Research Article

HOLOCENE LSA ARCHAEOLOGY FROM EQUUS CAVE, BUXTON-NORLIM LIMEWORKS, SOUTH AFRICA: AN ANALYSIS OF THE BONE TOOL ASSEMBLAGE

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ABSTRACT

Equus Cave, Buxton-Norlim Limeworks, near Taung, North West Province, South Africa, was first excavated between 1978 and 1982. While the site dates to the terminal Pleistocene and Holocene the precise age of the different layers is debated, as is the technological assignment of the deepest deposits, which are said to contain both Later or Middle Stone Age elements. While the faunal assemblage and some of the human remains have been published, the archaeology has never been fully analysed or reported. New excavations in 2012 revealed numerous artefacts including ochre, something not previously noted for this site. Comparison of total lithic artefact counts versus *faunal NISPs and MNIs shows that the height of human occupation occurred during the Holocene, with preliminary analysis of the >6000 lithic assemblage indicating a dominance of notched artefacts, which, coupled with the presence of 16 bone points, is characteristic of other Holocene Wilton (Later Stone Age) sites in the region. The focus of this paper is the 16 bone points, which include projectile points and link-shafts, and how these items were manufactured and used. The results provide one of the first detailed descriptions of Later Stone Age bone tools, including rare specimens that are mostly complete or still preserve the tips, making an important contribution to our limited understanding of Later Stone Age bone tool technology.*

Keywords: Later Stone Age, bone points, surface modification, Ghaap Plateau escarpment, Taung, Wilton.

INTRODUCTION

Equus Cave (27°37′S, 24°37′E) is located within the former Buxton-Norlim Limeworks, near the town of Taung in the North West Province, South Africa, and ~130 km due north of Kimberley (Fig. 1). The Limeworks is best known for the 1924 discovery of the late Pliocene type specimen of *Australopithecus africanus,* the 'Taung child' (Dart 1925; Herries *et al.* 2013; Hopley *et al.* 2013). However, the Limeworks also contains a wealth of other sites (e.g. Black Earth Cave, Equus Cave), covering the last 3 million years. These sites were formed within four distinct tufa flows that are yet to be fully investigated (Peabody 1954; Klein *et al*. 1991; McKee & Tobias 1994; Kuhn *et al.* 2016).

Equus Cave was named by Brain and Butzer based on the presumed association of the site to that of Peabody's (1954) Equus fossil find at locality 38-7 (McKee & Tobias 1994; Fig.1). However, McKee and Tobias (1994) suggest that the Equus find site and locality 38-7 are in fact distinct deposits, despite both being located close to each other within the Oxland Tufa Flow. Shackley and Beaumont undertook the first systematic excavations of Equus Cave in 1978, with an extension by Beaumont in 1982 (Fig. 2; Grine & Klein 1985; Klein *et al.* 1991). While the fauna and some of the human remains have been published (Grine & Klein 1985; Klein *et al.* 1991), other aspects of the archaeology have only been briefly mentioned, and are restricted to comments about there being abundant artefacts in unit 1A; that bone tools are present; and that Middle Stone Age (MSA) style artefacts may occur in the basal layers of the site. The occurrence of MSA artefacts is perhaps inconsistent with ages reported from the site (<34 000 cal BP; Fig. 2), and thus it has been suggested that the artefacts were washed in from possible open-air MSA assemblages near the cave entrance.

Bone points are seemingly ubiquitous within LSA assemblages in South Africa. However, their preservation is dependent on the specific taphonomic conditions of individual sites. Diagenetic processes are especially relevant to the preservation of bone, and particularly surface modification of bone artefacts, which is commonly utilised to infer behaviours. Bone points in LSA assemblages are often fragmented and highly damaged, with shaft fragments dominating assemblages (e.g. Plug 1982; Deacon 1984; Wadley 1987a, 2000a,b; Bradfield 2012). This situation has led to difficulty in assessing the technology. Owing to this fragmentary nature, our understanding of LSA technologies is biased to the better-preserved stone tool record.

Hunting weapons and domestic implements, such as bow and arrow technology, matting needles and awls, are composed primarily of organic elements. Both ethnographic and historical records show that significant components of hunter-gatherer toolkits were produced with organic materials, bone and wood being dominant (Wiessner 1983). Not only does the omission of bone tool analysis skew understanding of hunting and domestic behaviours, but these elements can also transmit information about personal and social identity, and can provide information about social organisation from stylistic comparison (Wiessner 1983).

Bone points dating to the MSA are first found in South Africa at Border Cave (Henshilwood *et al.* 2001a,b; d'Errico & Henshilwood 2007; Wadley & Jacobs 2006; Backwell *et al.* 2008) and are also part of the earliest LSA assemblage from the site at ~44–42 k cal yr BP (Villa *et al.* 2012). Bone points similar to ethnographic San examples also occur at many sites, for

