University of Reading

Sarsen stone in southern Britain: an archaeological and ethno-historical approach to an ancient industry

PhD

Department of Archaeology, School of Archaeology, Geography and Environmental Science

Katy A. Whitaker

September 2022

CONTENTS

ABSTRACT

This thesis is an inter-disciplinary study of human engagement with the silcrete called sarsen stone, found dispersed across parts of south-central and south-eastern England and used prolifically since prehistory. Prehistoric sarsen megaliths (for example, Stonehenge) have dominated discussion of the cultural contexts of its use, but it enjoys a far longer relationship with people and, in those places where it is most abundant, more recent architectural sarsen fabric is an integral component informing sense-of-place. This thesis reveals the variety of Neolithic sarsen engagement, drawing that together with post-medieval sarsen industries to foreground some of the many ways that it has been exploited. By focussing on different *chaînes opératoires* studied through archaeological and ethno-historical sources, I propose that sarsen stone behaves as a different material depending on the technical action applied to it and thus has the potential for varied ontological status dependent on context.

A collection of six published papers, this thesis first contextualises archaeological perceptions of sarsen stone that have dominated scholarly study thus far. Newly-digitised datasets from the archived collections of twentieth century sarsen surveys are considered. Secondly, different modes of sarsen exploitation are explored through multi-scalar methodologies. A landscape approach is applied to quarries in Buckinghamshire and Wiltshire study areas, combining aerial investigation and analytical earthworks surveys with an eclectic range of archival sources to cast light on traditional sarsen-working practices. A new methodology, developed to habilitate excavated sarsen assemblages into archaeological analysis, is applied to material from Neolithic sites in Wiltshire including Marden henge and West Kennet Avenue, which with data from the Windmill Hill enclosure shows how common non-megalithic uses of sarsen were. Value in attending to this previously under-studied material in its own right is demonstrated, encouraging more detailed analysis in future research.

DECLARATION

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

Katy A. Whitaker

ACKNOWLEDGEMENTS

This doctoral research project was funded by the Arts and Humanities Research Council through the South, West and Wales Doctoral Training Partnership, grant number AH\L503939\1.

With thanks to my Advisory Panel: Professor Martin Bell (University of Reading), Professor Josh Pollard (University of Southampton), Dr Jim Leary (University of York) and Dr Stuart Black (University of Reading); and with gratitude for the university resources that under-pin this research.

And to my examiners Professor Duncan Garrow (University of Reading) and Professor Mark Gillings (University of Bournemouth).

Dr Elaine Jamieson and Dr Krystyna Truscoe made it possible to complete fieldwork integral to this research.

The following organisations kindly provided data, access to collections, image reproduction permissions, access to land, training or other support:

British Geological Survey
Buckinghamshire Historic Environment Record
Buckinghamshire Museums
Centre for Buckinghamshire Studies
Dorset Historic Environment Record
EDINA Digimap
Forestry England
Hawley Tool Collection and the Ken Hawley Collection Trust
Historic England: Aerial Investigation and Mapping, Archive and Library
International Commission on Stratigraphy
Kent Historic Environment Record
Natural England
Salisbury Museum
Sharing Wycombe's Old Photographs

Society of Antiquaries of London
Swanton and Sons (West Overton, Wiltshire)
The Henry Moore Foundation
The National Trust
The Temple Estate (Wiltshire)
UK Data Service
Wiltshire and Swindon History Centre
Wiltshire Archaeological Field Group
Wiltshire Historic Environment Record
Wiltshire Museum

All images are © Katy A. Whitaker unless otherwise acknowledged and credited in Figure captions.

The following people are amongst many who supported this project in one way or another: by showing interest in my research; by collaborating; by providing training, equipment, lab access, advice, encouragement, entertainment; by pointing towards interesting reading and lines of enquiry; by being kind.

Coralie Aitcheson, Martyn Barber, Claire Boardman, Lisa Brown, Ros Cleal, Bert Coules, Steve Crowther, Nicola Cryer, Tim Daw, David Dawson, Michael Day, Kerry Donaldson, Brian Edwards, Penny Foreman, Rob Fry, Catherine Frieman, Shawn Graham, Susan Greaney, Chris Green, Martin Green, Richard Grove, Cain Hegarty, Sarah Hoile, Rob Hosfield, Mervyn Jones, Anais Lamesa, Angela Lansbury, Steve Marshall, Roger Matthews, Wendy Matthews, Dan Miles, Tim Milner, Chris Musgrave, David Nash, Maggie Noke, Matt Pope, Rachel Pope, Marie-Elise Pourqueddo, Kay Richardson, Lorna Richardson, Mike Robinson, Jim Rylatt, David Sabin, Hannah Sackett, Claudia Sciuto, Ruth Siddall, Fiona Small, Chris Speed, Paul Stamper, Peter Stanier, Gillian Swanton, John Swogger, Anne Teather, Helen Winton.

To

Mum and Dad

and in memory of

Ralph Plumridge (1887 - 1906)
of Speen, Buckinghamshire

Image courtesy of Pamela Smith/High Wycombe Library
(Sharing Wycombe's Old Photographs, swop.org.uk, RHW:50632)

'A coroner's inquest took place at High Wycombe into the circumstances attending the death of a young man named Ralph Plumridge who lost his life as the result of a sad accident which befell him when working in the famous Denner Hill stone quarry at Hughenden, Bucks. A ponderous block of stone, weighing ten tons, fell upon him, shockingly crushing his body.

Plumridge lay alive under the boulder half an hour. His mates were powerless to remove it, but at last they succeded in splitting the stone and releasing him. By this time, however, he was dead. Deceased realised that his end had come, and implored his mates to say good-bye to his mother. A verdict of "Accidental death" was returned.'

The Bucks Standard, 22 September 1906, p2

INTRODUCTION

In the popular US science fiction television series *Star Trek: Deep Space 9* (1993-1999), it is Constable Odo's job as Chief of Security to maintain order on the eponymous space station. Odo is a Changeling, a species of shape-shifter capable of turning from a naturally gelatinous liquid state into any animal, plant or object. Changelings make not merely a visual transformation: if scanned, they register as the very thing they have become (Behr 1996). In the day-to-day Odo chooses to live in the form of a dressed male humanoid. As a hawk he can soar through the air, enjoying the wind ruffling his feathers; as a scurrying brown rat with beadily observant eyes, he can surreptitiously gather evidence against criminals. When he first returns to his home planet, he even transforms into the stones he sees on the ground. Odo can experience the grain and heft of living rock.

In contrast, earth-bound humans are incapable of such petrous intimacy. Our mineral corporeality is a pale imitation of Odo's fossilization, hardly able as we are to feel our nevertheless indispensable carbonate skeletal frame. Our experience of stony materials is by necessity mediated by sense: beach-sand chafing the soles of our feet; the taste of salt sea-water; the sight of headland cliffs dipping into breakers; the sound of pebbles rasping in the tide; the smell of struck flint sparking a flotsam fire. Tools such as hammers, chisels, shovels, picks, mattocks and trowels intervene between us and earth materials, communicating hapticly via those translators of stone's messages. When encountering stone at work, whether as farmers, stone-workers, miners or archaeologists, we experience its properties in these enchained interpretive moments.

This thesis tilts at such moments, as they pertain to people's experiences of sarsen stone in southern Britain at times during the past 6,000 years. It does this by first, contextualising some of the archaeological perceptions of sarsen stone that have dominated its scholarly study thus far and secondly, considering the role that technical action has in revealing the properties of materials; specifically, different modes of sarsen exploitation. Rather than recounting all of the long and varied story of sarsen stone use, I concentrate on two contrasting periods in British sarsen history: the post-medieval quarrying industry and 'domestic' sarsen artefacts of the Neolithic. Those windows in time provide case studies of how intricate and varied are people's interactions with materials, encouraged by Conneller's call to 'tak[e] materials seriously' (2011, 21). The thesis proposes that sarsen stone behaves as a different material depending on the technical action applied to it, enabled by its homogeneity, hardness and brittleness that permit multiple ways of working the stone. Rather than being solely the tough, obstinate material of orthodox characterisations, sarsen is in fact mutable, flexible and supremely suited to a life enmeshed with human needs and purpose.

This introductory section provides a brief exploration of what sarsen stone is, through four contrasting lenses. The first is geological. I explain the lithological definition of sarsen and current understanding of its formation, contextualised in the background of earlier sarsen research. It is necessarily brief: a great proportion of research into silcrete, of which sarsen is a subset, is driven by bigger questions concerning palaeoenvironment that are not relevant here. The second lens is historiographical, focussing on the largely nineteenth century scientific explosion of interest that underpins much of more recent perceptions of sarsen stone. Third, I build on that review by looking at sarsen through the eyes of the general public during the nineteenth and early-twentieth centuries in the thesis's case study areas. Finally, I touch on some of the ways that sarsen is understood through a creative lens, taking in views from the artist's studio and writer's desk.

WHAT IS SARSEN STONE?

Geology

Sarsen stone is a type of silcrete. Silcrete is,

> 'an indurated product of surficial and penesurficial (near-surface) silicification, formed by the cementation and/or replacement of bedrock, weathering deposits, unconsolidated sediments, soil or other materials and produced by low temperature physico-chemical processes and not by metamorphic, volcanic, plutonic, or moderate to deep burial diagenetic processes.' (Summerfield 1983, 59)

In the United Kingdom (UK), pedogenic silcretes are found in Devon (south-west England), whilst silcretes formed by groundwater or pan-lacustrine processes are distributed discontinuously across central-southern and south-eastern England to the south of a line running approximately from the Bristol Channel to the Wash (Summerfield and Goudie 1980; Ullyott *et al.* 1998). The vernacular word 'sarsen' names the subset of UK silcretes formed in arenaceous facies by groundwater silicification: sarsen stone is rock created by the cementation of quartz sand host sediments by silica. The purity and homogeneity of sarsen's host sediments distinguish it from the UK's other groundwater silcretes, the puddingstones, which are conglomerates characterised by the high proportions of their pebble clasts (Fig. 1).

Sarsen stone is available in the form of pebbles, cobbles and boulders on the land surface and buried in other geological deposits, as explained in more detail below. Pieces of sarsen stone – usually the boulders – are called 'sarsens.' The name likely derives from 'Saracen stone', indicating a foreign material (Oxford English Dictionary 2020a) but other etymologies have been suggested including a Hampshire place-name Sarsden/Sarson and the Anglo-Saxon *sar stan*, 'troublesome stone' (Adams 1870, 104-105). Sarsen has other names including grey-wether, breeding stone, druid stone, heathstone and bridestone (Osborne White 1925, 74) and, in Buckinghamshire, it is known by the toponyms Denner Hill Stone and, less often, Wycombe Stone and Hampden Stone (Burtonwood 1995). In this thesis I use the names 'sarsen', 'sarsen stone' and 'sarsens' to refer to the material collectively and to individual pieces in a tradition stemming from the vernacular naming of this silcrete throughout the geological and archaeological literature.

The history of geological understanding of sarsen stone is intimately bound up with archaeological interests in sarsens. The seventeenth-century antiquary John Aubrey wrote about sarsen in his *Natural History of Wiltshire* (Britton 1847), describing amongst other things its material properties and local distribution. Sarsen origins confounded Aubrey and later commentators, who realised that sarsens were unusual curios, out of place in the landscape and requiring special explanation. The strangeness of sarsen boulders visible in fields overlying contrasting geology was neatly summarised by William Mavor (1809) in his Board of Agriculture report on Berkshire. Sarsens scattered in the combe at Ashdown Park appeared to him 'as if they had been showered from heaven in some convulsion of nature, being totally unconnected with the soil on which they lie, which is here chalky' (Mavor 1809, 34). Antiquaries proposed theories to explain these foreign stones, whilst folklore accounted for the everyday experience of living with the inconvenient breeding stones that troubled the plough (Fig. 2).

Sarsen's lithology and its general place in the geological succession was first described, in modern scientific terms, in the early-nineteenth century. Herbert Thomas (1923) attributes the first lithologically correct descriptions to Thomas Townson (1810) and Jasper Sowerby, who reported on this 'fine-grained species of siliceous sandstone' to Colt Hoare (1812, 149-150). Webster (1814, 224-225) compared English sarsens overlying chalk bedrock with the similarly positioned sandstone boulders – also silcretes – of

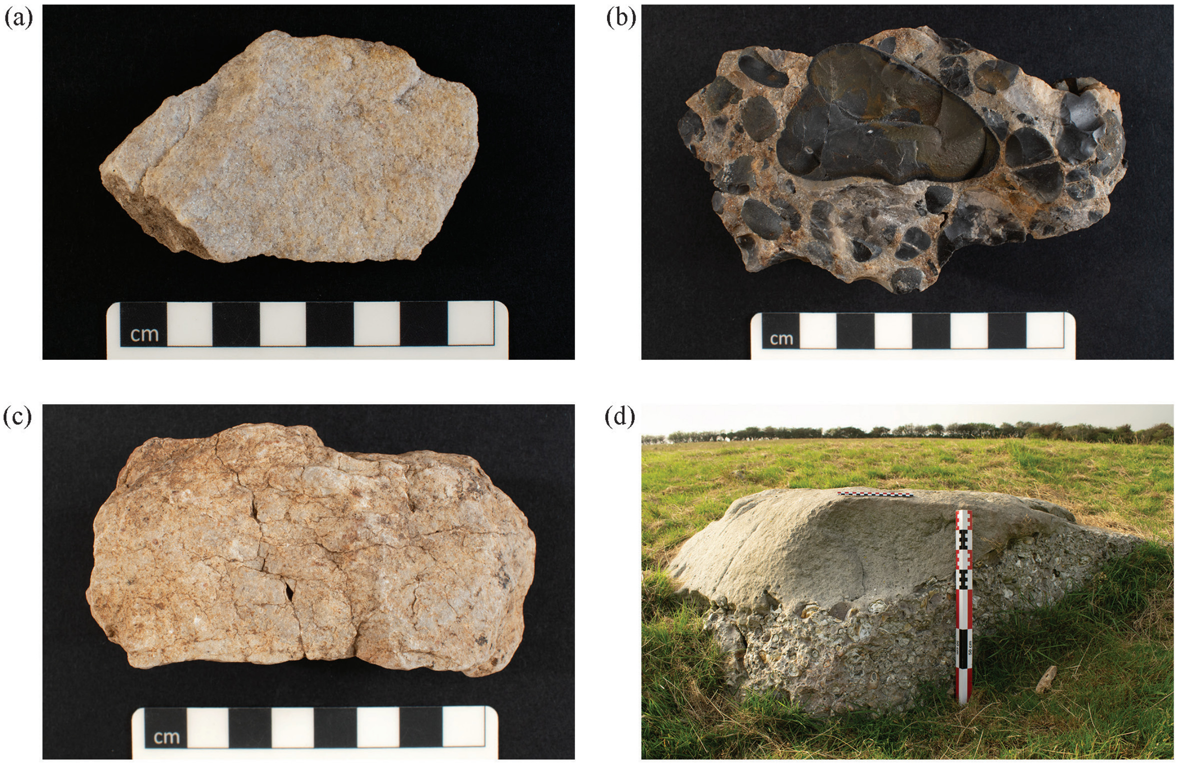


Figure 1. A selection of different types of UK silcretes including (a) saccharoid sarsen (Wiltshire), (b) Hertfordshire puddingstone, (c) quartzitic sarsen (Wiltshire), (d) a boulder in the Valley of Stones (Dorset) comprising saccharoidal and conglomeratic layers.

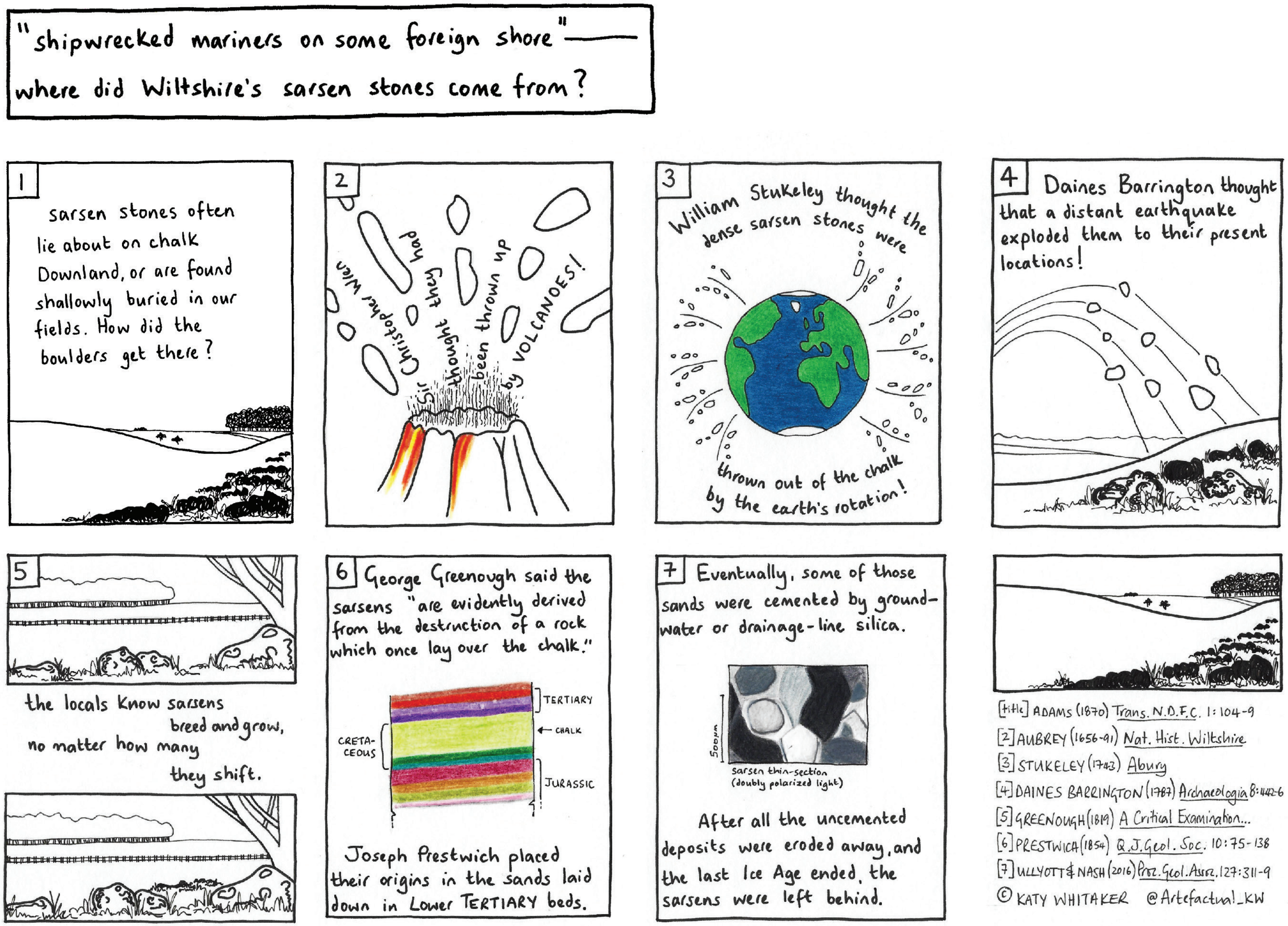


Figure 2. 'Shipwrecked mariners on some foreign shore' - where did Wiltshire's sarsen stones come from? Explanations for the presence of sarsens in the landscape (first presented at the University of Reading SAGES PGR Conference 2017).

Fontainebleau in France. Geologists such as Greenough (1819, 112) and Buckland (1823, 248) recognised that sarsens were the *remanié* of younger rock left stranded on older geological deposits following denudation; poetically described by Adams (1870, 109),

> ‘they are the waifs and strays of an appalling wreck, and their condition is akin to that of shipwrecked mariners on some foreign shore. They are in fact the lonely survivors of a land which the wasting elements have dissolved, and the floods have utterly swept away.’

Sarsen’s nomenclature has been highly fluid throughout the scientific literature, in which its prehistoric use or mythic nature were often key features by which to name the stone. Those early geologists all referred to it by variably-spelled vernacular names and Joseph Prestwich, in his lengthy explication of the Tertiary origins of the stone, used the name ‘sarsen’ only once (Prestwich 1854, 125): his preferred term was Druid Sandstone, followed by greyweather [*sic*]. Neither had archaeologists settled on a single name. For example, in 1911 Belcher used the name sarsden whilst Evans wrote about sarzen as late as 1950. Despite its indurated siliceous body, sarsen has shape-shifted its way through the geological and archaeological literature, harder to grasp than its simple geochemistry and hard, long-lived substance otherwise suggest.

The most recent, exhaustive, literature review of sarsen lithology, petrography and geochemistry can be found in Stewart Ullyott’s doctoral thesis (Ullyott 2002). That work has not yet been superseded for UK silcretes: accordingly, the following section describing the current understanding of sarsen draws heavily on Ullyott’s work. Much remains unknown: detailed lithological analysis is limited to Ullyott’s work in Sussex (Ullyott *et al*. 2004; Ullyott and Nash 2006), with one recent study focussed on Stonehenge’s sarsens (Wiltshire) (Nash *et al*. 2020; Nash *et al*. 2021) and another on a small number of samples from the Medway valley (Kent) (Day 2019). Similar work is required across sarsen stone’s UK distribution in order to clarify the range of host sediments in which it formed and when and how silicification took place.

Sarsen composition, formation processes and distribution

That sarsen is a groundwater silcrete is clear from its macro- and micromorphology, compared with the two genetic groups of silcrete established by research in the Paris

Basin. Pedogenic silcretes have a distinctive columnar structure and complex mineralogy whereas groundwater silcretes are typically tabular, lenticular or mammiform in shape comprising a simply structured silica-cemented sediment (Ullyott 2002, 89-96; Ullyott and Nash 2016). Sarsens exhibit those forms and petrology reveals that composition (Fig. 3).

Sarsens formed of a pure quartz sand are dubbed *saccharoid* ('sugary'), whilst those formed in a finer-grained host sediment are so-called *quartzitic* or *hard* sarsen: the former are often pale grey to light brown boulders; the latter are commonly very hard, grey to brown cobbles (Geddes 2000, 60-62) (Fig. 1). Most of the sarsen excavated by Pitts (1982) from contexts at Stonehenge and analysed by Hilary Howard is saccharoid, containing more rounded, frequently coarse to very coarse, sand grains than the far finer, angular, particles of the quartzitic examples. Howard also analysed comparative saccharoid samples taken from Piggledene and Clatford on the Marlborough Downs in north Wiltshire, all of which were formed of much coarser sands up to granule size (Pitts 1982, 121). In contrast, the grains of Stonehenge's saccharoid sarsen stone 58 are on average a fine sand with mean diameter of 187 microns (Nash *et al*. 2021, 15); those sampled in Kent by Day (2019, 3) are fine to medium sands.

These host sediments are cemented by silica, most commonly forming a grain-supported (GS) optically-continuous overgrowth fabric, or a floating (F) fabric (puddingstones are C-fabrics, that is, conglomeratic). GS-fabric is cemented by void-filling of the host sediment: in thin-section, the sand grains butt-up to one another and often appear to have grown together. In an F-fabric formed by grain replacement, dissolution or by replacement of an F-fabric host material, the grains appear separate from one-another in the siliceous matrix (Summerfield and Goudie 1980, 82). Fabric types can vary within an individual sarsen (Ixer and Bevins 2021). Petrographic analysis of a sample of Stonehenge's stone 58, a GS-fabric, reveals how the silica cement first infilled irregularities in the sand grain surfaces, followed by numerous concentric growths of cement layers (Nash *et al*. 2021, 39-40). That process is suggested, in relation to French silcretes, to have taken around 30,000 years (Ullyott *et al.* 1998, 261). This formation process explains why sarsens are so hard and tough. Sources of the silica are unknown but weathered silicate minerals are abundant and silica is a very common precipitate in earth environments (Summerfield 1983, 76; Ullyott 2002, 77-78).

The combination of quartzose host sediments and silica cementation means that sarsen geochemistry is dominated by its high silica content. Saccharoid sarsen sampled in Sussex by Ullyott (2002, 345) is more than 99% wt. SiO_2; Stonehenge stone 58 is 99.7%

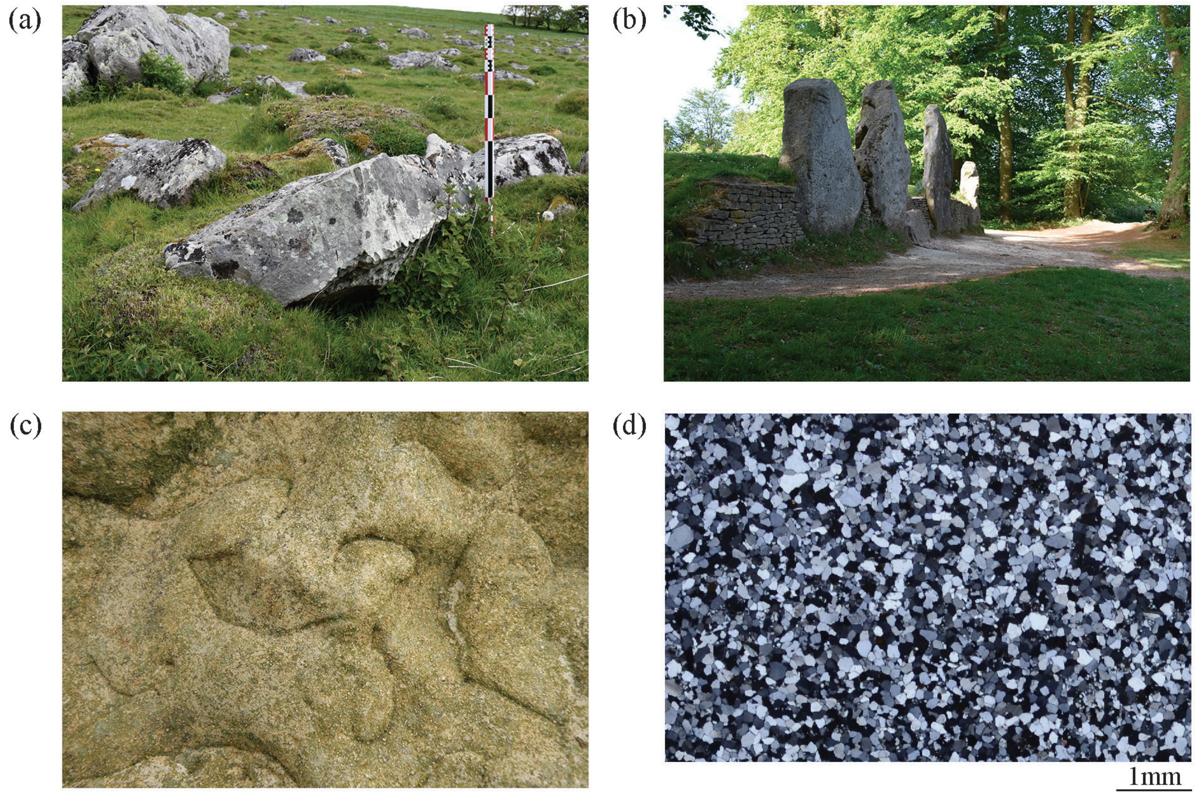


Figure 3. Sarsen stone morphology including (a) tabular (foreground) and pillowy (background) sarsens (Valley of Stones, Wiltshire), (b) tabular sarsens set upright at Wayland's Smithy (Oxfordshire), (c) mammilated sarsen (field of view *c*. 30cm) (Monkton Down, Wiltshire) and (d) sarsen fabric seen in thin-section comprising quartz sand grains in a self-supporting network (cross-polarised light) (Bishop's Cannings Down, Wiltshire, sample E42839, field of view *c*. 7mm; contains British Geological Survey Materials © UKRI 2022).

(Nash *et al*. 2021, 35) and the mean of six measurements on samples from Kent is 98.7% (Day 2019, 6). Those figures conform to the purity recorded by earlier analyses, but the immobile trace element geochemistry of sarsen's tiny non-silica content provides a means to investigate differences between boulders. The relative profiles of the major elements (Al, Ca, Fe, Mg, P and Ti), both detrital and diagenetic in origin, can essentially 'fingerprint' material from different locations (Nash *et al*. 2013; Nash *et al*. 2020).

Early recognition of root casts in sarsen cobbles was interpreted as an indication of near-surface silicification in a marshy or shallow marine environment (Carruthers 1885, 142-147; Rupert Jones 1886). By the mid-twentieth century, sarsens were thought to be the remains of a broken-up duricrust that had formed on a land surface in a hot and stable palaeolandscape, but later research proposed groundwater cementation models (Ullyott 2002, 59). Summerfield (1979, 1983) suggests that most silcrete was formed in alkaline, arid conditions except the very hard types (such as the dense, brown sarsen nodules used as hammerstones at Stonehenge) which formed in acidic, warm and humid conditions. Over the past 30 years, sarsen's patchy distribution has led authorities to question the presence of an extensive duricrust and in the UK the small population of pedogenic silcretes and majority groundwater silcretes in the form of sarsen and puddingstone are now recognised. Several modes of origin in varying palaeoenvironmental settings are possible (Ullyott 2002, 58-60).

As Ullyott *et al*. (2004, 1536) point out, although sarsens in Sussex are similar to those in other parts of south-east England, without detailed analysis it cannot be assumed that they all formed in precisely similar ways and within the same host sediments. Sarsens are likely to have formed in sandy deposits from Thanetian to Bartonian age, a period spanning *c*.22 million years including beds within the Thanet, Upnor, Reading, Woolwich, Harwich, Bagshot and Barton Sand Formations (Ullyott 2002, 61-62) (Fig. 4). Multiple periods of silicification may have happened soon after the sands were deposited, but the ages of the deposits provide only *termini post quem*. In fact, data from Sussex suggest that silicification occurred in the later Neogene or even Quaternary, many millions of years after the host sediments were laid down (Ullyott 2002, 350). A general model for sarsen formation is therefore illustrated here, taking the Lambeth Group as an illustrative host sediment (Fig. 5).

Sarsen localities and mapping are important from an archaeological perspective. Their origins mean, however, that while the Palaeogene and Quaternary deposits with which sarsen and puddingstone are associated are mapped by the British Geological

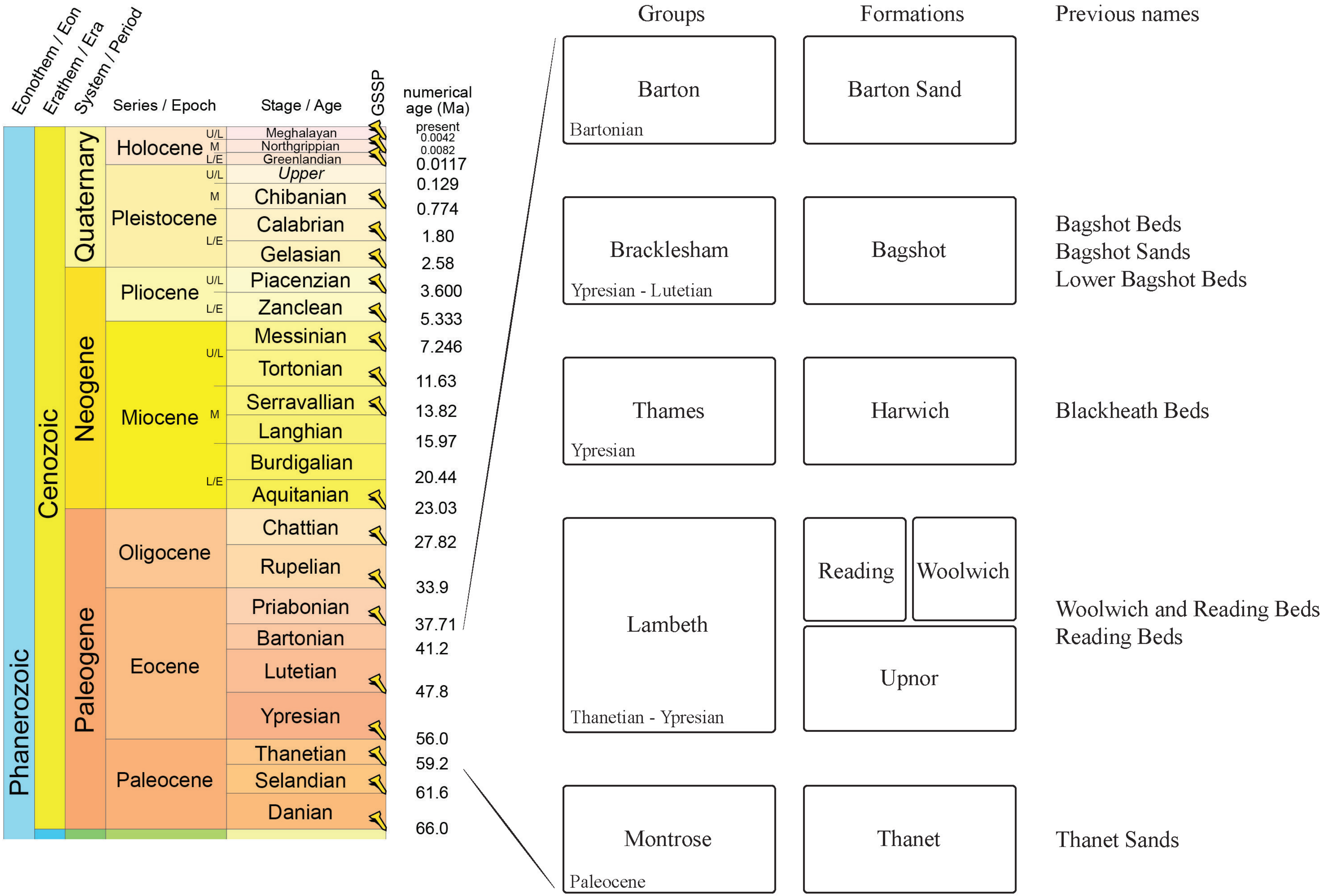


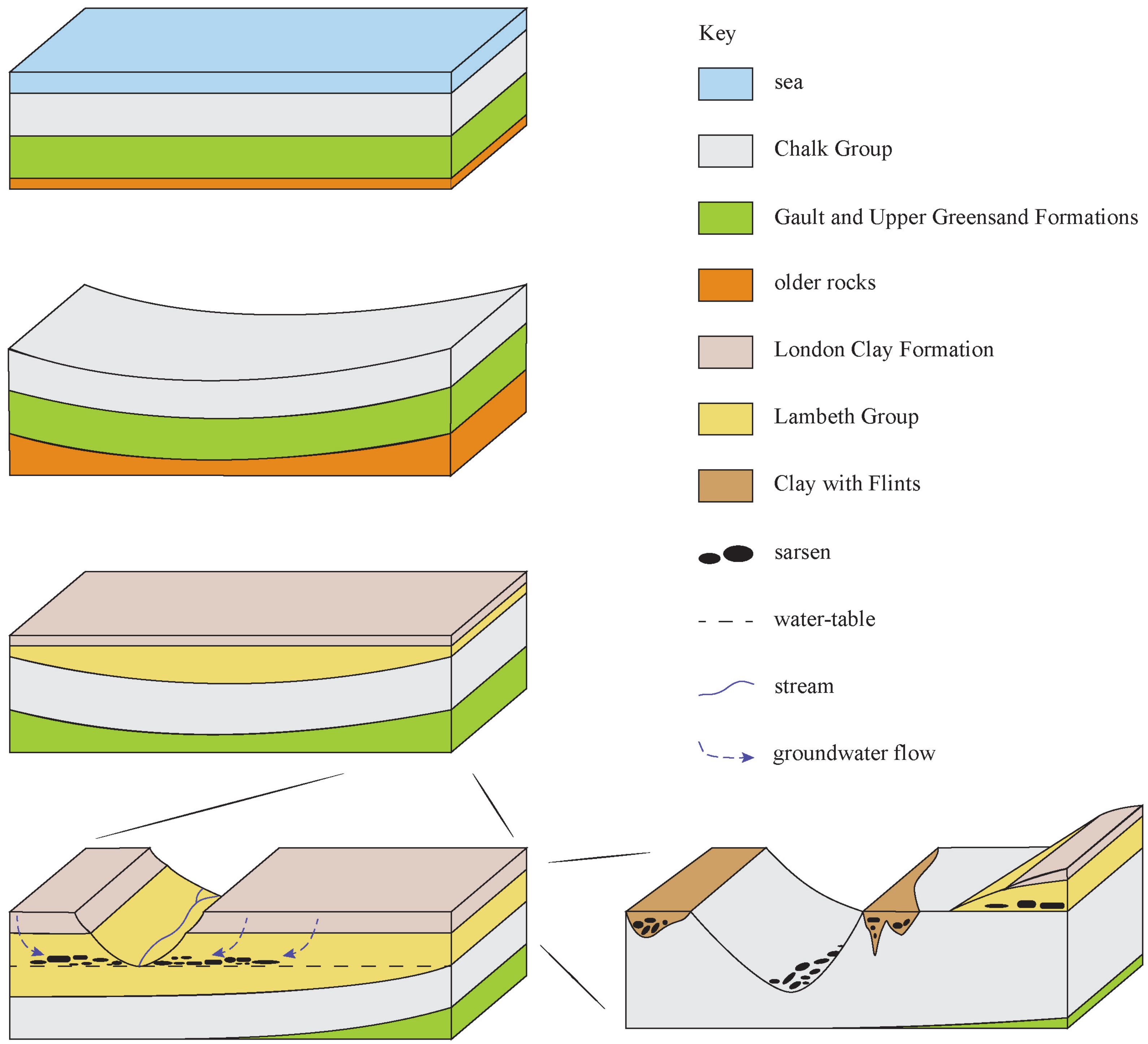
Figure 4. The geological deposits in which UK silcretes are likely to have formed. An extract from the International Chronostratigraphic Chart (Cohen *et al*. 2013; updated) to the left accompanies a schematic representation of the geological Groups and those of their Formations that have been proposed as host sediments for silcretes, arranged in relative chronological position. Previous names for deposits that are nevertheless commonly referred to in literature on silcrete are given. Includes data © International Commission on Stratigraphy, February 2022.

(a) Chalk formed during the Upper Cretaceous *c*.100-65 Ma ago in warm, shallow, seas.

(b) Chalk deposition ended at the time the Alps began to form as a result of the collision of the African and Eurasian tectonic plates. Folding and faulting were caused in Britain and the London and Hampshire Basins were formed.

(c) During the Palaeogene *c*. 66-23 Ma ago, marine clays, silts and sands including the Lambeth Group and London Clay (*c*. 59-47 Ma) were deposited into the basins. Following further uplift, these deposits were exposed above sea level.

(d) The Palaeogene sediments were cut into and eroded by water-courses. Groundwater carrying dissolved silica passed through the sediments, depositing the silica at the water-table where thick lenses of sarsen formed.



(e) Continuing erosion caused the sarsen lenses to break up and much of the Palaeogene sediments were removed. During the last Ice Age sarsens were deposited down slopes and in valley bottoms by periglacial processes. Sarsens are also found amongst superficial deposits including Clay-with-Flints, which is the weathered remains of Palaeogene sediments and residual insoluble Chalk components.

Figure 5. Model of sarsen formation. Perspectival visualisation by Katy A. Whitaker based on an original concept and 2D visualisation by David Nash.

