Research Article

THE LITHIC TECHNOLOGY OF HOLLEY SHELTER, KWAZULU-NATAL, AND ITS PLACE WITHIN THE MSA OF SOUTHERN AFRICA

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ABSTRACT

While the majority of research on the Middle Stone Age (MSA) in southern Africa has been conducted in the southern and western Cape, studies of the east coast of South Africa have become increasingly important due to the existence of well-stratified sites such as Sibudu. Because of the scarcity of comparable localities, however, we still know little about the spatial and temporal variability of MSA lithic technology in this region. We therefore chose to expand our research focus to other, lesser-known sites in the eastern part of South Africa. One such site is Holley Shelter which was excavated by Gordon Cramb between 1950 and 1960. Since its archaeological material was only studied in a cursory manner, we conducted a detailed technological study of the MSA lithic artefacts from Cramb's excavations, including attribute analysis and examination of reduction sequences. Our first aim was to assess the degree of potential mixing and recovery bias among the lithic material. We then characterised the different assemblages and investigated their diachronic variation throughout the occupation sequence. In order to obtain a rough age estimate of the so far undated sequence of Holley Shelter, we compared its lithic technology to other MSA sites in the eastern part of South Africa. Our results indicate three different phases of MSA occupation that vary in terms of raw material composition, core reduction, and tool manufacture. The assemblages are characterised by a blade and point technology that mostly derives from platform cores as well the highest proportions of splintered pieces reported from a southern African MSA site. The sequence does not feature Later Stone Age (LSA), Howieson's Poort, Still Bay or final MSA industries. Compared to other sites in the general region, the assemblages are most similar to lithic technology post-dating the Howieson's Poort, suggesting that the occupations fall broadly into the earlier part of MIS 3.

Keywords: lithic technology, Middle Stone Age, South Africa, KwaZulu-Natal, Holley Shelter.

INTRODUCTION

The discovery of an African origin of anatomically modern humans during the 1980s (Bräuer 1984; Smith *et al*. 1989; Stringer 1989; White *et al*. 2003; McDougall *et al*. 2005) led to an increased research interest in the archaeology of the Middle Stone Age (MSA, *c*. 300–35 ka) in the following decades. Scholars have paid special attention to indices of 'cultural modernity' that appear first during the MSA, including manifold applications of pigments as hafting element or base for symbolic engravings (Wadley 2005a; Henshilwood *et al*. 2009, 2011), heat-treatment of fine-grained raw material (Brown *et al*. 2009, Schmidt *et al*. 2013), the manufacturing of bone tools (Henshilwood *et al*. 2001, Backwell *et al*. 2008), personal ornaments like shell beads (Henshilwood et al. 2004; D'Errico *et al*. 2005), engravings on ostrich eggshell (Texier *et al*. 2010), and the consumption of marine resources (Parkington *et al*. 2004; Conard 2005; Marean *et al*. 2007; Will *et al*. 2013). However, apart from these features, the analysis of stone artefacts, encompassing their production, reduction and use, represent an indispensable tool for prehistoric archaeologists to reconstruct past human behaviour and build comparative cultural-technological sequences.

During the last four decades, research on the MSA has focused on specific geographic regions rich in archaeological records. The western and southern coast as well as the Cape region of South Africa have been studied extensively owing to the existence of several sites with long and well-preserved stratigraphic sequences such as Klasies River Mouth (Singer & Whymer 1982; Wurz 2000, 2002), Blombos Cave (Henshilwood *et al.* 2001), Diepkloof (Texier *et al.* 2010; Porraz *et al.* 2013) or Pinnacle Point (Marean *et al*. 2010). Although there are some comparable sites in KwaZulu-Natal, namely Border Cave (Cooke *et al.* 1945; Beaumont 1978; Villa *et al.* 2012), Umhlatuzana (Kaplan 1989, 1990; Lombard *et al.* 2010; Mohapi 2013) and particularly Sibudu (Wadley & Jacobs 2004; Wadley 2005b, 2007; Conard *et al.* 2012; Will *et al.* 2014; Conard & Will 2015), the last is the only locality with detailed technological data from lithic assemblages, including information on core reduction methods, reduction sequences and knapping techniques.

In order to move forward in our understanding of the geographic and diachronic variation within MSA lithic technology of southern Africa, it is important to shift the focus of research to less investigated regions like KwaZulu-Natal. As a starting point for this project, we chose Holley Shelter and reanalysed its lithic material using state-of-the-art analytical methods.

THE MSA SEQUENCE OF KWAZULU-NATAL

In order to place the lithic technology of Holley Shelter within the MSA sequence of South Africa, it is necessary to provide a general outline of the characteristics of this period in KwaZulu-Natal. As this region is generally understudied, compared to the western and southern Cape, the best candidate to provide an overview for this region is the archaeological site of Sibudu. This locality provides the most complete and well-published MSA sequence of stone artefact assemblages in KwaZulu-Natal. We further include Umhlatuzana in this brief outline because of its proximity to both Sibudu and Holley Shelter. The MSA sequence of Border Cave at the very northern border of KwaZulu-Natal will also be analysed in the discussion section.

In contrast to the southern and western Cape, no stratified early MSA assemblages dating to >80 ka have been found in KwaZulu-Natal. Starting from bottom to top, the lowermost layers at Sibudu published so far date to 77.2 ka and are informally designated as pre-Still Bay (Wadley 2012). Work on these layers is still in progress with little information available as of now. That being said, Wadley (2012) mentions large blades and flakes, as well as thin bifacial points.

The overlying layers date to 70.5 ka (Jacobs & Roberts 2008) and are described to be of Still Bay (SB) character, marked by the frequent occurrence of bifacial points (Lombard 2006; Wadley 2007). According to Wadley (2007), bifacial points and bifacial tools (including broken pieces) represent around 40% of the retouched tools in layers RGS and RGS2. Double pointed forms appear to be typical for the Still Bay. By comparison, unifacial points, backed tools and other formal tools like scrapers occur in very low proportions (10% and below). The distribution of blanks shows a flake- rather than blade-based industry (Wadley 2007: table 4). There is little information on core reduction methods. Wadley (2007) describes two radial, one cylindrical and one opposed platform core. At Umhlatuzana, Layers 25 to 27 have originally been attributed to the pre-Howieson's Poort. According to Lombard *et al.* (2010), however, they are most similar to a Still Bay industry. The assemblages are characterised by a flake-based technology with unifacial and bifacial points, but also segments (Kaplan 1989, 1990). What makes these layers unique so far is the existence of both unifacial and bifacial serrated points (Lombard *et al.* 2010). These pieces occur more frequently in the lower layers of the Still Bay at Umhlatuzana.

As in other parts of South Africa, Still Bay assemblages are followed by Howieson's Poort (HP) industries at both Sibudu and Umhlatuzana. The HP lithic assemblages of Sibudu have recently been described by de la Peña *et al*. (2013) and de la Peña and Wadley (2014a,b) and date to 63.8 ka (Jacobs & Roberts 2008). The HP at Sibudu shows many characteristics apart from backed tools, like small bifacial points from quartz (de la Peña *et al.* 2013), the production of very small quartz bladelets, and the frequent use of bipolar technology (de la Peña & Wadley 2014a). Different kinds of cores on flakes also play an important role during the HP occupations of Sibudu (de la Peña & Wadley 2014b). Apart from these features, the defining characteristics of the HP are the frequent occurrence of segments made on blades as well as a blade-based technology in general (Wadley & Mohapi 2008). The HP occupations at Umhlatuzana (Layers 22–26) are similar in this regard, showing a high amount of backed pieces and segments, a higher percentage of blades compared to the underlying layers, but unifacial and bifacial points are also present (Kaplan 1990).

The so-called post-Howieson's Poort (post-HP) period will only be summarised briefly here (see discussion for a more detailed description). Post-HP occupations at Sibudu follow the HP and date to *c.* 58 ka, thus falling into early MIS 3 (Wadley & Jacobs 2006; Jacobs *et al.* 2008). They reflect a much higher variability in lithic technology and are based on different methods of core reduction, proportions of raw materials, and blank production, that all change over time. The assemblages at Sibudu from this period are flake- rather than blade-based, without evidence of significant bladelet production (Conard *et al.* 2012; Will *et al.* 2014; Conard & Will 2015). Backed artefacts and segments are few in numbers and absent in most assemblages. They are replaced by unifacial points as the overall most frequent category of retouched pieces. The unifacial points encompass three different categories (Tongati, Ndwedwe, ACT), defined on techno-functional aspects and an emphasis on tool reduction and re-sharpening (Conard *et al.* 2012; Will *et al.* 2014). While unifacial points constitute the most important tool component in the upper layers of the post-HP (or Sibudan), there are marked differences throughout the sequence, with some of the older assemblages showing more notched and denticulated implements, and only few or no unifacial points (Conard & Will 2015).

Layer RSP overlies the post-HP assemblages at Sibudu and is informally denoted as late MSA by Villa *et al.* (2005). The late MSA dates to approximately 48 ka (Wadley & Jacobs 2006; Jacobs *et al.* 2008). Uni- and bidirectional platform cores with simply prepared platforms dominate – including bladelet cores – whereas Levallois technology is not common (Villa *et al.* 2005: 405). While flakes are the most common end products, blades make up a considerable portion of up to 37%. Almost all of the pieces have been knapped using direct hard hammer percussion. The most common tool types are pointed forms (most of them unifacial) and side scrapers. In general, the tool component is high at 15%. According to Villa *et al.* (2005), few of the retouched pieces were made on blades. A late MSA industry also exists at Umhlatuzana and will be discussed in more detail later.

The youngest stage of the MSA in KwaZulu-Natal is informally named as the final MSA. At Sibudu it dates to *c.* 38 ka (Wadley & Jacobs 2006; Jacobs *et al.* 2008) and is characterised by a variety of scrapers, unifacial and bifacial points in comparable amounts. Most importantly, these assemblages feature hollow-based points. Although they are not very frequent, Wadley (2005b) emphasises that hollow-based points do not occur in any other layers at Sibudu and thus mark a distinct feature of this part of the occupation sequence. The cores are mostly minimal ("chunk with two or three randomly placed removals") (Wadley 2005b: 54) or bipolar cores. However, a few examples of platform, radial and Levallois cores occur (Wadley 2005b). Knappers predominantly manufactured flakes (96%) rather than blades. Importantly, hollow-based and bifacial points are also an important feature of the uppermost three MSA/LSA-transitional layers at Umhlatuzana dated to ~36 ka, and single-platform cores are the most common core type (Kaplan 1989, 1990).

