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NUMBER 2
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BREATHING LIFE INTO FOSSILS:

Taphonomic Studies in Honor of C.K. (Bob) Brain

Editors

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COVER CAPTIONS AND CREDITS.

Front cover, clockwise from top left.

Top left:
Artist's reconstruction of the depositional context of Swartkrans Cave, South Africa, with a leopard consuming a hominid carcass in a tree outside the cave: bones would subsequently wash into the cave and be incorporated in the breccia deposits. © 1985 Jay H. Matternes.

Top right: The Swartkrans cave deposits in South Africa, where excavations have yielded many hominids and other animal fossils. ©1985 David L. Brill.

Bottom right: Reconstruction of a hominid being carried by a leopard. © 1985 Jay H. Matternes.

Bottom left: Photograph of a leopard mandible and the skull cap of a hominid from Swartkrans, with the leopard's canines juxtaposed with puncture marks likely produced by a leopard carrying its hominid prey. © 1985 David L. Brill.

Center: Photo of Bob Brain holding a cast of a spotted hyena skull signed by all of the taphonomy conference participants. © 2004 Kathy Schick, Stone Age Institute.

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CHAPTER 10

The Earlier Stone Age in South Africa: Site Context and the Influence of Cave Studies

Kathleen Kuman

Abstract

Although South Africa lacks volcanic deposits and sites with fauna are limited, its Earlier Stone Age (ESA) provides a long record which extends from the Oldowan (*c* 1.9 million years ago, Mya), through all phases of the Acheulean, and to final ESA industries transitional to the Middle Stone Age (MSA). Until now, the earliest sites have been identified mainly from secondary deposits within underground dolomitic limestone caves, but this record is set to expand with new dating of alluvial deposits in the Vaal River basin. Apart from four later Acheulean cave occupation sites and the early sites in underground cave fills, all other sites are found in open-air contexts, frequently close to standing water. These contexts are variable—in large river basins, in seasonal lake basins or pans, in river terrace and colluvial basin deposits, in one spring deposit, in coastal aeolian deposits, and in deflated inland lag deposits that in one case preserves three stratified cultural units. This paper presents the data for the sequence of ESA sites in the South and discusses the variety of contexts in which these archaic sites are found.

Introduction

The impact of Bob Brain's work on taphonomy is widespread and well appreciated. But perhaps less widely recognized is the profound influence that Bob has had on our understanding of cave systems and site formation processes. This is probably because there are fewer specialists who excavate dolomitic cave sites than there are taphonomists working with faunal collections. However, the understanding of cave infill formation and transformation is integral to taphonomic interpretations, and it is perhaps even more critical for archaeological interpretations made on such cave assemblages. The elegant explanations that Bob has developed on the cyclical nature of cave sedimentation and erosion processes have been of considerable influence in my own work in site formation analysis. For those prehistorians like myself who do not practice zooarchaeology, site formation is the sister discipline to taphonomy. It is the study of the processes by which sites form and become transformed through time and through geological forces. While these two methods are usually applied as independent specializations, practitioners of both disciplines have a tacit understanding of how well the two approaches complement each other in deciphering the history of any site that preserves both artifacts and fauna.

Site formation analysis has relied heavily on data generated by research on the open-air alluvial and lacustrine sites of East Africa (Isaac, 1967; Schick, 1987a, 1991, 1997; Morton, 1996). Experimental work has helped analysts to evaluate just how pristine (or primary) is the context of an open-air, stratified site. In addition to study of the sedimentary context, formation and disturbance processes can be assessed with the condition and size profile of an assemblage, as well as the orientations and dips of individual artifacts, and a site can then be ranked along a continuum from primary to secondary contexts. In contrast with East Africa, most of the earliest South African artifacts (*c.* 2-1 million years ago, Mya) occur in secondary context, re-deposited from surface occupations around shaft-like entrances that fed into underground cave infills. In thinking through interpretations of behaviour from these cave sites, I have also come to have a certain perspective on the overall South

African Earlier Stone Age (ESA). This paper reviews the contexts of ESA sites from 2 to 0.2 Mya and discusses the importance of site formation analysis to a general appreciation of prehistory in the southern sites.

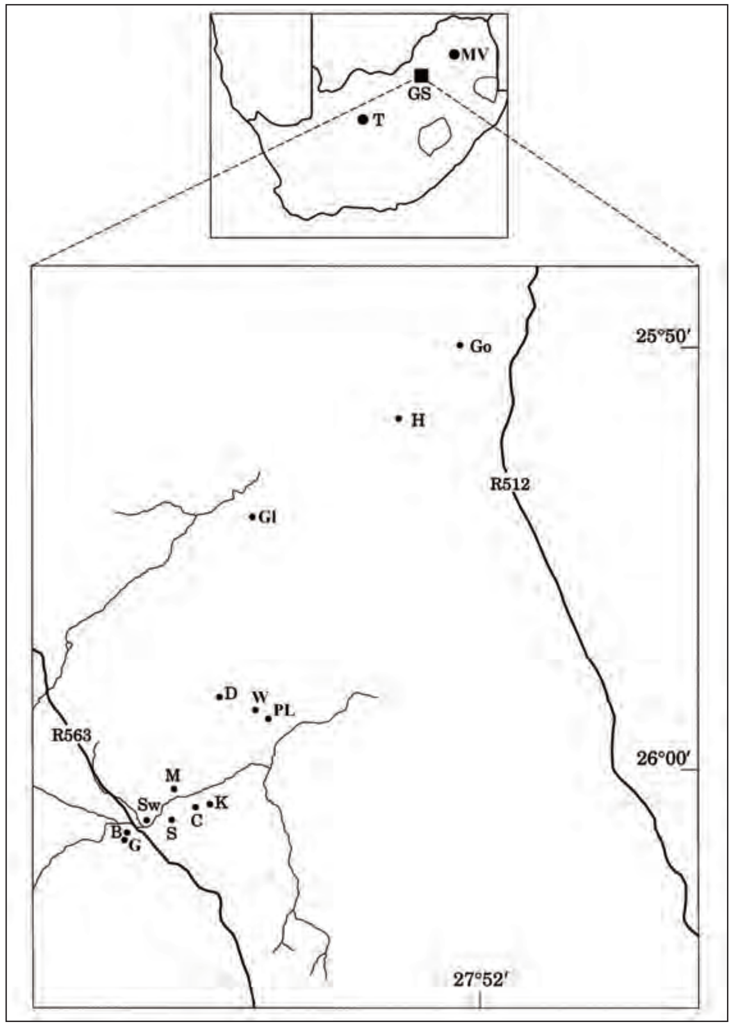

Figure 1. The Cradle of Humankind World Heritage Site, Gauteng Province (GS): G: Goldsmith's; B: Bolt's Farm; Sw: Swartkrans; S: Sterkfontein; M: Minnaar's; C: Cooper's; K: Kromdraai; D: Drimolen; W: Wonder Cave; PL: Plover's Lake; Gl: Gladysvale; H: Haasgat; Go: Gondolin; T: Taung; MV: Makapans Valley.

The ESA Record

The South African ESA is preserved in a variety of contexts, both as 'sites' in the traditional sense and as extensive surface and geological assemblages, and even as buried deflated assemblages. Artifacts of the ESA are so numerous in some parts of the country that the Abbé Breuil once commented that there were not only enough specimens to fill a museum (on Canteen Kopje) to overflowing but to build it of them (Clark, 1959: 127). The prolific nature of this record also led to its historical importance. In the first half of the 20th Century, the South African ESA was influential in establishing the antiquity of the *African* cultural record at a time when the European Palaeolithic was much better understood (Jansen, 1926; Breuil, 1930; Goodwin, 1928, 1933; Goodwin and Van Riet Lowe, 1929; Malan, 1947; and Van Riet Lowe, 1937, 1945, 1952a, 1952b). But it is not merely a rich record, it is also a record that is gradually becoming more complete, particularly in the earlier and later phases.

Earliest ESA Sites

Oldowan

Thus far there are only two sites confirmed old enough to belong to an Oldowan phase of the ESA.

