasive retouch than in the post-Howiesons Poort, but not by a significant amount. Faceted platforms have high frequencies as is also the case in the post-Howiesons Poort. There is a higher percentage of hornfels in this sample than elsewhere, but hornfels use is only significantly different from that in the Still Bay.

Final MSA

These points are thinner than those of the post-Howiesons Poort and late MSA, but thicker than Still Bay points. They are the shortest points in the sequence and their length/breadth ratio of 1.5 demonstrates that their shapes tend to be short and wide. However, the lack of standardization of length/breadth ratios means that shape is variable in this assemblage. Bases are thinner and narrower than points elsewhere, except those in the Still Bay. Final MSA points weigh less than the others, and significantly less than those from the post-Howiesons Poort. Penetrating angles are significantly larger than those in the Still Bay, but the value is smaller (though not significantly so) than those of other points in the sequence.

The influence of rock types on point attributes

There is no significant difference in the lengths of points when they are separated by rock types. However, quartz breadths are significantly smaller than quartzite breadths and quartzite breadths are significantly bigger than hornfels ones. Hornfels points are significantly narrower than dolerite ones. The base thickness of dolerite points is significantly larger than that of hornfels points, but there are no significant differences between any of the base breadths.

Umhlatuzana points

Points from this site are grouped by the cultural stratigraphic divisions used by Kaplan (1990), that is, the 'pre-Howiesons Poort' (layers 28-22), the 'late MSA' (layers 21-19) and 'MSA/LSA transition' (in this case layers 18-16). It should be noted, however, that there may be mixing of some tools between industries at Umhlatuzana because of rotational slippage (see Chapter Three).

One hundred and seventy five points and point fragments from Umhlatuzana were analysed. Sixty four (36.5%) of these are from the MSA/LSA transition; 21 (12%) from the late MSA and 90 (51.4%) from pre-Howiesons Poort layers (Table 5.38). Eighty-one (46.3%) Umhlatuzana points are made from hornfels; 51 (29.1%) from quartzite; 22 (12.6%) from mudstone; 13 (7.4%) from quartz; seven (4%) from dolerite and one (0.6%) from an indeterminate rock.

Table 5.38

Point and point fragment frequencies and percentages used for this study from all MSA phases at Umhlatuzana.

Points	MSA/LSA transition		late MSA		pre-Howiesons Poort	
	n	%	n	%	n	%
Whole	14	21.9	15	71.4	44	48.9
Almost complete (tip broken)	3	4.7	2	9.5	18	20.0
Medial-distal fragment	1	1.6	1	4.8	3	3.3
Medial-proximal fragment	0	0	0	0	2	2.2
Distal fragment	6	9.4	3	14.3	9	10.0
Distal tip	33	51.6	0	0	11	12.2
Proximal tip	7	10.9	0	0	3	3.3
n	64	100.1	21	100.0	90	99.9

Breadth, thickness and length of points

The pre-Howiesons Poort points from Umhlatuzana have mean breadths of 24.5 ± 6 mm, mean thicknesses of 9.7 ± 2.3 mm and mean lengths of 48.3 ± 12 mm (Tables 5.39-5.41).

Late MSA points from Umhlatuzana have a mean breadth of 27.9 ± 5.8 mm, a mean thickness of 10.8 ± 3 mm and a mean length of 49.1 ± 9.4 mm (Tables 5.39-5.41).

MSA/LSA transition points have a mean breadth of 26.3 ± 5.5 mm, mean thicknesses of 9 ± 2.6 mm and mean length of 46 ± 10.5 mm (Tables 5.39-5.41).

Table 5.39

Breadth (in mm) of points (including some distal/proximal fragments but excluding tips) from different MSA phases at Umhlatuzana

	MSA/LSA transition	late MSA	pre-Howiesons Poort
Mean	26.3	27.9	24.5
SD	5.5	5.8	6.0
Min	18.0	20.0	10.0
Max	39.0	39.0	39.0
n	16	17	62

Table 5.40

Thickness (in mm) of points (including some distal/proximal fragments but excluding tips) from different MSA phases at Umhlatuzana.

	MSA/LSA transition	late MSA	pre-Howiesons Poort
Mean	9.0	10.8	9.7
SD	2.6	3.0	2.3
Min	6.0	5.0	5.0
Max	15.0	17.0	17.0
n	17	17	63

Table 5.41

Length (in mm) of points (whole and side broken) from different MSA phases at Umhlatuzana.

	MSA/LSA transition	late MSA	pre-Howiesons Poort
Mean	46.0	49.1	48.3
SD	10.5	9.4	12.0
Min	33.0	34.0	30.0
Max	69.0	74.0	81.0
n	13	15	44

Length/breadth ratios of points

Pre-Howiesons Poort points at Umhlatuzana are elongated and were produced from blades or were trimmed to blade-like proportions because they have a mean length/breadth ratio of 2.0 (Table 5.42).

Late MSA points from Umhlatuzana are shorter and wider than the earlier points, with a length/breadth ratio which is less than 2.0 (Table 5.42).

MSA/LSA transition points, like the late MSA points, have a length/breadth ratio which is less than 2.0 (Table 5.42) and were either produced from flakes or were retouched and/or resharpened into short and wide forms.

Table 5.42

Length/breadth ratios of whole points from different MSA phases at Umhlatuzana.

	MSA/LSA transition	late MSA	pre-Howiesons Poort
Mean	1.8	1.9	2.0
SD	0.4	0.3	0.5
Min	1.2	1.4	1.3
Max	2.6	2.7	3.0
n	12	15	44

Base measurements of points

Pre-Howiesons Poort points from Umhlatuzana have bases with a mean thickness of 5.9 ± 2.8 mm and mean breadths of 17 ± 6.6 mm (Tables 5.43 & 5.44).

Late MSA points' bases have a mean thickness of 5.3 ± 2.4 mm and a mean breadth of 18.6 ± 6.5 mm (Tables 5.43 & 5.44).

MSA/LSA transition points have bases with a mean thickness of 9 ± 7.8 mm and a mean breadth of 19.1 ± 9.8 mm (Tables 5.43 & 5.44).

Table 5.43

Base thickness (in mm) of points (whole and some proximal fragments) from different MSA phases at Umhlatuzana.

	MSA/LSA transition	late MSA	pre-Howiesons Poort
Mean	9.0	5.3	5.9
SD	7.8	2.4	2.8
Min	2.0	2.0	2.0
Max	35.0	10.0	16.0
n	23	16	61

Table 5.44

Base breadth (in mm) of points (whole and some proximal fragments) from different MSA phases at Umhlatuzana.

	MSA/LSA transition	late MSA	pre-Howiesons Poort
Mean	19.1	18.6	17.0
SD	9.8	6.5	6.6
Min	3.0	11.0	7.0
Max	32.0	33.0	37.0
n	23	16	61

Mass of points

Pre-Howiesons Poort points have a mean mass of 12 ± 8.2 g (Table 5.45). Late MSA points' mean mass is 13.9 ± 8.9 g (Table 5.45). MSA/LSA transition points have a mean mass of 10.6 ± 5.1 g (Table 5.45).

Table 5.45

Mass (in g) of points (whole and some almost complete) from different MSA phases at Umhlatuzana.

	MSA/LSA transition	late MSA	pre-Howiesons Poort
Mean	10.6	13.9	12.0
SD	5.1	8.9	8.2
Min	4.7	4.9	1.5
Max	18.4	37.9	49.2
n	10	15	44

Penetrating angles and tip cross-sectional area (TCSA) of points

The pre-Howiesons Poort points have a mean penetrating angle of $109.5^\circ \pm 24.2^\circ$ and a mean TCSA of 121.1 ± 52.3 mm² (Tables 5.46 & 5.47).

Late MSA points have a mean penetrating angle of $115 \pm 23.5^\circ$ and mean TCSA of $157.2 \pm 70.5 \text{ mm}^2$ (See Tables 5.46 & 5.47).

Points in the MSA/LSA transition phase have a mean penetrating angle of $86.6 \pm 27.5^\circ$ and a mean TCSA of $122.8 \pm 55.3 \text{ mm}^2$ (Tables 5.46 & 5.47).

Table 5.46

Penetrating angle (in degrees) of points (whole plus distal/proximal tips $\geq 10 \text{ mm}$) from different MSA phases at Umhlatuzana.

	MSA/LSA transition	late MSA	pre-Howiesons Poort
Mean	86.6	115.0	109.5
SD	27.5	23.5	24.2
Min	37.2	47.1	31.9
Max	133.6	147.6	146.8
n	53	20	72

Table 5.47

Tip cross-sectional area (TCSA) (in mm^2) of points (whole, almost complete plus some distal/proximal fragments) from different MSA phases at Umhlatuzana.

	MSA/LSA transition	late MSA	pre-Howiesons Poort
Mean	122.8	157.2	121.1
SD	55.3	70.5	52.3
Min	54.0	60.0	30.0
Max	234.0	297.5	331.5
n	16	17	62

Point types

In the pre-Howiesons Poort, bifacial working is most common (55.6%) on points and point fragments. Unifacial points are the dominant point type in the late MSA where 57.2% of whole and broken points have this retouch. Unifacial retouch accounts for 57.8% of MSA/LSA transition points and point fragments. Details of point types and point fragment types are listed in Table 5.48 (also see Figs 5.8 & 5.9).

Table 5.48

Frequencies and percentages of point types found in the different MSA phases at Umhlatuzana.

Point type	MSA/LSA transition		late MSA		pre-Howiesons Poort	
	n	%	n	%	n	%
Unifacial						
Unifacial whole	7	10.9	9	42.9	30	33.3
Unifacial medial-distal fragment	1	1.6	1	4.8	3	3.3
Unifacial distal fragment	5	7.8	2	9.5	4	4.4
Unifacial proximal fragment	5	7.8	0	0	1	1.1
Unifacial tip (distal)	19	29.7	0	0	2	2.2
Bifacial						
Bifacial whole	7	10.9	5	23.8	24	26.7
Bifacial medial-distal	0	0	0	0	0	0
Bifacial distal fragment	1	1.6	0	0	5	5.6
Bifacial proximal fragment	1	1.6	0	0	2	2.2
Bifacial tip (distal)	7	10.9	0	0	8	8.9
Bifacial tip (proximal)	0	0	0	0	0	0
Partly bifacial whole	3	4.7	3	14.3	8	8.9
Partly bifacial medial-proximal fragment	0	0	0	0	2	2.2
Partly bifacial distal fragment	0	0	1	4.8	0	0
Partly bifacial proximal fragment	1	1.6	0	0	0	0
Partly bifacial tip (distal)	7	10.9	0	0	1	1.1
n	64	100.0	21	100.1	90	99.9

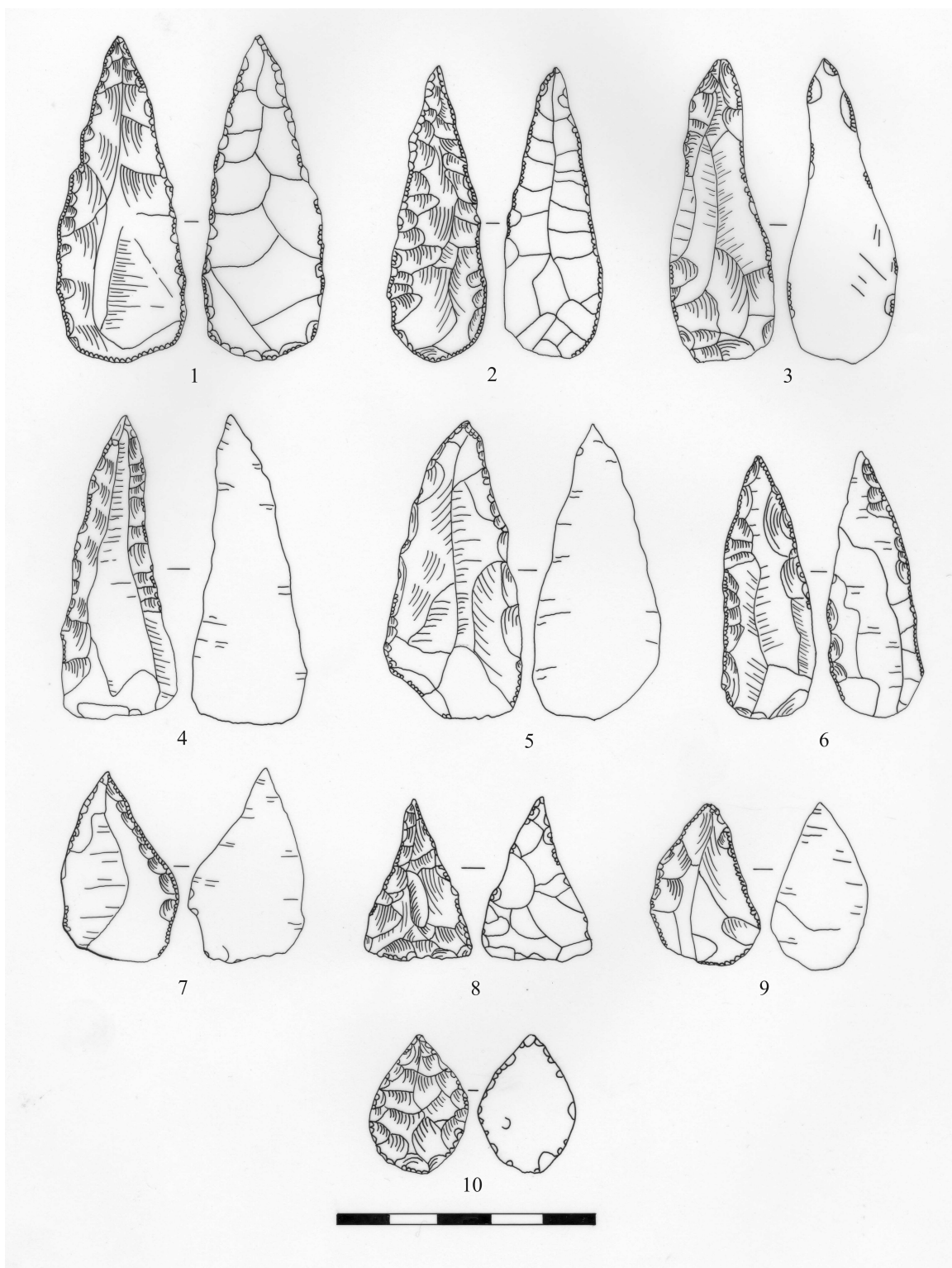


Fig. 5.8 Unifacial and bifacial points from Umhlatuzana: 1 - 3 are bifacial points, 4 & 5 unifacial points, 6 a bifacial point, 7 a unifacial point, 8 a bifacial point, 9 a unifacial point, 10 a bifacial point. All points are from pre-Howiesons Poort layers. Note the variability in sizes (Figures redrawn from Kaplan 1990).

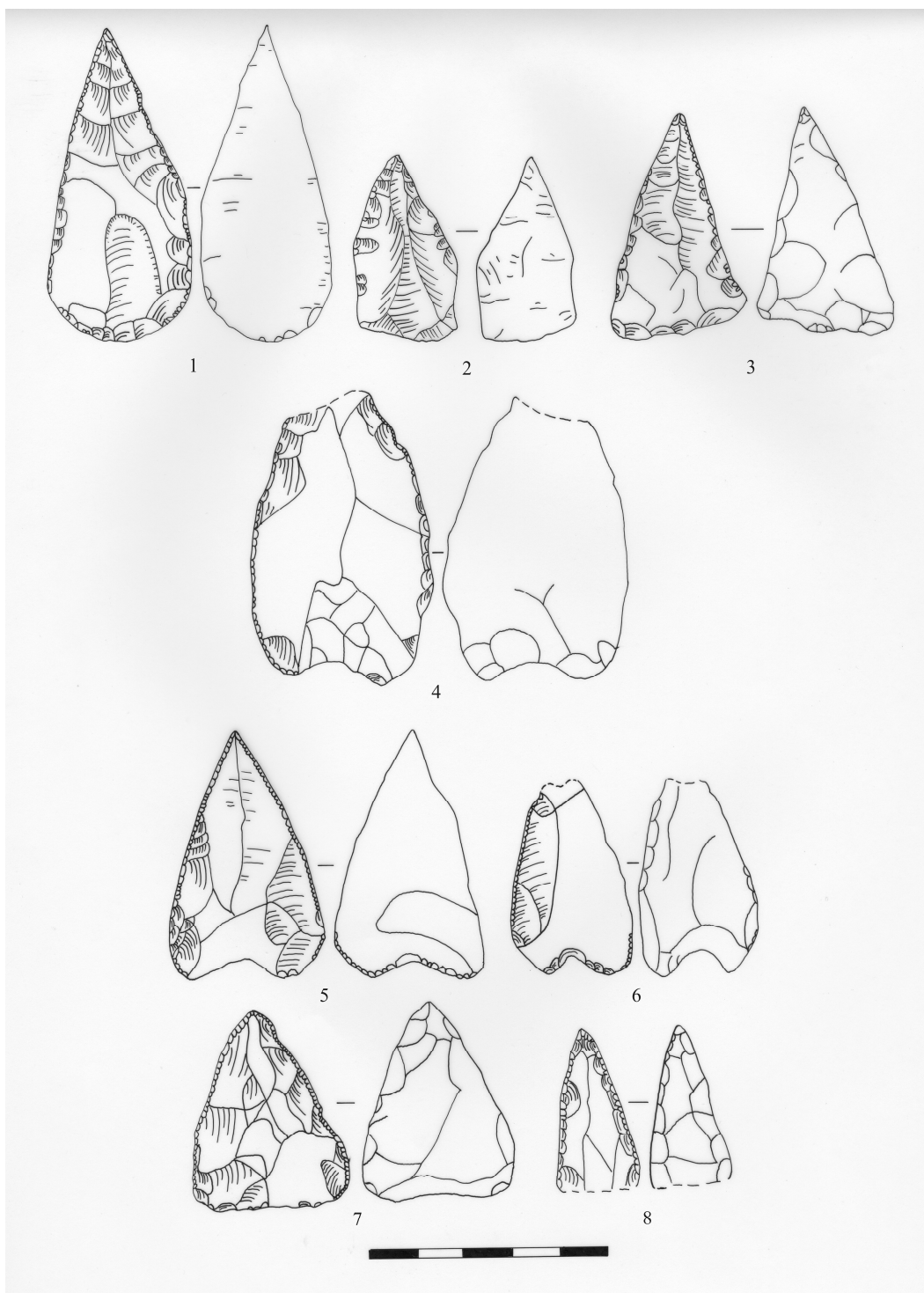


Fig. 5.9 Unifacial and bifacial points from pre-Howiesons Poort and MSA/LSA transition layers at Umhlatuzana: 1 & 2 are unifacial points, 3 a bifacial point (from pre-Howiesons Poort layers), 4 a hollow-based point with a broken tip, 5 a hollow-based point, 6 a hollow-based point with a broken tip, 7 a bifacial point, 8 a broken bifacial point. All hollow-based points are from MSA/LSA transition layers. Note the variability in bases (Figures redrawn from Kaplan 1990).

Retouch location and retouch type of points

Total retouch or retouch all over the point is the common location of retouch (28.9%) in the pre-Howiesons Poort. Again, in the late MSA, total retouch is predominant (33.3%) (Table 5.49). However, in the MSA/LSA transition phase, distal retouch is most common (53.1%). (see Table 5.49 for other retouch locations).

Invasive retouch is preferred throughout the sequence (Table 5.50).

Table 5.49

Frequencies and percentages of retouch locations on points in the different MSA phases at Umhlatuzana.

Retouch Location	MSA/LSA transition		late MSA		pre-Howiesons Poort	
	n	%	n	%	n	%
Total						
Total (dorsal)	9	14.1	7	33.3	26	28.9
Total (dorsal), left (ventral)	0	0	2	9.5	1	1.1
Total (dorsal), left partial (ventral)	0	0	1	4.8	0	0
Total (dorsal), left & right (ventral)	1	1.6	0	0	0	0
Total (dorsal), left partial & right (ventral)	0	0	1	4.8	0	0
Total (dorsal),right (ventral)	0	0	0	0	1	1.1
Total (dorsal),right partial (ventral)	0	0	0	0	1	1.1
Left lateral						
Left partial	0	0	0	0	1	1.1
Left & distal	1	1.6	0	0	1	1.1
Right lateral						
Right	0	0	0	0	2	2.2
Right partial (dorsal), total (ventral)	0	0	0	0	1	1.1
Left and right laterals						
Left & right	3	4.7	4	19.0	18	20.0
Left (dorsal), right (ventral)	1	1.6	0	0	0	0
Left & right (dorsal), left (ventral)	0	0	0	0	1	1.1
Left & right (dorsal), left partial (ventral)	0	0	0	0	2	2.2
Left & right (dorsal), left & right partial (ventral)	0	0	0	0	1	1.1
Left & right (dorsal), right (ventral)	1	1.6		0	0	0
Left & right (dorsal), right partial (ventral)	0	0	0	0	1	1.1
Left & right partial	2	3.1	1	4.8	2	2.2
Left & right partial (dorsal), left (ventral)	0	0	0	0	1	1.1
Left partial & right	0	0	1	4.8	2	2.2
Left partial & right partial	0	0	0	0	3	3.3
Left & right partial (dorsal), left partial (ventral)	0	0	0	0	1	1.1
Left & right partial (dorsal), total (ventral)	0	0	0	0	1	1.1

Table 5.49 continued

Left partial (dorsal) , left partial & right (ventral)	0	0	0	0	1	1.1
Left partial & right (dorsal), left (ventral)	0	0	0	0	1	1.1
Right (dorsal), left (ventral)	1	1.6	0	0	0	0
Distal						
Distal	34	53.1	3	14.3	19	21.1
Distal (dorsal & ventral)	0	0	0	0	0	0
Distal-medial	5	7.8	1	4.8	0	0
Proximal						
Proximal	6	9.4	0	0	2	2.2
n	64	100.2	21	100.1	90	99.7

Table 5.50

Frequencies and percentages of retouch types found on points from different MSA phases at Umhlathuzana.

Retouch type	MSA/LSA transition		late MSA		pre-Howiesons Poort	
	n	%	n	%	n	%
Invasive						
Invasive	59	92.2	17	81.0	72	80.0
Marginal						
Marginal	3	4.7	3	14.3	12	13.3
Combinations of retouch types						
Invasive & marginal	2	3.1	1	4.8	4	4.4
Marginal & short	0	0	0	0	2	2.2
n	64	100.0	21	100.1	90	99.9

Base types of points

Plain platforms are the most common bases (25.6%) in the pre-Howiesons Poort. Butts that are completely removed by retouch and are broad and curved (20.5%) and faceted platforms (19.2%) are also frequent at this stage (see Table 5.51).

Faceted platforms, butts that are completely removed by retouch, and broad and curved bases are preferred over other base types in the late MSA (Table 5.51).

Reduced platforms (40.6%) are preferred in the MSA/LSA transition (9 on the ventral and 4 on the dorsal), but butts that are completely removed by retouch, and are broad and curved, are also favoured (28.1%) (Table 5.51).

Table 5.51

Frequencies and percentages of base types found on points (whole and proximal fragments) from different MSA phases at Umhlatuzana.