HOLLEY SHELTER

Holley Shelter is an elongated rock shelter on the eastern exposure of a large canyon, completely surrounded by dense vegetation. The site lies in a sandstone area that is drained by small streams that flow west to the Umgeni River (Cramb 1952) about 25 km northeast of Pietermaritzburg in KwaZulu-Natal. Holley Shelter is located around 60 km inland from the Indian Ocean (Fig. 1) and approximately 780 m above the current sea level. A waterfall runs from the top of the shelter into a small river about 20 m down the cliff, flowing in western direction through the canyon. During the time of excavation, the area was owned by Mr. J. Hunt Holley (Cramb 1952) and the site was subsequently named after him. As Holley Shelter constitutes an inland site, fluctuations of sea level had no direct influence in terms of resource availability over time, distinguishing the site from the majority of MSA localities in South Africa that are often scattered along the modern coastlines. Having said this, little Stone Age research has been conducted in the region around Holley Shelter in the last decades.

During the 1950s, Gordon Cramb excavated Holley Shelter in five short campaigns (Cramb 1952, 1961). He excavated in three different areas of the shelter, a smaller, a larger and a trial trench. The smaller area was excavated first and without using a grid system in order to "conserve the limited space" of the area (Cramb 1952: 181). Before he started excavating the larger area, Cramb dug a trial trench close-by in order to probe the stratigraphic situation. This line of action was based on his experience from the smaller section, that the sediments are "of

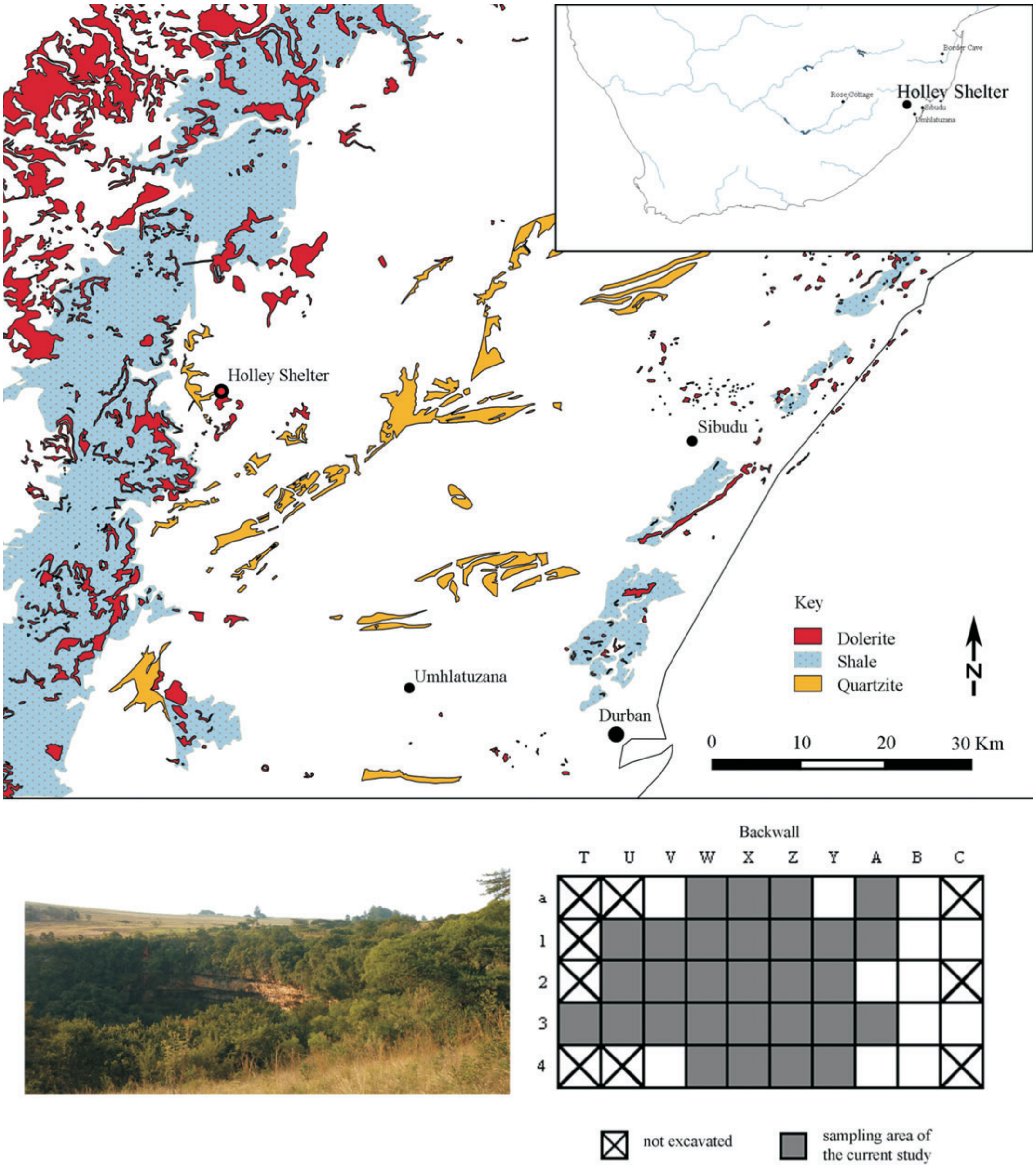

FIG. 1. **Top**: *location of Holley Shelter, Umhlatuzana and Sibudu within the geological context of the region. Map is designed based on 1:250000 geological map by the Department of Mineral and Energy Affairs.* **Bottom left**: *view to the shelter.* **Bottom right**: *sampling area of the current study.*

dustlike consistency" (Cramb 1961: 45) and too homogenous to identify separate layers. Due to these circumstances, Cramb excavated the bigger area in artificial inch spits and also used a grid system that he painted directly on the rock wall (Fig. 1). Unfortunately, there is no detailed information on the precise locality of the different trenches. Nevertheless, we were able to identify the larger excavation area in the northwestern corner of the shelter during a short visit to the site as the painted grid system was still preserved on the rock wall. In total, Cramb excavated this larger area within 38 square yards (~34.7 m^2). He reached a maximum depth of 48 inches (1.22 metres), but not in all squares.

Cramb proposed that the uppermost 6 inches contain a mixture of LSA and MSA artefacts, marked by the appearance of thumbnail- and duckbill endscrapers as well as backed blades, whereas the lower levels comprise only MSA occupations. Cramb (1952) also mentioned the presence of beads of different colours in the first 3 to 9 inches. He also published two radiocarbon dates from the MSA part of the larger trench that date to 4400 ± 150 and 18.200 ± 500 bp. We, however, reject these dates because of the clear MSA character of the assemblages. Wadley (2001: 4) also argues that the previous dating "is not representative of any of the MSA occupations, which are probably too old for dating by the radiocarbon method". As a result, the exact age of the MSA occupations at Holley Shelter remains unknown. Although Cramb's original publications (1952, 1961) point towards an MIS 3 occupation of the shelter based on the frequent manufacture of unifacial points, this assessment lacks comparable technological and quantitative data for validation. We therefore decided to re-analyse the lithic assemblages from Holley Shelter with modern methods. We also plan to obtain new absolute age estimates from the site in the future, but the locality is currently not accessible owing to legal issues regarding land ownership.

MATERIALS AND METHODS

The archaeological material from Cramb's excavation is stored in the KwaZulu-Natal Museum in Pietermaritzburg. The assemblages contain *c.* 4000 lithic artefacts in total. This study deals only with the artefacts deriving from the larger trench since it was excavated in coherent squares and therefore provides consistent horizontal and vertical distribution patterns. During excavations, Cramb sometimes changed the depth of spits and, as a consequence, the connection between distinct spit-depths varies (e.g. Inch 0–6 and Inch 3–12). Therefore, we could not include all stone artefacts in a reasonable way into our analysis. We selected those lithic artefacts which could be clearly attributed to successive 6 inch thick spits (approximately 15 cm) throughout the entire sequence. These standardised spits serve as analytical units to group assemblages in the absence of defined archaeological layers (Inch 0–6, Inch 6–12). All these groups derive from a coherent area of grid squares as shown in Fig. 1. Based on this sampling procedure, we analysed 1980 pieces individually, including blanks >3 cm and all retouched artefacts and cores regardless of size (Table 1). In addition, we quantified the type of raw material for 493 artefacts <3 cm. Because of the small number of artefacts (n = 5) in the lowermost spit (42–48 inches), we excluded this unit from our analyses. Further, we counted artefacts from spits 30–36 and 36–42 together since they contain only 87 pieces and show comparable technological features. The uppermost unit (Inch 0–6) contains a total of about 600 pieces but due to time constraints, we could only include 388 pieces in our sample.

As a first step, we aimed to establish whether the assemblages provide reliable features that can help to answer the question of potential mixing. With mixing, we mean significant exchange of artefacts between lithic assemblages by means of vertical movement that occurred throughout the sequence (e.g. intrusive LSA elements in an MSA assemblage). In order to resolve this problem – in absence of any geomorphological or taphonomic data – we defined several criteria the assemblages should meet. First, the technological criteria of both cores and end products within a defined layer (in this case inch spits) should fit to one another. Specific types of core reduction also frequently produce characteristic technological elements and should thus be associated with them in unmixed assemblages. Second, one would not expect numerous distinct guide fossils of a specific techno-complex in an assemblage that otherwise do not belong to it. For example, bifacial Still Bay points do not usually occur within an LSA Robberg assemblage. Finally, refits or conjoins of artefacts indicate a certain degree of stratigraphic integrity if found in the same spit. In combination, the existence of these features in an assemblage render a large degree of mixing unlikely, but cannot ultimately exclude post-depositional vertical movement of artefacts between layers.

Another problem arising from the early excavation at Holley Shelter is the likely scenario that the original excavators operated in a selective way and preferentially collected eye-catching pieces – such as large retouched artefacts – rather than unmodified blanks, cortical or technological items. The nature of the lithic assemblages provides the best evidence against such an excavation and collection bias. If specimens of many different artefact categories – blanks, cores, tools, technological pieces – occur in different sizes and frequencies in each individual layer, it is likely that there was either no or only minimal selection. The existence of small or informal artefacts would thus testify against a strong collection bias. Furthermore, one would expect a continuously high proportion of eye-catching pieces in each layer if a systematic bias applies, rather than gradual changes in their frequencies compared to cores or unmodified blanks. These criteria, combined with information on the actual field methods, can mount evidence against a strong collection and excavation bias.

