Journal of Archaeological Science (2002) **29,** 1001–1015
doi:10.1006/jasc.2001.0799, available online at http://www.idealibrary.com on IDEAL®

Variability in the Middle Stone Age Lithic Sequence, 115,000–60,000 Years Ago at Klasies River, South Africa

Sarah Wurz*

Department of Geography and Environmental Studies, University of Stellenbosch, Private Bag X1, Matieland, South Africa, 7602

(*Received 26 September 2001, revised manuscript accepted 27 November 2001*)

Stratified samples of artefacts from the Late Pleistocene deposit at the Klasies River main site, covering some 60,000 years, have been studied. Variability in the artefact sequence has been documented in the technologies of artefact production in addition to conventional typological analysis. Particular emphasis has been given to the recognition of the reduction sequences used in producing the pre-formed blanks that are a feature of the Middle Stone Age. The results show that the variability is due to changes between the dominant blade and or point technological conventions (traditions) through time. Technological study supports and gives meaning to the recognition of distinct sub-stages, MSA I (Klasies River), MSA II (Mossel Bay), Howiesons Poort and a post-Howiesons Poort at main site. These sub-stages are more than convenient, site-specific, organizational entities—they delineate separate technological conventions that may have relevance on a sub-continental scale.

Keywords: LATE PLEISTOCENE, MIDDLE STONE AGE SUB-STAGES, TECHNOLOGICAL CHANGE, KLASIES RIVER.

Introduction

Goodwin & Van Riet Lowe (1929) defined the Middle Stone Age in general terms as a flake industry involving the use of prepared cores. In their study of museum collections they recognized a degree of variability which in the absence of good stratigraphic and dating evidence they ascribed mainly to spatial factors. A concern was the influence of raw materials available in different areas. In what was a remarkable pioneering study they proposed a number of industries and less well-defined variations that were subsumed in the stage term, the Middle Stone Age. This paper analyses the variability within an excavated Middle Stone Age sequence at the Klasies River main site in an effort to clarify the nature of the kind of entities, properly sub-stages, that these workers proposed. The long stratified sequence at Klasies River main site (Singer & Wymer, 1982) provides adequate chronologically ordered samples to investigate changes in artefact production over a period spanning some 60,000 years in the first half of the Late Pleistocene. This is the time range over which there is high visibility of Middle Stone Age populations in southern Africa (Deacon, H. J. 2001).

Understanding patterning in the Middle Stone Age depends upon using the appropriate methodology and having access to relatively or chronometrically, well-dated samples. The paucity of retouched tools in the Middle Stone Age in contrast to the following Later Stone Age stage means that the conventional typological methods of describing and comparing artefact samples have restricted value. Middle Stone Age artefact design systems were directed at producing pre-formed blanks or end products and a more appropriate methodology is to use technological analysis as the primary approach with typologies providing ancillary and complementary information. The lack of understanding of technological patterning in the Middle Stone Age has encouraged the view that the artefacts show a low degree of variability (Klein, 1992, 1998; Thackeray, 1992, 2000; Clark, 1999; Noble & Davidson, 1996; Mithen, 1996) and that this stage represents an extended period of invariant artefact production. The apparent exception is the Howiesons Poort sub-stage, which is easily distinguished on typological grounds. The widely used numbering of the sub-stages MSA I–IV with only the Howiesons Poort referring to a name site reflects the uncertainty in describing variability that is not expressed in different frequencies of formal tools. However, the distinction between sub-stages is well founded and the problem lies in its adequate description.

To the end of his career Goodwin (1958) held that it was valid to draw a distinction between the Middle Stone Age and the Middle Palaeolithic but did not offer any substantive support for his view. Later researchers have followed him and currently the Middle Stone Age and Middle Palaeolithic are seen as

*E-mail: sjdw@sun.ac.za

0305–4403/02/$-see front matter

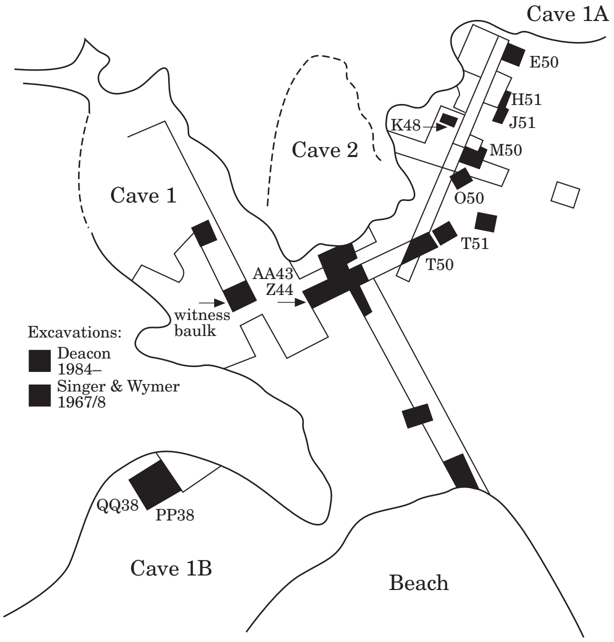

Figure 1. Klasies River main site plan.

geographically separate but contemporary stages with the former restricted to sub-Saharan Africa. Part of the reason for lack of progress in resolving inter-stage relationships is that while technological studies of the Middle Palaeolithic have advanced, those of the Middle Stone Age have lagged behind. This paper aims at providing a description of technological changes between sub-stages in a key South African Middle Stone Age sequence in terms that will be meaningful to students of the Middle Palaeolithic.

Site and Sample

The Late Pleistocene Klasies River main site (33·06°S, 23·24°E), on the Tsitsikamma coast, is one of the reference sites for the Middle Stone Age in southern Africa. The site formed in the lee of a cliff and different areas within the site are named caves 1, 1C, 2, 1A and 1B (Figure 1). The well-stratified deposits with a total thickness of 20 m (Deacon & Geleijnse, 1988) have been dated using a variety of techniques (Table 1). Different dating methods do not have the same precision and the geochemical conditions and quality of preservation of datable materials are not uniform throughout the site. As noted by Vogel (2001), some dating methods used to date deposits beyond the range of radiocarbon give high and others low estimates of ages. Thus there is a spread of age estimates. However, these are constrained by the base of the sequence being formed after the regression from the high sea level stand (Oxygen Isotope Stage 5e) of the Last Interglacial, 125,000 years ago and the top of the sequence (Vogel, 2001) dating to greater than 45,000 radiocarbon years ago. It is probable that deposits range in age between 115,000 and 60,000 years.

The sample of artefacts analysed in this study comes mainly from the excavations carried out by H. J. Deacon since 1984 (D-sample). The D-sample is from the SAS member in cave 1, from RS and SAS members in cave 1B and from the LBS, SAS and Upper members in a series of cuttings through the sequence in cave 1A. The inclusion of specimens from the Singer & Wymer (1982) excavation carried out in 1967/8 (SW-sample) enlarged the sample. Cores from the MSA I levels from area "a" in cave 1 (Singer & Wymer, 1982; Figure 3.2) and cores and retouched artefacts from the Howiesons Poort levels, cave 1A in the SW-sample were analysed. The stratigraphic divisions and the corresponding cultural phases are given in Table 2 and Figure 2. The MSA IV is known only from a small sample from the WS member (Layer 13) in cave 1 has not been considered in this study.

Methodology

Traditionally Middle Stone Age assemblages in South Africa have been studied through the typological classification and the metric analysis of the retouched artefacts and some classes of debitage. The method described by Singer & Wymer (1982) has been widely used with minor modifications (Thackeray & Kelly, 1988; Wadley & Harper, 1989; Kaplan, 1990; Thackeray, 2000). However, formal typology only describes a small part of the artefact variability because the incidence of shaping by retouch in these assemblages is low. The major investment is rather in shaping the core to produce standardized blanks that are end products in themselves and that are seldom retouched. Such a design system lends itself to technological analysis.

Technology encompasses a wide range of concepts, but it is often discussed in terms of the so-called *chaîne opératoire*, or reduction sequence approach (e.g., Bar Yosef & Dibble, 1995). The *chaîne opératoire* incorporates the full production cycle involved in stone artefact manufacture. Refitting allows the fullest understanding of reduction sequences and volumetric conceptions (e.g., Cziesla *et al.*, 1990). However, the sample integrity of the majority of the Palaeolithic material available, including the lithics from Klasies River, precludes this option. The technological approach followed here involved understanding the volumetric conception in core-reduction through a study of blank and core characteristics.