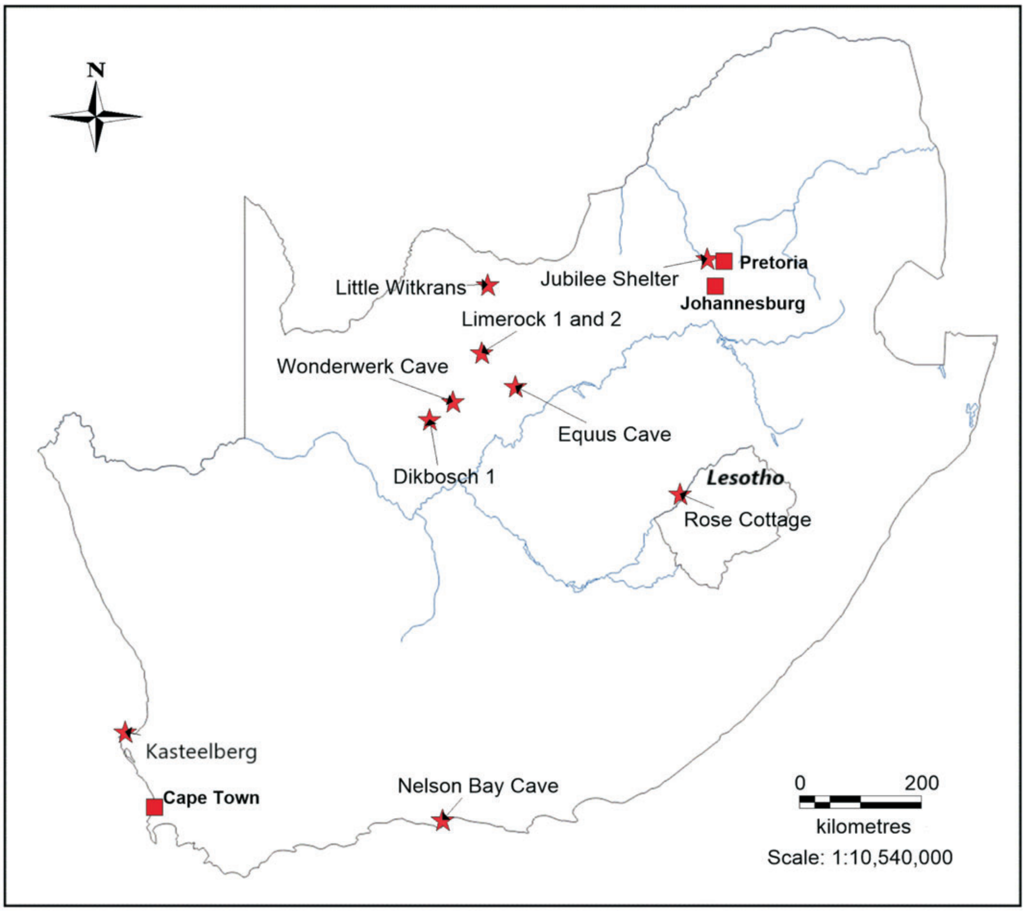

FIG. 1. *Map showing sites mentioned in this study.*

example, Jubilee Shelter, Rose Cottage Cave, Sehonghong (Wadley 1987b, 2000a,b; Mitchell 1995, 1996), Nelson Bay Cave (Klein 1972; Deacon 1984; Inskeep 1987), Kasteelberg (Smith & Poggenpoel 1988) and De Kelders Cave 1 (Schweitzer 1979); as well as Oakhurst Shelter, Bushman's Rock Shelter, and Giant's Castle Rock Shelter (Deacon & Deacon 1999). These sites have a wide distribution, located in the Free State, Mpumalanga, KwaZulu-Natal, and North West Provinces, and in Lesotho. Specifically within the Northern Cape, there are several sites containing LSA bone tool assemblages, dating to the Holocene. These sites include Wonderwerk Cave (Thackeray 1983a), Dikbosch 1 (Humphreys 1983a) Little Witkrans (Thackeray 1983b) Limerock 1 and 2 (Humphreys 1983b), Jakkalsberg L (Orton & Halkett 2010), Bokvasnaak 3 (Orton & Halkett 2010), Vlermuisgat (Orton & Halkett 2010), and Equus Cave (Scott 1987) (Fig. 1). However, few of these assemblages are described beyond noting the occurrence of bone points. This technology, or at least a similar one, exists well into the ethnographic and historical record with bone-tipped arrows being recorded in use as recently as the 1870s in the Northern Cape (Clark 1977).

Owing to the various issues in dating, unpublished data and minimal artefact analysis, a joint multi-disciplinary project between La Trobe University, the University of Johannesburg and the University of the Witwatersrand has started to re-explore the Equus Cave deposits, aiming to clarify the context and dating of the site as well as describe the archaeology. This paper seeks to contextualise the broader archaeological assemblage within Equus Cave to clarify the stratigraphic sequence and provide a basis for inferring how people used the site during the transition from the Pleistocene to the Holocene. However, this paper's primary focus is on investigating how the 16 bone points from Equus Cave were made and used, through use-wear analysis, to shed light on people's bone tool technology at this locality during the Holocene, and to place the bone tool assemblage within the regional context of the Ghaap Plateau escarpment.

ARCHAEOLOGICAL CONTEXT

Equus Cave has yielded a rich faunal and archaeological assemblage spanning the late Pleistocene to Holocene, and including the remains of *Homo sapiens* (Grine & Klein 1985). It has been argued that the faunal remains from units 1B–2B were accumulated primarily by brown hyaena den provisioning (Grine & Klein 1985; Klein *et al.* 1991), whereas Later Stone Age (LSA) people and porcupines were significant contributors to the unit 1A assemblage (Klein 1986).

There are four stratigraphic units currently recognised at Equus Cave, which have a combined thickness of 240 cm (Beaumont & Morris 1990). These are designated, top down, 1A, 1B, 2A, 2B, and vary in depth: 1A up to 50 cm; 1B varies from 30 to 60 cm; 2A from 60 to 70 cm; and 2B from 60 to 80 cm. Unit 1A is a greyish-brown sandy loam lying unconformably on top of unit 1B, and is the main focus of the current study. Units 1B, 2A and 2B comprise a conformable series of reddish-brown sandy loams thought to be aeolian in origin, interspersed with lenses of tufa grit (Klein *et al.* 1991). There is disagreement about whether units 1B, 2A and 2B are distinct stratigraphic units, or a combined layer (Klein *et al.* 1991).

The dating of Equus Cave has been problematic, with 13 radiocarbon dates having been obtained for the site as outlined in Fig. 2 (references for the original ages are provided in Fig. 2 and have been recalibrated; see Methods section). These dating samples consist of a range of materials including charcoal, ostrich eggshell (OES), tooth enamel, and bone (Vogel *et al.*

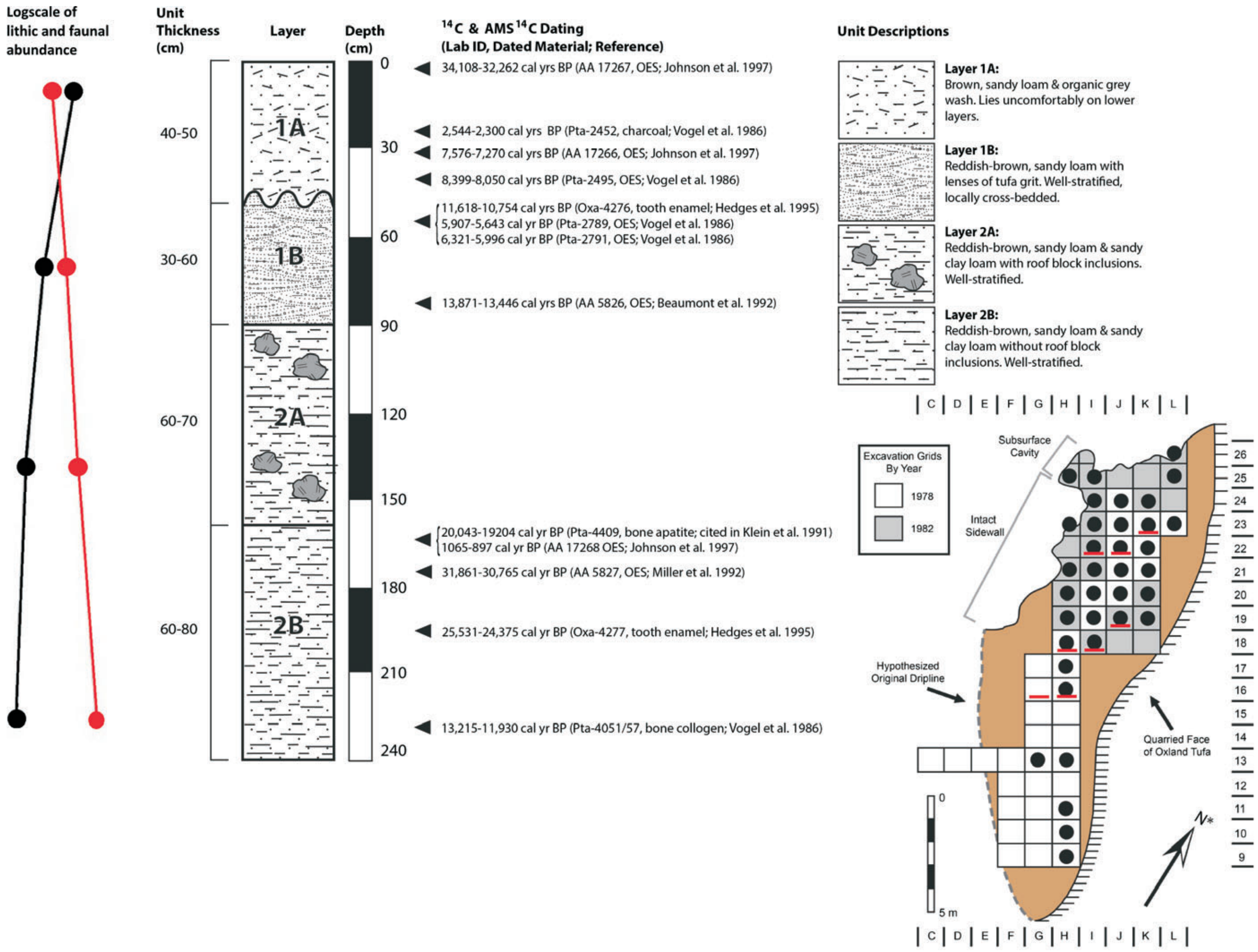

FIG. 2. *Stratigraphic profile of Equus Cave (redrawn from Johnson et al. 1997), including log scale showing relative abundance of fauna (grey/red online) and lithics (black) in the profile and excavation grid (redrawn from Klein* et al. *1991, by MVC; Black dots indicate square provenance of lithics, and red underline shows worked bone artefacts).*

1986; Klein *et al.* 1991; Miller *et al.* 1992; Hedges *et al.* 1995; Johnson *et al.* 1997). Many of the radiocarbon dates from Equus Cave are out of stratigraphic order. The displacement of dates may be owing to the unreliability of radiocarbon ages produced from specific materials, or an issue of mixing and movement through the sequence due to biogenic or recent anthropogenic processes (Johnson *et al.* 1997; see Kuhn *et al.* 2016 for a more detailed assessment).