Our next aim was to characterise the different assemblages of the site and investigate their variation over time. In order to achieve these goals, we collected data on raw material composition and economy (Andrefsky 1994; Floss 1994; Brantingham *et al.* 2000; MacDonald & Andrefsky 2008), discrete and metric attributes resulting from the knapping process (Dibble 1997; Wurz 2000; Odell 2004; Dibble & Rezek 2009) and the variation of core reduction methods over time (Boëda 1994; Conard *et al.* 2004, Delagnes *et al.* 2012). For characterising blank production, we employed four categories: (i) Blades denote pieces that are at least twice as long as wide with parallel edges and a width of >10mm (Hahn 1991); (ii) Bladelets fall under the same definition, but are narrower than 10 mm; (iii) Flakes are blanks with variable edge morphologies and less than twice as long as wide; whereas (iv) Points refer only to flakes with a convergent distal end (Hahn 1991).

Although our approach is of technological nature, we point to the need of using uniform typological taxonomies in order to convey a coherent picture of tool assemblages that renders them comparable to other sites and regions. To this end, we followed South African tool taxonomies which are commonly used in this part of the world to classify retouched artefacts (Volman 1981; Wurz 2000; Villa *et al.* 2005). Owing to the very high percentage of retouched artefacts in Holley Shelter, we also employed a techno-functional approach (Lepot 1993; Boëda 2001; Soriano 2001; Bonilauri 2010) similar to a recent analysis by Conard *et al.* (2012) for the post-HP, or Sibudan, layers of Sibudu. This approach provides more detailed data on retouch patterns and morphologies of modified edges. It also increases the number of comparable technological attributes of retouched artefacts between different sites. In addition, we conducted morphometric studies similar to Mohapi (2013) for the unifacial points.

A CLASSIFICATORY SYSTEM FOR SPLINTERED PIECES

Owing to the high frequency of splintered pieces at Holley Shelter (see results), as well as their morphological and diachronic variability, we developed a new classificatory system for these artefacts. Most of the splintered pieces at Holley Shelter resemble specimens from the late MSA at Sibudu (Layer RSP), published by Villa *et al.* (2005) (Fig. 8, Nos. 7–9). While discussions on the function of these pieces as either bipolar cores or

TABLE 1. *Distribution of artefact types throughout the sequence of Holley Shelter.*

Unit	Depth below datum (cm)	Blank *n* (%)	Tool *n* (%)	Core *n* (%)	Pebble *n* (%)	Angular debris *n* (%)	Total
Inch 0–6	15.0	279 (71.9)	91 (23.5)	10 (2.6)	0 (0)	8 (2.1)	388
Inch 6–12	30.0	405 (69.7)	142 (24.4)	17 (2.9)	4 (0.7)	13 (2.2)	581
Inch 12–18	45.0	217 (57.4)	150 (39.7)	5 (1.3)	0 (0)	6 (1.6)	378
Inch 18–24	60.0	128 (50.0)	111 (43.4)	12 (4.7)	0 (0)	5 (2.0)	256
Inch 24–30	75.0	209 (72.1)	56 (19.3)	6 (2.1)	2 (0.7)	17 (5.9)	290
Inch 30–42	105.0	48 (55.2)	13 (14.9)	9 (10.3)	4 (4.6)	13 (14.9)	87
Total %		64.9	28.2	3.0	0.5	3.1	1980

wedges/chisels are still ongoing (Hayden 1980; Barham 1987; LeBlanc 1992; Shott 1999; Brun-Ricalens 2006; De la Peña & Wadley, 2014), recent residue analyses by Langejans (2012) provide additional support for the assumption that at least some of these pieces have been used as tools in a chisel-like manner in the HP layers at Sibudu. Here, we present a morphological model for a more detailed classification of splintered pieces. Our approach is comparable to the work of Hays and Lucas (2007) for Le Flagelot I in southern France. That being said, our approach is only macroscopic and based on the following criteria:

1. The overall morphology of the pieces.
2. The location of the splintered edges and their orientation to each other.
3. The direction of the splintered negatives on the dorsal and ventral sides, as well as their orientation to one another.

The results of this analysis are presented below (*Tool assemblages*).

RESULTS

RAW MATERIAL PROCUREMENT

The procurement of raw materials constitutes the first step in the operational sequence of producing stone tools and plays an important role in the technological organisation of mobile hunter and gatherer groups. The knappers at Holley Shelter used four different raw materials: hornfels, quartz, dolerite and quartzite (see Fig. 1). While there is a small number of artefacts made on unknown raw materials for which we do not know the source, there are no signs for long distance transportation (>20 km) of raw materials to Holley Shelter.

Among pieces >3 cm, the most common raw material is hornfels (Table 2), a relatively fine-grained black or grey stone of contact metamorphic origin (Cairncross, 2004). Hornfels commonly originate in areas where sedimentary rocks, like shale, and intrusive rocks, like dolerite or granite, come into contact. As shown in Fig. 1, such contact zones occur in numerous areas around Holley Shelter. Between inches 0 to 30, hornfels constitutes the dominant raw material with over 90% abundance in the uppermost spits 0–6 and 6–12 inches. Below these levels, the number of hornfels decline constantly until quartz becomes the most frequent raw material used in lowermost inches 30 to 42. While its exact source remains unknown, quartz pebbles occur in the nearby river (Cramb 1952) and rounded, pebble-like cortex is frequently preserved on quartz artefacts from Holley Shelter. Besides hornfels and quartz, the inhabitants sometimes reduced quartzite and dolerite, but their frequency never exceeds 8%. Among pieces <3 cm, quartz has a disproportionally high abundance in all spits. This observation corresponds to the use of pebbles of small dimensions and the inherent fracturing tendencies of quartz, resulting in more (small) flakes per percussion event for quartz compared to other raw materials (Barham 1987; Conard 1992; Driscoll 2010). The proportion of close to 100% quartz for small debitage (<3 cm) in the two lowermost spits (inches 30–36 and 36–42), however, confirms a different provisioning of raw material in the earliest occupations at Holley Shelter.

CORE REDUCTION

At least three different strategies of core reduction characterise the MSA assemblages at Holley Shelter, following the unified core taxonomy proposed by Conard *et al.* (2004). First, platform cores occur in high frequencies in the upper five spits (inches 0–6, 6–12, 12–18, 18–24, 24–30) (Table 3). Second, most of the platform cores exhibit only one striking platform, mostly prepared but sometimes plain, associated with a unidirectional pattern of reduction. Rotated or multi-directional platform cores are rare. Third, cores often show flat cortical faces, suggesting the exploitation of slab-like raw materials, especially for hornfels. The majority of platform cores bear removal scars of blades, with a mean length of 35 mm.

We identified two different reduction strategies among the platform cores. The first and most common method can be described as 'semi- circumferential platform core reduction'. In this system, knappers exploited one striking platform of the cores around several available edges by turning the core during the reduction process (Fig. 2, Nos. 3–4). The second and less common method is a narrow-sided core reduction. Here, platform cores are reduced exclusively along their narrow edge (Fig. 2, No. 5), explaining their identification as narrow-sided cores (Monigal 2001; Delagnes *et al.* 2012). In general, the semi-circumferential cores exhibit platform preparation more

TABLE 2. *Distribution of raw materials used at Holley Shelter throughout the sequence.*

Unit	Depth below datum (cm)	Hornfels *n* (%)	Dolerite *n* (%)	Quartz *n* (%)	Quartzite *n* (%)	Sandtone *n* (%)	Other *n* (%)
0–6	15.0	369 (95.1)	8 (2.1)	7 (1.8)	1 (0.3)	2 (0.5)	1 (0.3)
6–12	30.0	539 (92.8)	6 (1.0)	32 (5.5)	2 (0.3)	1 (0.2)	1 (0.2)
12–18	45.0	328 (86.8)	21 (5.6)	17 (4.5)	8 (1.9)	3 (0.8)	2 (0.5)
18–24	60.0	217 (84.8)	15 (5.9)	8 (3.1)	11 (4.3)	2 (0.8)	3 (1.2)
24–30	75.0	217 (74.8)	22 (7.6)	35 (12.1)	5 (1.7)	7 (2.4)	4 (1.4)
30–42	105.0	37 (42.5)	3 (3.4)	40 (46.0)	5 (5.7)	0 (0.0)	2 (2.3)

TABLE 3. *Distribution of core types at Holley Shelter for each inch spit.*

Unit	Depth below datum (cm)	Platform core circumferential	Platform core narrow-sided	Parallel core	Bipolar core	IBC
Inch 0–6	15.0	8	0	1	1	0
Inch 6–12	30.0	6	8	2	1	0
Inch 12–18	45.0	2	2	0	1	0
Inch 18–24	60.0	5	0	3	2	1
Inch 24–30	75.0	3	1	1	2	0
Inch 30–42	105.0	0	1	0	7	1