Kromdraai

Kromdraai B (KB) has thus far yielded only two certain artifacts, a core and a flake (Kuman et al., 1997). The KB site has produced *Paranthropus* fossils and at least part of it is placed by paleomagnetism at 1.9 Mya (Thackeray et al., 2002; and see Vrba, 1975). It seems that KB was not much used by Oldowan hominids because its physical setting was less than ideal, as there is evidence in the fauna and geology that the cave was locally quite wet at this time (Brain, 1958; Vrba, 1981). As KB lies within easy reach of the same gravels used by hominids at Swartkrans and Sterkfontein, such conditions may explain the avoidance of the site by hominids and therefore the paucity of stone tools. All three of these sites lie within 300m of gravels associated with the Blaaubank River (T.C. Partridge, unpublished maps of the gravels).

Sterkfontein

In the early 1990s, a large Oldowan assemblage was excavated from Sterkfontein in Member 5 East, associated with fauna estimated at 2 to 1.7 Mya (Clarke, 1994a; Kuman, 1994a). The only associated hominids in the Oldowan Infill are a few fragmentary fossils of *Paranthropus*. However, one molar closely resembles the KB specimen TM 1536 (Kuman and Clarke, 2000), and the 1.9 Mya palaeomagnetic relative date for KB fits within the faunal age estimate for the Sterkfontein infill. The Oldowan assemblage consists of 3,245 pieces, 84% of which is small flaking debris under 20mm size. Almost all of the material one would expect to find in a completely preserved assemblage is present, with mainly flakes <10mm size poorly represented. The catchment of artifacts around the cave entrance was good, probably because the entrance to the cave lay on top of the hill rather than on its slope. A moderately wooded environ-

Table 1. The earliest occurrences of artifacts in South Africa. With the exception of the two alluvial site localities, all other occurrences are in underground dolomitic limestone cave infills. The age estimates are based on published sources and provide the range of possible dates. Although bifaces have been found in dump material, there are no provenanced examples thus far from the Swartkrans and Kromdraai assemblages, which are designated Early Acheulean on technological grounds.

Site Name	Age Estimate in Mya	Stratigraphic Context	Basis for Age Estimate	Cultural Industry
Sterkfontein	2.0-1.7	Oldowan Infill, Member 5 East	fauna	Oldowan
Kromdraai B	1.9	KB deposits	palaeomagnetism; fauna	Oldowan age
Swartkrans	1.8 or 1.7	Member 1, Lower Bank	fauna	undetermined
Sterkfontein	1.7-1.4	Member 5 West	fauna; artifacts	Early Acheulean
Swartkrans	1.5	Member 2	fauna	Early Acheulean
Swartkrans	1.0	Member 3	fauna	Early Acheulean
Kromdraai A	1.5-1.0	KA deposits and dump	fauna	Early Acheulean
Three Rivers and Klipplaatdrif	?	river gravels	artifacts	Early Acheulean
Coopers	1.6-1.9	Coopers D	fauna	unpublished
Goldsmith’s	1.4 or more	Miners’ dumps and associated infill	fauna	undetermined
Drimolen	1.5-1.8	Decalcified breccia	fauna	undetermined
Gladysvale	>0.780	Decalcified breccia	ESR; fauna	Acheulean
Rietputs Formation	1.3–1.7	alluvial gravel and sand	cosmogenic burial ^{26}Al–^{9}Be	Early Acheulean

ment is also reconstructed at this time (Luyt and Lee-Thorp, 2003), which probably helped to retain lithic debris around the cave entrance. Thus the land surface was stable and relatively little material was lost from surface occupations during the Oldowan. Fauna accumulated in the deposit as a death-trap assemblage, with only a minor contribution from slope wash around the cave entrance (Pickering, 1999).

Sixty-five percent of the Oldowan material is fresh, and 25% is weathered, showing that the bulk of the material entered the cave without lying on the surface for an extended period of time (Kuman, 1998; Field, 1999). The most logical scenario to explain the Oldowan accumulation envisions hominids sheltering under shade trees growing around a narrow cave opening. Debris around the cave entrance entered the cave with rainwater and gravitation. A smaller portion washed in from the surrounding landscape as an additional 10% of the artifacts are abraded. Some fauna from the slope-wash component were probably the result of hominid meals, but there is only one certain cut-marked bone and the bulk of the fauna seems not to be associated with hominid activities (Pickering 1999).

The top of the Oldowan Infill has been exposed to the surface by erosion of the cave roof. However, at the base of this infill lies a narrow shaft 12 m long which opens into the roof of an underlying cavern termed the Name Chamber. Beneath the shaft lies an enormous talus, which Clarke (1994a) suggests is likely to contain, within its heart, a collapsed breccia from an infill that preceded the Oldowan deposit. There are numerous artifacts and fauna in the outer, uncemented portion of this talus, which we have sampled. Thus far, the stone tools most resemble the Oldowan from the site, and both artifacts and fauna are currently under study. The size distribution of the artifacts will determine if the breccia sampled from this talus contains an earlier component of the Oldowan Infill, or alternatively, Oldowan material that has filtered down to a lower level through the narrow shaft.

Swartkrans?

It is uncertain whether any artifacts from Swartkrans may be old enough to belong to the Oldowan. Member 1 has a broad faunal age published as *c.* 1.7 or 1.8 Mya (Brain et al., 1988; Brain, 1993)—dates that encompass both Oldowan and Developed Oldowan sites elsewhere in Africa. While Clark (1993) suggested that the assemblage could be Oldowan, the material is undiagnostic and his reasons were tenuous. The Lower Bank of Member 1 has 277 artifacts and 21 manuports (Field, 1999), which found their way into the cave in a sporadic manner through slope wash and gravitation from the surface. The incomplete capture of debris from surface occupations seems related to the fact that the cave opening was located on the side of the hill. Fifty-five percent of the assemblage is weathered, showing that the majority of material was exposed on the surface for long periods of time (Field, 1999). Interestingly though, artifacts in a range of sizes entered the cave, with 36% being small flaking debris under 20mm size. This may indicate that the immediate area was well vegetated enough to preserve some smaller material. There are some water dependent species in Swartkrans Member 1 that suggest the presence of a river or stream near the cave supporting riparian woodland and reed beds (Watson, 1993; Reed, 1997).

The associated hominids in Member 1 are *Paranthropus* and *Homo* sp., with *Homo ergaster* found thus far only in a younger section of Member 1 (the Hanging Remnant; Brain, 1981, 1993; Clarke 1994b). No *Homo* fossils diagnostic to species have yet been found in the Lower Bank of Member 1. *H. ergaster* dates from 1.78 until 1.49 Mya (Schwartz and Tattersall, 2003), a period which spans both the Oldowan and early Acheulean. The earliest dates for assemblages more complex than the Oldowan are 1.6 Mya at Koobi Fora for the Developed Oldowan (Isaac, 1997) and *c.* 1.65 for the early Acheulean in western Kenya (Roche and Kibunjia, 1996), both of which industries are widely considered today to belong to the same industrial complex. Hence we cannot resolve the affinity of the Swartkrans assemblage through chronological comparisons. At Sterkfontein, *H. ergaster* is associated with early Acheulean deposits (Kuman and Clarke, 2000). We hope that renewed work on both the Lower Bank and the Hanging Remnant of Member 1 begun in 2005 may produce better information on the archaeology, as fauna is not a sensitive enough time indicator. If a larger sample produced bifaces, larger flake sizes and an abundance of manuports, this would indicate a post-Oldowan industry. Without such elements, only better dates for Member 1 could support an Oldowan designation, as this is a simple core and flake industry lacking the kind of diagnostics that appear after 1.7 Mya. Thus far, only the Lower Bank has produced artefacts, while the important Hanging Remnant section of Member 1 has not.