The stone artefacts recovered from this site are distributed throughout the stratigraphic sequence; the largest proportions were identified in units 1A–1B, and substantial (yet decreasing) quantities were excavated from units 2A–2B (Fig. 3). A recent preliminary investigation of the assemblage identified more than 6000 stone artefacts, including one quartz hammerstone, 10 pieces of potentially utilised ochre, and one OES bead. Most of the remaining flaked stone artefacts were made on black chert, with smaller quantities of quartz, silcrete, quartzite and other raw materials also present. Three-quarters of the assemblage comprises debitage, while artefacts with edge modification make up nearly one-quarter, and cores only a very small proportion. Most of the tools are notched artefacts; followed by utilised flakes and various forms of scrapers; and smaller quantities of backed artefacts, borer-like tools and other informal tools (Fig. 3). Elsewhere on the Ghaap Plateau escarpment, notched artefacts have been identified in mid-late Holocene (Wonderwerk Cave, Jakkalsberg N) and late Holocene (Jagt Pan 7, Jakkalsberg L); borers in mid-Holocene (Wonderwerk Cave) and terminal Pleistocene (Dikbosch 1) assemblages, and backed artefacts in early-late Holocene (Wonderwerk Cave, Little Witkrans, Dikbosch 1), mid-late Holocene (Jakkalsberg N) and late Holocene (Limerock 1 and 2, Jagt Pan 7, Melkboom1, Biesje Poort 2, Bokvasmak 3, Vlermuisgat, Canteen Kopje, Jakkalsberg L) assemblages (Forssman *et al.* 2010; Humphreys & Thackeray 1983; Orton & Halkett 2010; Parsons 2008). Overall the stone tool assemblage is consistent with a mid-Holocene Wilton assemblage, as suggested by the ~7 000–8 000 ages outlined below (Fig. 2). Furthermore, the sheer size of the stone artefact assemblage alone indicates that people, not just hyaenas, made good use of Equus Cave throughout the late Pleistocene-Holocene. Indeed, there is an inverse trend in the overall NISP and MNI of bones *versus* the number of lithic artefacts recovered (Fig. 2, Table 1) suggesting

TABLE 1. *NISP, MNI and lithic abundance per layer (NISP and MNI from Klein* et al. *1991).*

Unit	Lithic artefacts	Faunal NISP	Faunal MNI
2B	122	29723	1810
2A	239	8658	630
1B	837	3721	323
1A	6260	1465	156

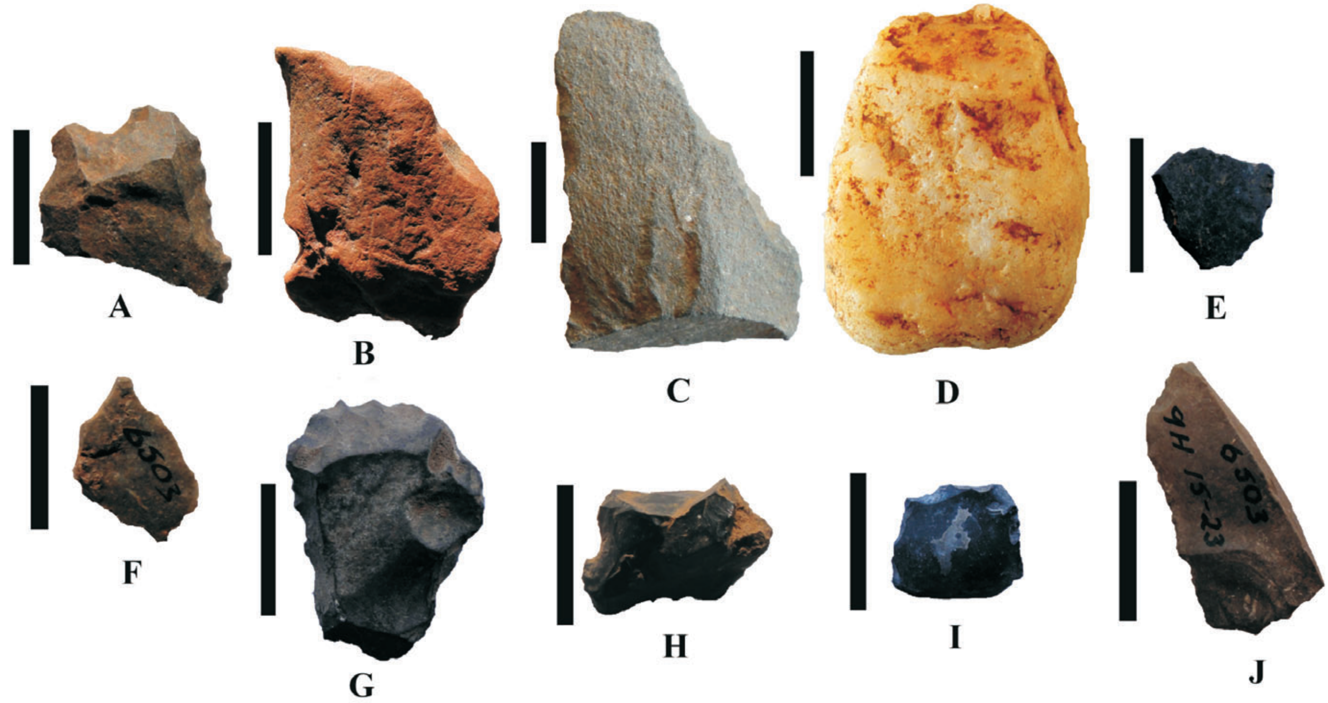

FIG. 3. *A sample of tools from the Equus Cave stone artefact assemblage (scale bar = 2 cm), comprising a chert scraper with a large complex notch/tanged point (371:* **A***: from layer 1B); a piece of ochre with possible engravings (383:* **B***: from layer 1B); a flat-edged scraper on an unidentified material (634:* **C***: from layer 1B); a quartz hammerstone (1271:* **D***: from layer 1B); a chert triangular backed artefact (1419:* **E***: from layer 1B); a chert borer-like tool with a broken edge (1560:* **F***: from layer 1B); a chert notched scraper (1752:* **G***: from layer 1A); a chert artefact with a complex notch (1839:* **H***: from layer 1A); a chert steep-edged scraper (2407:* **I***: from layer 1A); and a chert utilised flake (2596:* **J***: from layer 1A).*

that 1A in particular is dominated by human occupation of the cave.

