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Hafting adhesives from the final Later Stone Age layers at Sehonghong, Lesotho: a case study and commentary on the use of imported resources by nineteenth-century San

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ABSTRACT

There is longstanding evidence in the archaeological record of southern Africa for the application of hafting adhesives in the production of composite tool technology. Despite the limitations in the preservation of organics in archaeological contexts, the preservation of these materials can inform us about aspects of technological production and function, including hafting arrangements, adhesive production and resource acquisition. In some instances where we see the prevalence of organic materials that are at odds with the ecological landscape, these same materials can also elucidate social interactions between cultural groups. This paper presents the results of the analysis by microscopy and gas chromatography-mass spectrometry (GC-MS) of hafting residues from stone tools from the ceramic final Later Stone Age assemblages at Sehonghong, Lesotho. It argues that an adoption of novel resources including *Pinus* sp. resin, castor oil and paraffin by nineteenth-century San facilitated the continued existence of hunter-gatherer lifeways in increasingly marginalised circumstances amid tense relationships between the last hunter-gatherers of the Maloti-Drakensberg, newly arriving Basotho communities and European colonists.

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Later Stone Age; nineteenth-century Maloti-Drakensberg; hafting adhesives; gas-chromatography coupled mass spectrometry (GC-MS); *Pinus* resin; castor oil; paraffin

RÉSUMÉ

Il existe des preuves de longue date dans les archives archéologiques de l'Afrique australe de l'application d'adhésifs d'emmanchement dans la production de la technologie des outils composites. Malgré les limites de la préservation des matières organiques dans les contextes archéologiques, la préservation de ces matériaux peut nous informer sur les aspects de la production et de la fonction technologiques, y compris les arrangements d'emmanchement, la production d'adhésifs et l'acquisition de ressources. Dans certains cas où l'on constate la prédominance de matériaux organiques qui sont en contradiction avec le paysage écologique, ces mêmes matériaux peuvent également élucider les interactions sociales entre les groupes culturels. Cet article présente les résultats de l'analyse par microscopie et chromatographie en phase gazeuse-spectrométrie

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de masse (GC-MS) des résidus d'emmanchement des outils en pierre des assemblages de l'âge de pierre ultérieur final (final Later Stone Age) à Sehonghong, Lesotho. Il soutient que l'adoption de nouvelles ressources, y compris la résine du pin (*Pinus* sp.), l'huile de ricin et la paraffine par les San du dix-neuvième siècle ont facilité la continuation des modes de vie des chasseurs-cueilleurs dans des circonstances de plus en plus marginalisées au milieu de relations tendues entre les derniers chasseurs-cueilleurs du Maloti-Drakensberg, les nouvelles communités Basotho et les colons européens.

Introduction

While archaeological inquiry emphasises a preoccupation on first identifications, novel finds and the earliest finds, the appearance of common organic materials still has a role to play in the narratives grounded in the archaeological record, even among more recent archaeological assemblages. Hafting adhesives are the malleable and largely organic components of composite tool technologies, joining a working edge to a handle (Barham 2013). These materials have a longstanding, albeit punctuated prevalence in not only the archaeological record of southern Africa but also the ethnographic and historic records of the region.

The earliest surviving evidence of hafting adhesives is found in the Middle Stone Age (MSA) (<300,000 to >20,000 BP), with traces of components of adhesives recovered from Diepkloof Shelter in South Africa's Western Cape Province (Charrie-Duhaut *et al.* 2013, with imprints dated to 105,000 BP), Rose Cottage Cave in the eastern Free State (Williamson 1997; Gibson *et al.* 2004; Soriano *et al.* 2015) and Sibudu (Lombard 2005, 2006a, 2006b, 2008) and Umhlatuzana (Lombard 2007) in KwaZulu-Natal. This research, grounded in minimally invasive microscopy analysis and experimental studies, has provided the foundation for our understanding of hafting arrangements, tool function and the functionality of composite adhesive recipes (i.e. ochre and other inorganic additives as loading agents) during this period. The identification of *Podocarpus elongatus* pitch on a quartz flake from the Late Howiesons Poort (~60–56,000 BP) assemblages at Diepkloof provided the first chemical indicators of the use of plant exudates as a hafting adhesive. Attributing trace residues to a botanical taxon, this identification complemented a large-scale, systematic use-trace research programme grounded in MSA assemblages and added to ongoing discussions of behavioural modernity, complex cognition and the 'firsts' for the human species that stem from the MSA (Wadley 2010; Wadley *et al.* 2009).

The transition from the MSA to the Later Stone Age (LSA) (<18,000 BP to within the last few hundred years) brought with it an increase in the prevalence and diversity of surviving hafting adhesive finds. Contrary to the extensive research programmes undertaken on MSA assemblages, there has been a relative lack of research aiming to elucidate the relationship between adhesive manufacture, tool function and the surrounding ecological landscape of LSA adhesives (Veall 2022). To date, a handful of case studies of varying success published during the 1960s and 1970s (Deacon 1966; Walker 1974; Phillipson 1976) and — after a hiatus — movement towards applying multi-method chemical analyses over the last decade (Charrié-Duhaut *et al.* 2016; Veall 2019) have aimed at elucidating the composition of composite, multi-ingredient adhesives and extending the narrative of adhesive resource procurement and use within these archaeological contexts.

It has been well established that hunter-gatherers in southern Africa were pushed into marginal environments as favourable landscapes yielded to herding and farming subsistence strategies at the expenses of foragers over the last 2000 years (Parkington *et al.* 1986; Mitchell 2013). Rapid European colonial expansion into southern Africa represents yet another wave of interactions placing increasing pressure on the last hunter-gatherer populations. Where the historic and archaeological records collide, the identification of materials including plant resins, pitch, waxes and fats may not only provide a means of evaluating resource acquisition and material production, but also lend itself to further elaboration of aspects of economic, political, or cultural interactions. During the nineteenth century, the Maloti-Drakensberg region of the southern African interior, in particular, was a multifaceted landscape in the midst of rapid cultural, geopolitical and ecological change. As part of this, local San ethnic identities shifted through the co-option of dispossessed and marginalised groups that included other San as well as Khoekhoen, Bantu-speaking farmers and runaway slaves, resulting in a creolisation of San culture (Challis 2012; Challis and Sinclair-Thomson 2022). Rock paintings clearly document the blurring and reconstitution of cultural and economic boundaries along with the adoption of novel aspects of material culture acquired via (direct or indirect) contact with the expanding colonial frontier. By way of example, Challis and Sinclair-Thomson (2022) link representations of horses, guns, cattle and sheep with rain animals of a much more traditional San kind in paintings attributed to 'bandit' groups along the Tarka River of the Eastern Cape Province and the AmaTola, a creolised community of mostly San/Xhosa descent located in southeastern Lesotho and adjacent parts of South Africa. While distinctly different from the rock art record, we propose here that the application of optical light microscopy (OLM) and gas chromatography coupled mass spectrometry (GC-MS) to surviving organic residues from lithic assemblages dating to this time has the potential to add to the existing narrative models of the Maloti-Drakensberg region, thereby lending another facet to evaluating the encounters that unfolded in this particular region of southern Africa during the nineteenth century.

Archaeological and historical context

Sehonghong Shelter is notable archaeologically in that it is one of just a few sites in southern Africa with both longstanding evidence of hafting adhesives from multiple Later Stone Age (LSA) lithic assemblages and a relatively high prevalence of them (Mitchell 1995, 1996a, 1996b; Binneman and Mitchell 1997). The site lies in the Maloti Mountains of eastern Lesotho at approximately 1800 m a.s.l. and faces west-northwest (290°) on the south bank of the Sehonghong River at 29°46'S, 28°47'E (Figure 1) (Mitchell 1996c). Ecologically, Sehonghong lies within the summer rainfall zone and the Grassland Biome of southern Africa, with climate and vegetation heavily determined by altitude and by distance from the rain-shadow created by the barrier of the uKhahlamba-Drakensberg Escarpment that marks Lesotho's eastern boundary with South Africa. Aspect is an important factor affecting temperature, growing conditions and vegetation at the more local scale. The lower stretches of the Sehonghong River, like those of other nearby tributaries of the much larger Senqu (Orange) River into which it drains, support a

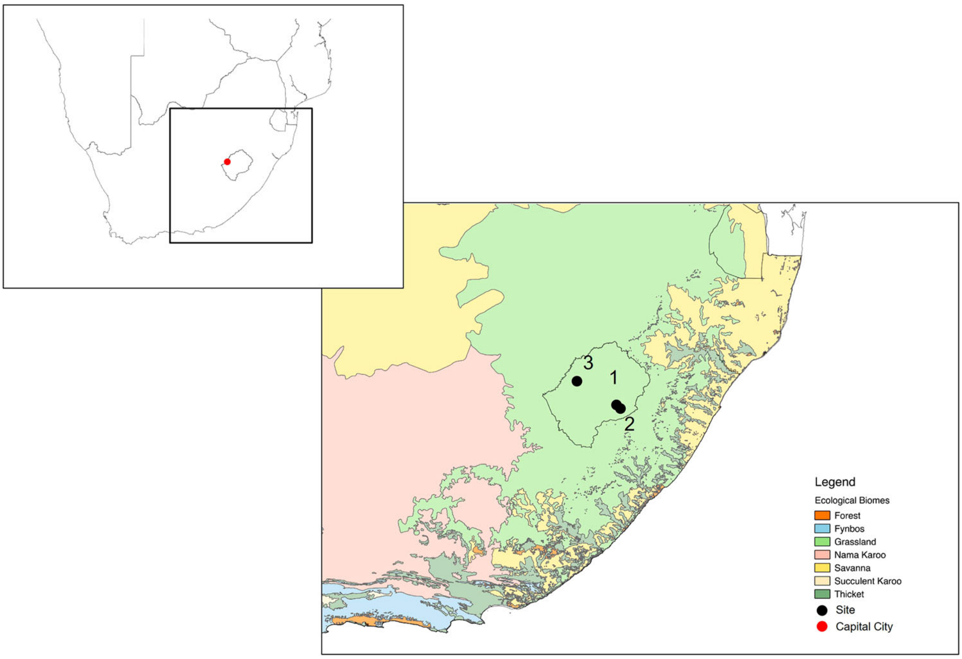

Figure 1. Location and known ecological biome of Sehonghong (1), relative to other notable archaeological sites in Lesotho, including Likoaeng (2) (Mitchell 2009) and Ha Makotoko (3) (Mitchell 1993). Maseru, the capital of Lesotho, is highlighted in red. Shapefile of The Vegetation Map of South Africa, Lesotho and Swaziland by SANBI (2006-), downloaded 5 December 2016. The shapefile of African countries was publicly available through Esri. Certain Esri ArcGIS Imagery in this work are owned by Esri and its data contributors and are used herein with permission. Copyright © 2023 Esri and its data contributors. All rights reserved. The map was created using QGIS (QGIS.org, 2022. QGIS Geographic Information System. QGIS Association).