Early Acheulean

Slightly younger artifacts are more widespread, occurring in at least three sites. These assemblages have been designated Early Acheulean (Kuman, 1998; Field, 1999), but they would also fit the definition of the Developed Oldowan used by some researchers because bifaces are rare. Only a few bifaces occur in good context (at Sterkfontein), but there are almost two dozen additional specimens from poorer contexts. In East Africa, years of research at Koobi Fora have demonstrated the validity of a Developed Oldowan lacking bifaces in the Karari Industry, which has its own distinctive character (Isaac and Harris, 1997). The Gauteng industry, on the other hand, includes bifaces, but they are rare or absent at individual sites presumably because of small sample size or activity differences. This paper thus considers the Developed Oldowan and Early Acheulean as industries within the early Acheulean complex of sites. I support the view that even a single biface justifies calling an assemblage Acheulean. Sites may be termed Developed Oldowan for descriptive or diagnostic purposes, but the possible causes for such differences and their significance are a point for discussion.

Sterkfontein

The largest assemblage is found at Sterkfontein in Member 5 West with 701 pieces (493 artifacts and 208 manuports). Vrba (1982) considers that one *Antidorcas recki* specimen compares well with Olduvai Lower Bed II specimens (1.7 Mya), and she states that the Sterkfontein bovids may either be similar in age to Swartkrans Member 1 or perhaps marginally younger. There are two bifaces—one cleaver and one handaxe—and the assemblage is heavily winnowed: only 4% of artifacts are under 20mm size. In contrast with the largely fresh Oldowan assemblage from Member 5 East at Sterkfontein, only 32% of artifacts are fresh, showing that occupation debris underwent long-term exposure, with erosion winnowing the site of most of the lighter material. The land surface by this time may have been more sloped, or the position of the cave entrance may have changed, resulting in a less stable catchment surface. Fauna and carbon isotopes both confirm that the environment was open savannah at this time (Vrba, 1975; Reed, 1997; Luyt and Lee-Thorp, 2003), and a drier habitat may have at times enhanced erosion on the Sterkfontein hill. A taphonomic study by Pickering (1999) shows that the fauna was accumulated by carnivores, and there are no cut-marked bones to indicate any obvious hominid involvement.

These Acheulean artifacts are in a secure context because the bulk of the Member 5 West breccia that we have excavated is well-cemented and undisturbed by decalcification. However, there are numerous artifacts excavated from adjacent breccias to the east and south of this area, and many of these may also be the work of Acheulean hominids. However, the site has been disturbed in places by solution pockets, and this could cause some mixing with younger material (Kuman and Clarke, 2000). Therefore only the Member 5 West assemblage with diagnostic artifacts and visible stratigraphy in calcified breccia has been used for the Early Acheulean description. From other locations in the site, there are in fact two additional cleavers and eight handaxes, most of which appear to be Early Acheulean. On its eastern side, the Member 5 West breccia is also truncated by a large solution channel that separates it from other Acheulean material in Member 5 East. An infill with some limited Middle Stone Age material subsequently filled the void and almost certainly connects with an underground deposit within the adjacent Lincoln Cave (Reynolds et al., 2003). An interesting feature of this latter deposit is that some ESA artifacts and two hominid teeth from Member

5 have been incorporated through erosion of older breccia (Reynolds et al., 2003). Such mixing of deposits can be visible if blocks of older breccia become incorporated in a younger infill, which Robinson (1962) noted in his excavation of western breccia. In the case of this younger infill, however, mixing cannot be detected in this manner, and the artifacts and hominid fossils tend to be much better indicators of mixing than the stratigraphy or the fauna.

In 2004, we discovered a new dump with over 100 Acheulean artifacts, several metres south of Member 5 West. It is undoubtedly one of the limeminers' dumps that went unnoticed because it was heavily obscured with vegetation. Although bifaces are absent, the artifacts appear to derive from decalcified areas of Member 5 West cleared by limeminers in search travertine. Such 'erosion channels' in solid breccia were noted by Robinson (1962) in his early work on the western breccia. The assemblage is highly consistent with the early Acheulean in Member 5 West in its typology, technology, and biased size profile, and it lacks mixing with younger tools that affects eastern portions of the site. This find has significantly enlarged the early Acheulean collection at Sterkfontein. The complicated nature of the Sterkfontein stratigraphy, with its mix of cemented and decalcified breccias, is a good illustration of how cautiously cave infill assemblages need to be approached by the analyst. In such contexts, artifacts generally prove to be more sensitive time-indicators than fauna. They can also alert one to mixing or complications in stratigraphy that may not be obvious in the sediments.

Swartkrans

Field's (1999) comprehensive study of the Swartkrans artefacts suggests that Member 1 could possibly belong to the Acheulean (see above for details), but Members 2 and 3 are not in question despite the absence of *in situ* bifaces (see also Clark, 1993). This view is supported by four bifaces processed from limeminers' dumps by Brain, which Leakey (1970) described. One cleaver and one handaxe had enough adhering breccia to allow Brain (1981) to assign them to Member 2. Member 2 is estimated by fauna at *c.* 1.5 Mya and has *H. ergaster* and *Paranthropus* fossils (Brain et al., 1988; Brain, 1993). Sixty-eight percent of the artifacts are weathered, reflecting a long period of surface accumulation before deposition in the cave (Field, 1999). Member 3, containing only *Paranthropus* fossils, is estimated at 1.0 Mya (Brain, 1993), although the carnivores suggest it could be as old as 1.5 Mya (Turner, 1997). Fifty-one percent of these artifacts are also weathered (Field, 1999). Both of these infills show a wider range of flake sizes than the early Acheulean deposit at Sterkfontein, but small flaking debris <20 mm is still under-represented (16% in M2 and 26% in M3). As with Member 1, the capture of material in the catchment area of the shafts was sporadic and incomplete, with the most weathered assemblage showing the poorest capture of small flaking debris. Overall, however, the local cave environment at Swartkrans appears to have been more vegetated than at Sterkfontein during the early Acheulean because water-dependent species are present in the faunas, but none is found in Sterkfontein Member 5 West.

Swartkrans is thus far the only early site where hominids have accumulated a significant portion of the fauna. A high frequency of cut and percussion marks on upper and intermediate limb bone shafts indicates that by 1 Mya hominids in the valley had early access to hunted or scavenged meat (Pickering et al., 2004), and such marks are also now being quantified for Members 2 and 1 (Pickering, pers. comm.). Further evidence of hominid influence in the faunal assemblage at Swartkrans has been suggested for Member 3, where large numbers of burnt bones have been heated to temperatures that suggest hominids had controlled the use of fire (Brain and Sillen, 1988; Brain, 1993). The counter-argument is that bone may have been heated to very high temperatures within the cave entrance or shaft if accumulations of vegetation and wood were ignited by natural fires, continuing to burn for longer periods than in open bushfires. If, however, the hominids were the responsible party, their fires were probably tended on the surface, with burnt bone washing into the cave in a manner similar to the artifacts. Had hominids tended fires within the cave or its entrance area, it is likely that they would have also flaked stone in these spots, and their lithics would then show less weathering and more complete size profiles. Although the controlled use of fire has been proposed in East Africa *c.* 1.5 Mya (Bellomo, 1994), perhaps the earliest date for less controversial evidence comes from the Acheulean site of Gesher Benot Ya'akov in Israel, nearly 790,000 years old (Goren-Inbar et al., 2004).

Kromdraai

Kromdraai A (KA) is a third early site with a small but significant collection of lithics. One hundred artifacts and manuports have been published (Kuman et al., 1997, Field, 1999), and some additional artifacts have been excavated in recent years by Thackeray (pers. comm.). The KA assemblage lacks bifaces but has some larger flakes more common in Developed Oldowan / Early Acheulean infills in the valley. Although the age of KA has only broadly been estimated at 2-1.0 Mya (Thackeray, pers. comm.), the artifacts are very similar to those excavated from Swartkrans and Sterkfontein Member 5 West, which suggests they date somewhere between 1.7 and 1 Mya. Like Swartkrans, the KA artifacts show a range of sizes reflecting a sporadic and incomplete capture of surface material.