Base type	MSA/LSA transition		late MSA		pre-Howiesons Poort	
	n	%	n	%	n	%
Pointed	0	0	0	0	1	1.3
Broad, curved and removed by retouch	9	29.0	5	26.3	16	21.1
Platform faceted	1	3.2	5	26.3	15	19.7
Platform plain	5	16.1	4	21.1	20	26.3
Platform cortical	0	0	0	0	5	6.6
Platform broken	0	0	1	5.3	5	6.6
Reduced	13	41.9	2	10.5	11	14.5
Straight	3	9.7	2	10.5	3	3.9
n	31	100.0	19	100.0	76	100.0

Rock types of points

In the pre-Howiesons Poort quartzite is the most common rock type (51.1 %) (see Table 5.52 and Fig. 5.10 for other rock types). In the late MSA phase, mudstone is the preferred rock (38.1%) (Fig. 5.10) (Table 5.52). Hornfels is most often used in the MSA/LSA transition (82.8%) (Fig. 5.10) (Table 5.52). Tables 5.53-5.58 have averages of breadth, thickness, length, base thickness, base breadth and mass (respectively) of dolerite, quartz, quartzite, hornfels and mudstone points from Umhlatuzana.

Table 5.52

Frequencies and percentages of point rock types in the different MSA phases at Umhlatuzana.

Rock type	MSA/LSA transition		late MSA		pre-Howiesons Poort	
Dolerite	4	6.3	2	9.5	1	1.1
Hornfels	53	82.8	6	28.6	22	24.4
Quartz	0	0	1	4.8	12	13.3
Quartzite	1	1.6	4	19.0	46	51.1
Mudstone	5	7.8	8	38.1	9	10.0
Indeterminate	1	1.6	0	0	0	0
n	64	100.1	21	100.0	90	99.9

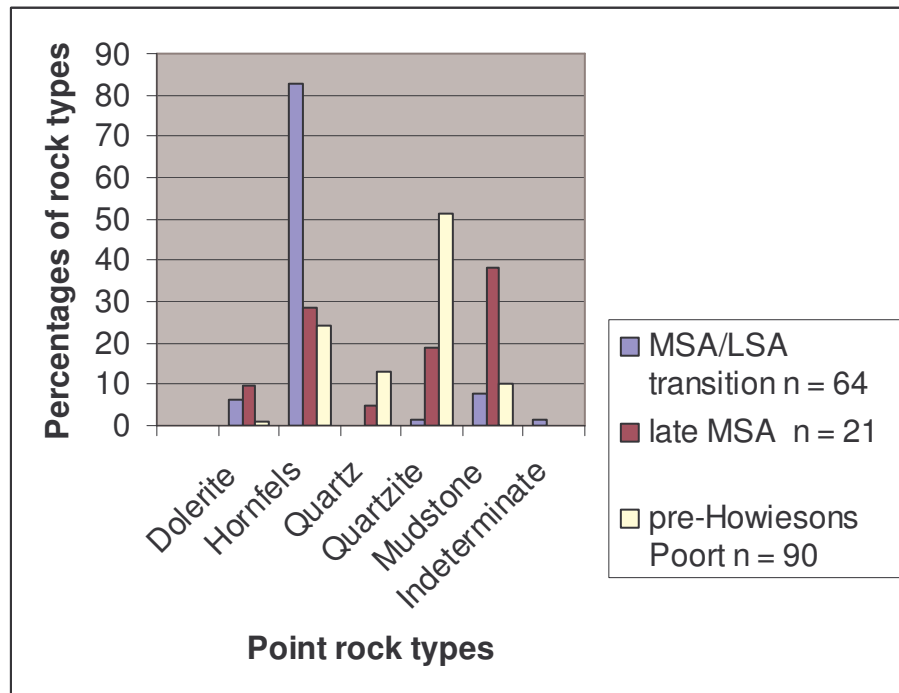


Fig. 5.10 Percentages of Umhlatuzana point rock types.

Table 5.53

Breadth (in mm) of whole and some broken dolerite, quartz, quartzite, hornfels and mudstone points from Umhlatuzana.

	Dolerite	Quartz	Quartzite	Hornfels	Mudstone
Mean	26.8	20.8	25.0	25.9	26.5
SD	6.7	8.9	6.2	5.1	5.2
Min	15.0	11.0	10.0	18.0	17.0
Max	32.0	39.0	39.0	39.0	39.0
n	6	8	36	29	15

Table 5.54

Thickness (in mm) of whole and some broken dolerite, quartz, quartzite, hornfels and mudstone points from Umhlatuzana.

	Dolerite	Quartz	Quartzite	Hornfels	Mudstone
Mean	9.7	9.9	10.3	9.1	9.4
SD	2.1	3.6	2.5	2.3	2.2
Min	8.0	5.0	6.0	6.0	5.0
Max	13.0	17.0	17.0	13.0	13.0
n	6	8	37	29	16

Table 5.55

Length (in mm) of whole and some side broken dolerite, quartz, quartzite, hornfels and points from Umhlatuzana.

	Dolerite	Quartz	Quartzite	Hornfels	Mudstone
Mean	46.3	49.5	48.0	46.8	48.9
SD	9.5	18.5	9.8	10.6	12.7
Min	28.0	30.0	31.0	33.0	30.0
Max	57.0	81.0	64.0	75.0	74.0
n	7	8	25	20	12

Table 5.56

Base thickness (in mm) of dolerite, quartz, quartzite, hornfels and mudstone points (whole and some proximal fragments) from Umhlatuzana.

	Dolerite	Quartz	Quartzite	Hornfels	Mudstone
Mean	5.8	5.5	6.2	5.4	4.7
SD	2.6	0.7	3.1	2.3	2.0
Min	3.0	5.0	2.0	2.0	2.0
Max	9.0	6.0	16.0	11.0	9.0
n	5	2	39	31	14

Table 5.57

Base breadth (in mm) of dolerite, quartz, quartzite, hornfels and mudstone points (whole and some proximal fragments) from Umhlatuzana.

	Dolerite	Quartz	Quartzite	Hornfels	Mudstone
Mean	25.8	11.5	17.3	20.4	18.4
SD	5.3	2.1	6.4	7.3	6.5
Min	18.0	10.0	7.0	9.0	11.0
Max	32.0	13.0	37.0	35.0	33.0
n	6	2	39	31	14

Table 5.58

Mass (in g) of dolerite, quartz, quartzite, hornfels and mudstone points (whole and almost complete) from Umhlatuzana.

	Dolerite	Quartz	Quartzite	Hornfels	Mudstone
Mean	14.7	12.6	13.1	11.1	11.0
SD	3.7	15.5	7.9	6.0	5.5
Min	9.5	1.5	4.7	4.9	3.9
Max	18.5	49.2	37.2	25.9	23.1
n	5	8	25	19	11

Coefficient of variation (CV)

As is the case at Sibudu, mass, thickness at base, and breadth at base are the least standardized categories, while there seems to be more standardization in length, breadth and, to some extent, thickness (Table 5.59). Pre-Howiesons Poort points' length/breadth ratios are not standardized and they are the least standardized length/breadth ratios in the sequence (Table 5.59). The CV of length/breadth ratios of late MSA points is the most standardized ratio in the sequence (even though a CV of 16 is too high to be considered standardized) (Table 5.59). MSA/LSA transition points' length/breadth ratios have a high CV and are therefore unstandardized like those of the pre-Howiesons Poort (Table 5.59).

Umhlatuzana points show more-or-less equal coefficients of variation among unifacial and bifacial points in length, breadth and thickness. Relative to the Sibudu ones, those from Umhlatuzana are slightly more standardized, although none can be considered standardized (Table 5.60).

Table 5.59

Coefficient of variation (CV) of measurements of points from MSA phases at Umhlatuzana.

Measurement	MSA/LSA transition	late MSA	pre-Howiesons Poort
Breadth	20.9	20.8	24.5
Thickness	28.9	27.8	23.7
Length	22.8	19.1	24.8
Length/breadth ratio	22.0	16.0	25.0
Thickness at base	86.7	45.3	47.5
Breadth at base	51.3	34.9	38.8
Mass	48.1	64.0	68.3

Table 5.60

Coefficients of variation (CV) for various measurements of unifacial and bifacial points from all MSA phases at Umhlatuzana.

Measurement	Unifacial points	Bifacial points
Breadth	22.5	24.3
Thickness	25.3	27.1
Length	21.7	23.9
Thickness at base	41.7	51.9
Breadth at base	31.6	41.9
Mass	61.5	68.0

T-tests

Pre-Howiesons Poort points from Umhlatuzana are significantly narrower than late MSA points (Table 5.61). Length/breadth ratio results discussed earlier show that the pre-Howiesons Poort points are more elongated than the others (Table 5.42). However, there are no significant differences between thicknesses (Table 5.62), lengths (Table 5.63) and masses (Table 5.66) of

points from the different MSA phases at Umhlatuzana. Pre-Howiesons Poort points are thicker at the base than the MSA/LSA transition points (Table 5.64). Breadths of bases of points from all the layers at Umhlatuzana do not differ significantly (Table 5.65). Late MSA points have bigger penetrating angles than MSA/LSA transition points (Table 5.67), and their TCSAs are significantly larger than those of pre-Howiesons Poort points (Table 5.68).

Quartz points at Umhlatuzana are significantly narrower than hornfels ones (Table 5.69); hornfels points are thinner than quartzite ones (Table 5.70) and quartz points have thinner bases than dolerite ones (Table 5.72). However, in comparison to Sibudu, there are generally few significant differences between Umhlatuzana points of different rock types. There are no significant differences in length, thickness at base and mass (Tables 5.71, 5.72 & 5.74).

Table 5.61

Differences in breadth of points (including some distal/proximal fragments but excluding tips) from various MSA phases in Umhlatuzana.

	late MSA	pre-Howiesons Poort
MSA/LSA transition	$t = 2.0; p = 0.4$	$t = 2.0; p = 0.3$
late MSA	-	$t = 2.0; p = 0.03$

Table 5.62

Differences in thickness of points (including some distal/proximal fragments but excluding tips) from various MSA phases in Umhlatuzana.

	late MSA	pre-Howiesons Poort
MSA/LSA transition	-	$t = 2.0; p = 0.1$
late MSA	-	$t = 2.0; p = 0.1$

Table 5.63

Differences in length of points (whole and side-broken) from various MSA phases in Umhlatusana.

	late MSA	pre-Howiesons Poort
MSA/LSA transition	$t = 2.0; p = 0.4$	$t = 2.0; p = 1.0$
late MSA	-	$t = 2.0; p = 1.0$

Table 5.64

Differences in thickness at base of points (whole and proximal fragments) from various MSA phases in Umhlatusana.

	late MSA	pre-Howiesons Poort
MSA/LSA transition	$t = 2.0; p = 0.1$	$t = 2.0; p = 0.01$
late MSA	-	$t = 2.0; p = 0.4$

Table 5.65

Differences in breadth at base of points (whole and proximal fragments) from various MSA phases in Umhlatusana.

	late MSA	pre-Howiesons Poort
MSA/LSA transition	$t = 2.0; p = 1.0$	$t = 2.0; p = 0.3$
late MSA	-	$t = 2.0; p = 0.4$

Table 5.66

Differences in mass of points (whole and almost complete) from various MSA phases in Umhlatusana.

	late MSA	pre-Howiesons Poort
MSA/LSA transition	$t = 2.0; p = 0.3$	$t = 2.0; p = 1.0$
late MSA	-	$t = 2.0; p = 0.4$

Table 5.67

Differences in penetrating angles of points (whole plus distal/proximal tips ≥ 10 mm) from various MSA phases in Umhlatuzana.

	late MSA	pre-Howiesons Poort
MSA/LSA transition	$t = 2.0; p < 0.01$	$t = 2.0; p < 0.01$
late MSA	-	$t = 2.0; p = 0.4$

Table 5.68

Differences in TCSA of points (whole, almost complete plus some distal/proximal fragments) from various MSA phases in Umhlatuzana.

	late MSA	pre-Howiesons Poort
MSA/LSA transition	$t = 2.0; p = 0.01$	$t = 2.0; p = 1.0$
late MSA	-	$t = 2.0; p < 0.01$

Table 5.69

Differences in breadth of hornfels, quartz, quartzite, mudstone and dolerite points (whole and some broken) from Umhlatuzana.

	Quartz	Quartzite	Mudstone	Dolerite
Hornfels	$t = 2.0; p = 0.04$	$t = 2.0; p = 1.0$	$t = 2.0; p = 1.0$	$t = 2.0; p = 1.0$
Quartz	-	$t = 2.0; p = 0.1$	$t = 2.1; p = 0.06$	$t = 2.2; p = 0.2$
Quartzite	-	-	$t = 2.0; p = 0.4$	$t = 2.0; p = 1.0$
Mudstone	-	-	-	$t = 2.1; p = 1.0$

Table 5.70

Differences in thickness of hornfels, quartz, quartzite, mudstone and dolerite points (whole and some broken) from Umhlatuzana.

	Quartz	Quartzite	Mudstone	Dolerite
Hornfels	$t = 2.0; p = 0.4$	$t = 2.0; p = 0.04$	$t = 2.0; p = 1.0$	$t = 2.0; p = 1.0$
Quartz	-	$t = 2.0; p = 1.0$	$t = 2.1; p = 1.0$	$t = 2.2; p = 1.0$
Quartzite	-	-	$t = 2.0; p = 0.2$	$t = 2.0; p = 1.0$
Mudstone	-	-	-	$t = 2.1; p = 1.0$

Table 5.71

Differences in length of hornfels, quartz, quartzite, mudstone and dolerite points (whole and side-broken from Umhlatuzana.

	Quartz	Quartzite	Mudstone	Dolerite
Hornfels	$t = 2.0; p = 1.0$	$t = 2.0; p = 1.0$	$t = 2.0; p = 1.0$	$t = 2.1; p = 1.0$
Quartz	-	$t = 2.0; p = 1.0$	$t = 2.1; p = 1.0$	$t = 2.2; p = 1.0$
Quartzite	-	-	$t = 2.0; p = 1.0$	$t = 2.0; p = 1.0$

Table 5.72

Differences in thickness at base of hornfels, quartz, quartzite, mudstone and dolerite points (whole and proximal fragments) from Umhlatuzana.

	Quartz	Quartzite	Mudstone	Dolerite
Hornfels	$t = 2.0; p = 1.0$	$t = 2.0; p = 0.2$	$t = 2.0; p = 0.3$	$t = 2.0; p = 1.0$
Quartz	-	$t = 2.0; p = 1.0$	$t = 2.1; p = 1.0$	$t = 2.6; p = 1.0$
Quartzite	-	-	$t = 2.0; p = 0.1$	$t = 2.0; p = 1.0$

Table 5.73

Differences in breadth at base of hornfels, quartz, quartzite, mudstone and dolerite points (whole and proximal fragments) from various MSA phases in Umhlatuzana.

	Quartz	Quartzite	Mudstone	Dolerite
Hornfels	$t = 2.0; p = 0.1$	$t = 2.0; p = 0.1$	$t = 2.0; p = 0.4$	$t = 2.0; p = 0.1$
Quartz	-	$t = 2.0; p = 0.2$	$t = 2.1; p = 0.2$	$t = 2.4; p = 0.01$
Quartzite	-	-	$t = 2.0; p = 1.0$	$t = 2.0; p < 0.01$
Mudstone	-	-	-	$t = 2.1; p = 0.02$

Table 5.74

Differences in mass of hornfels, quartz, quartzite, mudstone and dolerite points (complete and almost complete) from Umhlatuzana.

	Quartz	Quartzite	Mudstone	Dolerite
Hornfels	$t = 2.0; p = 1.0$	$t = 2.0; p = 0.4$	$t = 2.0; p = 1.0$	$t = 2.1; p = 0.2$
Quartz	-	$t = 2.0; p = 1.0$	$t = 2.1; p = 1.0$	$t = 2.2; p = 1.0$
Quartzite	-	-	$t = 2.0; p = 0.4$	$t = 2.0; p = 1.0$
Mudstone	-	-	-	$t = 2.1; p = 0.2$

Summary: characterization of Umhlatuzana points through time

Pre-Howiesons Poort

These points are narrower and more elongated than other points in the sequence, especially the late MSA points, which are significantly wider. Pre-Howiesons Poort points are, however, thicker at the base than MSA/LSA transition points. These points have a mean penetrating angle that is smaller than that of late MSA points (though not significantly so) and their mean TCSA is significantly smaller than that of pre-Howiesons Poort points. There are no significant differences in thickness, length, base breadth and mass of Umhlatuzana points throughout the sequence.

Bifacial working is common in the pre-Howiesons Poort and this is not the case in the other phases at Umhlatuzana. Pre-Howiesons Poort points are mostly retouched all over (total retouch) and this also applies to late MSA points. The commonly used retouch type in the pre-Howiesons Poort is invasive retouch (80%), which is also common throughout the sequence. Plain platforms are frequent in the pre-Howiesons Poort, but butts that are completely removed by retouch and are broad and curved, and faceted platforms, are also frequent. Quartzite is predominantly used in this phase and this does not happen anywhere else in the sequence.

Late MSA points

These points are wider and thicker (though not significantly so) than other points in the sequence. They have the biggest mean penetrating angle and TCSA than other points in the sequence. As noted earlier, unifacial working is common in the late MSA at Umhlatuzana and points are commonly retouched all over with invasive retouch, as is the case in the pre-Howiesons Poort. These points have equal frequencies of faceted platforms and butts that are completely removed by retouch and are broad and curved. The predominant rock type is mudstone.

MSA/LSA transition points

These points are less elongated than other points in the sequence (their length/breadth ratio is 1.8) and they have the smallest penetrating angle. Unifacial points and point fragments are common, as in the late MSA, and there are some hollow-based points which are not found anywhere else in the sequence. Most points and point fragments are retouched on their distal tips, though retouch all over the point is still common. Invasive retouch and reduced platforms are favoured. Hornfels is used more than any other rock type in this phase.

The influence of rock types on point attributes

There are very few differences between points made from different rock types at Umhlatuzana. There are no differences in length, thickness at base and mass. However, quartz points are significantly narrower than hornfels ones and have thinner bases than dolerite ones. Hornfels points are thinner than quartzite ones.

Comparison of Sibudu and Umhlatuzana points through time

Still Bay at Sibudu and pre-Howiesons Poort at Umhlatuzana

Both sets of points are elongated with blade proportions. Both are narrower than other points in their sequences and have narrow bases. Pointed bases are more common at Sibudu than Umhlatuzana, where there is only one pointed base. Both sites have points with the smallest TCSAs in their sequences, but Umhlatuzana has much larger penetrating angles than Sibudu. Both sets of points have high percentages of invasive retouch, but Umhlatuzana has far less bifacial working on points than Sibudu. No Still Bay points have faceted platforms at Sibudu, but they are common in the Umhlatuzana pre-Howiesons Poort. Quartzite is the most commonly used rock type (51.1 %) at Umhlatuzana; it is less often (23.3 %) favoured at Sibudu, where dolerite is more popular (46.7 %).

Differences between the Still Bay and the more recent assemblages at Sibudu are more marked than the differences at Umhlatuzana between the pre-Howiesons Poort and the late MSA and the MSA/LSA transition. I suggest that the observation at Umhlatuzana could be explained by mixing of assemblages. As documented earlier, rotational slippage at the site may have caused some mixing and this was probably exacerbated by the lack of observable stratigraphy. The Umhlatuzana pre-Howiesons Poort assemblage may contain some Still Bay points, but there is also a sample of points that would not normally be present in a Still Bay industry.

Post-Howiesons Poort and late MSA at Sibudu and late MSA at Umhlatuzana

Post-Howiesons Poort points at Sibudu are broader, thicker, longer and heavier than other points in the MSA sequence and they have the largest penetrating angle and TCSA. Late MSA points at Umhlatuzana are also wider and thicker than other points and have the largest penetrating angle and TCSA. Unifacial working and invasive retouch are common in both the post-Howiesons Poort and late MSA at Sibudu and also in the late MSA at Umhlatuzana. However, though hornfels is preferred for making points in the post-Howiesons Poort and late MSA at Sibudu, it is not the preferred rock type in Umhlatuzana late MSA where mudstone is preferred. Faceted platforms are common in the post-Howiesons Poort and late MSA of Sibudu and the late MSA of

Umhlatuzana, however, butts that have been completely removed by retouch, and are broad and curved, are equally favoured at Umhlatuzana.

Final MSA at Sibudu and MSA/LSA transition at Umhlatuzana

Both sites have hollow-based points in common, and this point type seems to be a local marker for final MSA tool-kits.

This technological study of the points from Sibudu and Umhlatuzana shows that there is considerable temporal change in points at both sites. I now move, in Chapter Six, to a technological analysis of segments from Sibudu, Umhlatuzana and Jubilee Shelter, with the intention of exploring similar diversity among segments within the Howiesons Poort industries of Sibudu and Umhlatuzana, and the Wilton Industry of Jubilee.

CHAPTER SIX

ANALYSIS OF SEGMENTS FROM SIBUDU, UMHLATUZANA AND JUBILEE

Segments in Sibudu are found in squares B5 and B6 in layers in the following phases: the Howiesons Poort, the post-Howiesons Poort, the late MSA and the Still Bay. A total of 65 segments from Sibudu was analysed in this study: 40 (61.5%) of these are whole, 21 (32.3%) almost complete (tip broken) and four (6.2%) are broken (Table 6.1). More segments are found in the Howiesons Poort than anywhere else because 92.3% of the segments analysed here are from the Howiesons Poort. There are three (4.6%) segments from the post-Howiesons Poort, and one (1.5%) segment each from the late MSA and the Still Bay (see Fig. 6.1 for drawings of these segments). It is possible that because of the thinness of the layers at this site, the one segment in the Still Bay could be from the Howiesons Poort, which is immediately overlying the Still Bay. There are 93 segments from Umhlatuzana; 69 (74.2%) of these are whole, 20 (21.5%) almost complete and 4 (4.3%) broken (Table 6.1). All segments from Umhlatuzana are from pre-Howiesons Poort/Howiesons Poort layers, except for one which is from the MSA/LSA transition (see Fig. 6.2 for drawings of these segments). A total of 41 segments from Jubilee Shelter was analysed and all are from the Wilton (LSA) Industry (Table 6.1 and see Fig. 6.3).

Table 6.1

Sibudu, Umhlatuzana and Jubilee segments (frequencies and percentages) used for this study.