Themeda-Cymbopogon-Eragrostis grassland in which grasses are mostly sweet (i.e. nutritionally rich and palatable all year round) or semi-sour (less so) (Bawden and Carroll 1968). Indigenous forests were never widespread in Lesotho (Leslie 1991), but thickets of indigenous trees and bushes occur in places here, including *Leucosidea sericea* and species of *Buddleia*, *Diospyros* and *Searsia*. Above the river valleys and extending across the plateau overlooking them to as much as 2745 m a.s.l. on north-facing slopes, although only up to about 2130 m a.s.l. on those that face south, is a typically sweet *Themeda-Festuca* Grassland, known locally as *seboku* (Staples and Hudson 1938: 13–16). Higher up still, the highlands are covered by a nutritionally poorer Alpine Grassland dominated by fescues (*Festuca* spp.) where high-quality grazing is restricted to the summer months (Staples and Hudson 1938). Under natural conditions, trees are absent from both this zone and the *Themeda-Festuca* Grassland below it, although today poplar (*Populus* spp.), weeping willow (*Salix babylonica*), eucalyptus (*Eucalyptus* spp.) and peach (*Prunus persica*) may occur close to villages as well as in the river valleys below. One and a half centuries of agropastoralist settlement have resulted in the eradication of most large mammals, a significant loss of indigenous woody vegetation and a degree of over-grazing and soil erosion (Conz 2017; pers. obs.).

Figure 2. Sehonghong Shelter (centre, behind the projecting spur in the foreground) lies on the south side of the Sehonghong River, a tributary of the Senqu, in the Maloti Mountains of eastern Lesotho. Photograph: Peter Mitchell, 2007.

The MSA and LSA assemblages present within Sehonghong Shelter (Figure 2) were first excavated by Patrick Carter in 1971 (Carter and Vogel 1974; Carter 1978; Carter *et al.* 1988). The site's LSA layers were then revisited by one of us (Mitchell) in 1992, excavating them following natural stratigraphic subdivisions rather than the spits employed by Carter (Mitchell 1996c). The two artefacts discussed in this paper both come from this work. Brian Stewart (University of Michigan) and Genevieve Dewar (University of Toronto) have more recently extended the re-excavation of the site into underlying Middle Stone Age layers dating >26,000 BP (Loftus *et al.* 2015). Overall, Sehonghong has a long sequence of archaeological occupation extending from the beginning of Marine Isotope Stage 3 *c.* 57.6 ± 2.3 kya until the late Holocene (Mitchell 1996c; Jacobs *et al.* 2008). Overall, the site provides a significant contribution to our understanding of hunter-gatherer populations in mountainous climatic refugia (Pargeter *et al.* 2017; Stewart and Mitchell 2018a) and its archaeozoological and palaeobotanical assemblages highlight the region's former ecological richness as well as detailing how people exploited this in the face of shifting ecological and historical circumstances (Mitchell 1996c; Plug and Mitchell 2008a, 2008b). Additionally, Sehonghong is of note for being one of just three locations in southern Africa (all in Lesotho and one barely a kilometre distant) where rock paintings were described and interpreted by a San individual — Qing — for whom painting and the beliefs associated with it were still a living tradition (Orpen 1874; McGranaghan *et al.* 2013). His testimony was recorded no more than a few years, at most, after a BaPhuthi woman, 'Me Elisabetha Môhanoé, saw men painting within the site (Mitchell 2006/07). Qing's explanations of paintings at Sehonghong and elsewhere have played a crucial part in developing today's ethnographically informed paradigm for the understanding of hunter-gatherer rock art in southern Africa (e.g. Lewis-Williams 2003; McGranaghan *et al.* 2013).

As part of a larger programme of research into Later Stone Age adhesive technologies in southern Africa (Veall 2019) two artefacts were analysed from Layer DC, the material culture of which is attributable to the ceramic final LSA (*sensu* Lombard *et al.* 2012). As reported elsewhere (Mitchell 1996b), the DC lithic assemblage is microlithic and dominated by fine-grained crypto-crystalline rocks, especially for manufacturing formally retouched tools. These consist mostly of end-retouched scrapers followed by adzes, a small number of backed microliths and a few pressure-flaked points, one of which retained traces of adhesive over both its ventral and dorsal surfaces (Mitchell 1996b: Figure 5:1). DC also provided the largest worked bone and ostrich eggshell bead assemblages in the Sehonghong sequence as well as a large number of pottery sherds that have been interpreted as having a hunter-gatherer origin (Mitchell 1996b).

DC sits at the top of the Sehonghong sequence and is a hard, friable, grey sediment rich in cattle and horse dung that comes away in large lumps when excavated. It becomes markedly finer and ashier with a reduced dung content toward its base. All the deposit removed from DC was sieved through a 3.0 mm mesh and all finds recovered were retained. The presence of horse dung confirms that DC continued to accumulate well into the nineteenth century since horses were only introduced into the Maloti-Drakensberg region in the middle part of the 1800s (Challis 2012). Much of the cultural material in it is, however, likely to be earlier than this and the layer is best interpreted as consisting of a deposit that has been heavily churned and compacted by the presence of livestock within the rockshelter. Artefacts and other finds are therefore not in a wholly primary context, although they postdate the *in situ* deposits of Layer GAP found below them. GAP is dated to the early first millennium AD by two radiocarbon dates, one from Carter's (1978) excavation and one from that of Mitchell (1996b). A second radiocarbon date previously assigned to GAP (Pta-6084, 1240 ± 50 BP, cal. AD 686–986) has subsequently had its stratigraphic provenance reassessed and been reassigned to Layer DC. Four further radiocarbon dates on finds from DC also provide further evidence that much — but by no means necessarily all — of the material recovered from it dates to a relatively tightly defined occupation pulse at the end of the first millennium AD (Table 1). Three of these dates are on bone and were obtained by Horsburgh *et al.* (2016), while the fourth (BRAMS-2612, 1161 ± 28 BP, cal. AD 885–994) directly establishes that the site's occupants had access to dairy products at this time (Fewlass *et al.* 2020). Previously unpublished OSL dates on pottery from DC reinforce the case for a late first-millennium AD occupation, but also suggest the possibility of further visits to the site during the Medieval Climatic Anomaly of the early centuries of the second millennium (Collis 2010; Table 1). There is, however, no evidence that Sehonghong Shelter was occupied during the ensuing Little Ice Age and people may have been absent from both it and the wider Lesotho highlands at this time until the nineteenth century (Stewart and Mitchell 2018b; Mitchell *et al.* 2022).

Oral histories confirm that Sehonghong Shelter was used by San people in the nineteenth century and on into the beginning of the twentieth, although, as Challis (2008, 2012) has shown, by this time we need to be thinking not of San in any 'pristine' sense, but rather of creolised groups with significant, but by no means exclusively, San membership, origins and cultural practices. One of these groups, the AmaTola, may

Table 1. Sehonghong: radiocarbon and optically stimulated luminescence (OSL) dates from Layer DC. Note that one further date (Wk-34787, 5870 ± 30 BP on bone; Horsburgh *et al.* 2016) is clearly intrusive from the underlying mid-Holocene GWA layer. All radiocarbon dates have been calibrated using the SHCal 20 calibration curve (Hogg *et al.* 2020) and OxCal 4.4. Note that the sherd producing OSL date X-3759, which came from the underlying mid-Holocene layer ALP, must have originated from Layer DC.

Laboratory number	Material	Date BP	Date cal. AD (95.4%) or date AD	Reference
Wk-34786	Bone	1130 ± 30	893–1021	Horsburgh *et al.* (2016)
Wk-34785	Bone	1130 ± 30	893–1021	Horsburgh *et al.* (2016)
BRAMS-2612	Dairy residue from sherd	1161 ± 28	885–994	Fewlass *et al.* (2020)
Wk-34784	Bone	1200 ± 30	772–988	Horsburgh *et al.* (2016)
Pta-6084	Charcoal	1240 ± 50	686–986	Mitchell (1996b)
X3756a	Sherd	-	1910 ± 10	Collis (2010)
X3756b	Sherd	-	1370 ± 110	Collis (2010)
X3761b	Sherd	-	1270 ± 85	Collis (2010)
X3758b	Sherd	-	1215 ± 75	Collis (2010)
X3761a	Sherd	-	1210 ± 95	Collis (2010)
X3758a	Sherd	-	1040 ± 70	Collis (2010)
X3759	Sherd	-	995 ± 90	Collis (2010)
X3761c	Sherd	-	950 ± 80	Collis (2010)
X3762	Sherd	-	880 ± 70	Collis (2010)

have ranged as far north as the general area of Sehonghong (Vinnicombe 1976: 85). A key set of narratives concerns Soai, the leader of a community living at Sehonghong Shelter in the years around 1870. Soai and his followers were visited at that time by the powerful BaPhuthi chief Moorosi (Mitchell 2006/07), but shortly thereafter they were attacked (possibly in 1871), and Soai killed, in a raid launched against them by two Basotho chiefs, Joel and Jonathan Molapo, from the west of Lesotho who accused them of stealing horses and cattle (Mitchell 2010). A precise chronology cannot now be recovered, but when a British-led expedition passed through in December 1873 in pursuit of the Hlubi chief Langalibalele and stopped over near Sehonghong Shelter, it completely failed to encounter San groups or individuals anywhere in the area; Basotho settlement along the upper Senqu Valley had also yet to begin (Mitchell and Challis 2008). Approximately five years later, however, Tlhakanelo, a younger son of the Basotho paramount Letsie I (ruled 1870–1891), was dispatched across the Senqu to establish royal control of the region. He did so by establishing himself at Ha Tlhakanelo, the core of the modern village of Sehonghong, and was followed by a wave of settlement across the highlands (Eldredge 1993: 63). As described by King (2019: 34), this was the outcome of a broader debate within the Basotho royal house about how best to allow its younger factions to claim more territory and followers for themselves and secure control of the nexus of valleys and passes through the Lesotho highlands along which raiders and goods moved.