Rietputs Formation, Vaal basin

In 2006, the first absolute dates for alluvial deposits in the Vaal River basin, in the interior of the country, were achieved through cosmogenic burial dating for the Rietputs Formation (not far from Pniel and Canteen Kopje, Fig 2). Alluvial deposits with Acheulean artifacts consist of coarse gravel and sand, exposed in active diamond mining pits at depths up to 16 m. Ratios of $^{26}Al/^{9}Be$ were measured using accelerator mass spectrometry in quartz grains collected from the pits (Gibbon, Granger, Kuman and Partridge, in submission). Although dating results will be finalized during 2007, it is already clear that the Rietputs Formation contains artifacts of early Acheulean age (1.3 to 1.7 Mya, R. Gibbon, pers. comm.). Artifacts are made mainly on lavas and occasionally on finer grained material such as hornfels, in contrast with quartz, quartzite and chert used in the Gauteng early sites. These early Acheulean artifacts now expand the distribution of the industry beyond the early hominid sites and provide new technological information of considerable value.

New Assemblages Not Yet Assigned to Industry

Coopers

Several hundred metres west of Kromdraai A is Coopers, a site with a similar lithic pattern to KA. Two areas of this site have yielded fauna and *Paranthropus* fossils: Coopers B (Steininger and Berger, 2001) and Coopers D (Berger et al., 2003). Since excavations began at Coopers D in 2001, it has also produced over 50 artifacts similar to others in the valley (Hall, 2004). Bifaces are currently absent but the tools are associated with a large faunal assemblage estimated at *c.* 1.6-1.9 m.y. (Berger et al., 2003). The site is located between Kromdraai and Sterkfontein, and hominids had access to the same Blaaubank River gravels for their raw materials.

Goldsmith's

Discovered in 2003, Goldsmith's is situated about 4 km southwest of Sterkfontein. R.J. Clarke and W. Mokokwe have processed faunal samples from breccia dumps prior to excavating undisturbed deposits, and a dozen stone tools have been recovered from these dumps (Mokokwe, 2005). Ten are similar to the 2-1 Mya old material from the other sites in the valley, while one flake and one core are MSA-like (pers. observation). The artifacts were found in loose earth within the dump and not in blocks of breccia. However, the fauna is also contained in both loose earth and breccia blocks within the dump, and we found no surface artifacts in a survey of the area. The ESA artifacts are thus most likely to derive from decalcified breccia, while the MSA pieces could come from a second decalcified breccia or from overburden. Generally speaking, ESA types found in surface or hillwash deposits are very rare in the Sterkfontein valley, and those found in dumps usually derive from decalcified site breccias. At present, the significance of these ten ESA artifacts is that they are found in the Blaaubank valley, in the vicinity of gravels and close to the more prolific artifact-bearing sites.

Drimolen and Gladysvale

Only four early artifacts have thus far been excavated from sites outside of the Blaaubank River valley. Drimolen, which has been worked for over 10 years, lies 7 km from Sterkfontein. It has produced many fossils of *Paranthropus*, plus a small number of *Homo* specimens from deposits estimated at *c.* 1.5 to 1.8 Mya (Keyser, 2000; Keyser et al., 2000). It has to date yielded only three stone tools (one core and two flakes). Drimolen is not situated near a good source of raw materials. The same is true of Gladysvale, 10 km from Sterkfontein, where one handaxe was excavated from a deposit considered to be >780,000 years (Lacruz et al., 2002; Hall et al. 2006). Although there are quartzite boulders in the vicinity of Gladysvale (Hall et. al, 2006), gravels are absent. In the Sterkfontein valley assemblages, some artifacts were made on rocks obtained from the landscape around the caves, but there was a distinct preference for river cobbles in assemblages from 2 to 1 Mya. The Drimolen and Gladysvale finds are significant in showing that hominids transported stone tools some considerable distances around the landscape. Due to the rather different nature of the faunal accumulations in the early Gauteng sites, they currently lack the pattern of cutmarked bone occurring in the absence of stone tools which is noted from even the earliest East African sites. However, these rare finds of artifacts at distance from good raw material sources attest to the planning and transport abilities of the early southern tool-making hominids—a pattern which has been well demonstrated in East African contexts.

Discussion

As excavations of sites like Drimolen and Gladysvale continue, we may anticipate additional artefacts, but the proximity of most early African sites to raw material sources (see Plummer, 2005) suggests that such finds will be small in number. It is striking that the sizeable Gauteng ESA collections lie within easy reach of a major source of cobbles in the Blaaubank River terrace. Boulders do occasionally occur in the Blaaubank gravels and may have been used to make the rare large flake or biface blank in the Early Acheulean, but river cobbles are dominant in all of the early assemblages (Field, 1999, Kuman, 2003).

Prior to the discovery of the Rietputs Formation early Acheulean, only one area outside of the dolomitic caves region has thus far been published as producing Early Acheulean artifacts. Mason (1962) excavated two series of artifacts from open alluvial sites at Three Rivers and Klipplaatdrif in southern Gauteng Province. Handaxes and cleavers are present, and the technology is indeed comparable to the artifacts at Sterkfontein. However, the material is excavated from river gravels and there is no associated fauna to support the age of the industry. Hence the assignment of the collection to the Early Acheulean is based only on technological grounds. The new dates for alluvial sediments of the Rietputs Formation is thus valuable new evidence that early Acheulean occupation occurred elsewhere in the country in a differing geologic context.

It is significant that the Sterkfontein assemblages are so large relative to the other Gauteng sites. Even compared with Swartkrans as the second largest collection, the Sterkfontein collection is many times larger. If all of the ESA and (unpublished) MSA artifacts from Swartkrans are tallied, there are close to 2,000 pieces. Sterkfontein, on the other hand, has about 9,000 ESA and MSA artifacts (Kuman, 1996). This figure includes over 4,000 pieces in good context and thousands more in disturbed or more complex stratigraphic situations that have not been published in detail. This fact remains, even though the three major sites all lie close to the same raw material source. The Blaaubank River terraces have been mapped by Partridge, who has found that gravel deposits lie within 300 m of each of the three major sites, Sterkfontein, Swartkrans and Kromdraai (T.C. Partridge, pers. comm.). The area under discussion is only about 4.5 km long, with sites situated on both sides of the Blaaubank River. Hence the extent of the accumulation at Sterkfontein suggests that the site had some physical properties that made it a favored location for hominid activities over long stretches of time. These features could have been good shade trees, low outcrops of dolomite that provided some shelter, dry ground with a good outlook, a setting safe from carnivores, or possibly some com-