Core characteristics were combined with end product characteristics in deducing reduction sequences because reduction sequences cannot be deduced solely from either cores or end products. Cores and end products with similar morphological appearances can be produced by different technical

Table 1. Dating of Klasies River deposits

Sub-stage	Location	Member (Layer*)	Method	Material	Date (ka)	Author(s)
MSA I (Singer & Wymer) MSA 2b (Volman) Klasies River (This paper)	cave 1	LBS (*Layer 37*)	AAR	Bone	90	Bada & Deems, 1975
	cave 1	LBS (*Layer 38*)	AAR	Bone	110	Bada & Deems, 1975
	cave 1	LBS (*Layer 38*)	OIS	Shell	OIS 5e	Shackleton, 1982
	cave 1	LBS	OIS	Shell	OIS 5e/5d	Deacon *et al.*, 1988
	cave 1	LBS (*Layer 40*)	Uranium series	Stalagmite	108	Vogel, 2001
	cave 1A	LBS	Luminescence	Sand	110–115	Feathers, in press
	cave 1B	LBS (*Layer 12*)	OIS	Shell	OIS 5e	Shackleton, 1982
MSA II (Singer & Wymer) MSA 2b (Volman) Mossel Bay (This paper)	cave 1	SAS (*Layer 16*)	AAR	Bone	89	Bada & Deems, 1975
	cave 1	SAS (*Layer 15*)	OIS	Shell	OIS 5c/5a	Shackleton, 1982
	cave 1	SAS	OIS	Shell	OIS 5c	Deacon *et al.*, 1988
	cave 1	SAS (*Layer 17*)	ESR	Tooth	88–93	Grün *et al.*, 1990
	cave 1	SAS (*Layer 14*)	Uranium series	Stalagmite (tip)	85	Vogel, 2001
	cave 1	SAS (*Layer 14*)	Uranium series	Stalagmite (base)	94	Vogel, 2001
	cave 1	SAS (*Layer 14*)	Uranium series	Stalagmite	101	Vogel, 2001
	cave 1	SAS (*Layer 15*)	Uranium series	Shell	37	Vogel, 2001
	cave 1	SAS (*Layer 15*)	Luminescence	Sand	75–85	Feathers, in press
	cave 1A	SAS (*Layer 27*)	ESR	Tooth	60–80	Grün *et al.*, 1990
	cave 1A	SAS (*Layer 30*)	Uranium series	Carbonate crust	77–82	Vogel, 2001
	cave 1A	RF (*Layer 22*)	Uranium series	Shell	28	Vogel, 2001
	cave 1A	RF (*Layer 22*)	Luminescence	Sand	70–80	Feathers, in press
Howiesons Poort	cave 1A	Upper	OIS	Shell	OIS 4	Deacon *et al.*, 1988
	cave 1A	Upper	ESR	Tooth	40–60	Grün *et al.*, 1990
	cave 1A	Upper (*Layer 14*)	Uranium series	Carbonate crust	65	Vogel, 2001
	cave 1A	Upper (*Layer 17*)	C14	Charcoal	>50	Vogel, 2001
	cave 1A	Upper (*Layer 18*)	C14	Charcoal	>40	Vogel, 2001
	cave 1A	Upper	Luminescence	Sand	55–60	Feathers, in press
	cave 2	Upper	Luminescence	Sand	55–60	Feathers, in press
MSA III/Post- Howiesons Poort	cave 1A	Upper (*Layer 6*)	C14	Charcoal	>45	Vogel, 2001
	cave 1A	Upper	Luminescence	Sand	50	Feathers, in press

*Stratigraphic designation of Singer & Wymer (1982) are italicized in parentheses.

Table 2. Grouping of layers at Klasies River main site

Sub-stage	Cave	Member	Unit and layers	Singer & Wymer (approximate equivalent)
MSA III	1A	Upper	E50 YS3–E 50 TSG	9–1
Howiesons Poort	1A	Upper	J51 Ysx5–E50 CP5	21–10
MSA II upper	1A	SAS	T50 BS4L–L51 YS	35–23
MSA II upper	1	SAS	SASW H1-J4	15–14
MSA II upper	1B	SAS	PP38 DCCP6–DC surf	5–1
MSA II lower	1A	SAS	AA43 SCB2–T50 SM5T	36
MSA II lower	1	SAS	SASU HHH–D1	16
MSA II lower	1B	SAS	PP38 DCCP12–DCCP7	11–6
MSA I	1	LBS	AA43 SBS–Y44 SCB3S	38–37
MSA I	1B	RBS	PP38 RSBCH–YS 1	15–12

systems (Marks & Volkman, 1983; Boëda, 1995; Tuffreau & Révillion, 1996). The cores have been classified according to the scars of the last end product removal(s) and not according to formally designated reduction systems such as Levallois or prismatic blade systems. In this study pieces that are symmetrical, and

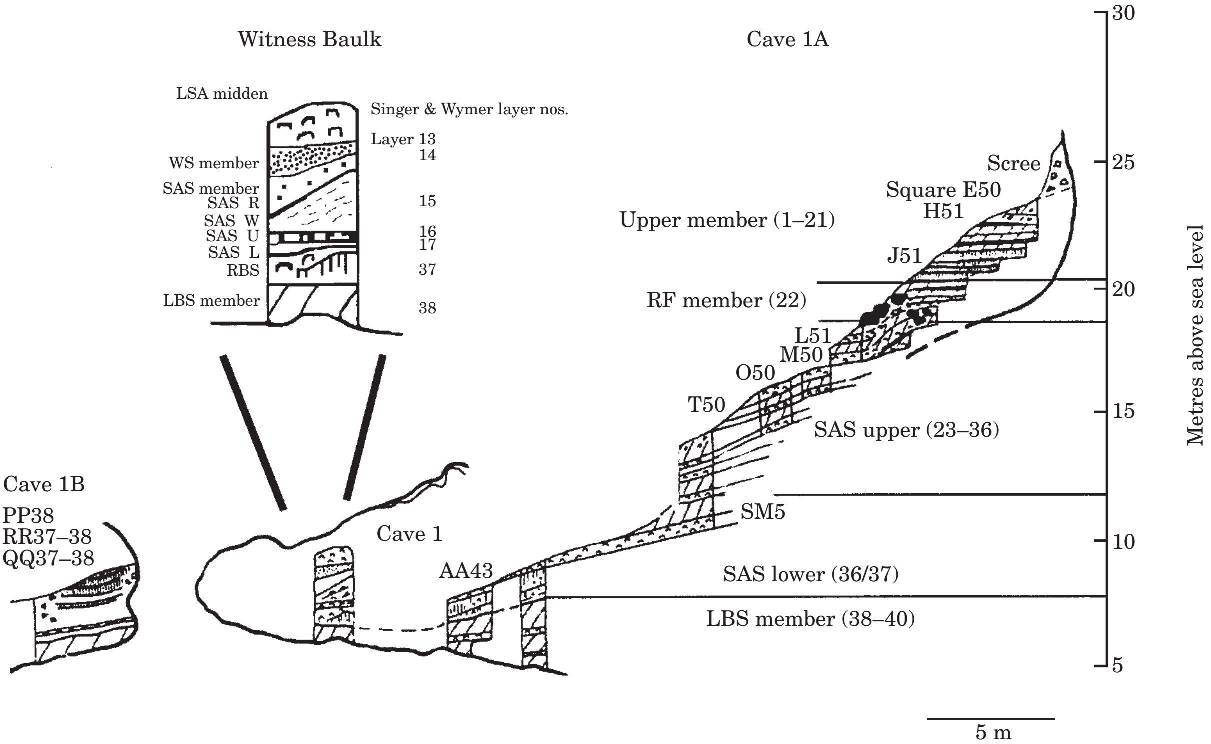

Figure 2. Scheme of sections showing units and members at Klasies River main site.

that have standardized dorsal patterning with carefully prepared butts are considered as end products (Boëda, 1995; Van Peer, 1995). The terms "point" and "blade" are used to describe them. Terms like pointed flake-blades (Singer & Wymer, 1982: 18) and convergent blades (Thackeray & Kelly, 1988: 18) refer to pieces classified here as points. The term blade (Inizian *et al*., 1999; McBrearty & Brooks, 2000; Wurz, 2000) is used instead of flake-blade (Singer & Wymer, 1982; Thackeray, 2000).

The small percentage of retouched pieces was noted and was classified according to conventional typology. The type list includes notched and denticulated pieces, scrapers, backed artefacts, knives, unifacial and bifacial points and "burins". A detailed analysis of the retouched artefacts unless they are considered a significant part of a sub-stage is not discussed here.

The technological convention followed in each Middle Stone Age sub-stage is discussed below. It should be emphasized that not all products from a sub-stage conform to the particular convention discussed, indicating that the dominant core reduction strategy always co-exists with other strategies. However, only the dominant strategy is considered here. The sequence is discussed in terms of the Singer & Wymer designations, with new terms proposed in brackets.