Oral histories make clear that when Soai and his group were attacked not everyone living at Sehonghong was killed; some survivors escaped, others were taken prisoner, and San groups continued to eke out a living in highland Lesotho until the late 1880s (Vinnicombe 1976: 103), even if identification of individuals as ‘San’ was prejudiced in the aftermath of the failed rebellion against British control by Moorosi’s BaPhuthi in 1879 (King 2019). Although visits to Sehonghong Shelter by Sir Marshall Clarke (1888) in 1887 and the Rev. Edouard Jacottet (1893) in 1893 make no mention of the presence there of San individuals, information obtained by Patricia Vinnicombe

(2009) when the site was first excavated in 1971 confirms that it was, in fact, inhabited after Soai's death. Two nonagenarian informants, Ntate Sello Mokoallo and Ntate Liselo Rankoli, vividly recalled a San when they were children in the late 1880s/1890s and provided information on their activities, including an eland hunt, which Ntate Rankoli had personally witnessed (Vinnicombe 2009: 177). Numbers cannot be ascertained, but at least for a time occupants clearly included multiple men, women and children. Many of them may have been killed or dispersed by Tlhakanelo *c.* 1890 (Vinnicombe 2009: 167), but a few continued to live locally until *c.* 1902 (Vinnicombe 2009: 173). The proliferation of graffiti on Sehonghong's rear wall from 1909 onward (preceded by one dated 24 January 1901), and the absence of any mention of San presence there when Captain Montague Dobson (1910) surveyed the region and the rest of Lesotho between 1904 and 1909, closely fit this date (Mitchell 2010).

Significantly, for the purposes of this paper, some of the narratives on which we have just drawn document the continued manufacture of stone artefacts in the second half of the nineteenth century. Visiting Sehonghong *c.* 1870, for example, 'Me Elisabetha Môhanoé noted that people employed stone tools in working animal hides (Mitchell 2006/07). More specifically, Vinnicombe's (2009: 167, 172, 175, 176) two informants observed those living at the site in the post-Soai era using stone-tipped poisoned arrows to hunt game and fish, harvesting *moseka* (*Eragrostis curvula*) seeds with 'sickles' featuring stones set in some kind of adhesive and butchering animals with stone 'knives'. Finds of what appear to be deliberately retouched flakes of bottle glass from near-surface contexts at Moshebi's Shelter in the southeast of Lesotho reinforce the case for lithic technologies persisting until the very end of an independent San presence in the region (Mitchell *et al.* 2022: 173).

Materials and methods

As previously indicated, analysis of the two specimens discussed in this paper formed part of a larger research programme focused on all of Sehonghong's LSA assemblages in the course of which 2786 formal tools were screened and a total of 30 specimens (1.08%) selected for further assessment by optical light microscopy (Veall 2019). Thirteen of these (43.3%) underwent gas chromatography - mass spectrometry (GC-MS) analysis. The selection of specimens containing macroscopically visible traces of residue on stone tools was made based on the following four criteria (adapted from Charrié-Duhaut *et al.* 2013): that the residues were of a sufficient density that distribution patterns were clear to the naked eye; that they showed clear outlines that were delimited on the piece; that they covered the surface of the tool, opposite to the sharpened or utilised edge; and that, as best as possible, residual trace was observable on both sides of the tool.

Microscopy

Optical light microscopy (OLM) was conducted on all the material analysed to qualitatively describe the nature of the adhesive and to document its extent. This procedure followed those studies conducted on MSA stone artefacts by Lombard (2005, 2006, 2008) to plot the distributions of residues associated with hafting on stone tools. A Zeiss Discovery

V8 stereo microscope with a Nikon D5000 camera, and an objective magnification of 1–12x was used for the analysis.

Gas chromatography coupled mass spectrometry (GC-MS)

Sample preparation

Selected specimens with sufficient black amorphous residue staining underwent a solvent extraction to remove organic materials. Reagents and analytical standards were acquired from Sigma Aldrich. Specimens were placed in glass conical bottom vials, with the proximal end of each tool submerged. Each specimen then underwent sonication (3 × 10 minutes) utilising hexane, dichloromethane and methanol in order of increasing polarity. These fractions were then combined for downstream analysis, with each aliquot dried under a stream of nitrogen in the same vial prior to undergoing derivatisation.

Sample derivatisation

Aliquots (of between 200 and 800 µL depending on solution colour) were dried under a stream of nitrogen and underwent derivatisation. Added to the dried aliquots were 10 µL of internal standard (tridecanoic acid, 100 µg/g, and hexadecane, 50 µg/g for samples analysed in Oxford), 20 µL of N,O-bis(trimethylsilyl)trifluoroacetamide (BSTFA) containing 1% trimethylchlorosilane (TMCS) and 100 µL of n-hexane as a solvent. The derivatisation reaction occurred at 60°C for 30 minutes.

Instrumentation details

The Oxford GC/MS system utilised an Agilent 7820A gas chromatograph equipped with a Restek Rxi-5 ms column (30 m length x 0.25 mm ID x 0.25 µm film thickness, 5% diphenyl/95% dimethylpolysiloxane stationary phase). Samples were injected in splitless mode at a temperature of 300°C. The chromatographic conditions were: initial temperature 50°C, two minute isothermal hold, 50–300°C at 10°C/minute with a ten minute isothermal hold at 300°C (Woodworth *et al.* 2015). The helium (purity 99.9995%) gas flow was set in constant flow mode at 1.2 mL/minute. The Agilent 5975 quadrupole mass spectrometer was set at the following parameters: operated in EI ionisation mode at 70 eV; transfer line interface temperature of 280°C; and a scan range of 50–650 m/z. The injection volume was 2 µL. Peak assignment for all acquired data was based on comparisons to mass spectra libraries including National Institute of Standards and Technology library (NIST 11 main EI MS) and a user-prepared Automated Mass Spectral Deconvolution and Identification System (AMDIS) library, in addition to published data.

Results

Details of all the other specimens analysed from Sehonghong can be found in Table 2 for which Table 3 provides relevant chronometric information. In brief, the most frequently occurring constituents were saturated and monounsaturated carboxylic fatty acids and phthalates. The saturated fatty acids observed, including short chain and mid-chain lengths, are not diagnostic of a particular source (Devièse *et al.* 2017). From samples SEH RBL01, SEH RBL02, SEH GWA03, hexadecenoic (both *cis-* and *trans*-isomers)

Table 2. Summary of the compounds identified in all other analysed artefacts from Sehonghong with information relating to the archaeological context of each sample (after Veall 2019).

Layer	Specimen details	Laboratory number	Artefact type	Main components identified
SS	SEH92 L12-003	SEH SS01	Adze	Phthalates, especially diisooctyl phthalate Monocarboxylic fatty acids ($C_{9:0}$, $C_{12:0}$, even number $C_{14:0}$-$C_{18:0}$) Monounsaturated fatty acids ($C_{16:1}$ and $C_{18:1}$)
DC	SEH92 M12-DC	SEH DC03	Scraper	Phthalates, especially diisooctyl phthalate Monocarboxylic fatty acids ($C_{8:0}$, $C_{9:0}$, even number $C_{14:0}$-$C_{18:0}$)
GWA	SEH92 M13-004	SEH GWA01	Scraper	Phthalates, especially diisooctyl phthalate Monocarboxylic fatty acids ($C_{8:0}$, $C_{9:0}$, even number $C_{14:0}$-$C_{18:0}$)
	SEH92 M13-004	SEH GWA02	Scraper	Phthalates, especially diisooctyl phthalate Monocarboxylic fatty acids ($C_{8:0}$, $C_{9:0}$, even numbers $C_{14:0}$-$C_{18:0}$)
	SEH92 H13-004	SEH GWA03	Scraper	Phthalates, especially diisooctyl phthalate Saturated monocarboxylic fatty acids ($C_{8:0}$, $C_{9:0}$, even numbers $C_{14:0}$-$C_{18:0}$) Monounsaturated fatty acids ($C_{16:1}$ and $C_{18:1}$)
SA	SEH92 K13-036A	SEH SA01	Bladelet	Phthalates, especially diisooctyl phthalate
BARF	SEH92 H13-064	SEH BARF01	Bladelet	Phthalates, especially diisooctyl phthalate Monocarboxylic fatty acids (even numbers $C_{14:0}$-$C_{18:0}$)
RF	SEH92 #2322	SEH RF01	Blade	Even number, mid-chain monocarboxylic fatty acids ($C_{14:0}$-$C_{18:0}$, $C_{18:1}$)
RBL-CLBRF	SEH92 I12-067	SEH RBL01	Bladelet	Phthalates, especially diisooctyl phthalate Saturated monocarboxylic fatty acids ($C_{8:0}$, $C_{9:0}$, even number $C_{14:0}$-$C_{18:0}$) Monounsaturated fatty acids ($C_{16:1}$ and $C_{18:1}$)
	SEH92 L12-067	SEH RBL02	Bladelet	Phthalates, especially diisooctyl phthalate Saturated monocarboxylic fatty acids ($C_{8:0}$, $C_{9:0}$, even number $C_{14:0}$-$C_{18:0}$) Monounsaturated fatty acids ($C_{16:1}$ and $C_{18:1}$), *cis*- and *trans*-isomers of $C_{16:1}$
	SEH92 J12-067	SEH RBL03	Bladelet	Long chain n-alkanes (hydrocarbon series) Sterols Triterpenoids, including α- and β- amyrin and their ketone derivatives Even numbered, mid- and long chain alcohols (C_{18}-C_{30}) Saturated monocarboxylic fatty acids ($C_{8:0}$-$C_{22:0}$)

and octadecenoic (oleic) acids were also found. These unsaturated fatty acids, in combination with a prominent peak of hexadecanoic acid ($C_{16:0}$), suggested the presence of heated plant lipids (Mills and White 1994; Colombini and Modugno 2009; Villa *et al.* 2012). SEH RBL03, a bladelet from the site's late Pleistocene Robberg layers (14,735–14,125 cal. BP; Pargeter *et al.* 2017), also contained markers from plant-derived sterols, triterpenoids α- and β-amyrin and their ketone derivatives, as well as a hydrocarbon wax. The combined presence of the sterols and triterpenoids may be indicative of the presence of plant material in the sampled residue, however, the triterpenoids identified are found in a number of taxa and without additional markers a botanical source cannot be narrowed down. Given the cultural affiliation of the bladelet, the presence of the hydrocarbon wax was identified as a modern contaminant acquired during the excavation process.

We focus now in detail on two of the three cryptocrystalline silica (CCS) scrapers from Layer DC, namely SEH DC01 and SEH DC02 (Figure 3), recovered from squares M12

Table 3. Radiocarbon determinations (all run on charcoal) of layers containing other stone artefacts analysed in this study (Veall 2019). The samples were obtained from the 1992 Sehonghong excavations by Mitchell (1995, 1996a, 1996b) and are shown in sequence with stratigraphic context and cultural association. The uncalibrated dates have been previously published by Mitchell and Vogel (1994) and Pargeter *et al.* (2017). They are recalibrated here using OxCal 4.4 and the SHCal 20 calibration curve (Hogg *et al.* 2020).