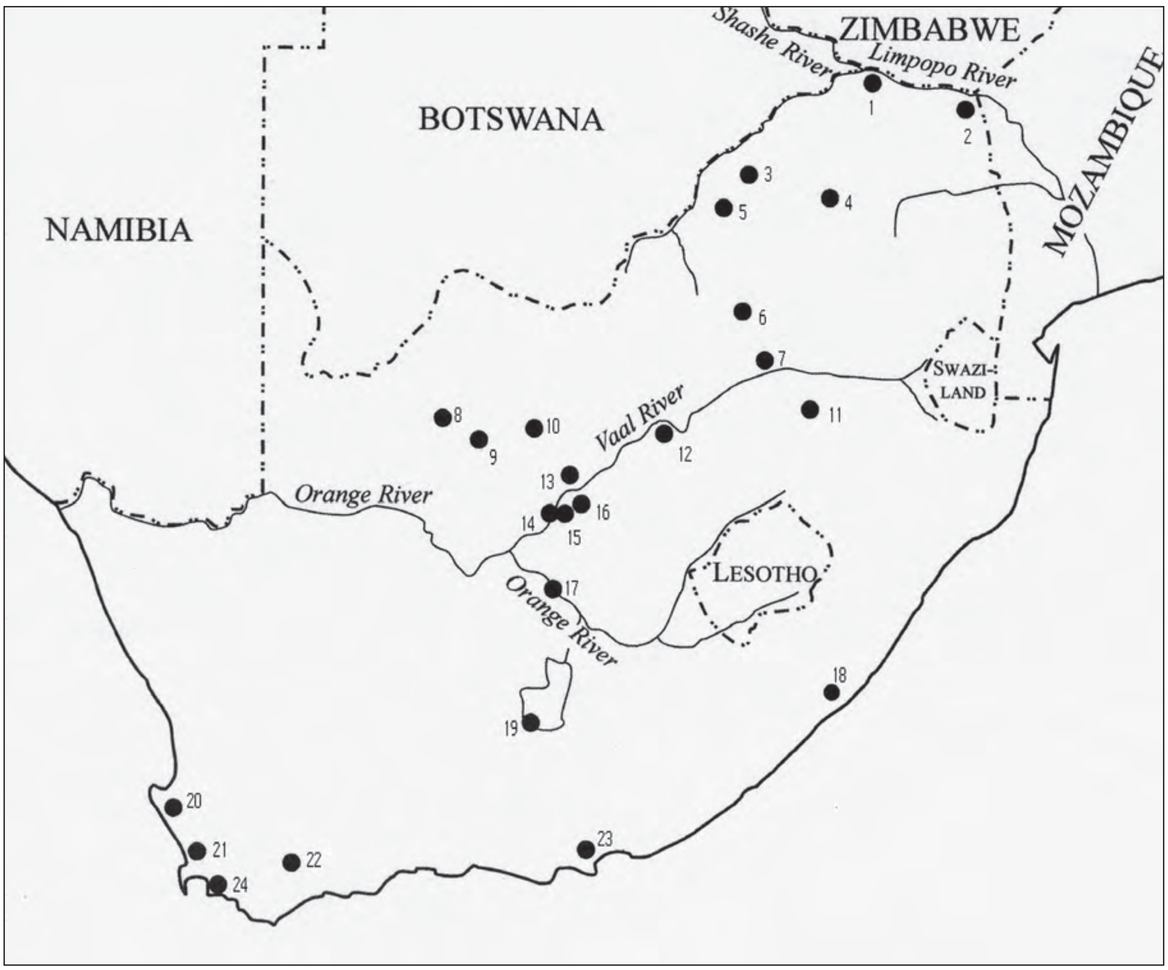

Figure 2. Approximate location of selected ESA sites mentioned in the text:

1. Kudu Koppie, Hackthorne, Keratic Koppie
2. Northern Kruger Park
3. Olieboomport Shelter
4. Cave of Hearths
5. Blaaubank River
6. Sterkfontein, Swartkrans, Kromdraai
7. Three Rivers, Klipplaatdrif
8. Kathu Pan
9. Wonderwerk Cave
10. Taung DB3
11. Cornelia
12. Munro
13. Pniel, Canteen Koppie
14. Muirton
15. Rooidam
16. Doornlagte
17. Orange River Scheme
18. Port Edward, Pondoland
19. Seacow Valley Survey
20. Elandsfontein
21. Duinefontein
22. Montagu Cave
23. Amanzi Springs
24. Cape Hangklip

Table 2. *Earlier Stone Age sites of South Africa less than 1.0 Mya. The chronological placement of the sites is based on published statements (see references within text). In some cases, the literature may suggest a middle, later or late sub-stage within the Acheulean or ESA. Given the paucity of absolute dates and systematic comparative studies, however, these designations should be read as interpretations subject to revision.*

Site Name	Broad Chronology in Mya	Sedimentary Context	Basis for Age Estimate
Cornelia	1.0–0.7	resorted hillside rubble and valley gravel deposits	fauna
Elandsfontein	1.0.–0.6	thin palimpsests in dune sands formed on land surface near waterhole	fauna possibly from two periods and later Acheulean bifaces
Powers Site	1.0–>0.2	disturbed alluvial sediments from different contexts	fauna mostly from Gravel C; Fauresmith artifacts from surface of Gravel C
Doornlaagte	middle Acheulean	pan margin sands: a lag of multiple occupations	artifacts
Kathu Pan	<ca1.0/later Acheulean	pan margin: silty to gravelly sands with spring vents	fauna
Cape Hangklip	later Acheulean	palimpsest exposed on raised beach	artifacts
Canteen Kopje: Stratum 1	final Acheulean?	Hutton Sands with palaeosols	artifacts (Fauresmith & MSA, unpublished)
Stratum 2a (top 30-40cm)	final Acheulean	predominantly colluvial gravel	artifacts (Fauresmith)
Stratum 2a (below 30-40cm)	Acheulean	predominantly colluvial gravel	artifacts (Victorial West and sporadic Levallois)
Stratum 2b Upper Unit	Acheulean	colluvial sandy gravel	artifacts (sporadic Levallois)
Stratum 2b Lower Unit	Acheulean	predominantly colluvial gravel	unpublished
Pniel 6, Stratum 4	Acheulean	colluvial rubble deposits	artifacts comparable with Pniel I with early Pleistocene fauna
Northcliff (Acacia Road)	Acheulean	hillslope rubble with artifacts in two conditions	artifacts
Northern Kruger Park	predominantly middle Acheulean	extensive landscape with alluvial and colluvial deposits (secondary contexts)	artifacts (some prepared core technology)
Haaskraal Pan	later Acheulean	pan floor and adjacent valley slope deposit within a 360,000 yr sequence	artifacts
Amanzi Springs	Acheulean	disturbed spring mound	artifacts
Montagu Cave	later Acheulean	cave strata	artifacts
Cave of Hearths Beds I–III	>0.4/later Acheulean	cave breccias	artifacts; fauna; ESR
Wonderwerk Cave: Major Unit 3	ca 0.276–0.286 Late Fauresmith	cave sediments	Uranium Series
Major Unit 4	>0.350, Middle Fauresmith	cave sediments	inferred age
Major Units 7–8	>0.780, Acheulean	cave sediments	palaeomagnetism

Table 2. (continued)

Site Name	Broad Chronology in Mya	Sedimentary Context	Basis for Age Estimate
Taung DB3	Acheulean	factory site on quartzite outcrop, only partially buried	Victoria West artifacts
Olieboompoort Shelter	Acheulean	rockshelter: palimpsest in basal rubble	artifacts
Wonderboom	later Acheulean	colluvial hill rubble	artifacts
Munro	later Acheulean	gravel and overlying calcretised colluvial and alluvial deposit	artifacts
Other Vaal Younger Gravels and Riverton Formation Sites	Acheulean	alluvial deposits	some faunal collections
Rooidam	>0.2/late Acheulean	deep pan sediments	Uranium Series minimum of 0.174 for higher stratum; Fauresmith artifacts
Duinefontein 2: Horison 3 Horison 2	0.290/late Acheulean 0.270/late Acheulean	accumulations on two land surfaces near a marsh or large pond and now encased in dune sands	OSL dates on encasing sands, confirmed by fauna, artifacts and capping U Series date
Muirton	late Acheulean	in calcified silty sand overlying Vaal Younger Gravels with Acheulean	artifacts
Nooitgedacht 2	late Acheulean	base of Hutton Sands and in underlying gravel	Fauresmith artifacts
Roseberry Plain 1	late Acheulean	base of Hutton Sands and on underlying bedrock	Fauresmith artifacts
Orange River Scheme	Acheulean late Acheulean	3 surface sites 1 site in thin gravel deposit	artifacts Fauresmith artifacts
Seacow Valley Survey	later and final Acheulean	quarry and surface sites in floodplain basin	artefact typology: Seven Acheulean and many Fauresmith assemblages
Nakop	Acheulean	surface exposure in gravel overlying aeolian sand	Victoria West artifacts
Blaaubank River	later ESA	surface of outwashed gravel	‘Earlier Sangoan’ and later Acheulean artifacts
Geelhoutboom	Acheulean	deflated coastal dune plain	artifacts
Kudu Koppie	final ESA	deflated lag deposit on sandstone, overlain by MSA palimpsest in koppie rubble, overlain by late Pleistocene sandcover with LSA	Sangoan-like artifacts stratified under MSA
Hackthorne	final ESA	deflated lag deposit on calcretised Miocene terrace beneath late Pleistocene sandcover	Sangoan-like artifacts, mixed with MSA?
Keratic Koppie	final ESA	deflated lag deposit on sandstone beneath late Pleistocene sandcover	Sangoan-like artifacts, mixed with MSA?
Port Edward and Pondoland	final ESA	surface exposures in deflated coastal dune deposits	Sangoan artifacts

bination of these factors (Kuman, 1994b). Significant numbers of manuports are found at the three main sites (Field, 1999), which shows that repeated visits occurred at some venues in the valley.