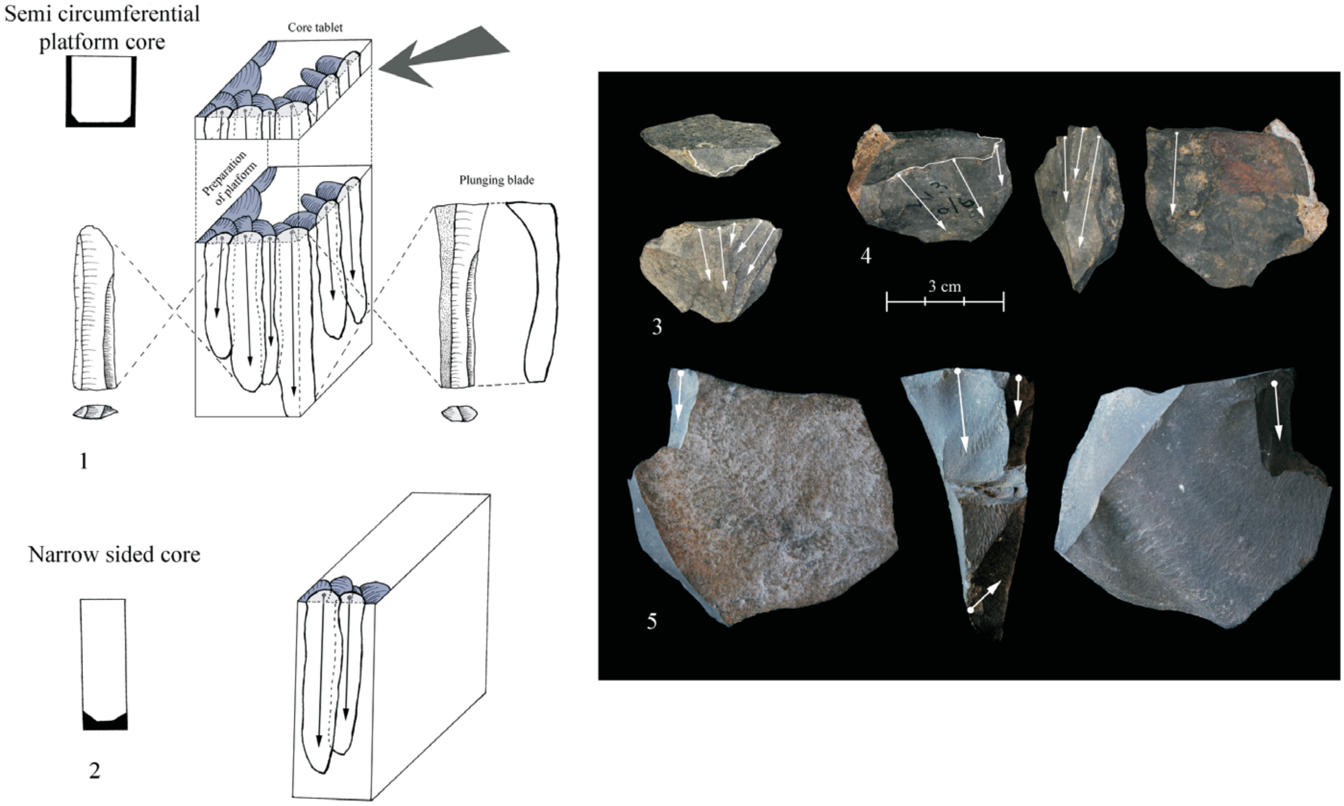

FIG. 2. (**1–2**) *Schematic model of the two kinds of platform core reduction at Holley Shelter;* (**3–4**) *semi-circumferential platform core (hornfels);* (**5**) *narrow-sided core (hornfels).*

often than the narrow-sided cores, but both core types frequently exhibit preparation of platforms. The primary products of both core types are thick elongated blades with unidirectional scar patterns and faceted platforms. We also found many products of core rejuvenation consistent with this strategy, such as core tablets with centripetal preparation and parallel negatives around the edge of the previous core, plunging blades and partially crested blades. Based on these observations, we can reconstruct the strategy of platform core reduction during the MSA at Holley Shelter as shown in Fig. 2, Nos. 1–2.

In contrast to platform cores, parallel reduction methods (Conard *et al.* 2004), which are similar to the concept of Levallois, play a minor role at the site. Nevertheless, the few (n = 7) but distinct examples demonstrate the application of this method by the inhabitants of Holley Shelter during the MSA. The scar patterns of these cores suggest end products with flake or point morphology. This observation is substantiated by a quartzite point, refitted to a parallel core. Both, core and point derive from the same spit (inches 18–24) and square.

Knappers predominantly applied bipolar reduction to small quartz pebbles, particularly in the two lowermost spits 30–36 and 36–42. Compared to the overlying occupation levels, there is an overrepresentation of bipolar cores on quartz in the lowest two spits (inches 30–42). In contrast to the upper occupation sequence, only one platform core occurs in these spits.

In summary, knappers at Holley Shelter predominantly employed two different modalities of platform core reduction with intense preparation of platforms to produce blades in the upper and middle part of the sequence (inches 0–30). The majority of blades with faceted striking platforms derive from these highly prepared cores. Parallel core reduction plays only a secondary role in this technological system, whereas inclined (or formally discoid) cores (Boëda 1993; Peresani 2003; Conard *et al.* 2004) and their respective products are absent in the MSA sequence of Holley Shelter. In the lowermost spits, bipolar cores appear in higher frequencies, a technological change that is closely associated with a raw material procurement geared towards an intense use of quartz.

BLANK PRODUCTION

Blades constitute the main blank type produced during the MSA occupations of Holley Shelter. In the lowermost two spits (inches 30–36 and 36–42), the frequency of blades (24%) is

TABLE 4. *Distribution of blank types throughout the sequence of Holley Shelter.*

Unit	Depth below datum (cm)	Blade *n* (%)	Flake *n* (%)	Point *n* (%)	Bladelet *n* (%)	Total *n*
Inch 0–6	15.0	129 (35.0)	202 (54.7)	32 (8.7)	6 (1.6)	369
Inch 6–12	30.0	209 (38.1)	287 (52.3)	50 (9.1)	3 (0.5)	549
Inch 12–18	45.0	115 (31.3)	206 (56.0)	45 (12.2)	2 (0.5)	368
Inch 18–24	60.0	99 (41.4)	82 (34.3)	57 (23.8)	1 (0.4)	239
Inch 24–30	75.0	92 (35.1)	143 (54.6)	24 (9.2)	3 (1.1)	262
Inch 30–42	105.0	16 (26.2)	39 (63.9)	4 (6.6)	2 (3.3)	61

comparatively low for the site. The blade component increases particularly in the upper five spits (inches 0–6, 6–12, 12–18, 18–24, 24–30) with a minimum of 31% in spit 12–18 and a maximum of 41% in spit 18–24 (Table 4). Bladelets constitute only a minor part of the assemblages (including pieces <3 cm) ranging between 0.4 and 1.6%. Points occur in lower frequencies than blades. In the lowermost spits, between 24 and 42 inches, they represent only 7–9% of the blanks. In the middle part of the sequence (inches 18–24) points reach a maximum of 24% and the younger occupation levels (inches 0–6) feature 9%.

Apart from blades and points, flakes are the most numerous blank types within the individual spits with the exception of spit 18–24, where blades occur in higher frequencies than flakes. Most of these flakes, however, are probably the by-product of the unidirectional platform reduction system. The aim of the knappers to produce blades is supported by the fact that most pieces that have been transformed into tools by retouch in all levels exhibit blade dimensions (between 63.6 and 47.3%). In accordance with the decreasing number of points from inch 24 to 0, the proportion of tools made on points decreases from 34% to 15%. In parallel, the importance of flakes as blanks for tool production increases from inch spit 24 to 0.

The artefacts in the lowermost spits 24–30, 30–36 and 36–42 demonstrate primarily plain platforms (Table 5). By contrast, knappers prepared around 50% of the blank platforms in the four uppermost spits (inches 0–6, 6–12, 12–18, 18–24). The blanks exhibit a high frequency of shattered bulbs (44–71%) as well as (strongly) developed bulbs in all spits (Table 6). Proximal lips, on the other hand, are almost absent. A high frequency of shattered bulbs is primarily associated with direct percussion by soft stone hammers (e.g. sandstone or limestone) (Pelegrin 2000; Soriano *et al.* 2007; Floss & Weber 2012). Contact points (or ring cracks) on the striking surfaces and ripple lines on the ventral faces are very common and associated with the application of a soft stone hammer. Although we are aware that most of these experiments have not been conducted with South African raw materials, our interpretation is supported by the fact that all hammer stones at Holley Shelter are of sandstone.

The striking platforms of the blanks are thick and wide for all spits (Table 6). The mean values for platform width varies between 15.2 and 19 mm with gradual changes. The platforms are also constant in their thickness that varies between a mean value for each assemblage of 5.3–6.5 mm. For all levels, the exterior platform angle (EPA), as described by Dibble and Rezek (2009), varies between a mean value of 82° and 84° (Table 6). Based on these observations, knappers predominantly employed soft stone hammers with a direct internal percussion movement, regardless of the type of blank they produced. The thick platforms in combination with the relatively high EPAs between 80° and 85° also explain the large dimensions of most blanks and tools at Holley Shelter (Dibble 1997; Pelcin 1997; Lin *et al.* 2013).

Regarding the dimension of blanks, blade length varies between 57 and 65 mm (mean value) with a maximum length of 134 mm. Flakes are markedly shorter, ranging between 38 and 44 mm mean length. They are also broader and thicker than blades in all spits. The number of completely preserved points and bladelets is too low to provide meaningful comparisons.

TABLE 5. *Platform characteristics for all artefacts throughout the sequence of Holley Shelter.*

Unit	Depth below datum (cm)	Faceted coarse *n* (%)	Faceted fine *n* (%)	Step flaking *n* (%)	Dihedral *n* (%)	Plain *n* (%)	Cortical *n* (%)	Crushed *n* (%)
Inch 0–6	15.0	39 (16.4)	49 (20.6)	11 (4.6)	12 (5.0)	98 (41.2)	4 (1.7)	25 (10.5)
Inch 6–12	30.0	68 (19.8)	53 (15.4)	20 (5.8)	22 (6.4)	127(36.9)	12 (3.5)	42 (12.2)
Inch 12–18	45.0	57 (23.0)	32 (12.9)	19 (7.7)	22 (6.4)	92 (37.1)	8 (3.2)	18 (7.3)
Inch 18–24	60.0	40 (23.7)	28 (16.6)	3 (1.8)	11 (6.5)	71 (42.0)	5 (3.0)	11(6.5)
Inch 24–30	75.0	30 (18.1)	6 (3.6)	9 (5.4)	12 (7.2)	80 (48.2)	4 (2.4)	25 (15.1)
Inch 30–42	105.0	2 (6.1)	2 (6.1)	0 (0)	3 (9.1)	20 (60.6)	0 (0)	6 (18.2)

TABLE 6. *Knapping characteristics for all artefacts throughout the sequence of Holley Shelter.*

Percussion marks		Unit					
		0–6	6–12	12–18	18–24	24–30	30–42
Bulb (%)	Shattered	69.7	71.3	64.2	55.2	43.5	61.8
	Well developed	10.3	9.2	13.2	16.4	14.3	11.8
	Developed	14.5	13.9	18.1	19.4	30.4	11.8
	Poorly developed	5.1	4.1	2.5	7.3	10.6	11.8
	na	0.4	1.5	2.1	1.8	1.2	2.9
Point of contact (%)		21.2	21.1	25.7	38.5	17.0	20.0
Ripple lines (%)		1.1	2.6	3.5	4.6	1.2	3.3
Hertzian cone (%)		2.5	0.4	1.4	4.1	2.8	8
Lip (%)		1.5	1.8	2.4	3.4	4.3	4.0
Platform thickness (mm)	Max	15	19	25	13	16	18
	Min	1	1	1	1	1	1
	Mean	5.3	5.7	6.5	5.9	5.3	5.8
Platform width (mm)	Max	35	37	58	42	46	44
	Min	1	4	4	1	1	5
	Mean	15.8	15.9	18.6	18	15.2	19
EPA (°)	Max	90	90	90	95	100	90
	Min	55	65	50	65	40	60
	Mean	83.5	84	81.8	83.3	81.7	82.9

TOOL ASSEMBLAGES

Holley Shelter features a comparatively low component of tools in the lowermost spits (30–36 and 36–42 inches), between 13.5 and 16%, which is still high for MSA assemblages. We observed an extremely high tool proportion in the upper and middle spits (inches 0 to 30). The frequency decreases from the middle part of the sequence (inches 18–24) where the assemblage contains a maximum of 43% retouched pieces (Table 1) to the uppermost spit (23.5% in inch 0–6). As a comparative value, the Sibudan at the nearby site of Sibudu has a maximum of 27% modified blanks >3 cm (Will *et al.* 2014). We are aware that the tool proportions from Holley Shelter have to be treated very carefully, keeping in mind the potential recovery bias associated with the old excavations as discussed above. Having said this, Cramb reports on the sieving of sediments (Cramb 1961), which is supported by the presence of small debitage products (<3 cm). While the frequencies of retouched specimens are probably overestimates, Cramb's application of relatively fine-grained field methods supports the observation that people frequently manufactured and curated tools at Holley Shelter.