MSA I (Klasies River Sub-Stage)

Little or no selection of non-local raw materials occurs in the layers assigned to MSA I (Table 3). There are cores that were set up to remove blades. These are pyramidal or flat cores on quartzite cobbles (Table 4; Figure 3, nos 1 & 4). The preparation of the under surfaces was not systematic or careful and was directed at creating elongated volumes. The upper surface of the core was used as production face. The first removals appear to have been thick-sectioned blades, some slightly twisted (Figure 3, no. 3). The removal of crested blades did not initiate blade production as in some other Middle Palaeolithic contexts (Révillion, 1995; Meignen, 2000). There are also many flat cores showing a point scar as last removal (Table 4; Figure 3, no. 2). These end-stage cores fulfill the criteria of a Levallois point core method (Van Peer, 1992; Inizian *et al*., 1999). The co-occurrence of these two kinds of cores may indicate that a Levallois reduction method coexisted with the laminar method, as documented in other Middle Palaeolithic contexts (Tuffreau &

Table 3. Non-local raw material usage at Klasies River

Sub-stage	*N*=	%
MSA I (SW-sample)	31,812	0·4
MSA I (D-sample)	9944	0·2
MSA II (SW-sample)	95,418	1·2
Lower MSA II (D-sample)	9454	0·5
Upper MSA II (D-sample)	12,900	2·1
KR1A HP (SW-sample)	119,336	27·0
Howiesons Poort (D-sample)	10,210	32·9
MSA III (SW-sample)	6577	4·0
MSA III (D-sample)	4993	6·1

Table 4. Core classification

	MSA I SW-sample		Lower MSA II D-sample		Upper MSA II D-sample		Howiesons Poort SW-sample		Howiesons Poort Cave 1A, D-sample		Howiesons Poort Cave 2, D-sample		MSA III D-sample	
	%	*N*=	%	*N*=	%	*N*=	%	*N*=	%	*N*=	%	*N*=	%	*N*=
Point	35	34	48	67	33	13	0	0	0	0	0	0	0	0
Blade	18	18	8	11	13	5	49	186	47	15	34	22	27	3
Irregular	4	4	7	10	3	1	11	45	3	1	15	10	27	3
Core fragment	38	37	36	51	49	19	24	103	44	14	51	33	45	5
Pre-form	5	5	1	2	3	1	7	31	3	1	0	0	0	0
"Bladelet"	0	0	0	0	0	0	2	7	3	1	0	0	0	0
"Microcore"	0	0	0	0	0	0	7	28	0	0	0	0	0	0
Total	100	98	100	141	100	39	100	400	100	42	100	65	100	11

Révillion, 1996; Meignen, 2000). On the other hand, these cores may represent the last stage in a blade removal method in which the configuration of ridges on the core inadvertently leads to the removal of a point as last product (Marks & Volkman, 1983). However, if the characteristics of the end products are taken into account, a laminar method dominated in the MSA I. The end products appear to have been produced by the systematic reduction of the volume of the core and not by exploitation of a single surface as in the case of Levallois production sequences (Tuffreau & Révillion, 1996; Bar-Yosef & Kuhn, 1999). From the scar patterns on the cores and the curved nature of the end products a recurrent unipolar strategy is inferred.

The blades ($n=84$) and points ($n=60$) in the MSA I are thin symmetrically shaped end products, often with a curved profile (Figure 4, nos 1–5). The blades in the sample are on average between 81 mm long, 28 mm wide and 8 mm thick while the points have average length, width and thickness values of 71 mm, 34 mm and 9 mm respectively (Table 5). These points and blades are significantly longer and thinner than the end products in the following MSA II sub-stage. Chi-square tests show that the length distributions of MSA I differ significantly from MSA II lower ($\chi^2=16{\cdot}49$, df=7, $P=0{\cdot}21$) and very significantly from MSA II upper and the Howiesons Poort (MSA II upper and Howiesons Poort, $\chi^2=53{\cdot}9$ and 165·12 respectively, df=12 and 8; $P=0{\cdot}00$ and 0·00). The trend for longer products to occur in the MSA I than in MSA II and Howiesons Poort is a feature that has been recognized in several long sequence sites in South Africa (Mason, 1962; Sampson, 1974; Volman, 1984; Watts, 1997). The length-thickness ratio of end products as well as the butt thickness-length ratio (Wurz, 2000), indicate that the MSA I end products in terms of relative dimension are most similar to blades in the Howiesons Poort sub-stage.

The characteristics of the butt and pattern of its preparation evident on the blades and points are specific to the MSA I. Many of the butts are small (Table 6; Figure 4) and have a lip and these are associated with diffused bulbs of percussion (blades 42%, $n=133$; points 13%, $n=9$). Faceted butts are more numerous than plain butts (blades with plain butt 41% ($n=131$), points with plain butts 22% ($n=15$); blades with faceted butts 59% ($n=192$), points with faceted butts 77% ($n=54$)). Crushing or abrasion on the dorsal edge of the butt has been observed on 30% ($n=115$) of the end products (Figure 4, nos 1, 2, 4, 5). This is related to the removal of the overhang of the previous removals from the core and is necessary to ensure the longitudinal dispersal of the force. Often associated with the rubbing, and sometimes occurring in absence of the rubbing, is the presence of step flaking on the dorsal margin of the platform. This step flaking had the same purpose as the rubbing. The butt angles are more acute than in the MSA II. These features are often ascribed to direct percussion with a soft hammer (Pelegrin, 1995; Inizian *et al*, 1999; references in Wurz, 2000: 47).

The retouched component is limited. Denticulated and notched pieces as well as a small number of retouched blades and points occur. It has been suggested that the presence of denticulation is a distinguishing feature of the MSA I (Singer & Wymer, 1982: 73; Volman, 1984: 203), but this finding was not confirmed in the D-sample (Wurz, 2000: 212). It is the technology of the MSA I core reduction that is characteristic and not the retouched component.

MSA II (Mossel Bay)

As in the previous sub-stage, the raw material is mainly quartzite (Table 3). The majority of the cores are maximally reduced and present concave active surfaces (debitage surfaces) with a point scar as the last removal (Figure 3, nos 5–7). Many of the cores are on split cobbles. This is indicated in the flatness of the split surface, the crushing at point of impact and radiating lines of force. The under surfaces are minimally prepared and many of the cores have almost full cortical cover (Wurz, 2000: 183). The stages in the preparation

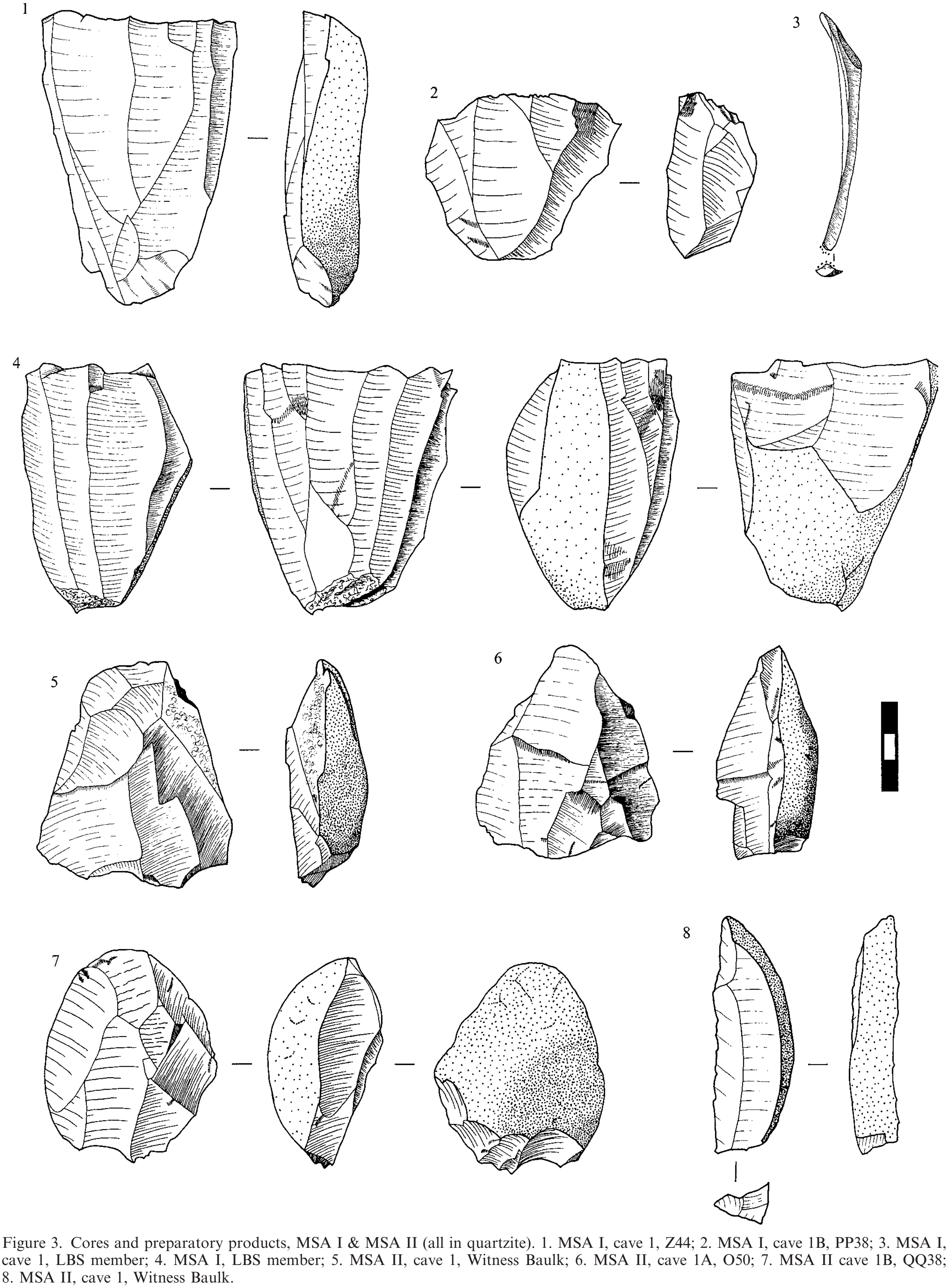

Figure 3. Cores and preparatory products, MSA I & MSA II (all in quartzite). 1. MSA I, cave 1, Z44; 2. MSA I, cave 1B, PP38; 3. MSA I, cave 1, LBS member; 4. MSA I, LBS member; 5. MSA II, cave 1, Witness Baulk; 6. MSA II, cave 1A, O50; 7. MSA II cave 1B, QQ38; 8. MSA II, cave 1, Witness Baulk.