Survey, the presence of the silcretes themselves is not. It has fallen to other interested parties to try to document this distribution. Examples include Brentnall (1946, 435) who provides a hand-drawn sketch of sarsen locations extending from Devon to Suffolk. The study by Davies and Baines (1953, 8) offers another sketch, fleshing out sarsen and puddingstone distribution on the Chiltern Hills. Mapping produced by the *Sarsen Stones in Wessex* project gives an overview at county-scale for Wiltshire, Dorset and Hampshire (Bowen and Smith 1977). Summerfield (1979, 138) fails to show sarsens in places including Kent and Dorset and Summerfield and Goudie (1980, 72) do not include data from Bowen and Smith (1977), although they provide a helpful summary map for some continental European silcretes. The best general depiction of sarsen distribution is by Ullyott (2002, 26), drawing on some of the aforementioned publications, a slightly augmented version of which is published in Ullyott *et al.* (2004, 1511). The issue of mapping sarsen is dealt with throughout the papers comprising this thesis. At this point, I introduce an alternative way of visualising sarsen distribution for the reader to hold in mind as the thesis progresses (Fig. 6).

Sarsenalia

During the past 200 years in which geologists have established sarsen stone's relationships with Tertiary and Quaternary geological deposits, archaeologists developed an eclectic interest in sarsen that I call 'sarsenalia.' It is a form of scrap-booking: collecting miscellaneous information about geology, distribution, nomenclature, prehistoric and modern human use of sarsen and so on. Interested parties shared their sarsenalia through the meetings and journals of the burgeoning local archaeology and natural history societies that sprang up during the mid-nineteenth century. As a subject, sarsen stone presented the perfect cross-over between natural history, archaeology and the then present-day exploitation of a locally-important economic resource.

The most prolific publisher of sarsenalia was Thomas Rupert Jones (1819-1911), Gideon Mantell's editor and Professor of Geology at the Military College, Sandhurst. He combined scientific geological enquiry with a curiosity about all aspects of sarsen history and archaeology. Living in places in Berkshire and Surrey where sarsens are found, Rupert Jones carried out many years of geological research in the Thames Valley. As well as a regular correspondent with his geological contemporaries (Woodward 2004), he was an active member of a number of local natural history and archaeology societies and

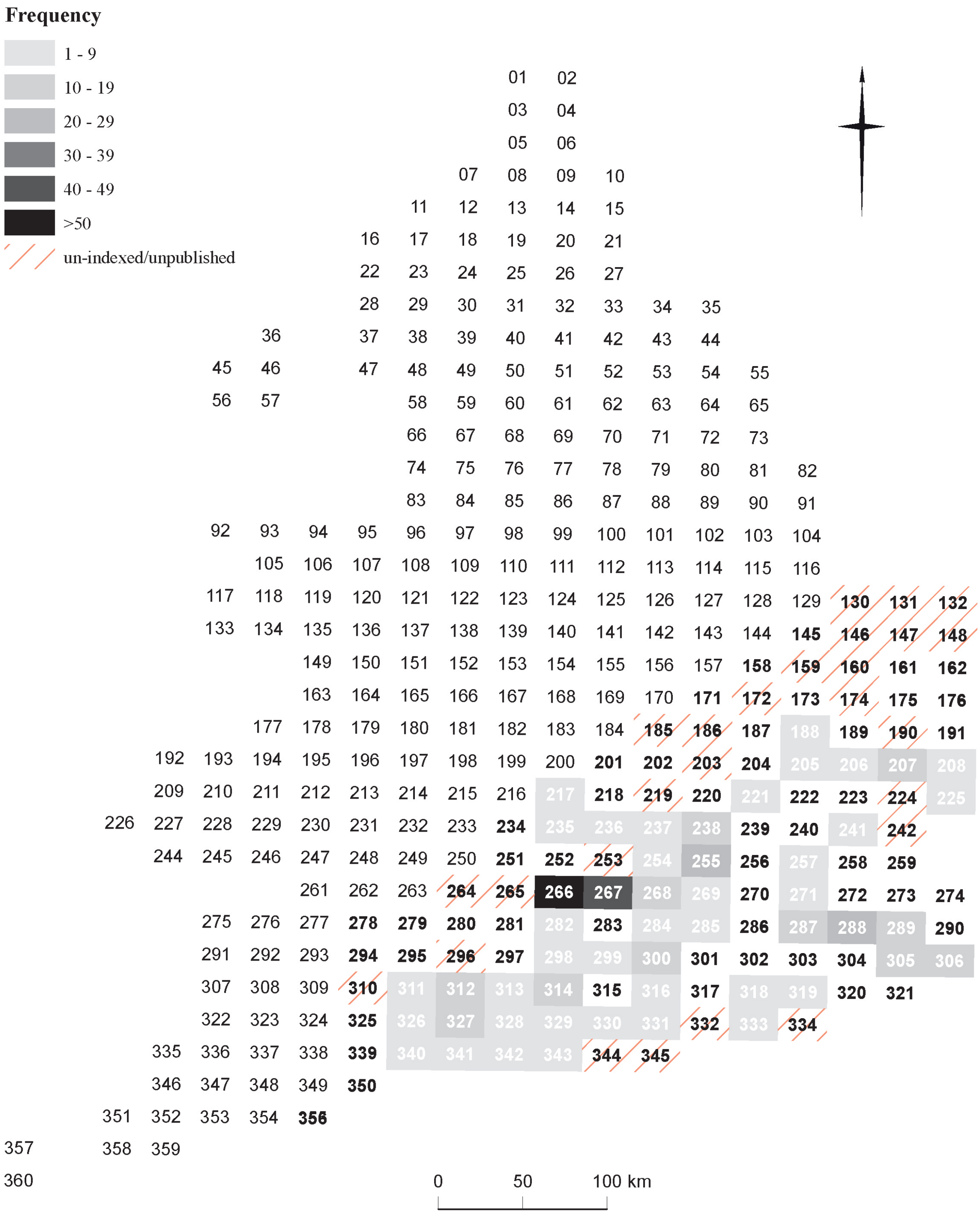


Figure 6. Frequency of the words sarsen, grey-wether, druidstone and Denner Hill Stone in British Geological Survey map sheet explanations published before the Second World War. Numbers in bold (both black and white) indicate the map sheets examined for this exercise; 50 of the 88 volumes include a term at least once. Twenty-three of the target map sheets have no published volume, or their volume is not indexed. Includes Charles Close Society data (2013) (online), https://www.charlesclosesociety.org/KMLFILE [accessed 22 June 2018]

published in their journals as well as in the geological press (such as Rupert Jones 1870, 1872-1875, 1886, 1901a, 1901b, 1901c). His approach was to collect heterogeneous references to sarsen stone from previously published memoirs and papers, notes about locations of sarsens, personal communications, sarsen folklore and his own field observations.

The first volume of the Newbury District Field Club's *Transactions* is particularly rich in sarsenalia. It includes papers by Stevens (1870) and Adams (1870) as well as Rupert Jones. Stevens was writing about sarsens in north Hampshire and Adams covered themes including sarsen nomenclature, geological formation processes, and archaeological and historical exploitation (1870, 104). Rupert Jones differed from enthusiasts like these by additionally carrying out field-work to investigate some of the documentary evidence that he had collated. For example, he visited the site of two sarsens near Aldworth (Berkshire) that had been reported in a 1760 edition of the *Gentleman's Magazine* (Rupert Jones 1901a, 56).

Papers like those typify content in the county archaeology journals published in sarsen stone's southern English distribution, well into the twentieth century. Although the geological backdrop had been more fully established, archaeological interests were still directed by themes couched by the earlier antiquaries including sarsen nomenclature, distribution, megalithic use and resistance to metal stone-working tools, augmented by a renewed interest in sarsen folklore (examples include D'Almaine 1929; Peers and Smith 1928, 1929; C. Peake 1923; H. Peake 1938).

It would be as well to make a small digression at this point to consider sarsen-built megalithic monuments. They feature prominently in sarsenalia, and not only prehistoric structures. Rupert Jones's notes include, for example, the grotto at The Grove, Stanmore (Middlesex) built of large sarsens riddled with root holes (Rupert Jones 1901b, 58-59) and the sarsen rockery and waterfall at Virginia Water (Surrey) (Rupert Jones 1901c, 115). Goddard (1926) explains how the Duke of Somerset arranged for sarsens to be taken from East Kennett to Maiden Bradley (Wiltshire) to form megalithic grave markers for himself and his wife. The poet Edward Thomas (at Shoulder of Mutton Hill, Hampshire) and the conservationist Sir Arthur Tansley (at Kingley Vale, West Sussex) are two of a number of prominent individuals commemorated by standing sarsens, theirs taken from Avebury and Fyfield Down respectively (The Nature Conservancy 1958/9; Thornton 2011) (Fig. 7). Yet the dominant popular understanding of sarsen stone as megalith is most likely centred in

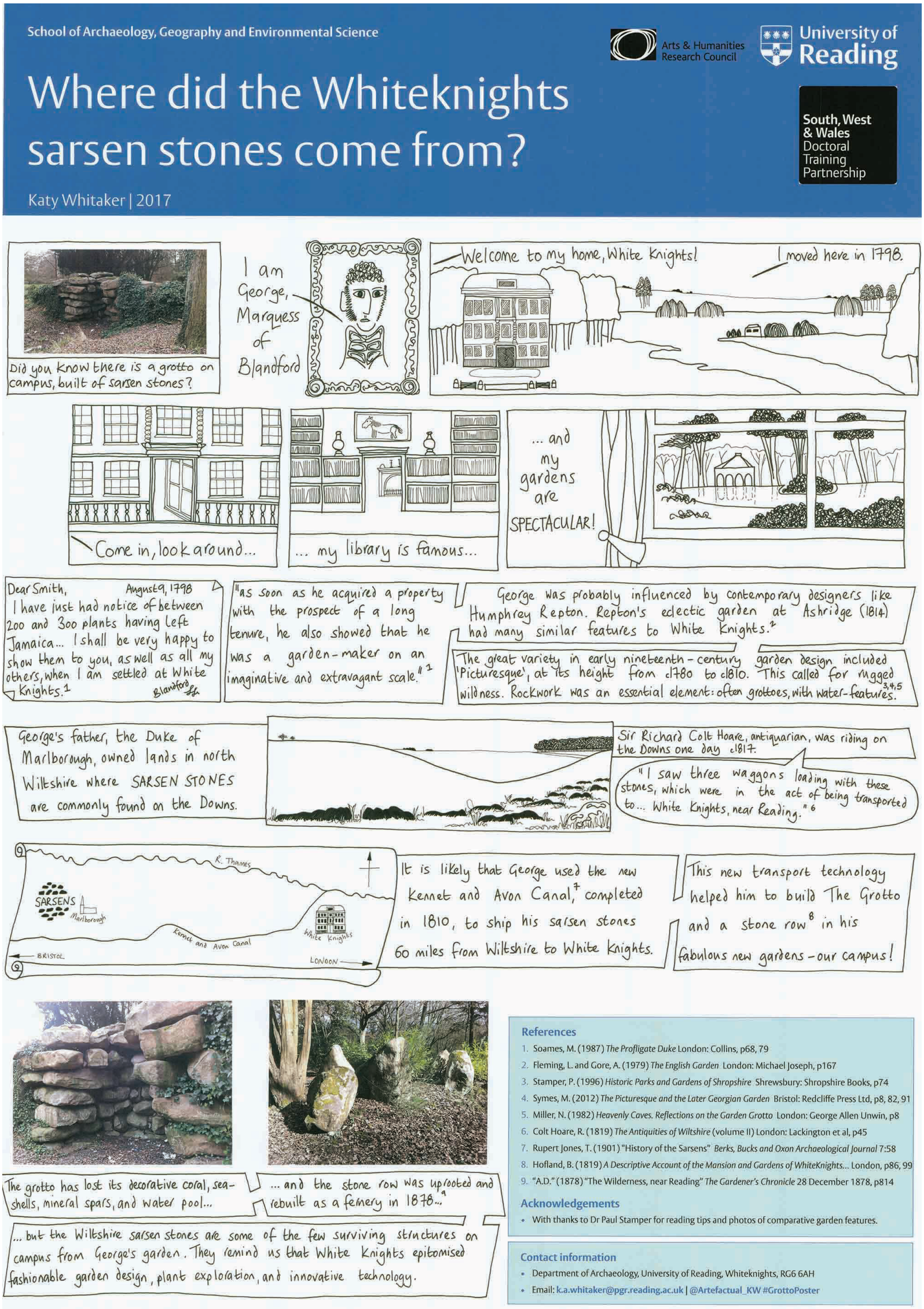


Figure 7. 'Where did the Whiteknights sarsen stones come from?' The story of The Grotto, Whiteknights, Reading (UK) (first presented at the University of Reading Graduate School Conference, 2017).

Neolithic and early Bronze Age monuments. I return to the dominance of Stonehenge and Avebury in the popular imagination in the following section of this Introduction. Here, I wish to draw attention to two points. First, the broader geographic distribution of prehistoric sarsen megalithic monuments that tends to be obscured by a popular focus on Wiltshire; and secondly, the relatively restricted way in which megalithic sarsens themselves are addressed by scholars.[1]

Sarsens are key structural elements of megalithic monuments from Dorset to Kent. They were used in some of the earliest Neolithic structures, including Coldrum chambered barrow (Kent), Wayland's Smithy (Oxfordshire), West Kennet chambered long barrow (Wiltshire) and the Grey Mare and Her Colts (Dorset) (Bayliss *et al.* 2007; Piggott 1946; Whittle e*t al.* 2007; Wysocki *et al*. 2013). Mid-third millennium BC dates are suggested for sarsen circles including those at Stonehenge (Darvill *et al.* 2012) and Avebury (Pollard and Cleal 2004) and that period may have seen the erection of similar, if smaller, structures such as the circles at Day House Farm (Swindon) and Kingston Russell (Dorset) (Burl 2004; Rylatt *et al.* 2022). Recent research at Avebury (Gillings *et al.* 2019), revealing complex construction sequences in the area of the Southern Circle, reminds us of how poorly-dated overall are most of these monuments: so few have radiometric determinations. Numerous monuments of unknown but presumed Neolithic or Bronze Age date have regrettably been lost, such as the tall standing sarsen at Broome Manor (Swindon) (Jones 1949).

While research has tended to focus on monument typologies or other characteristics such as the buried populations in the funerary structures, the sarsen components comprising these and other monuments are rarely considered in their own right. As mentioned in the sixth paper of this thesis, Stonehenge's sarsens tend to be subsumed in preoccupations with form, transportation and source: the application of new technology to its sarsens such as laser scanning (Abbott and Anderson-Whymark 2012) or the focus on sarsen properties including colour nuances (Tilley *et al.* 2007) are welcome contrasts. Innovations are being made in other areas. Placing the Kingston Russell circle's

[1] Sarsen-built megalithic monuments do not feature heavily in this thesis, apart from the constantly reappearing settings at Stonehenge and Avebury. This was not my original intention. However, my interest in the problem of the impacts on prehistoric landscapes of Modern era sarsen extraction first drew my research towards the post-medieval industry. The influence of the Social Construction of Technology (SCOT) and Science and Technology Studies (STS) traditions on my thinking around that industry also informed my choice to focus on 'artefactual' or 'portable' sarsen in prehistory, along with the need to develop a methodology to habilitate excavated sarsen assemblages into archaeological analysis. I hope the monuments are not affronted.

sarsens into their geological context through detailed landscape survey is hinting at new narratives of sarsen choice in construction (Jim Rylatt pers. comm.). As a result of their work around the Avebury landscape, Mark Gillings and Josh Pollard have started to show the potential in turning critical attention to the ontological status of megalithic sarsen in prehistory (for example, Gillings and Pollard 2016; Pollard and Gillings 2010).

To return to sarsenalia, most of it is limited to textual reports. The earliest work to integrate archaeological and geological information and produce a map was a major survey of 100 square miles centred on Avebury (Wiltshire), carried out by Reverend A.C. Smith (1884).[2] Smith's motivation was the destruction of barrows as more and more Downland was brought into cultivation during the later years of the nineteenth century. His methods were simple. He made his own larger scale maps from Ordnance Survey one inch to the mile map sheets. Between the 1850s and 1880s he rode with his wife across the north Wiltshire countryside, marking up his self-made map sheets with archaeological features as they saw them on their travels (Fig. 8). Later, he used published works to research and describe the marked features more fully, adding details garnered from older sources such as tithe maps culled from neighbouring clerics' parish chests (Smith 1884, v-vii). Smith paid great attention to sarsens wherever he saw them, 'not only because they are the quarry whence Abury [*sic*], Stonehenge, and all our Wiltshire stone monuments derived their material, but also because they are a very remarkable geological feature, rarely to be seen elsewhere' (Smith 1884, viii).[3]

Smith expanded archaeological sarsen studies in two key ways. First, he explicitly tied the natural stone spreads to the prehistoric monuments and thus to the threat posed by contemporary agricultural practices to archaeological features, visualising a whole landscape at risk. Secondly, in mapping sarsens along with prehistoric and Romano-British

[2] Reverend A.C. Smith (1822-1898) was a founder member of the Wiltshire Archaeological and Natural History Society, its Honorary Secretary and journal editor from 1857 to 1890 (Goddard 1899, 198). He was regularly in contact with sarsen enthusiasts including Rupert Jones who were publishing in the Society's journal during the 30 years in which Smith painstakingly surveyed Avebury's archaeological landscape. I have not had time during this doctoral research project to unpick the extent of the network of society members and correspondents with sarsen interests, or to try to find their personal papers (if archived).
[3] Slightly later than Smith, Francis J. Bennett (1845-1920) mapped sarsen in the Medway Valley (Kent) in association with his excavation of the megalithic funerary monument at Coldrum (Bennett 1913). Bennett retired from the British Geological Survey in 1889. He had given a talk to members of the Toynbee Hall Natural History Society about Neolithic north Wiltshire following their visit to Marlborough (Bennett 1892) and was active in the Kent Archaeological Society (Anon 1911, xlviii, liv). His motivation in mapping sarsens, however, differs from Smith's. He was interested in 'Meridional Lines' - the idea that monuments were a prehistoric star-map - and saw sarsens in the landscape as route markers (Bennett 1904, 1907) in an earlier version of Alfred Watkins's 'mark stones' (1925 [1974]).

Figure 8. Extract from map section XI (Smith 1884) showing the area around West and East Kennett villages, either side of the River Kennet (Wiltshire) (unscaled, north to top). Archaeological monuments are coloured red, roads and tracks in brown and green. Sarsens are shown in yellow, including a spread to the north-east of West Kennet long barrow ('b' bottom left) and on high ground to the north of the Seven Barrows (top right). Photograph © Mike Robinson, with permission.

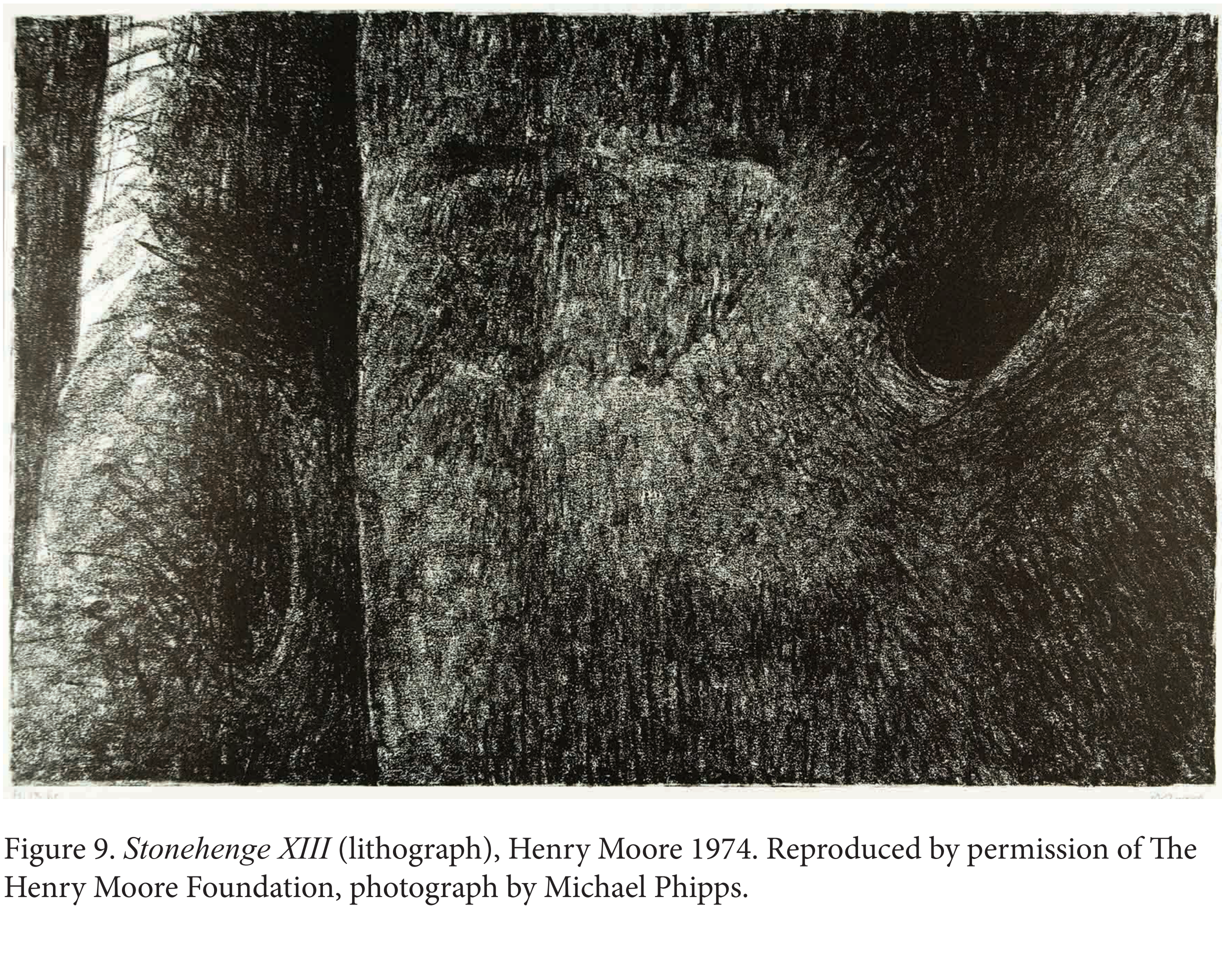


Figure 9. *Stonehenge XIII* (lithograph), Henry Moore 1974. Reproduced by permission of The Henry Moore Foundation, photograph by Michael Phipps.

features he created and depicted an archaeological landscape in which a geological component was now an essential cultural element.

A sacred material or a means to a livelihood?

Agriculture was not the only threat to Wiltshire's sarsens. Cobbles and boulders have been exploited for domestic building material since the Iron Age (Gillings *et al*. 2008, 291) and manual breaking had been going on for many years by the time John Aubrey mentioned it in passing in writing. The more interesting fire-setting – breaking sarsens up by using fire and water to induce thermal shock – was reported by Aubrey in the later-seventeenth century and illustrated by Stukeley in the 1700s (Fowles 1980, 38; Stukeley 1743, 15-16). Both men knew of sarsen's reputation as a supremely tough material, Aubrey commenting that weathered boulders on the ground-surface are 'so hard that no toole [*sic*] can touch them' (Britton 1847, 44); a belief originating in Rastell's description of sarsen at Stonehenge (Rastell 1530). In addition to being a dramatic and fascinating spectacle, first-hand accounts and direct observation of fire-setting explained to the antiquaries how sarsens could be destroyed. Later, Reverend Smith's reconnaissance was contemporary with the development of wide-spread, intensive sarsen quarrying using new steel tools that rapidly diminished Wiltshire's surface spreads not yet cleared by earlier agricultural Improvement (King 1968).

Despite the economic significance to the region of that activity, sarsen continued to enjoy a reputation amongst the reading public as a special, even magical, material. The strangeness of the boulders in the landscape and their prehistorical associations produced surprisingly romantic writing even in scientific literature; like Osbourne White's (1925, 74) rhapsody in his explanation of the geological map for Marlborough,

'There is something in their grey, recumbent forms, half hidden in long grass and scrub, that awakens a lively interest in the beholder, and even when their nature is known they continue to stir the imagination, their bulk, their legendary associations, and a touch of melancholy in their wild surroundings investing them with a kind of glamour.'

I use newspaper articles, available for the last *c*.100 years that the quarries were active, as a proxy for public perceptions of sarsen stone, here contrasting Wiltshire with Buckinghamshire. The history of the intensive industry is described in this thesis' fifth paper, so here I will simply mention that a specialist trade, developed in Buckinghamshire, was introduced to Wiltshire from 1847 by families skilled in the business. Sarsen-splitting in both counties ended as a going concern with the beginning of the Second World War (King 1968). Differences in scope and content between the articles published in these counties' newspapers give a general indication of how people saw sarsen at that time (assuming that the newspapers' journalists and editors understood the interests of their readership).

Wiltshire	**N**	**Buckinghamshire**	**N**
Reports on Amenity Society meetings and excursions to Wiltshire's prehistoric monuments and landscape	33	Reports from local government and other civic meetings (*e.g.* Boards of Guardians, Boards of Health) concerning infrastructure projects requiring Denner Hill Stone	97
Local-interest items on archaeology, history and countryside focussed on Avebury and Stonehenge	29	Adverts for sales of property mentioning structures built of Denner Hill Stone	10
Adverts, reviews and reports on books and lectures about Wiltshire's prehistoric monuments and landscapes	26	Public complaints about the state of Denner Hill Stone street furniture and road surfaces	6
News items about infrastructure including highways and sanitation, and local authority tenders for sarsen supplies	18	Reports of legal proceedings including theft of Denner Hill Stone, trespass at the quarries and other offences	4
Reports on excavations at Avebury and Stonehenge	17	Adverts for auctions of estates where land includes exploitable Denner Hill Stone	3
Extracts from publications about Avebury and Stonehenge	15	Purchasing authorities' calls to tender for Denner Hill Stone supplies	3
Local buildings such as churches with sarsen fabric identified during refurbishment	12	Sales of surplus Denner Hill Stone stock	3
Complaints about damage to monuments and agricultural clearance and the 1907/8 appeal to purchase Piggledene and Lockeridge Dene	10	Local history	2
Letters to the editor and articles with theories of the meaning of Avebury and Stonehenge	9	Advertisements by stone-cutters	1
Summer Solstice at Stonehenge	3	The accidental death in the quarry of a sarsen-cutter	1
TOTAL	**172**		**130**

Table 1 Summary of sarsen article types in Buckinghamshire and Wiltshire newspapers from the first early nineteenth-century publications until the Second World War.

Searching the British Newspaper Archive using the keywords 'sarsen' and 'greywether' in newspapers published in Wiltshire (1819 to 1939, eight titles) and the phrase 'Denner Hill Stone' in those published in Buckinghamshire (1829 to 1938, eight titles) produces 255 and 213 results respectively.[4] Searching for 'sarsen' in the Buckinghamshire newspapers produces 11 results of which 5 relate to the stone, all concerning sarsen outside of the county including one article about Stonehenge which mentions that sarsen is also found in Buckinghamshire (*The Bucks Herald* 1918, 2). After removing duplicate articles syndicated across multiple titles, the stories fall into general groups (Table 1).

The prehistoric archaeology of Avebury and Stonehenge dominate the narrative concerning sarsen stone in the Wiltshire newspapers. The three most common types of stories, and 132 articles overall (77%), concern the interests of the local readership and visiting groups in sarsen-built monuments and their landscape settings. Only 18 articles report on matters of infrastructure and local authority tendering for sarsen stone supplies, despite the likelihood that how their rates were spent was presumably of great interest to Wiltshire's residents. In contrast, the 97 articles (75%) on that topic dominate sarsen reporting in the Buckinghamshire press (Table 1). The difference cannot be due solely to the relative volume of sarsen being provided for civil engineering projects, which was high in both counties (Allen 2015; Burtonwood 1995; King 1968). The presence of two intriguing, internationally-important sarsen-built prehistoric monuments, and sarsen's accompanying positioning as an anciently sacred material, is part of how in Wiltshire it accreted associations and evocations that were irrelevant to sarsen, in the form of Denner Hill Stone, in Buckinghamshire. In Buckinghamshire, the local discourse was focused on the community's needs for sanitary streets, hard-wearing and clean roads, suitable surfaces for outside economic spaces and well-equipped business premises.

The stark contrast between the two very different geo-cultural landscapes is exemplified by a campaign in Wiltshire in 1907/8 to save natural sarsen spreads on the Downs from the quarrymen who were, nonetheless, providing the street furniture that was improving the conditions of nearby villages and towns. Fearing that the sale of the Meux estate would attract buyers intent on cashing-in on large-scale sarsen exploitation, promoters of the Grey Wethers Preservation Fund raised more than £600 to purchase just over 22 acres of sarsen spreads in Piggledene and Lockeridge Dene (Anon. 1907, 1908). Reverend E.H. Goddard's call to action echoed Reverend A.C. Smith's earlier remarks, mentioning the 'reasonable supposition that the sarsens of Stonehenge came from this immediate locality, and very possibly from Lockeridge Dean [*sic*] itself.' (Anon. 1907,

[4] Searches carried out at https://www.britishnewspaperarchive.co.uk/ on 24 November 2018 and 24 April 2020.

184). On completion of the purchase, examples of split and abandoned sarsens in Piggledene were even mortared together in an attempt to repair the damage done by the stone-cutters (Historic England Archive, SOA/03). Despite providing a living for families engaged in the stone trade in both counties, sarsen was viewed very differently in Wiltshire and Buckinghamshire.

Sarsen in folklore, art and literature

There are two sarsens next to the vicarage in Twyford village, Hampshire. Standing on the southern side of Berry Lane that leads down to a ford, these sarsens go down to the River Itchen to drink when the nearby church bells ring. This local folklore was reported through the *Sarsen Stones in Wessex* survey (Whitaker 2020, MS953/3/2/1/T8a). The megaliths have senses: they can hear, they respond to a stimulus, they decide, they act. Like the Swindon stone at Avebury which crosses the road each midnight before returning to its position in the morning (Jordan 1990, 57), the sarsens at Twyford are full of vitality. As breeding stones, sarsens have reproductive powers, populating fields with their progeny to become those troublesome stones, *sar stan*, that break ploughshares. They further disrupt human and animal lives by objecting to attempts to move them: a large sarsen near East Knoyle cannot be cleared despite the large number of horses brought into the draft (Grinsell 1976, 13) whilst an attempt to move the Kinwardstone killed the horses yoked to it (Jordan 1990, 54). Prehistoric sarsen settings and natural spreads of stone in the landscape have inspired similar story-telling through varied media. Here, it is not my intention to provide a comprehensive study of British landscape painting and writing that draws on sarsen for inspiration, but to focus on some specific examples of creative engagement with sarsen stone that reveal other ways of appreciating what it is or means.

Sensuous and pliant qualities of sarsen stone are revealed in the artwork of Henry Moore. Moore visited Stonehenge on numerous occasions and in 1974 published 15 lithographs depicting the monument in the album *Stonehenge* (Moore 1974). He chose lithography because of how suited the technique is to capture the stony textures which the images, like *Stonehenge XIII*, were intended to convey. Yet that image also gives the impression of soft, yielding, flesh-like form and it was Stephen Spender who, writing the introduction to the album and with Moore's agreement, re-titled *Stonehenge XIII* as 'Arm and Body.' Spender comments that each plate is both an accurate representation of the stones and also an ambiguous play of form and shadow that invites reinterpretation (Moore

1974, n.p.). At any moment, the torso of *Stonehenge XIII* might rise and fall with a breath taken, the arm reach across the navel to preserve the body's modesty (Fig. 9).

Sarsen has not only humanly physical qualities. Boulders lying out on the Downs are known as grey-wethers because of their visual similarity, at a distance or in the rain and mist, to recumbent sheep (Fig. 10).[5] The effect appears in Turner's watercolour of Stonehenge from the series *Picturesque Views in England and Wales* (1825-1838), in which the sheep closest to the storm-ridden monument are indistinct from the pillowy Station Stones. The sculptor Roger Leigh was fascinated by the confusion inherent in this visual conundrum, which he explored playfully in a series of montages and three-dimensional artworks using photographic collage and double-exposure techniques in work from the 1970s onwards (Wiltshire and Swindon History Centre, 4311/6). In numerous works he integrates sarsens and sheep, sometimes emphasising sheepy characteristics, at other times foregrounding the stony forms of recumbent boulders or towering orthostats. His sarsen-sheep-standing-stone at Avebury takes on the woolly texture of fleece, infusing the rough cold surface of the stone with the warmth and comfort of a staple product first introduced to Britain in the Neolithic (Fig. 11).

Avebury's standing stones and the Wiltshire Downland sarsens play the role of non-human relations to the protagonists Clare Warrener and Nicholas Lovel in Vita Sackville-West's novel *Grey Wethers* (Sackville-West 1923). The story is set in and around the fictional village of King's Avon, where the story plays out in a megalithic circle, a village of sarsen-built cottages and on the Downs amongst the spreads of sarsen stones. King's Avon is a more claustrophobic version of Avebury.[6] Sackville-West paints the Downland hills as a cold, spacious and lonely stage, 'their untilled defiance rolling eternally under the stars' (1923, 196). This speaks to the wildness that sets Clare and Nicholas apart from the book's other more conventional human characters. The country is 'personal, not inanimate' to them (1923, 58): the sarsens lying on the chalk hills use the breeze to communicate to them, 'it was a friend pleading with them, calling them back to the open…the breeze came to them direct as a messenger from the Grey Wethers' (1923, 190). The choice of this particular vernacular name for sarsen for the novel's title

[5] A wether is a ram, specifically a castrated ram. The name 'grey-wether' for sarsens first appears in print in the mid-1600s (Oxford English Dictionary 2020b).

[6] Sackville-West visited Avebury to research the book in 1922 and *Grey Wethers* was published before Alexander Keiller began reconstructing Avebury's sarsen settings (Glendinning 1983, 125). The henge, stone circles and West Kennet Avenue would have looked much more dilapidated compared to today yet Sackville-West conjures scenes dominated by sarsens at all scales: from the landscape, to the encircled village, to individual houses constructed of highly visible and psychologically affective sarsen fabric.

Figure 10. Sarsens and grazing sheep in the bottom of the coombe between Harestone Down and Cow Down, East Kennett parish (Wiltshire).

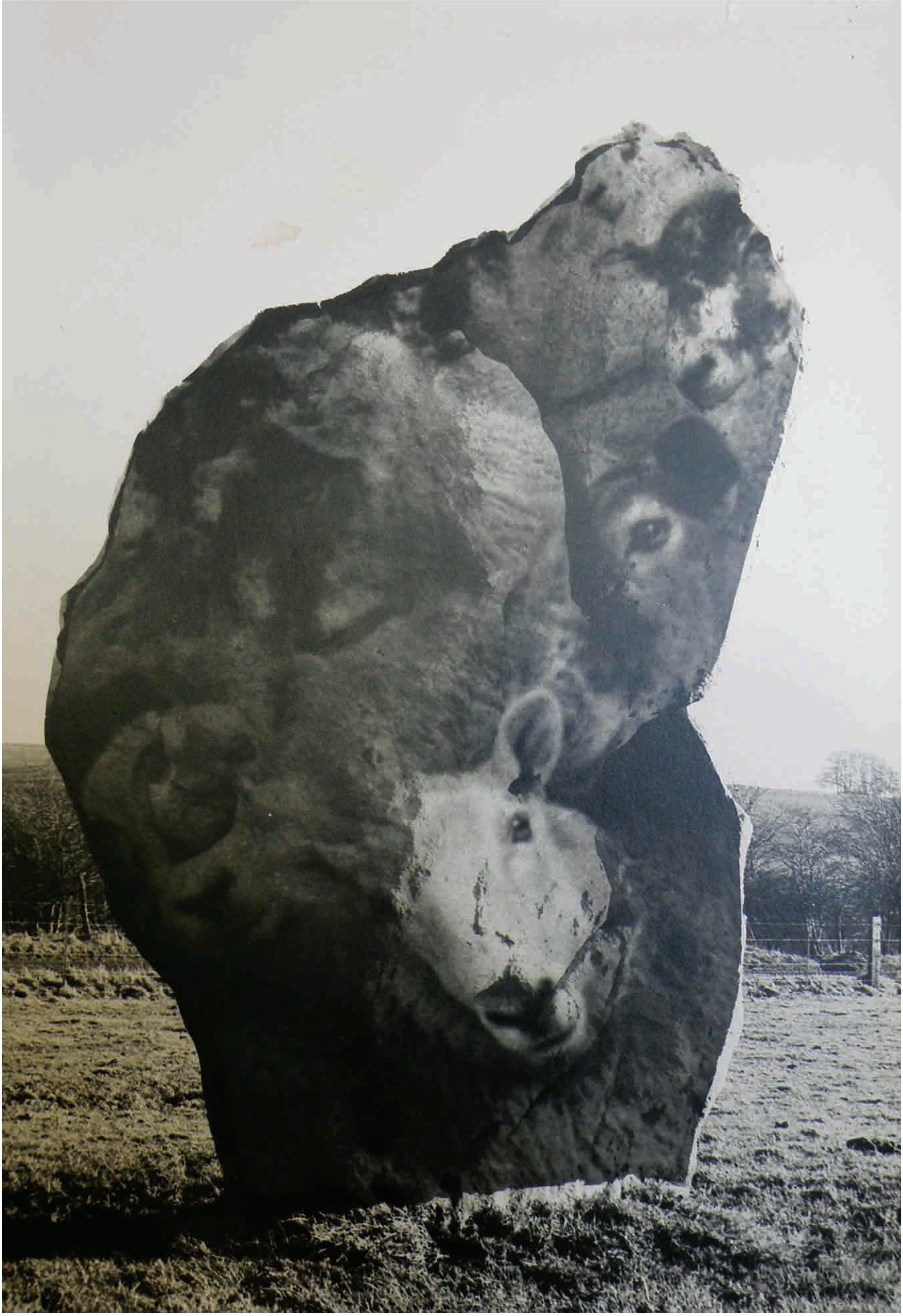


Figure 11. Montage by Roger Leigh. Paper and photographic print, undated (WSHC 4311/6/3).
© The estate of Roger Leigh/Wiltshire and Swindon History Centre.

references the same transformative nature that Roger Leigh plays with in his photographic collages. In the end, Clare and Nicholas are themselves transformed, disappearing into the world of the grey-wethers where they truly belong.

CONCLUSION

Throughout much of its southern English distribution, sarsen is a homogenous, sandy, siliceous type of stone found as cobbles and boulders arranged in surface spreads and shallowly buried in Tertiary and Quaternary deposits. It is tough and brittle with a reputation for conchoidal fracture; the more well-cemented it is, the more likely it is to split through, rather than around, the clasts and matrix of which it is made. It is most commonly encountered archaeologically as megaliths, worked and unworked cobbles and flakes, building material and as miscellaneous broken chunks of stone, as described throughout the following suite of papers.

Sarsen has stimulated scholarly interest since at least the seventeenth century. By the late-nineteenth century, the notion of sarsen as a special type of material – not only prehistoric megaliths, but anywhere and in any form – had coalesced out of the antiquarian literature and 'sarsenalia,' most clearly articulated by Smith (1884). A more detailed examination of how this went on to develop during the twentieth century is offered in this thesis's first paper. In the popular imagination, sarsen means different things to different people. The post-medieval sarsen industry provided a living to communities in both Buckinghamshire and Wiltshire; yet the economic and social significance that dominates Buckinghamshire's weekly press was over-shadowed in Wiltshire by sarsen's prehistorical associations.[7]

Sarsen's homogeneity and toughness are belied by creative interpretations of both megalithic and natural sarsen. The selection of artistic responses to sarsen that I highlight here foreground different visual and physical properties, including Henry Moore's fleshy, soft-looking standing stones and the living communities of hard-to-grasp, shape-shifting

[7] There was also an important medieval and post-medieval sarsen industry centred on the heathland at the Berkshire-Hampshire-Surrey border, where sarsen was known as 'heathstone'. The area supplied vast quantities of sarsen for the construction of Windsor Castle from the twelfth century onwards (St John Hope 1913). Examples of split sarsen building blocks can be seen in the eighteenth-century tower of St Michael's Church, Pirbright (Surrey). Aside from the Windsor Castle building accounts I have found only one, very brief, reference to the operations of this industry (Le Neve Foster 1894, 546). Much of the heath is now restricted MoD land. For pragmatic reasons, therefore, this area does not feature in this thesis: but it is a definite line of future research.

grey-wethers. There are many and varied ways to look at and understand sarsen stone, a theme to which I return in the thesis closing section.