The worked bone assemblage, the main focus of this study, only derives from Unit 1A, from a depth no greater than 45 cm. Discounting the age generated by Johnson *et al.* (1997) of 34 108–32 262 cal. BP from OES, all other ages for 1A are Holocene in age and younger than 8399–8050 cal. BP (Vogel *et al.* 1986). Younger ages of 2544–2300 cal. BP on charcoal may suggest 1A formed over 6000–5500 years or this charcoal might be intrusive. However, this charcoal determination is the only age so young, and the two other ages for the layer range between 8399 and 7270 cal. BP and are in stratigraphic order. It is also possible that the OES ages are too old if they contain dead carbon from the digestion of carbonate rocks by the ostriches that laid the shells. The layers below this section all suffer from dating issues as a number of Holocene ages occur amongst a majority of Pleistocene determinations (Fig. 2). Moreover, isotopic work by Lee-Thorp and Beaumont (1995) and pollen data by Scott (1987), which has the potential to clarify the environmental conditions in the area at certain time periods, suggest that there is a major environmental shift from more open grassland to more closed woodland between layers 1B and 1A. This environmental change would be consistent with changes seen in southern Africa at the Pleistocene to Holocene transition. In addition to the isotopic and pollen data, layers 1B–2B, while containing many species that are known in historical times, also contain extinct Florisian Land Mammal Age fauna, such as *Equus capensis* (giant Cape plains zebra), *Megalotragus priscus* (giant hartebeest), and *Antidorcus bondi* (Bond's springbok). These species are known to have gone extinct across the Pleistocene to Holocene transition (Klein *et al.* 1991).

METHODS

The 16 worked bone artefacts from Equus cave were analysed and imaged using a Dino-lite Edge AM4815ZTZ (AnMo Electronics Corp.) variable field of depth digital microscope. Under white LED cross-illumination, images were taken with the Dino-lite's built-in camera at magnifications between ×15 and ×50, according to the visibility of wear patterns and modifications on the materials. All measurements were taken using digital callipers of the maximum width and length of each artefact. These data are outlined and compared below.

Identification of modifications was based on comparison with reference materials collected by C.K. Brain (1981) during his tenure at the Ditsong National Museum of Natural History in Pretoria, South Africa (formerly the Transvaal Museum), fossils from the Florisbad spring site (Brink 1988) and reference materials housed at Arizona State University. These bones were modified by human and non-human agents, including hyaena, dog, leopard, cheetah, porcupine, river gravel, spring water, flood plain, wind, and trampling. Modifications were also compared against taphonomic literature (Maguire *et al.* 1980; Brain 1981; Shipman 1981; Cook 1986; Smith & Poggenpoel 1988; Olsen & Shipman 1988; White 1992; Lyman 1994; Fisher 1995), including published modifications on bone tools that were used to treat skin and hide with or without the addition of sand, remove bark from trees, process fruit and dig in various sedimentary environments (Shipman *et al.* 1984; Shipman & Rose 1988; Shipman 1989; Backwell & d'Errico 2004), that were intentionally shaped using different techniques (Webb 1987; LeMoine 1997; d'Errico & Backwell 2003) and that were submitted to treatments mimicking long-term transport in leather bags (d'Errico 1993).

To provide a basis for assessing the function of the worked bone assemblage, several previous studies of ethnographic and LSA bone artefacts were also utilised. These consisted of the published descriptions and measurements provided by Bradfield (2010) and Backwell *et al.* (2008) of the Fourie collection and those provided of archaeological, ethnographic and historical observations and artefact classifications by Clark

(1977). Published descriptions of the Fourie collection were utilised as the collection is one of the largest of its kind. Of particular interest to this study, it consists of over 100 bone-tipped arrows of two varieties collected from 13 traditional Bushmen/hunter-gatherer groups, including the ‡Ao-//Ein, !Kung and the Naron living in northern Namibia between 1916 and 1922 (Wanless 2007). Additionally, the archive contains field notes and photographs detailing activities and artefacts connected with hunting (Wanless 2010). Unfortunately, the Fourie collection could not be directly analysed by the authors of this study.

All historical radiocarbon dates presented here have been recalibrated using Oxcal 4.2 and the ShCal13 Curve (https://c14.arch.ox.ac.uk).

RESULTS

ETHNOGRAPHIC COMPARATIVE MATERIAL AND MANUFACTURING TECHNIQUES

The Fourie collection is an ethnographic collection comprising over 5000 artefacts from various hunter-gatherer groups in the Kalahari and Kaukau Veld, Namibia, collected by Dr Louis Fourie, a medical doctor, between 1916 and 1922 (Wanless 2010). Bradfield (2010) analysed 104 pointed bone artefacts from the collection. The Fourie collection consists of two varieties of bone points, namely, thin reversible poisoned points (Fig. 4i) with link-shafts (Fig. 4iii), and robust non-reversible, non-poisoned points without link-shafts. These two point types represent different hunting methods. The thin reversible poisoned points (Clark's [1977] Type 3 bone points; Fig. 4) are designed to detach from the link-shaft when lodged within the target, delivering poison to the animal (Clark 1977; Fig. 4i). The robust points (Clark's [1977] Type 4 bone points; Fig. 4) were connected to the reed shaft directly and designed not to detach on impact (Clark 1977). These robust points were poisoned when hunting large game, and not when hunting small game (Dunn 1879–1880).

The manufacturing techniques of LSA bone points have been widely extrapolated from ethnographic data and unfinished artefacts recovered from archaeological sites (Clark 1977; Smith & Poggenpoel 1988; d'Errico & Henshilwood 2007; d'Errico *et al*. 2012). The most conclusive archaeological evidence comes from Kasteelberg on the Vredenberg Peninsula, West Coast, South Africa. Here, Smith and Poggenpoel (1988) uncovered a workshop with evidence for each manufacturing stage. First, the proximal and distal ends of the selected bone are removed. Along each side, the bone is then hammered using a hammerstone and an intervening punch to create a deep groove to facilitate splitting of the bone along the long axis. Once this is achieved, the blank is flaked, producing a splinter that is then shaped by rotation abrasion, evidenced by oblique spindle-like diagonal modifications (this step can also involve scraping). Finally, the splinter is the finely ground and polished to achieve the desired shape (Radcliffe-Robinson & Cooke 1950; Parkington & Poggenpoel 1971; Smith & Poggenpoel 1988; Walker 1995). Comparative studies of manufacturing methods of bone points from MSA and LSA assemblages (d'Errico & Henshilwood 2007) support the techniques proposed by Smith and Poggenpoel (1988).

Additionally, it has been observed that there is a difference in the diameter of San bone points and link-shafts in ethnographic collections. Smith and Poggenpoel (1988) noted that bone points tend to have a diameter 5 mm or less and the link-shafts tend to have a diameter above 5 mm, although some overlap was documented. However, bone points tend to be thicker in assemblages deriving from northern areas of southern Africa (Smith & Poggenpoel 1988).

FIG. 4. *Ethnographic examples of Bushman Type 3 and Type 4 bone arrow points. Type 3 comprises poisoned bone points* (**i**), *bound with reed collars* (**ii**), *and bone link-shafts* (**iii**) *that insert into reed shafts. Scale bar = 10 mm (after Backwell* et al. *2008).*

Overall, these studies suggest that there are two varieties of bone points: thin reversible poisoned points with link-shafts and robust non-reversible, non-poisoned points without link-shafts. The bone points have a diameter less than 5 mm and link-shafts have a diameter greater than this dimension. It is also suggested that surface modifications, such as spindle-like diagonal grinding and longitudinal striations, can be indicative of function. These assumptions are utilised and tested in the Equus Cave worked bone analysis.