Segments	Sibudu		Umhlatuzana		Jubilee	
	n	%	n	%	n	%
Whole	40	61.5	69	74.2	41	100.0
Almost complete	21	32.3	20	21.5	0	0
Broken	4	6.2	4	4.3	0	0
Total	65	100.0	93	100.0	41	100.0

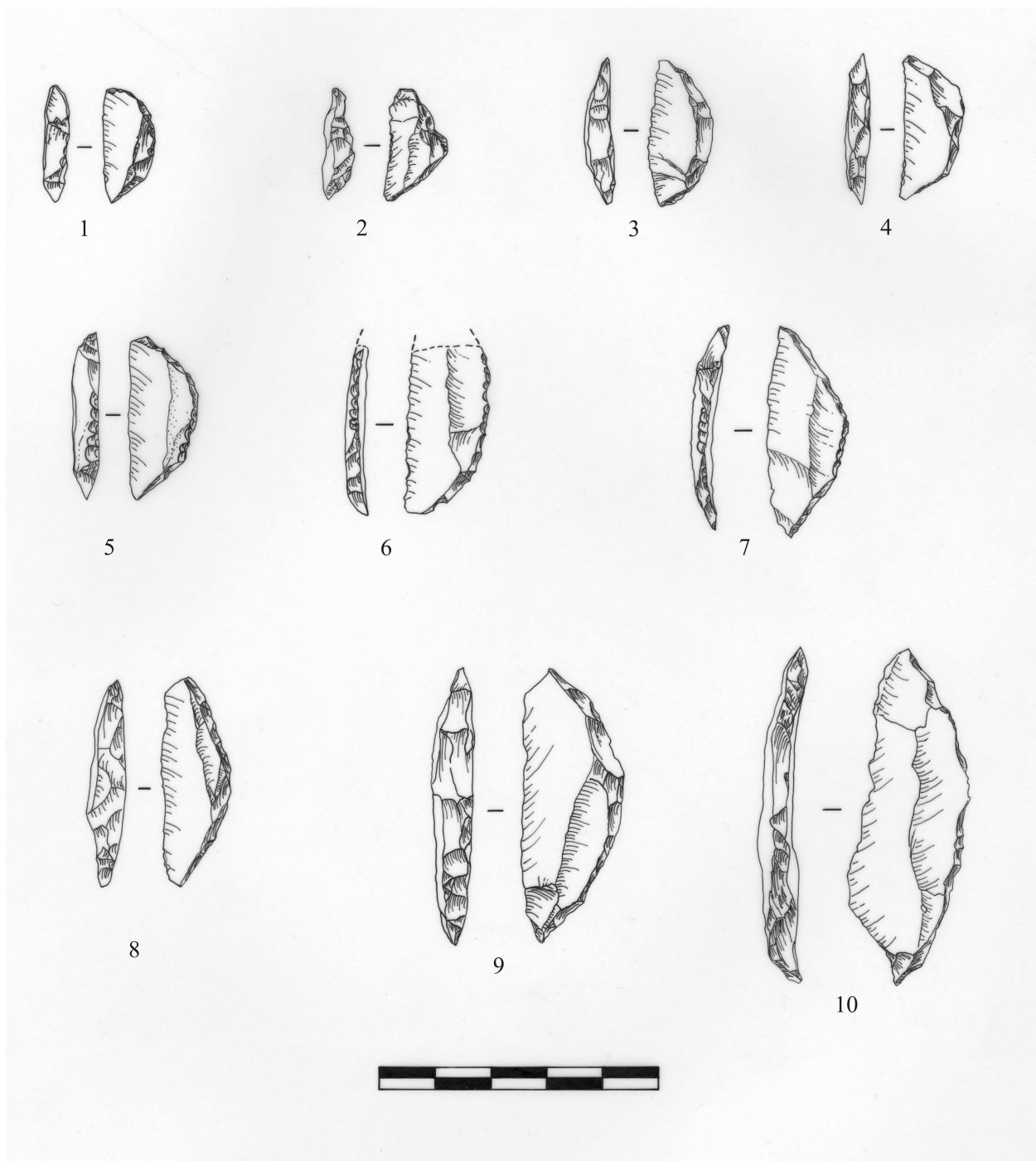


Fig. 6.1 Segments from Howiesons Poort layers at Sibudu: 1-2 are quartz segments from layers GS II and Hearth in PGS at Sibudu, 3-5 hornfels segments from layers GS II, GS and Hearth in GR II, 6 a broken dolerite segment from GR II, 7 a dolerite segment from GR II, 8-9 hornfels segments from GS above rock and PGS and 10 is a dolerite segment from Brown under YA2 in Grey. Note the variability in the sizes of the segments.

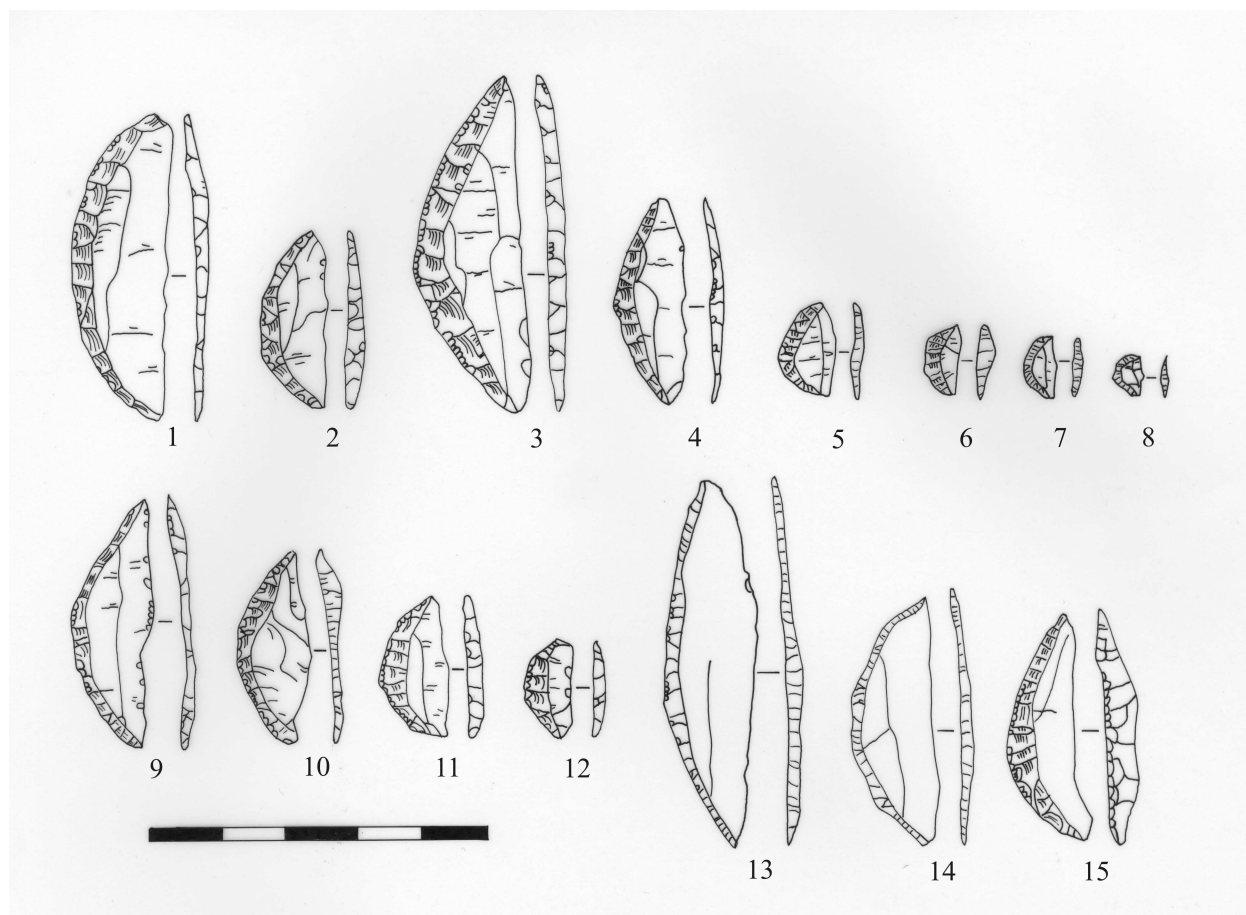


Fig. 6.2 Segments from Howiesons Poort layers at Umhlatuzana: 1-15. Note the variability in the sizes of the segments (segments redrawn from Kaplan 1990).

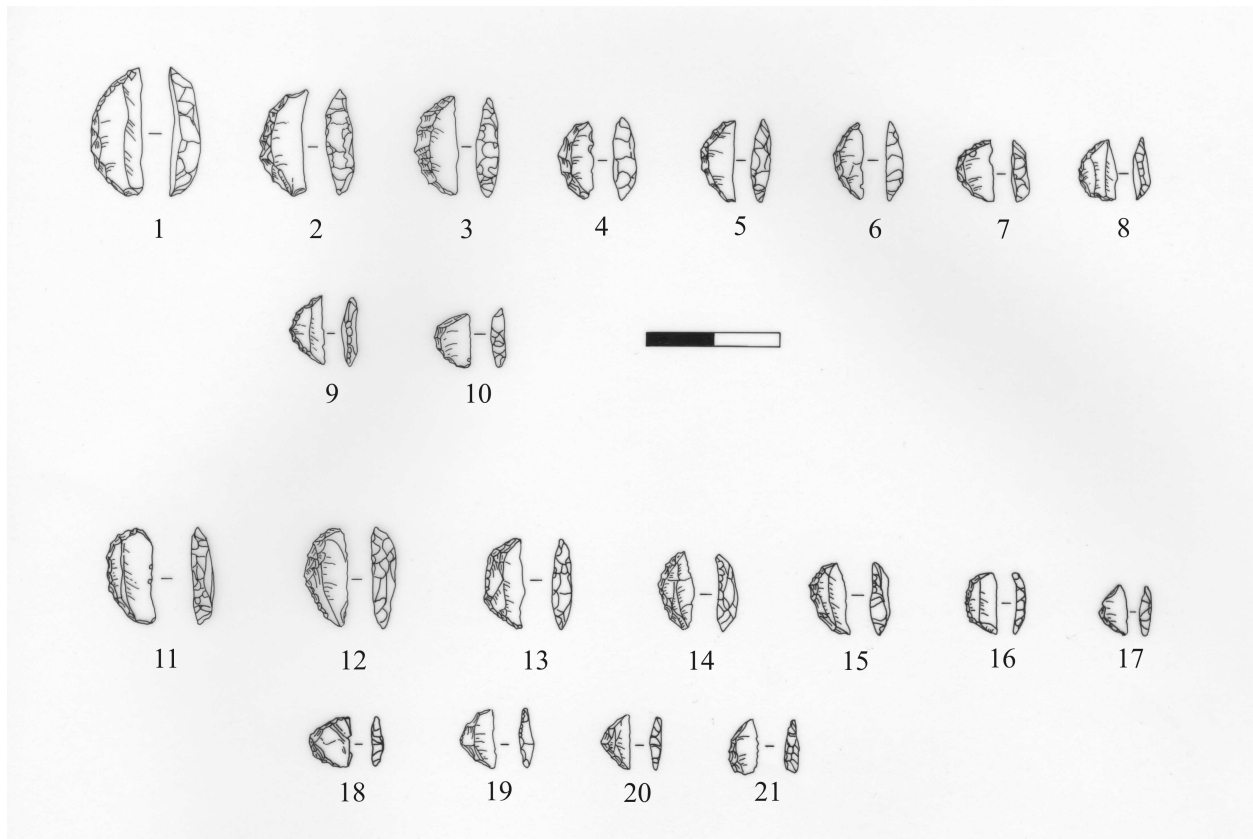


Fig. 6.3 Wilton segments from Jubilee: 1-21. Note the small size of most of these segments (Segments redrawn from Wadley 1987).

Breadth, thickness and length of Sibudu, Umhlatuzana and Jubilee segments

Sibudu segments' breadths are slightly smaller than those of Umhlatuzana Cave segments, but segments from both sites are much wider than those of Jubilee Shelter (Table 6.2).

Sibudu and Umhlatuzana segments have similar mean thicknesses of 4.1 ± 1.4 mm and 4.2 ± 1.3 mm, respectively. The mean thickness of Jubilee Shelter segments is almost half of those from Sibudu and Umhlatuzana segments (Table 6.3).

Sibudu segment lengths, like breadths, are slightly smaller than those of Umhlatuzana Cave segments, but segments from both sites are much longer than those of Jubilee Shelter (Table 6.4).

Table 6.2

Breadth (in mm) of segments (whole, almost complete and some broken) from Sibudu, Umhlatuzana and Jubilee Shelter.

	Sibudu	Umhlatuzana	Jubilee
Mean	11.8	12.1	5.1
SD	3.3	3.0	1.7
Min	6.0	6.0	3.0
Max	20.0	22.0	13.0
n	65	91	41

Table 6.3

Thickness (in mm) of segments (whole, almost complete and some broken) from Sibudu, Umhlatuzana and Jubilee Shelter.

	Sibudu	Umhlatuzana	Jubilee
Mean	4.1	4.2	2.4
SD	1.4	1.3	0.8
Min	2.0	2.0	1.0
Max	8.0	11.0	4.0
n	65	91	41

Table 6.4

Length (in mm) of segments (whole and side-broken) from Sibudu, Umhlatuzana and Jubilee Shelter.

	Sibudu	Umhlatuzana	Jubilee
Mean	25.0	29.8	10.3
SD	8.4	10.6	3.8
Min	13.0	11.0	5.0
Max	48.0	63.0	24.0
n	40	73	41

Length/breadth ratios of Sibudu, Umhlatuzana and Jubilee segments

The length/breadth ratio of all Umhlatuzana segments is larger than that of Sibudu, and Jubilee Shelter has the smallest length/breadth ratio (Table 6.5). These length/breadth ratios indicate that both MSA and LSA segments were made from blades or were trimmed to blade-like proportions, because all ratios are equal to, or greater than, 2.0.

Table 6.5

Length/breadth ratios of whole segments from Sibudu, Umhlatuzana and Jubilee Shelter.

	Sibudu	Umhlatuzana	Jubilee
Mean	2.3	2.6	2.0
SD	0.5	0.7	0.4
Min	1.4	1.4	1.2
Max	3.6	4.2	3.2
n	40	71	41

Mass of Sibudu, Umhlatuzana and Jubilee segments

The mean masses of Sibudu and Umhlatuzana segments are similar (1.3 ± 1.1 g and 1.5 ± 1.1 g, respectively) (Table 6.6). The mean mass of Jubilee Shelter segments could not be measured, however, because a number of segments (17 out of 41) have masses that are too tiny to move the digital scale. Even those whose masses can be measured have very low masses (the maximum mass is only 1.0 g).

Table 6.6

Mass (in g) of segments from Sibudu and Umhlatuzana.

	Sibudu	Umhlatuzana
Mean	1.3	1.5
SD	1.1	1.1
Min	0.2	0.3
Max	5.2	5.9
n	40	69

Penetrating angle and tip cross-sectional area (TCSA) of Sibudu, Umhlatuzana and Jubilee segments

Penetrating angles were measured on both the distal and proximal tips of the segments. In some cases proximal tips were recognized by a trace of a bulb of percussion, while in cases where there was no evidence for a bulb, the thicker, blunter tip was regarded as proximal. The mean distal penetrating angles of Sibudu and Umhlatuzana segments barely differ ($51.4 \pm 7.1^\circ$ and $51.7 \pm 9.8^\circ$, respectively). The mean proximal penetrating angles of these segments are, however, different: the Sibudu segment angle of $50.6 \pm 6.6^\circ$ is smaller than that of the Umhlatuzana segments ($55.6 \pm 28.6^\circ$). Jubilee Shelter's proximal and distal penetrating angles are even smaller: $42.3 \pm 11.1^\circ$ and $43.4 \pm 4.5^\circ$, respectively (Table 6.7).

As mentioned in Chapter Two, there have been archaeologically recorded cases where two segments were found hafted back-to-back. If this scenario also occurred at Sibudu, Umhlatuzana and Jubilee, these sites' distal double penetrating angles (hafted back-to-back) would approximately be 102.8° , 103.6° and 86.8° , respectively and their double proximal angles would approximately be 101.2° , 110.0° and 84.6° , respectively.

The mean TCSA values of Sibudu and Umhlatuzana segments are almost the same ($26 \pm 15.6 \text{ mm}^2$ and $26.4 \pm 15 \text{ mm}^2$, respectively). The mean TCSA of Jubilee segments is only $6.6 \pm 4.4 \text{ mm}^2$ (Table 6.8). Experiments by Pargeter (2006) show that segments function well when they are hafted horizontally (transversely). Thus, TCSAs have also been calculated using length in place of breadth (because when segments are hafted horizontally, their lengths become their breadths). At Sibudu, the resulting TCSA is $51.4 \pm 30.6 \text{ mm}^2$. At Umhlatuzana, the mean TCSA of segments using length in place of breadth is $63.3 \pm 33.0 \text{ mm}^2$ and this is more than twice the TCSA of the value using breadth in the calculation. At Jubilee Shelter the mean TCSA when length is used is $13.6 \pm 9.5 \text{ mm}^2$.

Table 6.7

Penetrating angle (in degrees) of segments from Sibudu, Umhlatuzana and Jubilee Shelter (values for proximal angles are in bold).

	Sibudu	Umhlatuzana	Jubilee
Mean: distal	51.4	51.8	43.4
: proximal	50.6	55.0	42.3
SD :distal	7.1	9.8	4.5
: proximal	6.6	12.0	11.1
Min : distal	36.0	30.0	35.0
: proximal	39.0	25.0	38.0
Max : distal	66.0	80.0	54.0
: proximal	63.0	100.0	60.0
n : distal	62	89	41
: proximal	35	51	41

Table 6.8

Tip cross-sectional area (TCSA) (in mm²) of segments from Sibudu, Umhlatuzana and Jubilee Shelter.

	Sibudu	Umhlatuzana	Jubilee
Mean	26.0	26.4	6.6
SD	15.6	15.0	4.4
Min	7.0	7.0	1.5
Max	80.0	121.0	24.0
n	65	90	41

Table 6.9

Tip cross-sectional area (TCSA) (in mm²) of segments from Sibudu, Umhlatuzana and Jubilee Shelter. In this calculation, length is substituted for breadth (see text for explanation).

	Sibudu	Umhlatuzana	Jubilee
Mean	51.4	63.3	13.6
SD	30.6	33.0	9.5
Min	19.0	15.0	2.5
Max	136.5	157.5	48.0
n	40	71	41

Rock types: Sibudu, Umhlatuzana and Jubilee

At Sibudu and Umhlatuzana, hornfels is the preferred rock type for segment production (50.8% and 53.8%, respectively). At Sibudu, dolerite is the next most popular (29.2%) rock type, while the remaining segments are made of quartz. At Umhlatuzana, quartz (29%) is the most common rock type after hornfels (see Table 6.10 for other rock types used on these sites). At Jubilee Shelter, the predominant rock type is chert (46.3%). Quartz is also common here (36.6%) (Table 6.10).

At Sibudu, dolerite segments are wider, thicker, longer and heavier than quartz and hornfels segments (Tables 6.11-15). Quartz segments are narrower, shorter and lighter than hornfels segments, but they are thicker than hornfels segments. Length/breadth ratios of hornfels and dolerite segments are much more elongated than those of quartz segments (Table 6.14).

At Umhlatuzana, dolerite segments are wider than quartz, hornfels, mudstone and quartzite segments (Table 6.16). Dolerite, hornfels, mudstone and quartzite segments have similar thicknesses, but quartz segments are slightly thinner (Table 6.17). Hornfels segments are the longest; mudstone and quartzite have similar mean lengths and all three are longer than dolerite and quartz segments. Quartz segments are the shortest and lightest (Tables 6.18 & 6.20). Hornfels segments weigh less than mudstone segments, but are heavier than the rest of the segments. Quartzite segments are heavier than dolerite ones (Table 6.20). Hornfels segments are

the most elongated and quartz the least elongated, but the mean length/breadth ratios of all rock types fall within blade proportions (Table 6.19).

At Jubilee Shelter, quartz and hornfels segments have similar mean breadths and are narrower than chert segments (Table 6.21). Quartz, hornfels and chert segments have similar thicknesses (Table 6.22). Quartz and hornfels segments have similar lengths and both are shorter than chert segments (Table 6.23). Hornfels segments are the most elongated and chert segments are the least elongated (Table 6.24). Mass could not be recorded.

Table 6.10

Frequencies and percentages of rock types of segments from Sibudu, Umhlatuzana and Jubilee.

Rock type	Sibudu		Umhlatuzana		Jubilee	
	n	%	n	%	n	%
Hornfels	34	50.8	50	53.8	3	7.3
Dolerite	19	29.2	3	3.2	0	0
Quartz	12	20.0	27	29.0	15	36.6
Quartzite	0	0	4	4.3	2	4.9
Mudstone	0	0	9	9.7	0	0
Chert	0	0	0	0	19	46.3
Chalcedony	0	0	0	0	1	2.4
Indeterminate	0	0	0	0	1	2.4
Total	65	100	93	100	41	99.9

Table 6.11

Breadth (in mm) of whole and some broken dolerite, quartz, and hornfels segments from Sibudu.

	Dolerite	Quartz	Hornfels
Mean	13.5	10.2	11.4
SD	3.2	3.5	2.9
Min	7.0	6.0	6.0
Max	19.0	18.0	20.0
n	19	12	34

Table 6.12

Thickness (in mm) of whole and some broken dolerite, quartz and hornfels segments from Sibudu.

	Dolerite	Quartz	Hornfels
Mean	4.7	4.1	3.9
SD	1.5	1.4	1.4
Min	3.0	3.0	2.0
Max	7.0	6.0	8.0
n	19	12	34

Table 6.13

Length (in mm) of whole dolerite, quartz and hornfels segments from Sibudu.

	Dolerite	Quartz	Hornfels
Mean	31.5	17.4	24.9
SD	10.0	3.5	6.1
Min	13.0	13.0	14.0
Max	48.0	24.0	38.0
n	11	9	20

Table 6.14

Length/breadth ratios of whole dolerite, quartz and hornfels segments from Sibudu.

	Dolerite	Quartz	Hornfels
Mean	2.5	1.9	2.4
SD	0.5	0.3	0.6
Min	1.6	1.4	1.5
Max	3.3	2.3	3.6
n	11	9	20

Table 6.15

Mass (in g) of whole dolerite, quartz and hornfels segments from Sibudu.

	Dolerite	Quartz	Hornfels
Mean	2.0	0.7	1.1
SD	1.4	0.4	0.8
Min	0.2	0.3	0.3
Max	5.2	1.7	4.1
n	11	9	20

Table 6.16

Breadth (in mm) of whole and some broken dolerite, quartz, hornfels, mudstone and quartzite segments from Umhlatuzana.

	Dolerite	Quartz	Hornfels	Mudstone	Quartzite
Mean	13.0	10.2	12.8	12.9	12.0
SD	1.0	3.1	2.7	3.3	2.9
Min	12.0	6.0	8.0	9.0	9.0
Max	14.0	18.0	22.0	20.0	15.0
n	3	25	50	9	4

Table 6.17

Thickness (in mm) of whole and some broken dolerite, quartz, hornfels, mudstone and quartzite segments from Umhlatuzana.

	Dolerite	Quartz	Hornfels	Mudstone	Quartzite
Mean	4.0	3.9	4.2	4.4	4.5
SD	1.0	1.1	1.4	1.1	1.3
Min	3.0	2.0	2.0	3.0	3.0
Max	5.0	6.0	11.0	7.0	6.0
n	3	25	50	9	4

Table 6.18

Length (in mm) of whole dolerite, quartz, hornfels, mudstone and quartzite segments from Umhlatuzana.

	Dolerite	Quartz	Hornfels	Mudstone	Quartzite
Mean	28.5	20.8	35.0	31.6	31.7
SD	7.8	6.3	9.6	6.8	9.8
Min	23.0	11.0	20.0	22.0	26.0
Max	34.0	34.0	63.0	40.0	43.0
n	2	24	36	5	3

Table 6.19

Length/breadth ratios of whole dolerite, quartz, hornfels, mudstone and quartzite segments from Umhlatuzana.

	Dolerite	Quartz	Hornfels	Mudstone	Quartzite
Mean	2.3	2.0	3.0	2.8	2.5
SD	0.8	0.3	0.6	0.7	0.5
Min	1.8	1.4	1.9	2.0	1.8
Max	2.8	2.7	4.1	4.2	2.9
n	2	24	35	6	4

Table 6.20

Mass (in g) of whole dolerite, quartz, hornfels, mudstone and quartzite segments from Umhlatuzana.