You may notice that I have not arranged the six papers that comprise this thesis by chronological order of publication. That is in part an artefact of the, sometimes lengthy, peer review and publication process. Nevertheless, I have arranged the papers in an order that I hope follows an intelligible arc leading from this introduction to the closing section of the thesis. Each paper is introduced by an informal forward that helps to place it on the arc. Where the data are available, each foreword also indicates each paper's citation count and downloads as at 24 August 2022. You need not, however, read the papers in the order in which I have presented them. Each is a stand-alone piece, although it makes sense to read paper 3 after paper 2 given the results of the *Geochemical fingerprinting the sarsen stones at Stonehenge* project; and the fourth paper, published as a book chapter, was always intended to provide a general introduction and scene-setter to the lengthier and more detailed content of the fifth paper.

A series of Appendices follow the six papers. They comprise reports on archive collections that I have used and my methodologies for digitising data from analogue archive material (Appendix 1 and 4); my fieldwork reports for this project's two analytical earthworks surveys (Appendix 2 and 3); and my post-excavation reports on sarsen stone from the 'Vale of Pewsey' and 'Between the Monuments' projects (Appendix 5 and 6). Had this been a conventional thesis of chapters, then much of the information in the Appendices would instead have appeared in Methods sections within the thesis. The Appendices thus augment the necessarily briefer descriptions of methods that my published papers offer. Appendix 7 is a public engagement diary. Taking my developing research results into communities to share my findings has been a significant part of this PhD project. That is not to say that the academic conferences and seminars that I have presented at are less important (I have not listed all those activities here). Rather, that walking in sarsen spreads and discussing sarsen in village halls (and on Zoom) with communities who live with the stone has shown me how interested people are, how much they have to tell and how fondly they think of their sarsen stone.

REFERENCES

Manuscript sources

Historic England Archive. SOA/03. Collin Bowen's papers relating to Society of Antiquaries of London projects.
Wiltshire and Swindon History Centre. 4311/6. Records of Roger Leigh, Sculptor. Photographs of Leigh's work.

Published sources

Abbot, M. and Anderson-Whymark, H. 2012. *Stonehenge Laser Scan: Archaeological Analysis Report.* Swindon: English Heritage Research Report 32-2012

Adams, J. 1870. Sarsens. *Transactions of the Newbury District Field Club* 1, 104-109

Allen, J. R. L. 2015. *Kerbside Geology in Reading, Berkshire. Aspects of historical archaeology in the explanding town, c1840-1914.* Oxford: Archaeopress

Anon. 1907. The Fifty-Fourth General Meeting of the Wiltshire Archaeological and Natural History Society. *Wiltshire Archaeological Magazine* 35, 181-190

Anon. 1908. The Grey Wethers Preservation Fund. *Wiltshire Archaeological Magazine* 35, 497-501

Anon. 1911. Abstract of Proceedings, 1908-1910. *Archaeologia Cantiana* 29, xliii-lxxv

Bayliss, A., Whittle, A. and Wysocki, M. 2007. Talking About My Generation: the Date of the West Kennet Long Barrow. *Cambridge Archaeological Journal* 17(1), 85-101

Behr, I. S. 1996. *Star Trek: Deep Space 9. Paradise Lost.* R. Badiyi (Producer), Paramount Domestic Television

Belcher, W. H. 1911. Waylen Smith's Cave. *The Berks, Bucks and Oxon Archaeological Journal* 17, 82-84

Bennett, F. J. 1892. *A Sketch History of Marlborough in Neolithic Times*. Marlborough: W. Gale

Bennett, F. J. 1904. On the Meridional Position of Megaliths in Kent compared with those of Wilts, and also with those of earthworks and churches. *Transactions of the South Eastern Union of Scientific Societies* 9, 29-36

Bennett, F. J. 1907. *Sacred Stone Structures. Our Kentish Sacred Stones. The White Horse Stone and its Legend*. West Malling: H.C.H. Oliver

Bennett, F. J. 1913. Coldrum Monument and Exploration 1910. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland* 43, 76-85

Bowen, H. C. & Smith, I. F. 1977. Sarsen Stones in Wessex: the society's first investigations in the Evolution of the Landscape Project. *The Antiquaries Journal* 57, 185-196

Brentnall, H. C. 1946. Sarsens. *Wiltshire Archaeological and Natural History Magazine* 51, 419-439

Britton, J. (ed.) 1847. *The Natural History of Wiltshire by John Aubrey F.R.S. written between 1656 and 1691.* Newton Abbot: David and Charles

Buckland, W. 1823. *Reliquiae Diluvianae; or, observations on the organic remains contained in caves, fissures, and diluvial gravels, and on other geological phenomena, attesting the action of an universal deluge*. London: John Murray

Burl, A. 2004. A.D. Passmore and the Stone Circles of North Wiltshire. *Wiltshire Archaeological and Natural History Magazine* 97, 197-210

Burtonwood, G. 1995. *Denner Hill Stone*. Halton: Buckinghamshire County Museum Archaeological Service

Carruthers, W. 1885. Notes on the fossil roots in the sarsen stones of Wiltshire. *The Geological Magazine* 2, 361-2

Cohen, K. M., Harper, D. A. T. & Gibbard, P. L. 2013; updated. *ICS International Chronostratigraphic Chart 2022/02.* International Commission on Stratigraphy: IUGS

Colt Hoare, R. 1812. *The Ancient History of South Wiltshire.* London: Miller

Conneller, C. 2011. *An Archaeology of Materials: Substantial transformations in early Prehistoric Europe.* Abingdon: Routledge

D'Almaine, H. G. W. 1929. Wayland, The Smith. *The Berks, Bucks and Oxon Archaeological Journal* 33, 112-114

Darvill, T., Marshall, P., Parker Pearson, M. and Wainwright, G. 2012. Stonehenge Re-modelled. *Antiquity* 86(334), 1021-1040

Davies, A. & Baines, A. H. J. 1953. A preliminary survey of the sarsen and puddingstone blocks of the Chilterns. *Proceedings of the Geologists' Association* 64, 1-9

Day, J. M. D. 2019. Determining the source of silcrete sarsen stones. *Journal of Archaeological Science: Reports* 28, 102051

Evans, J. H. 1950. Kentish Megalithic Types. *Archaeologia Cantiana* 63, 63-81

Fowles, J. (ed.) 1980. *Monumenta Britannica or A Miscellany of British Antiquities.* Sherborne: The Dorset Publishing Company

Geddes, I. 2000. *Hidden Depths. Wiltshire's Geology and Landscapes.* Trowbridge: Ex Libris Press

Gillings, M. and Pollard, J. 2016. Making Megaliths: Shifting and Unstable Stones in the Neolithic of the Avebury Landscape. *Cambridge Archaeological Journal* 26(4), 1-23

Gillings, M., Pollard, J., and Strutt, K. 2019. The Origins of Avebury. *Antiquity* 93(368), 359-377

Gillings, M., Pollard, J., Wheatley, D. & Peterson, R. 2008. *Landscape of the Megaliths. Excavation and fieldwork on the Avebury monuments, 1997-2003.* Oxford: Oxbow Books

Glendinning, V. 1983. *Vita. The Life of V. Sackville-West*. London: Weidenfield and Nicholson

Goddard, E.H. 1926. Modern use of sarsen as tombstones. *Wiltshire Archaeological and Natural History Magazine* 43(144), 335

Goddard, H.E. 1899. Alfred Charles Smith – In Memoriam. *Wiltshire Archaeological and Natural History Magazine* 30(91), 198-204

Greenough, G. B. 1819. *A Critical Examination of the First Principles of Geology; in a Series of Essays.* London: Longman, Hurts, Rees, Orme, and Brown

Grinsell, L.V. 1976. The Legendary History and Folklore of Stonehenge. *Folklore* 87(1), 5-20

Ixer, R. & Bevins, R. 2021. Petrography of sarsen debitage from the Stonehenge landscape - a broad and perhaps scattered church. *Wiltshire Archaeological and Natural History Magazine* 114, 18-33

Jones, J.B. 1949. Wiltshire's Oldest Sarsens. *Wiltshire Archaeological and Natural History Magazine* 53(140), 131-3

Jordan, K. 1990. *Folklore of Ancient Wiltshire*. Trowbridge: Wiltshire County Council

King, N. E. 1968. The Kennet Valley Sarsen Industry. *Wiltshire Archaeological and Natural History Magazine* 63, 83-93

Le Neve Foster, C. 1894. *A Textbook of Ore and Stone Mining*. London: Charles Griffin

Mavor, W. F. 1809. *General View on the Agriculture of Berkshire.* London: Richard Phillips

Moore, H. 1974. *Stonehenge*. London: Ganymed Original Editions
Nash, D. J., Ciborowski, T. J. R., Darvill, T., Parker Pearson, M., Ullyot, J. S., Damaschke, M., Evans, J. A., Goderis, S., Greaney, S., Huggett, J. M., Ixer, R. A., Pirrie, D., Power, M. R., Salge, T. & Wilkinson, N. 2021. Petrological and geochemical characterisation of the sarsen stones at Stonehenge. *PLOS ONE* 16, e0254760
Nash, D. J., Ciborowski, T. J. R., Ullyott, J. S., Parker Pearson, M., Darvill, T., Greaney, S., Maniatis, G. & Whitaker, K. A. 2020. Origins of the sarsen megaliths at Stonehenge. *Science Advances* 6, eabc0133
Nash, D. J., Coulson, S., Staurset, S., Ullyot, J. S., Babutsi, M., Hopkinson, L. & Smith, M. P. 2013. Provenancing of silcrete raw materials indicates long-distance transport to Tsodilo Hills, Botswana, during the Middle Stone Age. *Journal of Human Evolution* 64, 280-288
Osborne White, H. J. 1925. *The Geology of the Country Around Marlborough: explanation of Sheet 266*. London: HMSO
Oxford English Dictionary. 2020a. 'Saracen, n. and adj.' [online]: Oxford University Press
Oxford English Dictionary. 2020b. 'Sarsen, n.' [online]: Oxford University Press
Peake, C. M. A. 1923. *Pagan Corner*. London: Methuen and Co
Peake, H. J. E. 1938. Roeburgh Hundred and its Association. *Transactions of the Newbury District Field Club* 8, 63-70
Peers, C. R. & Smith, R. A. 1928. Wayland's Smithy, Berkshire. *The Berks, Bucks and Oxon Archaeological Journal* 32, 74-82
Peers, C. R. & Smith, R. A. 1929. Wayland's Smithy, Berkshire. *The Berks, Bucks and Oxon Archaeological Journal* 33, 17-23
Piggott, S. 1946. The Chambered Cairn of 'The Grey Mare and Colts'. *Proceedings of the Dorset Natural History and Archaeological Society* 67, 30-33
Pitts, M. W. 1982. On the Road to Stonehenge: report on the investigations beside the A344 in 1968, 1979 and 1980. *Proceedings of the Prehistoric Society* 48, 75-132
Pollard, J. and Cleal, R. 2004. Dating Avebury In J. Pollard and R. Cleal (eds) *Monuments and Material Culture*, 120-129. East Knoyle: Hobnob Press
Pollard, J. and Gillings, M. 2010. The World of the Grey Wethers. In B. O'Connor, G. Cooney and J. Chapman (eds) *Materialitas. Working Stone, Carving Identity,* 29-40. Oxford: Oxbow Books
Prestwich, J. 1854. On the Structure of the Strata between the London Clay and the Chalk in the London and Hampshire Tertiary Systems. Part II: the Woolwich and Reading Series. *Quarterly Journal of the Geological Society* 10, 75-138
Rastell, J. 1530. *The Pastyme of People: the cronycles of dyuers realmys and most specyally of the realme of Englond.* London: John Rastell
Rupert Jones, T. 1870. The Geology of the Kennet Valley. *Transactions of the Newbury District Field Club* 1, 21-32
Rupert Jones, T. 1872-1875. Notes on some Sarsden or Sarsen Stones. *Transactions of the Newbury District Field Club* 2, 248-250
Rupert Jones, T. 1886. History of the Sarsens. *Wiltshire Archaeological and Natural History Magazine* 23, 122-154
Rupert Jones, T. 1901a. History of the Sarsens. *The Berks, Bucks and Oxon Archaeological Journal* 7, 54-59
Rupert Jones, T. 1901b. III. History of the Sarsens. *Geological Magazine* 8, 54-59
Rupert Jones, T. 1901c. V. History of the Sarsens. *Geological Magazine* 8, 115-125
Rylatt, J., Teather, A., Pullen, R., Pinnell, J., Randell, S., Roberts, H. and Chamberlain, A. 2022. Re-examining stone circles in Dorset: the results of recent research and non-

intrusive surveys at Kingston Russell stone circle. *The Archaeological Journal* 179(1), 141-168
Sackville-West, V. 1923. *Grey Wethers*. London: William Heinemann
Smith, A. C. 1884. *Guide to the British and Roman Antiquities of the North Wiltshire Downs.* Marlborough: The Marlborough College Natural History Society
Stevens, J. 1870. Geological Notices of North Hampshire. *Transactions of the Newbury District Field Club* 1, 71-94
St John Hope, W.H. 1913. *Windsor Castle: An Architectural History*. London: Country Life
Stukeley, W. 1743. *Abury - A Temple of the British Druids, with some others, described, etc.* London: printed for the author
Summerfield, M. A. 1979. Origin and palaeoenvironmental interpretation of sarsens. *Nature* 281, 137-139
Summerfield, M. A. 1983. Silcrete. In A.S. Goudie & K. Pye (eds) *Chemical Sediments and Geomorphology: Precipitates and Residua in the Near-surface Environment.* London: Academic Press
Summerfield, M. A. & Goudie, A. S. 1980. The sarsens of southern England: their palaeoenvironmental interpretation with reference to other silcretes. In D.K.C. Jones (ed.) *The Shaping of Southern England,* 71-100. London: Academic Press
The Bucks Herald. 1918. Topical Notes: General and Local. Stonehenge. *The Bucks Herald* 5 October 1918, 2
The Nature Conservancy. 1958/9. *The Nature Conservancy. Report of the Nature Conservancy for the year ended 30th September 1958*. London: HMSO
Thomas, H. H. 1923. The source of the stones of Stonehenge. *The Antiquaries Journal* 3, 239-60
Thornton, C.G. 2011. The Edward Thomas Memorial Stone, Shoulder of Mutton Hill, *Steep. The Edward Thomas Fellowship Newsletter 66, 24-32*
Tilley, C., Richards, C., Bennett, W. and Field, D. 2007. Stonehenge - its landscape and architecture: a re-analysis. In M. Larsson and M. Parker Pearson (eds) *From Stonehenge to the Baltic. Living with Cultural Diversity in the Third Millennium BC,* 183-204. Oxford: BAR International Series 1692
Townson, T. 1810. *The Works of the Reverend Thomas Townson ... To which is prefixed an account of the Author, with an introduction to the Discourses on the Gospels, and a sermon on the Quotations in the Old Testament, by R. Churton.* London: F. C. and J. Rivington and T. Payne
Ullyott, J. S. 2002. *The distribution and petrology of sarsens on the eastern South Downs and their relationship to Palaeogene and Neogene sediments and palaeoenvironments.* PhD, University of Brighton.
Ullyott, J. S. & Nash, D. J. 2006. Micromorphology and geochemistry of groundwater silcretes in the eastern South Downs, UK. *Sedimentology* 53, 387-412
Ullyott, J. S. & Nash, D. J. 2016. Distinguishing pedogenic and non-pedogenic silcretes in the landscape and geological record. *Proceedings of the Geologists' Association* 127, 311-19
Ullyott, J. S., Nash, D. J. & Shaw, P. A. 1998. Recent advances in silcrete research and their implications for the origin and palaeoenvironmental significance of sarsens. *Proceedings of the Geologists' Association* 109, 255-270
Ullyott, J. S., Nash, D. J., Whiteman, C. A. & Mortimore, R. N. 2004. Distribution, petrology and mode of development of silcretes (sarsens and puddingstones) on the eastern South Downs, UK. *Earth Surface Processes and Landforms* 29, 1509-1539
Watkins, A. 1925 [1974]. *The Old Straight Track*. London: Abacus Sphere Books

Webster, T. 1814. On the freshwater formations in the Isle of Wight, with some observations on the strata over the chalk in the south-east part of England. *Transactions of the Geological Society of London* 1, 161-254

Whitaker, K. A. 2020. *Sarsen Stones in Wessex*. University of Reading Research Data Archive: University of Reading, https://doi.org/10.17864/1947.249

Whittle, A., Bayliss, A. and Wysocki, M. 2007. Once in a Lifetime: the Date of the Wayland's Smithy Long Barrow. *Cambridge Archaeological Journal* 17(1), 103-121

Woodward, H. B. 2004. Jones, Thomas Rupert (1819-1911). *Oxford Dictionary of National Biography.* 2004 ed. Oxford: Oxford University Press

Wysocki, M., Griffiths, S., Hedges, R., Bayliss, A., Higham, T., Fernandez-Yalvo, Y. and Whittle, A. 2013. Dates, Diet, and Dismemberment: Evidence from the Coldrum Megalithic Monument, Kent. *Proceedings of the Prehistoric Society* 79, 61-90

Foreword, paper 1

Whitaker, K. A. 2020. Sarsen Stones in Wessex: A Society of Antiquaries Project contextualised and renewed. *The Antiquaries Journal* 100, 432-456, https://doi.org/10.1017/S0003581520000256

Cited by: 2

Views: 653 (html), 340 (PDF)

See also

Whitaker, K. A. 2020. *Sarsen Stones in Wessex*. University of Reading: University of Reading Research Data Archive, https://doi.org/10.17864/1947.249

Data downloads: 67

The *Sarsen Stones in Wessex* survey was carried out in Wiltshire, Dorset and Hampshire during the 1970s, led by Fellows of the Society of Antiquaries of London. It was a large project that had no hope of being completed by a small team of professional archaeologists alone. Some 100 volunteers carried out literature searches and walked over areas to identify and record sarsen stones, whether unmodified 'natural' boulders (though often encountered in anthropogenic contexts like field clearance) and features made using sarsen ranging from prehistoric monuments to modern-era buildings. An article summarising the overall results was published by its organisers Collin Bowen and Isobel Smith (Bowen and Smith 1977). The survey's greatest influence has been to depict a detailed, yet small-scale, sarsen distribution in central-southern England that contributes to mapping, informing geological and archaeological work such as Gillings and Pollard (2016), Summerfield and Goudie (1980) and Ullyott *et al*. (2004).

The survey was the first major sarsen stone research project in the UK driven by archaeological questions. It created an important dataset that I wanted to target early on in my research. Anecdotally, I knew that other archaeologists had viewed the survey's archive at the Society of Antiquaries of London and that they felt it contained rich, untapped, content (Tim Darvill pers. comm.). Tackling the analogue records would serve two main purposes: first, to create digital spatial data for sarsen stone presence and use that could be interrogated in a Geographic Information System; secondly, gaining an understanding of the survey's motivations, organisation, results and significance beyond Bowen and Smith's 1977 article.

Digitising the data involved capturing information from the survey's 879 record sheets, known as 'Tally Cards' by the project's participants. The sheets are in multiple formats and include numerous data fields with mixed data types (spatial data, textual data, measurements, sketches etc) (Table 1). There is inconsistency in what and how data were recorded across the three counties. As a result, I devoted considerable time to researching and developing a methodology to digitise data from the archive, including protocols to direct the transcription. That research activity is unpublished but all the documentation, my Archaeology Data Service-compliant metadata and an ISAD(G)-compliant collection description are deposited with the full dataset in the University of Reading Research Data Archive (see also Appendix 1).[1] I worked from a combination of my own photographs of the Tally Cards archived at Burlington House and microfiched copies held by the Historic England Archive, manually transcribing data and exploring the survey's genesis and conduct through supporting documentation. Understanding the survey was made easier with access to ancillary papers in the Historic England Archive, including a selection of Collin Bowen's personal papers.

County	Tally Card: sarsens	Revised 5/74	Tally Card: sarsen JB	Handmade	Postcards	Other format	TOTAL
Hampshire	6	300	0	5	0	0	**311**
Dorset	41	5	86	0	0	1	**133**
Wiltshire	1	26	0	62	132	214	**435**
TOTAL	**48**	**331**	**86**	**67**	**132**	**215**	**879**

Table 1 Names and formats of record sheet ('Tally Card') used by volunteers in the *Sarsen Stones in Wessex* survey, with frequency by type and county.

The Tally Card format was an adaptation of a recording formula used by Collin Bowen and colleagues in the survey teams of the then Royal Commission on Historical Monuments of England (RCHME) (Bowen 1961, 63). As I read through archived papers such as correspondence between the survey's organisers and Collin Bowen's manuscript notes concerning the project, the influence of RCHME's ways of working and contemporary concerns in archaeology came to the fore. I was collecting sarsen distribution data for my

[1] Handwritten recognition technology for manuscript documents has developed further since I completed this work, with advances made by Transkribus in particular (https://transkribus.eu).

(and others') future use, but also exploring the later-twentieth century development of landscape archaeology and historic environment management. The sarsen survey was born out of a largely anthropocentric understanding of prehistoric environments and the 1960s/1970s status of archaeological remains, as yet unprotected through the planning process, at risk from industrial agriculture and large-scale infrastructure development such as aggregates extraction.

In that context, the following paper introduces an academic perception of sarsen stone as something significant to prehistoric people as either a material resource (for constructing monuments) or a material hindrance (inhibiting early agriculture). These are, respectively, an anthropocentric and an environmental axiology of landscape (Dalglish 2012). The paper reveals the challenge to those axiologies that the survey's results presented, forcing Collin Bowen to ask himself if, against his expectations, sarsen stones in fact attracted people to certain places in the landscape (Bowen n.d.). That hint at the potential agency of stone and a relational landscape ethics, as more recent archaeological theory would characterise it, opens this thesis's conceptual arc of thinking differently about sarsen and sarsen technologies.

The paper's starting point is the sarsen survey, but its wider relevance is in using that project as a lens through which to explore archaeology's later-twentieth century intellectual development. It contributes to the literature concerning landscape archaeology – of which Bowen was a notable pioneer (Taylor 2010) – bringing attention to a network of actors (professional, academic, amateur) through which this sub-discipline was starting to grow. My paper foregrounds the way in which vocational research and fieldwork were being re-oriented from the site- and period-specific to a concern with geographic breadth and time-depth. It also shows how this formative period for the discipline was influenced by the engagement of volunteers, learned society members and specialists in other subjects.

As a former RCHME member of staff, albeit too young to have known the survey's protagonists, I feel a personal connection to this story. I and my Historic England colleagues continue to grapple with similar issues: the impact on archaeology of changing agricultural regimes; how to record archaeology on a national scale with limited resources; leading and supporting multi-disciplinary research; managing data to FAIR principles so that it is Findable, Accessible, Interoperable and Reusable. To that last challenge, my research has contributed an open access dataset that could not have been created without the curatorial work of archive staff and repositories of the Society of Antiquaries of London and Historic England, for which I am very grateful.

References

Bowen, H.C. n.d. *Sarsens. Notes*. Historic England Archive SOA03/16
Bowen, H. C. 1961. *Ancient Fields. A Tentative Analysis of Vanishing Earthworks and Landscapes.* London: The British Association for the Advancement of Science
Bowen, H. C. & Smith, I. F. 1977. Sarsen Stones in Wessex: the society's first investigations in the Evolution of the Landscape Project. *The Antiquaries Journal* 57, 185-196
Dalglish, C. 2012. Archaeology and Landscape Ethics. *World Archaeology* 44, 327-341
Gillings, M. & Pollard, J. 2016. Making Megaliths: Shifting and Unstable Stones in the Neolithic of the Avebury Landscape. *Cambridge Archaeological Journal* 26, 1-23
Summerfield, M. A. & Goudie, A. S. 1980. The sarsens of southern England: their palaeoenvironmental interpretation with reference to other silcretes. In D.K.C. Jones (ed.) *The Shaping of Southern England*, 71-100. London: Academic Press
Taylor, C. 2010. Founders. Collin Bowen. *Landscapes* 11(1), 84-94
Ullyott, J. S., Nash, D. J., Whiteman, C. A. & Mortimore, R. N. 2004. Distribution, petrology and mode of development of silcretes (sarsens and puddingstones) on the eastern South Downs, UK. Earth Surface Processes and Landforms 29, 1509-1539

The Antiquaries Journal, 2020, pp 1–25 © The Society of Antiquaries of London, 2020. This is an Open Access article, distributed under the terms of the Creative Commons Attribution licence (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted re-use, distribution, and reproduction in any medium, provided the original work is properly cited.
doi:10.1017/S0003581520000256

'SARSEN STONES IN WESSEX': A SOCIETY OF ANTIQUARIES PROJECT CONTEXTUALISED AND RENEWED

Katy A Whitaker, FSA

Katy A Whitaker, 107 Pavenhill, Purton, Wiltshire SN5 4DB, UK. Email: k.a.whitaker@pgr.reading.ac.uk

This paper reviews the Society of Antiquaries' Evolution of the Landscape project, which started in 1974, and the project's Sarsen Stones in Wessex survey. The survey was an ambitious public archaeology undertaking, involving c *100 volunteers led by Fellows of the Society during the 1970s. Its aims, objectives and outcomes are described in this article. The survey's unique dataset, produced for the counties of Wiltshire, Hampshire and Dorset, has now been digitised. Drawing on the dataset, the paper situates the Evolution of the Landscape project in the context of later twentieth-century British archaeology. It demonstrates the importance not only of individual Fellows, but also contemporary movements in academic and development-led archaeology, to the direction of the Society's activities in this formative period for the discipline today, and shows how the Society's research was engaged with some of archaeology's most pressing cultural resource management issues.*

Keywords: landscape archaeology; palimpsest; sarsen; GIS; Wessex; Neolithic; agriculture

INTRODUCTION

> [It] might be useful to suggest a particular task which could be easily defined and probably achieved within a year. This was a search for the present and former location of sarsen stones.[1]

Those Fellows of the Society of Antiquaries and their guests, who gathered on 23 February 1974 to inaugurate the 'Evolution of the Landscape' project, trod in the footsteps of eminent men including Mantell, Prestwich, Rupert Jones and Smith.[2] In asking themselves 'what was the incidence of sarsen stone in prehistory?' (in particular, in the Neolithic), they situated themselves in a tradition of enquiry concerning the geological origins, distribution and uses of southern Britain's sarsen stones. Since the expansion of this research in the nineteenth century, aspects of geological, archaeological and ethno-historical research into sarsen have often overlapped.

Sarsen is a silcrete sandstone (fig 1). Discontinuously distributed across central-southern and eastern England as cobbles and boulders, sarsen was formed by the cementation of material in Tertiary sand and pebble beds by silica-rich groundwater or in

1. HEA, SOA03/01, Evolution of the Landscape, Wessex Pilot Scheme News Sheet No. 1.
2. Mantell 1833; Prestwich 1854; Smith 1884; Rupert Jones 1886.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

Fig 1. The Valley of Stones, Marlborough Downs (Wiltshire) has one of England's few remaining large sarsen spreads. It is reputed to resemble the chalk upland before prehistoric and more recent clearance, commonly for agricultural purposes, removed stones from their natural positions. Despite the historical quarrying industry, there are estimated to be more than 10,000 sarsens lying in this dry chalk coombe (Small *et al* 1970). *Photograph*: the author.

drainage-line or pan/lacustrine settings. Whilst the processes of silica deposition in the host sediments were varied and occurred at different times, indurate sarsen stones are accessible on the present-day land surface (for example, in south-west Dorset) or buried in superficial deposits (such as over south Buckinghamshire's Chiltern Hills).[3] Best known for its use in megalithic structures from Wiltshire to Kent, sarsen nevertheless can be seen in buildings of varying date, purpose and status (fig 2) across its distribution.

Since the Evolution of the Landscape project's sarsen survey in the 1970s, archaeologists have largely been concerned with megalithic monuments built with this type of stone. There has been limited focus on the sarsen material itself, with some exceptions led most notably by researchers working in and around Avebury (Wiltshire).[4] Contributing at a regional scale to an understanding of sarsen distribution in relation to prehistoric archaeology, the potential of the 'Sarsen Stones in Wessex' survey was never fully met by its

3. Small *et al* 1970; Summerfield and Goudie 1980; Ullyot *et al* 2004; Nash and McLaren 2007; Ullyot and Nash 2016.
4. See in particular Gillings and Pollard 1999, 2004 and 2016a; Gillings *et al* 2008; Pollard and Gillings 2009, 2010.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

Fig 2. Sarsen in the walls of St Peter's church, Broad Hinton (Wiltshire), demonstrates the variability both of its use – here as rubble walling rather than cut blocks – and its lithology, with flint pebble clasts amongst the cemented sand in some pieces. *Photograph*: the author.

instigators. This is largely because of problems with its analogue dataset, and also in part due to deficiencies of the Evolution of the Landscape project's theoretical framework, which are discussed below.

This paper contextualises the Sarsen Stones in Wessex survey. It identifies contemporary conceptualisations of landscape as the main influence on the project's treatment of sarsen stone, strongly directed by practitioners of the British field archaeology tradition whose professional interests lay in the project's study area. The Evolution project's Sarsen survey epitomises the development of landscape archaeology in Britain after the Second World War. Whilst the survey's outputs were limited and now are physically compromised, a newly digitised dataset means that the project can play a part in answering recent calls to make a more effective exploration of past sarsen-scapes.[5]

THE 'EVOLUTION OF THE LANDSCAPE' PROJECT

This project was one of two schemes introduced by Fellows H Collin Bowen and Barry Cunliffe in 1973, following suggestions that the Society become proactive in research[6] (the other, the proposed archaeological investigation of churches, was prompted by threats to the Church of England estate from redundancy following the 1968 Pastoral Measure). The Evolution project aimed to evaluate prehistoric population size and socio-economic organisation by researching changing land use. Like the churches proposal, it was also driven by perceived threats to the archaeological resource, which had already led to the creation of *Rescue* (The British Archaeological Trust) in 1971. Both proposals responded

5. Field 2005; Gillings and Pollard 2016a.
6. Barry Cunliffe, pers comm, 26 Feb 2018.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

to the Society's need for an overarching research framework to direct the allocation of its funds to the right grant applications, given these challenges.[7]

The idea of the first human-made landscape was at the heart of the preparations. The purpose of the Evolution project as first proposed was 'to investigate the origins of the first organised landscape in Britain' – in particular, 'the lowest layer in this palimpsest, disclosing the period and the manner in which man first imposed a visible order on his countryside'.[8] As the idea developed during 1972, with additional input from John Coles, the emphasis fell on 'the emerging possibility of recovering the earliest patterns of regular land allotment'.[9] Throughout, the emphasis was on a project that would apply geographical and archaeological precepts to 'break away from the single site and single period approach'.[10]

The promoters of the Evolution project had already identified the Somerset Levels and Wessex as possible study areas. Wessex was suggested because of its extensive, well-preserved, archaeological evidence for prehistoric land use, including earthwork field systems with stratigraphic relationships.[11] By the time the extended proposal was written, the overarching aim had become an understanding of 'the size and disposition of the population and the nature of its economic and social organization. In this way, the dynamic processes at work within society may begin to be better appreciated.' Research already underway by, amongst others, local societies, university departments and government agencies, could support the essentially low-budget, collaborative approach espoused by the project's proposers, who called for a working party to be convened. Before a meeting was held, the project had been re-named from 'The Organisation of the Landscape' to 'The Evolution of the Landscape',[12] prefiguring Christopher Taylor's vision for research to illuminate change over deep time.[13]

Collin Bowen then made a separate project proposal to his associates Richard Atkinson, Desmond Bonney, Richard Bradley, Geoffrey Kellaway and Isobel Smith. He proposed recording all the sarsen stones, whether extant or lost, in Hampshire, Wiltshire and Dorset, 'in order that archaeologists can assess the problems of clearance and the range of utilisation in geographical and functional terms from the earliest times'.[14]

By the time of the inaugural 'Evolution of the Landscape, Wessex Pilot Project' meeting, held on 23 February 1974 with about forty invited attendees (unfortunately un-named in the minutes), two distinct methodologies had been identified. Cunliffe presented on the first: an intensive study of a small area of landscape, which he illustrated with reference to work already underway around Danebury. Bowen advocated surveying a far larger area for one class of data, proposing a sarsen stone study. The meeting concluded that both were of interest: the Danebury project would receive financial support; the sarsen survey would commence, using a pre-prepared information sheet and record-card.[15]

7. Bowen and Cunliffe 1973.
8. SAL, MS953/1/1, Proposal for a scheme to investigate the origin of the first organised landscape in Britain.
9. SAL, MS953/1/1, Proposal for sponsorship of a scheme of research by the Society of Antiquaries of London.
10. SAL, MS953/1/1, The Organization of the Landscape – The Creation of the Project
11. Bowen and Cunliffe 1973, 9.
12. SAL, MS953/1/1, letter written by F H Thompson dated 9 Aug 1972.
13. Taylor 1974, 151.
14. HEA, SOA03/18, memorandum written by Collin Bowen dated 20 Dec 1973.
15. HEA, SOA03/01, Evolution of the Landscape, Wessex Pilot Scheme News Sheet No. 1.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

Volunteers led by Collin Bowen and Isobel Smith carried out the sarsen survey between 1974 and 1976, outlined below. The results were published in *The Antiquaries Journal* in 1977. Looking like an interim report, that paper was, in fact, the survey directors' only intended written output. Cunliffe's work at Danebury expanded into the 'Danebury Environs Project'.[16] The aspiration of the Evolution of the Landscape project to be the focal point for ongoing research into the transformation of the countryside from wilderness to an organised and divided agricultural landscape was, however, not realised. John Evans' 'Wessex Linear Ditches' fieldwork[17] and John Bailey's 'Parish Boundaries' project in Dorset[18] were supported financially by the Society of Antiquaries under the Evolution aegis, as was Martin Bell's 'Dry Valley' project.[19] But Collin Bowen withdrew from further involvement in late 1978 in anticipation of his retirement.[20]

THE 'SARSEN STONES IN WESSEX' SURVEY

Aims and objectives

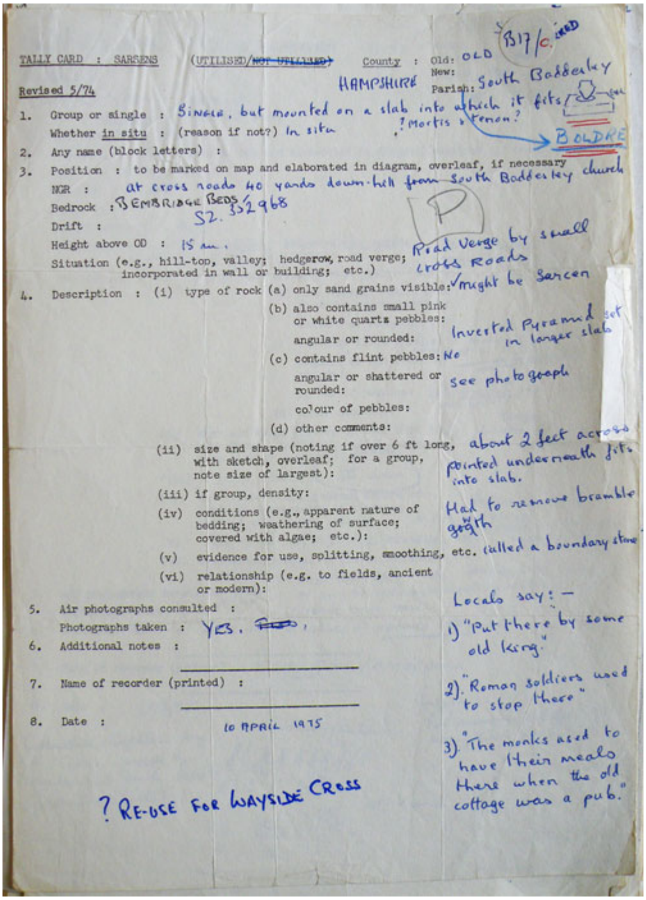
Intended to be the pilot scheme of the Evolution project, Collin Bowen proposed that a sarsen survey 'could be done by dividing the area between individuals and groups who would undertake to look everywhere within their individual pieces of jig-saw'. He advocated a project engaging volunteers, because they could complete work that for one person might take '24 man years'.[21] Three project aims were articulated: to establish the former incidence of sarsen stone in the study area; to describe how sarsens had been dealt with (as a useful mineral resource or as impediments to land use); and to understand the effect of sarsen stones on underlying chalk bedrock.

The methodology was outlined in the project's 'Information Sheet No. 1'. Volunteer participants would make a thorough search of Wiltshire, Dorset and Hampshire, annotating 1:25,000-scale Ordnance Survey maps with the positions of sarsen stones. They were to record details of each stone or group of stones on pro-forma sheets called 'Tally Cards' (fig 3). At the end of the project the maps and sheets would be archived and a collated list of all the stones published. Certain sarsens would be excavated to investigate their relationship with bedrock, aiming to shed light, as Bowen put it, on 'the hollows that occasionally puzzle excavators'.[22] Finally, a paper was to be published drawing the project's conclusions. The initial results were reviewed in May 1975. At that time, fieldwork in Dorset was 'substantially complete'[23] and continuing in Hampshire and Wiltshire. By 1977 it was almost finished, with acknowledged gaps in north-east Hampshire and in the militarily restricted Salisbury Plain Training Area.

The project leaders had, or came to develop, additional objectives not mentioned in either 'Information Sheet No. 1' as circulated to the volunteers in 1974, or in the final

16. Cunliffe 2000.
17. SAL, MS953/1/1, report written by John Evans dated 29 Nov 1977.
18. SAL, MS953/1/1, letters written by John Bailey dated 20 Mar 1978, 29 Oct 1981 and 11 Apr 1983.
19. Bell 1983.
20. SAL, MS953/1/1, letter written by Collin Bowen dated 6 Dec 1978.
21. HEA, SOA03/01, Evolution of the Landscape, Wessex Pilot Scheme News Sheet No. 1.
22. HEA, SOA03/03, Sarsen Symposium, Evolution of the Landscape Project News Sheet No. 2.
23. Bowen and Smith 1977, 185.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256


TALLY CARD : SARSENS (UTILISED/~~NOT UTILISED~~) County : HAMPSHIRE Old: OLD New: B17/c.