EQUUS CAVE BONE ARTEFACTS

The Equus Cave bone tool collection consists of 16 specimens, which include complete and broken bone points (detailed in Table 2, Fig. 5). The assemblage was recovered from both the 1978 and 1982 excavations (Fig. 2). The assemblage was first referred to, but not described, by Scott (1987), and subsequently mentioned briefly by Klein *et al.* (1991).

The clearest and most obvious traces found on the Equus bone tools result from manufacture rather than use, other modifications not related to manufacture are also present. Each modification is detailed below.

MANUFACTURING MODIFICATIONS

Grinding

The clearest and most abundant modification found on the Equus Cave points is the classic oblique spindle-like striations (referred to as spindle-like striations in Table 2; Webb 1987; d'Errico & Henshilwood 2007). These modifications are diagonal in nature, running diagonally to the long axis of the bone (Fig 6, I and II). Twelve of the artefacts display these striations (specimens 61, 62, 1500, 1502, 1503, 1504, 1507, 1508, 2624, 2626, 2627), which is produced by grinding the bone

FIG. 5. *Equus Cave bone points, 2628* (**A**), *1501* (**B**), *1500* (**C**), *2627* (**D**), *62* (**E**), *1507* (**F**), *1508* (**G**), *2626* (**H**), *1505* (**I**), *61* (**J**), *1504* (**K**), *1506* (**L**), *2624* (**M**), *1502* (**N**), *2625* (**O**), *1503* (**P**).

TABLE 2. *Details of the Equus Cave worked bone assemblage.*

Artefact ID no.	Square	Spit depth (cm)	Diameter (mm)	Length (mm)	Surface modification
61	I18	3	3.6	23.6	Spindle-like striations
62	I22	4	4.3	44.3	Spindle-like striations
1500	J20	22–30	4.3	73.6	Spindle-like striations
1501	Surface cleaning	Surface cleaning	5.1	87.8	Spindle-like striations, gnawing
1502	23K	0–7	4.1	19.8	Spindle-like striations, gnawing
1503	22J	0–7	4.3	18.5	Spindle-like striations
1504	20J	45–22	3.6	29.6	Spindle-like striations
1505	18H	30–37	3.8	24.2	Polish, striations, random diagonal marks, two sets of discrete cut marks, root etching, pitting
1506	17H	0–7	4.7	27.5	Polish, striations, random diagonal marks, root etching, pitting
1507	19I	22–30	3.4	40	Spindle-like striations, square in cross-section
1508	20J	37–45	5.2	37.6	Spindle-like striations
2624	G16	37–45	6.4	21.4	Spindle-like striations, medullary cavity preservation
2625	G16	37–45	4.3	20.7	Polish, striations
2626	G16	37–45	5	30	Spindle-like striations
2627	H16	22–30	5.7	52.9	Heavy spindle-like striations
2628	H16	22–30	5.7	141.43	Polish, striations, random diagonal marks, root etching, pitting

blank on a stone with a coarse matrix (Webb 1987; Smith & Poggenpoel 1988).

Scraping

The second manufacturing modification present on the materials is longitudinal scraping. This modification is present on four artefacts (specimens 1505, 1506, 2625, 2628) and presents as fine parallel striations, orientated longitudinal to the axis of the bone (Fig 6, III and IV; d'Errico & Henshilwood 2007; Backwell *et al.* 2008; d'Errico *et al*. 2012; Bradfield 2016).

Cross-sections

In all cases beside one (specimen 1507), the Equus Cave bone points are round to elliptical in cross-section (Fig. 7, insert). Specimen 1507 is not round but quadratic in shape (Fig. 7)

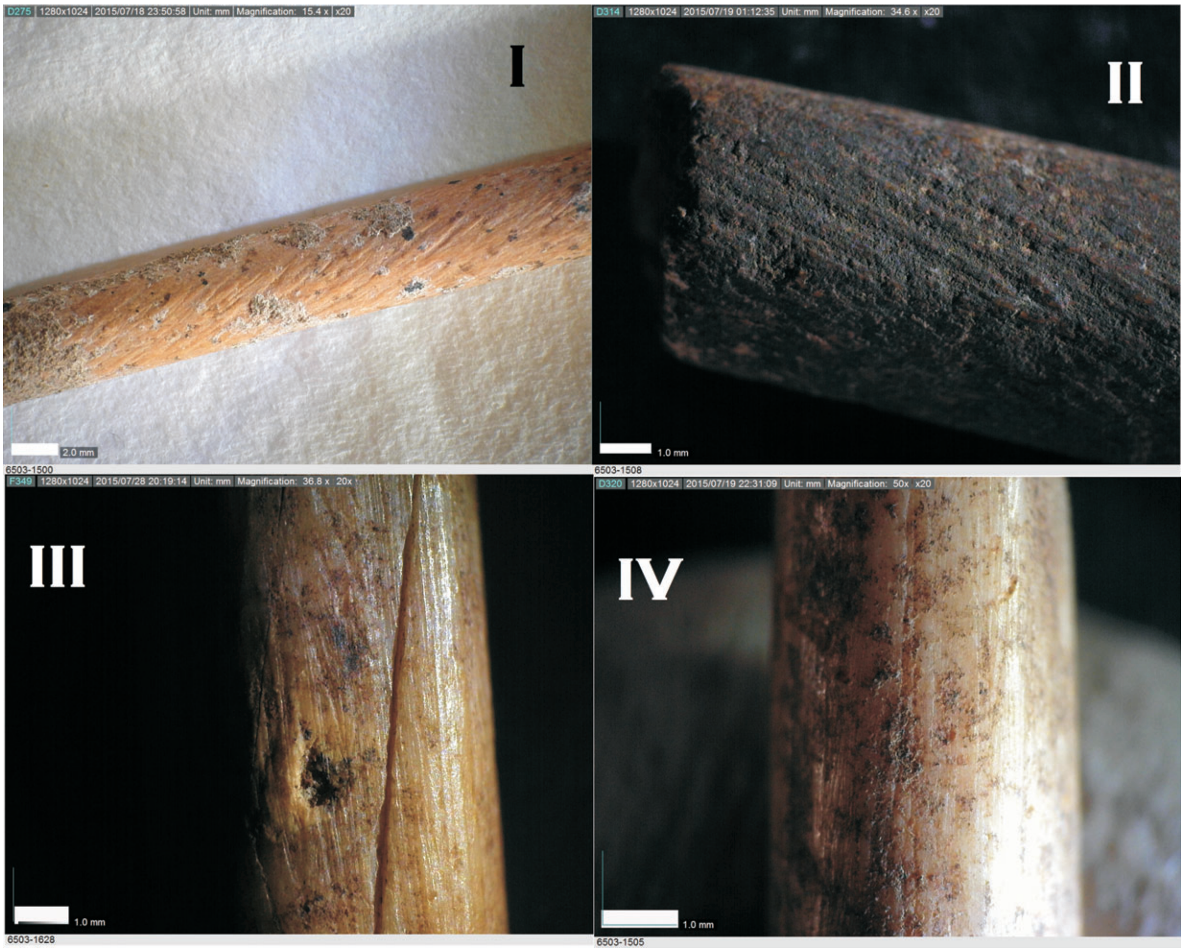

FIG. 6. *Typical spindle-like diagonal grinding present in the assemblage,* **I** *(1500, scale bar = 2 mm, ×15 magnification) and* **II** *(1503, scale bar = 1 mm, ×35 magnification); and typical fine longitudinal parallel striations* **III** *(2628, scale bar = 1 mm, ×35 magnification) and* **IV** *(1505, scale bar = 1 mm, ×50 magnification).*