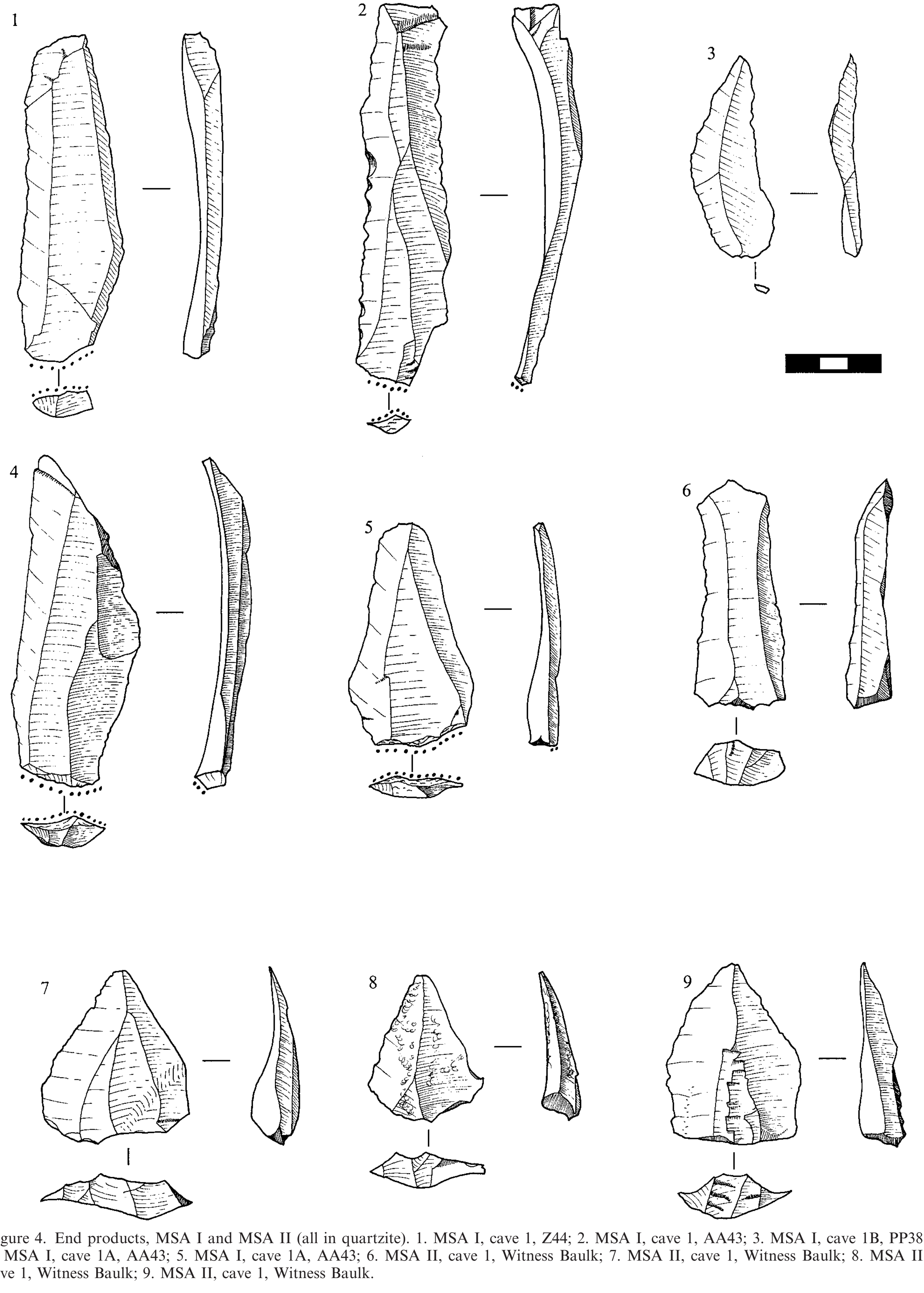

Figure 4. End products, MSA I and MSA II (all in quartzite). 1. MSA I, cave 1, Z44; 2. MSA I, cave 1, AA43; 3. MSA I, cave 1B, PP38; 4. MSA I, cave 1A, AA43; 5. MSA I, cave 1A, AA43; 6. MSA II, cave 1, Witness Baulk; 7. MSA II, cave 1, Witness Baulk; 8. MSA II, cave 1, Witness Baulk; 9. MSA II, cave 1, Witness Baulk.

Table 5. End product dimensions (average mm)

	Length				Width				Thickness			
	Blades		Points		Blades		Points		Blades		Points	
	X	*N*=	X	*N*=	X	*N*=	X	*N*=	X	*N*=	X	*N*=
MSA I	81·0	84	70·6	60	28·3	472	33·5	71	8·2	472	9·3	71
MSA II lower	75·9	454	65·3	414	30·2	1791	34·6	545	9·6	1791	11·0	545
MSA II upper	68·8	244	58·8	246	26·9	1074	31·6	298	8·7	1074	10·3	298
HP (D-sample, cave 1A)	43·9	75	—		18·8	714	—		4·9	714	—	
MSA III	77·8	23	64·2	11	25·7	259	34·0	15	7·7	259	10·2	15

of the lateral and distal convexities are not obvious from the study of the cores. However, there are flaked pieces that are backed by cobble cortex and overshot (*outrepassés*) in that they removed part of the distal end of the core (Figure 3, no. 8). These are interpreted as core-edge elements. At stages in the reduction process such pieces are removed as part of the process of forming the convexity of the core. The proximal striking platforms are well prepared for the removal of a restricted number of possibly no more than two or three pointed blanks. The cores in the MSA II conform to criteria typical of a unipolar convergent Levallois reduction method (Van Peer, 1992; Boëda, 1995; Meignen, 1995). The core reduction scheme in this sub-stage is clear, as almost all the cores and end products are uniformly patterned.

Nearly all of the preparation of the core was directed at the production of Levallois-like points. As noted by Singer & Wymer (1982: 53) the blade forms in this sub-stage are thick and irregular and less standardized in terms of butt characteristics (Wurz, 2000: 191) than in the MSA I (Figure 4, no. 6). The points constitute the end products because they have carefully prepared platforms and because they show a regular disposition of scars and a central ridge, extending over the whole of the dorsal surface, or at least to the distal region of this surface (Figure 4, nos 7–9). The butts are thick and regularly faceted. Many of the points are asymmetrical in plan view and transversal section. This can be related to the removal of a series of blanks in a recurrent mode (Meignen, 1995: 365). The butt characteristics on all the end products show the exclusive use of the hard hammer. The bulb is often splintered and the well developed "cracks" at the point of impact evidence the localized force of a hard hammer. There was no systematic removal of the overhanging lip from previous removals. This was unnecessary because the point of impact was set well below the active surface (debitage surface). This pattern of removal is a defining feature of the MSA II or Mossel Bay and resulted in characteristic thick points with prominent bulbs of percussion and dorsal surfaces with a straight profile.

Table 6. Butt width and butt thickness(mm) of blades and points, MSA I-MSA III (D-sample)

	Blades			Points		
	Width	Thickn.	*N*=	Width	Thickn.	*N*=
MSA I	19·6	6·8	323	25·3	8·6	70
MSA II lower	24·5	10·0	1338	29·7	11·3	527
MSA II upper	21·4	9·2	655	27·2	10·4	293
HP	11·6	3·7	383	—	—	
MSA III	20·6	7·9	137	28·5	11·1	15

The points in the MSA II from cave 1A become shorter and more standardized in terms of length/width ratio in the top of the SAS member (Thackeray & Kelly, 1988: 20). This trend is accompanied by a decrease in the dimensions of blade preparatory products (Wurz, 2000: 78). Points in the lower levels of the MSA II (Table 5) are on average 65 mm in length, 35 mm in width and 11 mm in thickness, whereas the points in upper part of the sequence are on average 59 mm long, 32mm wide, and 10 mm thick. There is a higher correlation (r=0·8 versus r=0·6) between platform thickness and point thickness in the upper MSA II than in the lower MSA II. There is also a notable decrease in coefficient of variation of thickness of the points (Wurz, 2000: 193, 200) in the upper MSA II. It is reasonable to suggest that the temporal trend for points in the MSA II to take a smaller, more regular form is an acceptable feature.

Typically, few pieces were transformed by retouch. In the D-sample MSA II lower 13% (n=311) and upper MSA II, 8% (n=108) of the pieces are notched (Table 7). Denticulation occurs on approximately 2·4% of the blades and points. Notching and denticulation are more common on points than on blades and tends to be localized at the tip, shoulder, or on the ventral side of the platform. The damage on the edges is not due to post-depositional processes. An investigation by 10 × magnification indicates that there are almost no characteristics on the products that can be associated with trampling and post-depositional damage (McBrearty *et al.*, 1998; Villa & Soressi, 2000). No smoothing and rounding of edges or dorsal ridges between the flake scars occur, and abrupt microscars with abrupt angles are not characteristic.