Revised 5/74 Parish: South Baddesley

1. Group or single : Single, but mounted on a slab into which it fits / ? Mortis & tenon?
   Whether in situ : (reason if not?) In situ → BOLDRE
2. Any name (block letters) :
3. Position : to be marked on map and elaborated in diagram, overleaf, if necessary
   NGR : at cross roads 40 yards down-hill from South Baddesley church
   Bedrock : Bembridge Beds / SZ. 352968
   Drift :
   Height above OD : 15 m.
   Situation (e.g., hill-top, valley; hedgerow, road verge; incorporated in wall or building; etc.) Road Verge by small cross Roads
4. Description : (i) type of rock (a) only sand grains visible: ✓ might be Sarsen
   (b) also contains small pink or white quartz pebbles:
   angular or rounded: Inverted Pyramid set in longer slab
   (c) contains flint pebbles: No
   angular or shattered or rounded: see photograph
   colour of pebbles:
   (d) other comments:
   (ii) size and shape (noting if over 6 ft long, with sketch, overleaf; for a group, note size of largest): about 2 feet across pointed underneath fits into slab.
   (iii) if group, density:
   (iv) conditions (e.g., apparent nature of bedding; weathering of surface; covered with algae; etc.): Had to remove bramble growth
   (v) evidence for use, splitting, smoothing, etc. Called a boundary stone
   (vi) relationship (e.g. to fields, ancient or modern):
5. Air photographs consulted :
   Photographs taken : Yes.
6. Additional notes : Locals say:— 1) "Put there by some old king." 2) "Roman soldiers used to stop there" 3) "The monks used to have their meals there when the old cottage was a pub."
7. Name of recorder (printed) :
8. Date : 10 APRIL 1975

? RE-USE FOR WAYSIDE CROSS

Fig 3. The Sarsen Stones in Wessex Tally Card for a possible sarsen stone recorded by a volunteer in Boldre (Hampshire), showing the information required by the project. Following the completion of the record, at least five additional notes were made, perhaps at different times and likely by different people, in pencils, black biro, red ink and blue felt-tip pen. SAL, MS953/3/2/1/B17c. Reproduced with the permission of the Society of Antiquaries of London. *Photograph*: the author.

published paper: Bowen had also wanted to identify owners, in order to persuade them of the importance of preserving the stones; to list sarsens on bedrock geology other than chalk; and to note sarsens incorporated into structures outside the generally recognised sarsen locales.[24] By 10 May 1975, when a progress meeting called the 'Sarsen Symposium' was held at Burlington House, Bowen was hopeful that the Wessex project archive would form the nucleus of a national sarsen record.[25] Bowen's manuscript notes recording discussions with Isobel Smith show that they talked about:[26] experimenting with sarsen stone dressing; investigating sarsen's 'case-hardening' effect;[27] and using excavation

24. HEA, SOA03/18, memorandum written by Collin Bowen dated 20 Dec 1973.
25. HEA, SOA03/03, Sarsen Symposium, Evolution of the Landscape Project News Sheet No. 2.
26. HEA, SOA03/16, Sarsens. Notes.
27. See Summerfield and Goudie 1980, 75.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

to find out whether or not sarsens occur naturally in mounds and as upright stones, and to investigate a standing stone. None of these wishes came to fruition, other than in minor ways; for example, the Wiltshire component of the survey includes records of sarsens on south-east Swindon's Greensand.

Outcomes

If considering solely the three main published aims and the field survey carried out by volunteers, the Sarsen survey was successful. The project mapped the presence of sarsen across the three counties, and a large dataset was gathered comprising nearly 900 records. As well as these field survey results, the dataset included a notable collection of published and unpublished references in its Tally Cards, especially for Dorset and Wiltshire, although little reference was made to commentaries on sarsen stone in the relevant British Geological Survey memoirs. If not the absolute former incidence of the stone in a geological sense, the project at least showed the range of sarsen's twentieth-century distribution in three counties in both 'natural' and anthropogenic contexts, hinting at the earlier availability of sarsen as a mineral resource. The project's valuable excavations at two sarsens on the Marlborough Downs demonstrated that one boulder lay directly on the Chalk bedrock, whilst the second, nearby, rested on a thin clay lens over the chalk.[28] A hoped-for comparison with sarsens excavated from Clay-with-flints and sarsens in an uncertainly-prehistoric setting[29] did not go ahead.

The concluding publication was co-authored by the project's leading investigators, Collin Bowen and Isobel Smith. Whilst it came out before the very last of the survey was assembled, the synthesis was felt to offer 'a consistent statement of distribution'[30] of the stone. Bowen and Smith concluded that sarsens had hardly been an obstacle to farming, having been densest in areas of Wiltshire and Dorset that were also densely occupied in prehistory.[31] Within the paper, the principal products included three black and white distribution maps.[32] Despite a note from Paul Ashbee to Collin Bowen mentioning that Ashbee had a 'rough list'[33] of sarsens in Kent, none appear in the published southern England general distribution map. Neither is the presence of sarsen in counties including Berkshire, Surrey or Sussex indicated. Some distribution data provided by Andrew Goudie for eastern England were included. The figures also indicate a few records in Surrey, just over the Hampshire county boundary, whilst records collected by volunteer Peter Gallup after publication could not be included.

The dataset had some significant gaps, including the absence of records of sarsen-built features and natural sarsen spreads from a substantial proportion of map-sheets SU16 and SU17, the area immediately to the south and east of Avebury (Wiltshire). Sarsen there had been deemed to be too prolific for enumeration;[34] it is unclear how points in these unrecorded areas around Avebury were created for the published Wiltshire distribution map. The West Kennet Long Barrow; the stone settings of Avebury henge; the Overton Down

28. Bowen and Smith 1977, 194–5.
29. HEA, SOA03/16, Sarsens. Notes.
30. Bowen and Smith 1977, 186.
31. Ibid, 195.
32. Ibid, 188 fig 1, 190 fig 2 and 192 fig 3.
33. HEA, SOA03/48, letter written by Paul Ashbee dated 14 Oct 1975.
34. SAL, MS953/4/1/SU16, MS953/4/1/SU17.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

Table 1. The different record formats used by volunteers in the Sarsen Stones in Wessex survey, with frequency by type and county. The total of 879 includes seven records of areas unsuccessfully searched for sarsens.

COUNTY	Tally Card: sarsens	Tally Card Revised 5/74	Tally Card: sarsen JB	Handmade	Postcards	Other format	TOTAL
Hampshire	6	300	0	5	0	0	**311**
Dorset	41	5	86	0	0	1	**133**
Wiltshire	1	26	0	62	132	214	**435**
TOTAL RECORDS	**48**	**331**	**86**	**67**	**132**	**215**	**879**

axe *polissoir* and the cup-marked sarsen; the 'sarsen villages'; sarsen spreads in Clatford, Lockeridge, Piggledene: none were recorded.

The analysis was beset by a number of issues. Differences between the survey's conduct in the three counties were conceded; for example, the Dorset results were felt to include a detailed record of 'natural' sarsen distribution, whilst Hampshire records focused on utilised sarsens in anthropogenic contexts.[35] This variability, resulting in part from inconsistencies in how records were made in each county and also volunteers' different interpretations of the Tally Card pro-forma, is apparent in the archived datasets.

There were three versions of the project's Tally Card recording forms. These included the original, 'Tally Card: sarsen' (forty-eight records), a later iteration 'Tally Card Revised 5/74' (331 records) and an expanded version made by John Bailey and used only in Dorset, 'Tally Card: sarsen JB' (eighty-six records). In total they account for 53 per cent of all records (table 1). The forms included eight broad categories of data. Each category comprised a number of more-or-less discrete items of information, recorded by the volunteers in a semi-structured way without controlled language or mandatory fields. Information could be written anywhere on the sheet, with sketches and additional information on the reverse (see fig 3). Most Tally Cards were not duplicated from a master document, but typed out when fresh sheets were needed. There are therefore some inconsistencies from sheet to sheet, with categories and questions missed out or placed in a slightly different location on the page. Occasionally a volunteer noticed a missing question and wrote it in themselves; at other times, not. Remaining records were made on handmade versions (sixty-seven records), postcards (132 records) and other formats (215 records) (see table 1).

All bar five of the 311 Hampshire and one of the 133 Dorset records used variants of the project's Tally Cards. In contrast, the bulk of the 435 records for Wiltshire were made on small postcards and typescript notes (see table 1). Capturing very few of the Tally Card data categories, they include many bibliographic references for both extant and long-lost stones. Isobel Smith had made an extensive literature search for the county (30 per cent of Wiltshire records), which neither the Hampshire co-ordinator, Peter Gallup, nor the Dorset co-ordinator, John Bailey, attempted. Only 5 per cent of Hampshire and 7 per cent of Dorset records came from published sources, compared with 77 per cent and 86 per cent respectively from visits (table 2). As well as the locations of sarsens in natural and anthropogenic contexts, the volunteers recorded their theories about what the stones represented, why they were there, local information and folklore. In Hampshire, for example, this

35. Bowen and Smith 1977, 186.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

Table 2. General characteristics of the 872 Sarsen Stones in Wessex records compiled by volunteer recorders, by county. *One Hampshire record is very clearly dated 1973, an obvious error on the part of the recorder, but cannot be re-attributed.

CLASS		Hampshire	Dorset	Wiltshire	TOTAL
'Utilised/not utilised'	**Utilised**	252	41	39	**332**
	Not utilised	51	28	31	**110**
	Not indicated	8	63	359	**430**
NGR	**no NGR**	2	0	49	**51**
	2-figure	0	0	1	**1**
	4-figure	4	1	11	**16**
	6-figure	249	74	110	**433**
	8-figure	54	57	258	**369**
	10-figure	2	0	0	**2**
Recorded names	**Primary recorder**	50	16	19	**85**
	Secondary recorder	5	6	4	**15**
	Unattributed	16	8	294	**318**
Record date	**to day**	74	71	87	**232**
	to month	194	46	9	**249**
	to year	11	0	3	**14**
	unrecorded	32	15	330	**377**
	Year range	1973*–86	1974–5	1974–6	
Data source	**visit**	241	115	249	**605**
	bibliographic	17	9	132	**158**
	own authority	10	1	3	**14**
	pers comm	23	4	11	**38**
	unrecorded	20	3	34	**57**

included identification of sarsens as 'mark stones'[36] and the tale of two thirsty sarsens in Twyford that drink from the river when the church bells ring.[37]

Various issues with the analogue records have longer-term archival implications. There is considerable variation in the visual quality of each record sheet, such as the handwriting, ink, legibility and text placement (see fig 3), as well as in the quality of the recorded content. As part of the original analysis, the records were collated and distribution maps for each county produced at 1:100,000. These showed sarsen locations coded by four general periods and as 'natural' stones, singly and as groups. Regrettably, these archived distribution maps are now compromised as the coloured markers stuck onto the sheets have lost their adhesion and fallen away (fig 4).

Archaeology enjoys a long history of public participation, including fieldwork by volunteers working at a national scale. Projects include, for example, the National Record of Industrial Monuments,[38] the War Memorials Register,[39] the Defence of

36. After Watkins 1925, 23–33.
37. SAL, MS953/3/2/1/T8a.
38. Buchanan 1969, 1971.
39. Catherine Long, pers comm, 3 Aug 2017.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

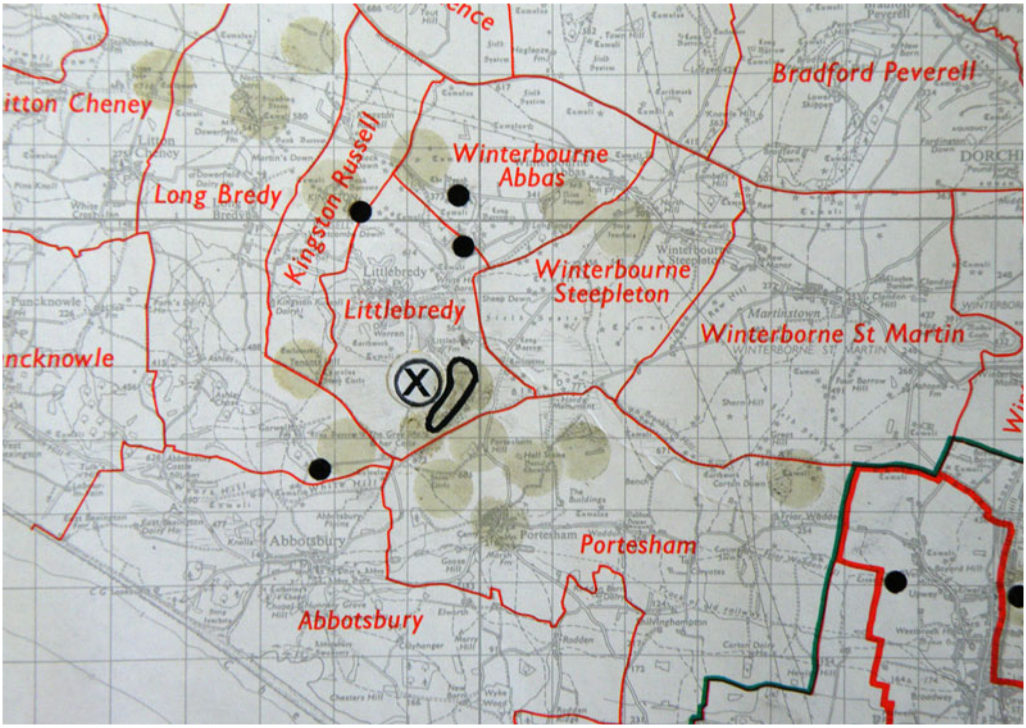


Fig 4. An extract from the Sarsen Stones in Wessex 1:100,000 distribution map for Dorset. Black dots show locations of single sarsen stones attributed to medieval, later and undated uses. The area outlined in black adjacent to the circled cross is the Valley of Stones in Littlebredy parish. Pale circular marks on the map show where coloured stickers once marked locations. The stickers were colour-coded to indicate information including date of use (eg red for prehistoric), or sarsens that were documented in bibliographic sources but no longer present on the ground. SAL, MS953/2/2a-b. Reproduced with the permission of the Society of Antiquaries of London. *Photograph*: the author.

Britain Project[40] and Home Front Legacy.[41] County-wide projects include Leicestershire's Community Heritage Initiative.[42] The sarsen survey's time-limited, regional, subject-specific fieldwork with a prehistoric focus stands out not only as a precursor to present-day collaborative citizen-science, but also for its ambition. It covered a big area and in a short space of time gathered a large dataset, drawing on multiple sources researched by a range of participants.

It is surprising that, despite the project's explicit aim to understand prehistoric relations with sarsen stone, no attempt was made to explore historical clearance of the stone and the undoubted relevance of this activity to interpreting the observable geological and archaeological records. An awareness of the potential to explore the historical industry is shown by a note typed in preparation for the 1975 Sarsen Symposium, tabling a report

40. Council for British Archaeology 2017.
41. Council for British Archaeology 2014.
42. Leicestershire County Council 2009.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

on 'evidence for movement/disappearance *including unfinished splitting etc*'.[43] At the Symposium, Noel King described the industry but dwelt on the Nature Conservancy Council's interests on the Marlborough Downs. It is noticeable that none of the Tally Cards deal with the immense quantities of sarsen street furniture in villages and towns in the study area. The project team could legitimately claim to have created 'a picture of the present distribution of the stones' in the study area, but without any assessment of modern clearance the assurance that the data also show 'their probably maximum incidence on the surface, whether naturally or quarried, within the last 6,000 years'[44] is true only at the smallest of scales at which the project's maps were reproduced.

The data

The sarsen survey records are difficult to use as an analogue dataset and because of their variability. That includes the diversity of non-standardised record formats, absence of controlled recording language and different interpretations by volunteers around what should be recorded, and the heterogeneous nature of the collected data. Additionally, the 1:100,000-scale distribution maps[45] are compromised and cannot be used to replicate or interpret the published mapping. The published figures have their utility but are static, small-scale, black and white illustrations that cannot be interrogated in ways made possible by modern Geographic Information Systems. Accordingly, a digital dataset is required to employ the information contextually, for example with geological or historical base-mapping.

Following an assessment of methodologies used by other archive projects digitising historical datasets, the complex visual properties of the Tally Cards were shown to preclude the use of scanning, computerised handwritten text recognition and data segmentation to create a digital dataset. A process of manual transcription was designed to capture data from the paper sarsen survey records in the Society of Antiquaries of London's collection MS 953 and from microfiche copies of that material held by the Historic England Archive. This exercise resulted in 872 separate records for individual sarsens, groups of sarsens and other features such as sarsen-built monuments. Data were transcribed following specific protocols into a spreadsheet comprising forty-five discrete fields, in which lengthy textual records were managed according to the precedent set by the British Museum's 'Micropasts' National Bronze Implements Index project.[46] The detailed methodology, paradata and transcription protocols are publicly archived alongside an archive report.[47]

Various measures can be used to explore data quality across the total dataset and, bearing in mind differences in how data collection was co-ordinated in each area, between the three counties. This is important in order to judge the weight that may be placed on the archived data. Replicating Bowen and Smith's general distribution map of 'natural' ('not utilised') and anthropogenic ('utilised') sarsens[48] demonstrates the difficulty of interpreting this classification. Figure 5 was produced using the total dataset (because it is not

43. HEA, SOA03/18, Future Sarsen Programme. Note that italics in the text indicate a handwritten addition to the typescript.
44. Bowen and Smith 1977, 186.
45. SAL, MS953/2/2a-b, MS953/3/3/1, MS953/4/3a.
46. Bonnachi *et al* 2015; Jennifer Wexler, pers comms, 13 Aug and 5 Sept 2017.
47. Whitaker 2020a, 2020b, 2020c.
48. Bowen and Smith 1977, 190 fig 2.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

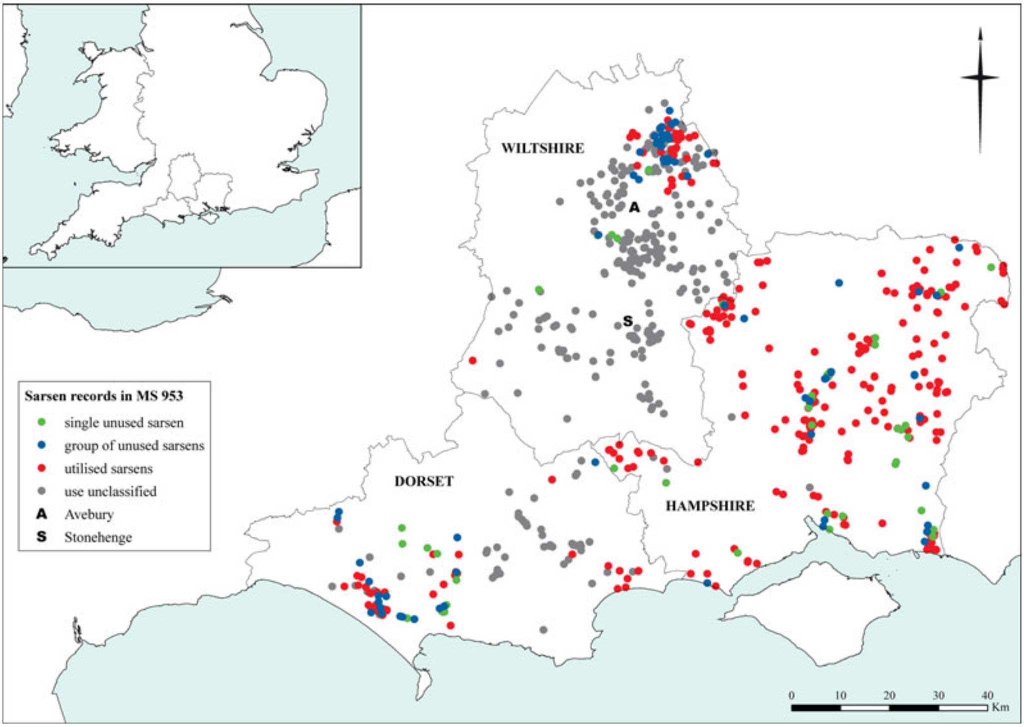


Fig 5. The distribution of all 872 digitised Sarsen Stones in Wessex project records. Bowen and Smith's original map published in 1977 displayed three classes: single natural sarsen; group of natural sarsens; utilised sarsen. Here, single and grouped unused sarsens (Bowen and Smith's 'natural' stones), utilised sarsen and the 430 records unclassed by volunteer recorders are shown. This dataset includes twenty-six records made after 1977 and may include duplicate records in the more complex Wiltshire subset. Includes Ordnance Survey data from 2017. *Map*: the author.

clear how Bowen and Smith selected points for their mapping). Of the 872 records, 332 (38 per cent) were marked as 'utilised', 110 (13 per cent) as 'not utilised'; but in 430 records (49 per cent) this field went unrecorded (see table 2). An exact replica of the original map is thus not possible. Key differences include, for example, the presence in Hampshire of groups of 'not utilised' sarsens, whereas the map published in 1977 shows only single 'natural' stones. The missing records to the east and south of Avebury are clear. Nevertheless, the new version is broadly similar.

The quality of grid-references is another useful measure, assessed in terms of *tolerance* (that is, the percentage of grid-references recorded to 4-, 6-, 8- or 10-figures). Overall, the quality is high. In Hampshire, 303 (97 per cent) of records had 6- or 8-figure grid-references; in Dorset, 131 (99 per cent); in Wiltshire, 368 (86 per cent). Although this measure is not one of *accuracy*, the large proportion of well-referenced records, given field recording without global positioning aids, is highly reassuring. Nearly 70 per cent of all records were the result of a field visit. The project's short timescale is reflected in the data collection date ranges, except for Peter Gallup's continuing research in Hampshire until 1986.[49]

49. HEA, HSS01, Hampshire Sarsen Survey.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

Table 3. The number of records created by the most active volunteers, by county, each volunteer making more than five Sarsen survey records.

HAMPSHIRE		DORSET		WILTSHIRE	
Volunteer	Records	Volunteer	Records	Volunteer	Records
P W G	130 (43%)	N H F	39 (30%)	B P	73 (17%)
M F H	23 (7%)	C J B	35 (27%)	I F S	21 (5%)
D M B	13 (4%)	D Y	15 (11%)	K F	9 (<3%)
F O	11 (4%)	M J	8 (6%)	J B	6 (<2%)
S C	11 (3%)	R A P	7 (5%)		
G H S	9 (<3%)				
J C D	7 (<3%)				
M C	6 (<2%)				
M D	6 (<2%)				
unattributed	16 (5%)		8 (6%)		294 (69%)

Although 377 (43 per cent) of records went undated, it is possible to profile much of the fieldwork to the day or month of the year (481 records, 55 per cent) (see table 2). Characteristics such as these suggest that confidence in the general dataset is warranted.

A feature of many modern digital crowd-sourced projects, such as 'Micropasts', is that a small number of participants create the greatest number of records.[50] A modest evaluation of this aspect of the dataset is possible by recording the survey's volunteer names (table 3). Although 318 (36 per cent) of all records were unattributed, the rest have a named primary recorder and sometimes a second partner (see table 2). Overall, a small number of volunteers did make the most records. In Hampshire, Peter Gallup recruited the biggest team, but made the most records himself (130 records, 43 per cent of Hampshire). John Bailey, who made thirty-five records (27 per cent of Dorset) recruited fewer volunteers there and shared much of the workload with N H Field (39 records, 30 per cent). Wiltshire had a similar number of volunteers as Dorset, but 294 (69 per cent) of the records are unattributed (see table 3). This figure is tied to the use of notes and postcards in Wiltshire. That county's dataset largely lacks the specially designed Tally Cards (see table 1) that included the prompt to record the volunteer's name.

It is also possible to assess the extent to which gaps in the map are due to absence of sarsen, or simply reflect where the volunteers worked. The most prolific volunteers working in Dorset and Hampshire were quite well-spread across those counties (fig 6), prompting more confidence in the survey coverage. In Wiltshire, the overall volume of records across the county is encouraging. Gaps in areas ST92 (south–west Wiltshire, between Shaftesbury and Fovant) and ST93 (west Wiltshire, between Hindon and Wylye) are explicitly explained in two notes confirming that the five volunteers searching there found no sarsens.[51] But the majority of attributable records in Wiltshire were made by Bernard Phillips, working only in the Swindon area (73 records, 17 per cent of Wiltshire) (see table 3). Furthermore, only 249 (58 per cent) of Wiltshire records were derived from field visits (see table 2). This suggests that particular care should be taken to review the Wiltshire data, interrogating the bibliographic sources that were so heavily used and characterising

50. For example, Holley 2010; Causer and Wallace 2012.
51. SAL, MS953/4/1/ST92, MS953/4/1/ST93.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

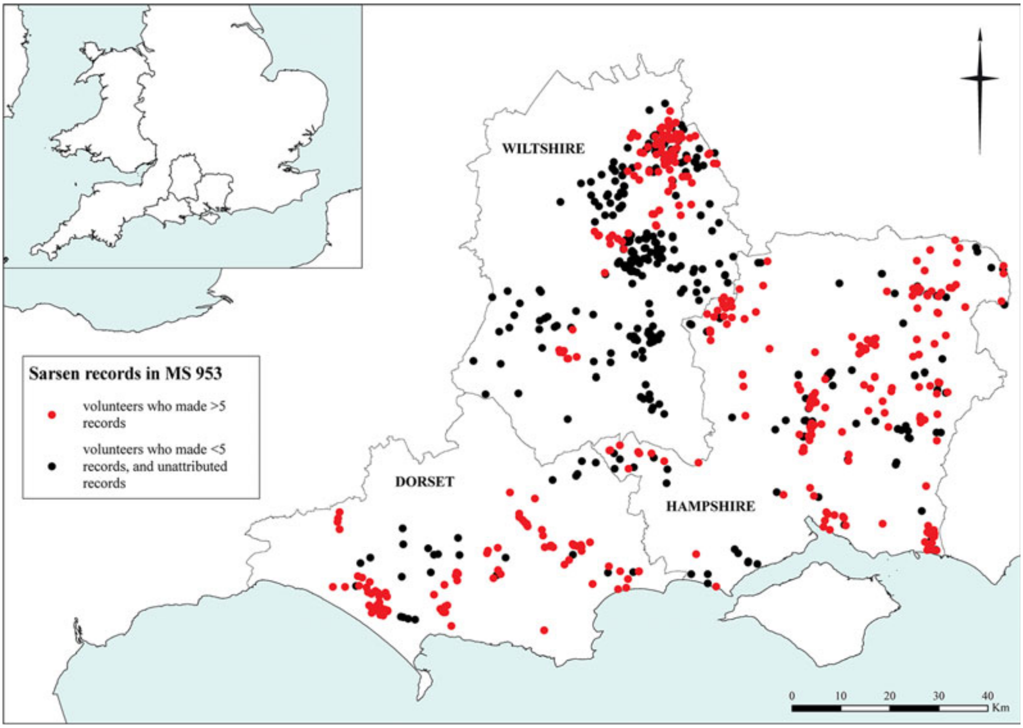


Fig 6. The distribution of all 872 digitised Sarsen Stones in Wessex project records distinguishing the most prolific volunteers. Includes Ordnance Survey data from 2017. *Map*: the author.

how the sarsen profile in Wiltshire differs from Dorset and Hampshire because of these recording practices.

Portesham (Dorset) provides a useful case study of aspects of the volunteers' practice and presents a means to reflect on the Sarsen project's stated aims. A large parish in the south of the county, Portesham's solid geology spans the late Jurassic to late Cretaceous, with an area of Tertiary Bracklesham/Barton Group deposits forming the highest hills to the north (fig 7). It lies immediately to the south-east of a surviving sarsen spread in Littlebredy parish. Portesham's records are for a mix of 'natural' sarsens recorded singly and in groups, prehistoric monuments and extensive sarsen use in more recent structures. Seventeen distinct records were made here, by three volunteers working from April 1974 to May 1975. No notes explain whether the large gaps were searched to no avail, or could not be accessed. The Tally Cards include material gathered from earlier published authorities, which the volunteers ground-truthed, as well as seeking out new data. The volunteers adapted their observations to the Tally Card format, resulting in a rich record including quotations from antiquarian authorities and in-person reports.

Two original reference numbers include multiple entries: PRT6 (Portesham village) and PRT7 (Black Down Barn area) account for ten of the records mapped in fig 7. In PRT6, one sarsen (D082) was visible as the result of recent building demolition. Two stones mapped by the Ordnance Survey in 1902 (D079) could not be found. There were very many stones in building fabric (D077, D078, D080, D081). This included a long wall along the west side of Front Street and garden walls on the east side including more than

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

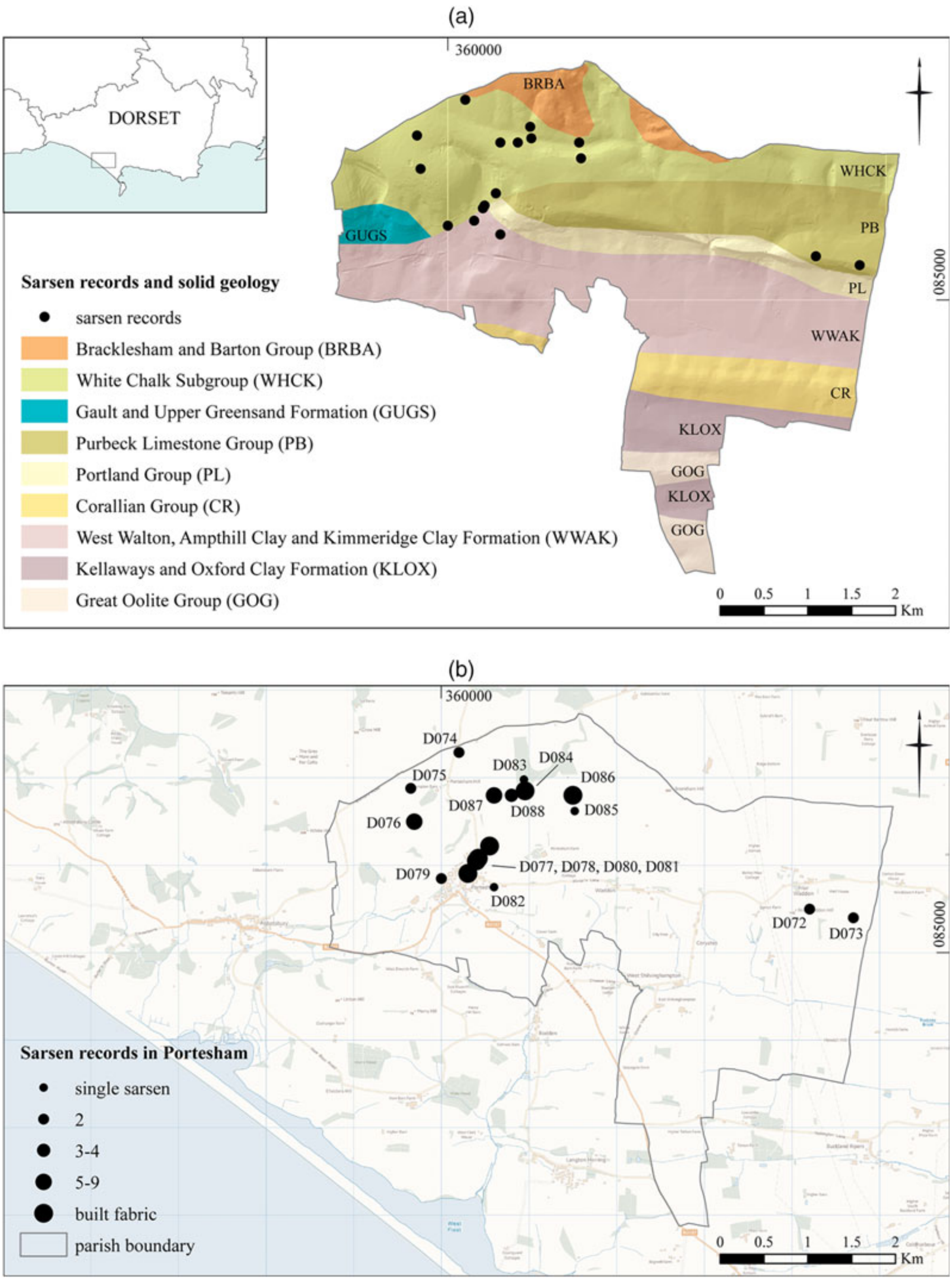


Fig 7. (a) The solid geology of the large parish of Portesham (Dorset) includes Cretaceous and Palaeogene rock units with which sarsen stone is commonly associated. (b) A short distance to the south-east of Dorset's large natural sarsen spread in the Valley of Stones, Portesham includes sarsens used in multiple ways since prehistory. See text for details of records numbered D072 to D088. Includes Ordnance Survey data from 2017 and British Geological Survey data from 2018. *Maps*: the author.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

160 sarsens (D080), and field walls on Portesham Lane (D081). Amongst PRT7, one sarsen (D083) was seen in a hilltop plantation but the other three reports in this record are also structural. D084 records sarsens used in agricultural building fabric, D085 refers to a single stone spotted in a field wall, and D086 includes more than 250 sarsens counted in field walls. On 16 September 1974, volunteer M Jackson noted in D084: 'farmworker said pasture grass of the field had been re-laid in past with great difficulty as many "boulders" just beneath the surface of the ground … [in] the field of the Hell Stones [D087] the ploughing is extremely difficult because of the numbers of large rocks below the surface of the ground.'[52]

In other records, D072 and D073 in the east of the parish represent four sarsens described as 'not utilised' (ie 'natural'), partially visible in the turf on the hilltop. One of the pair in D072 was 8ft long (2.4m). Combined with D074, two large 'not utilised' stones recorded by John Bailey as 'intermediate Valley of Stones and Black Down group',[53] this suite of records strongly suggests a once far greater presence of sarsen extending south-east of Littlebredy's surviving sarsen spread, in fields long-since cultivated. Taking this closer look at the richer information available in the records shows how the Sarsen survey made progress towards its first aim, to establish sarsen's former incidence.[54]

The second objective, to document prehistoric sarsen uses, was also addressed in Portesham. Four monuments incorporating sarsens were recorded in the parish. D075 records the remains of the long barrow[55] on the hilltop close to D076, Hampton Stone Circle.[56] On the hill opposite to the east is D087, the Hell Stone long barrow,[57] whilst D088 marks the location of the former stone setting 'Jeffrey and Joan and their dog Dinty and Eddy'.[58] In his record for D085, M Jackson noted 'Celtic' fields in the environs, on the north-facing slope of the valley defined by the spur of high ground running east-west from Portesham Hill. This sort of information was a Tally Card class intended to flag up possible co-locations of sarsens and other features, including early field systems.

DISCUSSION

Landscape archaeology

The concept of landscape archaeology, founded on the doing of field archaeology as exemplified by Aston and Rowley in their seminal book *Landscape Archaeology*,[59] forms the Evolution project's contemporary intellectual setting. Although not calling itself 'land-scape archaeology', the Evolution project as conceived, and its Sarsen survey as executed, can both be placed firmly in the context of increasingly panoptic approaches to archaeo-logical fieldwork in the twentieth century. Here is it important also to draw on the

52. SAL, MS953/2/1/PRT7.
53. SAL, MS953/2/1/PRT3.
54. Bowen and Smith 1977, 185, 190.
55. HE, scheduled monument DO507; Dorset HER 1 090 044.
56. HE, scheduled monument DO46; Dorset HER 1 090 058.
57. HE, scheduled monument DO87; Dorset HER 1 090 033.
58. Dorset HER 1 090 085.
59. Aston and Rowley 1974, 19–24.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

professional history of Collin Bowen in particular, his recognition of the extensive archaeological record visible on the ground and from the air, and his realisation of its vulnerability.

Dalglish has identified three axiologies of landscape[60] – three ways of locating value encompassing ethics and aesthetics amongst the web of agents, practices and being that comprise 'landscape' – each of which defines landscape differently. Archaeologists have conceptualised landscape according to all three: *anthropocentrically*, prioritising human interests in an objectified and commodified natural resource; *environmentally*, emphasising inherent value in the non-human world; and *relationally*, by denying, removing, connecting or eliding the human–non-human dyad that has tended to put 'natural' and 'cultural' landscapes in tension or contradiction.[61] Prior to more recent relational approaches, archaeologists have tended to adopt anthropocentric or environmental axiologies in which landscape, conceptualised as a material object, is susceptible to mensuration, recording and interpretation, especially in functionalist, adaptive, exploitative terms.[62]

Characteristics of an anthropocentric landscape axiology, in which field survey methods can be brought to bear on landscape-as-object in order to reveal how people adapted to, or exploited, the environment, inhabit the language of the Evolution project proposals and the Sarsen survey. The use of that key word *palimpsest*, introduced to archaeologists by Crawford[63] and popularised by Hoskins,[64] speaks to the project proposers' conceptualisation of landscape as 'hand-made artefact'.[65] For example, Bowen's intention to quantify natural phenomena (sarsens) envisioned as hindrances to the first people to have established ownership of the land by its division, was driven by the idea that fragments of the first-written landscape remain, and the possibility of unpicking these through meticulous survey.

The Portesham results fulfilled expectations of anthropocentric and environmental landscape axiologies. Its palimpsest as captured by Sarsen survey volunteers included the underlying geology, determining the presence of boulders in the parish. These had been exploited as useful resources at different times in over-written sequences of prehistoric monument building and more recent settlement structures and boundaries. The undertext included prehistoric field systems; but there was also confirmation of difficulties presented by the geology to agricultural practice, through the testimony of a modern farm-worker. The volunteer-collected data showed how people had exploited, and adapted to, the environment.

The Sarsen survey in particular was formulated and driven by Collin Bowen (1919–2011), an investigator with the Royal Commission on the Historical Monuments of England (RCHME) from 1949, who since 1952 had been collecting and enumerating archaeological features parish by parish for the Commission's *Dorset Inventory* volumes. Bowen was celebrated for his superior fieldcraft, described as 'a level of analytical fieldwork that never before had been achieved even by those of the stature of Crawford'.[66] For Bowen this was not only a metaphorical patrimony in the British field archaeology tradition maintained by the RCHME,[67] but also a literal one in his friendship with and likely pupillage by

60. Dalglish 2012.
61. Ibid, 329–33.
62. Darvill 2008, 61–2; Dalglish 2012, 333–4; Thomas 2012, 98.
63. Crawford 1953.
64. Hoskins 1955.
65. Gillings and Pollard 2016b, 11.
66. Taylor 2010, 85.
67. Ashbee 1972; Bowden 1999.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

O G S Crawford himself.[68] His approach to archaeology was characterised by his obituarist: 'No books, no theory, just detailed fieldwork on archaeological sites.'[69]

Believing that the first farmers in Britain encountered and transformed a heavily wooded environment, archaeologists reasonably anticipated confirmation of Neolithic origins of prehistoric field systems.[70] These expectations permeate a number of the papers given at contemporary conferences including in 1969 'Economy and Settlement in Neolithic and Early Bronze Age Britain and Europe',[71] the 'Highland Zone' in 1974 and 'Lowland Zone' (1975) Effect of Man on the Landscape meetings.[72] Bowen shared this interest in prehistoric field systems.[73] The rationale of the Evolution project and the Sarsen survey depended on his anthropocentric understanding of the agricultural processes leading to the formation of these archaeological features. His concern with stone clearance was underpinned by his assumptions about what the first farming looked like: the lowest layer of the palimpsest had to have been inscribed by clearing and breaking up ground, because, according to Bowen, that was the first requirement of agriculture 'for all periods'.[74] His original objective for the survey was to assess this essential clearance by recording how and where the sarsens had been used.[75] With Peter Fowler, Bowen had already encountered sarsens buried in lynchets during their work on the Marlborough Downs in Wiltshire. Finds including early Neolithic bowl pottery excavated from their cutting through one such field boundary[76] implied that there had been Neolithic activity in the area, perhaps prompting Bowen's thoughts about sarsen's nuisance value to pioneering agriculturalists.