Laboratory number	Layer	Cultural association	Date BP	Date cal. BP	Reference
Pta-6063	GAP	Ceramic Final LSA	1710 ± 20	1612–1527	Mitchell (1996b)
Pta-6154	GWA	Classic Wilton	5950 ± 70	6943–6557	Mitchell and Vogel (1994)
Pta-6278	ALP	Later Oakhurst	7290 ± 80	8311–7876	Mitchell (1996a)
Pta-6280	ALP	Later Oakhurst	7090 ± 80	8015–7701	Mitchell (1996a)
Pta-6072	ALP	Later Oakhurst	7210 ± 80	8179–7839	Mitchell and Vogel (1994)
Pta-6083	ALP	Later Oakhurst	7010 ± 70	7944–7672	Mitchell and Vogel (1994)
Pta-6368	SA	Oakhurst	9280 ± 45	10,564–10,254	Mitchell (1996a)
Pta-6057	SA	Oakhurst	9740 ± 140	11,618–10,587	Mitchell and Vogel (1994)
Pta-6065	BARF	Robberg	11,090 ± 230	13,433–12,624	Mitchell (1995)
Pta-6282	RF	Robberg	12,180 ± 110	14,804–13,771	Mitchell (1995)
OxA-32926	RF	Robberg	12,010 ± 50	14,041–13,618	Pargeter *et al.* (2017)
OxA-32925	RF	Robberg	12,355 ± 50	14,710–14,084	Pargeter *et al.* (2017)
OxA-32924	RF	Robberg	12,420 ± 50	14,856–14,177	Pargeter *et al.* (2017)
Pta-6062	RF	Robberg	12,410 ± 45	14,847–14,166	Mitchell and Vogel (1994)
Pta-6058	RF	Robberg	12,470 ± 100	15,030–14,148	Mitchell and Vogel (1994)
OxA-32923	RBL-CLBRF	Robberg	12,870 ± 55	15,556–15,145	Pargeter *et al.* (2017)
OxA-32922	RBL-CLBRF	Robberg	12,960 ± 55	15,647–15,258	Pargeter *et al.* (2017)

and M13 respectively. Microscopically, the identified residue traces on both artefacts can be described as amorphous, low relief smears, ranging between light brown and black in colour. These residues were distributed along the proximal ends and surfaces up to the medial/distal surfaces on both artefacts.

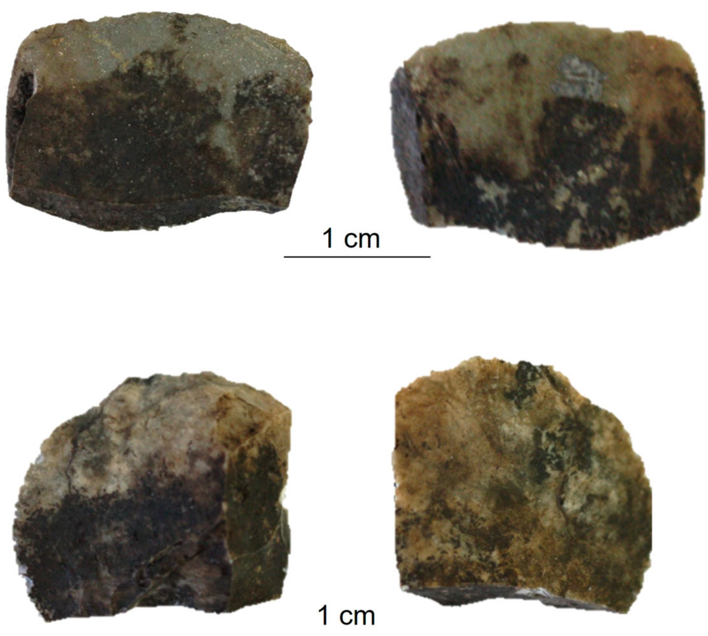

Figure 3. Cryptocrystalline silica scrapers from the DC layer at Sehonghong discussed in this paper: SEH DC01 (top) and SEH DC02 (bottom). Photographs by M. Veall.

Comparatively, the chromatography results from the sampled residues yielded more complex chromatograms than all the other artefacts analysed from Sehonghong in this study (cf. Table 2). Total ion chromatograms (TIC) and a list of complementing markers are given in Figures 4 and Table 4. Notable compounds from SEH DC01 included saturated and unsaturated monocarboxylic fatty acids, $C_{15:0}$ and $C_{17:0}$ branched chain fatty acids, cholesterol, ricinoleic acid, four abietane compounds — abietic acid, dehydroabietic acid (DHA), 7-hydroxy-DHA and 7-oxo-DHA — and the two pimaranes, pimaric acid and sandaracopimaric acid. Polycyclic aromatic hydrocarbons and squalene were also found. The constituents of SEH DC02 were similar, with the exception that long-chain *n*-alkanes (hydrocarbons) were present, but ricinoleic acid absent, in this sample.

Short and mid-chain saturated monocarboxylic fatty acids were identified in both samples but are not diagnostic of a particular source (Devièse *et al.* 2017). The relatively high abundance of hexadecenoic acid ($C_{16:0}$) and saturated hexadecenoic and octadecenoic acids (both *cis*- and *trans*-isomers) may suggest the presence of heated lipid material that is likely to be of plant origin (Mills and White 1987a; Colombini and Modugno 2009; Villa *et al.* 2012). The identification of cholesterol in combination with $C_{15:0}$ and $C_{17:0}$ saturated fatty acids in both SEH DC01 and SEH DC02 suggests, on the other hand, the presence of animal fats (Colombini and Modugno 2009; Regert 2011). It should be noted, however, that the latter set of markers, while associated with ruminant animal

Table 4. List of compounds corresponding to the marked peaks in Figure 1. TMS signifies trimethylsilyl derivative. Identifications and m/z values are from published sources including Helwig *et al.* (2008, 2014) and the NIST Database library.

Label	Compound*	Molecular weight	Characteristic fragment ions (% abundance)
1	Pentadecanoic acid, branched chain (iso- and anteiso-) TMS	314	299 (100), 117 (89), 73 (76), 75 (68), 129 (45), 132 (39), 145 (32), 57 (27), 55 (25)
2	Pentadecanoic acid, TMS	314	73 (100), 75 (74), 299 (65), 117 (64), 129 (31), 145 (24), 132 (23), 55 (22)
3	Hexadecanoic acid, TMS	328	73 (100), 117 (77), 75 (73), 313 (63), 129 (33), 145 (32)
4	Heptadecanoic acid, branched chain (iso- and anteiso-) TMS	342	117 (100), 327 (94), 73 (84), 75 (70), 129 (52), 132 (40), 145 (37), 55 (29), 57 (23)
5	Heptadecanoic acid, TMS	342	73 (100), 117 (72), 75 (70), 132 (48), 327 (41), 145 (30), 129 (29), 55 (26)
6	Octadecenoic acid, TMS	354	73 (100), 75 (88), 116 (63), 55 (55), 129 (45), 339 (44), 145 (30), 67 (26)
7	Octadecanoic acid, TMS	356	73 (100), 117 (79), 75 (75), 132 (65), 145 (33), 129 (31), 57 (20)
8	Pimaric acid, TMS	374	121 (100), 73 (70), 257 (24), 105 (20), 274 (11)
9	Sandaracopimaric acid, TMS	374	121 (100), 73 (95), 257 (21), 359 (18), 374 (10)
10	Dehydroabietic acid, TMS	372	239 (100), 240 (19), 73 (17), 357 (8), 372 (6)
11	Ricinoleic acid, TMS	442	73 (100), 187 (98), 75 (37), 55 (27), 103 (18), 188 (17). 328 (14)
12	Abietic acid, TMS	374	256 (100), 241 (48), 73 (48), 185 (30), 374 (12)
13	7-hydroxyabietic acid, TMS	460	237 (100), 73 (96), 191 (71), 445 (42), 460 (7)
14	Diisooctyl phthalate	390	149 (100), 167 (43), 57 (36), 71 (24), 279 (22), 70 (21), 113 (14)
15	7-oxo-dehydroabietic acid, TMS	386	253 (100), 73 (72), 268 (69), 187 (42), 386 (14)
16	Squalene	410	69 (100), 81 (56), 95 (16), 137 (14)
17	Cholesterol, TMS	458	329 (100), 129 (87), 37 (69), 73 (54), 95(38), 353 (32)
•	n-alkane series	N/A	57 (100), 71 (64), 85 (45), 99 (11)