No unifacial or bifacial pieces were recovered in the D-sample. It can be noted that the few unifacial and

Table 7. Notching, denticulation and retouch on blades and points from the MSA I–MSA III, D-sample

	MSA 1		Lower MSA II		Upper MSA II		Howiesons Poort		MSA III	
	%	*N*=	%	*N*=	%	*N*=	%	*N*=	%	*N*=
None	87·3	474	65·1	1521	61·8	848	95·5	2227	91·9	679
Lateral	6·8	37	18·2	425	27·0	370	1·2	27	5·1	38
Notched	5·0	27	13·3	311	7·9	108	0·5	11	0·9	7
Denticulate	0·9	5	2·4	57	2·4	33	0·2	5	0·9	7
Retouched	0·0	0	0·9	22	0·9	13	2·6	61	1·1	8
Total	100	543	100	2336	100	1372	100	2331	100·0	739

bifacial pieces of the SW-sample came from the top levels (Singer & Wymer, 1982: 72) of the MSA II and the base of the overlying Howiesons Poort. This is in accordance with the suggestion of Wurz (2000) and Henshilwood *et al.* (2001), that the culture-stratigraphic position of the Still Bay is between the MSA II or Mossel Bay and the Howiesons Poort.

Howiesons Poort

The main shift in raw material usage at main site occurs in the Howiesons Poort levels (Table 3). There is a marked increase in non-quartzite raw materials from negligible proportions in the MSA I and MSA II sub-stages to 27% in the SW sample and 33% in the D sample (Singer & Wymer, 1982; Wurz, 2000). The increases involve the materials quartz, hornfels, silcrete and chalcedony. In the Howiesons Poort all the cores relate to the production of blade blanks (Figure 5, nos 1–3). The most numerous form of core is a prismatic shaped blade core. The cores are elongated volumes and as in the MSA I, the lateral and distal convexities were formed by the removal of naturally backed twisted blades (Figure 5, no. 4), and not by crested blades. A few of the cores (Figure 5, no. 1) show that blades were peeled off the cortical surface of a cobble which had the appropriate convexities. There are some blade cores that are not prismatic in shape and these were formed on flat nodules. In most of these cases, centripetal removals can be observed (Figure 5, no. 3).

As in the other levels, almost invariably the blanks were struck from the proximal platform. However, preparation of the opposing distal surface (87%, *n*=163) is more common than in samples of cores from the other levels. Singer & Wymer (1982: 91) commented that the cores in non-local rock were more "methodically worked" and that the quartzite cores of the Howiesons Poort were treated in the same way as the other Middle Stone Age levels at main site. This study shows no conceptual differences in the reduction strategies of quartzite and non-quartzite cores although the non-quartzite cores show a greater degree of reduction as they are shorter and thinner (Wurz, 2000: 185).

The blanks in the Howiesons Poort are short thin blades, with an average length of approximately 44 mm (Table 5, Figure 5, nos 5–9). There are similarities between the blades of the MSA I and Howiesons Poort. The majority of the butts is small (Table 5), plain, lipped and is associated with diffuse bulbs. The angle of the butt to the dorsal surface is acute ranging between 50° and 70°. Butt preparation in the form of fine rubbing and step flaking (Figure 5, no. 8), occurs on the dorsal surface close to the butt. Again, this was to ensure the removal of elongated products, probably by direct percussion with a soft hammer (Pelegrin, 1991; Inizian *et al.*, 1999).

The Howiesons Poort is one of the better-known entities of the Middle Stone Age, as it includes "Upper Palaeolithic"-like retouched types in the occurrence of backed artefacts (Figure 5, nos 11, 12). The production of these backed artefacts involved selection of whole blades and the application of "light" backing (Movius *et al.*, 1968: 39) to shape the blanks into the geometric forms of segments, and infrequently, trapezes. Half of the backed pieces (53%, *n*=397) were backed along the whole edge. The backed artefacts range from 9 mm to 72 mm and large samples give a mean value that is close to 40 mm (Table 8). The backed artefacts are as standardized in terms of coefficient of variation as those from the Later Stone Age (Wurz, 1999).

A distinctive feature of the backed artefacts of Klasies River main site and other sites in the region is the use of non-quartzite materials. In the D-sample from cave 2, 41% (*n*=30), cave 1A, 25% (*n*=7) and in the SW-sample 46% (*n*=386) were made in non-local materials. At other sites, the backed artefacts were preferentially made on fine-grained rocks (Keller, 1973; Deacon, J., 1979, 1995; Kaplan, 1990; Harper, 1997; Vogelsang, 1996). The difference in the degree of selection may reflect the distance from available sources as in the Later Stone Age (Deacon, J., 1984).

The retouched component in the samples from Klasies River includes notched blades. An analysis of 131 of the 214 notched pieces noted by Singer & Wymer (1982) indicate that the majority was made on whole blade blanks in non-local raw material. Different classes of notches the following uses that the piece was put to.

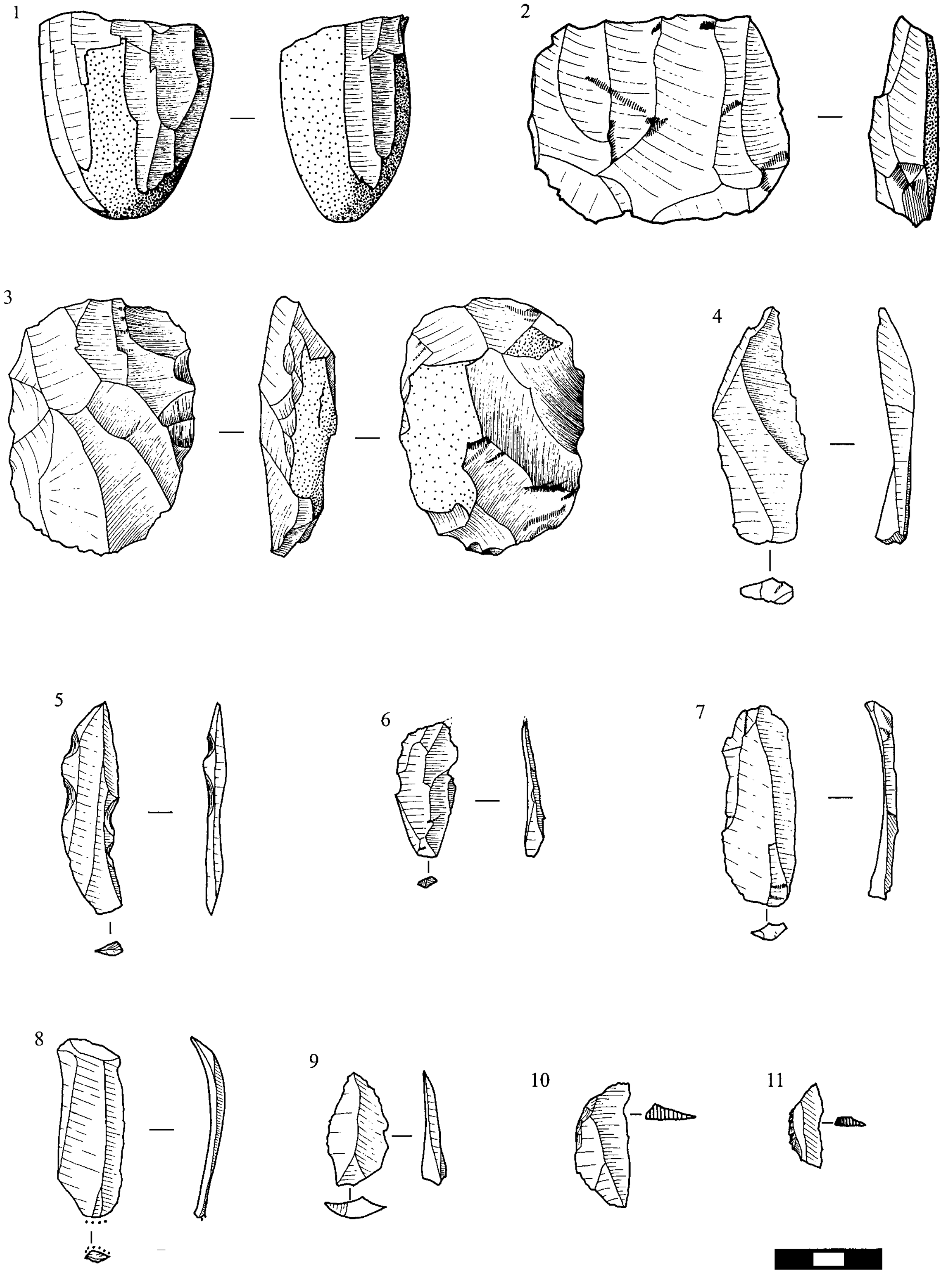

Figure 5. Howiesons Poort cores and products (all in quartzite unless stated differently). 1. Cave 2, sieving platform; 2. Cave 1A, Singer & Wymer layer 18; 3. Cave 1A, E50; 4. Cave 1A, H51; 5. Cave 1A, H51 (hornfels); 6. Cave 1A, H51 (silcrete); 7. Cave 2; 8. Cave 1A, H51; 9. Cave 1A, E50; 10. Cave 1A, E50; 11. Cave 1A, E50 (silcrete).