	Dolerite	Quartz	Hornfels	Mudstone	Quartzite
Mean	1.3	1.0	1.8	2.1	1.6
SD	0.2	0.8	1.2	1.3	1.4
Min	1.1	0.2	0.5	0.7	0.8
Max	1.5	2.9	5.9	4.5	3.3
n	2	24	34	6	3

Table 6.21

Breadth (in mm) of whole and some broken quartz, hornfels and chert segments from Jubilee.

	Quartz	Hornfels	Chert
Mean	4.6	4.0	5.5
SD	0.9	0	2.2
Min	3.0	4.0	3.0
Max	6.0	4.0	12.0
n	15	3	19

Table 6.22

Thickness (in mm) of whole and some broken quartz, hornfels and chert segments from Jubilee.

	Quartz	Hornfels	Chert
Mean	2.3	2.0	2.5
SD	0.6	0	1.0
Min	1.0	2.0	1.0
Max	3.0	2.0	4.0
n	15	3	19

Table 6.23

Length (in mm) of whole quartz, hornfels and chert segments from Jubilee.

	Quartz	Hornfels	Chert
Mean	9.2	9.3	10.5
SD	2.6	1.5	4.6
Min	6.0	8.0	5.0
Max	14.0	11.0	24.0
n	15	3	19

Table 6.24

Length/breadth ratios of whole quartz, hornfels and chert segments from Jubilee.

	Quartz	Hornfels	Chert
Mean	2.0	2.3	1.9
SD	0.4	0.4	0.4
Min	1.2	2.0	1.3
Max	2.6	2.8	2.8
n	15	3	19

Coefficient of variation (CV)

As is the case with points, the breadth, thickness and length of segments are more standardized than mass, which is the least standardized category. The CVs of length/breadth ratios of segments from all three sites are unstandardized, even though the Jubilee Shelter length/breadth ratio is the smallest (see Table 6.25). Interestingly, there is no development towards greater standardization in the LSA segments when all rock types are combined (see Table 6.25).

When the segments are divided by rock types, the picture is a bit more complex. At Sibudu, hornfels and dolerite mean breadths are more standardized than the quartz mean breadth. Thickness is the least standardized category amongst the different rock types (Table 6.26). The quartz mean length is more standardized than hornfels and dolerite mean lengths, and hornfels length is more standardized than dolerite length (Table 6.26). Coefficients of variation of length/breadth ratios of the segments indicate that quartz segments from Sibudu are more standardized (CV = 16.0) than length/breadth ratios of the hornfels or dolerite segments from the site. They are also more standardized than the length/breadth ratios of Jubilee Shelter quartz segments (CV = 20.0), but are slightly less standardized than those from Umhlatuzana (CV = 15.0) (Table 6.27). At Sibudu, hornfels segments' length/breadth ratios have a high CV (CV = 25) (Table 6.26).

At Umhlatuzana, hornfels, mudstone and dolerite breadths and lengths are more standardized than those of other rock types. Dolerite mean breadth has a particularly low CV (7.7), but there

are only three segments so this value may not be representative (Table 6.27). As is the case at Sibudu, Umhlatuzana hornfels segments' length/breadth ratios have a high CV (Table 6.27).

At Jubilee, chert segments are less standardized than hornfels and quartz ones in breadth, thickness and length. Quartzite breadth, thickness, length and length/breadth ratios have been excluded from Table 6.28 because there are only two segments in this category. Hornfels has perfectly standardized breadths and thicknesses, however, there are only three hornfels segments and the standardized CVs may be a chance occurrence here (Table 6.28). The Jubilee hornfels segment length/breadth ratio is more standardized (CV = 17.4) than those of Sibudu and Umhlatuzana (Table 6.28) but, as just mentioned, there are only three hornfels segments at Jubilee. Both quartz and chert length/breadth ratios are unstandardized (Table 6.28).

Table 6.25

Coefficient of variation for various measurements of segments from Sibudu, Umhlatuzana and Jubilee.

	Sibudu	Umhlatuzana	Jubilee
Breadth	27.7	24.8	33.3
Thickness	34.7	31	33.1
Length	33.8	35.6	36.9
Length/breadth ratio	22.0	27.0	20.0
Mass	83.2	73.3	-

Table 6.26

Coefficient of variation for various measurements of Sibudu segments according to rock type.

	Hornfels	Dolerite	Quartz
Breadth	25.4	23.7	34.3
Thickness	35.9	31.9	34.1
Length	24.5	31.7	20.1
Length/breadth ratio	25.0	20.0	15.8

Table 6.27

Coefficient of variation for various measurements of Umhlatuzana segments according to rock type.

	Hornfels	Quartz	Mudstone	Quartzite	Dolerite
Breadth	21.1	30.4	25.6	24.2	7.7
Thickness	33.3	28.2	25.0	28.9	25.0
Length	27.4	30.3	21.5	30.9	27.4
Length/breadth ratio	20.0	15.0	25.0	20.0	34.8

Table 6.28

Coefficient of variation for various measurements of Jubilee segments according to rock type.

	Quartz	Hornfels	Chert
Breadth	19.6	0	40.0
Thickness	26.1	0	40.0
Length	28.3	16.1	43.8
Length/breadth ratio	20.0	17.4	21.0

T-tests

Sibudu and Umhlatuzana segments' breadths and thicknesses are not significantly different when all rock types are combined (Tables 6.29 & 6.30). In all cases, Jubilee Shelter segments' attributes are significantly different from those of the MSA segments because the LSA ones are so much smaller (Tables 6.29-31). The LSA segments are not, however, standardized (Table 6.28). Umhlatuzana segments are significantly longer and weigh more than Sibudu segments (Tables 6.31 & 2.32). Distal penetrating angles of segments from Sibudu and Umhlatuzana are not significantly different, whereas those from Jubilee are significantly smaller than those from the MSA sites (Table 6.33). In addition, the Umhlatuzana proximal angle is significantly larger than those from Sibudu and Jubilee, and the Jubilee mean proximal angle is smaller than that from Sibudu (Table 6.34). Distal and proximal angles on the same segments are not significantly different at either Sibudu or Jubilee Shelter; however, Umhlatuzana distal and proximal ends of segments are significantly different (Table 6.35). The mean TCSAs of Sibudu and Umhlatuzana segments are not significantly different, but the mean TCSA from Jubilee Shelter is significantly smaller than those from the MSA sites (Table 6.36).

There is no significant difference in breadths, thicknesses and lengths of dolerite, quartz and hornfels segments from Sibudu and Umhlatuzana (Table 6.37).

At Sibudu, there generally seem to be as many differences between hornfels and dolerite as between quartz and dolerite. Dolerite segments are significantly wider than quartz and hornfels segments, but there is no significant difference between the breadths of quartz and hornfels segments (Table 6.38). There is no significant difference between the thicknesses of dolerite and quartz segments or those of quartz and hornfels segments. However, dolerite segments are thicker than hornfels segments (Table 6.39). All rock types at Sibudu have significantly different

lengths: dolerite lengths are the longest and quartz segments are the shortest (Table 6.40). Dolerite segments are also heavier than quartz and hornfels segments, but there is no significant difference between the mass of quartz and hornfels segments (Table 6.41).

Generally, quartz segments at Umhlatuzana are significantly different from hornfels and mudstone ones; the breadth, length and mass of quartz segments are significantly less than those of hornfels and mudstone segments (Tables 6.42, 6.43 & 6.45). There is no significant difference in the thicknesses of Umhlatuzana segments by rock type (Table 6.43). Quartz segments are shorter than quartzite segments, but they are not significantly shorter than dolerite ones (Table 6.44).

Jubilee quartz segments are significantly narrower than quartzite segments (Tables 6.46 & 6.48) and quartz and hornfels segments are both significantly shorter than quartzite segments (Table 6.48). However, there is no significant difference between the breadths of quartz and hornfels; quartz and chert; hornfels and chert, and quartzite and chert segments (Table 6.46). There is no significant difference in thickness between hornfels, quartzite and chert segments from Jubilee Shelter (Table 6.47), nor in the length of quartz and hornfels; quartz and chert; hornfels and chert, as well as quartzite and chert segments from Jubilee Shelter.

Table 6.29

Differences in breadth of whole and some broken segments from Sibudu, Umhlatuzana and Jubilee.

	Umhlatuzana	Jubilee
Sibudu	$t = 2.0; p = 1.0$	$t = 2.0; p < 0.01$
Umhlatuzana	-	$t = 2.0; p < 0.01$

Table 6.30

Differences in thickness of whole and some broken segments from Sibudu, Umhlatuzana and Jubilee.

	Umhlatuzana	Jubilee
Sibudu	$t = 2.0; p = 1.0$	$t = 2.0; p < 0.01$
Umhlatuzana	-	$t = 2.0; p < 0.01$

Table 6.31

Differences in length of whole segments from Sibudu, Umhlatuzana and Jubilee.

	Umhlatuzana	Jubilee
Sibudu	$t = 2.0; p = 0.02$	$t = 2.0; p < 0.01$
Umhlatuzana	-	$t = 2.0; p < 0.01$

Table 6.32
Difference in mass of whole and almost complete segments from Sibudu and Umhlatuzana.

	Umhlatuzana
Sibudu	$t = 2.0; p = 0.3$

Table 6.33
Differences in distal penetrating angle of segments (whole and distal/proximal tips) from Sibudu, Umhlatuzana and Jubilee.

	Umhlatuzana	Jubilee
Sibudu	$t = 2.0; p = 1.0$	$t = 2.0; p < 0.01$
Umhlatuzana	-	$t = 2.0; p < 0.01$

Table 6.34
Differences in proximal penetrating angle of segments (whole and proximal tips) from Sibudu, Umhlatuzana and Jubilee.

	Umhlatuzana	Jubilee
Sibudu	$t = 2.0; p < 0.05$	$t = 2.0; p < 0.01$
Umhlatuzana	-	$t = 2.0; p < 0.01$

Table 6.35
Differences between proximal and distal penetrating angles of segments (whole and distal/proximal tips) from Sibudu, Umhlatuzana and Jubilee.

	Proximal and distal penetrating angles
Sibudu	$t = 2.0; p = 1.0$
Umhlatuzana	$t = 2.0; p = 0.03$
Jubilee	$t = 2.0; p = 1.0$

Table 6.36
Differences in TCSA of whole and some broken segments from Sibudu, Umhlatuzana and Jubilee.

	Umhlatuzana	Jubilee
Sibudu	$t = 2.0; p = 1.0$	$t = 2.0; p < 0.01$
Umhlatuzana	-	$t = 2.0; p < 0.01$

Table 6.37
Differences in length, breadth and thickness of segments from Sibudu and Umhlatuzana by rock types.

	Dolerite	Quartz	Hornfels
Length	$t = 2.0; p = 0.2$	$t = 2.3; p = 0.3$	$t = 2.0; p = 1.0$
Breadth	$t = 2.0; p = 1.0$	$t = 2.3; p = 1.0$	$t = 2.0; p = 1.0$
Thickness	$t = 2.0; p = 0.1$	$t = 2.3; p = 0.1$	$t = 2.0; p = 1.0$

Table 6.38
Differences in breadth of whole and some broken dolerite, quartz and hornfels segments from Sibudu.

	Dolerite	Hornfels
Quartz	$t = 2.0; p = 0.01$	$t = 2.0; p = 0.2$
Dolerite	-	$t = 2.0; p = 0.02$

Table 6.39

Differences in thickness of whole and some broken dolerite, quartz and hornfels segments from Sibudu.

	Dolerite	Hornfels
Quartz	$t = 2.0; p = 0.3$	$t = 2.0; p = 1.0$
Dolerite	-	$t = 2.0; p = 0.05$

Table 6.40

Differences in length of whole dolerite, quartz and hornfels segments from Sibudu.

	Dolerite	Hornfels
Quartz	$t = 2.1; p < 0.01$	$t = 2.1; p < 0.01$
Dolerite	-	$t = 2.0; p = 0.02$

Table 6.41

Differences in mass of whole and almost complete dolerite, quartz and hornfels segments from Sibudu.

	Dolerite	Hornfels
Quartz	$t = 2.1; p = 0.02$	$t = 2.1; p = 0.2$
Dolerite	-	$t = 2.0; p = 0.05$

Table 6.42

Differences in breadth of whole and some broken segments from Umhlatuzana by rock types.

	Dolerite	Quartz	Mudstone	Quartzite
Hornfels	$t = 2.0; p = 1.0$	$t = 2.0; p < 0.01$	$t = 2.0; p = 1.0$	$t = 2.0; p = 1.0$
Quartz	$t = 2.1; p = 0.1$	-	$t = 2.0; p = 0.03$	$t = 2.1; p = 0.3$
Dolerite	-	-	$t = 2.2; p = 1.0$	$t = 3.0; p = 1.0$
Mudstone	-	-	-	$t = 2.2; p = 1.0$

Table 6.43

Differences in thickness of whole and some broken segments from Umhlatuzana by rock types.

	Dolerite	Quartz	Mudstone	Quartzite
Hornfels	$t = 2.0; p = 1.0$	$t = 2.0; p = 0.3$	$t = 2.0; p = 1.0$	$t = 2.0; p = 1.0$
Quartz	$t = 2.1; p = 1.0$	-	$t = 2.0; p = 0.2$	$t = 2.1; p = 0.4$
Dolerite	-	-	$t = 2.2; p = 1.0$	$t = 3.0; p = 1.0$
Mudstone	-	-	-	$t = 2.2; p = 1.0$

Table 6.44

Differences in length of whole segments from Umhlatuzana by rock types.

	Dolerite	Quartz	Mudstone	Quartzite
Hornfels	$t = 2.0; p = 0.4$	$t = 2.0; p < 0.01$	$t = 2.0; p = 0.5$	$t = 2.0; p = 1.0$
Quartz	$t = 2.1; p = 0.1$	-	$t = 2.1; p < 0.01$	$t = 2.1; p = 0.01$
Dolerite	-	-	$t = 3.0; p = 1.0$	$t = 3.2; p = 1.0$
Mudstone	-	-	-	$t = 2.4; p = 1.0$

Table 6.45

Differences in mass of whole and almost complete segments from Umhlatuzana by rock types.

	Dolerite	Quartz	Mudstone	Quartzite
Hornfels	$t = 2.0; p = 1.0$	$t = 2.0; p < 0.01$	$t = 2.0; p = 0.5$	$t = 2.0; p = 1.0$
Quartz	$t = 2.1; p = 1.0$	-	$t = 2.0; p = 0.01$	$t = 2.1; p = 0.2$
Dolerite	-	-	$t = 2.4; p = 0.4$	$t = 3.2; p = 1.0$
Mudstone	-	-	-	$t = 2.4; p = 1.0$

Table 6.46

Differences in breadth of whole and some broken hornfels, quartzite and chert segments from Jubilee Shelter.

	Hornfels	Quartzite	Chert
Quartz	$t = 2.1; p = 0.3$	$t = 2.1; p = 0.05$	$t = 2.0; p = 0.1$
Hornfels	-	-	$t = 2.1; p = 0.3$
Quartzite	-	-	$t = 2.1; p = 1.0$

Table 6.47

Differences in thickness of whole and some broken hornfels, quartzite and chert segments from Jubilee Shelter.

	Hornfels	Quartzite	Chert
Quartz	$t = 2.1; p = 0.5$	$t = 2.1; p = 0.1$	$t = 2.0; p = 0.4$
Hornfels	-	-	$t = 2.1; p = 0.4$
Quartzite	-	-	$t = 2.1; p = 1.0$

Table 6.48

Differences in length of whole hornfels, quartzite and chert segments from Jubilee Shelter.

	Hornfels	Quartzite	Chert
Quartz	$t = 2.1; p = 1.0$	$t = 2.1; p = 0.01$	$t = 2.0; p = 0.3$
Hornfels	-	$t = 3.2; p = 0.02$	$t = 2.1; p = 1.0$
Quartzite	-	-	$t = 2.1; p = 0.2$

Summary

Sibudu segments

Dolerite segments are wider, longer and heavier than quartz and hornfels segments, and quartz segments are the shortest. Segments form three distinct groups based on these rock types: dolerite segments are the biggest and quartz segments the smallest. Quartz length/breadth ratios are the most standardized of all the segment attributes at the site.

Umhlatuzana segments

Quartz segments are narrower, shorter and lighter than hornfels and mudstone segments. Quartz segments are shorter than quartzite, but not dolerite ones. Despite these differences, there are no

distinct groupings by rock type as is the case with Sibudu segments, although quartz length/breadth ratios are also the most standardized of the segment attributes at this site.

Jubilee segments

Quartz segments are narrower than quartzite segments and quartz and hornfels segments are shorter than quartzite segments. Quartz segments are the least standardized in all categories, including length/breadth ratios. Although hornfels segments have perfectly standardized breadths and thicknesses, there are only three segments and the sample may not be representative of hornfels segments generally.

Comparison of Sibudu, Umhlatuzana and Jubilee segments

Usually, Sibudu segments are smaller than Umhlatuzana segments. Sibudu segments are shorter and weigh less than Umhlatuzana segments. However, there are no significant differences in the breadth and thickness of segments from these two MSA sites. Jubilee segments are narrower, thinner and shorter than both the Sibudu and the Umhlatuzana segments. No attributes of any MSA segments are standardized when all rock types are combined (where the sample size is greater than two). There are no differences in the distal penetrating angles of Sibudu and Umhlatuzana segments, but Jubilee segments have a much smaller mean distal penetrating angle. The proximal penetrating angles of Sibudu and Jubilee are smaller than those of Umhlatuzana. Lastly, distal penetrating angles and TCSAs from Sibudu and Umhlatuzana are not significantly different, but those from Jubilee are much smaller. When segments are separated by rock types, hornfels segments from Umhlatuzana are more elongated than those from Sibudu and Jubilee (these two do not differ much in dimensions). Quartz segments from Sibudu are less elongated than quartz segments from Umhlatuzana and Jubilee. Length/breadth ratios of MSA quartz segments are more standardized than their LSA equivalents.

In the next chapter, I discuss the relevance of the technological results to ideas about hunting and hafting in both the MSA and the LSA.

CHAPTER SEVEN

DISCUSSION

In this chapter, I attempt an interpretation of the results recorded in the previous two chapters. The first section of the chapter will focus on analysing the results obtained from the morphometric study of the points while the second section will deal with segments. In both sections I compare my results with data from other southern African sites.

Points

In Chapter Five the following point attributes were measured: maximum breadth, length, thickness, maximum breadth and thickness at the base, and weight. Length/breadth ratios tip cross-sectional area, penetrating angles, and coefficients of variation were calculated and other technological variables related to the shape and form of tools, such as raw materials, retouch types and location, and base types were also looked at. The following sub-sections will discuss the results of these variables in light of the existing literature on points.

Breadth of points

According to Villa & Lenoir (2006) point breadth is at least partly related to the breadth of the haft. As such, it has been regarded as one of the effective discriminators of weapon armatures (Corliss 1972; Thomas 1978, Shea 2006). Villa and Lenoir compared points from the French Middle Palaeolithic site, Bouheben, with a sample of points from Sibudu and Rose Cottage Cave. The present study has a larger sample of Sibudu points than that of Villa & Lenoir (2006). They have only looked at final MSA layers, layers RSp-MOD and some layers below RSp (Villa & Lenoir 2006), while I analysed all points throughout the MSA sequence, from the Still Bay to the final MSA. With the exception of Still Bay points whose breadth is significantly smaller than those of late MSA points ($t = 2.0$; $p < 0.01$) and post-Howiesons Poort points ($t = 2.0$; $p < 0.01$), the remaining Sibudu points have breadths that are within the range of Bouheben and Rose Cottage points identified as hand-held spearheads (Villa & Lenoir 2006; Mohapi 2005, 2007)

(see Table 7.1). These points also have breadths that are closer to those of multi-purpose $\neq$ Gi points (Botswana) studied by Kuman (1989), some Tabun (Israel) and Aduma (Ethiopia) points studied by Brooks *et al.* (2006) (Table 7.1). The $\neq$ Gi MSA has an age of 77 ka, which is equivalent to the age of South African early Still Bay or late pre-Still Bay. Edge-wear analysis on $\neq$ Gi points and the fact that there is great variability between them implies that they were used as multi-purpose tools. Kuman (1989) suggests that the dominant function of these points could have been cutting, but she adds that they could also have been used as butchery tools and possibly as tips for hunting weapons (there is very little evidence for this function though) (*ibid*: 214, 286). Tabun points are said to have small lengths (in comparison to typical Middle Palaeolithic points from outside Africa) (average 41 mm) that place them within the range of ethnographic spearheads while Aduma points have dimensions that place them within the range of spear-thrower darts (Brooks *et al.* 2006). Some Aduma points are so small that they are less than 20 mm long (Brooks *et al.* 2006). It should be noted that Tabun B, C and D and Aduma 1, 4, 5 and 8 are stratigraphic layers (Brooks *et al.* 2006).

Sibudu points (with the exception of Still Bay ones) have mean breadths that are far smaller than those of $\neq$ Gi points believed to be darts by Brooks *et al.* (2006). The mean breadth of Still Bay points is slightly less than that of North American dart tips, but it is larger than that of North American and Rose Cottage arrow tips (Table 7.1). Rose Cottage spearheads also have small breadths which are slightly smaller than those of North American dart tips (Table 7.1).

Umhlatuzana points' mean breadths, like those of Sibudu points, fall within the range of mean breadths of points identified as spearheads by Villa & Lenoir (2006) and Mohapi (2005, 2007). These points, like those from Sibudu, have mean breadths that are close to those of the multi-purpose $\neq$ Gi points, and some Tabun and Aduma points (Table 7.1), and they are far smaller than the sample of $\neq$ Gi points studied by Brooks *et al.* (2006) (Table 7.1). However, the mean breadth of pre-Howiesons Poort points like that of Sibudu Still Bay points is very close to that of North American dart tips, but it is larger than that of North American and Rose Cottage arrowheads (Table 7.1).

Mean breadths of both Sibudu and Umhlatuzana points are unstandardized; they have high coefficients of variation (CV) which are all greater than 20.0. This seems to be the trend among breadths of MSA points because, as Table 7.1 shows, the CVs of mean breadths of points from all the sites are high. The most unstandardized breadths are those of $\neq$ Gi fully bifacial (BI), partly bifacial (PB) and fully unifacial (UN) points while $\neq$ Gi points with ventral retouch only on the base (UV) have a mean breadth with the smallest CV (Table 7.1). Unifacial and bifacial points from both Sibudu and Umhlatuzana have equally unstandardized breadths (Table 7.1).

With the exception of Still Bay and pre-Howiesons Poort points, Sibudu and Umhlatuzana points have breadths that place them within the range of spearheads. Still Bay and pre-Howiesons Poort points' thinness places them within the range of darts.

Table 7.1.

Breadth of points (in mm) from France, South Africa, North America, Botswana, Israel and Ethiopia. Sources: 1, Villa & Lenoir (2006); 2, Mohapi (2005, 2007); 3, Shott (1997); 4, Thomas (1978); 5, Kuman (1989); 6, Brooks *et al.* (2006). Where no sources are given, information provided is that from the present study.