In Portesham, however, the presence of prehistoric sarsen-built monuments in an area including prehistoric fields challenged Bowen's key assumptions. Bowen and his colleagues had recorded numerous field groups in and around Portesham,[77] and it was an area he referred to in *Ancient Fields*.[78] Here, the palimpsest's undertext thus comprised evidence for sarsen exploitation as a resource (for the earliest monument building), *and* no clear evidence that a discouraging stony presence had directed early cultivation elsewhere. The difficulty lay in both the problematically-long date range of 'Celtic' fields, defined as 'all fields of regular shape laid out before the Saxon conquest',[79] and also the expectations that underpinned the survey's stated aims, derived from an anthropocentric concept of landscape.

In notes accumulated in his project filing, Bowen wrote:

> Do sarsens attract interest. They didn't make people avoid. Two points we began with were
> a) nuisance value b) challenge to utilisation.

68. Taylor 2010, 87.
69. *The Times* 2011.
70. For example, Evans 1971; Fowler 1971; Pryor 1978.
71. Simpson 1971.
72. Evans *et al* 1975; Limbrey and Evans 1978.
73. Bowen 1961.
74. Ibid, 5.
75. HEA, SOA03/18, memoranda written by Collin Bowen dated 23 Nov and 20 Dec 1973.
76. Bowen and Fowler 1962, 105.
77. RCHME 1970, 622–34.
78. Bowen 1961, pl 2b.
79. RCHME 1970, 622.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

- sarsens are utilised in all periods
- orthostats and large stones are restricted Neo/BA
- the earliest therefore for the [...] of sarsens as boulders is Neo
- the earliest [...] for the breaking up of sarsens is also NEO

> Nuisance/utilisation: Did they attract??!! GEOL SURFACE CONCS NOT AVOIDED BUT OCCUR WHERE EARLY NODAL CONCS AVEBURY, VALLEY OF STONES[80]

Although his crabbed handwriting is difficult to interpret ('CONCS' is probably shorthand for 'concentrations'), not only was Bowen forced to conclude that sarsens presented no impediment to early farming (in the terms in which that farming was understood at the time), these manuscript notes also suggest that Bowen began to consider the possibility that the sarsens themselves *drew* people into certain locations, including north Wiltshire.

The archaeological record, revealed and under threat

The relationship between the aims of the Evolution of the Landscape project and the Sarsen survey results remained unspoken, as the parent-project faded away in the later 1970s. This is not the only reason, however, that the survey results were not related more closely to the Evolution project's aim to understand 'the whole time-conditioned environment'.[81] The empiricist approach taken towards both projects, in which Bowen at least saw it as essential to collect as much data as possible, despite openly acknowledging the crippling resource required, was problematic. Whilst seeking to move beyond studies of individual monuments in the hope of understanding past populations' economic and social organisation from more wide-ranging data,[82] the projects were under-theorised in how their empiricist methodology would cast light on the past.

The contiguity of the archaeological record was well-established in Bowen's mind through decades of fieldwork and studying aerial photographs. Having driven RCHME survey practices towards detailed description and interpretation,[83] he was moving conceptually ever further from the restrictions of monument-based inventorying within parish boundaries to wider landscapes, as indicated by his work on Bokerley Dyke.[84] His colleague Barry Cunliffe had done the same through an extensive survey of 'the total settlement pattern' of Chalton (Hampshire).[85] The call for the Evolution project to make 'a *total* search'[86] (original emphasis) of *c* 1,500 square miles of ground with air photograph analysis to plan archaeological features chimes with the 'Total Archaeology' and 'total landscape' of Bowen's RCHME colleague, Christopher Taylor.[87] By this, Taylor meant a multi-period and landscape-scale approach to research, going beyond a narrow single-site focus.

80. HEA, SOA03/16, Sarsens. Notes.
81. HEA, SOA03/18, Society of Antiquaries. Evolution of the Landscape Project.
82. Bowen and Cunliffe 1973, 9.
83. *The Times* 2011.
84. Martyn Barber, pers comm, 26 Jul 2017.
85. Cunliffe 1973.
86. Bowen and Cunliffe 1973, 10.
87. Taylor 1974, 150–1.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

He emphasised bringing, for example, geomorphology, art-history and place-names to mapping to 'trace the ebb and flow of agriculture in an area for 2,000 years'.[88]

In contemporary excavation, a similar approach was espoused by, for example, David Clarke in 1975 at Great Wilbraham[89] and by Margaret and Tom Jones working at Mucking from 1965 to 1978.[90] Investigating Mucking's extensive archaeology, Margaret Jones was confronting outmoded concepts of bounded site and monument whilst aspiring to 100 per cent excavation. Like Taylor, Clarke also advocated the assembly of diverse datasets to understand a 'totality' of evidence. Clarke's intention was to develop a scientific interdisciplinarity in partnership with expert colleagues from areas including botany and quaternary science. The extended Evolution project proposal authored by Barry Cunliffe, John Coles and Collin Bowen mentions a similarly wide-ranging set of interests and specialists,[91] including Geoffrey Kellaway (geology), David J Carter and Keith Barber (geography), Geoffrey Dimbleby and John Evans (environmental archaeology), Annie Grant and J Gaitens (osteo- and zoo-archaeology). As Bowen put it, 'we are a multidisciplinary project'.[92]

In 1960, Bowen had co-authored the highly influential *A Matter of Time*,[93] using aerial photography to identify the rapid loss by quarrying of archaeological remains in river valley gravels. The aerial evidence had finely attuned his understanding of risks to historic landscapes. Threat similarly permeates the tone of the Evolution project's archived papers. A general threat to the archaeological resource, including explicit references to prioritising Society of Antiquaries' budgets, underpinned the justification for the Evolution of the Landscape project. Threats to sarsens in particular were at the forefront of Bowen's mind. For example, he wrote to friends and colleagues on 23 November 1973 lamenting sarsen clearance by the estate manager from an area north of Old Totterdown (Wiltshire), commenting, 'It seems further to illustrate the desirability of listing all such sites in a way that would ensure archaeological/geological examination before destruction'.[94] On 20 December he followed this with the need to identify ownership to discourage stone clearance.[95]

The point was emphasised in the Information Sheet issued to project volunteers.[96] Attendees of the Sarsen Symposium agreed that intelligence about sarsen destruction should be passed on to the Society's Secretary so that investigations could be arranged.[97] Even in 1978,[98] Bowen was pursuing correspondence with the National Trust regarding a local farmer's clearance of sarsens from land close to the protected spread in Piggledene (Wiltshire). Concern at the loss of sarsens from 'natural' spreads by agricultural clearance could be said to have begun with Colt Hoare,[99] but it came to a head with the early twentieth-century campaign to protect sarsens from quarrymen working in Lockeridge and Piggledene

88. Ibid, 150.
89. Evans *et al* 2006, 118.
90. Evans *et al* 2016, 2.
91. SAL, MS953/1/1, Proposal for sponsorship of a scheme of research by the Society of Antiquaries of London.
92. HEA, SOA03/01, Evolution of the Landscape 23 Feb 1973.
93. RCHME 1960.
94. HEA, SOA03/18, memorandum written by Collin Bowen dated 23 Nov 1973.
95. HEA, SOA03/18, memorandum written by Collin Bowen dated 20 Dec 1973.
96. HEA, SOA03/01, Evolution of the Landscape, Wessex Pilot Scheme News Sheet No. 1.
97. HEA, SOA03/03, Sarsen Symposium, Evolution of the Landscape Project News Sheet No. 2.
98. HEA, SOA03/03, letter written by Frank Swanton dated 21 Feb 1978.
99. Colt Hoare, 1819.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

in Wiltshire.[100] 'Those who have watched the district through this century,' wrote local observer H C Brentnall, 'have seen the wolf at work in many a fold of the grey-wethers.'[101] This sarsen advocacy formed the backdrop to Bowen's angst.

The Society of Antiquaries' need to respond to these threats, Bowen's call for detailed extensive survey in the manner of 'total archaeology' as the extent of the record became clear and his personal concern for sarsen stones are similarly reflected in a contemporary call to arms by Aston and Rowley. They wrote, 'Scholars in the future may have the leisure to analyse and synthesise, but at the moment we are all in the front line', calling for 'comprehensive regional archaeological distribution maps'.[102] In this sense the Society's research, promoted by Bowen and his peers, exemplifies the contemporary awareness of archaeological loss[103] and the requirement to collect data that prompted the establishment of local authority Sites and Monuments Records at that time.[104]

CONCLUSION

Collin Bowen was an important figure, influencing a generally more frequently published generation of researchers like Corney, Fowler and Taylor,[105] for whom, as Gillings and Pollard remark,[106] the idea of landscape archaeology and history arguably seemed straightforward. He held an anthropocentric concept of landscape as a resource to be tapped by the first farmers, and an object of partial features that could nevertheless now be observed, measured and represented if only they could be salvaged in time. The Evolution project has those Hoskinian hallmarks of landscape archaeology identified by Johnson:[107] deeply empirical practices employed by surveyors not afraid to dirty their walking-boots to study a landscape of immense age, beguiled, as Johnson suggests,[108] by the idea of the palimpsest.

The Evolution of the Landscape project was an aspirational response to some of archaeology's most pressing cultural resource management problems of the later twentieth century, including the impact of industrial agriculture and large-scale infrastructure development destroying un-researched archaeological evidence. Society of Antiquaries' Fellows were concerned about how to dispose finite research grants in the face of widespread threats to an archaeological record that had been extended physically by aerial photographic evidence and conceptually by the leap from 'site' to 'landscape'. Collin Bowen was a significant contributor to this understanding and the driving force behind the project's proposals, attempting to harness multi-disciplinary research to tackle the idea of 'total landscape'.

The Sarsen survey struggled partly because of the limitations of its anthropocentric landscape axiology and partly because of difficulties in handling its highly heterogeneous analogue data in all its varied formats. In fact, the project's aim to explore how sarsen stones had been dealt with by the first farmers was tantamount to an unspoken

100. Goddard and Bouverie 1908.
101. Brentnall 1946, 424.
102. Aston and Rowley 1974, 12, 25.
103. Rahtz 1974.
104. RCHME 1993.
105. Fowler 1978; Taylor 1983; Corney 2000.
106. Gillings and Pollard 2016b.
107. Johnson 2007.
108. Ibid, 58.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

acknowledgement that the boulders themselves had been active agents in Neolithic and later lifeways. But the absence of a concept of, for example, agential stones in the sense of, say, Richards,[109] or an ambiguity of natural-cultural place,[110] hindered the extent to which the datasets could be applied to the objectives articulated in 1972 and 1973.

Nevertheless, the public archaeology methodology was ambitious in its response to a research burden that could not be met by the professional sector. The valuable archive resource is strengthened by the myriad notes that back up the volunteers' individual records and considerable weight can be placed on their observations. The survey's large dataset presents some difficulties in both its heterogeneity and current physical condition, but, approached with the spirit of contingency and creativity encouraged by Evans *et al*,[111] and in digital form, the data can more easily be visualised and interrogated in order to play a part in informing our perceptions of sarsen-scapes. Thanks to collections cared for by the Society of Antiquaries of London and Historic England, new life can be breathed into old archaeological archives.

ACKNOWLEDGEMENTS

This work was supported by the Arts and Humanities Research Council (grant number AH\L503939\1) through the South, West and Wales Doctoral Training Partnership. The author thanks the Society of Antiquaries of London and Historic England for access to archive collections; Martin Bell, Jim Leary and Josh Pollard for commenting on previous drafts of this paper; and the anonymous reviewers who kindly provided feedback. Any errors remaining are the author's own.

ABBREVIATIONS AND BIBLIOGRAPHY

Abbreviations

HE	Historic England
HEA	Historic England Archive
HER	Historic Environment Record
RCHME	Royal Commission on the Historical Monuments of England
SAL	Society of Antiquaries of London

Bibliography

Primary sources

HEA, Swindon, HSS01, Hampshire Sarsen Survey
HEA, Swindon, RCHME Microfiche, Wessex Sarsen Survey
HEA, Swindon, SOA03, Sarsen Stones in Wessex
SAL, MS953, Wessex Sarsen Survey

109. Richards 2013.
110. For example, Bradley 2000; Harmansah 2014.
111. Evans *et al* 2016, 526–30.

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

Secondary sources

Ashbee, P 1972. 'Field archaeology: its origins and development', in P J Fowler (ed), *Archaeology and the Landscape*, John Baker, London

Aston, M and Rowley, T 1974. *Landscape Archaeology: an introduction to fieldwork techniques on post-Roman landcapes*, David and Charles, Newton Abbot

Bell, M 1983. 'Valley sediments as evidence of prehistoric land-use on the South Downs', *Proc Prehist Soc*, **49**, 119–50

Bonnachi, C, Bevan, A, Pett, D and Keinan-Schoonbeart, A 2015. 'Crowd- and community-fuelled archaeology: early results from the Micropasts project', in F Giligny, F Djindjian, L Costa, P Moscati and S Robert (eds), *Proceedings of the 42nd Annual Conference on Computer Applications and Quantitative Methods in Archaeology, CAA 2014*, 279–88, Archaeopress, Oxford

Bowden, M 1999. *Unravelling the Landscape: an inquisitive approach to archaeology*, Tempus, Stroud

Bowen, H C 1961. *Ancient Fields: a tentative analysis of vanishing earthworks and landscapes*, The British Association for the Advancement of Science, London

Bowen, H C and Cunliffe, B 1973. 'The Society's research projects', *Antiq J*, **53**, 9–13

Bowen, H C and Fowler, P J 1962. 'The archaeology of Fyfield and Overton Downs, Wiltshire (interim report)', *Wiltshire Archaeol Natur Hist Mag*, **58**, 98–115

Bowen, H C and Smith, I F 1977. 'Sarsen Stones in Wessex: the Society's first investigations in the Evolution of the Landscape project', *Antiq J*, **57**, 185–96

Bradley, R 2000. *An Archaeology of Natural Places*, Routledge, London

Brentnall, H C 1946. 'Sarsens', *Wiltshire Archaeol Natur Hist Mag*, **51**, 419–439

Buchanan, R A 1969. 'The national record of industrial monuments', in N Cossons and K Hudson (eds), *Industrial Archaeologists' Guide 1969–70*, 11–14, David and Charles, Newton Abbot

Buchanan, R A 1971. 'The national record of industrial monuments', in N Cossons and K Hudson (eds), *Industrial Archaeologists' Guide 1971–73*, 23–30, David and Charles, Newton Abbot

Causer, T and Wallace, V 2012. 'Building a volunteer community: results and findings from transcribe Bentham', *Digital Hum Q*, 6, <http://www.digitalhumanities.org/dhq/vol/6/2/000125/000125.html> (accessed 18 May 2020)

Colt Hoare, R 1819. *The Ancient History of Wiltshire*, Lackington, Hughes, Harding, Mavor and Jones, London

Corney, M 2000. 'Characterising the landscape of Roman Britain: a review of the study of Roman Britain 1975–2000', in D Hooke (ed), *Landscape, the Richest Historical Resource*, Supp Series 1, 32–45, The Society for Landscape Studies, Exeter

Council for British Archaeology 2014. 'Home Front Legacy: about the project', *Home Front Legacy*, <https://www.homefrontlegacy.org.uk/wp/about-the-project/> (accessed 31 Jan 2018)

Council for British Archaeology 2017. 'Defence of Britain archive', Archaeology Data Service <http://archaeologydataservice.ac.uk/archives/view/dob/> (accessed 7 Sept 2017)

Crawford, O G S 1953. *Archaeology In The Field*, Phoenix House, London

Cunliffe, B 1973. 'Chalton, Hants: the evolution of a landscape', *Antiq J*, **53** (2), 173–90

Cunliffe, B 2000. *The Danebury Environs Programme: the prehistory of a Wessex landscape*, Institute for Archaeology, Oxford

Dalglish, C 2012. 'Archaeology and landscape ethics', *World Archaeol*, **44**, 327–41

Darvill, T 2008. 'Pathways to a panoramic past: a brief history of landscape archaeology in Europe', in B David and J Thomas (eds), *Handbook of Landscape Archaeology*, 60–76, Routledge, London

Evans, C, Appleby, G, Lucy, S, Appleby, J and Brudenell, M 2016. *Lives in Land. Mucking excavations by Margaret and Tom Jones, 1965–1978: prehistory, context and summary*, Oxbow Books, Oxford

Evans, C, Edmonds, M, Boreham, S, Evans, J, Jones, G, Knight, M and Legge, T 2006. '"Total archaeology" and model landscapes: excavation of the Great Wilbraham causewayed enclosure, Cambridgeshire, 1975–76', *Proc Prehist Soc*, **72**, 113–62

Evans, J G 1971. 'Notes on the environment of early farming communities in Britain', in Simpson 1971, 11–26

Evans, J G, Limbrey, S and Cleere, H (eds) 1975. *The Effect of Man on the Landscape: the Highland Zone*, Council for British Archaeology, London

Field, D 2005. 'Some observations on perception, consolidation and change in a land of stones',

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

in G Brown, D Field and D McOmish (eds), *The Avebury Landscape: aspects of the field archaeology of the Marlborough Downs*, 87–94, Oxbow Books, Oxford

Fowler, P J 1971. 'Early prehistoric agriculture in Western Europe: some archaeological evidence', in Simpson 1971, 153–83

Fowler, P J 1978. 'Lowland landscapes: culture, time, and personality', in S Limbrey and J G Evans (eds), *The Effect of Man on the Landscape: the Lowland Zone*, 1–12, Council for British Archaeology, London

Gillings, M and Pollard, J 1999. 'Non-portable stone artefacts and contexts of meaning: the tale of Grey Wether (www.museums.ncl.ac.uk/Avebury/stone4.htm)', *World Archaeol*, **31**, 179–93

Gillings, M and Pollard, J 2004. *Avebury*, Gerald Duckworth and Co Ltd, London

Gillings, M and Pollard, J 2016a. 'Making megaliths: shifting and unstable stones in the Neolithic of the Avebury landscape', *Cambridge Archaeol J*, **26**, 1–23

Gillings, M and Pollard, J (eds) 2016b. *Landscape Archaeology: critical concepts in archaeology*, Routledge, London

Gillings, M, Pollard, J, Wheatley, D and Peterson, R 2008. *Landscape of the Megaliths: excavation and fieldwork on the Avebury monuments, 1997–2003*, Oxbow Books, Oxford

Goddard, H E and Bouverie, E O P 1908. 'The fifty-fifth general meeting of the Wiltshire Archaeological and Natural History Society', *Wiltshire Mag*, **35**, 529–33

Harmansah, O (ed) 2014. *Of Rocks and Water: towards an archaeology of place*, Oxbow Books, Oxford

Holley, R 2010. 'Crowdsourcing: how and why should libraries do it?', *D-LIB: Mag Dig Lib Res*, **16** (3/4), <http://dlib.org/dlib/march10/holley/03holley.html> (accessed 18 May 2020)

Hoskins, W G 1955. *The Making of the English Landscape*, Hodder and Stoughton, London

Johnson, M 2007. *Ideas of Landscape*, Blackwell, Oxford

Leicestershire County Council 2009. *Report on the Completion of the Community Heritage Initiative and its Legacy*, Leicestershire County Council, Leicester

Limbrey, S and Evans, J G (eds) 1978. *The Effect of Man on the Landscape: the Lowland Zone*, Council for British Archaeology, London

Mantell, G 1833. *The Geology of the South-East of England*, Longman, Rees, Orme, Brown, Green and Longman, London

Nash, D J and McLaren, S J (eds) 2007. *Geochemical Sediments and Landscape*, Blackwell, Oxford

Pollard, J and Gillings, M 2009. 'The world of the Grey Wethers', in B O'Connor, G Cooney and J Chapman (eds), *Materialitas: working stone, carving identity*, Prehist Soc Res Paper 3, 29–41, Oxbow Books, Oxford

Pollard, J and Gillings, M 2010. 'Sarsen stories', in H Lewis and S Semple (eds), *Perspectives in Landscape Archaeology: Papers presented at Oxford 2003–5*, BAR Brit Ser **2103**, 7–11, Oxbow, Oxford

Prestwich, J 1854. 'On the structure of the strata between the London clay and the chalk in the London and Hampshire tertiary systems. Part II: the Woolwich and Reading series', *Q J Geol Soc*, **10**, 75–138

Pryor, F 1978. Excavation at Fengate, Peterborough, England: the second report, Royal Ontario Museum, Ontario

Rahtz, P A (ed) 1974. *Rescue Archaeology*, Penguin, Harmondsworth

RCHME 1960. *A Matter of Time: an archaeological survey of the river gravels of England prepared by the Royal Commission on Historical Monuments (England)*, HMSO, London

RCHME 1970. *An Inventory of the Historic Monuments in Dorset. Vol 2: south-east*, Roy Comm Hist Monuments Engl Inv, HMSO, London

RCHME 1993. *Recording England's Past: a review of national and local sites and monuments records in England*, HMSO, London

Richards, C 2013. 'Interpreting stone circles', in C Richards (ed), *Building the Great Stone Circles of the North*, 2–30, Windgather Press, Oxford

Rupert Jones, T 1886. 'History of the sarsens', *Wiltshire Archaeol Natur Hist Mag*, **23**, 122–54

Simpson, D D A (ed) 1971. *Economy and Settlement in Neolithic and Early Bronze Age Britain and Europe*, Leicester University Press, Leicester

Small, R J, Clark, M J and Lewin, J 1970. 'The periglacial rock-stream at Clatford Bottom, Marlborough Downs, Wiltshire', *Proc Geol Assoc*, **81**, 87–98

Smith, A C 1884. *Guide to the British and Roman Antiquities of the North Wiltshire Downs*, The Marlborough College Natural History Society, Marlborough

Summerfield, M A and Goudie, A S 1980. 'The sarsens of southern England: their

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

palaeoenvironmental interpretation with reference to other silcretes', in D K C Jones (ed), *The Shaping of Southern England*, Inst Brit Geog Special Pub 11, 71–100, Academic Press, London

Taylor, C 1974. *Fieldwork in Medieval Archaeology*, Batsford, London

Taylor, C 1983. *Village and Farmstead: a history of rural settlement in England*, George Philip, London

Taylor, C 2010. 'Founders: Collin Bowen', *Landscapes*, **11**, 84–94

The Times, 11 Nov 2011, 'Collin Bowen', 66

Thomas, J 2012. 'Archaeologies of place and landscape', in I Hodder (ed), *Archaeological Theory Today*, 2nd edn, 115–31, Polity Press, Cambridge

Ullyott, J S and Nash, D J 2016. 'Distinguishing pedogenic and non-pedogenic silcretes in the landscape and geological record', *Proc Geol Assoc*, **127**, 311–19

Ullyott, J S, Nash, D J, Whiteman, C A and Mortimore, R N 2004. 'Distribution, petrology and mode of development of silcretes (sarsens and puddingstones) on the eastern South Downs, UK', *Earth Surf Proc Landforms*, **29**, 1509–39

Watkins, A 1925. *The Old Straight Track*, 1974 edn, Abacus, Sphere Books Ltd, London

Whitaker, K A 2020a. 'Sarsen Stones in Wessex project: Data transcription strategy, methodology and protocols', *Humanities Commons CORE*, <http://dx.doi.org/10.17613/c2x9-d837> (accessed 18 May 2020)

Whitaker, K A 2020b. 'Sarsen Stones in Wessex project survey archive report', *Humanities Commons CORE*, <http://dx.doi.org/10.17613/fvnh-xc15> (accessed 18 May 2020)

Whitaker, K A 2020c. 'Sarsen Stones in Wessex', University of Reading. Dataset, <http://dx.doi.org/10.17864/1947.249> (accessed 1 June 2020)

Downloaded from https://www.cambridge.org/core. IP address: 86.152.151.158, on 07 Aug 2020 at 09:18:54, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0003581520000256

Foreword, paper 2

Whitaker, K.A. 2019. What if none of the building stones at Stonehenge came from Wiltshire? *Oxford Journal of Archaeology* 38(2), 148-163, https://doi.org/10.1111/ojoa.12161

Cited by: 3

Views: not recorded by the publisher

The theme of the third Neolithic and Early Bronze Age Research Student Symposium (NEBARSS), held in 2016 at University College London, was 'Anarchy in the UK?' The call for papers challenged participants 'to construct alternative pasts that either diverge from, disrupt, or invert linear narratives of social evolution' for the period 4000-1500 cal BC (Harris and Kaleta 2016). It brought to my mind two things. The first was my notes from a lecture to undergraduates delivered by Ian Hodder for Cambridge University's Archaeology Part 1 Paper 2, 'The Archaeology of Europe and Neighbouring Areas', critiquing Colin Renfrew's (1973) model of Neolithic social evolution based on labour effort to build monuments from long barrows to henges. The second was Josh Pollard's (2013) description of Renfrew's 1973 article as 'sticky' in a paper given during a Neolithic Studies Group meeting: forty years on and Renfrew's paper is still hanging around in scholars' citations. Evidently, Josh's presentation had struck others at that meeting, as it was also referenced by student convener Barney Harris during NEBARSS.

At the same time, it was bothering me that there is a largely unspoken assumption in archaeological literature that sarsen stone is a 'local' material. That is to say, during the Neolithic, sarsen boulders were conveniently available in certain places for building megalithic monuments and were used in those places, or near enough not to warrant any special attention to explore characteristics of individual stones themselves. Sarsen boulders' 'normalness' for their locations is taken for granted, rarely requiring explanation. Their multitude of attributes fade into the background and are rendered anonymous by the simple fact of not having travelled far, if at all, to be incorporated into megalithic structures. Yet sarsen stone distribution is widespread across central-southern and south-east England. What if Stonehenge's sarsen stone settings included boulders from Kent?

My paper for NEBARSS, later published in the *Oxford Journal of Archaeology*, was an opportunity to challenge orthodox ways of thinking about sarsen stone and to propose its better integration in the suite of stony materials so often encountered on Neolithic sites.

Different stone types from various sources are in complex relation at Stonehenge. Although it is perhaps unwise to isolate stone from other substances in the material assemblage that comprises the monument *c*.2500 cal BC, I use this as a rhetorical device to cast light on the selection, quarrying and movement of stone as social practice. Rocky pieces including oolite and Chilmark stone had to have been excavated to be brought to Stonehenge: and not, as Colonel Hawley (1922) suggested, because of a lack of suitable construction material at the monument, of which there was plenty. Rather, they were carefully sought out and incorporated in the later Neolithic stone settings, begging questions about their properties and meanings that necessitated or enabled this bricolage. Sarsen boulders should be seen in a similar light.

Although Chris Green (1997) has earlier summarised the multiple rock types at Stonehenge, providing the geological context for this anthropogenic collection, my paper's relevance lies in problematising the implied mundanity of sarsen stone and beginning to contextualise it with other bulk minerals encountered at Neolithic monuments. That theme continues in the fifth and sixth papers comprising this thesis, running through post-modern sarsen stone exploitation as well as Neolithic non-megalithic sarsen. In particular, this thesis emphasises the importance of taking seriously all types and forms of stone encountered during fieldwork. The paucity of detailed recording and retention of stone excavated historically from Stonehenge contexts is unfortunate, causing Cleal *et al*. (1995, 398) to conclude that,

'as each of these stone types (various sandstones, limestone, etc) is present only as a small number of pieces it is difficult to comment on their presence. Suffice it to say that the presence of a number of 'foreign' stones at a henge monument in southern England is not unexpected.'

Begging the question, why not unexpected? – what are the reasons for these assemblages of chunks and flakes of stone taken out of the earth and brought to different places? Emily Banfield (2016) takes care to remind us of the inseparability of the below- and above-ground of megalithic monuments: she challenges us to re-consider geological classification in order to reveal the contextually-situated meanings of substances derived from the regolith. But to understand how fluctuating '[m]aterial qualities…emerge through relationships' (Banfield, 2016, 12), we must first adequately record those substances present in our fieldwork.

However, the bubble of my thought experiment in which community groups contributed sarsens to Stonehenge from across southern England would soon be burst, as described in the third thesis paper that explains how the majority are sourced from one location only *c*.15 miles from the monument.

References

Banfield, E. 2016. Sticky Notes: Some Thoughts on the Use of Clay in the Neolithic Deposits within the Avebury Megalithic Complex. *Norwegian Archaeological Review* 49, 99-112

Cleal, R., Walker, K. & Montague, R. (eds.) 1995. *Stonehenge in its Landscape*. London: English Heritage

Green, C. P. 1997. The provenance of rocks used in the construction of Stonehenge. In B. Cunliffe & C. Renfrew (eds) *Science and Stonehenge*, 257-270. Oxford: Oxford University Press

Harris, B. & Kaleta, R. 2016. *Neolithic and Early Bronze Age Research Student Symposium 2016 Conference Programme*, *University College London*. Unpublished

Hawley, W. 1922. Second report on the excavations at Stonehenge. *The Antiquaries Journal* 2, 36-52

Pollard, J. 2013. Renfrew's Monuments and Mobilisation 40 Years On. *Neolithic Studies Group annual meeting. The Last Great Monuments: ceremonial complexes of the 3rd millennium BC* [conference presentation]

Renfrew, C. 1973. Monuments, mobilization and social organisation in Neolithic Wessex. In C. Renfrew (ed.) *The Explanation of Culture Change: Models in Prehistory*, 539-558. London: Duckworth

KATY A. WHITAKER

WHAT IF NONE OF THE BUILDING STONES AT STONEHENGE CAME FROM WILTSHIRE?

Summary. *The sarsen and bluestone stones at Stonehenge (Wiltshire, UK) have played a significant role in the development of twentieth-century ideas about Neolithic and early Bronze Age social structure. Sarsen and bluestone are not, however, the only rock types used at Stonehenge. The varied stones present at the monument include previously under-studied material, such as the normally unseen, and largely forgotten, packing stones for Stonehenge's famous settings. By reflecting on more recently developed theoretical frameworks to interpret this variety, this paper exposes the possibility that an alternative to the dominant discourse, in which Stonehenge represents the culmination of Neolithic social evolution, is possible.*

INTRODUCTION

So, what if none of the building stone at Stonehenge came from Wiltshire? This thought experiment starts with the revolutionary proposition that not only the exotic Welsh bluestones, but all of Stonehenge's building stones are 'foreign' to the region. The purpose is to discuss the role of Stonehenge's stones in some 60 years of debate about Neolithic and early Bronze Age social structure. Stonehenge has played – still plays – a key role in ideas about how prehistoric communities were organized, involved, engaged with one another, and with the environment, landscape, and resources around them. How immense stones were sourced and moved to the monument, from one location in south-west Wales and another in north Wiltshire, is central to these ideas. The vision of this herculean effort colours understanding of the complexity of Neolithic and early Bronze Age society: from Richard Atkinson's 'shadowy and insubstantial' (1956, 165) ruler of men directing thousands of labourers, to Colin Renfrew's (1973) hypothetical Wessex chieftain in command of local tribal groups.

More recent archaeological theory presents more nuanced and dynamic readings of monument building than did previous culture-historical or processual interpretations. Instead of hierarchal political power enabling large-scale prehistoric construction projects, archaeologists, such as Barrett (1994) and Richards (2013) among others, have drawn on agency theory and ethnographic analogy to propose that multi-skilled, multi-faceted, long-term building episodes were performative acts in which social relationships and personal positions were negotiated, built up, and, perhaps, broken down. If Stonehenge's stones came from more dispersed sources, they could have been brought to Salisbury Plain by far more varied, heterogeneous groups of participants whose

OXFORD JOURNAL OF ARCHAEOLOGY 38(2) 148–163 2019
© 2019 John Wiley & Sons Ltd

choices, decisions, and actions sometimes chimed, sometimes contradicted, but ultimately contributed to social change.

Having wondered where Stonehenge's building stones came from, this paper looks in more detail at what those building stones actually were and where their sources might have been located. It considers the unsung (because largely unseen) packing stones that were essential supports, both physically and metaphysically, to the massive upright settings familiar to visitors today, and touches on the Welsh bluestones – which quite clearly did not come from Wiltshire. Finally, it addresses sarsen stones, the biggest of Stonehenge's megaliths that form the iconic lintelled shapes recognized around the world. These are rocks best known in Wiltshire but which, in Britain, can be sourced as far afield as Kent in south-east England.

If it *is* possible that none of Stonehenge's building stones came from Wiltshire, what are the implications for understanding prehistoric social structure? The paper suggests that an alternative to the dominant twentieth-century discourse, in which Stonehenge represents the culmination of Neolithic social evolution, is possible.

STONEHENGE IN SOCIETY

During the later twentieth century, interpretations of Neolithic barrow, enclosure, henge, mound and stone-circle building developed in which increasingly labour-intensive construction through time, and therefore of inferred complexity of resource-management requiring control and leadership, was seen to indicate concomitant centralization of political authority. The outstanding example in the archaeological literature, described by Josh Pollard in 2013 as 'sticky' because of the way it has hung around in the debate since its publication more than 40 years ago, is Colin Renfrew's 1973 paper 'Monuments, mobilization and social organization in Neolithic Wessex.' Taking his lead from Atkinson's (1961) estimations of workloads to build Stonehenge's stone settings, and demanding that prehistoric monumentality needs to be accounted for, Renfrew applied concepts of tribe and chiefdom described by anthropologists to the archaeological record. He hypothesized that 'developed social stratification' (1973, 542), culminating in the over-lordship of five theoretical Wessex tribes by a great chieftain (1973, 552), explained the construction of Silbury Hill and the complex stone settings at Stonehenge (Wiltshire). In this endogenous explanation of culture change, these monuments 'are seen as the natural counterpart of other features of the society.' (Renfrew 1973, 556).

More recently archaeologists have been exploring the contrasting idea that Neolithic monument construction provided conditions in which social differentiation could develop. Barrett (1994), for example, disputed the notion that massive stone settings like those at Avebury or the timber settings within Durrington Walls (both in Wiltshire) represent monuments imagined by such a great chieftain. Instead, he proposed that it was in making, in using, and in further altering and re-using these architectural sets or stages, that social relationships, authority and power were generated (Barrett 1994, 13, 23, 29–32). Richards (2004, 74) developed this concept when he observed that building a megalithic monument 'is more than a means to an end.' Rather than such a monument being an index of existing political power, the initial desire to build provided the environment in which social relationships were materialized and negotiated in order to prepare for and then carry out the work. Cooney (2008, 208–9), for example, has brought this idea into the realm of everyday Neolithic encounters with stone, suggesting that social relationships were inflected and informed even at smaller scales – knapping, post-packing, clearance cairn-building, for example – as people worked together day-to-day.

© 2019 John Wiley & Sons Ltd

The henge earthworks, stone settings and avenue at Stonehenge play a prominent role in such contrasting interpretations. In 1973, Stonehenge's sarsen stone settings were placed in Atkinson's (1956) Phase IIIa-c of the monument's re-development: whilst the smaller and, on the whole, less impressive, bluestones belonged to his Phase II. Renfrew (1973, 548) proposed that the estimated 30 million hours of labour for Phase III construction represented the peak of a hierarchy of labour that had its origins, on the smallest scale, with earlier Neolithic long barrow building. It is hardly surprising that Stonehenge's unique sarsen settings of five immense trilithons and a ring of lintelled uprights should, in this model, be representative of control of an equally immense labour force by a powerful leader over the years of construction (Fig. 1). For Barrett (1994, 29), however, the 'inner façade-like setting of the trilithons' at Stonehenge was the stage on which people were able to take up leading roles: construction had created a new space in which only specific actors would come to shine.

STONEHENGE IN WILTSHIRE

To return to this paper's question: in one, rather obvious, sense none of Stonehenge's stones came from Wiltshire. This is a prehistoric monument in an Anglo-Saxon county: the administrative boundary of the people of Wilton is irrelevant. But modern areas and names are

Figure 1
Stonehenge viewed from the north-east, including the causeway through the earthwork henge enclosure. The familiar sight of Stonehenge's immense sarsen stones has dominated debate about prehistoric social structures since William Stukeley proposed that the monument had been erected under the direction of druids (Photo: K. Whitaker). [Colour figure can be viewed at wileyonlinelibrary.com]

© 2019 John Wiley & Sons Ltd

useful to think with. Stonehenge has enjoyed a very long life. Comprised of earthworks, lost timber features, surviving stone settings erected and altered at different times, it includes rocks from as far afield as south-west Wales. Some of its building stones, however, have long been assumed to have come from what we now call Wiltshire.

Surviving at the monument today are 37 upright sarsen stones (including supported lintels), 15 fallen sarsen stones, 14 standing bluestones, 15 fallen bluestones, and 10 bluestone stumps (Cleal *et al.* 1995) (Table 1). The monument's other building stones are the hundreds of packing stones and rocky packing material placed into stoneholes to support the uprights. This material has been singularly ignored in discussions about the monument's overall construction. One such packing stone type is Chilmark stone. This Jurassic limestone, formed between 146 and 151 million years ago, was found by William Hawley (1922) to have been used as a packing material in the stoneholes for Stone 1, Stone 29, and Stone 30.

Chilmark stone is a component of the Portland beds of the Vale of Wardour anticline, found some 19 km to the south-west of Stonehenge (Fig. 2). Its geographical limits are within a small area either side of the Nadder Valley: to the north, between Fonthill Bishop and Chilmark villages; to the south, between Wockley and Chicksgrove. At this location, the Portland beds are *c*.33 m thick, of which the top *c*.6 m in the sequence are pale grey, fine-grained limestones (Geddes 2003, 45). Chilmark stone has been quarried for many years, extracted from open and underground quarries in the side of the Chilmark Ravine where the member is *c*.4 m thick (Hopson *et al.* 2007, 10). Whilst Romano-British material excavated in the environs hints at the possibility of earlier stone exploitation, the quarries around Chilmark village were Wiltshire's most significant stone source of the Middle Ages, used especially for churches including both Salisbury and, further afield, Rochester cathedrals. The neighbouring Chilmark stone quarries around the village of Teffont Evias were similarly productive (Crittall 1959, 247–9).

Stonehenge's sarsen circle, of which Stones 29, 30, and 1 are in the north-east arc, was erected 2580–2475 cal BC (Darvill *et al.* 2012, 1033). Chilmark stone was deployed in at least these three of the circle's stoneholes (and it should be borne in mind that not all of the circle's stoneholes have been excavated), in which it comprised a significant proportion of the packing stones. The presence of stone from such a restricted source begs the question: why this stone? As well as Chilmark stone, Hawley identified other stone types in the packing material that are not from the Stonehenge basin's chalk geology: glauconite and oolite, along with Hurdcott stone (1922, 44) (Table 2).

TABLE 1
Stonehenge stone identification numbers (following Petrie 1880) for extant sarsens and bluestones, using Cleal *et al.* (1995). Other tallies are reached depending on how fallen and broken stones are counted, and the definition of 'stump'

	SARSEN		BLUESTONE		
	Upright/in place	Fallen	Upright	Fallen	Stump
Stone number	1, 2, 3, 4, 5, 6, 7, 10, 11, 16, 21, 22, 23, 27, 28, 29, 30, 51, 52, 53, 54, 56, 57, 58, 60, 91, 93, 96, 100, 102, 105, 107, 122, 130, 152, 154, 158	8, 9, 12, 14, 15, 19, 25, 26, 55, 59, 95, 120, 127, 156, 160	31, 33, 34, 37, 46, 47, 49, 61, 62, 64, 65, 68, 69, 70	32, 35b, 36, 38, 39, 40, 41, 42, 43, 45, 48, 67, 71, 72, 150	32c, 32d, 32e, 33e, 35a, 40c, 40 g, 41d, 42c, 66

© 2019 John Wiley & Sons Ltd

It is not clear what Hawley meant by glauconite. It could have been a Greensand: Wiltshire is the type locality for Upper Greensand, a Cretaceous sand rich in the iron-potassium silicate mineral called glauconite (Geddes 2003, 49). As the crow flies, the nearest Upper Greensand to Stonehenge is the formation in the Vale of Pewsey *c*.15 km to the north, where a few rock layers are hard enough for building purposes (Booth *et al*. 2010, 23; Geddes 2003, 76). The Shaftesbury Sandstone scarps and ridges of the formation in the Vale of Wardour are to the south-west (Hopson *et al*. 2007, 13). Here, *c*.14 km from Stonehenge, Hurdcott Greenstone is still being quarried for architectural purposes by the Lovell Stone Group at the Barford St Martin quarry (Fig. 2). Hurdcott stone can be seen in buildings in Mere, is identifiable in various Norman churches in south Wiltshire, and is often seen in foundations or as part of a damp course for brick and timber buildings in this locality (Geddes 2003, 79–80).