*TMS = trimethylsilyl derivative

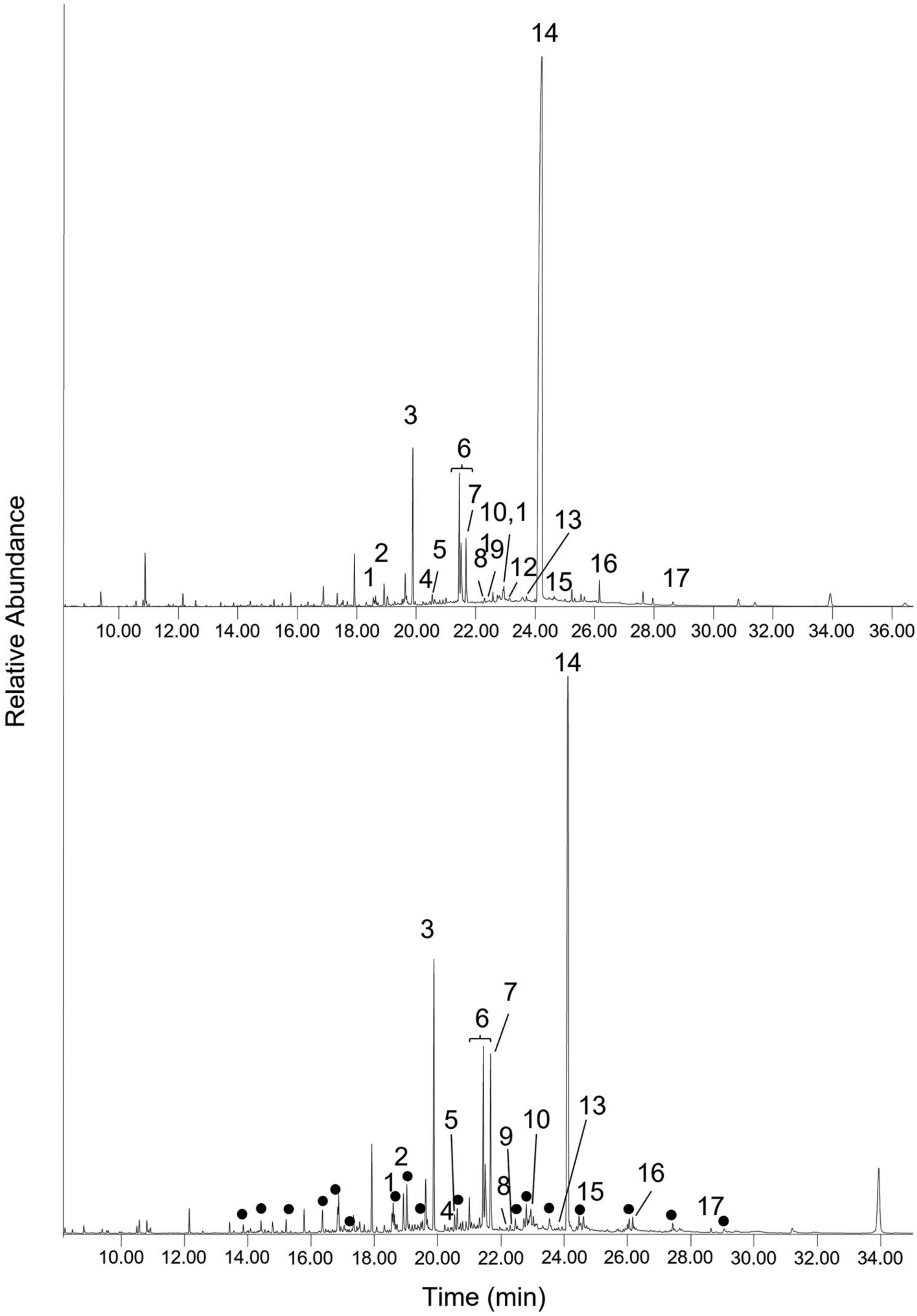

Figure 4. Sehonghong: total ion chromatogram (TIC) obtained from samples removed from the proximal ends of SEH DC01 (top) and SEH DC02 (bottom). The labels on the chromatograms are explained in Table 4.

fats, can also derive from bacterial sources and are generally interpreted with a degree of caution (Dudd *et al.* 1998; Corr *et al.* 2008; Kedrowski *et al.* 2009). In both instances, it is not possible to confirm whether the animal fat, if present, was a purposeful addition to the adhesive or the result of the use of the scraper.

The combination of abietane and pimarane diterpenoids is indicative of the presence of an exudate of a conifer from the *Pinaceae* family, most likely from the genus *Pinus*. (Mills and White 1987b; Otto and Wilde 2001; Colombini *et al.* 2003; Helwig *et al.* 2008, 2014). The abietane dehydroabietic acid (DHA) is a very stable derivative of abietic acid and is present in hardened pine resins; its oxidised derivatives, including 7-oxo-DHA and 7-hydroxy-DHA, are also commonly identifiable in archaeological and art objects (Osete-Cortina *et al.* 2005; Helwig *et al.* 2008). The preservation of pimarane skeleton diterpenoids is rare in archaeological contexts (Colombini and Modugno 2009), although they have been documented in instances of exceptional preservation such as ice patch finds (Helwig *et al.* 2008).

Uniquely among the artefacts analysed from Sehonghong, SEH DC01 also yielded ricinoleic acid (12-hydoxy-9-octadecanoic acid). This fatty acid is the main component of castor oil, making up between 83 and 89% of its total fatty acid content, and it is a marker for this material (Mills and White 1987a). The interpreted presence of castor oil in the residue from this specimen is consistent with the relatively recent age of this layer. A series of long-chain *n*-alkanes, with an abundance distribution that resembles a mineral-based hydrocarbon wax series, such as paraffin, was also identified in SEH DC02 (Ng *et al.* 1994; Waś *et al.* 2016).

Three further classes of compound merit brief mention. Phthalates, of which diisooctyl phthalate is the most abundant compound present in both chromatograms, are common additives in plastics (Meeker *et al.* 2009). These compounds are most likely to be modern contaminants associated with the post-excavation storage of the archaeological collections from Sehonghong in polyethylene bags. These were also identified in all the other analysed samples (Table 2). Squalene is a steroidal precursor and a ubiquitous component of both plant and animal lipids and is present in human skin (Smith and Thiboutot 2008). In archaeological residue studies, its identification tends to be associated with handling contamination as it readily degrades (Whelton *et al.* 2021). Finally, polycyclic aromatic hydrocarbons detected are indicative of biomass burning and fossil fuel use (Khalili *et al.* 1995). They are common in wood smoke and their presence may reflect their occurrence in the depositional environment from which the artefacts studied were recovered.

Discussion

At Sehonghong, the markers identified on the scrapers analysed from Layer DC at the very top of the site's depositional sequence (SEH DC01 and SEH DC02) derived from non-local materials including paraffin wax, castor oil and resin from one or more members of the family *Pinaceae*. This combination of resources provides a relative chronology for the production of the hafting adhesive the residues of which were found on the proximal ends and surfaces of these two tools.

Petroleum-derived products, i.e. paraffins, have a variety of uses as lubricants and sources of heating and lighting (wax candles), as well as in medicines (e.g. liquid paraffin and petroleum jelly (Vaseline®) and cosmetics. Although it has been known since the seventeenth century that mineral oil could be distilled from coal sources, paraffin did not enter manufacture until after 1850 and was not widely available on a commercial scale until the latter half of the nineteenth century (Sharif *et al.* 2001; Golan 2004: 89–90; Jayakumar and Micheletti 2017). Based on the fact that San occupied Sehonghong into the early 1870s and that some individuals returned to live there at some point after the death of Soai *c.* 1872, continuing to do so until the beginning of the twentieth century (Vinnicombe 2009; Mitchell 2010), it is entirely plausible that the presence of a paraffin product on one of the two scrapers we have analysed is authentic and consistent with the chronology available.

Castor oil, which is derived from the beans of the castor oil plant (*Ricinus communis* L.), has a long history of use in commercial industry in the manufacture of soaps, lubricants, cosmetics and coatings (Patel *et al.* 2016) and an even longer record in medicine due to its purgative qualities (Gaginella *et al.* 1998). Multiple regions, including India, tropical and northern Africa and the Mediterranean, have been listed as sources of its natural distribution (Gaginella *et al.* 1998; Patel *et al.* 2016). Although d'Errico *et al.* (2012a) identified the presence of ricinoleic acid on a possible wooden poison applicator at Border Cave in Layer 1BS Lower B-C, an Early Later Stone Age (ELSA) context dating to roughly 24,000 years ago, their interpretation of this as evidence for the use of ricin as an arrow poison has been contested (Evans 2012; cf. d'Errico *et al.* 2012b) and seems unlikely given the general consensus that the species is not native to the wider region. Significantly, *R. communis* does not appear elsewhere in the southern African archaeological record until relatively recently, with seeds in rockshelter deposits at Umhlatuzana (Kaplan 1990) and Shongweni South (Deacon 1986) elsewhere in KwaZulu-Natal potentially being intrusive. The much larger number of seeds in second-millennium AD deposits at Sibudu Cave is more convincing and could reflect a pre-European introduction of the species into southeastern southern Africa, but even here downward movement through stratigraphic disturbance cannot be excluded (Scott 2005). Otherwise, *R. communis* is first identified in historic assemblages in a seventeenth-century context at Khami, Zimbabwe (Jonsson 1998) and in finds from sites in the Olifants Valley of South Africa's Western Cape Province dating from the eighteenth century onward (Parkington and Poggenpoel 1971; Anderson 1991). In both cases its presence is thought ultimately to reflect an introduction to the region by Europeans, namely the Portuguese along the Indian Ocean coast of eastern Africa and the Dutch starting from Cape Town. Today, it is widely cultivated, as well as occurring as a weed, across much of the Cape and South Africa's summer rainfall region (van Wyk *et al.* 2000: 216), including lowland Lesotho, although even today it is absent from the highland regions of the country (Kobisi *et al.* 2019). This last point suggests that, as with the presence of paraffin, its presence on the artefacts we have analysed reflects access to industrial products, not living plants. Moreover, its absence from all the stone artefacts analysed at Sehonghong except the SEH DC01 scraper argues strongly against its being a contaminant acquired during the excavation process.

No species of the family *Pinaceae* is native to southern Africa, although many have been introduced there (Coates Palgrave 1983: 58). Members of the genus *Pinus* first arrived in the Cape at the time of Van Riebeeck's initial colonisation in the 1650s, encouraged by the Dutch East India Company to stave off a potential timber shortage.

The first species to land was the Scots pine (*Pinus sylvestris*), with the Italian stone pine (*P. pinea*) and the Mediterranean pine (*P. pinaster*) arriving later in the seventeenth century (Showers 2010). *P. sylvestris* is exclusively Eurasian in origin, but *P. pinaster* and *P. pinea* are native to the Mediterranean Basin, occurring in Europe and the northern Maghreb, with the latter also indigenous to Turkey and the Levant. Other species were introduced to South Africa during the later 1800s from Europe, Japan, China and North America (Hutchins 1905: 396–397) with the principal goal of providing local supplies of timber for buildings, railways, mines and domestic purposes rather than having to continue to rely upon imports or radically reduced indigenous alternatives (Brown 2001). Collectively, at least nine species now occur in the region, both on conifer plantations and in invasive form, especially in the Fynbos Biome of the Cape (Richardson *et al.* 1994: Table 2).

Pines spread inland from the Cape in the wake of the expansion of European settlement and subsequently onward into what is now KwaZulu-Natal in the second half of the nineteenth century (Showers 2010). Lesotho came under British protection in 1868 and, after being briefly governed by the Cape Colony (from 1871), reverted to direct British control in 1884. Stone pines were planted by some of the earliest missionaries at Morija in the west of the country in 1833 (Leslie 1992) and as early as 1876 colonial administrators are documented as sponsoring efforts to plant trees as a source of fuel, with prizes offered to those who would grow the greatest number; the Australian blue gum (*Eucalyptus globulus*) was considered the most desirable species because of its rapid growth, but oaks, acacias, poplars and willows were also encouraged (Germond 1967). Concentrated in the western lowlands of Lesotho, some of these early efforts included members of the genus *Pinus (P. halepensis, P. pinaster, P. radiata, P. thunbergii)*, although their success was variable (Colonial Annual Report 1902–03, 1903–04, 1912–13; Heywood 1908; Hall and Green 1989: 57). Serious tree-planting campaigns only got underway in the 1930s, linked to efforts to promote soil conservation and included pines, but mostly focused on poplars and willows (Showers 2006: 18). Pines along with eucalypts then gained in favour following the post-independence establishment of the Lesotho Woodlot Project in 1973 (Ambrose *et al.* 2000: 83). The highly invasive nature of members of the genus *Pinus* raises the possibility that they could have spread from South Africa into Lesotho independently of such initiatives. However, the historical record and poor survival of *Pinus* species in experimental plantings across most of Lesotho's highlands (Leslie 1992), coupled with the exposed nature of the high mountain ranges present in the centre of the country and along the uKhahlamba-Drakensberg Escarpment — locations that extend well above the tree line — make this unlikely. Evidence of *Pinus* in the two scrapers reported here from Sehonghong's DC layer is, instead, we suggest, almost certainly the result of access to pine resin-derived products such as rosin (a solid form of pine resin), soaps and tars. This is made all the more likely by the final disappearance of individuals of San descent from Sehonghong Shelter early in the twentieth century, i.e. before pine was widely introduced as part of national tree-planting projects (Vinnicombe 2009; Mitchell 2010).