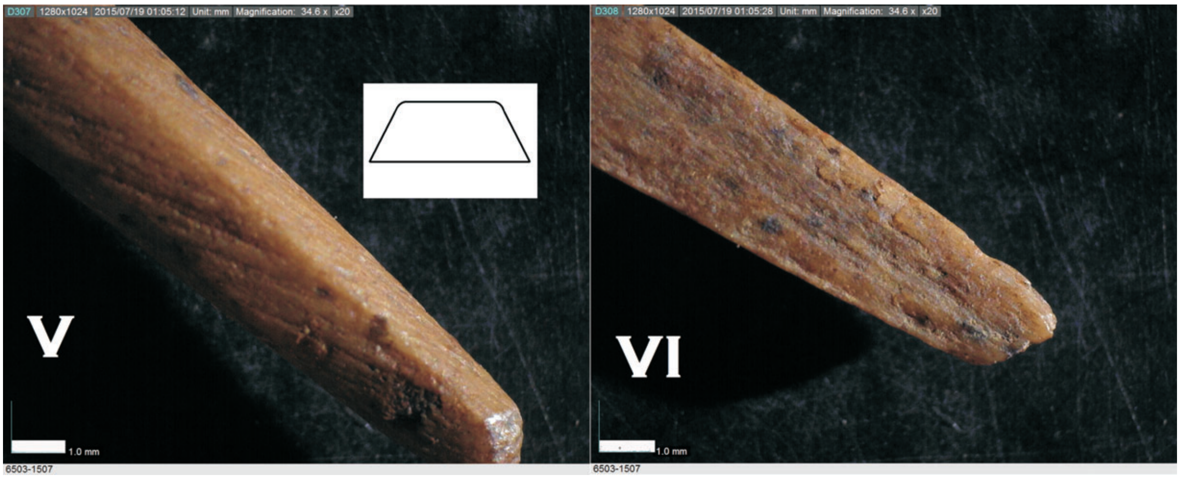

FIG. 7. *Top view of 1507 (***V***) and longitudinal split (***VI***) with cross-section detail (insert) (scale = 1 mm, ×35 magnification).*

Parallel hatching

Specimen 1505 (Fig. 8V, right and left) displays two discrete sets of transverse parallel hatching, running perpendicular to the long axis of the bone. These marks have been inserted into a flattened area of the point and overlay the manufacturing modification on this specimen.

Terminations

Three artefacts (specimens 62, 1500, and 2624; Fig. 8VI), are near-complete and preserve a right-angled ground proximal extremity.

USE-WEAR MODIFICATIONS

Random diagonal striations

Striations that are shallow and random in orientation are present on three specimens: 1505, 1506 and 2628 (Fig. 8VII). These diagonal striations are not uniform in appearance, like the roughing-out spindle striations, and are suggestive of use-wear.

Spin-off fracture

Specimen 2625 (Fig. 3O) is a point tip with a spin-off

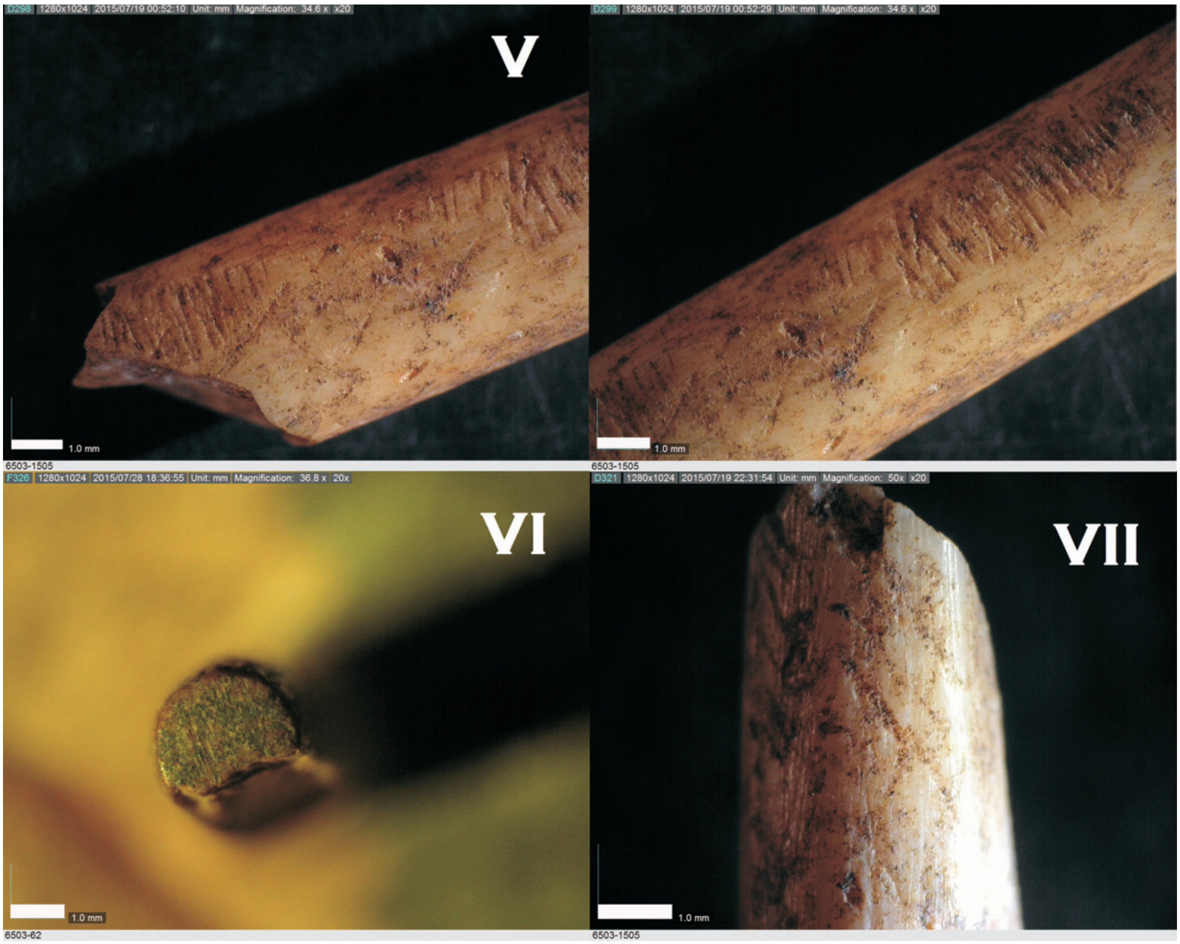

FIG. 8. *Transverse parallel hatching, potential lashing fixtures (1505:* **V***, scale bar = 1 mm, ×35 magnification). The right-angled ground proximal extremity of 2624 (***VI***, scale bar = 1 mm, ×35 magnification), an example of shallow and random diagonal use-wear striations (1505:* **VII***, scale bar = 1 mm, ×50 magnification).*