Table 8. Summary statistics of backed artefacts, cave 1, 1A and 2, D-sample & SW-sample

	SW-sample cave 1A			D-sample cave 1A			D-sample cave 2		
	Length	Width	Thickn.	Length	Width	Thickn.	Length	Width	Thickn.
Mean (mm)	36·6	15·9	4·6	35·1	15·3	4·6	36·6	13·74	4·3
SD	9·4	3·4	1·2	9·7	2·7	1·1	10·5	3·6	1·2
CV	25·8	21·7	26·4	28·0	18·0	25·0	29·0	27·0	30·0
Min.	9·0	5·0	2·0	16·0	9·0	2·0	21·0	8·0	2·0
Max.	72·0	29·0	9·0	62·0	19·0	7·0	70·0	24·0	8·0
N=	630	828	828	28	28	28	58	74	74

MSA III

The study of the MSA III artefacts is constrained by small sample size and for this reason no alternative term is proposed. The use of non-local raw material is high in relation to that in the MSA I and ll sub-stages, but not as high as in the Howiesons Poort (Table 3). Only 11 cores were analysed, but none resembled those of the MSA Il. Although the sample is small, the core configuration is more similar to the Howiesons Poort than to the other sub-stages (see also Singer & Wymer, 1982: 48). Refitting of some of the flaked products to a silcrete core (from square E50, unit TSC) in the D-sample demonstrates that the the active surface was prepared by removing thin products to set up the controlling ridges. The proximal platforms were elaborately prepared, while the distal platform was informally prepared.

The available sample is again too small to adequately characterize the range of blanks produced. There is an indication that they may be points and blades, larger than those from the Howiesons Poort. In general there are more blades in the MSA III D-sample than in the MSA II (see also Singer & Wymer, 1982: 62). The flaking products in the MSA include blades with small platforms similar to those found in the Howiesons Poort and these relate to core preparation rather than the final products. Their occurrence is not the result of mixing, as suggested by Singer & Wymer (1982). The retouched component in the MSA III consists of “knives”. The knives are larger in size relative to other products in the Howiesons Poort. Only two knives have been recovered from these levels in the D-sample and a further 10 knives were located in the SW-sample. The blanks on which the knives were produced are blades of varying sizes, but the placement and kind of retouch is standardized. The knives have flat retouch along the full extent of one or both laterals.

Discussion

An impression has been created that the Middle Stone Age at Klasies River encompasses a very extended period during which little significant change took place (Singer & Wymer, 1982: 64), typified by technological and typological continuity throughout (Thackeray & Kelly, 1988; Thackeray, 1989). The small range of retouched tools and the similar proportions of different classes of debitage through the sequence are seen to indicate a lack of change. However, the observed trends in the morphometric characteristics of blades and points observed by Singer & Wymer (1982), Thackeray & Kelly (1988) and Thackeray (1989) are more significant from the perspective of reduction sequences. These trends seen in the light of the characteristics of the cores and end products detailed in this paper indicate different conventions or traditions in artefact production or technology. The sub-stages proposed by Singer & Wymer (1982) are robust and fully supported by this study.

The MSA I (Klasies River) is a blade production strategy that is followed by a Levallois-like point production strategy in the MSA II (Mossel Bay). In turn these are succeeded in time by another blade strategy aimed at producing smaller blades that served as blanks for segments in the Howiesons Poort. The succeeding MSA III cannot be adequately described on the available samples but again is clearly distinct. Even given these different traditions in artefact production, the Middle Stone Age at Klasies River has a unity. Almost all the cores were exploited unifacially and more than half of all the cores has cortex remaining on the passive surface. The end products of all the sub-stages tend to be elongated (Wurz, 2000; Tables 84 & 85) and removed in a unidirectional fashion. But through time different technological reduction strategies and different typological characteristics dominated in the sub-stages.

The spatial and temporal resolution of these technological conventions needs to be investigated in a study encompassing other Middle Stone Age sites. The succession of sub-stages described at Klasies River appears to be duplicated in part or whole in long-sequence sites in Southern Africa for which there are adequate data (Mason, 1957, 1962; Wendt, 1972; Beaumont, 1978; Beaumont *et al*., 1978; Kaplan, 1990; Mitchell & Steinberg, 1992; Vogelsang, 1996; Wadley, 1997; Watts, 1997; Thackeray, 2000). Table 9 shows some of the sites that may be correlated with the sequence at Klasies River. The Howiesons Poort is the sub-stage for which the spatial and temporal resolution is best known. It appears to have a spatial distribution

Table 9. A selection of sites in southern Africa showing the suggested culture-stratigraphic correlations

MSA I (MSA 2a)	MSA II (MSA 2b)	Still Bay	Howiesons Poort	Post Howiesons Poort
Klasies River main site	Klasies River main site		Klasies River main site	Klasies River main site
Apolo 11 (Vogelsang, 1995; Watts, 1997)	Apolo 11 (Vogelsang, 1995; Watts, 1997)		Apolo 11 (Vogelsang, 1995; Watts, 1997)	Apolo 11 (Vogelsang, 1995; Watts, 1997)
Cave of Hearths (Sampson, 1974; Volman, 1984)	Cave of Hearths (Mason, 1957; Volman, 1984)		Cave of Hearths (Mason, 1957; Volman, 1984)	
Border Cave (Beaumont, 1978; Volman, 1984)	Border Cave (Beaumont, 1978; Volman, 1984)		Border Cave (Beaumont, 1978, Volman, 1984)	Border Cave (Beaumont, 1978; Volman, 1984)
Peers Cave (Volman 1984)	Peers Cave (Volman, 1984)	Peers Cave (Volman, 1984)	Peers Cave (Volman, 1984)	
?De Kelders (Thackeray, 2000)	?De Kelders (Thackeray, 2000)		?De Kelders (Thackeray, 2000)	
Nelson Bay Cave (Volman, 1984)	Nelson Bay Cave (Volman, 1984)		Nelson Bay Cave (Volman, 1984)	
?Florisbad (Kuman *et al.*, 1999)	?Florisbad (Kuman *et al.*, 1999)			
Herolds Bay (Volman, 1984)				
Mwulus cave (Volman, 1984)	Mwulus cave (Volman, 1984)			
Bremen 1C (Vogelsang, 1995)			Bremen 1C (Vogelsang, 1995)	
AAR1 (Vogelsang 1995)	AAR1 (Vogelsang, 1995)		AAR1 (Vogelsang, 1995)	
Bremen 2B (Vogelsang, 1995)				
	Blombos Cave (Henshilwood *et al.*, 2001)	Blombos Cave (Henshilwood *et al.*, 2001)		
	Pockenbank (Vogelsang, 1995)		Pockenbank (Vogelsang, 1995)	
	Umhlatuzana (Kaplan, 1990)		Umhlatuzana (Kaplan, 1990)	Umhlatuzana (Kaplan, 1990)
	Rose Cottage Cave (Harper, 1994)		Rose Cottage Cave (Harper, 1994)	Rose Cottage Cave (Clark, 1999)
	Sehonghong (Volman, 1984)		Sehonghong (Volman, 1984)	Sehonghong (Volman, 1984)
	Moshebis shelter (Volman, 1984)		Moshebis shelter (Volman, 1984)	Moshebis shelter (Volman, 1984)
	Hollow rock shelter (Watts, 1997)			
	Tiras 5 (Vogelsang, 1995)			
			Melikane (Thackeray, 1992)	Melikane (Thackeray 1992)
			Ha Soloja (Thackeray 1992)	Ha Soloja (Thackeray, 1992)
			Montagu Cave (Keller, 1973, Volman, 1984)	Montagu Cave (Keller, 1973, Volman 1984)
			Boomplaas (Deacon H. J., 1979)	Boomplaas (Deacon H. J., 1979)
		Tunnel Cave (Volman, 1984)	Haalenberg (Vogelsang, 1995)	Sea Harvest (Volman, 1984)
		Skildergatkop (Volman, 1984)	Diepkloof (Volman, 1984)	
		Trappieskop (Volman, 1984)	Howiesons Poort rockshelter (Deacon, 1995)	
		Hollow Rock Shelter (Watts, 1997)	Oakley Farm QOB (Volman, 1984)	
			Kathupan (Thackeray, 1992)	

Table 10. Suggested nomenclature for Middle Stone Age sub-stages

Proposed terms	Singer & Wymer (1982)	Volman (1984)	Chronology
Post-Howiesons Poort	MSA III & IV	Post-Howiesons Poort	65,000–22,000
Howiesons Poort	Howiesons Poort	Howiesons Poort	<70,000
Still Bay			<80,000
Mossel Bay	MSA II	MSA 2b	<100,000
Klasies River	MSA I	MSA 2a	<115,000

restricted south of the Zambezi River in southern Africa (Deacon, 1992). Further investigation of other sub-stages may indicate a similar distribution.