The majority of retouched artefacts do not correspond to formally defined tool forms such as scrapers, but can be best described as minimally retouched blades, flakes or points (Table 7). There are only two tool categories that occur in significant numbers. Splintered pieces of different forms amount to between 26 and 61% of the tools (Table 7), making them the most frequent tool type in almost all spits. Most of these pieces (93.5%) are on hornfels. In the middle part of the sequence, unifacial points, that were also made on hornfels, occur frequently in proportions up to between 23 and 41% (Table 7).

By employing the morphological approach described above, we could identify three main categories of splintered pieces. **Single edge splintered piece**s (Fig. 3, Nos. 1–4) are characterised by splintering only on the distal edge, while the proximal part is well-preserved and thick, often with a developed bulb. There are either no or few splintered negatives on the proximal part. Although residue- and use-wear analyses are required to clarify the exact function and manner of use for these pieces, we suggest that this one-sided damage pattern might be an indication of hafting. **Opposed edge splintered** pieces (Fig. 3, Nos. 5–10) show splintered negatives on a minimum of two straight and opposed edges. In some cases, all four edges are splintered. The orientation of the damage scars is parallel. As Hays and Lucas (2007) demonstrated, their experimental pieces showed splintering only on the actively knapped edge, while the opposed edge showed blunting only. They pointed out that splintered pieces with damage scars on two opposed edges might have been rotated during their use life. This could be an indication of rotating the opposed edge pieces from Holley Shelter during use as well. However, we recently conducted small-scale experiments using dolerite and quartzite flakes as chisels in order to split bone: during this experiment, both ends of the piece splintered without rotation. Finally, **diagonal splintered** pieces (Fig. 4) denote specimens with one straight and one opposed asymmetric edge, both with splintered negatives. Considering the orientation of the dorsal and ventral scars of these pieces, they have been most likely used obliquely to their main axis. The remaining pieces are mostly broken and do not fit in any of the three categories.

We are aware that we cannot exclude the possibility that splintered pieces from Holley Shelter have been bipolar cores, especially since no residue- or use-wear analyses have been conducted so far. We likewise admit that we cannot ultimately solve this problem here. However, based on the following criteria, we consider it unlikely that the splintered pieces from Holley Shelter functioned as cores. First, we observed many pieces that are made on blades and bear only marginal splintered negatives along the proximal and distal edges (Fig. 3, No. 7). These pieces produced tiny shatters, instead of useful flakes that could be seen as end products. We interpret this kind of splintered pieces as being in an early stage of their use cycle. Other specimens show complete coverage with negatives resulting from bipolar impact on both faces and exhibit intensely splintered edges (Fig. 3, Nos. 5–6). Interpreting those pieces as cores might be more comprehensible but in our view they reflect a final stage of their use life. This is mostly based on the observation that there is no evidence for bipolar knapping on any of the hornfels blanks at Holley Shelter, regardless of size. Furthermore, comparable pieces appeared during our

TABLE 7. *Distribution of tool types throughout the sequence of Holley Shelter (including retouched tools and splintered pieces).*

Tool type	Unit							
	0–6	6–12	12–18	18–24	24–30	30–36	36–42	Total
Backed piece	2	2	1	3	0	0	0	9
Burin	2	3	2	1	0	0	0	8
Denticulate	2	4	3	1	3	0	0	13
Stone hammer	1	1	1	0	3	0	0	6
Notch	8	6	3	0	2	0	0	19
Retouch on Blade	15	13	17	13	10	1	0	69
Retouch on Flake	9	6	10	5	4	0	0	34
Retouch on Point	6	6	4	2	2	0	0	20
Retouch on Bladelet	0	0	0	0	1	1	0	2
Scraper end	1	2	1	1	1	0	0	6
Scraper side	0	0	10	7	2	1	2	22
Splintered piece	42	86	61	29	20	4	1	243
Unifacial point	2	9	35	46	3	1	2	98
Unifacial tool	0	4	2	3	5	0	0	14
Strangled piece	1	0	0	0	0	0	0	1
Tools total N	91	142	150	111	56	8	5	563
Artefacts total N	388	581	378	256	290	50	37	1980
Tools total % per inch	23.5	24.4	39.7	43.4	19.3	16	13.5	

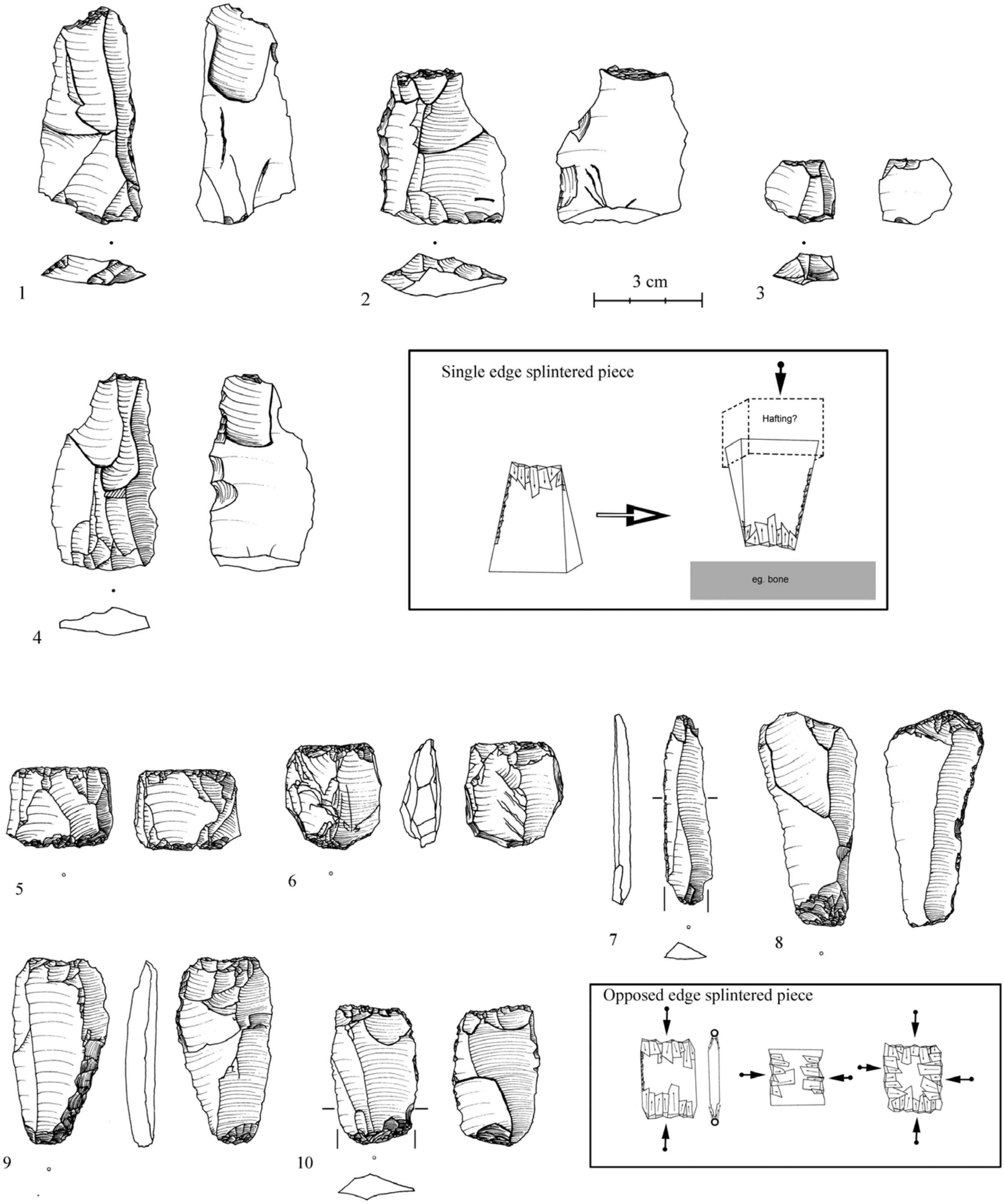

FIG. 3. (**1–4**) *Single-edge splintered pieces;* (**5–10**) *opposed-edge splintered pieces (all hornfels) from Holley Shelter.*

small-scale experiments mentioned above when we used unretouched dolerite flakes as chisels in order to split bone.