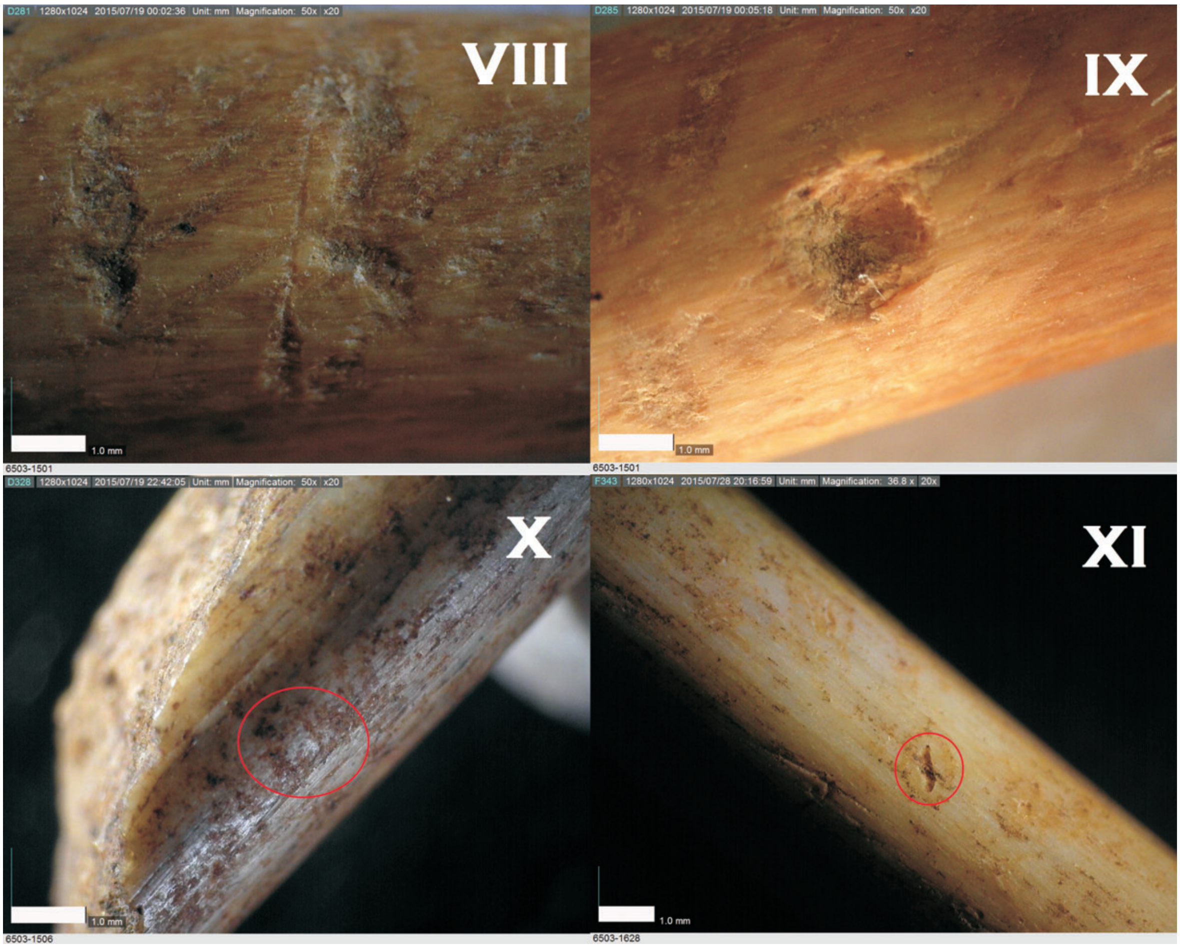

FIG. 9. *Taphonomic modifications present on the assemblage including tooth marks (1501:* **VIII** *and* **IX**, *scale bar = 1 mm, ×50 magnification), pitting (1506:* **X**, *scale bar = 1 mm, ×50 magnification) and root etching (2628:* **XI**, *scale bar = 1 mm, ×37 magnification).*

fracture (as defined by Bradfield 2010). This modification is indicative of the specimen being used as a projectile point.

Pitting, tooth marks and root etching

Tooth modification is also present in the assemblage. Specimens 1501 (Fig. 9, VIII and IX), 1506 and 2628 display several modifications. These are small, ranging from <1 mm up to 1.5 mm in diameter. They consist of modifications with a shallow crescent pit on one end of a linear mark (Fig. 9VIII) and roughly cone-shaped perforations (Fig. 9IX). It is unclear, primarily because of size, whether these modifications are carnivore- or human-induced (see Oliver 1994). The modifications are superimposed over the spindle-like grinding marks.

Three tools have superficial pitting (specimens 1505, 1506 and 2628), most likely from post-depositional abrasion (Fig. 9X; Fernández-Jalvo & Andrews 2016). This overlies manufacturing and use-wear marks on all three specimens.

Specimens 1505, 1506 and 2628 preserves small non-linear 'U'-shaped marks produced by root etching (Fig. 9XI; d'Errico & Henshilwood 2007; Fernández-Jalvo & Andrews 2016). A post-depositional modification, these overlie and incise other modifications.

Broadly speaking, surface modification of the Equus Cave pointed bone tool assemblage falls into two categories: manufacturing traces and secondary modifications. Two distinct manufacturing techniques are present, namely spindle-like grinding and longitudinal scraping. These manufacturing techniques are not necessarily indicative of function in the Equus Cave assemblage; however, they may be in ethnographic samples. Secondary modifications such as tooth marks and root etching are also present in the assemblage, suggesting several agents were responsible for post-abandonment modifications.

Owing to the heavy modifications employed in the production of the assemblage, it is not possible to identify the species or element on which the artefacts were produced. However, limb bones, particularly metapodials, of large and medium-large size bovid are known both ethnographically and archaeologically to be selected for arrow and bone awl production (Poggenpoel & Robertshaw 1981; Smith & Poggenpoel 1988; Bartram *et al.* 1991; Kent 1993).

Polish can develop in a variety of ways and through a number of activities (Lyman 1994; Fernández-Jalvo & Andrews 2016). In the case of bone points, this type of surface modification is sometimes argued to be characteristic of projectile implements (Fischer *et al*. 1984). As well as a defining feature of the separation of 'arrow' and 'awl' tool types at Blombos Cave (d'Errico & Henshilwood 2007). Similar longitudinal faceting and fine striations have been suggested to be produced by scraping the bone tool blank with a burin or unretouched stone edge during manufacture (Backwell *et al*. 2008). The superposition of the diagonal striations over the longitudinal faceting and parallel striations suggest that this process is represented in the Equus Cave materials.

In the Fourie collection, polish striations have predominantly been recorded as associated with link-shafts (Bradfield 2010). Bradfield (2010) argues that since link-shafts were not subject to poison, they would have been the section of the arrow that received the most handling. Additionally, he argues that this 'polish' wear would not have been conducive to the adhesion of poison. In the Equus Cave material, artefacts 1505

(Fig. 5I) and 1506 (Fig. 5L) display this kind of modification and, therefore, may be link-shafts. However, 2628 (Fig. 5A), which also shows the same polish modification, is a complete specimen, measuring 141.4 mm in length. An artefact of this size is far larger than recorded link-shafts; therefore, this manufacturing wear is not necessarily a proxy for function. Additionally, 2625 (Fig. 5O) is a point tip with a spin-off fracture (as defined by Bradfield 2010). This modification was created in antiquity, exhibiting signs of post-fracture smoothing, indicating that it was probably re-used after the fracture had occurred (d'Errico *et al* 2003; Buc 2011; Bradfield 2012). Equally, this smoothing could be post-depositional. Spin-off fractures are considered a good diagnostic feature of the tool being utilised as a projectile (Bradfield 2010, 2012).

Specimens 62 (Fig. 5E), 1500 (Fig. 5C), and 2624 (Fig. 5M) all display a squared-off ground termination. Bone points with similar ground terminations are also present in specimens from the Fourie collection. This extremity form suggests that these specimens would not have been part of the point-links haft-reed complex, but instead examples of the non-reversible bone point (Clark's [1977] Type 4 bone points). However, Goodwin (1929) describes similar squared-off terminations present on points that are included in the reversible point-links haft-reed complex.