To summarise, we have found biochemical evidence for the presence in two stone scrapers from Layer DC at Sehonghong of three materials that are either derived from plants exotic to southern Africa (pine and castor oil) or that result exclusively from an industrial manufacturing process (paraffin). Collectively, these materials are known to be present in a variety of domestic products, including soap, tar, lubricants, cosmetics, medicines and candles, all of which would have been plausibly available via shops and stores in later nineteenth-/early twentieth-century southern Africa. Paraffin, an industrial product, and almost certainly *Pinus* would not have been available naturally in Lesotho at this time. Since castor oil plants are restricted to the country's western lowlands even today (Kobisi *et al.* 2019), it seems likely that they too would not have been readily available in the highland region where Sehonghong is located. All three substances could, however, have been obtained in one form or another from traders, whose numbers proliferated in Lesotho following the country's annexation by Britain in 1868. Within a decade over 70 fixed trading stations existed (Keegan 1986; Mahiele 2021) and they then gradually expanded into the highlands following in the wake of Basotho settlement. Sehonghong, as the oldest village east of the Senqu River (established in 1878) and seat of the oldest mission station in the area (established in 1892), may have been a particularly attractive location. People living there in the 1880s and 1890s — including those inhabiting Sehonghong Shelter — are therefore likely to have had access to products containing pine, castor oil and paraffin via these expanding colonially oriented commercial networks.

Alternatively, such access could have been gained over longer distances, for example via travel to, or exchange connections with, trading locales below the uKhahlamba-Drakensberg Escarpment in KwaZulu-Natal. Here, it is worth remembering that there is extensive archival evidence for groups of at least partial San descent locating themselves within Lesotho and raiding or trading with communities in Natal from at least the 1840s into the 1870s (Wright 1971; Vinnicombe 1976). Rock paintings left by one of these groups, the AmaTola, concentrate as we have noted in Lesotho's southeastern highlands and immediately adjacent parts of South Africa. In conjunction with historical records, they testify to their access to a range of European-derived items of material culture in the form of firearms, clothing, iron cooking pots, saddles and other goods (How 1970; Wright 1971; Vinnicombe 1976; Challis 2008, 2012). Even further afield, Basotho men were already working in large numbers on farms and mines in the British colonies and Afrikaner republics of what later became South Africa in the 1870s and by 1908 several tens of thousands were doing so out of a total population of no more than 350,000 (Ashton 1967: 162). Migrant labour of this kind drew in men from across Lesotho (Eldredge 1993), providing another means whereby trade goods could enter the local economy and, conceivably, become available to San descendants.

Our discussion here has been necessarily speculative, but there is no doubt that individuals of San descent continued to live in Sehonghong Shelter until the end of the nineteenth/beginning of the twentieth centuries and that at least on some occasions they continued to make stone tools while so doing. The killing of Soai and the dispersal, death or capture of his followers around 1872 thus emerges as more of a punctuation mark rather than a point of termination in the San history of Sehonghong during the nineteenth century. Both before that event and in its aftermath, people living at Sehonghong, whether of San descent or Basotho who settled there from 1878, adopted and made use of trade goods and engaged in a series of technological transitions and adaptations. Among these changes, we submit, was a transition in the source and kinds of adhesives they used for mounting stone artefacts, from local resources which could not be identified in this analysis to the incorporation of other materials ultimately sourced in the industrialising Western world.

The appearance of such materials at Sehonghong indicates that the tools to which they were applied must have been produced by some of the very last hunter-gatherer populations to occupy this part of southern Africa. Presented herein, then, is another story, one not told by people (Indigenous or European) or by rock art imagery. The use and acquisition of resources that were neither native to the region nor representative of a traditional repertoire of adhesive components provides a concrete, material culture example of King's (2017: 14) assessment of the meaning of refuge during this time and of the "complex and sustained series of engagements" in which those inhabiting the nineteenth-century Maloti-Drakensberg Mountains were involved. The historical narrative of those engagements begins in the early 1800s by describing relationships between hunter-gatherer groups once described as the 'Bushman raiders of the Drakensberg' (Wright 1971) and Bantu-speaking and European farmers living east of the uKhahlamba-Drakensberg Escarpment in modern-day KwaZulu-Natal and south into the Eastern Cape Province of South Africa. Violence and extermination appear as the dominant subject-matter in these records (Wright 1971). Oral histories recall the presence of San at Sehonghong both around 1870 and, following the death of Soai, in the late 1880s/1890s (Vinnicombe 2009; Mitchell 2010). These dates readily place the last hunter-gatherer-descended inhabitants of Sehonghong Shelter within contact distance of the expanding colonial economy and its local manifestations and relationships and, by extension, of the products that it offered (paraffin, castor oil, and pine derivatives such as rosin, soap, printing inks and varnish [Gibbs 1939; Mills and White 1987b]). Their presence in local hafting adhesives reflects the penetrability of such items over cultural, topographic and geographical distance at a time when colonial settlement (by Basotho as well as Europeans; Mitchell 2018) was encroaching on, and bringing to an end, the lifeways and movement of hunter-gatherers within a region previously viewed as largely untameable (King 2017). Stray items of iron and bottle glass in the DC Layer at Sehonghong may also reflect this (Mitchell 1996b).

The trace remnants of adhesives from the two scrapers from Sehonghong's Layer DC thus lend a novel dimension to a historic record that frequently emphasises the tense relationships between the last hunter-gatherer populations of the Maloti-Drakensberg, the Basotho and advancing European colonial rule. In this case, we see the adoption of a landscape of novel resources to enable people of ultimately hunter-gatherer origin to maintain aspects of traditional lifeways by actively navigating their way through a world of dramatic material changes within increasingly marginalised social and economic circumstances. While we cannot know precisely how these ingredients made their way into the hands of the tools' fabricators, the application of analytical techniques to understand better the composition of organic materials that are components of complex technologies contributes to our knowledge of the items themselves while also allowing us to re-engage with — and re-evaluate — existing narratives of inter-societal contact from an unusual perspective.

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References

Ambrose, D., Pomela, E.M. and Talukdar, S. (eds). 2000. *Biological Diversity in Lesotho*. Maseru: National Environment Secretariat.

Anderson, G. 1991. "Andriesgrond revisited: material culture, ideologies and social change." MA diss., University of Cape Town.

Ashton, H. 1967. *The Basuto: A Social Study of Traditional and Modern Lesotho*. Oxford: Oxford University Press.

Barham, L.S. 2013. *From Hand to Handle: The First Industrial Revolution*. Oxford: Oxford University Press.

Bawden, M.G. and Carroll, D.M. 1968. *The Land Resources of Lesotho*. Tolworth: United Kingdom Directorate of Overseas Surveys.

Binneman, J.N.F. and Mitchell, P.J. 1997. "Usewear analysis of Robberg bladelets from Sehonghong Shelter, Lesotho." *Southern African Field Archaeology* 6: 42–49.

Brown, K. 2001. "The conservation and utilisation of the natural world: silviculture in the Cape Colony, *c.* 1902–1910." *Environment and History* 7: 427–447.

Carter, P.L. 1978. "The prehistory of eastern Lesotho." PhD diss., University of Cambridge.

Carter, P.L., Mitchell, P.J. and Vinnicombe, P. 1988. *Sehonghong: The Middle and Later Stone Age Industrial Sequence at a Lesotho Rock-Shelter*. Oxford: British Archaeological Reports.

Carter, P.L. and Vogel, J.C. 1974. "The dating of industrial assemblages from stratified sites in eastern Lesotho." *Man* 9: 557–570.

Challis, S. 2008. "The impact of the horse on the AmaTola 'Bushmen': new identity in the Maloti-Drakensberg Mountains of southern Africa." DPhil diss., University of Oxford.

Challis, S. 2012. "Creolisation on the nineteenth-century frontiers of southern Africa: a case study of the AmaTola 'Bushmen' in the Maloti-Drakensberg." *Journal of Southern African Studies* 38: 265–280.

Challis, S. and Sinclair-Thomson, B. 2022. "The impact of contact and colonization on Indigenous worldviews, rock art, and the history of southern Africa: 'the disconnect'." *Current Anthropology* 63: 91–127.

Charrié-Duhaut, A., Porraz, G., Cartwright, C.R., Igreja, M., Connan, J., Poggenpoel, C.A. and Texier, P.-J. 2013. "First molecular identification of a hafting adhesive in the late Howiesons

Poort at Diepkloof Rock Shelter (Western Cape, South Africa)." *Journal of Archaeological Science* 40: 3506–3518.

Charrié-Duhaut, A., Porraz, G., Igreja, M., Texier, P.-J. and Parkington, J. E. 2016. "Holocene hunter-gatherers and adhesive manufacture in the West Coast of South Africa." *Southern African Humanities* 29(1): 283–306.

Clarke, M. 1888. "Unexplored Basutoland." *Proceedings of the Royal Geographical Society* 10: 519–530.

Coates Palgrave, K. 1983. *Trees of Southern Africa*. Cape Town: Struik Publishers.

Collis, B. 2010. "Dating the introduction of pottery to the Maloti-Drakensberg region of southern Africa using optically stimulated luminescence." BA (Hons) diss., University of Oxford.

Colombini, M.P., Giachi, G., Modugno, F., Pallecchi, P. and Ribechini, E. 2003. "The characterization of paints and waterproofing materials from the shipwrecks found at the archaeological site of the Etruscan and Roman harbour of Pisa (Italy)." *Archaeometry* 45: 659–674.

Colombini, M.P. and Modugno, F. 2009. *Organic Mass Spectrometry in Art and Archaeology*. Chichester: John Wiley & Sons.

Colonial Annual Report 1902–03. *Colonial Annual Report, Basutoland, 1902–1903*. London: His Majesty's Stationery Office.

Colonial Annual Report 1903–04. *Colonial Annual Report, Basutoland, 1903–1904*. London: His Majesty's Stationery Office.

Colonial Annual Report 1912–13. *Colonial Annual Report, Basutoland, 1912–1913*. London: His Majesty's Stationery Office.

Conz, C.R. 2017. "'Wisdom does not live in one house': compiling environmental knowledge in Lesotho, southern Africa, *c.* 1880–1965." PhD diss. Boston University.