The presence of larger artifact collections at the three main sites is not merely a product of the intensity of excavations. The richest site, Sterkfontein, also has an abundance of artifacts in the overburden above intact breccia. This is a feature that is not so prominent at other sites and must result from certain favourable physical properties. The sporadic finds of artifacts at sites like Drimolen and Gladysvale, or the alluvial sites in southern Gauteng and the Vaal basin, attest to the fact that tool-using early hominids were more widely distributed than the best sites would indicate. Early artifacts in secondary context are also present elsewhere in southern Africa in Angola, the Democratic Republic of the Congo, and possibly Botswana (see Kuman, 1998 for references). Thus the best southern evidence for cultural behaviour *c.* 2 to 1 m.y. ago is found mainly at sites in special geographic settings near good sources of river cobbles. With the exception of Swartkrans, the lack of direct associations between early Pleistocene faunas and hominid activities also shows the limitations of the South African record. Nevertheless, it is a valuable early record because it complements the East African sites and shows that the distribution of early industries was quite widespread on the African continent. The increase in the numbers of manuports at Sterkfontein and other sites after 1.7 Mya also parallels the East African evidence (Potts, 1991; Schick, 1987b), reflecting the more habitual use of stone by hominids (probably *H. ergaster*) following the Oldowan period.

Middle, Later and Late ESA Sites

Chronology

After 1 Mya, ESA sites and surface occurrences become more numerous (Sampson, 1974). Table 2 provides a list of published sites. The list is not exhaustive as some published surface and gravel collections are not detailed, but it illustrates the variety of contexts in which South African ESA material is preserved. Unfortunately, datable volcanic sediments do not occur in South Africa, and only three sites have published radiometric ages based on other methods (**Wonderwerk Cave**, **Rooidam**, and **Duinefontein**. All are at the younger end of the ESA chronology, and for two of these sites, the dates provide only minimum ages. Fauna is preserved at only some of the sites. Although many of the associations are not horizon-specific, these fauna are valuable in illustrating the great antiquity of some of the sites.

Artifacts from a few of the sites may possibly be called middle Acheulean on technological or faunal grounds (**Cornelia**, **Canteen Kopje** in part, **Doornlaagte**, and **northern Kruger Park**). Because of the poor dating resolution, however, this distinction is not widely used, and most researchers prefer to lump all of the sites 1 Mya or younger into the 'Upper Acheulean,' in contrast with the 'Lower Acheulean' of the Gauteng cave sites (Volman, 1984; Klein, 2000). In this paper, the 'middle Acheulean' category is kept as potentially useful. As refinements in dating techniques develop, we may hope one day to test the idea of change within these industries over time, as has been suggested for a few sites by Mason (1962). In East Africa, for example, the lengthy sequence at Olduvai Gorge shows that the Acheulean is not totally static in that region. The overall evaluation of the assemblages through time shows that, in contrast with the heavier, thicker, less standardized handaxes of the early Acheulean in Bed II, the middle Acheulean Bed IV handaxes (from ca 1.2 Mya) show more regularity of shapes and improved flatness in section, while cleavers become more frequent and are often more elegantly made (Roe, 1994: 204). In the post-Bed IV or Masek sites (>0.4 but <ca 1.0 Mya), handaxes show even greater standardization of preferred shapes and a high degree of technological competence. Another East African site that should be re-evaluated for the concept of a middle Acheulean is Olorgesailie, where new dates place the majority of the beds between 992,000 and 601,000 years (Deino and Potts, 1990). Prior to the benefit of these older daters, Isaac (1977: 213) classified the site as Upper Acheulean because "reliable chronological distinctions…are not possible." However, he commented that the assemblages are somewhat less refined than those from other sites and that one might be tempted to designate them as middle Acheulean. Like Isaac, Noll (2000) found no trends within the Olorgesailie artefact sequence in his comparison of material from Member 1 (0.99 Mya) and Member 6/7 (0.97-0.75 Mya), relating differences only to intensity of flaking and raw materials Noll (2000). It is widely noted that only in the final phase of the ESA do significant changes in lithic character and regional differences appear (Noll, 2000; Klein, 2000), which Clark (1970, 2001a) attributed to the emergence of more modern humans.

A few of the sites in Table 2 have faunal age estimates that may shed light on such a distinction between the middle and later Acheulean. The highly refined bifaces of **Kathu Pan**, for example, are associated with elephant fossils that are more evolved than the form found in Olduvai Bed IV (Volman, 1984: 184), which translates to an age of <ca 1.0 Mya. Hence Kathu Pan is classed as later Acheulean on both technological and faunal grounds. The **Cave of Hearths** also has refined bifaces and a younger fauna, and has been published as later Acheulean (Mason, 1988a; see also Ogola, 2003; and McNabb et al., 2004). Efforts to date the site with ESR have recently been undertaken by Grun (2003), who announced a preliminary estimate of 0.4 to 0.6 Mya for the hominid mandible in the top Acheulean bed. Grun (pers. comm.) is now working to expand the sample of ESR readings to refine these preliminary results. For **Canteen Kopje**, Mason (1962) had designated an assemblage

from this site as middle Acheulean, but renewed work by Beaumont and McNabb (2000) indicates that a longer sequence is present.

Sites in Table 2 are termed 'Acheulean' if there is insufficient information to suggest a middle, later or late placement. Within the later to late Acheulean, a few authors have noted a trend toward smaller and broader handaxes over time, particularly at **Rooidam** and **Montagu Cave** (Fock, 1968; Keller, 1973), or in comparisons across sites (Mason, 1962). Late or final Acheulean assemblages in the table are designated either by dates that suggest an age of *c.* 0.3–0.2 Mya, or by a refined technology often termed **'Fauresmith'** in the literature. **Rooidam** is perhaps the best example of a Fauresmith site but has only a minimum Uranium Series date (Szabo and Butzer, 1979). The top Acheulean stratum at **Wonderwerk Cave** has been published as containing Fauresmith tools dated by amino acid racemisation at >0.2 Mya (Binneman and Beaumont, 1992). Recently, Beaumont and Vogel (2006) revised the age of the late Fauresmith unit to 0.276-0.286 Mya and also inferred an age of >0.35 Mya for a middle Fauresmith unit. Small numbers of Acheulean artefacts also derive from lower units >0.780 Mya based on palaeomagnetic readings. **Duinefontein 2** currently has the best late Acheulean dating result, but the tool assemblage is rather informal (Cruz-Uribe et al., 2003). Fauresmith assemblages are said to include small, refined handaxes, sometimes associated with points, blades and prepared cores. Based on the occurrence of facetted platforms and convergent flaking, Beaumont (Beaumont and Vogel 2006) assigns Fauresmith assemblages to the MSA, whereas I prefer to refer to them as a final ESA phase due to the persistence of handaxes and cleavers. However, there is clearly much variability in the late ESA, and patterns are more important than nomenclature in this period, which is increasingly understood to be a time of change, in terms of both technology and evolutionary biology. The origins of prepared core technology in southern Africa appear to extend back to the Victoria West industry. Its antiquity is not yet understood as sequences are limited, and detailed descriptions are currently lacking, except at sites that lack stratigraphy (e.g., **Taung DB3**, Kuman, 2001; or **Nakop**, Brain, and Mason, 1955). Although prepared core or Levallois technology becomes more widespread in the later Acheulean, it cannot be assumed that it originated in this phase. The earliest published dates for some form of this technology are *c.* 0.7–0.8 Mya at Gesher Benot Ya'aqov in Israel (Goren-Inbar and Saragusti, 1996; Goren-Inbar et al., 2000), but detailed descriptions are awaited to aid its assessment.