The hatching marks present on specimen 1505 (Fig. 5I) are most likely a modification to allow for the application of a point to an arrow shaft *via* the means of lashing (see d'Errico *et al.* 2012 for similar concept). Additionally, this modification could potentially be decoration to the piece. As this artefact is a fragmentary mesial piece, it is not possible to identify whether it is a terminal section of a point and confirm either of these hypotheses.

One artefact, specimen 1507 (Fig. 5F), is not round in cross-section like all other artefacts, but quadratic (Fig. 7VI). It is split longitudinally at the tip. Surface modification on this artefact includes the typical spindle-like grinding; however, they appear less sharp in relief than others. The artefact also displays a purposefully ground flattened tip. It is uncertain from a review of the literature what the purpose of this morphology might be.

The assemblage also highlights the obscurity of surface modification as a sole identifier of function within bone tool analysis, and specifically ethnographic bone point types. Functional interpretations based on such visual observations require to be substantiated by explicit functional studies before they can be utilised with confidence (see Lombard & Phillipson 2010; Bradfield 2010). Although traditionally interpreted as an identifier of link-shafts, longitudinal faceting and fine striation polish is present on materials in the assemblage that fall outside both the published and ethnographic dimensions for link-shafts. This is particularly the case with artefact 2628 (Fig. 5A), a complete arrow point, which only displays the longitudinal faceting and fine striation wear.

THE EQUUS WORKED BONE ASSEMBLAGE IN A SITE AND REGIONAL CONTEXT

The environmental and technological context of the time period from which material derives is important when assessing the functional significance of worked bone assemblages. Today, Equus Cave is situated within the semi-arid zone, with vegetation in the area comprising Kalahari Thornveld, or low savannah, where C4 grasses, C3 shrubs and trees coexist (Acocks 1953). This floral community has existed around Equus Cave for at least the last ~17 ka (Johnson *et al.* 1997). However, at this time, the climate was regionally cooler and drier than today, peaking at approximately 8000 years ago (Scott 1989). From about 12 000–8000 years ago, temperatures in southern Africa and rainfall started to increase (Wadley 1993, 2007). Specifically, in the Ghaap Plateau escarpment area, modern precipitation levels (Scott 1989; Johnson *et al.* 1997) and faunal and floral communities were present by approximately 6000–6500 years ago (Wadley 1993, 2007). This increase in rainfall allowed for a greater diversity of both flora and fauna (Wadley 1993, 2007) and would have made the Equus Cave area attractive to hunter-gatherers. Technologically, a shift from bladelet-dominated industries, such as the Robberg, to those of scrapers, adzes and bone points, of Oakhurst and Oakhurst-like industries, appear in the record during this time (Deacon, H.J. 1976; Deacon, J. 1984; Wadley 1993, 2007).

This array of technologies, correlating to this time period, is also present at Equus Cave. This shift in technology is not the first occurrence of this suite of artefacts (Henshilwood & Dubreuil 2011), but a period in which they become far more abundant. By ~10 000 years ago, the Robberg Industry had been replaced by the Oakhurst complex in the interior and the coast. By the time the Equus Cave bone tools were deposited, the Wilton complex was dominant in the Northern Cape. The timing of modern environmental conditions and the appearance of Wilton-type technology in the Cape correlates well with the deposition of Layer 1A, the extinction of the Florisian Land Mammal Age fauna and the deposition of the LSA lithic artefacts at Equus Cave. A change in site use, or occupation intensity, is also seen, with a decreasing depositional abundance of faunal materials and an increase in the deposition of lithic materials (Fig. 2). This suggests that people were making greater use of the cave as conditions improved in this semi-arid region in the Holocene.

Evidence for bow and arrow technology, similar to that seen at Equus Cave, exists at the majority of LSA sites in the Kuruman Hills and the Ghaap Plateau escarpment during the Holocene. Wonderwerk Cave (Thackeray 1983), Dikbosch 1 (Humphreys 1983a) Little Witkrans (Thackeray 1983), and Limerock 1 and 2 (Humphreys 1983b) all preserve bone tools.

Unfortunately, analyses of the bone tools in these assemblages have only been reported as a presence/absence index, with minimal description of the artefacts provided, except in the case of Dikbosch 1 and Limerock 1 and 2. Dikbosch 1 preserves 40 bone points, dating to younger than 3450–2980 cal. BP (Humphreys 1983b). On average, the Dikbosch 1 artefacts measure 4.3 mm in diameter, with three complete/near complete bone points measuring 49.1 mm (3.7 mm diameter), 50.1 mm (4.2 mm diameter), and 43 mm (3 mm diameter). Limerock 1 and 2 dates to younger than both the Equus and Dikbosch 1 artefacts, deriving from a period no greater than 1705–1509 cal. BP (Humphreys 1983b). At Limestone 1, the average diameter of the bone points is 4.5 mm, and 4.4 mm for Limestone 2. Three complete/near complete points were reported, measuring 22 mm (4.5 mm diameter) for Limestone 1, and 65. 5 mm (7.5 mm diameter) and 58.04 mm (4 mm diameter) from Limestone 2 (Table 3).

Although a small assemblage, the Equus bone points conform to the average diameter of like material in the Ghaap area.

TABLE 3. *Comparison of pointed bone artefacts from the Ghaap Plateau escarpment sites.*

	Limerock 1	Limerock 2	Dikbosch 1	Equus
Avg. diameter (mm)	4.5	4.4	4.3	4.6
Avg. length (mm)	22	61.77	43	43.3

However, Equus Cave preserves the largest specimen, 2628 (Fig. 5A), which falls above the average diameter (4.7 mm) of these artefacts. It is unclear from reports (see Humphreys & Thackeray 1983) specifically what surface modification these complete/near complete artefacts have. However, both spindle-like diagonal grinding striations from grinding and polish are reported on all assemblages and suggest a similar manufacturing process.

DISCUSSION AND CONCLUSION

The Equus Cave worked bone materials display spindle-like grinding striations and longitudinal striation polish, both indicative of the manufacturing process to produce the artefacts. Post-production modifications are also present on the materials. These modifications include tooth marks, cut marks, and potentially, post- production re-shaping. Although the assemblage is small in number, when compared to the sites of Dikbosch 1, and Limerock 1 and 2, the Equus materials display a continuity of bone technology along the Ghaap Plateau escarpment with little morphological difference in the assemblages. This relative similarity of artefacts suggests that bow and bone arrow technology was in use across the Ghaap Plateau escarpment, and that a similar hunting strategy was employed regionally by LSA peoples. It could also suggest a form of relationship between the peoples of these sites, or periodic use by migratory groups from a single population. Unfortunately, the published descriptions of bone technology in the Ghaap Plateau escarpment are not substantial. This study is the first in-depth analysis of bone points from this area, and provides a basis for comparative research.

The presence of a large Wilton-type LSA stone and bone tool assemblage, the absence of Florisian Land Mammal Age fauna, and a change of occupation intensity between layers 1B–2B and 1A, support a Pleistocene age for layer 1B–2B, and a ~7 000–8 000 Holocene age for the 1A layers at Equus Cave. Moreover, a comparison of the faunal and stone tool data suggests that during the oldest layers of the site's accumulation the cave was primarily a carnivore den, although the presence of over 100 stone tools suggests there was perhaps still a human component. With over 6000 artefacts in the Holocene 1A layers and much lower fossil numbers, the site's use changed significantly between the Pleistocene and Holocene, with human occupation replacing carnivore denning.

Continued research into worked bone assemblages within the context of LSA sites along the Ghaap Plateau escarpment will improve our understanding of regional variability and assist in our understanding of the social and technological organisation and variability in the area.

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