A variety of terms has been used to describe division in the Middle Stone Age. At Klasies River, Singer & Wymer (1982) adopted the terms MSA I, MSA II, Howiesons Poort, MSA III and MSA IV and this terminology has been widely followed. Volman (1981, 1984) proposed a modified version of this cultural stratigraphic scheme for the southern African region that included MSA I, MSA 2a and 2b, Howiesons Poort and post-Howiesons Poort (see Table 10 for correlation with Singer & Wymer). The current mix use of numerical and type locality terms for sub-stages of the Middle Stone Age is confusing. For this reason alternative terms are proposed and these may obviate some of the confusion (Table 10). The MSA I has been labelled the "Klasies River" sub-stage because main site has a large sample. Goodwin (1930) has described the typical MSA II (MSA 2b) as the Mossel Bay and therefore that is the preferred term. Adequate descriptions are available for the Howiesons Poort (Wurz, 1999) and this nomen has validity. Still to be adequately defined are sub-stages that may predate the base of the Klasies River sequence and any post-Howiesons Poort entities. The use of terminology is a matter of agreement and acceptance depends on how useful particular labels will be in expressing concepts.

Concluding Remarks

Much of the variability in the South African Middle Stone Age recognized by Goodwin & Van Riet Lowe (1929) has to do with temporal patterning and the influences of raw materials on artefact production was less significant than they assumed. Further investigation will probably reveal that the spatial scale of patterning is at the sub-continental and not the local regional level. If so, variability in the Middle Stone Age exhibit the same kind of time restricted patterning on a sub-continental scale as recorded in the Later Stone Age (Deacon, J., 1984). It has been posited that the tempo of change, the archaeological reflection of innovation, was much lower in the Middle than the Later Stone Age and that this implies cognitive differences between the respective populations (Clark, 1999). Falling outside the range of radiocarbon, estimates for the duration of any of the sub-stages of the Middle Stone Age lack precision. There is the suggestion that the Howiesons Poort may have a duration of no more than 15,000 years (Deacon & Wurz, 1996) and this would be of the same order as the duration of the Robberg sub-stage in the Later Stone Age (Deacon & Deacon, 1999). It is the overriding concern of archaeologists with typology that has encouraged the idea that the Middle Stone Age is fundamentally different from the Later Stone Age in the rate at which changes were innovated.

This study details episodes of blade production in a South African Middle Stone Age context. Blade industries are known from other Middle Stone Age (McBrearty & Brooks, 2000) and Middle Palaeolithic contexts (Révillion, 1995; Tuffreau & Révillion, 1996; Meignen, 1998, 2000; Delagnes, 2000). Blade industries occur in various areas and time periods before the advent of the Upper Palaeolithic (Bar-Yosef & Kuhn, 1999). The simple occurrence of blades at main site or elsewhere cannot be seen as anticipating developments in the Upper Palaeolithic (Vishnyatsky, 1994). The techniques of blade production in the Middle Stone Age are different from those adopted in the Upper Palaeolithic. Goodwin & Van Riet Lowe (1929) in describing the difference between the Middle and Later Stone Ages stressed the occurrence of flakes in the former and blades in the latter. This has encouraged some authors (e.g., Gamble, 1993) to equate the transition from the Middle to Later Stone Age in South Africa with the transition between the Middle and Upper Palaeolithic. These transitions are not equivalent events and were played out in different parts of the world at different times. *Contra* Goodwin & Van Riet Lowe (1929) the Later Stone Age did not mark the earliest appearance of blades in South Africa. Blade production methods were employed and contributed to the artefact variability in the Middle Stone Age.

A question raised by this paper but which cannot be discussed adequately here, is the relationship of the two apparently contemporaneous stages recognized, the Middle Stone Age in sub-Saharan Africa and the Middle Palaeolithic elsewhere. There is no reason to suspect the isolation of these continental regions at this time and every reason to suspect the dichotomy is a matter of terminology and a consequence of the history of research. It may be appropriate to reconsider Goodwin's reasons for proposing the term Middle Stone Age and see the variability in the artefacts from the first half of the Late Pleistocene at Klasies River and other sites in South Africa as part of the Middle Palaeolithic record in a particular sub-continental region.

Acknowledgements

H. J. Deacon is thanked for guidance and illuminating deliberations, and L. van Pletzen-Vos for the illustration of the artefacts. I benefited from discussions with J. Pelegrin of CNRS, Nanterre, P. van Peer of the Katholieke University of Leuven, L. Pirnay and P. Pirson of Préhistosite de Ramioul, Liége on a sample of the stone artefacts. P. van Peer and V. Rots of the Katholieke University of Leuven and P. Villa of University of Colorado, Boulder provided comments on an earlier draft that improved the version presented here. The Katholieke University of Leuven, Belgium and the University of Stellenbosch, are thanked for supporting this study through post-doctoral research fellowships. This paper is based on a Ph.D. study for which financial assistance was provided by the NRF (Centre for Scientific Development). The Struwig Trust facilitated research in the field and the Iziko Museums of Cape Town made collections available for study.

References

Bada, J. L. & Deems, L. (1975). Accuracy of dates beyond the 14-C dating limit using the aspartic acid racemization reaction. *Nature* **255,** 218–219.

Bar-Yosef, O. & Dibble, H. L. (1995). Preface. In (O. Bar-Yosef & H. L. Dibble, Eds) *The definition and interpretation of Levallois Technology Monographs in world archaeology No 23*. Wisconsin: Prehistory Press, pp. ix–xiii.

Bar-Yosef, O. & Kuhn, S. L. (1999). The big deal about blades: laminar technology and human evolution. *American Anthropologist* **101,** 322–338.

Beaumont, P. B. (1978). *Border Cave*. Masters Thesis. University of Cape Town.

Beaumont, P. B., De Villiers, H. & Vogel, J. C. (1978). Modern man in Sub-Saharan Africa prior to 49,000 years BP: a review and evaluation with particular reference to Border Cave. *South African Journal of Science* **74,** 409–419.

Boëda, E. (1995). Levallois: a volumetric construction, methods, a technique. In (O. Bar-Yosef & H. L. Dibble, Eds) *The definition and interpretation of Levallois Technology. Monographs in world archaeology No 23*. Wisconsin: Prehistoric Press, pp. 41–68.

Clark, A. M. B. (1999). Late Pleistocene technology at Rose Cottage Cave: a search for modern behavior in a Middle Stone Age context. *African Archaeological Review* **16,** 93–119.

Cziesla, E., Eickoff, S., Arts, N. & Winter, D. (1990). *The Big Puzzle. International Symposium on Refitting Stone Artefacts. Studies in modern archaeology volume 1*. Holos Verlag: Bonn.

Deacon, H. J. (1979). Excavations at Boomplaas Cave—a sequence through the Upper Pleistocene and Holocene in South Africa. *World Archaeology* **10,** 241–257.

Deacon, H. J. (1992). Southern Africa and modern human origins. *Philosophical Transactions of the Royal Society, London B* **337,** 177–183.

Deacon, H. J. (2001). Modern human emergence: an African archaeological perspective. In (P. V. Tobias, M. A. Raath, J. Maggi-Cecchi & G. A. Doyle, Eds) *Humanity from African Naissance to Coming Millennia—Colloquia in Human Biology and Palaeoanthropology*. Florence: Florence University Press, pp. 217–226.

Deacon, H. J. & Geleijnse, V. B. (1988). The stratigraphy and sedimentology of the main site sequence, Klasies River, South Africa. *South African Archaeological Bulletin* **43,** 5–14.

Deacon, H. J., Talma, A. S. & Vogel, J. C. (1988). Biological and cultural development of Pleistocene people in an Old World southern continent. In (J. R. Prescott, Ed.) *Early man in the southern hemisphere*. Adelaide: Department of Physics and Mathematical Physics, University of Adelaide, pp. S23–S31.

Deacon, H. J. & Wurz, S. (1996). Klasies River main site, cave 2: a Howiesons Poort occurrence. In (G. Pwiti & R. Soper, Eds) *Aspects of African Archaeology*. Harare: University of Zimbabwe Publications, pp. 213–218.

Deacon, H. J. & Deacon, J. (1999). *Human beginnings in South Africa—uncovering the secrets of the Stone Age*. Cape Town: David Philip Publishers.

Deacon, J. (1979). *The Howiesons Poort and related industries in southern Africa with special reference to the name site collection*. Paper presented at a workshop of the Southern African Association of Archaeologists, Stellenbosch.

Deacon, J. (1984). *The Later Stone Age of Southernmost Africa*. British Archaeological Reports, International Series 213, Oxford.

Deacon, J. (1995). An unsolved mystery at the Howieson's Poort name site. *South African Archaeological Bulletin* **162,** 110–120.

Delagnes, A. (2000). Blade production during the Middle Paleolithic in Northwestern Europe. *Acta Anthropologica Sinica.* Supplement to Vol. **19,** 169–176.

Feathers, J. (in press). Luminescence dating in less than ideal conditions: case studies from Klasies River main site and Duinefontein, South Africa. *Journal of Archaeological Science*.

Gamble, C. (1993). *Timewalkers: The prehistory of global colonization*. Cambridge: Harvard University Press.

Goede, A. & Hitchman, M. A. (1987). Electron spin resonance analysis of marine gastropods from coastal archaeological sites in southern Africa. *Archaeometry* **29,** 163–174.

Goodwin, A. J. H. (1930). Chronology of the Mossel Bay industry. *South African Journal of Science* **26,** 562–572.