Despite the relative proximity to Stonehenge of sources for these rocks, it is nevertheless quite possible, in geological terms, that some came from locations much further away. Upper Greensand building products, for example, have been taken from quarries in the environs of Shaftesbury (Geddes 2003, 195) some 32 km west of Stonehenge. Exposures of the sequence can be seen still further afield such as in cliffs to the west of Upper Branscombe (Devon) (Hamblin 2013, 134 fig. 2); whilst the Reigate Stone quarries in Upper Greensand in east Surrey provided one of the most commonly-used freestones for medieval building in London, the earliest documentation of surface quarrying there dating to the early-thirteenth century (Tatton-Brown 2001).

The few packing stones from sarsen Stonehole 8 identified as oolite by Hawley (1926, 6) might have come from the top of the sequence at Chilmark, the only oolitic source in the Tisbury/Chilmark Stone Portlandian sequence in the Vale of Wardour (Hopson *et al*. 2007, 33). Alternatively, they could have been taken from one of the next nearest sources, the Great and Inferior Oolite Groups in the environs of Box Hill, *c*.40 km to the north-west, and *c*.36 km to the west near Frome (Fig. 2). But Hawley's generic identification does not prohibit them from being brought to Stonehenge from as far afield as the extensive oolite outcrops in Northamptonshire, Lincolnshire, or Yorkshire.

Did this range of Stonehenge packing material really comprise local stones? It is remarkable that Hawley (1922) supposed that glauconite and Chilmark stone were used during the erection of Stone 30 because there was too little local sarsen for packing material, 'consequently stone had to be searched for and brought from distant places' (1922, 42). This despite the fact that he had found 363 quartzite sarsen cobbles in the environs of Stones 1 and 30 (1922, 37), having stripped the turf and topsoil to expose the archaeological layers. The oolitic stone, whether quarried from Bath or Barnack, was brought to the monument in prehistory just like those other packing stones, regardless of the availability of local sarsen: and were brought by people, not a geological process such as a result of glaciation, a point noted by Green (1997, 260). Not only that: although close to the surface, rocks in the Wiltshire locations mentioned are unlikely to have been exposed, and to be found had to have been dug for. I would suggest that these stones are akin to the cairn material at dolmens discussed by Richards (2004), present at monuments not merely as waste but just as important as the large stones selected for the architectural form we recognize as a monument (2004, 78).

What does 'local' mean? Does it, in the context of ideas about resource management and organization in prehistory, mean 'convenient'? How far does something have to travel before the distance becomes significant to us? If 'local' means a walk there and back in a day, then it changes with the seasons as the days lengthen and shorten – assuming that travelling is conducted in daylight. Or 'local' could mean to the horizon and back. In these senses, certain of Stonehenge's building stones were neither from Wiltshire nor local: the bluestones from locations in south-west Wales.

© 2019 John Wiley & Sons Ltd

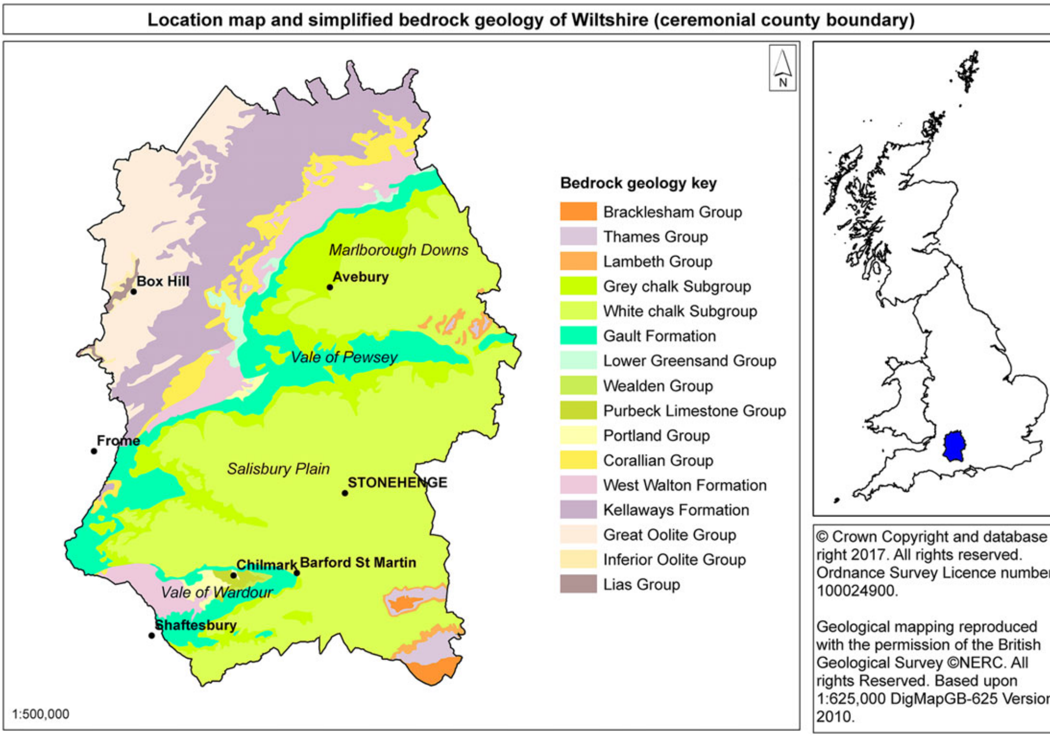


Figure 2
Chalk, depicted by green shades, dominates the bedrock geology of southern and central Wiltshire. The Vale of Pewsey (an anticline) and the Vale of Wardour (the valley of the River Nadder) cut through the chalk uplands. The valleys and the north-west-facing scarp provide access to a variety of rock types.

TABLE 2
Packing stones in Stonehenge stoneholes 29, 30, 1, and 8 (Hawley 1922, 39, 40, 42, 44; Hawley 1926, 6)

Sarsen	N identified packing stones	Stone type	N of stone type
29	47	Flint	2
		Sarsen	19
		Chilmark and Hurdcott	26
		Chalk	rubble throughout
30	58	Sarsen	'a few only'
		Glauconite and Chilmark	'chiefly'
		Chalk	rubble throughout
1	48	Sarsen	'mostly'
		Glauconite and Chilmark	'about one-third'
8	43	Oolite	'one or two'
		Sarsen	'mostly'
		Chalk	rubble to one side

© 2019 John Wiley & Sons Ltd

SPECIAL STONES

Igneous rocks at Stonehenge, present as standing and fallen stones, buried stumps, implements, and stone chips throughout deposits across the site, were first identified petrologically in the 1920s (Thomas 1923). The Preseli mountains in Pembrokeshire are *c*.230 km as the crow flies from Stonehenge and the monument's variety of stone types from outcrops in that region are still subject to investigation (including recently Ixer and Bevins 2016). Parker Pearson *et al.* (2016) have identified prehistoric bluestone quarrying at Craig Rhos-y-felin, following the provenancing of chips known as 'rhyolite with fabric', found in the Stonehenge area, to that isolated outcrop by Ixer and Bevins (2011).

Possible glacial explanations for the presence of bluestone in Wiltshire have been firmly contradicted on a number of grounds (Darrah 1993; Green 1973, 1997; Pitts 2000; Bevins *et al.* 2016). Whilst various reasons have been theorized to explain the prehistoric human transportation of bluestones over such a challenging distance to the Salisbury Plain, the common theme in all is the special nature of the stones, whatever they signified. Interestingly, Atkinson (1956, 175) centred this significance in the materiality of the very mountains themselves. Parker Pearson *et al.* (2015, 1350) ascribe ancestral identities to the specific stones selected for transportation, for example. More generally, Jones (2007) comments on the importance of the connections that were made between one place, a stone source, and another, its monumental place of use: for Jones, '[s]tone is a material that embodies the significance of place' (2007, 184). Thus, the prehistoric selection and use of specific stony material was an act of engaging with particular qualities, special places, sacred associations; and transporting these qualities to new locations, re-worked into new forms.

The idea that already special stone could be re-worked into new and different special structures is not unfamiliar to accounts of Stonehenge. Two of the uprights (67 and 70) in the bluestone horseshoe appear to have had tenons; Stones 150 and 36 appear to have been lintels once, because they have mortice holes; Stone 69 has a dished top; whilst Stone 66 and Stone 68 appear once to have been attached to one another (or to other similarly shaped, but now lost, stones) by means of a carved tongue and groove arrangement (Cleal *et al.* 1995, 29). These stones are long thought to have originated in an earlier setting which, although it could have been at Stonehenge, is just as likely to have stood elsewhere prior to re-use at the monument. Thomas (1923, 258) suggested that a stone circle in the Preseli mountains had been translated to Salisbury Plain; most recently, Parker Pearson *et al.* (2016, 23) have mused that a Pembrokeshire passage tomb was dismantled and re-used at Stonehenge.

The possible special nature of otherwise apparently 'local' stone, or raw stone in its natural state prior to extraction, has been touched on by David Field (2010). Referring to traditional, un-mechanized, quarrying practices that are bound up in rituals, and carried out by people intimately familiar with places, Field raises the possibility that stony places in the landscape had long-standing cultural associations (2010, 169–70). Far from being a neutral or inanimate resource available for economic exploitation in which the best material, in technological terms, will be targeted, stone has a multiplicity of characteristics. These include agential qualities, as highlighted by Gillings and Pollard (1999) who imagine people encountering sarsens, visible as they are around Avebury on the ground surface, in the early third millennium BC prior to the eventual use of stone in Avebury henge's great stone settings. These strange rocks are unlike so many of the others that can be found: they include immense boulders, unlike the flint cobbles and pebbles that can be found in the soil or streambeds; they lie about in the vegetation, not raised up in the craggy cairns and tors of the igneous West, for example; their scattered presence in some locations, but not others that are apparently similar in all other respects, so requiring an explanation.

© 2019 John Wiley & Sons Ltd

It is likely that sarsens had become special stones through such accrual of meaning and enmeshing in myth and story (Gillings and Pollard 1999, 183; Field 2005, 89–90). The authors take this further when considering examples of smaller, often non-structural, sarsens in Neolithic long mounds (Pollard and Gillings 2009), identifying these to have been significant stones playing key roles in the initiation of each mound-building process. Smaller boulders with no clear structural importance, such as the sarsens placed in the Beckhampton Road long mound, may have been vested with cultural importance for some time prior to their appropriation for the monument (2009, 36). In contrast to these insights from the Avebury landscape, and while considerable attention has been paid to Stonehenge's 'special' bluestones, the focus on its sarsens has commonly been restricted to technological questions to do with working and moving these vast, dense, indurate blocks.

WILTSHIRE IN STONEHENGE

Like Chilmark and Hurdcott stone and their possibly near neighbours the glauconite and oolite, sarsen stone is found in Wiltshire. Whilst the archaeological literature includes some proposals about how close to the Stonehenge basin sarsens could have been found in prehistory (McOmish *et al.* 2002, 152; Bowden *et al.* 2015, 40–2), the prevailing view is that the monument's sarsens were sourced in the Kennet Valley and on the Marlborough Downs some 30 km to the north (Fig. 2).

There are a number of strong and persistent reasons for this assumption. Partly, it is to do with its antiquity. The oldest published suggestion that the Marlborough Downs were the source for Stonehenge's sarsens dates to the sixteenth century (Lambarde, 1730 edn). Authorities including Inigo Jones in the seventeenth century and John Aubrey, who had known Salisbury Plain since his youth, agreed (Britton 1847, 44; Fowles 1980, 36), as did William Stukeley (1740, 5). Although these assertions carried less weight with Judd (1902), Stone (1924), Thomas (1923), and Thorpe *et al.* (1991), it remains the prevailing view reinforced by, amongst many others, such authorities as Atkinson (1956), Cleal *et al.* (1995), Scourse (1997) and Tilley *et al.* (2007). Fieldwork in 2011 and 2012 carried out in Clatford Bottom (Wiltshire) by the *Stones of Stonehenge Project* was based on the assumption, and driven by William Stukeley's drawing of large sarsens in the area (Parker Pearson 2012, 292–302).

The assumption is also coloured by the way in which the bluestones have long been characterized as 'other', casting the sarsen, so clearly available in Wiltshire, in the role of a 'local' stone. Both Gowland (1902) and Hawley, throughout his excavation reports of the 1920s, consistently referred to bluestone as the 'foreign' stone. In this sense, bluestone is special, sarsen is not. In north Wiltshire sarsen is obvious, and has been for many years: famously, Richard Symonds could write a diary entry in 1644, claiming that in one parish it was possible to walk for a mile and a half stepping from one sarsen boulder to another (ed. Long 1859) (Fig. 3). In those places where sarsens are visible on the surface, they are inevitably presumed to have been the source for the nearest prehistoric stone settings in sarsen. This is just as true in Dorset as Wiltshire, for example. In recommending a visit to the Valley of Stones near to Portesham, Grinsell and Dyer (1971, 20) remark '[t]his valley is of interest in that it probably provided the stones for the various megalithic monuments in the vicinity', for which the visitor will undoubtedly be making the trip.

© 2019 John Wiley & Sons Ltd

Figure 3
'a place so full of grey pibble stone of great bignes as is not usually seen...and in this parish, a myle and a half in length, they lye so thick as you may goe upon them all the way.' (R. Symonds, 1644; edn. Long 1859). Sarsens in the Valley of Stones, Marlborough Downs (Wiltshire), hint at the visual effect that so struck Symonds (Photo: K. Whitaker). [Colour figure can be viewed at wileyonlinelibrary.com]

A further aspect of this visibility is the so-called 'sarsen villages' of the Marlborough Downs. Atkinson (1956, 111) claimed, 'it is only around Avebury that sarsen is used for building at all.' This led him to conclude that further south on Salisbury Plain, where there are apparently no similar villages, there had been no such natural concentrations of sarsen stone. Buildings in Kennet Valley villages near Avebury, constructed in sarsen, are a very important element of the local sense of place and architectural character (Fig. 4) and the 'sarsen village' argument is often repeated despite the fact that sarsen use in construction is in fact more commonplace across its geological range than these assertions claim. Examples increasingly distant from Avebury include buildings in Chiseldon (Wiltshire), Aldbourne (Wiltshire), Lambourn (Berkshire) and Letcombe Regis (Oxfordshire).

SARSEN BEYOND WILTSHIRE

Taking the exotic bluestones as the exemplar of long-distance transportation, Mike Parker Pearson (2016, 368) has recently reflected on the possibility that the selection of Stonehenge's sarsens had less to do with local convenience than the assumptions described above prescribe. If special stone, and special stones, were selected for use in Stonehenge, what is to stop the monument's sarsens having come from a wider source area than the Marlborough Downs? Is it actually possible for sarsen stones to have been brought to Salisbury Plain from locations outside of Wiltshire?

The *in situ* locations, in a geological sense, of sarsen stone in southern England are unknown. The UK's sarsen boulders and cobbles are predominantly groundwater silcretes. These

© 2019 John Wiley & Sons Ltd

Figure 4
Houses in East Kennet, one of the 'sarsen villages' near Avebury (Wiltshire), are built in a variety of local materials. Sarsen stone, in the form of both rubble walling and cut blocks, is nevertheless a characteristic feature that contributes to the sense of place and has drawn the attention of commentators, over and above other media such as brick and cob walling (photo: K. Whitaker). [Colour figure can be viewed at wileyonlinelibrary.com]

rocks formed when silica accumulated in near-surface Tertiary sediments, commonly over-lying older Cretaceous geology such as the chalk of central and southern Wiltshire, cementing the younger sands, gravels and pebbles to form an indurated duricrust. The host deposits have been subject to later geological erosion processes, removing much, if not all, of any un-silicified sediments to leave cemented boulders and cobbles free. Subsequent periglacial action, and the boulders' long exploitation by people, result in the discontinuous present-day distribution (Huggett 2016, 298; Ullyott and Nash 2016, 311–12). The 'natural' distribution of sarsen stone in the UK is on the whole an archaeological concept, referring to the geographic availability of the dispersed sarsen fields to people from the Mesolithic onwards. The current best depiction of this dispersed distribution is that mapped by Ullyott *et al*. (2004, 1511 fig. 1): whilst clearly showing the intensity of sarsen survival in Wiltshire, the wider availability of the stone from Dorset to Kent is made clear.

Certain characteristics of the selected stones, however, appear to have been important to the people making Stonehenge. Wherever they came from, certain boulders had to have been big enough. This is a very difficult aspect of sarsen sourcing to investigate today, precisely because of the more recent exploitation of sarsen especially in the modern era. There are very few large sarsens remaining in the field. Two surviving examples include the Toad Stone (Fig. 5) and an

© 2019 John Wiley & Sons Ltd

Figure 5
The Toad Stone in the Valley of Stones on the Marlborough Downs (Wiltshire) is one of the few remaining very large sarsens in this area. It stands well over 2 m tall. Slightly to one side of the adjacent natural sarsen spread, Passmore (1922) suggested that this boulder is out of place: he proposed it had been intended for the stone circles at Avebury a short distance to the west, was moved, and then abandoned by the builders (photo: K. Whitaker). [Colour figure can be viewed at wileyonlinelibrary.com]

immense boulder on Monkton Down, both in north Wiltshire. The Upper White Horse Stone, Aylesford (Kent) is another large survival, and there are still three very large sarsens on Odstone Down to the east of Weathercock Hill, marking the administrative area boundary (Lambourn Downs, Oxfordshire). But on the South Downs in Sussex, for example, although some large sarsens are present, the average length available today is *c*.2 m (Ullyott *et al*. 2004, 1522): a survey of the sarsens on Fyfield Down, Wiltshire, would likely return similar results.

A more accessible aspect of Stonehenge's sarsens is their visual appearance. The possible importance of the colour of selected sarsens has been commented on, for example by Atkinson (1956, 2–3), and by Tilley *et al*. (2007, 196) noting the positioning of greyer and browner stones in Stonehenge's trilithon arrangement. Similar comments have been made about sarsens in other monuments: Pollard and Gillings (1998, 157) remarked on the tinge of red seen in certain stones selected for settings at Avebury henge, for example. Variability in the external colours of sarsen stones can be seen across the geographic range (Fig. 6), sometimes influenced not only by levels of iron oxide in the stone itself but also by biological factors. And whilst nineteenth-century quarrymen in Buckinghamshire, for example, located sarsens buried in clay-with-flints by probing (Green 2016, 357 fig. 9), in many areas the boulders are readily visible where they lie on the surface. Although there is not the space here to explore the nature of prehistoric sarsen extraction practices, the point is that across its natural distribution the stone is commonly visible, and not only in Wiltshire.

© 2019 John Wiley & Sons Ltd

Figure 6
An orange-brown sarsen set into the roadside outside The Anchor, Faversham, (Kent). This is one of a number of sarsens dotted around the wharves beside the River Stour in this part of the town. Although small sarsens are occasionally found buried in Tertiary and later deposits in this area (Holmes 1981), it is possible that these sarsens arrived as ballast in Thames wherries and were used, as this one, to keep road vehicles from hitting the closely-spaced buildings (photo: K. Whitaker). [Colour figure can be viewed at wileyonlinelibrary.com]

That these boulders outside of Wiltshire were seen and used in the Neolithic is clear. A fine example is Kit's Coty House long barrow in Kent, where four large sarsens of the originally-covered burial chamber are now exposed. Other sarsens are likely to have been in position as a revetment to the (now destroyed) earthen mound of the barrow. It sounds trite to make this point in the face of the monumental evidence, but during the Neolithic people were not unaware of these stones, whether Medway or Marlborough sarsens, and made decisions to interact with them in a variety of ways. Whilst it is now very difficult to demonstrate the likely availability of large sarsens in possible source locations across its natural distribution, other characteristics such as colour variation in boulders, and the visibility and availability of sarsen beyond Wiltshire's boundaries, are more easily demonstrated.

COALS TO MANCHESTER, OR, SARSENS TO WILTSHIRE

Bringing stones to Stonehenge, shaping and dressing some of them, erecting them, re-configuring the settings, are all activities that occurred over a long period of time in the third millennium cal BC (Darvill *et al.* 2012, 1026 table 3). The heights of these laborious exercises, perceived as the culminations of pre-imagined and planned building episodes (albeit to a timeframe not yet informed by radiocarbon dating), heavily influenced Richard Atkinson 60 years ago when he described 'a single man' in control of Neolithic communities, 'who alone could create and maintain the conditions necessary for this great undertaking' (Atkinson 1956, 165). Renfrew's (1973) conceptualization of Neolithic social organization, informed by the anthropological literature and describing the evolution of tribal and chiefdom systems in Wessex, is similarly underpinned by

© 2019 John Wiley & Sons Ltd

the perceived enormity of the undertaking to move more than 75 sarsen stones some 30 km into the Stonehenge basin.

Ideas about where Stonehenge's 75+ sarsens came from have a strong influence on the visualization of prehistoric social organization. If the stones came from the Marlborough Downs, they require a *route*. Richard Atkinson drew one dotted line (1956, 112 fig. 4), Mike Parker Pearson (2016, 364 fig. 2) another, but what these have in common is that one line on a map looks like a mass-movement. The huge physical effort along *the route*, the vision of immense numbers of people moving some number of large boulders in one direction before walking back for more, has a 'corporate-ness' about it. Furthermore, *the route* has a tendency to diminish the lengthy duration of the construction process, this reduction being a problem highlighted by Richards (2004, 74). Consequently, an outcome of *the route* is that it supports the concept of monument building as a unitary process.

In contrast, Richards (2004, 2013) has encouraged us to think differently about monument construction, rejecting the concept of building solely intended to result in a final structural form, the fulfilment of one person's architectural vision. Instead, 'the main social focus is the process of construction' (Richards 2004, 73). An important aspect of this alternative way of looking at megalithic monuments is the recognition, via ethnographic evidence, that individual stones are likely to have held significance 'as material entities' (Richards 2013, 26) in their own right, not only because of certain innate physical qualities but also because of their origin story, special source, or attributed qualities arising from ongoing human interaction with them.

Similarly, Pollard and Gillings (2009) have highlighted the importance of individually-significant sarsens stones in, for example, earlier Neolithic long barrow construction (2009, 35–7), as well as in the later great stone circle settings of a monument like Avebury. Perhaps individual stones in a megalithic setting like Stonehenge (and the stones arranged in any dolmen, circle, or alignment) could each be recognized as the work of but one of many social groups (Richards 2004, 77), rather than being the expression of power of Renfrew's 'Salisbury Plain chief' (1973, 553). Stonehenge's other building stones, the packing material, cast another light on the significance of stone selection. The presence of non-local limestone drystone walling in long barrows such as the West Kennet megalithic chambered tomb (Piggott 1962, 14, 58) has attracted comment: in such monuments, we see early examples of practices of stone collection, transportation, and mixed use that are also evidenced by Stonehenge's Chilmark, Hurdcott, glauconite and oolite stones that William Hawley observed but which have since been largely ignored.

Just as the stonehole packing stones at Stonehenge were not simply discarded rubbish used expediently, but carefully selected materials gathered from some kilometres away, so the individual sarsens each were significant stones wrapped up in, as Richards puts it, 'the extended web of social practices surrounding the building of a monument' (2013, 7). Not only the Welsh bluestones, but all the stony building materials at Stonehenge were brought from varying locations, travelling over variable distances. The majority of these locations are yet to be ascertained with certainty, for whilst the lithology and petrography of the bluestones are readily susceptible to analysis enabling their sources to be identified, similar work has yet to be carried out on those other rock types. Nevertheless, it remains a possibility that Stonehenge's sarsens came from further afield than the Marlborough Downs, and that instead of a map showing *the route* of these boulders, a set of snaking paths across southern England could be revealed. Whilst I do not want to deny the major undertaking that moving just one megalith in prehistory involved, a more nuanced view of the stony variety at Stonehenge is possible. If none of Stonehenge's building stones came from Wiltshire, but

© 2019 John Wiley & Sons Ltd

were contributed over time in a series of collaborative undertakings by varied groups of people from far and wide, then the monument might typify social differentiation as the outcome of, rather than the precursor to, prehistoric monument building.

Acknowledgements

In 2016, the conveners of the third Neolithic and Early Bronze Age Research Students' Symposium threw down a gauntlet. The provocation, *'Anarchy in the UK?'*, challenged speakers to construct alternative pasts diverging from, disrupting, or inverting, linear narratives of social evolution in the period *c*.4000 cal BC–*c*.1500 cal BC. This paper resulted from that challenge. This work was supported by the Arts and Humanities Research Council (grant number AH\L503939\1) through the South, West, and Wales Doctoral Training Partnership.

School of Archaeology, Geography and Environmental Science
University of Reading
Wager Building, Whiteknights
Reading RG6 6AB
UNITED KINGDOM
E-mail: k.a.whitaker@pgr.reading.ac.uk

doi: 10.1111/ojoa.12161

BIBLIOGRAPHY

ATKINSON, R.J.C. 1956: *Stonehenge* (London).

ATKINSON, R.J.C. 1961: Neolithic engineering. *Antiquity* 35, 292–9.

BARRETT, J.C. 1994: *Fragments from Antiquity. An Archaeology of Social Life in Britain, 2900–1200BC* (Oxford).

BEVINS, R., ATKINSON, N., IXER, R. and EVANS, J. 2016: U-Pb zircon age constraints for the Ordovician Fishguard Volcanic Group and further evidence for the provenance of the Stonehenge bluestones. *Journal of the Geological Society* 174(1), 14–17.

BOOTH, K.A., HOPSON, P.M., FARRANT, A.R., NEWELL, A.J., MARKS, R.J., BATESON, L.B., WOODS, M.A., WILKINSON, I.P. and EVANS, D.J. 2010: *Geology of the Devizes District – a brief explanation of the geological map. Sheet Explanation of the British Geological Survey. 1:50 000 Sheet 282 Devizes (England and Wales).* (Keyworth).

BOWDEN, M., SOUTAR, S., FIELD, D. and BARBER, M. 2015: *The Stonehenge Landscape. Analysing the Stonehenge World Heritage Site* (Swindon).

BRITTON, J. (ed.) 1847, 1969 edn: *The Natural History of Wiltshire* by John Aubrey F.R.S. written between 1659 and 1691 (Newton Abbot).

CHIPPENDALE, C. 1994: *Stonehenge Complete* (London).

CLEAL, R., WALKER, K. and MONTGAGUE, R. 1995: *Stonehenge in its Landscape* (London).

COONEY, G. 2008: Engaging with stone: making the Neolithic in Ireland and Western Britain. In FOKKENS, H., COLES, B.J., van GIJN, A.L., KLEINE, J.P. PONJEE, H.H. and SLAPPENDEL, C.G. (eds.), *Between Foraging and Farming* (Leiden, Analecta Praehistorica Leidensia 40), 201–14.

CRITTALL, E. (ed.) 1959: *A History of Wiltshire. Volume 4* (London).

DARRAH, J. 1993: The Bluestones of Stonehenge. *Current Archaeology* 134, 78.

DARVILL, T., MARSHALL, P., PARKER PEARSON, M. and WAINWRIGHT, G. 2012: Stonehenge remodelled. *Antiquity* 86(334), 1021–40.

FIELD, D. 2005: Some observations on perception, consolidation and change in a land of stones. In BROWN, G., FIELD, D. and MCOMISH, D. (eds.), *The Avebury Landscape. Aspects of the Field Archaeology of the Marlborough Downs* (Oxford).

© 2019 John Wiley & Sons Ltd

FIELD, D. 2010: Pen Pits, New Grange and progress in the archaeology of extraction. In BREWER-LA PORTA, M., BURKE, A. and FIELD, D. (eds.), *Ancient Mines and Quarries – a trans-Atlantic Perspective* (Oxford).

FOWLES, J. (ed.) 1980: *Monumenta Britannica or A Miscellany of British Antiquities by Mr John Aubrey… Compiled mainly between the Years 1665 and 1693* (Sherbourne).

GEDDES, I. 2003: *Hidden Depths: Wiltshire's Geology and Landscapes* (Bradford-on-Avon).

GILLINGS, M. and POLLARD, J. 1999: Non-portable stone artefacts and contexts of meaning: the tale of Grey Wether (www.museums.cls.ac.uk/Avebury.stone4.htm) In MARSHALL, Y. and GOSDEN, C. (eds.), *The Cultural Biography of Objects. World Archaeology* 31(2), 179–93.

GOWLAND, W. 1902: Recent excavations at Stonehenge. *Archaeologia* 58(1), 37–118.

GRINSELL, L. and DYER, J. 1971: *Discovering Regional Archaeology. Wessex* (Tring).

GREEN, C.P. 1973: Pleistocene river gravels and the Stonehenge problem. *Nature* 243, 214–16.

GREEN, C.P. 1997: The provenance of rocks used in the construction of Stonehenge. In CUNLIFFE, B. and RENFREW, C. (eds.), *Science and Stonehenge* (Oxford, Proceedings of the British Academy 92), 257–70.

GREEN, C.P. 2016: The exploitation of silcretes (sarsen and puddingstones) in England and Normandy since Stonehenge. *Proceedings of the Geologists' Association* 127, 349–58.

HAMBLIN, R. 2013: The Upper Greensand of the Haldon Hills and East Devon. *Mercian Geologist* 18(2), 133–8.

HAWLEY, W. 1922: Second report on the excavations at Stonehenge. *Antiquaries Journal* 2, 36–52.

HAWLEY, W. 1926: Report on the excavations at Stonehenge during the season of 1924. *Antiquaries Journal* 6, 1–25.

HOLMES, S. C. A. 1981: *Geology of the Country around Faversham* (London).

HOPSON, P.M., FARRANT, A.R., NEWELL, A.J., MARKS, A.J., BOOTH, K.A., BATESON, L.B., WOODS, M.A., WILKINSON, I.P., BRAYSON, J. and EVANS, D.J. 2007: *Geology of the Salisbury District – a brief explanation of the geological map. Sheet Explanation of the British Geological Survey. 1:50 000 Sheet 298 Salisbury (England and Wales)* (Keyworth).

HUGGETT, J. 2016: Puddingstones and related silcretes of the Anglo-Paris Basin – an overview. *Proceedings of the Geologists' Association* 127, 297–300.

IXER, R.A., and BEVINS, R.E. 2011: Craig Rhos-y-felin, Pont Saeson is the dominant source of the Stonehenge rhyolitic 'debitage'. *Archaeology in Wales* 50, 21–32.

IXER, R.A. and BEVINS, R.E. 2016: Volcanic Group A debitage: its description and distribution within the Stonehenge landscape. *The Wiltshire Archaeological and Natural History Magazine* 109, 1–14.

JONES, A. 2007: *Memory and Material Culture* (Cambridge).

JONES, I. 1725 edn.: *The Most Notable Antiquity of Great Britain, Vulgarly Called Stonehenge, on Salisbury Plain Restored* (London).

JUDD, J.W. 1902: Note on the nature and origin of the rock-fragments found in the excavations made at Stonehenge by Mr Gowland in 1901. *Archaeologia* 58(1), 106–18.

LAMBARDE, W. 1730 edn.: *Dictionarium Topographicum et Historicum* (London).

LONG, C.E. (ed.) 1859: *Diary of the Marches kept by the Royal Army during the Great Civil War; Kept by R. Symonds* (London).

MCOMISH, D., FIELD, D. and BROWN, G. 2002: *The Field Archaeology of the Salisbury Plain Training Area* (Swindon).

PARKER PEARSON, M. 2012: *Stonehenge: Exploring the Greatest Stone Age Mystery* (London).

PARKER PEARSON, M. 2016: The sarsen stones of Stonehenge. *Proceedings of the Geologists' Association* 127, 363–9.

PARKER PEARSON, M., BEVINS, R., IXER, R., POLLARD, J., RICHARDS, C., WELHAM, K., CHAN, B., EDINBOROUGH, K., HAMILTON, D., MACPHAIL, R., SCHLEE, D., SCHWENNINSISGER, J-L., SIMMONS, E. and SMITH, M. 2015: Craig Rhos-y-felin: a Welsh bluestone megalith quarry for Stonehenge. *Antiquity* 89(348), 1331–52.

PARKER PEARSON, M., POLLARD, J., RICHARDS, C., SCHLEE, D. and WELHAM, K. 2016: In search of the Stonehenge quarries. *British Archaeology* 146, 16–23.

PASSMORE, A.D. 1922: Notes on fieldwork in N. Wilts 1921–22. *Wiltshire Archaeology Magazine* 42 (137), 49–51.

PETRIE, W.M.F. 1880, 1989 edn.: *Stonehenge: Plans, Description and Theories* (London).

PIGGOTT, S. 1962: *The West Kennet Long Barrow Excavations 1955–56* (London, Ministry of Works Archaeological Reports 4).

© 2019 John Wiley & Sons Ltd

PITTS, M. 2000: *Hengeworld* (London).
POLLARD, J. 2013: Renfrew's monuments and mobilisation 40 years on. Neolithic Studies Group meeting. The Last Great Monuments: Ceremonial Complexes of the 3rd Millennium BC, 4 November 2013.
POLLARD, J. and GILLINGS, M. 1998: Romancing the stones: towards a virtual and elemental Avebury. *Archaeological Dialogues* 5(2), 140–64.
POLLARD, J. and GILLINGS, M. 2009: The world of the Grey Wethers. In O'CONNOR, B., COONEY, G. and CHAPMAN, J. (eds.), *Materialitas. Working Stone, Carving Identity* (Oxford, Prehistoric Society Research Paper 3), 29–41.
RENFREW, C. 1973: Monuments, mobilization and social organisation in Neolithic Wessex. In RENFREW, C. (ed.), *The Explanation of Culture Change: Models in Prehistory* (London, Proceedings of a Meeting of the Research Seminar in Archaeology and Related Subjects Held at the University of Sheffield), 539–58.
RICHARDS, C. 2004: Labouring with monuments: constructing the dolmen at Carreg Samson, south-west Wales. In CUMMINGS, V. and FOWLER, C. (eds.), *The Neolithic of the Irish Sea* (Oxford), 72–80.
RICHARDS, C. 2013: Interpreting stone circles. In RICHARDS, C. (ed.), *Building the Great Stone Circles of the North* (Oxford), 2–30.
SCOURSE, J.D. 1997: Transport of the Stonehenge Bluestones: testing the Glacial Hypothesis. In CUNLIFFE, B. and RENFREW, C. (eds.), *Science and Stonehenge* (Oxford, Proceedings of the British Academy 92), 271–314.
STONE, E.H. 1924, 2009 reprint: *The Stones of Stonehenge* (London).
STUKELEY, W. 1740, 1743: *Stonehenge: A Temple Restor'd to the British Druids and Abury, A Temple of the British Druids* (London).
TATTON-BROWN, T. 2001: The quarrying and distribution of Reigate Stone in the Middle Ages. *Medieval Archaeology* 45(1), 189–201.
THOMAS, H.H. 1923: The source of the stones of Stonehenge. *The Antiquaries Journal* 3, 239–60.
THORPE, R.S., WILLIAMS-THORPE, O., GRAHAM JENKINS, D. and WATSON, J.S. 1991: The geological sources and transport of the Bluestones of Stonehenge, Wiltshire, UK. *Proceedings of the Prehistoric Society* 57(2), 103–57.
TILLEY, C., RICHARDS, C., BENNETT, W. and FIELD, D. 2007: Stonehenge – its landscape and its architecture: a reanalysis. In LARSON, M. and PARKER PEARSON, M. (eds.), *From Stonehenge to the Baltic* (Oxford, BAR International Series 1692), 183–204.
ULLYOTT, J.S. and NASH, D.J. 2016: Distinguishing pedogenic and non-pedogenic silcretes in the landscape and geological record. *Proceedings of the Geologists' Association* 127, 311–19.
ULLYOT, J.S., NASH, D.J., WHITEMAN, C.A. and MORTIMORE, R.N. 2004: Distribution, petrology and mode of development of silcretes (sarsens and puddingstones) on the eastern South Downs, UK. *Earth Surface Processes and Landforms* 29, 1509–39.

© 2019 John Wiley & Sons Ltd

Foreword, paper 3

Nash, D.J., Cibarowski, J.R., Ullyott, J.S., Parker Pearson, M., Darvill, T., Greaney, S., Maniatis, G., Whitaker, K.A. 2020. Origins of the sarsen megaliths at Stonehenge. *Science Advances* 6(31), https://doi.org/10.1126/sciadv.abc0133

Cited by: 14

Downloads: 7,256

Wednesday 29 July 2020 was a sunny, warm, day in north Wiltshire. David Nash, Tim Darvill and Susan Greaney, with three small TV-news crews from national broadcasters the BBC, ITV and Channel 4, were following me along a woodland track in Fowles Copse, West Woods (near Marlborough, Wiltshire). We were heading for a picturesque cluster of large sarsen boulders surrounded by beech trees that I had chosen for being nonetheless conveniently close to a footpath and a small car-park, making it less irksome to carry all the film and sound equipment. The plan was to film some pieces to camera, walking around the boulders or sitting on them as we were interviewed by the journalists. Everyone was trying their best to keep a little distance from one another, without getting lost. It was, after all, only five months into the UK's experience of the Covid-19 pandemic and everyone had to have some kind of risk-assessed dispensation from their employers to be there.

David, Tim and Susan had been up since dawn to film with the TV teams at Stonehenge, revealing the outcome of the following research paper: all bar two of Stonehenge's surviving sarsen stones are geochemical matches with sarsen sampled from West Woods *c*. 25 km (*c*.15 miles) north-north-east of the monument. The huge megaliths were sourced from the environs, confounding long-held expectations that they had been taken from sarsen spreads on the chalk Downland north of the River Kennet. To our surprise, the West Woods samples were distinct even from those taken in Lockeridge Dene less than 1 km to the north. 'Why did you come here?' asked one of the TV people, as we picked our way around the muddiest patches of the footpath. 'It's all Katy's fault,' David replied.

Earlier on during his British Academy/Leverhulme Trust Small Research Grant project (SG170610) *Geochemical fingerprinting the sarsen stones at Stonehenge*, David Nash had asked for my recommendations for north Wiltshire sarsen sampling locations. He had to augment from new sites the material that he and colleagues had collected over previous years, but didn't want to damage anything of archaeological significance. He needed to draw on my detailed knowledge of both surviving, accessible sarsen in the area and also its archaeological context. My role in the project was to propose safe and ethical sampling locations, provide landowner contact details and in late-Spring 2019 to guide David with Jake Cibarowski to suitable sarsen stones in the target areas. Later on, I worked on the text of the resulting research paper in the team editing process, supporting David to write an archaeologically-sound and suitably referenced text. As well as East Farm (Winterbourne Monkton) and Temple (Totterdown), both on the high chalk Downs, I had insisted that the sampling include West Woods, to the south of the River Kennet. The wooded area has been largely ignored in discussions about sarsen stone and prehistoric Wiltshire thus far, despite being such a rich location, geologically- and archaeologically-speaking.