As Hiscock (2015) pointed out, bipolar reduction provides the possibility to reduce cores to very small sizes, which is an advantageous strategy especially when raw materials are scarce. This does not fit the circumstances at Holley Shelter, a site located in an environment very rich in raw material (Fig. 1). In addition, we recognised that many of the splintered pieces have intentional retouch on their lateral edges (Fig. 3, No. 2, Nos. 7–9). This likely indicates a recycling process for exhausted tools. The majority of the splintered pieces are elongated and also quite thin (between 8 and 9 mm on average) with regards to their length (see Fig. 3, Nos. 7–9), making their use as cores difficult. Apart from the problems and discordances above, we tried to shed light on this special kind of artefact and its variability over time with the categories provided here. While we

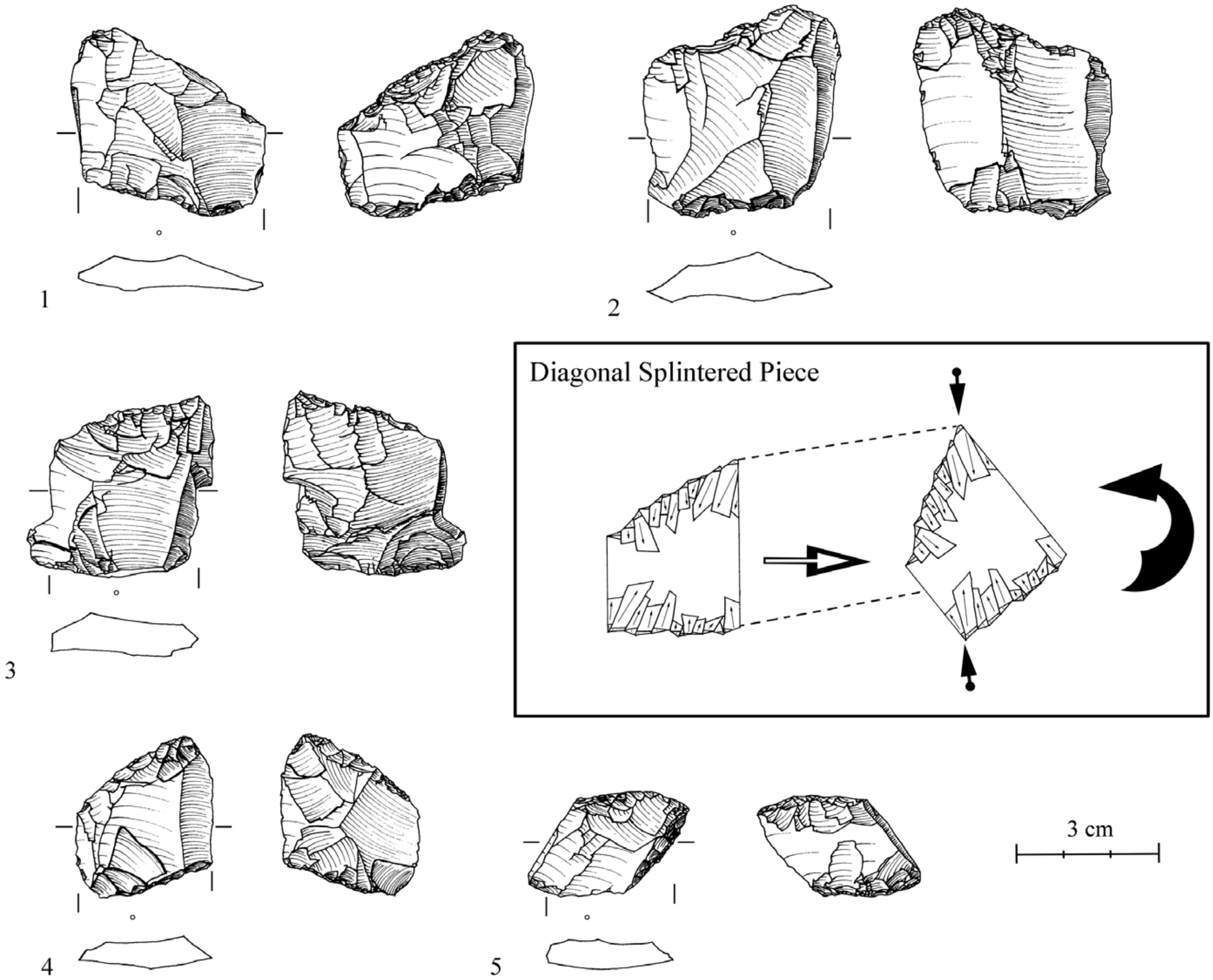

FIG. 4. (**1–5**) *Diagonal splintered pieces (all hornfels) from Holley Shelter.*

subsume splintered pieces as formal tools for the above reasons, Holley Shelter's tool assemblage can easily be calculated without them (Tables 1, 3, 7).

Regarding their frequencies, **opposed-edge splintered pieces** (see Table 8) are the most common representatives in all spits, ranging between 40 and 76%. **Single-edge splintered** pieces amount to between 14 and 18% in the uppermost three spits (inches 0–18). In the lower spits, they occur only in marginal frequencies. **Diagonal splintered pieces** only occur in the upper part of the sequence. In the 12–18 inch spit, they amount to 10%. In the overlying spits, the number declines to only 2%. Based on this new classification of splintered pieces,

TABLE 8. *Classification of splintered pieces at Holley Shelter:* ***On tool*** *describes the number of pieces that bear retouch modifications in addition to their splintered edges.*

Unit	Depth below datum (cm)	Single edge		Opposed edge		Diagonal		Broken		Total *n*	Total on tool (%)
		Total	On tool	Total	On tool	Total	On tool	Total	On tool		
Inch 0–6	15.0	7 (14.3%)	4	31 (63.3%)	8	1 (2%)	0	3 (6.1%)	2	49	28.6
Inch 6–12	30.0	15 (18.1%)	4	49 (59.0%)	7	6 (7.2%)	0	13 (15.7%)	4	83	18.1
Inch 12–18	45.0	10 (6.9%)	6	37 (62.7%)	7	6 (10.2%)	2	6 (10.2%)	2	59	28.8
Inch 18–24	60.0	2 (6.9%)	0	22 (75.9%)	10	0 (0%)	0	5 (17.2%)	4	29	48.3
Inch 24–30	75.0	1 (5%)	0	11 (55%)	2	0 (0%)	0	8 (40%)	3	20	25
Inch 30–42	105.0	0 (0%)	0	2 (40%)	0	0 (0%)	0	3 (60%)	2	5	40
Total *n*		20	14	152	34	13	2	38	17	245	

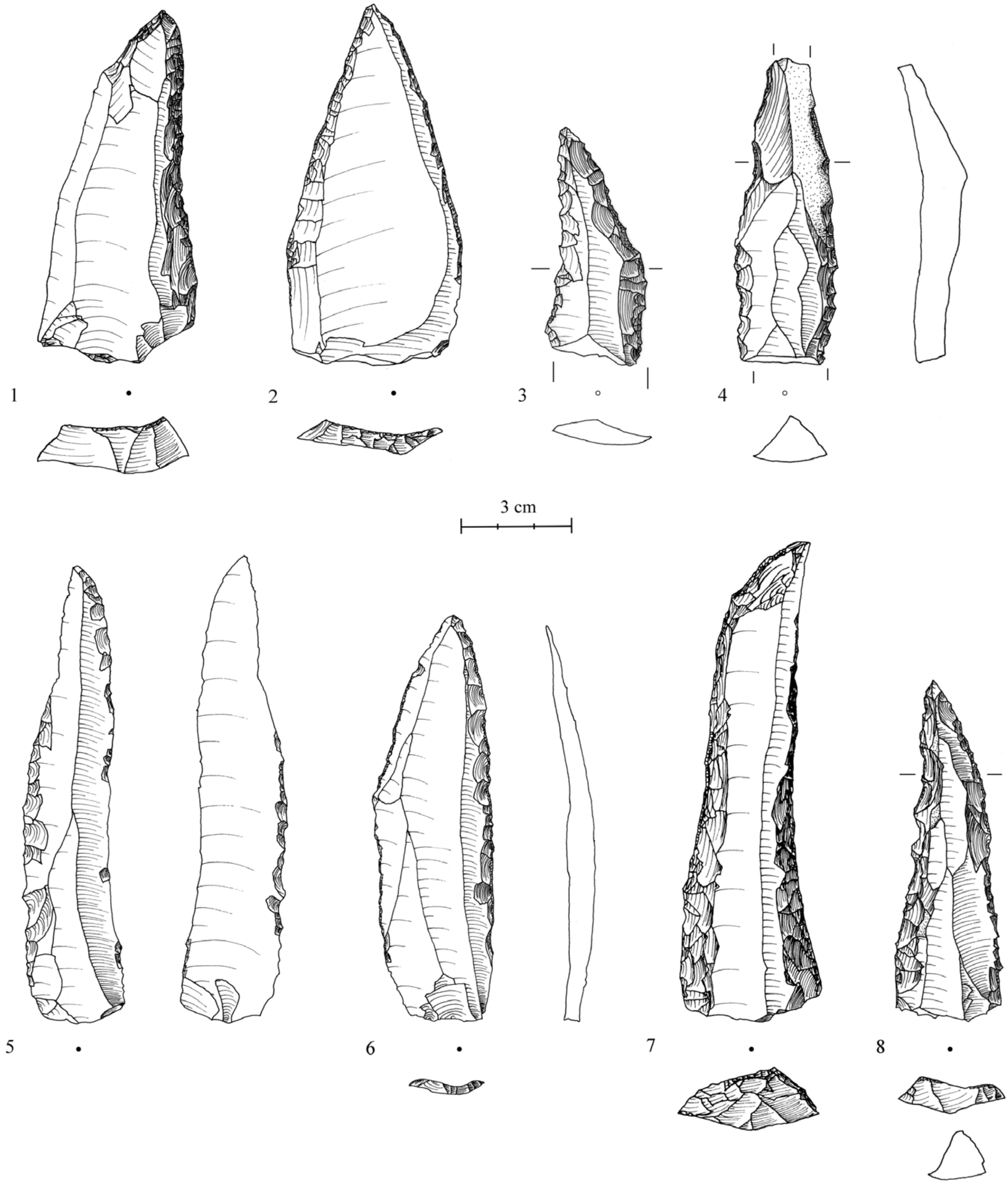

FIG. 5. (**1–8**) *Unifacial points (all hornfels) from Holley Shelter.*

we see clear temporal changes during the sequence of Holley Shelter.

Unifacial points constitute the second important tool type at Holley Shelter. They occur in significant numbers only in the middle of the sequence (inches 12–18 and 18–24). In these spits they are the most common tool type. Owing to the similarities between the unifacial points from Holley Shelter and Sibudu (especially layers BSP–BM) (Conard *et al*. 2012; Will *et al*. 2014) we decided to adopt the techno-functional system of analysis for these tool classes proposed by Conard *et al.* (2012). Using this conceptual framework, most of the unifacial points from Holley Shelter can be classified as Ndwedwe tools (Fig. 5). Following the definition of Conard *et al.* (2012), Ndwedwe tools are "characterised by distinctive, strong, lateral retouch that usually runs the entire length of both sides of the tool. […] With progressive retouch the pieces become narrower and narrower, while the length remains nearly constant over the course of reduction and modification" (Conard *et al.* 2012: 192).