Goodwin, A. J. H. (1958). Formative years of our prehistoric terminology. *South African Archaeological Bulletin* **13,** 25–33.

Goodwin, A. J. H. & Van Riet Lowe, C. (1929). *The Stone Age cultures of South Africa*. Annals of the South African Museum 27.

Grün, R., Shackleton, N. J. & Deacon, H. J. (1990). Electron-spin resonance dating of tooth enamel from Klasies River Mouth Cave. *Current Anthropology* **31,** 427–432.

Harper, P. T. N. (1997). The Middle Stone Age sequence at Rose Cottage Cave: a search for continuity and discontinuity. *South African Journal of Science* **93,** 470–475.

Henshilwood, C., Sealy, J. C., Yates, R., Cruz-Uribe, K., Goldberg, P., Grine, F. E., Klein, R. G., Poggenpoel, C., Van Niekerk, K. & Watts, I. (2001). Blombos Cave, Southern Cape, South Africa: Preliminary Report on the 1992–1999 excavations of the Middle Stone Age levels. *Journal of Archaeological Science* **28,** 421–448.

Inizian, M., Reduron-Ballinger, M., Roche, H. & Tixier, J. (1999). *Technology and terminology of knapped stone*. Nanterre: CREP.

Kaplan, J. (1990). The Umhlatuzana rock shelter sequence: 100,000 years of Stone Age history. *Natal Museum Journal of Humanities* **2,** 1–94.

Keller, C. M. (1973). *Montagu Cave in prehistory: a descriptive analysis*. University of California Anthropological Records 28, 1–98.

Klein, R. G. (1992). The archaeology of modern human origins. *Evolutionary Anthropology* **1,** 5–14.

Klein, R. G. (1998). Why anatomically modern people did not disperse from Africa 100 000 years ago. In (T. Akazawa, K. Aoki & O. Bar-Yosef, Eds) *Neandertals and modern humans in Western Asia*. New York: Plenum Press, pp. 509–521.

Marks, A. E. & Volkman, P. (1983). Changing core reduction strategies: a technological shift from the Middle to the Upper Palaeolithic in the Southern Levant. In (E. Trinkhaus, Ed.) *The*

Mousterian Legacy: human biocultural change in the Upper Pleistocene. British Archaeological Reports, International series, 164, pp. 13–34.

Mason, R. J. (1957). *The Transvaal Middle Stone Age and statistical analysis*. South African Archaeological Bulletin **12**, pp. 119–137.

Mason, R. J. (1962). *Prehistory of the Transvaal*. Johannesburg: University of the Witwatersrand Press.

Mc Brearty, S., Bishop, L., Plummer, T., Dewar, R. & Conard, N. J. (1998). Tools underfoot: human trampling as an agent of lithic artifact edge modification. *American Antiquity* **63,** 108–129.

McBrearty, S. & Brooks, A. (2000). The revolution that wasn't: a new interpretation of the origin of modern human behavior. *Journal of Human Evolution* **39,** 453–563.

Meignen, L. (1995). Levallois lithic production systems in the Middle Paleolithic of the Near East: the case of the unidirectional method. In (H. L. Dibble & O. Bar-Yosef, Eds) *The definition and interpretation of Levallois Technology. Monographs in world archaeology No. 23*. Wisconsin: Prehistory Press, pp. 31–380.

Meignen, L. (1998). Hayonim Cave lithic assemblages in the context of the Near Eastern Middle Paleolithic: A preliminary report. In (T. Akazawa, K. Aoki & O. Bar-Yosef, Eds) *Neandertals and modern humans in western Asia*: New York: Plenum Press, pp. 165–180.

Meignen, L. (2000). Early Middle Palaeolithic Blade technology in southwestern Asia. *Acta Anthropologica Sinica.* Supplement to Vol. **19,** 170–180.

Mitchell, P. J. & Steinberg, J. M. (1992). Ntloana Tsoana: a Middle Stone Age sequence from western Lesotho. *South African Archaeological Bulletin* **47,** 26–33.

Mithen, S. (1996). *The prehistory of the mind: a search for the origins of art, religion and science*. London: Thames and Hudson.

Movius, H. L., David, N. C., Bricker, H. M. & Clay, R. B. (1968). *The analysis of certain major classes of Upper Palaeolithic tools*. American School of Prehistoric Research Bulletin 26. Cambridge, Mass.: Peabody Museum, Harvard University.

Noble, W. & Davidson, I. (1996). *Human evolution, language and mind – a psychological and archaeological inquiry*. Cambridge: Cambridge University Press.

Pelegrin, J. (1991). Sur une recherche technique experimentale des techniques de debitage laminaire. *Archeologie Experimentale, Actes du Collogue International 'Expérimentation en archéologie: Bilan et Perspectives'* les Avril 1988, 118–167.

Pelegrin, J. (1995). Technologie Lithique: le Châtelperronien de Roc-De Combe (Lot) et de La Côte (Dordogne). IN *Cahiers du Quarternaire* 20. Paris: CNRS Éditions.

Révillion, S. (1995). Technologie du débitage laminaire au Paléolithique Moyen en Europe septentrionale: état de la question. *Bulletin de la Sociéte Préhistorique Française* **92,** 425–438.

Singer, R. & Wymer, J. (1982). *The Middle Stone Age at Klasies River Mouth in South Africa*. Chicago: Chicago University Press.

Shackleton, N. J. (1982). Stratigraphy and chronology of the Klasies River Mouth deposits: oxygen isotope evidence. In (R. Singer & J. Wymer, Eds) *The Middle Stone Age at Klasies River Mouth in South Africa*. Chicago: University of Chicago Press, pp. 194–199.

Thackeray, A. I. & Kelly, A. J. (1988). A technological and typological analysis of Middle Stone Age assemblages antecedent to the Howiesons Poort at Klasies River main site. *South African Archaeological Bulletin* **43,** 15–26.

Thackeray, A. I. (1989). Changing fashions in the Middle Stone Age: The stone artefact sequence from Klasies River main site, South Africa. *African Archaeological Review* **7,** 33–57.

Thackeray, A. I. (1992). The Middle Stone Age south of the Limpopo River. *Journal of World Prehistory* **6,** 385–431.

Thackeray, A. I. (2000). Middle Stone Age artefacts from the 1993 and 1995 excavations of Die Kelders Cave 1, South Africa. *Journal of Human Evolution* **38,** 147–168.

Tuffreau, A. & Révillion, S. (1996). Variabilité des chaînes opératoires Levallois et laminaires au Paleolithique moyen en Europe du Nord-Ouest. *Quaternaria Nova* **VI,** 31–55.

Van Peer, P. (1992). *The Levallois reduction strategy{7{Monographs in world archaeology No. 13. Wisconsin: Prehistory Press.*

Van Peer, P. (1995). Current issues in the Levallois Problem. In (H. L. Dibble & O. Bar-Yosef, Eds) *The definition and interpretation of Levallois Technology. Monographs in world archaeology No. 23*. Wisconsin: Prehistory Press, pp. 1–10.

Villa, P. & Soressi, M. (2000). Stone tools in carnivore sites: the case of Bois Roche. *Journal of Anthropological Research* **56,** 187–215.

Vishnyatsky, L. B. (1994). "Running ahead of time" in the development of Palaeolithic industries. *Antiquity* **68,** 134–140.

Vogel, J. C. (2001). Radiometric dates for the Middle Stone Age in South Africa. In (P. V. Tobias, M. A. Raath, J. Maggi-Cecchi & G. A. Doyle, Eds) *Humanity from African Naissance to Coming Millennia-Colloquia in Human Biology and Palaeoanthropology*. Florence: Florence University Press, pp. 261–268.

Vogelsang, R. (1995). Middle-Stone-Age-Fundstellen im Südwestern Namibias. *Archäologische Informationen* **18,** 31–40.

Vogelsang, R. (1996). The Middle Stone Age in south-western Namibia. In (G. Pwiti & R. Soper, Eds) *Aspects of African Archaeology*. Harare: University of Zimbabwe Publications, pp. 207–212.

Volman, T. P. (1981). *The Middle Stone Age in the southern Cape*. Ph.D. Thesis. University of Chicago.

Volman, T. P. (1984). Early prehistory of southern Africa. In (R. G. Klein, Ed.) *Southern African Prehistory and Palaeoenvironments*. Rotterdam: Balkema, pp. 169–220.

Wadley, L. & Harper, P. (1989). Rose Cottage cave revisited: Malan's Middle Stone Age collection. *South African Archaeological Bulletin* **44,** 23–32.

Wadley, L. (1997). Rose Cottage Cave: Archaeological work 1987 to 1997. *South African Journal of Science* **93,** 439–444.

Watts, I. (1997). *The origins of symbolic culture: The Southern African Middle Stone Age and Khoisan ethnography*. Ph.D. Thesis, University of London.

Wendt, W. E. (1972). "Art Mobilier" from the Apollo 11 cave, south West Africa: Africa's oldest dated works of art. *South African Archaelogical Bulletin* **31,** 5–11.

Wurz, S. (1999). The Howiesons Poort at Klasies River—an argument for symbolic behaviour. *South African Archaeological Bulletin* **54,** 38–50.

Wurz, S. (2000). The Middle Stone Age sequence at Klasies River, South Africa. D.Phil Thesis, University of Stellenbosch.