The **Fauresmith** has traditionally been seen as a late or final industry within the Acheulean, which equates with the end of the ESA. However, there is a second final ESA industry thought to be comparable in time to the Fauresmith, namely the **Sangoan** (or Sangoan Industrial Complex). Classic Sangoan assemblages have been described in Zambia and Uganda (Clark, 1970, 2001b), but a variant occurs in Kenya in the Sangoan-Lumpemban Industrial Complex (McBrearty, 1988, 1991). It has also been suggested to occur in Zimbabwe (Cooke, 1966), although here the assemblages are small and require further substantiation. In South Africa, surface finds of Sangoan-like tools occur along the KwaZulu-Natal and Eastern Cape Wild Coast (Davies, 1976). In 2006, we confirmed that some of these deflated surface sites (respectively at **Port Edward** and **Pondoland**) are Sangoan-like, and survey for intact deposits should begin in the near future. Deacon (1970) also suggests that the relatively heavy and unstandardized form of artifacts at **Amanzi Springs** could similarly suggest a late to final ESA placement of this near-coastal site.

In the Transvaal, Mason (1962) excavated a small collection of 'Sangoan' artifacts from a river gravel, but his sample was identified typologically from a mixed collection, and thus its integrity was questioned. Recently, however, the first evidence for the stratified occurrence of a Sangoan-like industry in South Africa has been found in the far north of the country, close to the borders with Botswana and Zimbabwe. This is at **Kudu Koppie**, where a large assemblage occurs in a deflated context, stratified below a palimpsest of MSA artifacts (Kuman et al., 2005). At two nearby sites, similar Sangoan-like material has also been excavated from deflated contexts at **Hackthorne** (Kuman et al., 2004) and **Keratic Koppie** (Kuman et al., 2005). However, these are single-component lag deposits buried by younger sands, and there is a stronger likelihood that mixing with younger (early? MSA) material may have occurred as stratification is absent. At Kudu Koppie, however, the integrity of the stratified occurrences is confirmed by differences in sedimentary matrix and in artefact typology and technology (Pollarolo, 2004; Kempson, 2005; Kuman et al., in prep.) Elsewhere in Africa, Sangoan occurrences are generally thought to date to *ca* 300,000 years (McBrearty and Brooks, 2000). Both the Sangoan and Fauresmith have long been considered to be the first signs of regional specialization at the end of the ESA (Clark, 1959).

Site Contexts

The variety of contexts in which these southern ESA sites are preserved is interesting, and each has implications for the nature of the archaeological data.

Alluvial Sands and Gravels

A majority of sites has deposits formed in alluvial sediments or exposed on alluvial surfaces: **Cornelia**, **Powers**, **Munro**, **Muirton**, **Nooitgedacht 2**, and other **Vaal basin sites** are prominent among them, along with **Nakop**, **Blaaubank River**, the **Orange River basin**, the adjacent **Seacow valley sites**, and extensive alluvial exposures in **Northern Kruger Park** (Clark, 1974; Humphreys, 1969; Mason, 1962, 1967, 1969; Sampson, 1972, 1974, 1985; Helgren, 1978; Butzer, 1984; and previously cited references). The quality of such sites is obviously least good on exposed surfaces or within gravels, the latter representing high energy conditions. Sands can also represent disturbed conditions, but finer sands and silts have better potential for preservation of a greater range of artifact sizes. Cornelia, Powers and some other Vaal basin sites preserve faunal collections, which are highly valuable for their age estimates. Overall, the value of this group of sites is the information it provides on the wide-ranging geographic distribution of Acheulean peoples.

Colluvial Deposits

Colluvial deposits form through slope wash or the gravitation of sediment. Such processes often result in better preservation of assemblages as the associated gravitational and erosional processes can be less destructive than high-energy alluvial forces. During very arid periods, thinner ground covers enhance erosion, especially on hillslopes, and substantial deposits of coarse colluvial rubbles can result. While colluvium is often a component associated with sedimentation processes at alluvial, pan or other sites, colluvial rubble deposits are especially prominent at **Pniel**, **Northcliff**, **Wonderboom**, and in areas of **Northern Kruger Park** (Mason, 1962; Beaumont, 1969; Beaumont, 1990d; Gibbon, 2004). In rare circumstances, a stratified sequence may accumulate. At **Canteen Kopje**, for example, a stratigraphic sequence occurs with four components that appear to span a large part of the Acheulean (Beaumont and McNabb, 2000).

Pans

Sites found in pan settings generally provide good preservational contexts because they form under lower energy depositional conditions and incorporate colluvial pan margin sediments. Many pan sites also tend to preserve long term, time-averaged accumulations because hominids repeatedly visited such venues for water and game. At **Doornlaagte**, preservation is good, with artifacts occurring as a vertically dispersed accumulation that is the lightly winnowed lag of multiple occupations (Mason, 1988b; Deacon, 1988). **Haaskraal Pan** is another deep site that may contain over 360,000 years of deposits (Partridge and Dalbey, 1986). **Rooidam** is a late Acheulean pan site that has deep sediments, preserving a lengthy accumulation of Fauresmith artifacts which shows some change in handaxe breadth over time (Fock, 1968). Finally, **Kathu Pan** preserves three components of later Acheulean artifacts; however, this site is complicated by its association with underground springs that have created dolines or collapsed areas (Beaumont, 1990a). The artifacts are often associated with spring vents in complex sedimentary contexts, but the collections are large and represent a lengthy sequence of refined, later Acheulean material fortunately associated with fauna.

Spring Mound

The only ESA spring mound site in the country is **Amanzi Springs**. Two phases of accumulation preserve large numbers of ESA material in the lower deposits. The context of the artifacts has been disturbed by spring activity, but Amanzi is especially valuable as the only Acheulean site in South Africa to preserve wood and other botanical remains (Deacon, 1970).

Coastal Dune Sites

Four sites are preserved in coastal dune fields. The first two were associated with standing water during moister periods. **Elandsfontein** is a later Acheulean site that formed on a land surface associated with a waterhole, created by large-scale deflation that scoured out sediments to a point at which the water table became exposed (Butzer, 1973; Klein, 1978; Klein and Cruz-Uribe, 1991; Deacon, 1998; Klein et al. 2006). Artifacts occur in thin palimpsests accumulated on an ancient landsurface associated with the waterhole. **Duinefontein 2** is a somewhat younger site in a similar context (J. Deacon, 1976; Klein et al., 1999; Cruz-Uribe et al., 2003). In this case, two ancient land surfaces are preserved as separate horizons associated with a large pond or marsh. Although deflation has played a role in concentrating material on the land surfaces at Elandsfontein and possibly at Duinefontein, these two sites provide extremely valuable records as both preserve fauna and land surface stratigraphy. The OSL and Uranium Series dates for Duinefontein are particularly useful for late ESA chronology. Two further sites occur in poorer contexts. **Cape Hangklip** is a later Acheulean palimpsest of artifacts that appears to have accumulated on an ancient shoreline, with the site now exposed through deflation (Sampson, 1972). **Geelhoutboom** is a lesser known coastal site with artifacts in a series of deflation platforms in coastal dunes (Laidler, 1945; Deacon, 1970). The **Port Edward** and **Pondoland** Sangoan sites thus far surveyed contain artefacts deflated onto red dune sands from overlying deposits that no longer exist. These sands are intermittently exposed along a stretch of coast over 20 km long from Pondoland to Port Edward, and deposits east of Port Edward are likely to be similarly extensive. Weathering has produced the red coloration of the sand, and aeolian activity has resulted in concentrations of heavy minerals. It is on these more resistant, mineral-rich horizons that stone tools have come to rest. We hope that a thorough survey of more inland areas may potentially locate Sangoan sites that are less altered by deflation.