TABLE 9. *Morphometric comparison between Holley Shelter, Sibudu and Umhlatuzana (following Mohapi 2013). All metrics are in mm, mass is in grams. TCSA is calculated following Hughes (1998) and Shea (2006).*

Metrics (mm)	Statistics	Holley Shelter Inch 18–30	Sibudu Post-HP	Umhlatuzana Level 18–16	Umhlatuzana Level 23–19
Length	Mean	67	41.2	46	47.7
	Range	37–130	13–90	33–69	34–74
	n	45	169	13	18
Breadth	Mean	29.0	26.7	26.3	28
	Range	18–45	7–54	18–39	20–39
	n	46	226	16	20
Thickness	Mean	9.1	8.4	9	10.7
	Range	5–15	3–19	6–15	5–17
	n	46	275	17	20
Platform breadth	Mean	22.3	18.8	22.7	19.2
	Range	7–42	3–37	9–35	11–33
	n	45	145	23	19
Platform thickness	Mean	7.4	6.8	5.4	5.3
	Range	2–15	1–17	2–11	2–10
	n	45	153	23	19
Length/breadth ratio	Mean	2.3	1.6	1.8	1.8
	Range	1.3–4.8	0.5–5.0	1.2–2.6	1.3–2.7
	n	46	157	12	18
Mass	Mean	19.3	12.0	10.6	13.5
	Range	4.8–64.47	1.5–64.4	4.7–18.4	4.9–37.2
	n	46	148	10	18
TCSA	Mean	135.3	119.0	122.8	153.9
	Range	60–280	13.5–465.5	54–234	60–297.5
	n	46	222	16	20

In inch spits 12–18 and 18–24, more than 60% of the unifacial points constitute Ndwedwe tools. Among the unifacial points, we also found some Tongati tools (Conard *et al.* 2012) and asymmetric convergent tools (ACTs) (Will *et al.* 2014). In contrast to Ndwedwe tools, Tongati tools are continuously reduced from the distal to the proximal end, but always retain their convergent distal configuration. ACTs are similar to Tongati tools, but the distal tip is always asymmetrical. Most specimens have steeper, retouched edges opposed to a sharp non- or only marginally retouched edge. These two tool classes appear in much lower frequencies than the Ndwedwe points at Holley Shelter. Additional techno-functional tool classes, such as naturally backed tools (NBTs), occur at Holley Shelter, but only in low frequencies. Table 9 compares several metrics of the unifacial points from Holley Shelter, Sibudu and Umhlatuzana. These comparisons show that the points from Holley Shelter are by far the longest and possess the highest length/breadth ratio. They are also characterised by very thick platforms and a high tip cross-sectional area (TCSA; after Hughes 1998; Shea 2006; Sisk & Shea 2011).

DISCUSSION

STRATIGRAPHIC INTEGRITY OF THE LITHIC ASSEMBLAGES FROM HOLLEY SHELTER

As many stratigraphic and taphonomic studies have shown (e.g. Cahen & Moeyersons 1977; Hofman 1986; Eren *et al.* 2010; Staurset & Coulson 2014) archaeologists need to be particularly careful when interpreting assemblages without having detailed knowledge about the depositional and post-depositional situation of the site. Based on the results presented above, we can conclude that the stratigraphic situation at Holley Shelter is more reliable than appears from first sight. Within individual spit levels, we observed homogeneous technological signals from cores and blanks. There are also no diagnostic artefacts or tool types (e.g. LSA material such as small segments, microliths or microlithic cores) that do not fit with the rest of the assemblages (Table 7). The high proportion of splintered pieces might be an exception, but this is discussed in detail below.

Although we found only one refit, both the core and its refitted product belong to the same spit and even to the same square. Further, the nature of the lithic assemblages suggests that we can exclude a strong selection of eye-catching pieces by Gordon Cramb, though there is a minor degree of recovery bias. This observation is based on the original excavator's report on sieving sediments and the concomitant existence of numerous pieces in the assemblage that are smaller than 1 cm without showing any outstanding feature. While the extraordinarily high amount of retouched artefacts may be exaggerated by recovery bias, unmodified blanks still constitute the most abundant category of lithic specimens throughout the sequence. In comparison with sites like Sibudu, which was excavated by state-of-the-art field methods, the high number of retouched artefacts is also not extraordinary. In conclusion, the MSA sequence of Holley Shelter features no obvious extent of mixing to a degree larger than at any modern site. The minor collection bias stemming from the old excavations does not ultimately compromise the nature and completeness of the lithic assemblages. We are thus confident in deriving further-reaching interpretations based upon the MSA material from Holley Shelter.

OCCUPATIONAL PHASES AT HOLLEY SHELTER BASED ON TECHNO-TYPOLOGICAL ANALYSES

Based on the techno-typological analyses of the lithic assemblages, we distinguish three different occupational phases. The first comprises the lithic assemblages of the lowermost two spits (inches 30–36 and 36–42), primarily characterised by a different strategy of raw material procurement compared to the overlying inch spits. Here, knappers predominantly collected and used quartz, with hornfels being second in abundance. The number of tools is comparably low and bipolar percussion is the most prevalent core reduction strategy. The abundance of quartz is associated with the organisation of the lithic technological system towards bipolar percussion. There are only few unifacial points (*n* = 3) and splintered pieces (*n* = 5). The latter occur exclusively as opposed-edge splintered pieces or broken specimens. The near absence of prepared platform cores results in a relatively low number (21.3%) of faceted butts, with most platforms being plain or crushed. The composition of blanks shows the highest abundance of flakes in the Holley Shelter sequence (63.9%). Finally, the number of artefacts >3 cm is the lowest for the entire sequence with only 50 pieces in the inch spit 30–36 and 37 specimens in inch spit 36–42.

The middle part of the sequence, inches 12–18, 18–24, and 24–30, comprise the second coherent technological system during the MSA occupations at Holley Shelter. The abundance of tools increases in these layers as well as the frequency of hornfels from bottom to top. From a metrical perspective, blanks and tools are larger compared to the underlying spits and artefact density is much higher. Knappers preferentially produced blades with faceted platforms but points are also frequent, especially in inches 18–24. In the same spit, 34% of the retouched tools are made on points confirming an increasing importance of this blank type. Different to the underlying spits, platform cores constitute the most important reduction strategy. People adopted soft stone hammer techniques for producing the majority of all blanks. Splintered pieces of all three categories occur and opposed-edge splintered pieces constitute the most common subtype. Single-edge splintered pieces increase towards the top of the sequence while diagonal splintered pieces occur the first time in the inch spit 12–18 of about 10%. Unifacial points appear in the highest frequencies in this part of the sequence. Based on direct comparison with unifacial points from the Sibudan (Conard *et al.* 2012; Will *et al.* 2014), most of these pieces are comparable to Ndwedwe tools.

The two uppermost spits (inch 0–6 and 6–12) correspond to a third coherent occupation phase. Although Cramb noted that the first six inches represent a mixture of LSA and MSA artefacts (Cramb 1961), we did not find any LSA signature in the lithic technology at Holley Shelter. Apart from a single strangled endscraper that could be of LSA character (see Goodwin 1930), the assemblage from the first spit conforms in all techno-typological aspects to a typical MSA technology without evidence for microlithic reduction systems (Deacon 1984; Opperman 1987; Carter *et al.* 1988). The assemblages from spits 0–6 and 6–12 are characterised by the almost exclusive use of hornfels, the preferential production of blades with faceted butts made on unidirectional platform cores, a low tool component compared to the underlying spits and the use of soft stone hammer percussion. Splintered pieces constitute the most abundant tool type, which are almost exclusively made on hornfels. All categories of splintered pieces, as defined above, occur with a dominance of opposed-edge splintered pieces. Single-edge and diagonal splintered pieces increase from top to bottom.

THE PLACE OF HOLLEY SHELTER WITHIN THE MSA OF SOUTHERN AFRICA

As stated above, the absolute age of the occupations at Holley Shelter remains unknown to date. Owing to the described problems of obtaining access to the site, we had no opportunity to extract datable material. We thus tried to narrow down the potential age of the MSA occupation at Holley Shelter by a techno-typological and morphometric comparison with other sites in South Africa, particularly its eastern part in the region of KwaZulu-Natal.

Owing to the absence of bifacial technology and small backed segments at Holley Shelter, we can exclude the existence of Howieson's Poort and Still Bay occupations at the site from our comparative analyses. The lack of bifacial cutting tools and hollow-based points also rules out a final MSA comparable to those at Sibudu or Umhlatuzana. These observations are important for chronological interpretations of the thick sequence at Holley Shelter, as the SB and HP are commonly found in various regions of southern Africa – including KwaZulu-Natal – and can serve as marker horizons for MIS 4 technology (Wadley 2007; Jacobs & Roberts 2008; Lombard *et al.* 2010; Mackay 2011; Henshilwood *et al.* 2014; but see Tribolo *et al.* 2013). Furthermore, the absence of final MSA markers at Holley Shelter helps to further narrow down the potential age of the site to before 35 ka.

There are two well-published sites in the vicinity of Holley Shelter: (i) Sibudu (Wadley & Jacobs 2004, 2006; Wadley 2005b, 2007; Wadley & Mohapi 2008; Conard *et al.* 2012, Will *et al.* 2014; Conard & Will 2015) located about 40 km away; and (ii) Umhlatuzana (Kaplan 1989, 1990; McCall & Thomas 2009; Mohapi 2008, 2013; Lombard *et al.* 2010) at about 60 km distant. In order to obtain more comparable data, we also included Border Cave (Cooke *et al*. 1945; Beaumont 1978; Villa *et al.* 2012) and Rose Cottage Cave (Wadley & Harper 1989; Clark 1997a; Harper 1997; Wadley 1997; Soriano *et al.* 2007) in our comparative analyses, which are both about 300 km away from Holley Shelter.