Samples	Mean	SD	Min	Max	CV	n	Source
Bouheben	32.1	7.8	17.0	57.0	24.3	98	1
Sibudu, final MSA (layers Ore to Co)	27.7	8.6	9	45	31.0	23	1
Sibudu, RSp to MOD	27.0	6.4	12	42	23.7	73	1
Sibudu, layers below RSp	28.7	7.2	18	52	25.1	43	1
Sibudu Still Bay	20.7	6.8	7.0	30.0	32.8	15	
Sibudu post-Howiesons Poort	29.2	8.0	14.0	49.0	28.0	46	
Sibudu late MSA	26.9	7.1	7.0	52.0	26.9	101	
Sibudu final MSA	27.9	9.0	16.0	41.0	32.3	13	
Sibudu unifacial	27.2	7.6	7.0	52.0	27.9	137	
Sibudu bifacial	25.2	7.3	7.0	44.0	29.0	43	
Umhlatuzana pre-Howiesons Poort	24.5	6.0	10.0	39.0	24.5	62	
Umhlatuzana late MSA	27.9	5.8	20.0	39.0	20.8	17	
Umhlatuzana MSA/LSA transition	26.3	5.5	18.0	39.0	20.9	16	
Umhlatuzana unifacial	26.2	5.9	17.0	39.0	22.5	45	
Umhlatuzana bifacial	24.7	6.0	10.0	39.0	24.3	49	
Rose Cottage post-Howiesons Poort	21.4	4.0	13.0	32.0	18.7	47	1
Rose Cottage post-Howiesons Poort	21.6	3.9	15.0	32.0	18.1	38	2
Rose Cottage Dc	6.9	1.7	5.0	10.0	24.6	16	2
≠Gi, BI	35.3	18.8	–	–	53.3	–	5
≠Gi, PB	34.4	15.3	–	–	44.5	–	5
≠Gi, UN	32.8	14.3	–	–	43.6	–	5
≠Gi, UV	30.1	4.7	–	–	15.6	–	5
≠Gi	46.8	14.7	–	–	31.4	16	6
Tabun B	36.7	7.6	–	–	20.7	9	6
Tabun C	34.4	8.1	–	–	23.5	16	6
Tabun D	35.9	8.9	–	–	24.8	31	6
Aduma 1	27.4	10.0	–	–	36.5	69	6
Aduma 8	32.8	10.8	–	–	32.9	33	6
Aduma 4	23.9	8.6	–	–	36.0	39	6
Aduma 5	30.1	6.1	–	–	20.3	299	6
North American dart tips	23.1	4.4	14.0	32.0	19.0	30	3
North American arrow tips	14.4	3.4	9.2	32.4	23.6	130	4

Thickness of points

Thicknesses of both Sibudu and Umhlatuzana points throughout the MSA sequence are within the range of mean thicknesses of points identified as spearheads by Villa & Lenoir (2006) (Table 7.2). The mean thickness of Still Bay points is, however, closer to that of North American darts, Aduma 4 points (thought to be darts) and Tabun points (thought to be spearheads) than it is to those of experimental spearheads and it is greater than that of North American arrowheads and Rose Cottage points interpreted as arrowheads (Table 7.2). Sibudu and Umhlatuzana points' thicknesses are also within the range of thicknesses of $\neq$ Gi points analysed by Kuman (1989) though, as with breadths, their values are still slightly less than those of $\neq$ Gi (Tables 7.2).

As is the case with breadths, mean thicknesses of Sibudu and Umhlatuzana bifacial and unifacial points are highly unstandardized. Their CVs are high, and Still Bay points from Sibudu have the most unstandardized mean thickness. Points from other sites also have mean thicknesses with high CVs and are therefore unstandardized, however, North American dart tips reported by Shott (1997) have a low CV compared with other points (Table 7.2).

Thicknesses of Sibudu and Umhlatuzana points from all the MSA phases, except for the Still Bay, place them within the range of spearheads' thicknesses. Invasive retouch of the type used for Still Bay points may have contributed to the relative thinness of these points.

Table 7.2.

Thickness of points (in mm) from France, South Africa, North America, Botswana, Israel and Ethiopia. Sources: 1, Villa & Lenoir (2006); 2, Mohapi (2005, 2007); 3, Shott (1997); 4, Thomas (1978); 5, Kuman (1989); 6, Brooks *et al.* (2006). Where no sources are given, information provided is that from the present study.

Samples	Mean	SD	Min	Max	CV	n	Source
Bouheben	10.7	2.8	5.0	16	25.7	98	1
Sibudu, final MSA (layers Ore to Co)	7.3	2.5	2	11	34.2	26	1
Sibudu, (layers RSp to MOD)	8.1	2.5	3	15	31.0	79	1
Sibudu, (layers below RSp)	9.6	2.4	5	16	25.0	42	1
Sibudu Still Bay	6.9	3.0	3.0	13.0	43.2	16	
Sibudu post-Howiesons Poort	10.2	3.3	5.0	23.0	32.4	47	
Sibudu late MSA	8.4	2.9	2.0	17.0	34.5	102	
Sibudu final MSA	7.6	3.0	2.0	13.0	39.3	14	
Sibudu unifacial	9.0	3.2	2.0	23.0	35.6	139	
Sibudu bifacial	7.6	2.2	3.0	13.0	28.9	45	
Umhlatuzana pre-Howiesons Poort	9.7	2.3	5.0	17.0	23.7	63	
Umhlatuzana late MSA	10.8	3.0	5.0	17.0	27.8	17	
Umhlatuzana MSA/LSA transition	9.0	2.6	6.0	15.0	28.9	17	
Umhlatuzana unifacial	9.9	2.5	6.0	39.0	25.3	46	
Umhlatuzana bifacial	9.6	2.6	5.0	17.0	27.1	51	
Rose Cottage	7.1	2.2	3	12	31.0	47	1
Rose Cottage post-Howiesons Poort	7.4	2.1	4.0	11.0	28.4		2
Rose Cottage Dc	1.8	0.5	1.0	2.0	27.8	16	2
≠Gi, BI	11	3.3	—	—	30.0	—	5
≠Gi, PB	10	2.7	—	—	27.0	—	5
≠Gi, UN	10	3	—	—	30.0	—	5
≠Gi, UV	10	2.4	—	—	24.0	—	5
≠Gi	14.1	3.8	—	—	27.0	16	6
Tabun B	7.2	1.9	—	—	26.4	9	6
Tabun C	8.3	2.4	—	—	28.9	16	6
Tabun D	8.7	2.3	—	—	26.4	31	6
Aduma 1	9.0	2.3	—	—	25.6	69	6
Aduma 8	10.7	4.7	—	—	43.9	33	6
Aduma 4	7.3	2.7	—	—	37.0	39	6
Aduma 5	10.2	2.7	—	—	26.5	260	6
North American dart tips	5.0	0.9	2.9	7.2	18.0	30	3
North American arrow tips	3.9	1.1	1.8	8.2	28.2	130	4

Length and length/breadth ratios

All Sibudu points, both from this study and that of Villa & Lenoir (2006), have lengths that are smaller than those of Bouheben points, $\neq$ Gi dart points and Tabun spearheads. However, the mean length of post-Howiesons Poort points does not differ that much from those of Bouheben and Tabun (Table 7.3). Brooks *et al.* (2006: 239) say that mean lengths of Tabun points (ranging from 50 to 70 mm) are within the range of ethnographic spearheads, yet they also say that the “small” size of $\neq$ Gi points (length = 74.0 ± 24.9 mm) “places them on the lower limits of ethnographically known spear armatures and within the range of ethnographically known spear thrower darts and large arrowheads”. However, one would expect that Tabun and $\neq$ Gi points would fall within the size range dimensions of the same weapon armature.

The final MSA points at Sibudu have a particularly small mean length which does not differ much from those of Rose Cottage and Aduma 1 and 2 points, whereas the rest of the points have mean lengths within the range of those from Sibudu studied by Villa *et al.* (2005) and Villa & Lenoir (2006) and within the range of those from $\neq$ Gi (Kuman 1989). The small size of Rose Cottage Cave points could be related to the small size of opaline nodules from which the points are made and may not be related to the function of the points (Mohapi 2005, 2007; Villa & Lenoir 2006). Opaline is locally available at Rose Cottage and is the preferred rock type. Points made from other rock types, that is, hornfels and tuff, are longer than opaline points (the longest is 76 mm long) (Mohapi 2005, 2007) and so it appears that the choice of blanks for point manufacturing depended on what was available to the knappers. It is possible that the small mean size of final MSA points at Sibudu is partly the result of the presence of hollow-based points (whose lengths are reduced) found only in this final phase of the MSA, not only at Sibudu, but also at Umhlatuzana. MSA/LSA transition points at Umhlatuzana, like those of the final MSA from Sibudu, have the smallest mean length compared to the older MSA phases at Umhlatuzana (Table 7.3). The rest of the points at Umhlatuzana, like those from Sibudu, have lengths that fall within the range of lengths of points interpreted as spearheads by Villa *et al.* (2005) and Villa & Lenoir (2006) and they are slightly bigger than Rose Cottage points. Points from both Umhlatuzana and Sibudu have lengths that are bigger than the Rose Cottage Dc points interpreted as arrowheads by Mohapi (2005, 2007) (Table 7.3).

The lengths of Sibudu points (those from this study and also from Villa & Lenoir's 2006 study) and Umhlatuzana points are unstandardized and have CVs that are all above 20.0. Sibudu Still Bay points are the most unstandardized of all points. Mean point lengths from Bouheben, Rose Cottage and #Gi are also unstandardized. However, #Gi (BI) and #Gi (UV) have low CVs compared to other sites, though their lengths cannot be said to be standardized either (Table 7.3). Both at Sibudu and Umhlatuzana, unifacial and bifacial point mean lengths are equally unstandardized.

Table 7.3.

Length of points (in mm) from France, South African, Botswana, Israel and Ethiopia. Sources: 1, Villa & Lenoir (2006); 2, Mohapi (2005, 2007); 3, Kuman (1989); 4, Brooks *et al.* (2006). Where no sources are given, information provided is that from the present study.

Samples	Mean	SD	Min	Max	CV	n	Source
Bouheben	57.4	14.5	28.0	96.0	25.3	95	1
Sibudu, final MSA (layers Ore to Co)	46.9	10.6	30.0	73.0	22.6	19	1
Sibudu, (layers RSp to MOD)	41.8	10.2	24.0	71.0	24.4	64	1
Sibudu, (layers below RSp)	45.3	11.2	28.0	74.0	24.7	42	1
Sibudu Still Bay	43.9	16.0	25.0	66.0	36.4	7	
Sibudu post-Howiesons Poort	50.7	14.7	32.0	114.0	29.0	41	
Sibudu late MSA	42.7	12.9	20.0	98.0	30.2	92	
Sibudu final MSA	38.4	9.8	21.0	55.0	25.5	13	
Sibudu unifacial	45.7	15.5	20.0	114.0	33.9	125	
Sibudu bifacial	42.7	9.1	28.0	66.0	21.3	33	
Umhlatuzana pre-Howiesons Poort	48.3	12.0	30.0	81.0	24.8	44	
Umhlatuzana late MSA	49.1	9.4	34.0	74.0	19.1	15	
Umhlatuzana MSA/LSA transition	46.0	10.5	33.0	69.0	22.8	13	
Umhlatuzana unifacial	46.0	10.0	30.0	75.0	21.7	34	
Umhlatuzana bifacial	49.8	11.9	30.0	81.0	23.9	38	
Rose Cottage post-Howiesons Poort	36.6	8.7	23.0	60.0	23.8	43	1
Rose Cottage post-Howiesons Poort	39.6	10.9	23.0	76.0	27.5	38	2
Rose Cottage Dc	15.6	4.0	12.0	27.0	25.6	16	2
≠Gi, BI	43.4	7.9	—	—	18.2	—	3
≠Gi, PB	41.6	8.7	—	—	20.9	—	3
≠Gi, UN	41.7	9.5	—	—	22.8	—	3
≠Gi, UV	40.7	7.1	—	—	17.4	—	3
≠Gi	74.0	24.9	—	—	33.6	16	4
Tabun B	53.6	11.1	—	—	20.7	8	4
Tabun C	67.8	12.5	—	—	18.4	16	4
Tabun D	71.9	13.9	—	—	19.3	31	4
Aduma 1	35.4	7.4	—	—	20.9	68	4
Aduma 8	48.5	16.3	—	—	33.6	32	4
Aduma 4	32.5	11.0	—	—	33.8	39	4
Aduma 5	40.2	8.4	—	—	20.9	299	4

Still Bay points have a length/breadth ratio of 2.0 which means that they are elongated and were made either from blades or pieces that were deliberately shaped to blade-like proportions. All the other points have length/breadth ratios less than 2.0 (see Table 5.8 in Chapter 5 for these

length/breadth ratios) and therefore have flake rather than blade proportions or were retouched and/or resharpened into short and wide forms.

Pre-Howiesons Poort points at Umhlatuzana, like Sibudu Still Bay points, are elongated because they also have a mean length/breadth ratio of 2.0 (Table 5.42 [Chapter 5]). Late MSA and MSA/LSA transition points are, however, shorter and wider than the earlier points, because they have length/breadth ratios which are less than 2.0 (Table 5.42 [Chapter 5]).

Length/breadth ratios like other attributes of points from Sibudu and Umhlatuzana are unstandardized and have high CVs. Still Bay points at Sibudu have a length/breadth ratio with the smallest CV in the point sequence, while at Umhlatuzana, late MSA points have the smallest CV (see Tables 5.22 & 5.60 [Chapter 5] for CVs).

Though length and length/breadth ratios are not usually used as discriminators of weapon armatures, they are provided here for comparison with points from other sites. Length/breadth ratios at both Umhlatuzana and Sibudu show that there is a difference in shapes of points between older assemblages, (that is, the Still Bay at Sibudu and pre-Howiesons Poort at Umhlatuzana) and younger assemblages. Points from the older layers are elongated while those from the younger layers are generally short and broad. This change in shape could be related to the functions of these points, especially because it occurs at both sites which are only about 90 km apart. Maybe the older, elongated points were used differently from the younger, short and broad points. This possibility will be discussed in detail shortly.

Point base breadth and thickness

Pre-Howiesons Poort/Howiesons Poort points at Umhlatuzana have significantly thinner bases than the MSA/LSA transition points ($t = 2.0$; $p < 0.01$). At Sibudu, late MSA points are significantly thicker at the base than final MSA points (Table 7.4). Still Bay points are thinner at the base than late MSA and post-Howiesons Poort points and are more like the thin final MSA points (Table 7.4).

Table 7.4.

Comparison of base thickness of points from Sibudu.

	post-Howiesons Poort	late MSA	final MSA
late MSA	$t = 2.0; p = 0.4$	–	$t = 2.0; p < 0.01$
Still Bay	$t = 2.0; p < 0.01$	$t = 2.0; p < 0.01$	$t = 2.0; p = 0.6$

There is no significant difference in the thickness or breadth of bases of combined points from Umhlatuzana and Sibudu. This is likely to be because all points are hafted and there is a suitable range of shaft widths for points. However, there is some change through time at Sibudu. Still Bay base breadths are significantly narrower than those of late MSA and post-Howiesons Poort points (Table 7.5). Post-Howiesons Poort points are significantly wider than final MSA, late MSA ($t = 2.0; p < 0.01$) and Still Bay points. Differences in base breadth and thickness of Still Bay points and those of points from younger MSA layers at Sibudu suggest differences in the ways that these points were hafted. If all Sibudu points were hafted similarly one would expect that base breadths and thicknesses of these points would be similar throughout the MSA sequence because these are related to hafts. This possibility will be discussed more shortly.

Table 7.5

Comparison of base breadth of points from Sibudu.

	post-Howiesons Poort	late MSA	final MSA
Still Bay	$t = 2.0; p < 0.01$	$t = 2.0; p < 0.01$	–
post-Howiesons Poort	–	$t = 2.0; p < 0.01$	$t = 2.0; p = 0.01$

Mass of points

Mass is said to be one of the important attributes in discriminating between arrowheads and dart tips (Hughes 1998, Brooks *et al.* 2006, Shea 2006).

Newton's second law predicts that a lighter projectile must be propelled with greater acceleration to achieve the same force or penetration (or, conversely, a more forceful propulsion system allows use of a lighter projectile) (Brooks *et al.* 2006: 245-6).

According to Christenson (1986), the range of mass for 132 North American arrowheads is 0.3-17.4 g and that of ten hafted dart tips from museum collections is 1.6-7.9 g. However, Villa & Lenoir (2006) caution that the sample of dart tips is too small to be representative of all dart tips. Hughes (1998) does not use mass-velocity relationship as an indicator of the function of spearheads because the mechanics of throwing and thrusting are different.

The mean mass of post-Howiesons Poort points at Sibudu is similar to that of Bouheben points interpreted as spearheads by Villa & Lenoir (2006) (Table 7.6). The mass of Still Bay and late MSA points from Sibudu and those of points from all the MSA phases at Umhlatuzana are within the range of masses of Sibudu points studied by Villa & Lenoir (2006) and interpreted as spearheads (Table 7.6). However, the mean mass of Sibudu final MSA points in this study is closer to that of the large Rose Cottage points and the smaller Aduma 4 points (Brooks *et al.* 2006) (Table 7.6). I am uncomfortable, though, relying on mass measurements and predictions from Brooks *et al.* (2006) because they emphasize the importance of light mass for projectiles, which implies that points used as darts and arrowheads should be lighter than spearheads, yet the weight of $\neq$ Gi points (which they say are spear-thrower darts) is far greater than that of Tabun points which they suggest are spearheads (Table 7.6). In any event, mass appears to be a problematic attribute because sometimes the haft can be weighted to compensate for light-weight stone tools. For instance, in recent experiments using replicated Howiesons Poort segments, Pargeter (2006) used rods to weight hafts on which segments were mounted. The rods add weight at the head, in the middle and at the end of the haft and this helps the weapon to maintain a forward trajectory, while overcoming the imbalance caused by the light base of the spear compared to its slightly heavier tip (Pargeter 2006: 22).

Mass is the least standardized category of all measurements of points from this study as well as other studies (Table 7.6). Sibudu final MSA points (layers Ore to Co) from Villa & Lenoir's study (2006) are the only exception, with a CV below 20.0 (which is still unstandardized, though) (Table 7.6). The CVs of the mean mass of all Sibudu and Umhlatuzana points are all very large (all above 50.0) and unifacial and bifacial points are equally unstandardized. The

reason for the lack of standardization of mass might be that, as already mentioned, the total mass of any weapon armature is not only dependent on the point (tip) but also on the haft.

Table 7.6

Mass of points (in g) from France, South Africa, Botswana, Israel and Ethiopia. Sources: 1, Villa & Lenoir (2006); 2, Brooks *et al.* (2006).

Samples	Mean	SD	Min	Max	CV	n	Source
Bouheben	18.9	10.7	3.9	58.9	56.6	94	1
Sibudu, final MSA (layers Ore to Co)	10.7	4.6	3.4	19.3	43.0	16	1
Sibudu, RSp to MOD	11.9	7.1	3.1	31.5	59.7	38	1
Sibudu, layers below RSp	14.2	10.2	4.1	54.0	71.8	39	1
Sibudu Still Bay	10.5	8.2	1.2	25.3	78.1	7	
Sibudu post-Howiesons Poort	18.1	15.8	3.0	81.1	90.0	41	
Sibudu late MSA	11.0	9.5	0.3	70.0	87.2	91	
Sibudu final MSA	7.9	4.6	1.0	15.0	57.9	13	
Sibudu unifacial	13.4	12.4	0.3	81.1	92.5	126	
Sibudu bifacial	9.2	5.1	1.0	27.2	55.4	28	
Umhlatuzana pre-Howiesons Poort	12.0	8.2	1.5	49.2	68.3	44	
Umhlatuzana late MSA	13.9	8.9	4.9	37.9	64.0	15	
Umhlatuzana MSA/LSA transition	10.6	5.1	4.7	18.4	48.1	10	
Umhlatuzana unifacial	12.2	7.5	3.9	37.2	61.5	33	
Umhlatuzana bifacial	12.2	8.3	1.5	49.2	68.0	37	
Rose Cottage post-Howiesons Poort	5.2	2.7	1.1	12.0	51.9	40	1
≠Gi	50.1	43.9	—	—	87.6	16	2
Tabun B	12.6	6.0	—	—	47.6	9	2
Tabun C	16.8	11.9	—	—	70.8	14	2
Tabun D	19.0	9.6	—	—	50.5	31	2
Aduma 1	8.8	6.0	—	—	68.2	68	2
Aduma 8	19.7	20.2	—	—	102.5	32	2
Aduma 4	6.6	6.8	—	—	103.0	39	2
Aduma 5	11.8	7.2	—	—	61.0	299	2

Tip penetrating angle of points

Mean penetrating angles of Sibudu and Umhlatuzana points throughout the MSA sequence are bigger than the Solutrean foliate point mean angle (Table 7.7). Solutrean points have the widest angle of all Upper Palaeolithic points and may have been used as tips for thrusting spears (Peterkin 1997). Sibudu and Umhlatuzana points' penetrating angles are bigger than, or similar to, angles of points suggested to have been used as tips of thrusting or throwing spears at other sites, for instance, Rose Cottage Cave points studied by Mohapi (2005, 2007) and Villa and Lenoir (2006) (Table 7.7), Bouheben points and a variety of Sibudu points studied by Villa and Lenoir (2006). Sibudu Still Bay points have a mean distal penetrating angle similar to those of

≠Gi points (Table 7.7) interpreted as multi-purpose tools by Kuman (1989). However, the Still Bay points' mean penetrating angle is also significantly smaller than those of other MSA phases at Sibudu (Tables 7.7 & 7.8). The fact that point penetrating angles become bigger over time at Sibudu could be related to ways in which these points were used. It is possible that Still Bay points might have been used in a way different from the way points from the other younger MSA phases were used. This possibility will be discussed shortly.

It should be noted that the proximal mean penetrating angle of Still Bay points is significantly greater than that of the distal one (Tables 7.7 & 7.8). This supports Wadley's (2007) suggestion that the double-pointed Still Bay points were not reversible in their hafts. In a previous study, Shea (2006) commented that at least some Still Bay points might have been knives, rather than spearheads, because their dimensions make them fragile. Residue analyses of some Still Bay points (Lombard 2006) support Shea's suggestion.

The mean penetrating angle of MSA/LSA transition points at Umhlatuzana is also small in comparison to those of late MSA and pre-Howiesons Poort points (Table 7.7) and is significantly different from the late MSA angle ($t = 2.0$, $p < 0.01$). It is unclear what this suggests because all the other variables of MSA/LSA transition points do not indicate any decrease in the size of points at Umhlatuzana during this phase. However, all the penetrating angles are still within the range of spearheads from other sites as indicated above.

Points from Tabun in the Levant are said to have dimensions within the range of spearheads while Aduma and ≠Gi points studied by Brooks and colleagues are suggested to have been used to tip spearthrower darts (Brooks *et al.* 2006). However, the penetrating angle of Tabun B points is close to that of ≠Gi and Aduma 1, 8 and 4, and is far less than that of Aduma 5 points. Tabun C and D points have penetrating angles that are smaller than those of points thought to be spearthrower darts from Aduma and ≠Gi (See Table 7.7). Most penetrating angles of points from Sibudu and Umhlatuzana are larger than those of Tabun, Aduma and ≠Gi points in Brooks *et al.*'s (2006) study. Brooks *et al.* (2006) do not consider penetrating angles to be important indicators of function because the points that they interpret as darts have penetrating angles bigger than those of points they suggest might have been used as spearheads (Brooks *et al.* 2006,

Brooks personal communication). One would expect spearhead angles to be bigger than those of dart tips, however, I earlier mentioned that some of the San arrows studied by Clark (1977) also had very wide angles when the inserts were transversely hafted, so there is a possibility that Brooks *et al.* (2006) are correct in suggesting that penetrating angles are not always a useful indicator of tool function.