Discovering that the majority of Stonehenge's sarsens did in fact come from one locality put an end to my picture, conjured in the previous paper, of a multi-sourced stone setting with origins extending across southern England. Nevertheless, we have drawn attention to an area better known for its early medieval archaeology (in the form of Wansdyke) and medieval history (as part of Savernake Forest), at the edge of the Avebury environs that have dominated prehistoric research here thus far. Our sampling location was close to – in fact, was probably once part of – a former surface spread of sarsen boulders on Boreham Down, mapped by the Ordnance Survey until the 1920s (Ordnance Survey 1924). That area was exploited by nineteenth century sarsen cutters (King 1968). Today, whilst many sarsens probably lie buried in the Clay-with-Flints and Head that cover Boreham Down and Wool's Grove, only a few are visible on the surface within the wooded area. Agricultural improvement and cultivation have rendered sarsens largely invisible where once they were more obvious and would have been better known.

Although the geochemical fingerprinting links most of Stonehenge's surviving sarsen stones to our West Woods samples, it does not provide exact locations for where the boulders had been taken up. On 25 March 2020 Mike Parker Pearson emailed me, excitedly referencing John Aubrey's note of 14 April 1655 about a pit containing sarsens (reproduced in Scurr 2015, 105),

'I find it strange that Mr Camden in his *Britannia* does not notice that the stones at Stonehenge are Grey Wethers and come from a pit no more than fourteen miles away, where there are thousands of such stones to be drawn out of the earth. Some stones, not big enough for use at Stonehenge or Avebury, still lie on the brink of the pit.'

Could we find this pit, Mike asked, possibly in the environs of West Woods given the similarity of distance quoted by Aubrey? There are so many pits in this landscape, I replied. Sarsen's distribution means that extraction and exploitation of multiple periods overlaps and interrupts one another. Solution features, hollows, pits and scrapes, spoil tips and trails left by more recent workings lie amongst prehistoric features. This is less like a simple palimpsest (Crawford 1953; Hoskins 1955), more like Michel Serres's crumpled handkerchief (1995, 60-61) in which the three-dimensional extraction, quarrying and tipping of many different periods is collapsed into a confusing medley of negative and positive forms. Neither was sarsen the only useful earth material to be taken from the ground. A whole range of bulk minerals were dug out in the area of West Woods, pock-marking the surface: like the deep *c*.0.15 ha flint pit at SU 1572 6554; probable clay pits that may have fed industrial activity in Brick Kiln Copse; and likely marl pits regularly spaced in the arable fields to the north of the deserted medieval village of Shaw, now visible in Royal Air Force vertical aerial photographs of the late 1940s. How can we tell which of these sorts of features might have been Aubrey's sarsen pit, and which if any are prehistoric? This theme arises in the fourth paper of this thesis and remains an important research question requiring more attention in the future.

The following paper takes the opportunity to contribute to the debate about a (the) route taken to bring sarsens from their source to Stonehenge, but I am more interested in why these boulders were selected. What were the characteristics or attributes that made them suitable? I pick up the theme of how materials are known and understood in the thesis' fifth and sixth papers, but here suggest that a detailed study of Boreham Down and the West Woods wider environs is an important next step to addressing my question. If, as I suggest in the sixth paper, to explore Neolithic relations with sarsen stone we need to elaborate the many ways in which it was being experienced, used and worked at that time, then we need carefully documented archaeological and geological evidence. That will entail building on and augmenting the methodologies developed in this thesis in order to unpick the entwined threads of prehistoric and modern sarsen exploitation on hillsides and in valleys in sarsen country.

References

Crawford, O. G. S. 1953. *Archaeology In The Field.* London: Phoenix House
Hoskins, W. G. 1955. *The Making of the English Landscape.* London: Hodder and Stoughton
King, N. E. 1968. The Kennet Valley Sarsen Industry. *Wiltshire Archaeological and Natural History Magazine* 63, 83-93
Ordnance Survey. 1924. *Wiltshire XXXV.3*, 1:2500. Southampton: Ordnance Survey

Scurr, R. 2015. *John Aubrey. My Own Life.* London: Vintage
Serres, M. 1995. *Conversations on science, culture, and time / Michel Serres with Bruno Latour translated by Roxanne Lapidus.* Ann Arbor: University of Michigan Press

ARCHAEOLOGY

Origins of the sarsen megaliths at Stonehenge

David J. Nash[1,2]*, T. Jake R. Ciborowski[1], J. Stewart Ullyott[1], Mike Parker Pearson[3], Timothy Darvill[4], Susan Greaney[5], Georgios Maniatis[1], Katy A. Whitaker[6,7]

Copyright © 2020 The Authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original U.S. Government Works. Distributed under a Creative Commons Attribution NonCommercial License 4.0 (CC BY-NC).

The sources of the stone used to construct Stonehenge around 2500 BCE have been debated for over four centuries. The smaller "bluestones" near the center of the monument have been traced to Wales, but the origins of the sarsen (silcrete) megaliths that form the primary architecture of Stonehenge remain unknown. Here, we use geochemical data to show that 50 of the 52 sarsens at the monument share a consistent chemistry and, by inference, originated from a common source area. We then compare the geochemical signature of a core extracted from Stone 58 at Stonehenge with equivalent data for sarsens from across southern Britain. From this, we identify West Woods, Wiltshire, 25 km north of Stonehenge, as the most probable source area for the majority of sarsens at the monument.

INTRODUCTION

The origins of the stones used to build the monument of Stonehenge and their transportation methods and routes have been the subject of debate among archaeologists and geologists for more than four centuries (*1*–*6*). Two main types of stones are present at the monument (Fig. 1). The smaller "bluestones" have attracted the most geological attention. These stones—which include dolerites, tuffs, rhyolites, and sandstones—are clearly not local to Stonehenge, which stands in an area underlain by Chalk bedrock. Recent studies suggest that the igneous bluestones originated from the Preseli Hills in southwest Wales [e.g., (*7*–*9*)], over 200 km west of the monument, and that the sandstone Altar Stone came from east Wales (*10*). However, with the exception of work by Howard (*11*), no research has been published on the sources of the larger sarsens [a vernacular term for the duricrust silcrete; (*12*)], erected during the mid-third millennium BCE, that comprise the main architecture of Stonehenge (*13*, *14*). Today, only 52 of the original ~80 sarsen stones remain at the monument. These include all 15 stones forming the central Trilithon Horseshoe, 33 of the 60 uprights and lintels from the outer Sarsen Circle, plus the peripheral Heel Stone, Slaughter Stone, and two of the four original Station Stones.

Typical sarsen uprights at Stonehenge have a long-axis length of 6.0 to 7.0 m (including sections below ground) and weigh ~20 metric tons, with the largest reaching 9.1 m (Stone 56) and having an above-ground weight of ~30 metric tons (Stone 54) (*15*). Their size, coupled with the limited occurrence of sarsen boulders on Salisbury Plain today (*16*), has led to the perceived wisdom that these stones were sourced from the Marlborough Downs (Fig. 1B), 30 km to the north of the monument (*17*). This view has prevailed since the writings of the 16th century antiquary William Lambarde (*1*) but is rarely challenged and has never been rigorously tested. It is certainly true that the most extensive spreads of sarsen boulders in Britain today occur on the Marlborough Downs (Fig. 1A). However, given that sarsen was used to construct megalithic monuments in Kent, Dorset, and Oxfordshire [e.g., (*18*)], it is not impossible that these regions could also have supplied stones for Stonehenge. Furthermore, as the distant sources of the bluestones attest, the choice of stone used to construct Stonehenge was far from pragmatic or based simply on local availability (*14*, *19*).

Here, we apply a novel combination of geochemical and statistical approaches, developed and validated on silcretes in southern Africa (*20*, *21*), to determine the provenance of the sarsen stones at Stonehenge. First, we use portable x-ray fluorescence spectrometry (PXRF) to provide an initial chemical characterization of all extant sarsen uprights and lintel stones. The resulting data are analyzed statistically to determine the degree of chemical variability present across the monument. We then undertake inductively coupled plasma mass spectrometry (ICP-MS) and ICP–atomic emission spectrometry (ICP-AES) analyses of (i) samples from a recently rediscovered core drilled through sarsen Stone 58 at Stonehenge and (ii) a representative range of sarsen boulders from across southern Britain. These analyses are used to generate high-resolution chemical signatures for the monument and potential source regions. Comparisons of these signatures allow us to identify the most likely source area for the sarsens at Stonehenge.

RESULTS

Chemical variability within the sarsen stones at Stonehenge

Nondestructive chemical analyses of all 52 sarsens present at Stonehenge were undertaken using PXRF. This involved taking five readings at random positions across each stone, generating 260 analyses for 34 chemical elements (see Materials and Methods; full dataset is provided in data file S1). The PXRF data demonstrate that the sarsens typically comprise >99% silica, with only traces of each of the other major elements (Al, Ca, Fe, K, Mg, Mn, P, and Ti) present. This high purity is in line with the previous analyses of British sarsens [e.g., (*22*–*24*)] and reflects the mineralogy of the stones, which comprise quartz sands cemented by quartz. Ten of the PXRF analyses at the monument record anomalously low Si (see Materials and Methods), which most likely indicates that nonquartz accessory mineral grains were excited by the x-ray beam during data acquisition. These readings are excluded from subsequent statistical investigations.

Linear discriminant analysis (LDA) and Bayesian principal component analysis (BPCA) were used to analyze the PXRF data (see Materials and Methods). BPCA was chosen over standard principal

[1]School of Environment and Technology, University of Brighton, Lewes Road, Brighton BN2 4GJ, UK. [2]School of Geography, Archaeology and Environmental Studies, University of the Witwatersrand, Johannesburg, South Africa. [3]Institute of Archaeology, University College London, 31-34 Gordon Square, London WC1H 0PY, UK. [4]Department of Archaeology and Anthropology, Bournemouth University, Fern Barrow, Poole, Dorset BH12 5BB, UK. [5]English Heritage, 29 Queen Square, Bristol BS1 4ND, UK. [6]Department of Archaeology, University of Reading, Whiteknights, Reading RG6 6AH, UK. [7]Historic England, 4th Floor, Cannon Bridge House, 25 Dowgate Hill, London EC4R 2YA, UK.
*Corresponding author. Email: d.j.nash@brighton.ac.uk

Downloaded from http://advances.sciencemag.org/ on July 29, 2020

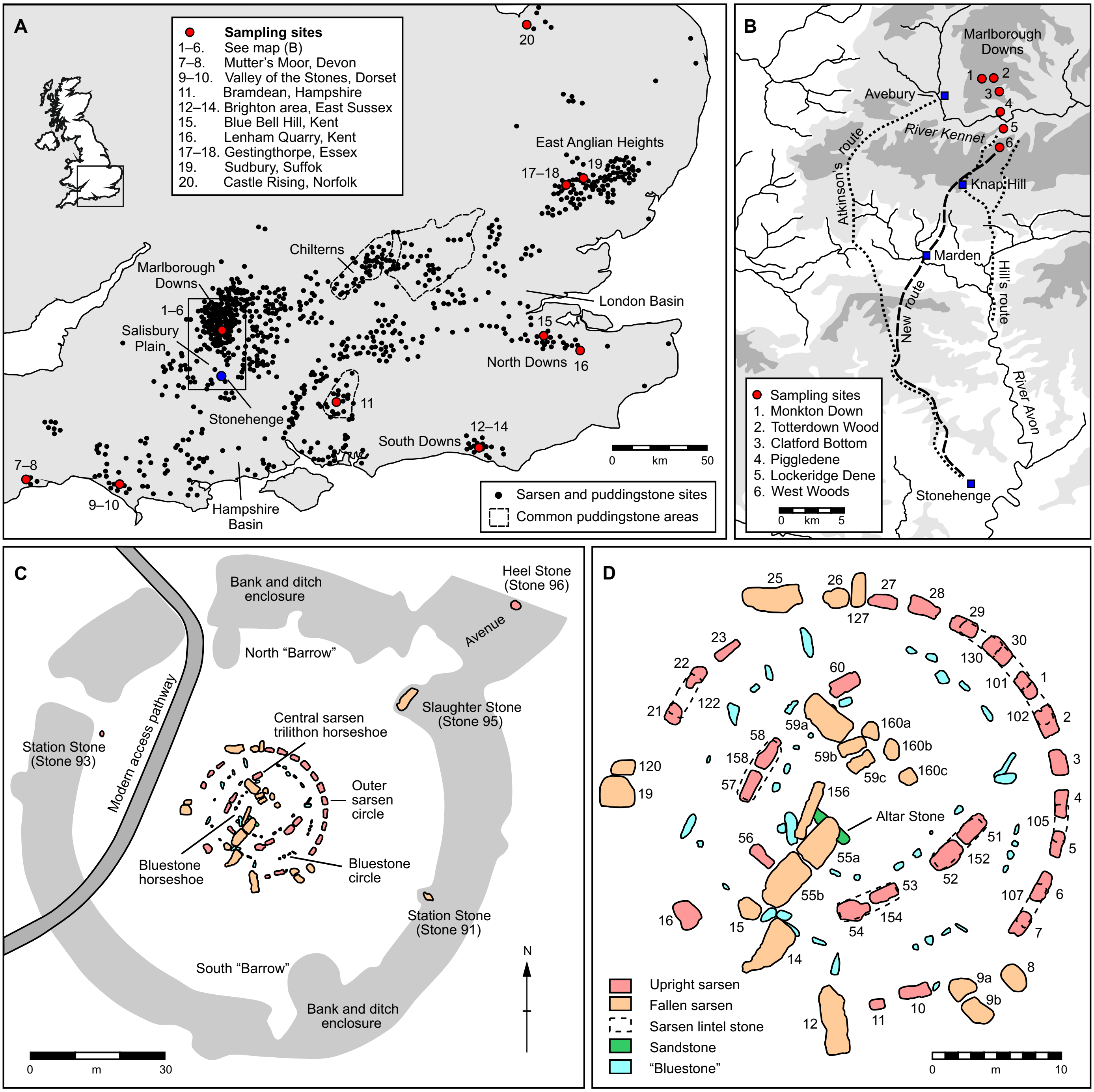


Fig. 1. Stonehenge in context. (**A**) Distribution of silcrete boulders across southern Britain, including sarsens and conglomeratic variants known as puddingstone [data from (*16*, *22*, *28*, *46*, *47*)]. (**B**) Sampling sites and topography in the Stonehenge-Avebury area [areas in pale gray at 100 to 175 m above sea level (asl), and those in dark gray at 175 to 270 m asl], along with proposed transportation routes for the sarsen stones. (**C**) Plan of Stonehenge showing the area of the monument enclosed by earthworks plus numbered peripheral sarsen stones. (**D**) Detail of the main Stonehenge monument showing the remaining bluestones and numbered sarsen stones.

component analysis (PCA) as the latter has limited utility for zero-inflated or incomplete datasets (*25*), both common issues in geochemical studies where many elements are at such low concentrations that they fluctuate close to or below instrumental detection limits. For all statistical analyses, data for the following elements were omitted—Si, Ca, and Fe [to avoid potential anomalies caused by the introduction of iron and replacement of Si by Ca during late-stage diagenesis and subaerial weathering; (*23*)], and Co, Cd, Se, Sb, and Sn (which were below detection limits in all PXRF readings).

Exploratory LDA models indicate significant clustering of the PXRF data (model accuracy, ~0.25), with most analyses falling within a single cluster (Fig. 2A). We define a sarsen as being statistically

Downloaded from http://advances.sciencemag.org/ on July 29, 2020

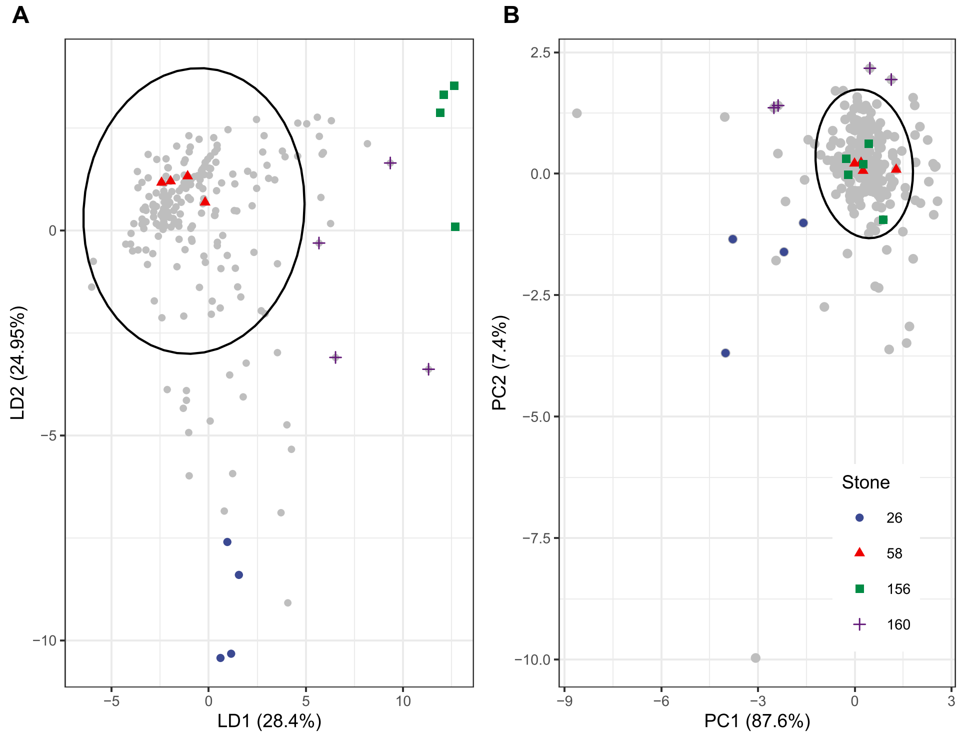


Fig. 2. Results of the statistical analysis of PXRF data from all 52 sarsen stones at Stonehenge. (**A**) Results of linear discriminant analysis and (**B**) Bayesian principal component analysis. LD1, linear discriminant 1; PC1, principal component 1. Only selected sarsens discussed in the text are highlighted in each graphic. Covariance of the first six principal components from the BPCA is shown in fig. S1, with the respective element loadings in table S1 (see figs. S2 and S3 for BPCA results for other stones, and figs. S4 and S5 for BPCA results according to the main structural components at the monument). Ellipsoids indicate the 95% normal confidence ellipses.

different from this cluster only where all individual PXRF analyses for the stone fall beyond the 95% confidence ellipsoid. Using this criterion, three sarsens—upright 26 and lintels 156 and 160—can be identified as chemically distinct from the rest of the monument.

The LDA results are supported by the outcomes of the BPCA (Fig. 2B). The BPCA model performs very well in terms of explaining the variability of the PXRF dataset (PC1 to PC2, $R^2 = 0.95$; covariance of the first six principal components is shown in fig. S1, with respective element loadings in table S1). Here, the majority of analyses, including those from lintel 156, fall within a well-defined cluster enclosed by an approximately circular loading. All analyses of upright 26 and lintel 160 fall beyond the 95% confidence limit. Results for other sarsens are presented in fig. S2 (Stones 1 to 30) and fig. S3 (Stones 51 to 158). The BPCA results further indicate no geochemical difference between the separate structural elements of Stonehenge (i.e., the Trilithon Horseshoe, Sarsen Circle, and peripheral stones; fig. S4) nor between sarsen uprights and lintel stones (fig. S5).

In summary, the results of LDA and BPCA show that 50 of the 52 remaining sarsens at Stonehenge share a similar geochemistry. Upright 26 and lintel 160 have distinctly different chemistries, both from each other and from the rest of the sarsens at the monument. While exploratory LDA results suggest that lintel 156 may also have a different chemistry, the more statistically powerful, unsupervised BPCA method indicates that the chemistry of this stone is instead closer to that of most other sarsens at Stonehenge.

Chemical composition of sarsen Stone 58 at Stonehenge

During a restoration program at Stonehenge in 1958, three sarsen stones that fell in 1797 were reerected (uprights 57 and 58 and lintel 158 from the Trilithon Horseshoe; Fig. 1D). Details of the conservation work are provided in two unpublished reports held in the Ministry of Works registry archive (Registry Files AA 71786/2R Part 2,9 and Part 2,16). In the course of this work, longitudinal fractures were noted through Stone 58. After reerection, to conserve the integrity of the upright, three horizontal holes were drilled through the full thickness of the stone by Van Moppes (Diamond Tools) Ltd. of Basingstoke (UK). Metal ties were inserted into these holes and secured using recessed metal bolt heads, with the holes at the surface of the upright filled using plugs of sarsen.

The drill cores from Stone 58 were assumed "lost." However, in 2018, one complete (1.08 m long, 25-mm diameter) but fragmented core was returned to the United Kingdom from the United States by Robert Phillips, a former employee of Van Moppes who was on-site during the drilling operations. Following publicity generated by the return of this core (referred to here as the "Phillips' Core"), a 0.18-m section of a second core was located at the Salisbury Museum in 2019. The whereabouts of the third core and the remainder of the second core are currently unknown.

With permission from English Heritage, a 67-mm-long section of the Phillips' Core (from between 0.29 and 0.36 m along the core length) was sampled. This involved cutting the core fragment in half lengthways, with one semicylinder retained by English Heritage and the other cut into three equal-sized samples for petrological, mineralogical, and geochemical investigations; these included high-resolution whole-rock ICP-MS and ICP-AES analyses (see Materials and Methods; full dataset is provided in data file S1).

The statistical results in Fig. 2 indicate that Stone 58 falls near the centers of the main clusters identified by both LDA and BPCA

Downloaded from http://advances.sciencemag.org/ on July 29, 2020

analyses. By inference, the ICP-MS/-AES data from this stone can therefore be considered as chemically representative of the majority of sarsens at Stonehenge. Under standard major element rock classification schemes (*26*), the Phillips' Core samples would be considered as quartz arenites. The ICP-MS/-AES data show that Stone 58 is silica rich [$SiO_2 \geq 99.7$ weight % (wt %)], with very little variation in major element chemistry (0.05 to 0.06 wt % Al_2O_3, 0.01 wt % CaO, 0.09 to 0.12 wt % Fe_2O_3, and 0.06 wt % TiO_2). The remaining major element oxides (Na_2O, MgO, K_2O, MnO, and P_2O_5) are at or below instrumental detection limit (0.01 wt %) in each of the three samples. The consistency between the ICP-MS/-AES and PXRF major element data for Stone 58 is self-supporting.

Comparison of the chemistry of Stone 58 with potential source areas

Sarsen stone is not found as a continuous geological stratum in southern Britain. Rather, it most likely formed as patchy groundwater silcrete lenses within areas of sandy sediment (*23*) and, following erosion and local transport by geomorphological processes (*27*), now occurs as unevenly distributed scatters of boulders resting mainly on the Chalk (Fig. 1A) (*22*, *28*). The original thickness of each sarsen deposit is unknown. However, the dimensions of the largest megaliths at Stonehenge and Avebury (Fig. 1B) indicate that the thickness of some silcrete lenses must have exceeded 1.5 m (*14*). Similarly, little is known about the original extent of sarsen deposits. Prehistoric and later stoneworkers used sarsen for structures including prehistoric monuments, Roman villas, medieval churches, and farm buildings, and in road construction (*29*). The long-axis length of surviving boulders rarely exceeds 4.0 to 5.0 m (*22*), and none reaches the size of the Stonehenge megaliths.

Despite historical extraction, it is still possible to identify the most likely provenance of the sarsens at Stonehenge by using a geochemical fingerprinting approach to characterize the chemistry of remaining boulder scatters. Sarsens in southern Britain developed through the silicification of a range of sedimentary units (*22*), including various sandy Paleogene formations and, in Norfolk, the Cretaceous Greensand. These formations have been shown to exhibit distinctive and regionally variable heavy mineral assemblages [e.g., (*30*)]. By inference from silcrete provenancing studies in southern Africa (*20*, *21*) and Australia (*31*), this should mean that the remaining sarsens in different areas will exhibit different inherited heavy mineral assemblages and, hence, different chemistries.

To assess the chemical variability within British sarsens, we sampled boulders (with landowner permission) in 20 representative areas of sarsen concentration. This included sites from Devon in the west to Norfolk in the east (Fig. 1 and table S2). Areas dominated by conglomeratic silcrete (locally called "puddingstone") were not sampled, as this material is not present at Stonehenge. Greatest attention was paid to Wiltshire, with six areas sampled in the Marlborough Downs alone; these include three on the highest points of the Downs (sites 1, 2, and 6 in Fig. 1B) and three lower-lying "sarsen trains" within chalk dry valleys (sites 3 to 5). Stones at each site were selected at random, and three ~100-g samples of sarsen were collected using a geological hammer and chisel. Each of these samples was analyzed by ICP-MS/-AES using the same analytical protocol as applied to the Phillips' Core samples from Stonehenge (see data file S1 for full dataset).

Like the Phillips' Core samples, the geochemistry of the sarsens in different areas of Britain is dominated by silica and therefore records very little variability in the major elements. However, differences in trace element geochemistry, controlled by the nonquartz mineralogy of the stone, can be identified. To quantify these differences, we calculated Zr-normalized trace element ratios to produce geochemical signatures for each of the 20 sarsen sampling areas (see Materials and Methods). Data for individual trace elements were used only if that element (i) is normally immobile in near-surface weathering environments (*32*, *33*), (ii) was measured with an instrumental precision of 1 part per million (ppm) or better, and (iii) was recorded at or above detection limits in at least two of the three analyses per site. The resulting signatures (Fig. 3) reflect both within-site chemical variability and instrumental uncertainty.

To determine the most likely source area for Stone 58 (and hence the majority of the Stonehenge sarsens), we compared the median immobile trace element signature for the Phillips' Core with the 20 site-specific geochemical signatures (Fig. 3). In semianalogous geochemical studies [e.g., (*34*)], the typical approach used to "match" chemical fingerprints relies on simple visual comparison of the shape of the trace element signatures of potentially cogenetic rocks to prove provenance. In the case of Stonehenge, such a simple comparison is insufficient, given the subtle differences in trace element chemistry between some of the potential source areas.

For there to be a permissible match between the immobile trace element signature for Stone 58 and a potential source area, we argue that all the trace element ratios for the Phillips' Core must lie within the limits of instrumental uncertainty of that area. As shown in Fig. 3, the geochemical signature for the Phillips' Core exhibits a poor match for all sites beyond the Marlborough Downs (sites 7 to 20 on Fig. 1), with disparities evident for two or more of the 21 trace element ratios calculated for each site. It is therefore highly unlikely that Stone 58 was sourced from these areas. On the same basis, we can discount five of the six sampling localities within the Marlborough Downs (sites 1 to 5) as potential sources; this includes Piggledene, identified previously as an unlikely source region on the basis of heavy mineral analyses (*11*).

The remaining site, West Woods, in the southeast Marlborough Downs, yields permissible matches for all median immobile trace element ratios from the Phillips' Core; this includes Pr/Zr, U/Zr, and La/Zr, which fall within instrumental uncertainty. We can therefore conclude that, based on our data, Stone 58 and, hence, the majority of the sarsens used to construct Stonehenge were most likely sourced from the vicinity of West Woods. Archaeological investigations and further detailed sampling of sarsens from West Woods and surrounding areas are now required to more tightly constrain the precise source area(s) and identify prehistoric sarsen extraction pits.

DISCUSSION

Overlooking the Kennet Valley to the north, West Woods covers a ~6-km^2 area and comprises a plateau rising to 220 m above sea level that is dissected by two narrow valleys. The area once contained a dense concentration of sarsens, including a sarsen train mapped by the Ordnance Survey as recently as 1924. Most of the stones were broken up and removed from the mid-19th century onward. However, many large boulders remain, both in valleys and on high ground, and sarsen extraction pits are common, particularly in the northern woodland (*35*, *36*). West Woods lies within a concentration of Early Neolithic activity, being close to Avebury, numerous long barrows, and the causewayed enclosure at Knap Hill (*37*).

Downloaded from http://advances.sciencemag.org/ on July 29, 2020

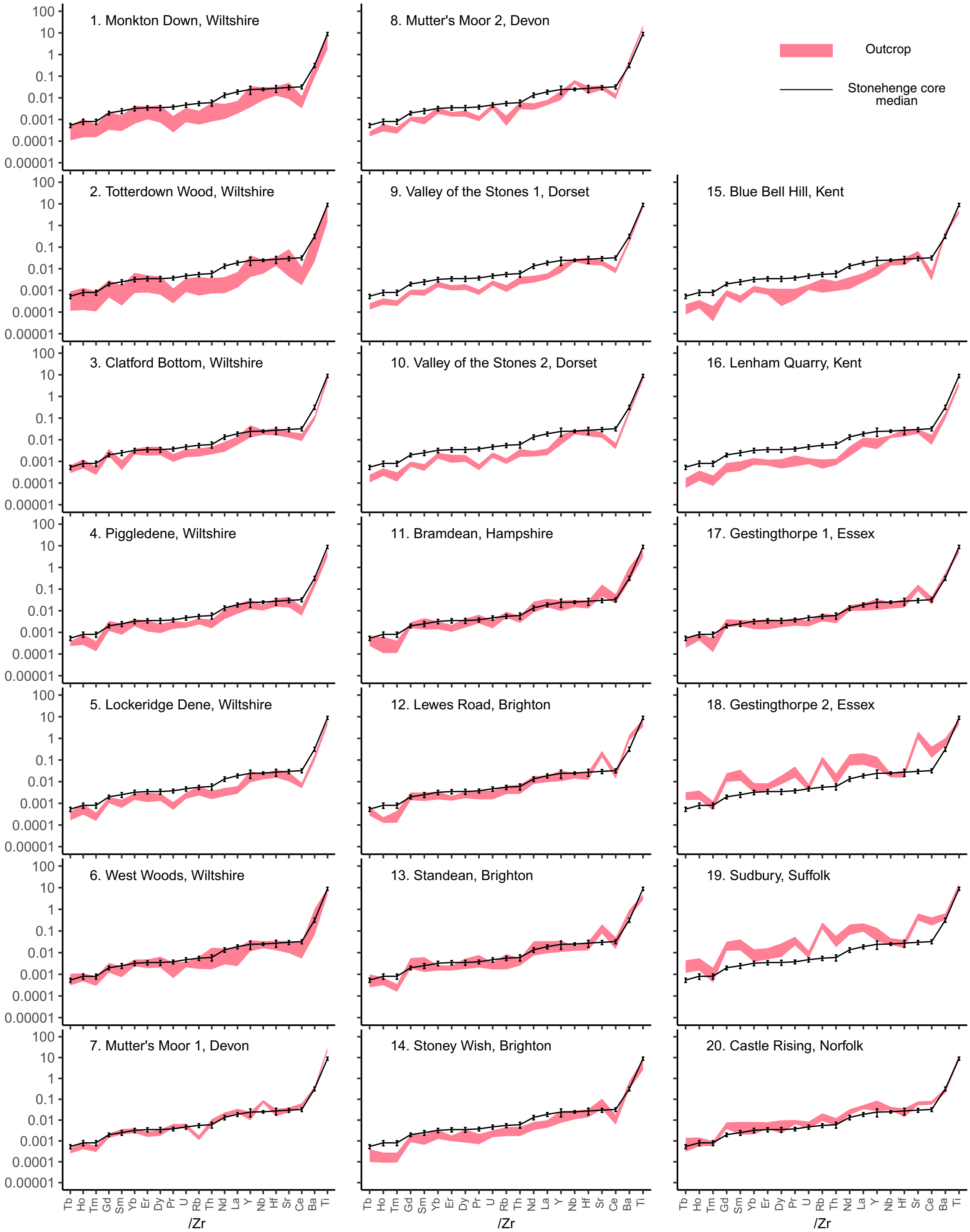


Fig. 3. Zr-normalized immobile trace element ratio data for 20 sarsen localities across southern Britain and the Phillips' Core from Stone 58 at Stonehenge. Data ranges for each of the sarsen localities are indicated by the pink shaded region on each plot. The upper (lower) boundary for each area is defined by the maximum (minimum) Zr-normalized ratio calculated for each element plus (minus) 3 SD of instrumental uncertainty. The solid black line is the median value for each Zr-normalized ratio from the three analyses of the Phillips' Core. The maximum (minimum) error bars represent plus (minus) 3 SD of instrumental uncertainty.

Downloaded from http://advances.sciencemag.org/ on July 29, 2020

Evidence of Mesolithic through Iron Age occupation has been recorded in the area, including a 40-m-long Early Neolithic chambered long barrow, sarsen standing stones, a sarsen *polissoir* used to sharpen stone axes, and prehistoric fields where now-wooded ground was previously open, cultivated land (*36*, *38*, *39*).

Why, in a region with the greatest density of extant sarsen stones in Britain (Fig. 1A), West Woods was selected as the primary source for the Stonehenge sarsens is unclear. Its significance most likely derives from the size and quality of the stones present there, making the area an important location for Neolithic people (*37*). Its topographic position on high ground south of the Kennet and its relative proximity to Salisbury Plain would also have made it an efficient place from which to obtain the sarsens. West Woods is located ~3 km south of the area where the majority of antiquaries and archaeologists have looked for Stonehenge's sarsen quarries [e.g., (*14*, *40*)] and, thus, lies slightly closer to the monument at ~25 km in a direct line. Only the antiquary John Aubrey had previously postulated a link between "Overton Wood," probably a former name of West Woods, and Stonehenge (*41*).

The identification of a single source area for the majority of the sarsens at Stonehenge and the chemical consistency across the different structural components of the monument support previous suggestions that the stones were all erected at much the same time [around 2500 BCE, during the monument's second stage of construction; (*13*)]. It had been proposed, based on its large size and undressed nature, that the Heel Stone (Stone 96) was a natural sarsen from the immediate vicinity of Stonehenge that was erected early in the history of the monument (*13*). Our PXRF data, however, show that Stone 96 has a similar chemical composition to most other sarsens at Stonehenge, which suggests that it, too, was brought from West Woods.

Our results further help to constrain the most likely route along which the sarsens were transported to Stonehenge. Atkinson (*42*) chose a route that headed southwest from a source area near Avebury and then south toward Salisbury Plain, while Hill (*5*) proposed an alternative route along the River Avon (Fig. 1B). A more recent reappraisal (*43*) used an origin north of the River Kennet, a crossing of the river at Clatford, and then a journey northwest of West Woods, down into the Vale of Pewsey beside Knap Hill, across the River Avon at Marden and then southward to climb the scarp slope of Salisbury Plain at its most gentle incline. Atkinson's route can now be dismissed. However, as our sarsen samples were collected from the western side of West Woods, a route from West Woods via Knap Hill could be appropriate (Fig. 1B). If stones were also sourced from the eastern woods, then an alternative route might run 2 km to the east, along what is now the White Horse Trail, dropping down to the Vale of Pewsey, and then along the River Avon close to Hill's proposed route.

Why Stones 26 and 160 were obtained from different source areas from the other sarsens at Stonehenge is intriguing. Both lie at the northernmost points of their respective arrays: Stone 26 is the northernmost upright of the Sarsen Circle, and Stone 160 the lintel of the northernmost trilithon. While this could be coincidental, one possibility is that their presence marks out the work of different builder communities who chose to source their materials from a different part of the landscape. A similar theory has been proposed for the digging of separate segments of the surrounding ditch at Stonehenge (*43*). We cannot discount the possibility that Stones 26 and 160 were sourced relatively close to the monument site. However, ICP-MS/-AES analyses from these stones and sarsen samples from locations closer to Stonehenge are required to confirm or refute this. It is possible that some of the ~28 stones missing from the Sarsen Circle and peripheral settings were also derived from these different source areas, but we will probably never know.

MATERIALS AND METHODS

Method used for PXRF analysis

PXRF analyses of each of the 52 extant sarsen stones at Stonehenge were undertaken using an Olympus Innov-X Delta Professional Portable XRF device. The model operates at 40 kV, is equipped with an Rh anode 4-W x-ray tube, and uses a Silicon Drift Detector. The "Geochem" mode, which captures Mg, Al, Si, P, S, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Rb, Sr., Y, Zr, Nb, Mo, Ag, Cd, Sn, Sb, W, Hg, Pb, Bi, U, and Th, was used for all analyses. The instrument has a detector window approximately 20 mm in diameter, while the x-ray source excites a target circle with a 3-mm diameter.

PXRF analyses of standing and fallen sarsen uprights and fallen lintel stones (see Fig. 1D) were undertaken by authors D.J.N. and T.J.R.C. from ground level. Analyses of the nine in situ sarsen lintel stones were undertaken by T.J.R.C. from a mobile scaffold tower provided courtesy of English Heritage. Five points that were as flat as possible and free of lichen cover were selected on the surface of each sarsen stone. Each point was analyzed for 120 s of total exposure. The device was positioned such that the PXRF detector window was completely covered by the stone. At the start/end of analyses and after every 15 analyses (i.e., three stones), a calibration check was made against a 316 Stainless Steel Calibration Check Reference Coin to ensure accuracy and consistency of the results. All data were processed in Microsoft Excel. The full PXRF dataset for this investigation is available in Worksheet 1 of data file S1.

Method used for ICP-MS and ICP-AES analyses

Three subsamples of sarsen from the Phillips' Core plus three samples from each of the 20 sarsen localities across southern Britain (Fig. 1) were processed and analyzed by ALS Minerals (Seville, Spain). Any weathered outer surface material present on the 20 field samples was removed using a rock saw before dispatch to Spain. In Spain, each sample/subsample was first crushed using a hardened steel jaw crusher such that >70% of the resulting fragments passed through a 2-mm screen size (ALS Geochemistry preparation package CRU-31). The crushed samples were then powdered in an agate ball mill such that >85% passed a 75-μm screen size (ALS Geochemistry package PUL-42). Major and minor oxides were analyzed by lithium metaborate fusion digestion and ICP-AES (ALS Geochemistry method ME-ICP06). Trace elements, including rare earth elements, were determined using lithium metaborate fusion digestion and ICP-MS (ALS Geochemistry method ME-MS81). As, Bi, Hg, In, Re, Sb, Se, and Te were determined by aqua regia digestion, followed by ICP-MS (ALS Geochemistry method ME-MS42). Ag, Cd, Co, Cu, Li, Mo, Ni, Pb, Sc, and Zn were determined by four-acid digestion and ICP-AES (ALS Geochemistry method ME-4ACD81).

In all cases, ICP-MS analyses were conducted using an Elan 9000 instrument and ICP-AES analyses using a Varian 700 Series instrument. Total C and S were analyzed by Leco induction furnace and Leco sulfur analyzer (ALS Geochemistry methods C-IR07 and S-IR08, respectively). Loss on ignition (LOI) was calculated following ignition of sample powders at 1000°C (ALS Geochemistry method

Downloaded from http://advances.sciencemag.org/ on July 29, 2020

OA-GRA05). The full ICP-MS and ICP-AES data for this investigation, including Certified Reference Materials (CRMs) and blank and repeat analyses, are available in Worksheets 2 and 3 of data file S1.

Generation of Zr-normalized trace element ratios from ICP-MS/-AES data

To generate the geochemical signatures presented in Fig. 3, we use ICP-MS/-AES data only for trace elements that (i) are normally immobile in near-surface weathering environments, (ii) were measured with an instrumental precision of 1 ppm or better, and (iii) were recorded at or above detection limits in at least two of the three analyses per site. These trace elements are Ba, Ce, Dy, Er, Gd, Hf, Ho, La, Nb, Nd, Pr, Rb, Sm, Sr, Tb, Th, Ti, Tm, U, Y, and Yb.