The only assemblages that compare well from the four sites mentioned above are those post-dating the HP. Most of these assemblages feature frequent unifacial points and all belong to MIS 3 (~58–24 ka). In the late MSA of Umhlatuzana, between 37 and 40% of the tools are unifacial points (Kaplan 1989, 1990). In the post-HP, or Sibudan, of Sibudu (layers BSP-BM) this tool form even comprises between 38 and 54% of all retouched artefacts (Will *et al.* 2014). Unifacial points with faceted butts are also characteristic for the post-HP or MSA3 at Border Cave (layer 2WA – 2BSUP) (Beaumont 1978; Volman 1981; Villa *et al.* 2012). At Rose Cottage Cave, unifacial points occur in both the pre-HP and the post-HP layers. Based on published drawings by Harper (1997), specimens from the pre-HP layers show a more leaf-shaped morphology with reduced butts that do not correspond to the morphology of unifacial points from Holley Shelter. Similarly to Holley Shelter, unifacial points occur predominantly in the middle part of the post-HP sequence at Rose Cottage Cave and their number decreases towards the underlying HP (Soriano *et al.* 2007). In contrast to Holley Shelter, however, the unifacial points from all four comparative sites exhibit flake or point proportions and not elongated blade shapes. While most unifacial points at Holley Shelter are best comparable to Ndwedwe tools from Sibudu (Conard *et al.* 2012), most other sites yield points that are more comparable with Tongati tools. As an additional point regarding tool kits, all comparative sites exhibit higher proportions of retouched artefacts during the post-HP/late MSA occupations compared to both under- and overlying layers.

In order to enlarge the possibilities of comparing assemblages we also conducted a morphometric analysis. Umhlatuzana and Sibudu constitute the best sites for such an analysis since they have detailed morphometric data. Table 5 directly compares various measurements between the unifacial points from the middle sequence of Holley Shelter with those from the late MSA at Umhlatuzana, based on work by Mohapi (2013) as well as the unifacial points from layers directly post-dating the HP at Sibudu based on our own data. The unifacial points from the different sites bear more similarities than differences. Most measurements show only little variation of a few millimetres for mean values. Having said that, the Holley Shelter points are markedly longer and heavier and also have a higher length to width ratio than those from Umhlatuzana (both sections) and Sibudu. While there might be several reasons for this pattern, one simple explanation derives from the geographic position of Holley Shelter nearby many potential occurrences of hornfels (Fig. 1). The inhabitants of Holley Shelter thus had better access to larger amounts of hornfels compared to those at Sibudu or Umhlatuzana, an interpretation consistent with the existence of large blocks of this raw material in the MSA assemblages.

In terms of blank production, the post-HP at Border Cave is characterised by a higher percentage of blades which declines from the oldest post-HP layer 2WA with 80% to the youngest 2BSUP with 40% (Villa *et al.* 2012). Rose Cottage Cave also shows a strong signal of blade production in the occupations following the HP (Soriano *et al.* 2007). In the layers that follow the HP at Sibudu, blades never exceed 20% (Will *et al.* 2014; Conard & Will, 2015) and Umhlatuzana does not feature blades in significant frequencies during the late MSA (Kaplan 1990). Turning to core reduction strategies, the Sibudan at Sibudu also yielded many platform cores (Will *et al.* 2014: fig. 10, 8–9) which show technological similarities to Holley Shelter. At Holley Shelter, however, platform cores occur in much higher frequencies and play a more important role compared to Sibudu. While there is little published information on core reduction at Umhlatuzana, Kaplan (1989, 1990) mentioned single platform and bipolar cores. In the post-HP of Border Cave, narrow-sided cores occur as well as parallel cores (based on figures SI4, SI6 and SI8 in Villa *et al.* 2012). Finally, Rose Cottage Cave also yielded both laminar platform and parallel cores in the post-HP (Soriano *et al.* 2007: fig. 13).

Based on raw material proportions, Holley Shelter, Sibudu and Umhlatuzana share many similarities. The late MSA at Umhlatuzana features up to 80% of hornfels. In the older and younger strata, the number of hornfels artefacts declines and quartz becomes the most common raw material (Kaplan 1989, 1990). There is a similar trend in the Sibudan at Sibudu. Here dolerite followed by hornfels are the dominant raw materials (Will *et al.* 2014; Conard & Will 2015) while quartz is the more common raw material around the immediate transition between the HP and post-HP (Cochrane 2006; our own observations). These observations match well with the raw material shift at Holley Shelter from quartz, which dominates the bottom of the sequence, to hornfels in the middle and upper occupation horizons. Considering the short distances between Holley Shelter, Sibudu and Umhlatuzana, changes in environmental, demographic and socio-cultural variables probably affected the organisation of lithic technologies in similar ways at all three sites.

Apart from many similarities with stone artefact assemblages postdating the HP, there are differences in lithic technology of this period between the comparative sites and Holley Shelter. The extremely high proportions of retouched artefacts remain unique. This might be in part explained by the dominant use of hornfels in the upper and middle part of the sequence at Holley Shelter in combination with a minor recovery bias. Wadley and Kempson (2011) showed that hornfels is a relatively soft and fragile material, meaning that edges need to be resharpened more often compared to other raw materials. This could be one reason why knappers retouched hornfels more intensely than, for example, dolerite. It is conspicuous that the same over-representation of tools made on hornfels compared to other materials appears at Sibudu (Will *et al.* 2014; Conard & Will 2015). Having said that, we point to the fact that Umhlatuzana shows low proportions of retouched artefacts although hornfels is the preferred raw material here (Kaplan 1989, 1990). The high proportion of retouched blanks at Holley Shelter in the middle and upper part of the sequence cannot be explained by the scarcity of raw material or long distance import. Under such conditions we would expect a higher variability in raw material composition and a higher proportion of retouched tools made on non-local raw materials compared to local raw material (*cf.* Bamforth 1986; Andrefsky 1994; Floss 1994; Auffermann 1998; MacDonald & Andrefsky 2008). However, this is not the case in the upper and middle part of the sequence at Holley Shelter where knappers almost exclusively used hornfels to produce both tools and unretouched blanks. Furthermore, many potential outcrops of hornfels occur within a 10 km radius around Holley Shelter and the inhabitants introduced large blocks of this raw material to the site. We have identified only a few pieces of potentially non-local raw materials and they exhibit less frequent modifications than hornfels. The situation might be different for the lowest phase of occupation, during which people preferentially collected and knapped quartz but continued to manufacture most tools on hornfels (10 out of 13).

Another feature that distinguishes Holley Shelter from most MSA sites in the eastern part of southern Africa is the high percentage of blades (on hornfels). Most of the comparative sites show much lower percentages of blades and tools are usually made on flakes and points (Kaplan 1989, 1990; Villa *et al.* 2012; Will *et al.* 2014). Only the blade-based post-HP assemblage from Rose Cottage Cave shows high percentages of retouched blades similar to Holley Shelter (Soriano *et al.* 2007). In part, this might again be associated with the natural proportions of hornfels and its abundant occurrence near Holley Shelter. Based on the frequent preservation of slab-like cortex on hornfels artefacts, we suggest that knappers intentionally chose large slabs from around Holley Shelter. Various authors have proposed that slabs often provide favourable conditions for producing blades (Moncel 2005; Carmignani 2010; Shimelmitz *et al.* 2011; Delagnes *et al.* 2012).

Turning to one of the main characteristics of Holley Shelter, the splintered pieces, in the uppermost part of the sequence with up to 61% of this tool category, show strong similarities to the Early LSA (ELSA) occupation at Border Cave (Villa *et al.* 2012) and Rose Cottage Cave (Wadley 1996; Clark 1997b). This observation, however, is the only similarity. In the ELSA at Border Cave, (i) the core technology becomes "unorganised" and "wasteful" (Villa *et al.* 2012: 13210) compared to the underlying post-HP, (ii) the percentage of blades strongly decreases, (iii) bipolar knapping becomes more important, and (iv) a systematic production of microliths is evident (Villa *et al.* 2012). The ELSA at Rose Cottage Cave is marked by irregular cores, bipolar knapping and bladelet production (Wadley 1996; Clark 1997b). We observed none of the above cited changes at Holley Shelter. By contrast, there is clear continuity in technology during the upper and middle part of the sequence. The frequent occurrence of splintered pieces at Holley Shelter is strongly associated with MSA technology, rendering this a unique feature of the site. In fact, we know of no other MSA assemblage in Africa with such a high proportion of splintered pieces.

In summary, the stone artefact assemblages from Holley Shelter share most similarities with lithic industries that post-date the HP in southern Africa. Furthermore, they are clearly distinguished from the Still Bay and Howieson's Poort technologies which mostly date to MIS 4. The most parsimonious explanation is that the entire MSA occupation of Holley Shelter took place during MIS 3 and before ~35 ka. Based on our data, we cannot completely reject Cramb's original observation of a short LSA occupation at the top of the sequence as most of his examples derive from excavation of the smaller area of the shelter which is not included in our analysis. This might be an indication of different activity areas during different times. Such an interpretation is also supported by Cramb's notion that "the paucity of split quartz pebble scrapers in the larger section – as compared with the smaller section – is puzzling." (Cramb 1961: 45).

CONCLUSION

We concur with Cramb's statement that "the entire assemblage can best be described as a point and blade industry in a perfect state of preservation" (Cramb 1952: 183). With our re-analysis of the original material, however, we could distinguish different technological phases and were able to show that the structure in lithic technology of Holley Shelter is much more complex. The three phases of occupation that we define most likely belong to settlements during MIS 3 following the Howieson's Poort. The uppermost part of the sequence comprises typical MSA technology together with an extremely high proportion of splintered pieces that is elsewhere only known from ELSA occupations (Clark 1997b; Villa *et al.* 2012). The middle part of the sequence resembles in many ways the Sibudan as defined by Conard *et al.* (2012) and Will *et al.* (2014). We base this assessment on similarities in core reduction, knapping strategies, morphometrics of unifacial points and provisioning of raw material, but also on the appearance of distinct techno-functional markers, namely the Ndwedwe and Tongati tools.

To the best of our knowledge, the frequency of splintered pieces at Holley Shelter is higher than for any other African MSA site. Based on this observation, we used a morphological classification system for this type of artefact. Apart from the still ongoing 'tool *vs* core'– debate, our results show that splintered pieces have a much higher morphological and temporal variability than recognised so far. These observations can serve as a starting point for more technological and functional studies of splintered pieces deriving from MSA contexts.

Our analyses of the techno-typological markers of Holley Shelter show that knappers possessed a highly structured lithic technology with many diagnostic features, outside of a Howieson's Poort or Still Bay context. If our temporal placement of the settlement within MIS 3 is correct, these results support recent arguments that the MSA after the HP in southern Africa is characterised by increased regionalisation and divergent cultural evolutionary trajectories, but does not show evidence for cultural regression (Mitchell 2008; Lombard & Parsons 2010, 2011; Mackay 2011; McCall 2011; Conard *et al.* 2012; Lombard *et al.* 2012; Villa *et al.* 2012; Porraz *et al.* 2013; Mackay *et al.* 2014; Will *et al.* 2014; Conard & Will 2015). At Holley Shelter, this hypothesis will need to be tested by absolute dates deriving from modern chronometric methods.

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