Both Umhlatuzana and Sibudu points have mean penetrating angles that are unstandardized. Still Bay points, however, have a relatively low CV for proximal ends of points, and so these points have the most standardized penetrating angles in the Sibudu sequence, and also compared with Umhlatuzana and other sites on Table 7.7. However, as mentioned before (Wadley 2007), the proximal ends of these points are likely to have been permanently hafted and did not serve as tips that would have penetrated prey. As a category, penetrating angles are not as unstandardized as other categories.

Table 7.7

Penetrating angles (in degrees) of points from France, South Africa, Botswana, Ethiopia, Israel and North America. Sources: 1, Villa & Lenoir (2006); 2, Mohapi (2005, 2007); 3, Kuman (1989); 4, Brooks *et al.* (2006); 5, Peterkin (1997). Where no sources are given, information provided is that from the present study.

Samples	Mean	SD	Min	Max	CV	n	Source
Bouheben	63.8	9.7	38.6	87.1	15.2	107	1
Sibudu, final MSA (layers Ore to Co	62.3	13.2	43.6	106.9	21.2	36	1
Sibudu, RSp to MOD	68.3	12.7	38.6	95.5	18.6	126	1
Sibudu, layers below RSp	61.9	12.3	31.5	85.5	19.9	68	1
Sibudu Still Bay distal	73.8	31.6	31.9	140.2	42.8	22	
Sibudu Still Bay proximal	121.8	14.8	108.4	146.5	12.2	7	
Sibudu post-Howiesons Poort	112.0	25.0	34.0	151.7	22.3	49	
Sibudu late MSA	107.0	27.6	13.1	151.6	25.8	150	
Sibudu final MSA	96.4	36.9	42.2	147.2	38.2	19	
Umhlatuzana pre-Howiesons Poort	109.5	24.2	31.9	146.8	22.1	72	
Umhlatuzana late MSA	115.0	23.5	47.1	147.6	20.4	20	
Umhlatuzana MSA/LSA transition	86.6	27.5	37.2	133.6	31.8	53	
Rose Cottage post-Howiesons Poort	62.4	11.3	33.0	81.0	18.1	50	1
Rose Cottage post-Howiesons Poort	74.1	12.6	43.0	95.5	17.0	41	2
Rose Cottage Dc	48.8	8.3	33.4	61.9	17.0	16	2
≠Gi BI	72.0	14.9	–	–	20.7	–	3
≠Gi PB	76.0	14.2	–	–	18.7	–	3
≠Gi UN	70.0	14.3	–	–	20.4	–	3
≠Gi UV	71.0	13.0	–	–	18.3	–	3
≠Gi	55.3	11.8	–	–	21.3	16	4
Tabun B	55.6	8.8	–	–	15.8	9	4
Tabun C	46.0	11.7	–	–	25.4	14	4
Tabun D	45.5	10.3	–	–	22.6	31	4
Aduma 1	61.2	15.6	–	–	25.5	68	4
Aduma 8	57.3	19.1	–	–	33.3	32	4
Aduma 4	55.8	13.9	–	–	24.9	39	4
Aduma 5	70.5	10.6	–	–	15.0	299	4
Solutrean foliate points	54.8	12.5	–	–	22.8	92	5

Table 7.8

Comparison of penetrating angles of Still Bay points and those of post-Howiesons Poort, late and final MSA points from Sibudu.

	Still Bay proximal	Post-Howiesons Poort	late MSA	final MSA
Still Bay distal	$t = 2.0; p < 0.01$	$t = 2.0; p < 0.01$	$t = 2.0; p < 0.01$	$t = 2.0; p = 0.04$

Tip cross-sectional area (TCSA) of points

Throughout the MSA sequence Sibudu points have TCSA values that are far greater than values suggested by Shea (2006) for North American hafted arrowheads ($33 \pm 20 \text{ mm}^2$) and hafted dart tips ($58 \pm 18 \text{ mm}^2$) (Table 7.9). Yet, the Sibudu TCSA values are below the value for experimental and ethnographic thrusting spears ($168 \pm 89 \text{ mm}^2$) (Shea *et al.* 2001, 2002; Shea 2006). The smallest TCSA values are from the Still Bay where the mean TCSA value ($88.7 \pm 54.5 \text{ mm}^2$) is smaller than those of final MSA ($110.2 \pm 47.3 \text{ mm}^2$), late MSA ($123.2 \pm 71.9 \text{ mm}^2$) (not significantly different though) and is significantly smaller than that of post-Howiesons Poort points ($133.7 \pm 59.9 \text{ mm}^2$) (Table 7.10 has results of a t-test comparing these TCSA values). The Still Bay TCSA value ($117 \pm 41 \text{ mm}^2$) of points studied by Wadley (2007) is bigger than the value in this study because Wadley only used bifacial points in her study while I used both bifacial and unifacial points. Again, Wadley (2007) excluded one exceptionally small bifacial point which she felt was an outlier and that point was included in my study. The Sibudu Still Bay TCSA value is even less than the TCSAs of Still Bay points from other South African sites, for example, Blombos ones. At Blombos Cave, Still Bay points have a TCSA of 143 mm^2 for all points or a TCSA of 100 mm^2 if the outliers are excluded (Shea 2006). Moreover, Sibudu points' TCSA values are bigger than those of Rose Cottage post-Howiesons Poort spearheads studied by Mohapi (2005, 2007) and Villa & Lenoir (2006).

Umhlatuzana points' TCSA values are also far greater than those of North American arrowheads and dart tips and smaller than experimental thrusting spears reported by Shea (2006) (Table 7.9). The central tendency for most MSA points in Shea's (2006) study is for their TCSA values to be significantly higher than those of arrowheads and spear-thrower dart tips, but lower than those of experimental thrusting spears. Shea (2006) says that this pattern suggests that if these points

were used as hafted weapon armatures, they were used as tips for hand-cast or thrusting spears, but not as projectiles. Shea bases this suggestion on results of recent experiments using triangular flakes as spear points and on micro-wear and residue analyses of later MSA triangular flakes and retouched points from Sibudu Cave. Based on this suggestion, it seems safe to say that the TCSA values of all Sibudu and Umhlatuzana points place them in the range of hand-held spears, as is the case for the points from other sites recorded in Table 7.9 (except for North American arrowheads and dart tips and Rose Cottage Dc points).

As is the case with other measurements and attributes of Sibudu and Umhlatuzana points, TCSAs have high CVs and are therefore unstandardized (Table 7.9). TCSAs of other MSA points in Table 7.9 are also unstandardized.

Table 7.9

Tip Cross-sectional Area (TCSA) (in mm²) for French points, South African points and North American arrowheads and dart tips. Sources: 1, Villa & Lenoir (2006); 2, Wadley 2007; 3, Mohapi (2005, 2007); 4, Shea (2006). Where no sources are given, information provided is that from the present study.

Samples	Mean	SD	Min	Max	CV	n	Source
Bouheben (Mousterian points)	165.0	67.2	50.0	322	40.7	70	1
Sibudu, final MSA (layers Ore to Co)	116.2	41.5	45.0	200.0	35.7	21	1
Sibudu, RSp to MOD	117.7	57.6	19.5	294.0	48.9	71	1
Sibudu, layers below RSp	139.4	60.0	54.0	320.0	43.0	42	1
Sibudu Still Bay (bifacial only)	117.0	41.0	63.0	183.0	35.0	9	2
Sibudu Still Bay (unifacial & bifacial)	88.7	54.5	24.0	195.0	61.4	12	
Sibudu post-Howiesons Poort	133.7	59.9	31.5	320.0	44.8	41	
Sibudu late MSA	124.4	71.3	16.0	399.5	57.3	103	
Sibudu final MSA	110.2	47.3	24.0	205.0	42.9	16	
Umhlatuzana pre-Howiesons Poort	121.1	52.3	30.0	331.5	43.2	62	
Umhlatuzana late MSA	157.2	70.5	60.0	297.5	44.8	17	
Umhlatuzana MSA/LSA transition	122.8	55.3	54.0	234.0	45.0	16	
Rose Cottage post-Howiesons Poort	78.0	33.0	19.5	192.0	42.3	47	1
Rose Cottage post-Howiesons Poort	81.0	33.0	32.0	192.0	40.7	41	3
Rose Cottage Dc	6.4	2.6	2.5	10.5	40.6	16	3
Experimental & ethnographic thrusting spears	168.0	89.0	50.0	392.0	53.0	28	4
North American dart tips	58.0	18.0	20.0	94.0	31.0	40	4
North American arrowheads	33.0	20.0	8.0	146.0	60.6	118	4
South African Still Bay	145.0	100.0	25.0	754.0	69.0	203	4
South African Still Bay < 200 mm ²	108.0	39.0	25.0	197.0	36.1	168	4
Blombos Cave Still Bay	143.0	109.0	4.0	842.0	76.2	239	4
Blombos Cave Still Bay < 200 mm ²	100.0	53.0	4.0	199.0	53.0	190	4
Klasies River Mouth MSA 1	160.0	60.0	55.0	350.0	37.5	71	4
Klasies River Mouth MSA 1 < 200 mm ²	138.0	37.0	55.0	198.0	26.8	58	4
Klasies River Mouth MSA 2 Lower	199.0	105.0	50.0	1210.0	52.8	545	4
Klasies River Mouth MSA 2 Lower < 200 mm ²	139.0	36.0	50.0	198.0	25.9	328	4
Klasies River Mouth MSA 2 Upper	170.0	79.0	36.0	512.0	46.5	298	4
Klasies River Mouth MSA 2 Upper < 200 mm ²	131.0	39.0	36.0	198.0	29.8	213	4

Table 7.10

Comparison of TCSA values of Still Bay points and those of post-Howiesons Poort, late and final MSA points from Sibudu.

	Post-Howiesons Poort	late MSA	final MSA
Still Bay	$t = 2.0; p = 0.001$	$t = 2.0; p = 0.01$	$t = 2.1; p = 0.05$

Hafting of Sibudu and Umhlatuzana points

The morphologies of the bases of Sibudu points suggest different hafting strategies for the Still Bay points and those from the younger phases. Several Still Bay points have bases which are pointed and these are not found anywhere else in the MSA sequence; this would probably require a haft different from the type used for the broad, faceted platforms and plain platforms common in the post-Howiesons Poort and the late MSA. In fact, Wadley (2007) has suggested that the Still Bay double-pointed points were not intended to be reversible in their hafts, but that the bases were pointed to facilitate a special type of haft that was preferred at the time. Another indication that Still Bay points' distal and proximal pointed ends were not intended to be reversible in their hafts is the fact that the distal ends of Still Bay points studied by Minichillo (2005) from some South African sites were constantly resharpened in their hafts thus creating a clear line between the mid-point and the base. According to Minichillo (2005), this resharpening leaves the base wider than the rest of the point. This hypothesis was confirmed by results of use-trace analyses of some bifacial points from Still Bay layers at Sibudu analysed by Marelize Lombard (2006b). Lombard (2006b) found that there is a greater concentration of residues on the proximal/medial portions than on the distal portions and this can be due to resharpening of the point while it is still attached to its haft because original residues on the distal portion would have been removed during resharpening. The present study supports this hypothesis, too, because the penetrating angles of the proximal and distal ends of Sibudu Still Bay points are significantly different as indicated earlier. The distal end should have a smaller penetrating angle than the proximal end and, if the distal end was resharpened, this angle would become even smaller. This was, indeed, the case.

Use-trace/wear analyses of two whole Still Bay bifacial points with pointed and asymmetrical bases from Sibudu suggests that these points were hafted and used as butchery tools or knives

and not as spearheads (Lombard 2006b). This suggestion is consistent with experimental work by showing that long, thin points (such as the Still Bay ones) are better suited for use as knives rather than spearheads because they are fragile and vulnerable to breakage (Shea *et al.* 2001; also see Wadley 2007). Furthermore, other archaeological analyses of South African Still Bay points have yielded results indicating that there are few Still Bay points with impact fractures typical of hunting weapons (Minichillo 2005). For this reason, Minichillo (2005: 126-7), too, argues that the Still Bay points were used as knives because “...a robust hafting element, large proportion of the point inside the haft, and consistent evidence for resharpening all support the primary interpretation of Still Bay points as bifacial knives”.

Another attribute which is suggestive of hafting in points is bulbar thinning. Bulbar thinning involves the removal of the striking platform and extensive flaking of the ventral surface of the point and this is generally seen as a way of accommodating the bases of the points to specific hafting procedures (Villa & Lenoir 2006). A substantial proportion of points at Umhlatuzana (32.6%) and Sibudu (11.2%) have bulbar thinning and this is indicative of the use of these points as part of hafted weapons. It should be noted that percentages for bulbar thinning were derived from combining proportions of bases which are completely removed by retouch and are broad and curved, with those of completely reduced bases. Hollow-based points in the final MSA of Sibudu and the MSA/LSA transition at Umhlatuzana have almost identical bulbar thinning (Figs 5. 2 & 5.9) and this is suggestive of a specific and local way of hafting. One of the Sibudu hollow-based points from layer Co (with an age of ~35 ka) contained plant and ochre residues on its proximal portion and animal residues on its distal end, and these have been taken to suggest hafting with plant twine and mastic loaded with ochre (Lombard pers. comm. as cited in Wadley 2005c). I cannot make any suggestions about these hafting strategies, based on the technological studies that I have completed, but it is clear that different hafts would be required for the different sizes and shapes of point bases.

Further strong evidence for the use of some of the Sibudu points as hafted hunting weapons comes from the multi-analytical studies carried out by Marlize Lombard. A comparison of results of experiments involving the use of replicated MSA points, together with the results of micro-wear, residue and macro-fracture analyses on points from the post-Howiesons Poort at Sibudu,

suggests that most Sibudu points were both hafted and used as hunting spears (Lombard 2004, 2005a; Lombard *et al.* 2004). Macro-fracture analysis has also provided evidence for the use of some Umhlatuzana points as hafted spearheads (Lombard 2007c). A good proportion of these points have diagnostic impact fractures (36.5 % for post-Howiesons Poort and 12% for pre-Howiesons Poort points) indicative of their use as hunting spears (Lombard 2007c).

Furthermore, it has been discovered that ochre was an integral part of the hafting technologies of the MSA points at Sibudu. Analyses of distribution patterns of ochre residues on post-Howiesons Poort and Howiesons Poort segments from Sibudu suggest that ochre was mixed into adhesives used to glue tools to their hafts (Lombard 2006b, 2007b, also see Wadley 2005a, 2005b, 2006a; Wadley *et al* 2004, Hodgskiss 2006).

Point retouch types

The predominant retouch type at both Sibudu and Umhlatuzana is invasive retouch. At Sibudu, 90% of points in the Still Bay have invasive retouch. This seems to be related to the high frequency of bifacial retouch (80%) in this phase because invasive retouch decreases in the post-Howiesons Poort (57.1%) where unifacial retouch is common (91%). Invasive retouch is also frequent in the late MSA (73%) where there is more bifacial retouch than there is unifacial retouch. At Umhlatuzana, invasive retouch is common throughout the MSA sequence; 80% in the pre-Howiesons Poort, 81% in the late MSA and 92% in the MSA/LSA transition phase. Invasive retouch seems to have played a role in shaping points to desired forms suitable for specific hafts and ultimately for specific functions. For instance, heavy invasive retouch was required to reduce points' platforms to either pointed bases (in the Still Bay at Sibudu and pre-Howiesons Poort at Umhlatuzana) or hollow bases (in the final MSA of Sibudu and the MSA/LSA transition at Umhlatuzana). Other retouch types that were used in these two sites are marginal, short and very rarely, abrupt retouch. Invasive retouch has commonly been used to shape other MSA points in South Africa and everywhere; for instance, about half of post-Howiesons Poort points from Rose Cottage have this retouch type (Mohapi 2005, 2007).

Point rock types

In some cases, changing rock types are associated with changes in morphology and even functions of points (Tomka & Prewitt 1993; Ellis 1997). The manufacture of a point from a coarse-grained rock, such as a small quartzite pebble, may result in a thicker, smaller projectile than a point made from highly siliceous, well-crystallized and larger flint nodules (Tomka & Prewitt 1993). In Sibudu, hornfels and dolerite are the preferred rock types while other rocks such as quartz, quartzite and chert are rarely used. It does not appear that the source of the rocks at Sibudu involved long distance travel (Wadley 2005c). A dolerite intrusion into the sandstone cliff is found a few hundred metres from the site and this is likely to be one of the sources of dolerite used in the manufacture of tools at Sibudu (*ibid*: 52). Another source of dolerite, quartz and quartzite nodules is the Tongati River just below Sibudu Cave (Wadley 2005c). Even though hornfels of the quality used at Sibudu is presently available approximately 20 km south of the site (in the Verulam area), it is possible that outcrops that were exposed near the site in the past may now be covered with dune sand (Wadley 2005c).

At Sibudu, hornfels and quartz points are lighter in weight, narrower and thinner than dolerite and quartzite points. However, there are no significant differences in the lengths and almost none in base thickness and/or breadth of these points across rock types. This similarity suggests that rock types probably did not play an important role in determining haft types, in other words, it does not appear that points were hafted differently by rock type. This, coupled with the fact that there are no significant differences in lengths of points across rock types, suggests that points made from different rock types were not necessarily used differently. This scenario is different from the one for Sibudu segments, which will be discussed shortly.

At Umhlatuzana, hornfels is the most common rock type; however, quartzite is also common in the pre-Howiesons Poort phase. As is the case at Sibudu, the manufacture of points using different rock types does not seem to have influenced their form or function. There are very few differences between points made from different rock types. There are no significant differences in mass, length and thickness at base. However, quartz points are narrower than hornfels ones; hornfels points are thinner than quartzite points and quartz points have thinner bases than dolerite ones.

Segments

The analysis of segments in this study involved measuring maximum length, breadth and thickness and calculating length/breadth ratio, coefficient of variation, TCSA and penetrating angle. The following discussion examines the results of these measurements and calculations in the light of other studies on segments.

Breadth, thickness, length and length breadth ratios of segments

Segments or other backed tools were not always used singly, and even where they were, they may have been hafted in a variety of positions (this will be discussed shortly). Therefore morphometric data such as breadth, thickness, length and mass, as well as TCSA values and penetrating angles, are not necessarily reliable indicators of segment functions. This applies whether or not segments were used as part of composite tools (also see Shea 2006, Wurz & Lombard 2007). The morphometric data can be most effectively used in the study of segments hafted singly whether vertically, transversely or diagonally and in conjunction with use-wear and residue analyses. However, it is possible for TCSAs and angles of segments hafted back-to-back to be calculated and the subsequent discussion will examine this issue.

Sibudu and Umhlatuzana segments are within the size range of Howiesons Poort backed pieces from other sites. Breadths and thicknesses of these segments (Tables 7.11 & 7.12, respectively) are within the range of breadths and thicknesses of backed pieces from a site such as Klasies River Mouth (Sarah Wurz and J. Deacon samples) (Tables 7.11 & 7.12) (Wurz 1997, 1999, 2000). These segments have been interpreted as armatures for hunting weapons (Wurz & Lombard 2007). Sibudu and Umhlatuzana segments' breadths and thicknesses are, however, significantly bigger (Table 7.13) than those of Jubilee Shelter (Tables 7.11 & 7.12)

Sibudu and Umhlatuzana segment mean breadths (11.8 ± 3.3 mm and 12.1 ± 3.0 mm, respectively) are both within Shott's (1997) arrow shoulder-width range. Shoulder-width (breadth) is regarded as an important discriminator of weapon types by Shott (1997) and he reports that mean shoulder-widths of arrows and darts are significantly different (arrows = 14.7 mm; darts = 23.1 mm). The width of a weapon's stone tip can vary depending on the angle at

which the insert is hafted. For example, if the short quartz segments at Sibudu were hafted transversely, instead of vertically, then their lengths (mean length = 17.4 ± 3.5 mm) would become their shoulder-widths (Wadley & Mohapi, in press). In this scenario, the quartz segments would fit within the range of Shott's (1997) shoulder-width dimensions for arrows (Wadley & Mohapi, in press).

Shoulder-widths of dolerite segments (13.5 ± 3.2 mm) from Sibudu also fit well with Shott's (1997) mean dimensions for arrowheads, but if they had been transversely hafted their lengths (31.5 ± 10.0 mm) fit the range of shoulder-widths for darts (Wadley & Mohapi, in press). Shoulder-widths of segments hafted as pairs, back-to-back (mean = 23.8 mm), also fit Shott's dart category. This illustrates the versatility of segments as inserts for hunting weapons.

The mean lengths of Sibudu and Umhlatuzana segments (25 ± 8.4 mm and 29.8 ± 10.6 mm, respectively) are close to lengths of Howiesons Poort segments from sites such as Klasies River Mouth (Sarah Wurz and Deacon samples) and Montagu Cave segments (Table 7.14). Nelson Bay Cave and Border Cave segments are especially larger than other MSA segments while Sibudu segments fall within the shorter end of the spectrum.

Sibudu and Umhlatuzana segments are also within the size-range of the 33 replicated MSA flint segments (mean length = 33.3 mm; mean breadth = 13.1 mm; mean thickness = 3.1 mm) used by Pargeter (2006, in press) in his hunting experiments. These experimental segments functioned effectively as projectile tips (Pargeter 2006, in press). The lengths of Umhlatuzana segments are significantly longer ($t = 2.0$, $p = 0.02$) than Sibudu segments, even though all the other attributes like breadth, thickness, TCSA and distal angles (to be discussed later), are not significantly different. All MSA segments' mean lengths are much greater than the mean length of LSA Jubilee Shelter segments (10.3 ± 3.8 mm) and those of other LSA segments, such as those from Melkhoutboom (H.J. Deacon 1976), Uniondale (Leslie-Brooker 1987) and Wilton Rock Shelter (J. Deacon 1972) (Table 7.14). This could suggest that LSA segments were used in entirely different ways from MSA segments. Micro-wear analysis of some segments from Jubilee Shelter suggests that these may have been used as cutting tools, not weapons (Wadley & Binneman 1995). Jubilee Shelter segments seem, in any event, too small to inflict lethal damage on large

prey without the addition of poison. Replicas of ethnographic San bows and arrows fitted with segments the size of LSA segments, were also found to be ineffective for penetrating a calf carcass (Binneman 1994). Notwithstanding this, a LSA hafted arrow discovered at Adam's Kraal by Binneman (1994) contained a tiny stone insert the size of some of the smallest segments from Jubilee Shelter. It seems certain that the LSA innovation must have been the use of poison with arrows, rather than the invention of arrows.

At Sibudu, segments have significant length differences across rock types; quartz segments are shorter than hornfels and dolerite ones and hornfels segments are shorter than dolerite ones. Quartz segments are also narrower than dolerite ones, but are not narrower than hornfels ones. A similar pattern has been observed on a bigger sample of Sibudu segments studied by Wadley and Mohapi (in press). Wadley and Mohapi suggest that the three segment populations (that is: quartz, hornfels and dolerite) found at Sibudu could each have been part of separate tool-kits used for specific functions, and they may even have been hafted differently. The length/breadth ratio of the large sample of quartz segments is standardized ($CV = 7.0$), supporting the idea that quartz tools represent a distinct segment population (Wadley & Mohapi in press).