Corr, L.T., Richards, M.P., Jim, S., Ambrose, S.H., Mackie, A., Beattie, O. and Evershed, R.P. 2008. "Probing dietary change of the Kwädąy Dän Ts'ìnchį individual, an ancient glacier body from British Columbia: I. Complementary use of marine lipid biomarker and carbon isotope signatures as novel indicators of a marine diet." *Journal of Archaeological Science* 35: 2102–2110.

d'Errico, F., Backwell, L., Villa, P., Degano, I., Lucejko, J.J., Bamford, M.K., Higham, T.F.G., Colombini, M.P. and Beaumont, P.B. 2012a. "Early evidence of San material culture represented by organic artifacts from Border Cave, South Africa." *Proceedings of the National Academy of Sciences of the United States of America* 109: 13214–13219.

d'Errico, F., Backwell, L., Villa, P., Degano, I., Lucejko, J.J., Bamford, M.K., Higham, T.F.G., Colombini, M.P. and Beaumont, P.B. 2012b. "Reply to Evans: use of poison remains the most parsimonious explanation for Border Cave castor bean extract." *Proceedings of the National Academy of Sciences of the United States of America* 109: E3291–E3292.

Deacon, H.J. 1966. "Note on the X-ray of two mounted implements from South Africa." *Man* 1: 87–90.

Deacon, J. 1986 "Human settlement in South Africa and archaeological evidence for alien plants and animals." In *The Ecology and Management of Biological Invasions in Southern Africa*, edited by I.A.W. MacDonald, F.J. Kruger and A.A. Ferrar, 3–19. Cape Town: Oxford University Press.

Devièse, T., Ribechini, E., Castex, D., Stuart, B., Regert, M. and Colombini, M.P. 2017. "A multi-analytical approach using FTIR, GC/MS and Py-GC/MS revealed early evidence of embalming practices in Roman catacombs." *Microchemical Journal* 133: 49–59.

Dobson, M.C. 1910. *Military Report on Basutoland*. London: The War Office.

Dudd, S.N., Regert, M. and Evershed, R.P. 1998. "Assessing microbial lipid contributions during laboratory degradations of fats and oils and pure triacylglycerols absorbed in ceramic potsherds." *Organic Geochemistry* 29: 1345–1354.

Eldredge, E.A. 1993. *A South African Kingdom: The Pursuit of Security in Nineteenth-Century Lesotho*. Cambridge: Cambridge University Press.

Evans, A.A. 2012. "Arrow poisons in the Palaeolithic?" *Proceedings of the National Academy of Sciences of the United States of America* 109: E3290.

Fewlass, H., Mitchell, P.J., Casanova, E. and Cramp, L.J.E. 2020. "Chemical evidence of dairying by hunter-gatherers in highland Lesotho in the late first millennium AD." *Nature Human Behaviour* 4: 791–799.

Gaginella, T.S., Capasso, F., Mascolo, N. and Perilli, S. 1998. "Castor oil: new lessons from an ancient oil." *Phytotherapy Research* 12: S128–S130.
Germond, R.C. 1967. *Chronicles of Basutoland*. Morija: Morija Sesuto Book Depot.
Gibbs, F.W. 1939. "The history of the manufacture of soap." *Annals of Science* 4: 169–190.
Gibson, N.E., Wadley, L. and Williamson, B.S. 2004. "Residue analysis of backed tools from the 60 000 to 68 000 year-old Howiesons Poort layers of Rose Cottage Cave, South Africa." *Southern African Humanities* 16: 1–11.
Golan, T. 2004. *Laws of Men and Laws of Nature: The History of Scientific Expert Testimony in England and America*. Cambridge: Harvard University Press.
Hall, D. and Green, T. 1989. *Community Forestry in Lesotho: The People's Perspective*. Morija: Morija Printing Works.
Helwig, K., Monahan, V. and Poulin, J. 2008. "The identification of hafting adhesive on a slotted antler point from a southwest Yukon ice patch" *American Antiquity* 73: 279–288.
Heywood, A.W. 1908. "Report on forestry in Basutoland to Government Secretary, Maseru." In *Colonial Office: High Commission for South Africa, Original Correspondence. Despatches, Basutoland and Portuguese Territory 1908*. London: Public Records Office CO 417.455.
Hogg, A.G., Heaton, T.J., Hua, Q., Palmer, J.G., Turney, C.S.M., Southon, J., Bayliss, A., Blackwell, P.G., Boswijk, G., Bronk Ramsey, C., Pearson, C., Petchey, F., Reimer, P., Reimer, R. and Wacker, L. 2020. "SHCal20 Southern Hemisphere calibration, 0–55,000 years cal BP." *Radiocarbon* 62: 759–778.
Horsburgh, A.K., Moreno-Mayar, J.V. and Gosling, A.L. 2016. "Revisiting the Kalahari debate in the highlands: ancient DNA provides new faunal identifications at Sehonghong, Lesotho." *Azania: Archaeological Research in Africa* 51: 295–306.
How, M.W. 1970. *The Mountain Bushmen of Basutoland*. Pretoria: J.L. van Schaik Ltd.
Hutchins, D.E. 1905. "Forestry in South Africa." In *Science in South Africa: A Handbook and Review*, edited by W. Flint and J.D.F. Gilchrist, 375–390. Cape Town: T. Maskew Miller.
Jacobs, Z., Roberts, R.G., Galbraith, R.F., Deacon, H.J., Grün, R., Mackay, A., Mitchell, P.J., Vogelsang, R. and Wadley, L. 2008. "Ages for the Middle Stone Age of southern Africa: implications for human behavior and dispersal." *Science* 322: 733–735.
Jacottet, E. 1893. "L'oeuvre des Maloutis (2)." *Journal des Missions Evangéliques* 68: 510–519.
Jayakumar, K.L. and Micheletti, R.G. 2017. "Robert Chesebrough and the dermatologic wonder of petroleum jelly." *Journal of the American Medical Association Dermatology* 153: 1157.
Jonsson, J. 1998. *Early Plant Economy in Zimbabwe*. Uppsala: Uppsala University Press.
Kaplan, J. 1990. The Umhlatuzana Rock Shelter sequence: 100 000 years of Stone Age history. *Natal Museum Journal of Humanities* 2: 1–94.
Kedrowski, B.L., Crass, B.A., Behm, J.A., Luetke, J.C., Nichols, A.L., Moreck, A.M. and Holmes, C.E. 2009. "GC/MS analysis of fatty acids from ancient hearth residues at the Swan Point archaeological site." *Archaeometry* 51: 110–122.
Keegan, T. 1986. "Trade, accumulation and impoverishment: mercantile capital and the economic transformation of Lesotho and the conquered territory, 1870–1920." *Journal of Southern African Studies* 12: 196–216.
Khalili, N., Scheff, P.A. and Holsen, T. 1995. "PAH source fingerprints for coke ovens, diesel and gasoline engines, highway tunnels, and wood combustion emissions." *Atmospheric Environment* 29(4): 533–542.
King, R. 2017. "Living on edge: new perspectives on anxiety, refuge and colonialism in southern Africa." *Cambridge Archaeological Journal* 27: 533–551.
King, R. 2019. *Outlaws, Anxiety and Disorder in Southern Africa: Material Histories of the Maloti-Drakensberg*. Cham: Palgrave Macmillan.
Kobisi, K., Seleteng-Kose, L. and Moteetee, A. 2019. "Invasive alien plants occurring in Lesotho: their ethnobotany, potential risks, distribution and origin." *Bothalia: African Biodiversity & Conservation* 49(1): a2453.
Leslie, A.D. 1991. "Indigenous forest and woodland in the kingdom of Lesotho." *South African Forestry Journal* 158: 97–103.

Leslie, A.D. 1992. *Conifer Trials in Lesotho, A Review of Results*. Maseru: Research Section, Forestry Division, Ministry of Agriculture.

Lewis-Williams, J.D. 2003. *Images of Mystery: Rock Art of the Drakensberg*. Cape Town: Double Storey.

Loftus, E., Stewart, B.A., Dewar, G.I. and Lee-Thorp, J.A. 2015. "Stable isotope evidence of late MIS 3 to middle Holocene palaeoenvironments from Sehonghong Rockshelter, eastern Lesotho." *Journal of Quaternary Science* 30: 805–816.

Lombard, M. 2005. "Evidence of hunting and hafting during the Middle Stone Age at Sibudu Cave, KwaZulu-Natal, South Africa: a multianalytical approach." *Journal of Human Evolution* 48: 279–300.

Lombard, M. 2006a. "Direct evidence for the use of ochre in the hafting technology of Middle Stone Age tools from Sibudu Cave." *Southern African Humanities* 18(1): 57–67.

Lombard, M. 2006b. "First impressions of the functions and hafting technology of Still Bay pointed artefacts from Sibudu Cave." *Southern African Humanities* 18(1): 27–41.

Lombard, M. 2007. "The gripping nature of ochre: the association of ochre with Howiesons Poort adhesives and Later Stone Age mastics from South Africa." *Journal of Human Evolution* 53: 406–419.

Lombard, M. 2008. "Finding resolution for the Howiesons Poort through the microscope: micro-residue analysis of segments from Sibudu Cave, South Africa." *Journal of Archaeological Science* 35: 26–41.

Lombard, M., Wadley, L., Deacon, J., Wurz, S., Parsons, I., Mohapi, M., Swart, J. and Mitchell, P.J. 2012. "South African and Lesotho Stone Age sequence updated (I)." *South African Archaeological Bulletin* 67: 120–144.

Mahiele, S.M. 2021. *Commerce as Politics: The Two Centuries of Struggle for Basotho Economic Independence*. Oxford: Berghahn.

McGranaghan, M., Challis, S. and Lewis-Williams, J.D. 2013. "Joseph Millerd Orpen's 'A glimpse into the mythology of the Maluti Bushmen': a contextual introduction and republished text." *Southern African Humanities* 25: 137–166.

Meeker, J.D., Sathyanarayana, S. and Swan, S. H. 2009. "Phthalates and other additives in plastics: human exposure and associated health outcomes." *Philosophical Transactions of the Royal Society B: Biological Sciences* 364: 2097–2113.

Mills, J.S. and White, R. 1987a. *The Organic Chemistry of Museum Objects*. London: Butterworth-Heineman.

Mills, J.S. and White, R. 1987b. "Natural resins and lacquers." In *The Organic Chemistry of Museum Objects*, edited by J.S. Mills and R. White, 83–110. London: Butterworth-Heineman.

Mitchell, P.J. 1993. "Archaeological investigations at two Lesotho rock-shelters: terminal Pleistocene/early Holocene assemblages from Ha Makotoko and Ntloana Tsoana." *Proceedings of the Prehistoric Society* 59: 39–60.