Cave Deposits

Although each site has some limitations, four later Acheulean sites are fortunately preserved in cave deposits. **Montagu Cave** in the Cape has a lengthy sequence of artifacts with extensive factory site debris (Keller, 1973). It is a site rich in artifacts but unfortunately lacks fauna. **Cave of Hearths** is the next richest site and has a sequence of later Acheulean in three beds, with artifacts that have been very well published (Mason, 1962, 1988a; McNabb et al., 2004). It also has fauna, accumulated and modified by a number of agents, including both humans and carnivores (Ogola, 2003). Its limitation is that the deposits consist of cemented cave breccias that complicate the stratigraphy, with some areas having undergone subsidence and collapse. Nevertheless, the Acheulean sequence has been carefully ascribed to the original three beds (Mason, 1988a), and fauna from the most reliable positions have been studied, showing the complex nature of its accumulation processes (Ogola, 2003). **Wonderwerk Cave** is close to the Vaal basin sites and has deep stratified deposits, including Fauresmith (from ca 0.27 to >0.35 Mya) (Beaumont and Vogel 2006). An inferred age of ca 0.5 Mya has been suggested for the lowest Fauresmith levels, but more detailed assemblage descriptions or dating resolution would aid assessment. Underlying Acheulean material said to be >0.78 Mya is present but unfotunately sparse. Fauna is present but limited, with some deposits disturbed by diggers for bat guano. (Malan and Wells, 1943; Beaumont, 1990b; Binneman and Beaumont, 1992). However, the stratified sequence and dating potential make this site especially important for future excavation, especially as it may assist with understanding the rich regional record of open-air sites in the Vaal basin. Finally, **Olieboompoort Shelter** is a rock-shelter with a small sample of Acheulean artifacts noted to occur in a basal rubble deposit (Mason, 1962). There are some indications for the controlled use of fire at Cave of Hearths, Montagu Cave, and Wonderwerk Cave.

Aeolian Sands and Underlying Deposits (Vaal Basin)

Two late Acheulean sites in the Vaal basin are **Nooitgedacht 2** and **Roseberry Plain 1**, both of which contain Fauresmith artifacts in the lowest levels of an aeolian sand cover known as Hutton Sands (Beaumont, 1990c). At Nooitgedacht the artifacts continue down into an underlying gravel, but at Roseberry Plain they continue downwards to lie on bedrock. These sites have not been published in detail and are thus more difficult to discuss, but they are apparently just two examples of widespread occurrences around Kimberley that are "discontinuously mantled by up to *c.* 3m depth of Hutton sands, in the lowest levels of which occur a normally low density of Fauresmith artifacts" (Beaumont, 1990c; van Riet Lowe, 1927). The nature of the underlying deposits in which the artifacts from these two sites continue requires further clarification. **Taung DB3** is a third site preserved in a related circumstance (Kuman, 2001). It is a factory site located on a quartzite outcrop, only partially buried in a thin veneer of aeolian sediment weathered from the parent rock on which the site is located. The site is located on a high escarpment in the upper Vaal basin, and its interest lies in the presence of Victoria West technology in a factory context.

Aeolian Sands and Underlying Lag Deposits (Limpopo basin)

The lag deposits at **Kudu Koppie** were originally accumulated as colluvium and rock rubble associated with an adjacent outcrop of sandstone that provided shade and shelter for hominid occupations during more mesic regional climatic conditions. These occupations were followed by ensuing phases of large-scale, intense deflation episodes during xeric periods that transformed the original sediments into lag deposits (Pollarolo, 2004; Kuman et al., 2005; Kempson, 2005). The basal unit is a closely packed deflated lag deposit with a weathered, small particle size matrix (Kuman et al., in prep). Above this is a thick unit of deflated koppie rubble, less weathered and with a larger particle size matrix. A thick sand unit of predominantly late Pleistocene age directly overlies the MSA rubble. It contains LSA with pottery in the upper levels, and sparse LSA material throughout, which has filtered down through the unconsolidated sand. Two other deflated sites occur within 1-2 km of Kudu Koppie. **Hackthorne** is an unstratified site at which Sangoan-like artifacts have been deflated onto a calcretised Miocene river terrace, with pockets of artifact-bearing sediments also contained in numerous solution cavities within the calcrete (Kuman et al., 2004). **Keratic Koppie** is a similar deflated site, but in this case the artifacts lie within a deflated basal horison on sandstone bedrock (Le Baron, 2004; Kuman et al., 2005). At both of these single component sites, late ESA artefact types occur. To determine the degree of mixing, Kempson (2007) has compared these two assemblages with the stratified sequence at Kudu Koppie, where there are clear differences between the ESA and MSA assemblages. Like Kudu Koppie, Hackthorne and Keratic Koppie are buried under aeolian sand. OSL dating at all three sites has produced age estimates of *c.* 15–23,000 years for this regional sandcover (Kuman et al. in prep.).

Conclusion

For many years, the earliest phases of the ESA have been best known from the dolomitic limestone caves of Gauteng, in deposits *c.* 2-1 Mya. If Oldowan hominids initially favored the semi-tropical sheltered valleys in which these early hominid sites are found (Bamford, 1999), by early Acheulean times they had certainly become more visible in southern Africa (Kuman, 1998). Absolute dating of the Rietputs Formation deposits (1.7 to 1.3 Mya, Vaal River basin) is now set to provide a new suite of sites, significantly expanding the geological context in which such early material is found. The prominence of erosion is undoubtedly responsible for our limited record of earliest ESA sites, and the restricted preservation of fauna and limited dating methods have been responsible for our difficulty in recognizing the true antiquity of some alluvial occurrences.

ESA sites in a variety of contexts fill the gap between these earliest sites and the early MSA, which appears about 260,000 years ago in South Africa (Grun et al., 1996; McBrearty and Brooks, 2000). South African landscapes are dominated by erosion and planation (Deacon, 1975; Klein, 2000), which is evidenced in the widespread distribution of surface finds in poor context. Assemblages in river gravels are common, but those in alluvial and colluvial sediments with lower energy sedimentary processes preserve a better record. Pan sites, which are remnants of older, more extensive drainage systems, provide a few of the best sedimentary contexts. Aeolian activity is prominent in coastal areas and in the drought-prone far north of the country, and despite their extreme conditions, such contexts have preserved a few stratified sites of much significance. Cave occupation sites are generally limited to the later Acheulean, but they preserve a key record, especially in terms of dating potential, stratified sequences, and evidence for the controlled use of fire.

The overwhelming impression one has of the South African ESA is that sites are most visible close to good raw material sources. This is certainly the case for the early Gauteng cave infills, where only small numbers of tools are found at sites lying more than 500 m from good gravels (Kuman, 2003). It is also a clear pattern at all but one of the Acheulean sites—only Elandsfontein has exotic raw materials carried in from 20–30 km distance, while all other sites lie either close to rock sources, or within several km (Klein, 2000). This is also true for the Sangoan-like sites. Miocene gravels of the Limpopo River deposits provided raw materials close to Kudu Koppie, Hackthorne and Keratic Koppie, while beach and stream cobbles were readily available at the Port Edward and Pondoland sites. We cannot know, however, whether this pattern of proximity to raw materials reflects hominid ranging patterns, or merely 'cultural visibility.' The strong association of ESA sites with standing water in one form or another has often been noted, and even linked to the inability of Acheulean hominids to transport water in containers (Deacon, 1975; Deacon and Deacon, 1999; Klein, 2000). However, standing water, raw materials and good sedimentation processes are often physically associated, which suggests that the location of ESA sites may not be the most reliable evidence for cultural conservatism. However, it seems that the artifacts themselves provide strong clues to this conservatism. Detailed studies of biface technology and form indicate that ESA hominids did not impose stylistic differences in their toolkits, whether these are considered regionally within Africa or across the Old World. Differences that 'appear' to be stylistic have been shown to relate only to raw material size and shape (McPherron, 2000). This view has recently been confirmed by McNabb et al. (2004) for the later Acheulean bifaces at Cave of Hearths. They argue that the most important determinant in the shaping of bifaces is not style, but the least-effort approach to the creation of functional cutting edges.

The South African ESA record has its limitations as many sites lack stratigraphy, primary contexts, or good materials for absolute dating. However, it is a rich record, nonetheless, and one which now includes all of the stages of cultural development, from the earliest to the latest industries. The long-term, persevering research by Bob Brain at Swartkrans over three decades has served as a true model for the kind of patient and insightful approach needed to understand site formation and transformation through the ESA. This work should serve as an inspiration to archaeologists, as much as it does to taphonomists.

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