At Umhlatuzana, quartz segments are significantly shorter and narrower than hornfels, mudstone and quartzite segments. Otherwise, there are no differences between Umhlatuzana segments across rock types.

As at Umhlatuzana, Jubilee has no segment populations based on rock types. Quartz segments are not shorter or narrower than hornfels and chert segments. There are no differences in length, breadth or thickness between hornfels and chert segments and between quartzite and chert segments. This lack of differences between segments produced from different rock types could imply that all segments at Jubilee were intended to perform the same function.

Length/breadth ratios indicate that both MSA and LSA segments were made from blades or were trimmed to blade-like proportions, because most ratios are equal to, or greater than, 2.0. It appears that blanks from which segments were produced did not change over time. What changed were sizes of the segments and the way they were used.

The morphometric and macro-fracture analyses provide strong evidence for the use of Sibudu and Umhlatuzana segments as tips of hunting weapons, but the range of sizes and the potential for hafting in a variety of ways, implies that not only arrows need be implicated. Segments could also have been used as darts or sometimes even spearheads, depending on how they were hafted.

Length is said to be one variable over which knappers could exercise most control or choice and is therefore a good measure of standardization (Wurz 2000). None of the segments from the MSA sites (Sibudu and Umhlatuzana) and the LSA site (Jubilee Shelter) have standardized lengths; the CVs of these points' lengths are all high. Breadths and thicknesses of these segments are also highly unstandardized (Tables 7.11-7.14) This is in contrast to a suggestion that LSA backed tools are more standardized than MSA ones (Thackeray 1992) and is in support of Wurz's (1997, 1999) argument that MSA and LSA backed tools are equally unstandardized.

Table 7.11

Breadth (in mm) of segments and backed tools from South African MSA sites. Sources: 1, Wurz (2000). Where no sources are given, information provided is that from the present study.

Samples	Mean	SD	Min	Max	CV	n	Source
Sibudu segments	11.8	3.3	6.0	20.0	28.0	65	
Umhlatuzana segments	12.1	3.0	6.0	22.0	24.8	91	
Jubilee segments	5.1	1.7	3.0	13.0	33.3	41	
Klasies River Mouth backed tools (SW sample)	15.9	3.4	5.0	29.0	21.7	828	1
Klasies River Mouth backed tools (D sample Cave 1)	15.3	2.7	9.0	19.0	18	28	1
Klasies River Mouth backed tools (D sample Cave 2)	13.7	3.6	8.0	24.0	27.0	74	1

Table 7.12

Thickness (in mm) of segments and backed tools from South African MSA sites. Sources: 1, Wurz (2000). Where no sources are given, information provided is that of the present study.

Samples	Mean	SD	Min	Max	CV	n	Source
Sibudu segments	4.1	1.4	2.0	8.0	34.1	65	
Umhlatuzana segments	4.2	1.3	2.0	11.0	31.0	91	
Jubilee segments	2.4	0.8	1.0	4.0	33.3	41	
Klasies River Mouth backed tools (SW sample)	4.6	1.2	2.0	9.0	26.4	828	1
Klasies River Mouth backed tools (D sample Cave 1)	4.6	1.1	2.0	7.0	25.0	28	1
Klasies River Mouth backed tools (D sample Cave 2)	4.3	1.2	2.0	8.0	30.0	74	1

Table 7.13

Breadth and thickness of Jubilee segments compared to those of Sibudu and Umhlatuzana.

	Jubilee breadth	Jubilee thickness
Sibudu	$t = 2.0, p < 0.01$	$t = 2.0, p < 0.01$
Umhlatuzana	$t = 2.0, p < 0.01$	$t = 2.0, p < 0.01$

Table 7.14

Length (in mm) of segments and backed tools from Southern African MSA and LSA sites. Sources: 1, Wurz (2000); 2, Volman (1981); 3, Keller (1973); 4, Beaumont (1978); 5, Mehlman (1989); 6, H. J. Deacon (1976); 7, J. Deacon (1972); 8 Leslie-Brooker (1987). Where no sources are given, information provided is that from the present study.

Samples	Mean	SD	Min	Max	CV	n	Source
Sibudu segments	25.0	8.4	13.0	48.0	33.6	40	
Umhlatusana segments	29.8	10.6	11.0	63.0	35.6	73	
Jubilee segments	10.3	3.8	5.0	24.0	37.0	41	
Klasies River Mouth backed tools (SW sample)	36.6	9.4	9.0	72.0	26.0	630	1
Klasies River Mouth backed tools (D sample Cave 1)	35.1	9.7	16.0	62.0	28.0	28	1
Klasies River Mouth backed tools (D sample Cave 2)	36.6	10.5	21.0	70.0	29.0	58	1
Nelson Bay Cave segments	46.1	–	–	–	16.0	45	2
Montagu Cave segments	29.9	–	–	–	23.0	37	3
Border Cave backed tools	47.7	–	–	–		16	4
Mumba backed tools	34.2	–	–	–	29.0	27	5
Melkhoutboom LSA backed tools	11.9	–	–	–	24.0	101	6
Wilton LSA backed tools	15.4	–	–	–	25.0	54	7
Uniondale LSA backed tools	17.2	–	–	–	19.0	178	8

Mass of segments

As previously mentioned, arrowheads are supposed to be light for aerodynamic reasons (Hughes 1998, Brooks *et al.* 2006). The masses of Sibudu (mean = 1.3 ± 1.1 g; range = 0.2-5.2 g) and Umhlatusana (mean = 1.5 ± 1.1 g; range = 0.3-5.9 g) segments are much less than those of reported spearheads and dart tips (see Table 7.6 for some of these spearheads and dart tips). These segments' masses are somewhere between the range of masses of North American arrowheads (0.3-17.4 g) and those of North American dart tips in Museum collections (1.6-7.9 g) (Villa & Lenoir 2006). As noted in the previous chapter, the mean mass of Jubilee Shelter segments has not been calculated because many of these do not move the scale because of their small size. Mass measurements of Sibudu and Umhlatusana segments do not dispute the hypothesis of the use of these segments as arrowheads. But as previously mentioned, mass is a problematic attribute.

Masses of Sibudu and Umhlatuzana segments like all other attributes discussed above, are highly unstandardized (CVs: Sibudu = 84.6; Umhlatuzana = 73.3).

Tip penetrating angle

Both distal and proximal angles were measured for all whole segments because of the possibility of the two ends being used interchangeably. All the penetrating angles of segments in this study are less than those of Sibudu and Umhlatuzana points (Tables 7.7 & 7.15). Multi-stranded evidence supports the use of points as spearheads. Mean distal and proximal penetrating angles of Sibudu ($51.4 \pm 7.1^\circ$ and $50.6 \pm 6.6^\circ$, respectively) and Umhlatuzana ($51.8 \pm 9.8^\circ$ and $55.0 \pm 12.0^\circ$, respectively) segments are closer to, but less than those of MSA points that Brooks *et al.* (2006) suggest are darts (see Table 7.7 for penetrating angles of $\neq$ Gi and Aduma points). These segments' angles also fall between the penetrating angle of tiny Rose Cottage Dc points (which I believe are arrowheads) (Mohapi 2005, 2007) and the angle of Solutrean foliate points which are interpreted as spearheads (Peterkin 1997) (Table 7.15). Dc points have dimensions that are smaller than those of Sibudu and Umhlatuzana segments, but slightly bigger than those of Jubilee Shelter segments (mean length = 15.6 ± 4.0 mm, mean breadth = 6.9 ± 1.7 mm, mean thickness = 1.8 ± 0.5 mm, TCSA = 6.4 ± 2.6 mm²). Perhaps Dc points are variants of the type of projectiles represented by the segments. Jubilee Shelter distal and proximal angles are both significantly different from those at Sibudu and Umhlatuzana (Table 7.16) and are smaller than that of Rose Cottage Dc points.

Mean penetrating angles of hypothetical back-to-back segments from the three sites (Sibudu distal angle = $102.8 \pm 14.2^\circ$, proximal angle = $101.2 \pm 13.2^\circ$; Umhlatuzana distal angle = $103.6 \pm 19.6^\circ$, proximal angle = $110.0 \pm 24.0^\circ$; Jubilee distal angle = $86.9 \pm 9.0^\circ$, proximal angle = $84.6 \pm 22.2^\circ$) are within the range of penetrating angles of points from Sibudu and Umhlatuzana, which multi-stranded evidence suggests were used as spearheads (see Tables 7.7 for mean penetrating angles of Sibudu and Umhlatuzana points).

Distal and proximal angles on the same segments are not significantly different at either Sibudu or Jubilee Shelter whereas they are significantly different at Umhlatuzana (Table 7.17). Lombard (2007b) has shown that it is unlikely that distal and proximal tips of quartz segments from

Sibudu were used interchangeably because resin residues associated with hafting were found only on one tip.

Table 7.15

Tip penetrating angle (in degrees) of MSA and LSA segments and Rose Cottage Cave DC points (arrowheads). Sources: 1, Mohapi (2005, 2007); 2, Peterkin (1997). Where no sources are given, information provided is that of the present study.

Samples	Mean	SD	Min	Max	CV	n	Source
Sibudu: Distal	51.4	7.1	36.0	66.0	13.8	62	
Proximal	50.6	6.6	39.0	63.0	13.0	35	
Umhlatuzana: Distal	51.8	9.8	30.0	80.0	18.9	89	
Proximal	55.0	12.0	25.0	100.0	21.8	51	
Jubilee: Distal	43.4	4.5	35.0	54.0	10.4	41	
Proximal	42.3	11.1	38.0	60.0	26.2	41	
Rose Cottage Dc points (arrowheads)	48.8	8.3	33.4	61.9	17.0	16	1
Solutrean foliate points	54.8	12.5	–	–	22.8	92	2

Table 7.16.

Distal and proximal angles of Jubilee segments compared to those of Sibudu and Umhlatuzana.

	Jubilee distal angle	Jubilee proximal angle
Sibudu	$t = 2.0, p < 0.01$	$t = 2.0, p < 0.01$
Umhlatuzana	$t = 2.0, p < 0.01$	$t = 2.0, p < 0.01$

Table 7.17

Differences between proximal and distal penetrating angles of segments (whole and distal/proximal tips) from Sibudu, Umhlatuzana and Jubilee.

	Proximal and distal penetrating angles
Sibudu	$t = 2.0; p = 1.0$
Umhlatuzana	$t = 2.0; p = 0.03$
Jubilee	$t = 2.0; p = 1.0$

Tip cross-sectional area (TCSA)

Mean TCSA values of Sibudu ($26.0 \pm 5.6 \text{ mm}^2$) and Umhlatuzana ($26.4 \pm 15.0 \text{ mm}^2$) segments are within values of arrowheads suggested by Shea (2006) (Table 7.18). Jubilee Shelter segments' TCSA value is, however, much less ($6.6 \pm 4.4 \text{ mm}^2$) and, interestingly, it is similar to the TCSA calculated for the tiny backed points from Dc at Rose Cottage cave (6.4), which were thought to be arrowheads (Mohapi 2005, 2007). Jubilee segments' TCSA is significantly smaller than those of Sibudu and Umhlatuzana (Table 7.19). In fact, results of micro-wear analysis conducted on some of these segments by Wadley & Binneman (1995) led them to conclude that Jubilee Shelter Wilton segments were used as single or composite cutting implements, but not as hunting tools. Sibudu hypothetical transversely hafted segments have TCSA values that place them within the range of Shea's (2006) dart tips (Table 7.18). Umhlatuzana's hypothetical transversely hafted segments have a TCSA value that is within the range of Shea's (2006) dart tips (Table 7.18). The TCSA of Jubilee's hypothetical transversely hafted segments is much smaller than that of North American arrowheads. Mean TCSA values of Sibudu segments ($52.0 \pm 31.2 \text{ mm}^2$) and Umhlatuzana's ($53.2 \pm 30.0 \text{ mm}^2$) hypothetical back-to-back segments place them in Shea's (2006) dart category. Jubilee Shelter hypothetical back-to-back segment TCSA value ($13.2 \pm 8.8 \text{ mm}^2$) is at the lowest end of the range for arrowhead values suggested by Shea (2006). Pargeter's (2006) experimental back-to-back segments have TCSA values that place them somewhere between the category of dart and spear tips. However, Pargeter (2006) notes that his back-to-back sample is small and the results are therefore inconclusive. Pargeter's (2006) individual experimental segments have TCSAs which could also qualify as arrowheads (Table 7.18).

All segments (whichever way they are hafted) from Sibudu, Umhlatuzana and Jubilee have TCSAs with very high CVs and are therefore unstandardized (Table 7.18).

Table 7.18

Tip cross-sectional area (TCSA) (in mm²) of MSA, LSA and Pargeter's (2006) experimental segments, North American arrowheads, North American darts and experimental/ethnographic thrusting spears (Shea 2006). Sources: 1, Pargeter (2006); 2, Shea (2006). Where no sources are given, information provided is that from the present study.

Samples	Mean	SD	Min	Max	CV	n	Source
Sibudu	26.0	15.6	7.0	80.0	60	65	
Sibudu (transversely hafted)	51.4	30.6	19.0	136.5	59.5	40	
Umhlatuzana	26.6	15.0	7.0	121.0	56.4	90	
Umhlatuzana (transversely hafted)	63.3	33.0	15.0	157.5	52.1	71	
Jubilee	6.6	4.4	1.5	24.0	66.7	41	
Jubilee (transversely hafted)	13.6	9.5	2.5	48.0	69.9	41	
Diagonally hafted experimental segments	28.0	–	–	–	–	–	1
Transversely hafted experimental segments	20.7	–	–	–	–	–	1
Vertically hafted experimental segments	23.0	–	–	–	–	–	1
Experimental & ethnographic thrusting spears	168.0	89.0	50.0	392.0	53.0	28	2
North American dart tips	58.0	18.0	20.0	94.0	31.0	40	2
North American arrowheads	33.0	20.0	8.0	146.0	60.6	118	2

Table 7.19

TCSA of Jubilee segments compared to those of Sibudu and Umhlatuzana.

	Jubilee
Sibudu	$t = 2.0; p < 0.01$
Umhlatuzana	$t = 2.0; p < 0.01$

Evidence for use of segments as weapons

As noted earlier (Chapter Two), Lombard (2007b) believes that the main function of Sibudu and Umhlatuzana segments was as inserts of composite hunting weapons. Most of the animal residues on the Howiesons Poort segments from Sibudu and Umhlatuzana are concentrated on the blades or cutting portions of the segments and this suggests that the Howiesons Poort segments might have been used mostly on animal material either in butchering or hunting (Lombard 2007b). Use-wear traces on these segments show little evidence of their use as cutting, sawing or scraping implements (*ibid*: 8).

The issue of hafting segments

As mentioned in Chapter Two, segments from different Sibudu and Umhlatuzana Howiesons Poort layers were hafted (Lombard 2006a). There is a possibility that segments at Sibudu were both hafted and used in different ways (Lombard 2008). The oldest Howiesons Poort segments (mostly made on hornfels) from Sibudu were generally hafted onto bone hafts. The youngest Howiesons Poort segments, mostly made on dolerite, seem to have been more often hafted to wood (Lombard 2008). The different raw materials of the hafts may imply that different positions were required for the segments used as weapon tips. This, in turn, could be pointing to two distinctive sets of hunting weapons using segments (Wadley & Mohapi, in press).

Various potential hafting positions are illustrated by Clark *et al.* (1974), Clark (1977) and Nuzhnyj (2000). Nuzhnyj (2000) has illustrated a variety of potential hafting positions of microliths as projectile weapons, for instance, horizontally (transversely), vertically, diagonally, and two segments hafted back-to-back (Fig. 7.1). Some historic San arrowheads also comprise two microliths set in mastic at an angle so that they are hafted back-to-back to create a broad, sharp cutting edge (Clark 1977) that looks like a point. It is this kind of hafting combination that I have suggested for some of the segments at Sibudu and Umhlatuzana. Large segments hafted in this way could sometimes create a point for use as a spearhead, rather than for use as an arrowhead. Such potential flexibility makes the interpretation of segment use difficult.

Nonetheless, the various positions illustrated by Nuzhnyj and Clark may be implied by the results of micro-residue and use wear analyses of Sibudu segments. Fifty per cent of segments from PGS (the oldest Howiesons Poort layer) seem to have been hafted in longitudinal, transverse or paired configurations, while 30% of the segments show evidence for diagonal hafting (Lombard 2008). In GS and GS2 (the middle Howiesons Poort layers) 50% of segments were hafted diagonally, while 25% were hafted in other configurations. Forty-five per cent of the segments from layers GR and GR2 (the youngest Howiesons Poort layers) show signs of longitudinal, transverse or pair hafting, and a further 45.5% could have been hafted diagonally. Pargeter's experiment (2006, 2007) shows that all of the hafting positions suggested above work well when segments are projected.

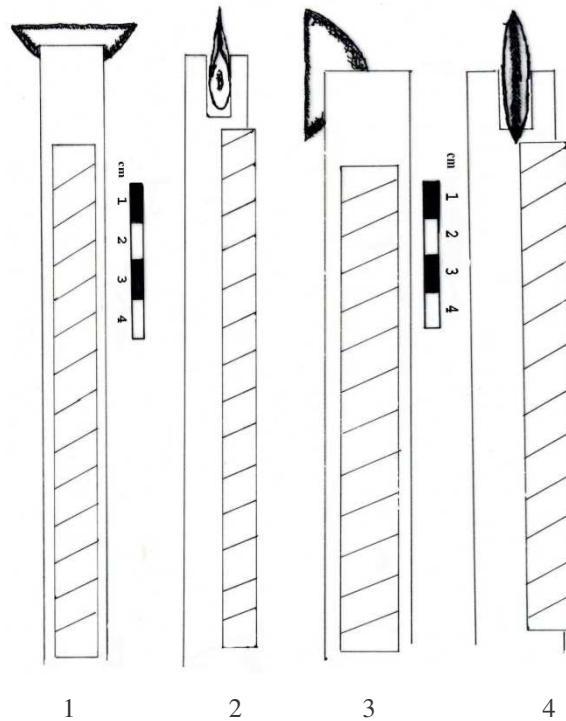


Fig. 7.1 Examples of segments hafting configurations: 1 transverse hafting, 2 vertical hafting, 3 diagonal hafting and 4 back-to-back hafting (from Pargeter 2006).

According to Lombard (2007b), quartz backed tools from Sibudu could have been hafted as multiple or single barbs on hunting weapons, because resin is only observed on one tip of the backed tool, suggesting that this end was glued to the shaft. However, Wadley and Mohapi (in press) favour the interpretation of these segments as tips of transversely-mounted weaponry because the adhesive recipe (resin without a loading agent) used for attaching quartz segments to their hafts is ideal for weapons that are intended to break within the body of prey and arrowheads would be intended to do so. In contrast, barbs could be expected to be firmly attached to the shaft to prevent it from being rubbed off the body of prey (Wadley & Mohapi, in press).

In contrast, dolerite segments (which had ochre mixed in their adhesives) may have been parts of spears that were designed to remain firmly in their shafts during repeated thrusts. However, if the dolerite segments were hafted diagonally, thereby creating a barb at the base of the stone insert, this may imply that the weapon was intended to remain embedded in the prey.

Sibudu and Umhlatuzana within the broader southern African MSA sequence

MSA sequences like those at Sibudu and Umhlatuzana

Sibudu is unusual in the southern African MSA context because it has a long sequence, including both Still Bay and Howiesons Poort technocomplexes, as well as a long sequence of post-60 ka MSA assemblages (Wadley 2005c, 2006a, 2007; Wadley and Jacobs 2006). Umhlatuzana, only about 90 km from Sibudu, also has a long MSA sequence, but the rotational slippage at the site (Kaplan 1990) and the possible mixing of assemblages makes it difficult to assign specific spits to technocomplexes. However, there is undoubtedly a Howiesons Poort Industry at Umhlatuzana and a pre-Howiesons Poort with a great variety of points. In addition, there is a long post-Howiesons Poort sequence and a final MSA assemblage that resembles that at Sibudu. Apart from the potential Howiesons Poort component at the lost site, Alfred County Cave and Border Cave (Mitchell 1998), there are no other known sealed Howiesons Poort assemblages in KwaZulu-Natal. Moreover, there are several Howiesons Poort occurrences in eastern Lesotho's highlands, at Melikane and perhaps also at Ha Soloja and Moshebi's Shelter (Mitchell 2002). However, sites with both Howiesons Poort and Still Bay are rare throughout South Africa. Diepkloof in the Western Cape contains both technocomplexes (Parkington & Poggenpoel 1987; Parkington *et al.* 2005; Rigaud *et al.* in press) and Peers Cave also seems to have both Howiesons Poort and Still Bay assemblages (Volman 1981; Minichillo 2005).

Blombos, which has a rich and well-publicised Still Bay Industry (Henshilwood & Sealy 1997; Henshilwood *et al.* 2001a; Soressi & Henshilwood 2004; Henshilwood 2005), has no Howiesons Poort, nor does Hollow Rock Shelter (Evans 1994). Blombos Still Bay points are within the same age range as Sibudu Still Bay points (>70 ka) (Wadley 2007). Klasies River, Border Cave and Rose Cottage Cave have Howiesons Poort Industries that are preceded and succeeded by MSA assemblages, but these sites lack a Still Bay Industry (Mitchell 2002). The Pinnacle Point sites appear to have early MSA assemblages of about 165 ka (Marean *et al.* 2004, Marean *et al.* 2007), but they have not yet yielded either Howiesons Poort or Still Bay industries.

Evidence for use of points and segments as hunting weapons from morphological and use trace analyses

Points

Sibudu and Umhlatuzana points seem to fulfill all the morphometric requirements for being spears, with the exception of some of the Still Bay points, which as previously mentioned, are more likely to have been knives. The impact fractures and animal residues on their tips, support the spearhead interpretation. It seems probable that points were restricted to a single upright method of hafting, which makes them different, and less versatile than segments, which appear to have had flexible hafting arrangements. There seems to be no significant difference between points made on different rock types at either site.

Segments

At Rose Cottage, only a few backed pieces from the Howiesons Poort Industry have impact scars, but this is not necessarily an indication that they were not arming spears or projectiles since Rose Cottage was a residential, not an ambush site, and both weapons and domestic tools were manufactured on site (Soriano *et al.* 2007).

The backed pieces of the Howiesons Poort at Klasies Main site were thought by Singer & Wymer (1982) to have been used as spear barbs or arrow tips and the notches found on these backed tools may be indicative of both hafting and use as weapons. In fact, as indicated earlier, macro-fracture analysis of these backed pieces has confirmed that they were, indeed, used as parts of hunting weapons (Wurz & Lombard 2007). Twenty-one percent of these segments have impact scars that are indicative of their use as hunting weapons (Wurz & Lombard 2007). This percentage is in accordance with those for diagnostic impact fractures found on Howiesons Poort segments from Sibudu (22%) and Umhlatuzana (24%) (2007c). However, there is no real evidence for the use of Jubilee Shelter segments as arrowheads. It is possible that, like the replicated segments in Binneman and Hall's experiments (Binneman 1994), they too would have been ineffective in inflicting any lethal damage to prey if used to tip arrowheads or spear-thrower darts.