Mitchell, P.J. 1995. "Revisiting the Robberg: new results and a revision of old ideas at Sehonghong rock shelter, Lesotho." *South African Archaeological Bulletin* 50: 28–38.

Mitchell, P.J. 1996a. "Filling a gap: the early and middle Holocene assemblages from new excavations at Sehonghong Rock Shelter, Lesotho." *Southern African Field Archaeology* 5: 17–27.

Mitchell, P.J. 1996b. "Sehonghong: the late Holocene assemblages with pottery." *South African Archaeological Bulletin* 51: 17–25.

Mitchell, P.J. 1996c. "The late Quaternary of the Lesotho Highlands, southern Africa: preliminary results and future potential of ongoing research at Sehonghong shelter." *Quaternary International* 33: 35–43.

Mitchell, P.J. 2006/07. "Remembering the Mountain Bushmen: observations of nineteenth century hunter-gatherers in Lesotho as recorded by Victor Ellenberger." *Southern African Field Archaeology* 15/16: 3–11.

Mitchell, P.J. 2009. "The flaked stone artefact assemblages from Likoaeng: a late Holocene sequence in the Lesotho Highlands and its regional context." *Southern African Humanities* 21: 117–155.

Mitchell, P.J. 2010. "Making history at Sehonghong: Soai and the last Bushman occupants of his shelter." *Southern African Humanities* 22:149–170.

Mitchell, P.J. 2013. "Southern African hunter-gatherers of the last 25,000 years." In *The Oxford Handbook of African Archaeology*, edited by P.J. Mitchell and P.J. Lane, 473–490. Oxford: Oxford University Press.

Mitchell, P.J. 2018. "The final frontier: colonization and colonialism in the nineteenth-century Maloti Mountains, southern Africa." In *The Resilience of Heritage: Cultivating a Future of the Past. Essays in Honour of Prof. Paul J.J. Sinclair*, edited by A. Ekblom, C. Isendahl and K.-J. Lindholm, 343–360. Uppsala: University of Uppsala Press.

Mitchell, P.J., Arthur, C., Pinto, H. and Capelli, C. 2022. "Moshebi's Shelter at fifty: reinvestigating the Later Stone Age of the Sehlabathebe Basin, Lesotho." *Quaternary International* 611–612: 163–176.

Mitchell, P.J. and Challis, S. 2008. "A first glimpse into the Maloti Mountains: the diary of James Murray Grant's expedition of 1873–1874." *Southern African Humanities* 20: 401–463.

Ng, L-K., Whitehead, D. and Dalton, C. 1994. "Gas chromatography method for the analysis of waxes project # 10062-MD." Ottawa, Ontario: Revenue Canada. Unpublished report.

Orpen, J.M. 1874. "A first glimpse into the mythology of the Maluti Bushmen." *Cape Monthly Magazine* 9: 1–13.

Osete-Cortina, L. and Doménech-Carbó, M.T. 2005. "Analytical characterization of diterpenoid resins present in pictorial varnishes using pyrolysis–gas chromatography–mass spectrometry with on line trimethylsilylation." *Journal of Chromatography A* 1065: 265–278.

Otto, A. and Wilde, V. 2001. "Sesqui-, di-, and triterpenoids as chemosystematic markers in extant conifers — a review." *The Botanical Review* 67: 141–238.

Pargeter, J., Loftus, E. and Mitchell, P.J. 2017. "New ages from Sehonghong rock shelter: implications for the late Pleistocene occupation of highland Lesotho." *Journal of Archaeological Science: Reports* 12: 307–315.

Parkington, J.E. and Poggenpoel, C.A. 1971. "Excavations at De Hangen, 1968." *South African Archaeological Bulletin* 26: 3–36.

Parkington, J., Yates, R., Manhire, A. and Halkett, D. 1986. "The social impact of pastoralism in the southwestern Cape." *Journal of Anthropological Archaeology* 5: 313–329.

Patel, V.R., Dumancas, G.G., Visiwanath, L.C.K., Maples, R. and Suibong, B.J.J. 2016. "Castor oil: properties, uses, and optimization of processing parameters in commercial production." *Lipid Insights* 9: 1–12.

Phillipson, D.W. 1976. *The Prehistory of Eastern Zambia*. Nairobi: British Institute in Eastern Africa.

Plug, I. and Mitchell, P.J. 2008a. "Sehonghong: hunter-gatherer utilization of animal resources from the highlands of Lesotho." *Annals of the Transvaal Museum* 45: 31–53.

Plug, I. and Mitchell, P.J. 2008b. "Fishing in the Lesotho highlands: 26,000 years of fish exploitation, with special reference to Sehonghong Shelter." *Journal of African Archaeology* 6: 33–55.

Regert, M. 2011. "Analytical strategies for discriminating archaeological fatty substances from animal origin." *Mass Spectrometry Reviews* 30: 177–220.

Richardson, D.M., Williams, P.A. and Hobbs, R.J. 1994. "Pine invasions in the southern hemisphere: determinants of spread and invadability." *Journal of Biogeography* 21: 511–527.

Sanderson, C., Emmanuel, J. and Campbell, P. 1988. "A historical review of paraffin and its development as an embedding medium." *Journal of Histotechnology* 11: 61–63.

Scott, C. 2005. "Analysis and interpretation of botanical remains from Sibudu Cave, KwaZulu-Natal." MSc. diss., University of the Witwatersrand.

Sharif, F., Crushell, E., O'Driscoll, K. and Rourke, B. 2001. "Liquid paraffin: a reappraisal of its role in the treatment of constipation." *Archives of Disease in Childhood* 85: 121–124.

Showers, K.B. 2006. "From forestry to soil conservation: British tree management in Lesotho's grassland ecosystem." *Conservation and Society* 4: 1–35.

Showers, K.B. 2010. "Prehistory of southern African forestry: from vegetable garden to tree plantation." *Environment and History* 16: 295–322.

Smith, K.R. and Thiboutot, D.M. 2008. "Thematic review series: skin lipids. Sebaceous gland lipids: friend or foe?" *Journal of Lipid Research* 49: 271-281.

Soriano, S., Villa, P. Delagnes, A., Degano, I., Pollarolo, L., Lucejko, J.J., Henshilwood, C.S. and Wadley, L. 2015. "The Still Bay and Howiesons Poort at Sibudu and Blombos: understanding Middle Stone Age technologies." *PLoS ONE* 10 (7): e0131127.

South African National Biodiversity Institute. 2006. *The Vegetation Map of South Africa, Lesotho and Swaziland*, edited by L. Mucina, M.C. Rutherford, and L. W Powrie, Online, http://bgis.sanbi.org/Projects/Detail/185, Version 2012

Staples, R.R. and Hudson, K.W. 1938. *An Ecological Survey of the Mountain Area of Basutoland*. Tolworth: Crown Agents.

Stewart, B.A. and Mitchell, P.J. 2018a. "Beyond the shadow of a desert: aquatic resource intensification on the roof of southern Africa." In *Foraging in the Past: Archaeological Studies of Hunter-Gatherer Diversity*, edited by A.K. Lemke, 159–208. Boulder: University of Colorado Press.

Stewart, B.A. and Mitchell, P.J. 2018b. "Late Quaternary palaeoclimates and human-environment dynamics of the Maloti-Drakensberg region, southern Africa." *Quaternary Science Reviews* 196: 1–20.

van Wyk, B.-E., van Oudtshoorn, B. and Gericke, N. 2000. *Medicinal Plants of South Africa*. Pretoria: Briza Publications.

Veall, M.-A. 2019. "Stuck like glue: assessing variability in hafting adhesives in the southern African Later Stone Age." DPhil diss., University of Oxford.

Veall, M-A. 2022. "Hafting technology in the Stone Age of southern Africa." In *The Oxford Research Encyclopedia of Anthropology*. Oxford: Oxford University Press. https://oxfordre.com/anthropology/display/10.1093acrefore/9780190854584.001.0001/acrefore-9780190854584-e-60?rskey=qoZoM2&result=14 Site accessed 21 May 2023.

Villa, P., Soriano, S., Tsanova, T., Degano, I., Higham, T.F.G., d'Errico, F., Backwell, L., Lucejko, J.J., Colombini, M.P. and Beaumont, P.B. 2012. "Border Cave and the beginning of the Later Stone Age in South Africa." *Proceedings of the National Academy of Sciences of the United States of America* 109: 13208–13213.

Vinnicombe, P.V. 1976. *People of the Eland: Rock Paintings of the Drakensberg Bushmen as a Reflection of their Life and Thought*. Pietermaritzburg: University of Natal Press.

Vinnicombe, P.V. 2009. "Basotho oral knowledge: the last Bushman inhabitants of the Mashai District, Lesotho." In *The Eland's People: New Perspectives in the Rock Art of the Maloti-Drakensberg Bushmen. Essays in Memory of Patricia Vinnicombe*, edited by P.J. Mitchell and B.W. Smith, 165–191. Johannesburg: Wits University Press.

Wadley, L. 2010. "Compound-adhesive manufacture as a behavioral proxy for complex cognition in the Middle Stone Age." *Current Anthropology* 51: 111–119.

Wadley, L., Hodgskiss, T. and Grant, M. 2009. "Implications for complex cognition from the hafting of tools with compound adhesives in the Middle Stone Age, South Africa." *Proceedings of the National Academy of Sciences* 106: 9590–9594.

Walker, N.J. 1974. "The analysis of Late Stone Age hafting cements from the Cape Province, South Africa." Honours thesis, University of Cape Town.

Waś, E., Szczęsna, T. and Rybak-Chmielewska, H. 2016. "Efficiency of GC-MS method in detection of beeswax adulterated with paraffin" *Journal of Apicultural Science* 60 (1): 145–162. https://doi.org/10.1515/jas-2016-0012

Whelton, H.L., Hammann, S., Cramp, L.J.E., Dunne, J., Roffet-Salque, M. and Evershed, R.P. 2021. "A call for caution in the analysis of lipids and other small biomolecules from archaeological contexts." *Journal of Archaeological Science* 132: 105397.

Williamson, B.S. 1997. "Down the microscope and beyond: microscopy and molecular studies of stone tool residues and bone samples from Rose Cottage Cave." *South African Journal of Science* 93: 458–464.

Woodworth, M., Bernal, D., Bonifay, M., De Vos, D. and Garnier, N. 2015. "The content of African Keay 25/Africana 3 amphorae: initial results of the CORONAM Project." In *ArchaeoAnalytics: Chromatography and DNA Analysis in Archaeology*, edited by C. Oliveira, R. Morais and A. Morillo Cerdan, 41–57. Esposende: Municipio de Esposende.

Wright, J.B. 1971. *Bushman Raiders of the Drakensberg 1840–1870: A Study of Their Conflict with Stock Keeping Peoples in Natal*. Pietermaritzburg: University of Natal Press.