The morphometric analyses, TCSAs and penetrating angles strongly support the use of Sibudu and Umhlatuzana segments as arrowheads, although darts or even spearheads could sometimes have been constructed through the back-to-back arrangement of two segments or transverse hafting. The arrowhead interpretation is strengthened by evidence from macro-fracture and residue studies by Lombard (2006a, 2007b, 2007c) on Sibudu and Umhlatuzana Howiesons Poort segments. However, the interpretation of some of the segments as potential barbs (Deacon 1995; Lombard 2008) is still a possibility. What is clear from my study and the studies of other researchers is that segments provided highly adaptable inserts for weapons, and that they could be hafted in several positions, either singly or in a compound arrangement.

The evidence for standardization in MSA and LSA sites

As noted earlier, LSA backed tools have been said to be more standardized than MSA ones and this has been regarded as evidence of modernity in the LSA (J. Deacon 1972; Thackeray 1992). However, Wurz (1997, 1999) reported that there is no significant difference between the CVs of Howiesons Poort backed tools from Klasies River Mouth and those of backed tools from various LSA sites. She therefore suggested that the lack of standardization of both MSA and LSA backed tools implies similar behaviour in these chronologically separate industries, implying modern minds in the Howiesons Poort and the LSA. Contrary to Wurz's (1997, 1999) findings, lengths and breadths of Wilton Rock Shelter silcrete segments from the LSA layer 3F *are* highly standardized (Deacon 1972). Thus, it seems that, when variables are reduced (for example, calculating CVs from one rock type only), there is a greater chance of standardization within a single tool class. Thus there are sometimes examples of standardization in LSA assemblages. A lesson learnt in this study is that high CVs indicating a lack of standardization are common when all tools are amalgamated regardless of rock types. In looking for standardization, it is important to reduce, as far as possible, the number of variables in the sample.

The morphometric attributes of points and segments from the two MSA sites in this study are unstandardized (using a CV of 10.0 as the cut-off point), as are those of segments from the LSA site, Jubilee Shelter. Moreover, crystal quartz backed tools (incorporating backed blades, trapezes and some segments) from Sibudu were shown by Delagnes *et al.* (2006) to lack

standardization of lengths like the LSA crystal quartz segments from Jubilee Shelter. Although the nine Sibudu quartz segments in this study have length/breadth ratios with a CV of 16.0, which is not considered standardized here, this value is more standardized than the length/breadth ratios of segments made on other rock types. Also, the larger quartz segment sample studied by Wadley and Mohapi (in press) has a lower CV (7.0) for length/breadth ratios, suggesting that some standardization of form can occur in the Howiesons Poort, as it can in the LSA.

The role of rock types at Sibudu, Umhlatuzana and Jubilee

At Sibudu there are several changes through time in preferences for rock types, although hornfels and dolerite are most common in all except the immediate post-Howiesons Poort layers, where quartz (and to a lesser extent, quartzite) is favoured (Cochrane 2006). Quartzite is never common at the site, but this coarse-grained rock is more popular for the production of Still Bay points than for artefacts at any other time. However, rock types do not appear to have constrained any of the morphometric attributes of points at the site. This is not the case in the Howiesons Poort at Sibudu, where rocks played an important role in determining the morphologies of segments. The three segment populations based on rock types seem to have been hafted and used differently. At Sibudu, all rock types for Still Bay and more recent industries are considered to have been local and it seems that it was not necessary to travel far to get desirable rocks. Kaplan (1990) did not comment on the local or non-local nature of the rock types used at Umhlatuzana and no study of the availability of rock types has been carried out there.

Local rock types were also used for tools from Florisbad, where MSA occupations pre-date and post-date the Still Bay and Howiesons Poort industries from other parts of the country (Kuman 1989; Brink & Henderson 2001). At Blombos, Still Bay bifacial points are also mostly made on fine-grained, local materials such as silcrete (Henshilwood & Sealy 1997; Henshilwood *et al.* 2001a; Henshilwood 2005) and travelling for these rocks was not an issue. At Rose Cottage Cave most of the stone tools were produced from opaline, whose source was probably the Caledon River less than 8 km from the cave (Clark 1997; Wadley 1997; Soriano *et al.* 2007). Since opaline is present as the dominant rock throughout the MSA and LSA sequences, there is no

change in the rock collection strategy through time. However, this situation is thought not to be the case at all southern African MSA sites.

For example, silcrete and hornfels are not locally available at Hollow Rock and greater distances might have been travelled to acquire these during the later part of the Still Bay occupation when these materials are found in high frequencies (Evans 1994). Evans (1994) suggests that exchange networks may have been more extensive during these later MSA units than they were earlier on when ‘exotic’ rocks were not found in high frequencies.

At Diepkloof, the Howiesons Poort has especially big segments, most of which are made of non-local silcrete. Above this, the MSA layers have unifacial points, also mostly made from non-local silcrete although some are made from local quartz (Parkington *et al.* 2005). At Klasies, MSA I tools are mostly made from quartzite which is locally available (Singer & Wymer 1982; Wurz 1999). In contrast, the younger Howiesons Poort backed tools are mostly made from non-local rocks such as silcrete, quartz and shale while local quartzite is minimally used (Singer & Wymer 1982; Thackeray 1992; Wurz 1997, 1999, 2000). Singer & Wymer (1982), on the one hand, argue that the non-local rocks are sharp and strong while local quartzite is brittle and that this might be the reason why non-local rocks were favoured over the local ones. Wurz (1999), on the other hand, argues that the use of non-local materials during the Howiesons Poort indicates symbolic behaviour because the backed artefacts in both local and non-local rocks have the same attributes.

The issue of increased use of ‘non-local’ and ‘exotic’ rock types during the Howiesons Poort led to a debate between Minichillo (2006) and Ambrose (2006). Minichillo (2006) challenges Ambrose and Lorenz’s (1990) interpretation of foraging strategy theory to explain the occurrence of the Howiesons Poort and to link it to modern human behaviour. According to the foraging strategy, the use of fine-grained, non-local materials in the Howiesons Poort was a response to the potential effectiveness of these better quality rocks. Travelling long distances to procure these materials during the Howiesons Poort reflected the invention of a social system of information exchange and an increase in foraging range (Ambrose & Lorenz 1990). This increased foraging range did not persist because during OIS 3, when climatic conditions

improved, resources became more abundant and information sharing became less important. Coarse-grained materials therefore became sufficient and the Howiesons Poort Industry disappeared (Ambrose & Lorenz 1990). Minichillo (2006) argues that sources of fine-grained rock types such as silcrete and quartz at sites like Klasies River, Nelson Bay Cave and the Howiesons Poort name site are local, not “exotic”, because they are found in the vicinity of the sites in the “form of secondary water-borne deposits” (2006: 5). He argues that a formal rock type survey was never conducted around Klasies River and that Singer and Wymer (1982) speculated when they said that the rocks used on this site were ‘nonlocal’ (*ibid*: 3). The increased use of fine-grained rocks observed at Klasies River in the Howiesons Poort could be due to selective rock type procurement of local but scarce resources requiring time-consuming or “time-dependent” foraging strategies (Minichillo 2006).

It is difficult to adjudicate between the two arguments, but this brief overview of rock type uses at various sites suggests that there is no simple correlation between, for example, Howiesons Poort segments and fine-grained rocks, and points (from other MSA assemblages) and coarse-grained rocks. What does seem apparent is that the knappers of MSA assemblages knew well the properties of the rocks that they were using and selected them with these properties in mind.

Evidence from faunal remains for changing hunting strategies

Howiesons Poort and post-Howiesons Poort inhabitants at Sibudu were capable hunters because bone accumulation at this site was primarily by humans (Clark & Plug 2008) and human signatures on bones such as carcass processing and human-related burning are more abundant than post-depositional modification (Cain 2006; Wells 2006). There was a shift from a preference for small animals such as vervet monkey (*Cercopithecus aethiops*), red duiker (*Cephalophus natalensis*), bushbuck (*Tragelaphus scriptus*) and bushpig (*Potamochoerus porcus*) in the Howiesons Poort (where segments occur) to that of very large animals such as blue wildebeest (*Connochaetes taurinus*), red hartebeest (*Alcelaphus buselaphus*), giraffe (*Giraffa camelopardalis*) and zebra (*Equus quagga*) in the post-Howiesons Poort, where points occur (Plug 2004; Clark & Plug 2008).

Sibudu is not alone in having a pattern of exploiting small fauna during the Howiesons Poort phase of the MSA and large fauna in the post-Howiesons Poort. Assemblages with many unifacial points at Diepkloof are associated with big animal bones (for example, Cape horse [*Equus capensis*] and black wildebeest [*Connochaetes gnou*]) while those with many segments are dominated by small forms (for example, dune mole rat [*Bathyergus suillus*], dassie [*Procavia capensis*] and hare [*Lepus* sp.]) (Parkington *et al.* 2005). This is in accordance with the argument by some scholars that spears were used for hunting mostly large animals (Ellis 1997; Hitchcock & Bleed 1997) while bows and arrows were used mostly in the hunting of small game (Terashima 1983; Ellis 1997; Hitchcock & Bleed 1997; Wadley 1998). If the points and segments at Diepkloof were used as inserts of hunting weapons, this could support my argument that points at Sibudu and Umhlatuzana were likely to have been used as spearheads while MSA segments from the same sites are likely to have been used, at least some of the time, as arrowheads or other forms of projectiles such as darts.

Technological and typological change through time

Not only do we see points replacing and succeeding segments in the Howiesons Poort, in concert with changing prey, but points and segments also change morphologically through time. At Sibudu, Still Bay points are narrower and more elongated than post-Howiesons Poort points, late MSA and final MSA points. As indicated above, some of these points are likely to have been knives, while others have evidence of having been used as spearheads. Post-Howiesons Poort, late MSA and final MSA points are also likely to have been spearheads and there is no evidence of these points having been multi-functional. Hafting strategies of Sibudu points seem to change over time too because there are certain point bases which are restricted to particular phases of the MSA sequence.

Moreover, Sibudu segments form three groupings based on rock types which are predominant in different stages of the Howiesons Poort. Segments, even more than points, may have been hafted at various angles and in various combinations, and they may therefore have been used as parts of different hunting weapons, some as arrows, others as darts or even spearheads.

At Umhlatuzana, change (for both points and segments) is not as evident as at Sibudu and this homogeneity within tool classes is likely to be due to the rotational slippage of sediments that was noted in Chapter Three. However, hollow-based points occur in the final MSA at Umhlatuzana, as well as in the final MSA at Sibudu, suggesting a new, and possibly local, type of hafting strategy at the end of the MSA.

MSA segments and Jubilee LSA segments differ tremendously in size; the MSA ones are likely to have been used as parts of hunting weapons while there is no strong support for the use of the LSA ones as parts of hunting weapons.

The following Chapter will summarise and conclude this study.

CHAPTER EIGHT

CONCLUSION

This study was intended to look for changing hunting strategies through time in the Middle Stone Age (MSA) and Later Stone Age (LSA) by examining changing lithic technologies, specifically MSA points and segments from MSA and LSA contexts. Points from the whole Sibudu Cave MSA sequence, that is, from the Still Bay to the final MSA layers, and those from different levels of Umhlatuzana Rock Shelter, were analysed. In addition, segments from the Howiesons Poort layer and final MSA layers at Sibudu and those from Howiesons Poort layers at Umhlatuzana were compared with LSA segments from Jubilee Shelter. This comparison was intended to see if LSA and MSA segments were technologically related and could have been used for the same purposes. A technological analysis was used to achieve the objectives of this study; basic measurements were taken and penetrating angles and tip cross-sectional areas of points and segments were calculated.

Points

There is overwhelming evidence that points from Sibudu and Umhlatuzana were used as hafted spearheads.

- First, with the exception of Still Bay points, all points from Sibudu have breadths that are within the breadths of other Sibudu, Bouheben and Rose Cottage points identified as hand-held spearheads by Villa & Lenoir (2006). As mentioned earlier, point breadth is said to be partly related to the breadth of haft and as such regarded one of the most effective discriminators of weapon armatures (Villa & Lenoir 2006). However, Still Bay points are exceptional because they have breadths that are smaller than those of points from other phases and have a mean breadth which is slightly less than that of North American dart tips but larger than that of North American arrow tips. Umhlatuzana points also have breadths that fall within the range of the points studied by Villa & Lenoir

(2006). The only exception is pre-Howiesons Poort points' breadths which are closer to those of North American dart tips but larger than those of arrowheads.

- Secondly, though point thickness has not necessarily been identified as one of the discriminators of weapon armatures, thicknesses of both Sibudu and Umhlatuzana points throughout the MSA sequence are within the range of thicknesses of points identified as spearheads by Villa & Lenoir (2006). However, as with breadths, Still Bay points' thickness is closer to the mean thickness of darts and greater than that of arrowheads.
- Thirdly, tip penetrating angles of both Sibudu and Umhlatuzana points are all greater than those of Solutrean points which are regarded as spearheads (Peterkin 1997). These points' penetrating angles are also similar or greater than those of other points identified as spearheads elsewhere, for instance, Rose Cottage Cave post-Howiesons Poort points (Mohapi 2005, 2007). Still Bay points' penetrating angles are, however, significantly smaller than those of final MSA, late MSA and post-Howiesons Poort points and are similar to those of $\neq$ Gi points interpreted as multi-purpose tools by Kuman (1989). Still Bay points are likely to have been used similarly. All the evidence provided above points to differences in the way Still Bay points and points from the other younger phases were used. The results of the technological study carried out in this study strengthen a point made earlier on by Marlize Lombard (2006b) that Still Bay points from Sibudu are likely to have been used as multi-purpose tools rather than solely as hand-held spears. This suggestion was based on use trace/wear analysis (Lombard 2006b). Shea (2006) has also commented that very long, thin points break easily if used as projectiles and are therefore better suited to being knives. Analyses of Still Bay points from other South African sites studied by Minichillo (2005) have also led to the conclusion that most Still Bay points were not used as spearheads because they did not have impact fractures typical of those found in hunting weapons.

This study also confirms a suggestion made by Wadley (2007) that Sibudu Still Bay points' distal and proximal points were not intended to be used reversibly, but that the pointed base was to facilitate a particular hafting technique. This suggestion is in line with results of residue

analysis of the same points by Marlize Lombard (2006b). The distal and proximal penetrating angles of the Still Bay points analysed in this study are significantly different as mentioned earlier and this is a clear indication that these pointed ends were not used for the same function.

Tip penetrating angle may not be a useful measurement on its own and is therefore better used with other measurements. For instance, Egyptian arrowheads sometimes made use of segments hafted as pairs and the angle of such an arrowhead is very wide (Clark *et al.* 1974). Wide angles are always associated with spearheads while arrowheads are always associated with small/thin angles, but this is not the case with Egyptian arrows. Although this measurement is used in this study, it could not be conclusive on its own. Its results have therefore been correlated with other measurements such as TCSA and the results of other people's work.

Further support for the use of Sibudu and Umhlatuzana points as hand-held spear tips comes from the fact that these points' tip cross-sectional area (TCSA) values (with the exception of Sibudu Still Bay points), are all greater than values suggested for hafted arrowheads and hafted dart tips by Shea (2006). Still Bay points' TCSAs are smaller than those of final MSA, late MSA (not significantly so) and post-Howiesons Poort points (significantly so) and are even less than those of Still Bay points from other South African sites such as Blombos Cave (Shea 2006). As noted earlier, MSA points' TCSA values tend to be less than those of experimental thrusting spear points and according to Shea (2006), this pattern suggests that if these points were used as hafted weapon armatures, they were used as tips for hand-held spears or thrusting spears.

Sibudu and Umhlatuzana points were clearly hafted. This suggestion is based on use trace analyses by Lombard (2004, 2005a, 2005b, 2007c) and on the thinned bases of some of these points. Different hafts were used for Sibudu points throughout the MSA. The morphologies of these points' bases suggest different hafts: for instance, the pointed bases of Still Bay points would require a special haft suited to that base, whereas another type of haft would be used with hollow based points found only in the final MSA. Base measurements of these points support this suggestion. Late MSA points are significantly thicker at the base than final MSA ones and this is probably because some of the final MSA points have thinned bases. In addition, Still Bay points are significantly thinner at the base in comparison with late MSA and post-Howiesons

Poort points. Still Bay points are also significantly narrower than late MSA and post-Howiesons Poort points. Post-Howiesons Poort points are significantly thicker than final MSA, late MSA and Still Bay points. Umhlatuzana points do not have significant differences in the breadths or thicknesses of their bases through time. This could mean that these points were hafted in the same way throughout the MSA sequence, but it could imply that the Umhlatuzana points are from mixed assemblages because of the rotational slippage at the site.

There was no increased standardization in the morphology of points as time progressed in the MSA at both Sibudu and Umhlatuzana. All the traits looked at have coefficients of variation that are high (mostly greater than 20) thus suggesting no standardization amongst points. Although bifacial points from both sites have slightly lower coefficients of variation in comparison to unifacial points, they are still not standardized.

It does not appear that rock types impacted on function and form of points from both Sibudu and Umhlatuzana because there are only a few differences between points produced from different rock types. Furthermore, the lack of difference in base thickness and breadth of points from these two sites suggests that rock types did not have a bearing on the hafting of these points.

Generally, the present study supports Marlize Lombard's suggestion (based on residue and macro-fracture analyses) that post-Howiesons Poort points from Sibudu were used as hafted hand-held spears while Still Bay points served several functions. Results of morphometric analyses, TCSA and penetrating angles also give support to the use of Umhlatuzana points as hafted, hand-held spears. Changes in the way these points were used over time are not as evident as at Sibudu, but certainly, final MSA points were hafted differently from points in the older MSA phases.

Segments

Size attributes of Sibudu and Umhlatuzana segments are within the range of attributes of other MSA segments (from other South African contexts), some of which have been suggested to have been used as hunting weapons. For instance, these segments are within the size range of Klasies River Mouth Howiesons Poort segments; macro-fracture analysis of these has led to the suggestion that they were used as hunting weapons (Wurz & Lombard 2007). Sibudu and Umhlatuzana segments are within the size range of experimental segments used in Pargeter's

(2006, in press) experiments. Pargeter's segments functioned very successfully as projectiles when hafted singly and even in pairs (back-to-back).

Residue analysis by Marlize Lombard of some segments from Sibudu (including some of the segments forming part of this study) implies that they were hafted in various configurations to hafts made from bone or wood (Lombard 2008). Moreover, most animal residues on segments from both Sibudu and Umhlatuzana are concentrated on the blade/cutting portions. There is very little evidence for the use of these segments as cutting implements, so they are more likely to have been used as tips of hunting weapons (Lombard 2007b). Jubilee Shelter segments may, however, have been too small to have been used effectively as hunting tools. Their length, breadth and thickness are significantly different from those of MSA segments (statistics in previous chapter). A micro-wear analysis of these tools by Wadley and Binneman (1995) suggests that they were used as knives rather than projectiles.

Both distal and proximal penetrating angles of the tips of segments from Sibudu and Umhlatuzana are within the range of penetrating angles of final MSA points, from layer Dc at Rose Cottage Cave, identified as arrowheads (Mohapi 2007). Jubilee Shelter segments' distal and proximal penetrating angles are significantly less than those of the MSA segments from Sibudu and Umhlatuzana.

The tip cross-sectional areas (TCSA) of Sibudu and Umhlatuzana segments are within the range of TCSAs suggested for arrowheads by Shea (2006). The TCSA values of Sibudu and Umhlatuzana are also within the range of TCSA values of Pargeter's (2006) experimental segments which have functioned well as projectiles. The TCSA value of segments hafted singly in Pargeter's (2006) experiments puts them within the range of arrowheads while that of segments hafted in pairs puts them somewhere in between spearheads and darts. Transversely hafted Sibudu segments have a mean TCSA that falls within Shea's (2006) dart category while that of Umhlatuzana is slightly bigger but much smaller than that of Shea's (2006) spearheads. Sibudu and Umhlatuzana hypothetical back-to-back segments have TCSAs that place them in the dart category. Jubilee Shelter's mean TCSA is significantly smaller than those of Sibudu and Umhlatuzana and much less than that of arrowheads suggested by Shea (2006). They are therefore unlikely to have been used as tips of hunting weapons unless they were hafted either

transversely so that length became the arrow breadth, or in pairs because TCSAs of hypothetical transversely hafted and back-to-back Jubilee segments place them in the size range of the smallest arrowheads.

As noted by Wadley and Mohapi (in press) on a bigger sample of Sibudu segments, Sibudu segments in this study have three populations based on rock types used on this site, that is, quartz, hornfels and dolerite. These segment populations suggest that the points made from these rock types were intended to be utilized differently. Quartz tools might have been hafted transversely (Lombard 2007b) and used as arrowheads (Wadley & Mohapi, in press). Their length would become their shoulder-width if hafted in this position and it fits Shott's (1997) arrowhead shoulder-width (Wadley & Mohapi, in press). Hornfels segments might have been hafted to bone diagonally and used as arrowheads. Dolerite segments might have been hafted to wood and also hafted diagonally (Wadley & Mohapi, in press).

Umhlatuzana segments do not have any populations based on rock types. This lack of differences in Umhlatuzana segments could be due to the fact that there was rotational slippage on this site which resulted in mixing of assemblages. One would expect similarities in segments from Umhlatuzana and Sibudu because the sites are not far apart and the rock types found on these sites are similar and locally found.

As in Umhlatuzana, there are no major differences between Jubilee shelter segments across rock types. It does not appear that these segments were used differently.

Contrary to reports that LSA segments are more standardized than MSA ones, Jubilee segments (LSA) are not more standardized than Sibudu and Umhlatuzana segments (MSA). Both LSA and MSA segments have CVs which are high and are therefore unstandardized. Wurz (1997, 1999) has argued that this equal lack of standardization amongst LSA and MSA backed pieces means that MSA people were as modern as LSA people. Though segments in this study generally lack standardization, a larger quartz segment sample from Sibudu studied by Wadley and Mohapi (in press) has a lower CV (7.0) for length/breadth ratios, suggesting that some standardization of form can occur in the Howiesons Poort, as it can in the LSA. High CVs indicating a lack of standardization are common when all tools are amalgamated regardless of rock types. In looking

for standardization, it is important to reduce, as far as possible, the number of variables in the sample.

It is apparent from the discussion above that Sibudu and Umhlatuzana segments were most likely to have been used as hunting weapons that were flexible in the way that they were hafted and used. The technological study of Sibudu segments has strengthened Lombard's (2007b) suggestion that, through time, Sibudu segments were used and hafted differently. Although MSA segments in this study replaced points as hunting weapons during the Howiesons Poort, they were not the same type of weapon as Sibudu and Umhlatuzana points, which were unequivocally spearheads. They were probably used in a variety of ways depending on the need for a particular type of weapon. They had the potential to be hafted in a variety of ways.

There is very little evidence for the use of Jubilee Shelter segments as hunting weapons and therefore these segments are likely to have been used as knives as earlier suggested by Wadley & Binneman (1995), unless they were hafted transversely or in pairs (back-to-back). Transversely hafted Jubilee segments and segments hafted in pairs are likely to have been used as small arrowheads.

The results of this study further demonstrate the importance of multi-stranded evidence in interpreting lithics. The study confirms empirically what archaeologists have long suspected that points and segments served as different types of hunting weapons. There is a need for more studies of this nature in Southern Africa for comparative purposes.

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