For all samples, the concentrations (ppm) of the listed elements were each divided by the concentration (ppm) of Zr for the same sample to yield a set of unitless Zr-normalized trace element ratios. The Zr-normalized trace element ratios for the three samples from each site define maximum, median, and minimum values for that site. An equivalent set of Zr-normalized trace element ratios was calculated for the three samples from the Phillips' Core (SHCORE1 to 3), with the median values used to define the solid black line in Fig. 3.

During the acquisition of geochemical data, four separate CRMs were analyzed by ALS Minerals in the sample batch pursuant to the ICP-MS and ICP-AES data presented here. The GRE-3 and SY-4 CRMs were analyzed twice each, while OREAS-122 and REE-1 were both analyzed five times. The results of these 14 CRM analyses and the published values for the four CRMs are shown in Worksheet 3 of data file S1.

The differences between the published CRM values and our 14 CRM analyses were used to plot the *y* axis error bars for the Phillips' Core and define the compositional range for each of the 20 sarsen sampling areas shown in Fig. 3. To do this, the percentage difference in trace element concentration between the published values and our analyses was calculated for each CRM to give a measure of analytical uncertainty (%) for each element. We then summed the analytical uncertainty (%) for each element and the analytical uncertainty (%) for Zr to give the analytical uncertainty (%) for each Zr-normalized trace element ratio. The SD (σ) in analytical uncertainty (%) for each Zr-normalized trace element ratio was then calculated from the resulting data. To define the maximum (minimum) errors bars for the Phillips' Core, three times this percentage value was added to (subtracted from) each median Zr-normalized trace element ratio. To define the compositional range for each of the 20 sarsen sampling areas, three times this percentage value was added to (subtracted from) the maximum (minimum) Zr-normalized trace element ratio derived for each site. The resulting values define the upper and lower boundaries for the shaded regions for each site shown in Fig. 3. The full workings for the derivation of analytical uncertainty are shown in Worksheet 4 of data file S1.

Statistical analysis

Both LDA and BPCA are commonly used dimensionality reduction techniques. These techniques were applied to 250 of the 260 individual PXRF readings from Stonehenge. Ten readings were excluded as they contained anomalously low (<75%) Si once the PXRF data had been normalized to 100% to remove the light element fraction (data file S1). Only the following 26 elements from the PXRF dataset were included in the statistical analyses: Mg, Al, P, S, K, Ti, V, Cr, Mn, Ni, Cu, Zn, As, Rb, Sr, Y, Zr, Nb, Mo, Ag, W, Hg, Pb, Bi, Th, and U. Where any element was recorded at below detection limits ("ND" in data file S1), it was treated as an unknown value. Si, Ca, and Fe were excluded to avoid potential anomalies caused by the introduction of iron and replacement of Si by Ca during late-stage diagenesis and subaerial weathering. Co, Cd, Se, Sb, and Sn were below detection limits in all PXRF readings; as such, these elements cannot be used as discriminatory variables and were also excluded.

LDA was applied to the PXRF dataset using the R statistical suite (*44*) and specifically the default lda() function. For the analysis, PXRF readings were grouped by stone. Eighty percent of the dataset was used for training. Results are presented in Fig. 2A. While showing clear clustering, the LDA model has limited interpretational value, as the first two discriminant functions combined explain <60% of the variance in the dataset. As such, no further breakdown of LDA results is presented.

BPCA was applied to the PXRF dataset using the pcaMethods R package (*45*). BPCA was selected over standard PCA on the basis that the technique can handle >10% of unknown values in a dataset; the pcaMethods R package was specifically developed for treating incomplete datasets. The results of BPCA (Fig. 2B) explain 95% of the dataset between the first two principal components. The covariance between the first six principal components is shown in fig. S1, and the element loadings for each of these principal components are shown in table S2. BPCA performs an automated calculation for dimensionality.

SUPPLEMENTARY MATERIALS

Supplementary material for this article is available at http://advances.sciencemag.org/cgi/content/full/6/30/eabc0133/DC1

REFERENCES AND NOTES

1. W. Lambarde, *Dictionarium Angliae Topographicum et Historicum: An Alphabetical Description of the Chief Places in England and Wales; with an Account of the Most Memorable Events Which Have Distinguish'd Them* (F. Gyles, London, 1730).
2. W. Stukeley, *Stonehenge a Temple Restr'd to the British Druids* (W. Innys and R. Manby, London, 1740).
3. W. Gowland, J. W. Judd, III.—Recent excavations at Stonehenge. *Archaeologia* **58**, 37–118 (1902).
4. H. H. Thomas, The source of the stones of Stonehenge. *Antiquaries J.* **3**, 239–260 (1923).
5. P. A. Hill, The sarsens of Stonehenge: The problem of their transportation. *Geogr. J.* **127**, 488–492 (1961).
6. G. A. Kellaway, Glaciation and the stones of Stonehenge. *Nature* **232**, 30–35 (1971).
7. R. E. Bevins, R. A. Ixer, N. J. G. Pearce, Carn Goedog is the likely major source of Stonehenge doleritic bluestones: Evidence based on compatible element geochemistry and Principal Component Analysis. *J. Arch. Sci.* **42**, 179–193 (2014).
8. T. Darvill, G. Wainwright, Beyond Stonehenge: Carn Menyn Quarry and the origin and date of bluestone extraction in the Preseli Hills of south-west Wales. *Antiquity* **88**, 1099–1114 (2014).
9. M. Parker Pearson, J. Pollard, C. Richards, K. Welham, C. Casswell, C. French, D. Schlee, D. Shaw, E. Simmons, A. Stanford, R. E. Bevins, R. A. Ixer, Megalith quarries for Stonehenge's bluestones. *Antiquity* **93**, 45–62 (2019).
10. R. Ixer, R. Bevins, D. Pirrie, P. Turner, M. Power, No provenance is better than wrong provenance: Milford Haven and the Stonehenge sandstones. *Wilts. Arch. Nat. Hist. Soc. Mag.* **113**, 1–15 (2020).
11. H. Howard, A petrological study of the rock specimens from excavations at Stonehenge, 1979–1980, in On the road to Stonehenge: Report on the investigations beside the A344 in 1968, 1979 and 1980, by M.W. Pitts. *Proc. Prehist. Soc.* **48**, 104–124 (1982).
12. D. J. Nash, J. S. Ullyott, Silcrete, in *Geochemical Sediments and Landscapes*, D. J. Nash, S. J. McLaren, Eds. (Blackwell, Oxford, 2007), pp. 95–143.
13. T. Darvill, P. Marshall, M. Parker Pearson, G. Wainwright, Stonehenge remodelled. *Antiquity* **86**, 1021–1040 (2012).
14. M. Parker Pearson, The sarsen stones of Stonehenge. *Proc. Geol. Assoc.* **127**, 363–369 (2016).
15. M. Abbott, H. Anderson-Whymark, *Stonehenge Laser Scan: Archaeological Analysis Report* (English Heritage Research Report 32-2012, Swindon, 2012).

Downloaded from http://advances.sciencemag.org/ on July 29, 2020

16. H. C. Bowen, I. F. Smith, Sarsen stones in Wessex: The society's first investigations in the evolution of the landscape project. *Antiquaries J.* **57**, 185–196 (1977).
17. C. P. Green, The provenance of rocks used in the construction of Stonehenge. *Proc. Brit. Acad.* **92**, 257–270 (1997).
18. J. M. D. Day, Determining the source of silcrete sarsen stones. *J. Arch. Sci. Rep.* **28**, 102051 (2019).
19. K. A. Whitaker, What if none of the building stones at Stonehenge came from Wiltshire? *Oxford J. Arch.* **38**, 148–163 (2019).
20. D. J. Nash, S. Coulson, S. Staurset, J. S. Ullyott, M. Babutsi, L. Hopkinson, M. P. Smith, Provenancing of silcrete raw materials indicates long-distance transport to Tsodilo Hills, Botswana, during the Middle Stone Age. *J. Hum. Evol.* **64**, 280–288 (2013).
21. D. J. Nash, S. Coulson, S. Staurset, J. S. Ullyott, M. Babutsi, M. P. Smith, Going the distance: Mapping mobility in the Kalahari Desert during the Middle Stone Age through multi-site geochemical provenancing of silcrete artefacts. *J. Hum. Evol.* **96**, 113–133 (2016).
22. M. A. Summerfield, A. S. Goudie, The sarsens of southern England: their palaeoenvironmental interpretation with reference to other silcretes, in *The Shaping of Southern England*, D. K. C. Jones, Ed. (Academic Press, London, 1980), pp. 71–100.
23. J. S. Ullyott, D. J. Nash, Micromorphology and geochemistry of groundwater silcretes in the eastern South Downs, UK. *Sedimentology* **53**, 387–412 (2006).
24. M. A. Summerfield, Origin and palaeoenvironmental interpretation of sarsens. *Nature* **281**, 137–139 (1979).
25. C. M. Bishop, Bayesian PCA, in *Advances in Neural Information Processing Systems 11 (NIPS 1998)*, M. J. Kearns, S. A. Solla, D. A. Cohn, Eds. (1998), pp. 382–388.
26. M. M. Herron, Geochemical classification of terrigenous sands and shales from core or log data. *J. Sed. Res.* **58**, 820–829 (1988).
27. R. J. Small, M. J. Clark, J. Lewin, The periglacial rock-stream at Clatford Bottom, Marlborough Downs, Wiltshire. *Proc. Geol. Assoc.* **81**, 87–98 (1970).
28. J. S. Ullyott, D. J. Nash, C. A. Whiteman, R. N. Mortimore, Distribution, petrology and mode of development of silcretes (sarsens and puddingstones) on the eastern South Downs, UK. *Earth Surf. Proc. Landf.* **29**, 1509–1539 (2004).
29. N. E. King, The Kennet Valley sarsen industry. *Wilts. Arch. Nat. Hist. Mag.* **63**, 83–93 (1968).
30. A. C. Morton, The provenance and diagenesis of Palaeogene sandstones of southeast England as indicated by heavy mineral analysis. *Proc. Geol. Assoc.* **93**, 263–274 (1982).
31. G. W. G. Cochrane, J. A. Webb, T. Doelman, P. J. Habgood, Elemental differences: Geochemical identification of aboriginal silcrete sources in the Arcadia Valley, eastern Australia. *J. Arch. Sci. Rep.* **15**, 570–577 (2017).
32. J. J. Middelburg, C. H. van der Weijden, J. R. W. Woittiez, Chemical processes affecting the mobility of major, minor and trace elements during weathering of granitic rocks. *Chem. Geol.* **68**, 253–273 (1988).
33. J. A. Pearce, A user's guide to basalt discrimination diagrams, in *Trace Element Geochemistry of Volcanic Rocks: Appliction for Massive Sulphide Exploration*, D. Wyman, Ed. (Geological Association of Canada, Mineral Deposits Division, Winnipeg, 1996), pp. 79–113.
34. R. E. Ernst, W. Bleeker, U. Söderlund, A. C. Kerr, Large Igneous Provinces and supercontinents: Toward completing the plate tectonic revolution. *Lithos* **174**, 1–14 (2013).
35. K. A. Whitaker, Sarsen stone quarrying in southern England: An introduction, in *Mining and Quarrying in Neolithic Europe: A Social Perspective,* A. Teather, P. Topping, J. Baczkowski, Eds. (Neolithic Study Group Seminar Papers 16, Oxbow Books, Oxford, 2019), pp. 101–113.
36. L. Amadio, *West Woods, Wiltshire: An Archaeological Survey* (Wiltshire Archaeological and Natural History Society, Devizes, 2011); https://wiltshireafg.weebly.com/uploads/1/5/5/1/15516698/167-0304-1_west_woods.pdf.
37. M. Gillings, J. Pollard, Making megaliths: Shifting and unstable stones in the Neolithic of the Avebury landscape. *Camb. Arch. J.* **26**, 537–559 (2016).
38. A. D. Passmore, Chambered long barrow in West Woods. *Wilts. Arch. Nat. Hist. Mag.* **42**, 49–51 (1923).
39. P. J. Fowler, *Landscape plotted and pieced. Landscape history and local archaeology in Fyfield and Overton, Wiltshire* (Society of Antiquaries of London, London, 2000).
40. T. Darvill, *Stonehenge: The Biography of a Landscape* (Tempus, Stroud, 2006).
41. J. Aubrey, *The Natural History of Wiltshire* (Wiltshire Topographical Society, London, 1847).
42. R. J. Atkinson, *Stonehenge* (Hamish Hamilton, London, 1956).
43. M. Parker Pearson, *Stonehenge: Exploring the Greatest Stone Age Mystery* (Simon and Schuster, London, 2013).
44. R Core Team, *R: A Language and Environment for Statistical Computing* (R Foundation for Statistical Computing, Vienna, Austria, 2013); www.R-project.org/.
45. W. Stacklies, H. Redestig, M. Scholz, D. Walther, J. Selbig, pcaMethods—A bioconductor package providing PCA methods for incomplete data. *Bioinformatics* **23**, 1164–1167 (2007).
46. H. C. Brentnall, Sarsens. *Wilts. Arch. Nat. Hist. Mag.* **51**, 419–439 (1946).
47. D. K. C. Jones, Evolving models of the Tertiary evolutionary geomorphology of southern England, with special reference to the chalklands in *Uplift, Erosion and Stability, Special Publication 162*, W. B. Whalley, B. J. Smith, M. Widdowson, Eds. (Geological Society, London, 1999), pp. 1–24.

Acknowledgments: We would like to thank the following: H. Sebire (English Heritage) for authorizing site access to Stonehenge; landowners, including the National Trust and Forestry Commission, for permission to sample individual sarsen localities; M. Allfrey (English Heritage) for permission to sample the core from Stone 58; J. Shaw and R. Turley (University of Bristol) for subsampling the core from Stone 58; M. Higgins (Open University) for sample preparation; and ALS Minerals (Seville, Spain) for ICP-MS/-AES characterization of sarsen samples. **Funding:** Fieldwork and analyses were supported by the British Academy/Leverhulme Trust Small Research Grant SG170610—"Geochemical fingerprinting the sarsen stones at Stonehenge." **Author contributions:** Conceptualization and funding acquisition—D.J.N., T.J.R.C., J.S.U., M.P.P., and T.D.; methodology and validation—D.J.N., T.J.R.C., G.M., and S.G.; investigation—D.J.N., T.J.R.C., J.S.U., G.M., S.G., K.A.W.; statistical analysis—G.M. and D.J.N.; other formal analysis—all authors; writing (original draft)—D.J.N., T.J.R.C., G.M., M.P.P., T.D., S.G., K.A.W.; writing (review and editing)—all authors; project administration and data curation—D.J.N. **Competing interests:** The authors declare that they have no competing interests. **Data and materials availability:** All data needed to evaluate the conclusions in the paper are present in the paper and/or the Supplementary Materials.

Submitted 1 April 2020
Accepted 10 June 2020
Published 29 July 2020
10.1126/sciadv.abc0133

Citation: D. J. Nash, T. J. R. Ciborowski, J. S. Ullyott, M. P. Pearson, T. Darvill, S. Greaney, G. Maniatis, K. A. Whitaker, Origins of the sarsen megaliths at Stonehenge. *Sci. Adv.* **6**, eabc0133 (2020).

Downloaded from http://advances.sciencemag.org/ on July 29, 2020

Science Advances

Origins of the sarsen megaliths at Stonehenge

David J. Nash, T. Jake R. Ciborowski, J. Stewart Ullyott, Mike Parker Pearson, Timothy Darvill, Susan Greaney, Georgios Maniatis and Katy A. Whitaker

Sci Adv **6** (31), eabc0133.
DOI: 10.1126/sciadv.abc0133

ARTICLE TOOLS	http://advances.sciencemag.org/content/6/31/eabc0133
SUPPLEMENTARY MATERIALS	http://advances.sciencemag.org/content/suppl/2020/07/27/6.31.eabc0133.DC1
REFERENCES	This article cites 31 articles, 1 of which you can access for free http://advances.sciencemag.org/content/6/31/eabc0133#BIBL
PERMISSIONS	http://www.sciencemag.org/help/reprints-and-permissions

Downloaded from http://advances.sciencemag.org/ on July 29, 2020

Use of this article is subject to the Terms of Service

Science Advances (ISSN 2375-2548) is published by the American Association for the Advancement of Science, 1200 New York Avenue NW, Washington, DC 20005. The title *Science Advances* is a registered trademark of AAAS.

Copyright © 2020 The Authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original U.S. Government Works. Distributed under a Creative Commons Attribution NonCommercial License 4.0 (CC BY-NC).

Foreword, paper 4

Whitaker, K. A. 2019. Sarsen stone quarrying in southern England. An Introduction. In A. Teather, P. Topping and J. Baczkowski (eds), *Mining and Quarrying in Neolithic Europe. A Social Perspective*, 101-113. Oxford: Neolithic Studies Group Papers 16

Cited by: 1

Sarsen stone is most generally visible in the remaining spreads of boulders in places like Dorset's Valley of Stones and the wood-pasture of Ashdown House, Oxfordshire, as well as on Wiltshire's Marlborough Downs. These are places for visitors to enjoy and they feature in advertising aiming to attract people to the peaceful countryside, like the North Wessex Downs and Dorset Areas of Outstanding Natural Beauty. Both surface sarsens and invisible boulders buried in superficial deposits require extraction, however, activities that have left distinct archaeological traces depending on the quarrying methods that had been used. Across these beautiful but formerly industrial landscapes, episodes of sarsen exploitation include the unexpected: in May 1874, John Downie of the British Dynamite Company demonstrated his wares by demolishing tree stumps and sarsen boulders in Great Lodge Bottom, Savernake (near Marlborough, Wiltshire). He applied six cartridges of explosives to a three-ton sarsen, breaking it in two and 'hurling fragments high over the trees' some 120 yards into the sheltering spectators (*Wiltshire Independent* 28 May 1874, 4). Downie died ten months later in an explosives accident, trying to prevent a disaster (*Engineering* 1875, 346).

The significance of this story, and other examples of dynamiting sarsens, lies in highlighting the variety of techniques through which people have engaged with sarsen stone. Wherever it has been exploited in prehistory, people have gone on over the years to take it for road metal, construction material and to clear fields. Sarsen extraction and splitting was not limited to the traditional fire-setting techniques described in Wiltshire by John Aubrey (Britton 1847) and William Stukeley (1740-3) that so stimulate the imagination as to dominate accounts of pre-modern sarsen exploitation (as outlined for example by Geddes 2000). Gillings *et al*. (2008) show how those methods were in fact varied. Neither was post-medieval sarsen cutting as described by Free (1950) and King (1968) a uniform 'black box' technology. How can prehistoric use of this material be approached archaeologically, without considering the time-depth and variety of this sarsen 'quarry'?

The following paper is a chapter in an edited volume arising from the 2017 Neolithic Studies Group meeting. Responding to the call for papers *Extracting more than rock? Insights into the acquisition of stone and flint in the Neolithic*, I was concerned to discuss the concept of signatures of sarsen extraction, yet felt like an interloper – apart from the work of Gillings and Pollard (2016) in the West Kennet Avenue (Avebury, Wiltshire) I was introducing the delegates to predominantly historical archaeology and ethnohistory. The purpose of the paper in this thesis is two-fold: first, to emphasise the problems that I touched on in the foreword to the previous paper in identifying prehistoric sarsen extraction; second, to provide a general summary of the variety of historical sarsen exploitation prior to the detailed fieldwork at quarry sites presented in the fifth paper. In anticipation of that work, the following paper dwells on the importance of multi-scalar research that intertwines numerous sources in order to attend to surface stone quarrying.

The current Research Framework and Agenda for quarrying and mining in England (Newman 2016) draws attention to the paucity of research into surface extraction sites of all periods and materials. The wider significance of the following paper, with the fifth paper, lies in the attention it draws to aspects of extraction in locations not well-known for hard-stone industry. It tackles head-on the problem that 'field evidence [is] perceived as not sufficiently interesting or inspiring to motivate investigation' (Thomas 2016, 74). In doing so, it begins to address, for sarsen stone, numerous Research Aims laid out in the Framework. I elaborate on those aims in the foreword to the fifth paper.

The work underpinning this fourth and the fifth paper in this thesis enabled me to broaden my thoughts about industrial landscapes from a focus on sarsen stone exploitation to the place of former bulk mineral and other industries in rural environments. Coloured by much that I had learnt whilst working on the first paper presented here, especially responding to Matthew Johnson's (2007) *Ideas of Landscape*, I took some time to consider that the focus of my archive research and my fieldwork locations were all in Areas of Outstanding Natural Beauty (AONB). This resulted in presenting two (unpublished) conference papers.

The first, part of Mike Nevell's 2018 TAG session *Steaming Plant or Steam Punk? Researching Industrial Archaeology and Heritage in the 21st Century* is titled *'Belford's Divergence': or, is industrial archaeology relevant in an AONB?* (Fig. 1). Mike's call for papers encouraged challenges to traditional approaches to industrial archaeology, echoing themes in an important edited volume in which Paul Belford (2009) had expressed concerns about how English industrial landscapes were being addressed. In contrasting the role of industrial archaeology in the management plans for the Chilterns and the North Wessex Downs AONBs, I agreed with Paul and concluded that in some areas industrial heritage was being minimised by a concept of landscape that obscures the motivations of past human interactions with place. The second paper was co-authored with Coralie Aitcheson, whose doctoral research at the University of Birmingham focused on visitor relationships with heritage and the ‘natural’ environment presented at the Ironbridge World Heritage Site. Titled *Rural Landscapes, Industrial Pasts* and presented at the Landscape Survey Group meeting held in 2019, we were answering the conference call to contrast past landscape use with present-day landscape management. We brought together our research in rural industrial landscapes that are now protected through World Heritage Site (WHS) and AONB designations, exploring how modern management is underpinned by the ways that industry and ruralness are imagined. We concluded that WHS ‘universal value’ – the reasons why these places matter to everyone – is overshadowed by ‘outstanding value’ (the Wow! factor), consequently diminishing routes to a more holistic vision of the past. These are topics to which I would like to return having concluded my doctoral work.

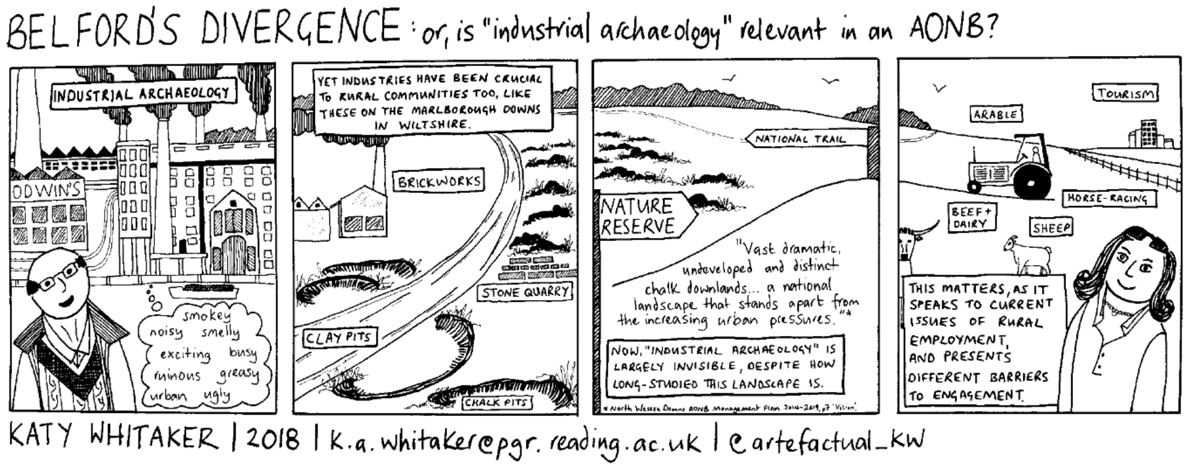


Figure 1 Visual abstract for the paper ‘Belford’s divergence: or, is industrial archaeology relevant in an AONB?’, presented at TAG in 2018.

References

Wiltshire Independent. 1874. District News. 28 May 1874, 4
Engineering. 1875. The Late Mr Downie, vol. 19, 346

Belford, P. 2009. English Industrial Landscapes – Divergence, Convergence and Perceptions of Identity. In A. Horning & M. Palmer (eds) *Crossing Paths or Sharing Tracks? Future directions in the archaeological study of post-1550 Britain and Ireland,* 179-194. Woodbridge: Boydell and Brewer

Britton, J. (ed.) 1847. *The Natural History of Wiltshire by John Aubrey F.R.S. written between 1656 and 1691.* Newton Abbot: David and Charles

Free, D. W. 1950. *Marlborough and District: An Original Peep Into the Past.* Marlborough: privately printed

Geddes, I. 2000. *Hidden Depths. Wiltshire's Geology and Landscapes.* Trowbridge: Ex Libris Press

Gillings, M. & Pollard, J. 2016. Making Megaliths: Shifting and Unstable Stones in the Neolithic of the Avebury Landscape. *Cambridge Archaeological Journal* 26, 1-23

Gillings, M., Pollard, J., Wheatley, D. & Peterson, R. 2008. *Landscape of the Megaliths. Excavation and fieldwork on the Avebury monuments, 1997-2003.* Oxford: Oxbow Books

Johnson, M. 2007. *Ideas of Landscape.* Oxford: Blackwell

King, N. E. 1968. The Kennet Valley Sarsen Industry. *Wiltshire Archaeological and Natural History Magazine* 63, 83-93

Newman, P. (ed.) 2016. *The Archaeology of Mining and Quarrying in England: A Research Framework.* Matlock: The National Association of Mining History Organisations

Stukeley, W. 1740-3. *Stonehenge: a temple restor'd to the British druids [and, Abury, a temple of the British druids]*. London: W. Innys and R. Manby

Thomas, I. 2016. Bulk Minerals. In P. Newman (ed.) *The Archaeology of Mining and Quarrying in England. A Research Framework for the Extractive Industries in England*, 33-83. Matlock: The National Association of Mining History Organisations

Whitaker, K. A. (2019) *Sarsen stone quarrying in southern England: an introduction.* In: Teather, A., Topping, P. and Baczkowski, J. (eds.) Mining an Quarrying in Neolithic Europe: A Social Perspective. Neolithic Studies Group Seminar Papers, 16. Oxbow Books. ISBN 9781789251487 doi: https://doi.org/10.2307/j.ctvkjb2v8

The published version of this chapter has been redacted from pp. 102-116 of the thesis as copyright permissions prohibit the published version from being archived in CentAUR. The accepted version of the full text is available on CentAUR at https://centaur.reading.ac.uk/90603/.

Foreword, paper 5

Whitaker, K.A. (in press). Sarsen stone quarrying in southern England. *Post-medieval Archaeology*

It can be difficult to attend to past stone-quarrying. A quarry is by necessity a destructive place, constantly destroying itself 'through fulfilment (and exhaustion) of its purpose. It is a place where there is nothing to see as such' (Bennett 2014, n.p.). Quarries and pits are often reclaimed, by people or by nature. How best to tackle sites returned to farmland or re-developed? Or ephemeral, shallow features scattered across the countryside, hollows and broken stone dotted over pasture and in woodland? These questions are addressed in the following paper, the purpose of which is to present the results of two lengthy episodes of gathering and analysing primary data in sarsen quarrying locations in Buckinghamshire and Wiltshire. The work was supported in the field by Elaine Jamieson and Krystyna Truscoe who made two analytical earthworks surveys possible using equipment loaned by the University of Reading Archaeology Department; and by members of Historic England's Aerial Investigation and Mapping team who coached me to improve my skills processing, interpreting and mapping archaeological features from air photograph and Lidar datasets. Two earthworks survey reports are deposited with Wiltshire HER (Appendix 2, 3) whilst the aerial survey dataset is part of Buckinghamshire HER.

Much post-medieval bulk minerals extraction is unrecorded in official sources because surface quarrying was largely unregulated. Until the (rather late) first Quarry Act of 1894, stone extraction was inspected under other statutory powers such as the Mines Act (1842), health and welfare regulations, and so on. Moreover, quarries under 20' deep (*c*. 7.5 m) were outside the purview of the 1894 Act. Even then, sarsen pits in Buckinghamshire that were excavated down to *c*. 15 m went unreported other than in exceptional circumstances: only the 1907 and 1908 Inspector's reports mention by name 591 and 570 tons of sarsen respectively (Stokes 1908, 37; 1909, 36). Property valuation summaries have proved similarly unhelpful so far. For example, no quarries are valued in the Marlborough Division (Wiltshire) or Desborough Division (Buckinghamshire) in the 1859-60 return on Property and Income Tax (House of Commons 1860), despite large quantities of sarsen being taken from land in those areas at that time. The single Buckinghamshire valuation that year likely relates to sand and gravel pits in Lambeth Group deposits around Coleshill; whilst the assessed Wiltshire quarries were working principally the stone slates and valuable freestones amongst Forest Marble, Corallian Rag and Great and Inferior Oolite formations (Table 1).

Nevertheless, other archive sources provide direct evidence or proxies for extraction locations, practices and outputs, some of which I draw together in the following paper.

County/parish	**£**
Buckinghamshire	
Coleshill	12
Wiltshire	
Fovant and Sutton Mandeville	4
North Bradley	7
Hilperton	8
West Harnham and Netherhampton	10
Luckington	10
Yatton Keynall	12
Swindon	14
Kington St Michael	17
Westwood and Iford	20
Warminster	24
Atworth and South Wraxell	29
Winsley and Simpley Stoke	30
Bradford Borough and Great Trowle	65
Calne	74
Tisbury, Chicksgrove, Hatch and Staple	122
Monkton Farleigh	203
Box	1,425
Corsham	2,703

Table 1 Gross annual value of quarries in Buckinghamshire and Wiltshire for the year ending 5 April 1860 (House of Commons 1860).

Taking a landscape perspective is key to addressing sarsen exploitation distributed across hillsides and valleys amongst remnant Tertiary deposits and later periglacial sediments. It was important for both the following and the last paper in this thesis to find ways to show where sarsen may be found over quite wide areas. In Buckinghamshire that is made possible by combining information from British Geological Survey (BGS) memoirs with a survey of Chiltern Hills silcrete carried out in 1951-2 (Davies and Baines 1953). That survey's 180 index cards are cared for by Buckinghamshire County Museum at its Resource Centre in Halton and I am grateful for access. The index cards are simple compared with the *Sarsen Stones in Wessex* survey 'Tally Cards', making data digitisation easier using my transcription methodology. For this project I digitised only the sarsen records, but my documentation including an ISAD(G)-compliant collection description are made available here (see Appendix 4) and a full dataset, including also puddingstone records, will be deposited with Buckinghamshire County Museum. For Wiltshire, proxies for sarsen distribution include three main datasets: *Sarsen Stones in Wessex* survey data; Wiltshire and Swindon Historic Environment Records mentioning sarsen; and Ordnance Survey (OS) depictions of sarsen stone spreads. The mapping exercise contributes to the Stonehenge and Avebury World Heritage Site Research Agenda Question C.13, 'map the former extent of natural sarsen trails' (Leivers and Powell 2016, 17).

The Ordnance Survey's depiction of sarsen spreads is a remarkable feature of 1:2,500 scale County Series mapping made during the later-nineteenth century. In locations in north Wiltshire, West Berkshire/Oxfordshire and in the Valley of Stones near Little Bredy (Dorset), OS surveyors plotted surface sarsens. Although they used conventional shapes to represent many of the boulders, close examination reveals two interesting features: first, they used variations in patterns to ensure that the carefully delimited areal extents are highly realistic; secondly, they very often plotted individual boulders, including specific sarsens such as the Toad Stone and stones in prehistoric field edges on Overton Down. Creating point data using pre-Second World War OS mapping has enabled me to generate heat maps of sarsen spreads including those in unprotected areas where the numbers of boulders are today greatly diminished.

I am also indebted to the curators of photographic collections at Buckinghamshire County Museum, Buckinghamshire Archives, the *Sharing Wycombe's Old Photographs* community archive, the Temple estate (Preshute, Wiltshire) and the British Geological Survey. Images from those collections combined with BGS accounts of historical sarsen quarrying, information from quarrying and mining treatises and my fieldwork and air photograph transcriptions have enabled me to situate sarsen exploitation as a normal quarrying activity, wherein lies the significance of the following paper. It presents the first detailed – extensive and intensive – research into post-medieval sarsen working, developing multi-scalar methodologies to tackle ephemeral surface quarrying. Influenced by scholars including Lamesa (2017), Morleghem (2021) and Willies *et al*. (2011), I demonstrate the value of attending to the smallest details of tool marks and quarry waste that can potentially reveal working practices of individual quarry workers. The following paper thus demonstrates the importance of tacking between the geological and human scales in order to show how, after Conneller (2011), material properties are revealed through technical action.

One of the peer reviewers who provided feedback on the following paper requested more information about the people working the sarsen stone. I had intended to write a section on them and their families, having spent considerable time working through numerous sources to track down at least the later-nineteenth and early-twentieth century personnel. In the event, as I explained in my response to the journal editor, I will write a separate paper on that networked community of practice in order to do it justice. Nevertheless, the following paper addresses not only the mining and quarrying Research Agenda general aims 01 and 02 to promote and improve understanding of quarrying, but also comparative regional study (research aim 03), encouraging Higher Education engagement with extractive industries (research aim 07) and developing appropriate multi-scalar methodologies to study the evidence in the context of a landscape approach to archaeology (research aims 14 to 18) (Newman 2016).

References

Bennett, L. 2014. Gazing up, looking down: following cathedral stone back to its source. *lukebennett13: Tracing the spectacular within the humdrum of the built environment* [online]. Available from: https://lukebennett13.wordpress.com/2014/04/18/gazing-up-looking-down-following-cathedral-stone-back-to-its-source/ [Accessed 22 May 2017]

Conneller, C. 2011. *An archaeology of materials: substantial transformations in early Prehistoric Europe.* Abingdon: Routledge

Davies, A. & Baines, A. H. J. 1953. A preliminary survey of the sarsen and puddingstone blocks of the Chilterns. *Proceedings of the Geologists' Association* 64, 1-9

House of Commons. 1860. Return of gross Annual Value of Property assessed under Schedules (A) and (B) of Income Tax in England, Wales and Scotland, 1859-60; Return of net Amount of Profits assessed under Schedule (D). *House of Commons Papers 546.* London: HMSO

Lamesa, A. 2017. If techniques help to date a monument…three case studies. In M. Parise, C. Galeazzi, R. Bixio & A. Yamac (eds) *Cappadocia – Hypogea 2017. Proceedings of the International Congress of Speleology in Artificial Cavities,* 58-64. Kapadokya: Dijital Dusler

Leivers, M. & Powell, A. B. 2016. *A Research Framework for the Stonehenge, Avebury and Associated Sites World Heritage Site. Research Agenda and Strategy.* Salisbury: Wessex Archaeology

Morleghem, D. 2021. Archaeology of Early Middle Ages Sarcophagi Quarries in the Southern Paris Basin (France). In C. Sciuto, A. Lamesa, K. Whitaker & A. Yamaç (eds) *Carved in Stone. The archaeology of rock-cut sites and stone quarries,* 113-142. Oxford: BAR International Series S3054

Newman, P. (ed.) 2016. *The Archaeology of Mining and Quarrying in England: A Research Framework.* Matlock: The National Association of Mining History Organisations

Stokes, A. H. 1908. Mines and Quarries. Reports of Mr A.H. Stokes, H.M. Inspector of Mines for the Midlands District (No.8) to His Majesty's Secretary of State for the Home Department…for the year 1907. *UK Parliament Command Papers Cd. 4045.* London: HMSO

Stokes, A. H. 1909. Mines and Quarries. Reports of Mr A.H. Stokes, H.M. Inspector of Mines for the Midlands District (No.8) to His Majesty's Secretary of State for the Home Department…for the year 1908. *UK Parliament Command Papers Cd. 4672.* London: HMSO

Willies, L., Redvers-Higgins, N. & Wain, I. (eds) 2011. *'Finished Labour of a Thousand Hands'. The Archaeology of the Combe Down Stone Mines, Bath, Somerset.* Oxford: Oxford Archaeology

Sarsen stone quarrying in southern England

By KATY A. WHITAKER

SUMMARY: This paper reports on new research into the previously poorly-documented post-medieval sarsen stone industry of southern England. Two significant centres of the trade are explored using complimentary methodologies. In Buckinghamshire, where a major quarry has been lost to redevelopment, archaeological features are mapped from historical aerial photographs and other remotely-sensed data. In Wiltshire, analytical earthworks survey at two quarries records different stone-working practices. The interpretation goes beyond a conventional industrial archaeological focus on commodity production, to examine the complexity of the relationships between people, materials and technology in three different taskscapes.

Keywords: quarrying; sarsen stone; Buckinghamshire; Wiltshire; taskscape.

INTRODUCTION

'Sarsen building…' wrote Harold Brentnall FSA (1946) 'would be a small evil if it had not taken in the past such a disastrous toll…From the crest of Avebury Down we surveyed the scene dotted with the gleaming surfaces of blocks freshly split and incongruous arrays of virgin setts grouped pavement-wise on the turf…We had come too late.' (423-4). Brentnall was lamenting the effects of Wiltshire's sarsen stone quarrymen who seemed to be clearing the landscape of boulders intimately associated with British prehistoric monuments. Yet the trade was a successful industry with a regional reach, providing building stone and street furniture that today contributes to local sense-of-place through vernacular architecture. This paper presents new research into post-medieval sarsen stone quarrying in southern England to describe extraction, cutting and working in case study areas in Wiltshire and Buckinghamshire, two prolific centres of the industry.

GEOLOGY

Sarsen stone is a silcrete dispersed across southern England from Devon to Norfolk. It appears amongst superficial deposits and scattered on the present-day land surface as cobbles and boulders known as sarsens (Fig. 1). Sarsens are composed of Tertiary quartz sands (occasionally with sparse flints) of the Lambeth Group aged *c*. 55 to 56 Ma. The sarsen blocks were formed underground more recently by geochemical processes, when silica carried in groundwater cemented areas of the sands together. The very hard, dense, homogenous bodies were left amongst surviving Tertiary deposits, became part of Clay-with-Flints and Plateaux Drift, or were deposited on denuded land surfaces, as a result of complex later Tertiary and Quaternary erosional processes. The boulders' final positions are the result of periglacial movement and human activity. Usually comprising >90% silica, sarsen is also brittle with a reputation for sub-conchoidal fracture (Catt 2010; Entwistle *et al.* 2013; Geddes and Walkington 2005; Jones and Green in press; Nash and Ullyott 2007; Summerfield and Goudie 1980; Ullyott *et al*. 2004). The distribution means that the 'sarsen quarry' is a dispersed and largely ephemeral feature, including the sites examined in this paper.

To an extent the vernacular term 'sarsen' became standard use in the 19th century (for example, Rupert Jones 1886). Other names include 'breeding stone' because of the boulders' propensity to appear and multiply (perhaps lifted by ploughing or frost-heave), 'druid stone' for its use in prehistoric monuments, 'grey-wether' in analogy to browsing sheep and 'saracen-stone', as a foreign stone unrelated to the underlying geology (Adams 1870; Geddes 2000).

SARSEN STONE USES

Sarsen has been exploited since prehistory, most notably in Neolithic megalithic ritual monuments but also for tools such as querns and as building material in later prehistoric, Roman and early medieval structures (Bowen and Smith 1977). The stone serves both high and low status buildings, ranging from Windsor Castle's extensive stone-built defences and residential quarters to cottages and agricultural buildings in both sarsen rubblestone and block walling (St John Hope 1913; Osborne White 1907). It may be used as the principal building or facing material (such as at Marlow Town Hall or Wycombe Abbey, Buckinghamshire); sometimes replacing or combined with timber-framing, paired with brick walling, or with brick or freestone dressings (for example College House, Lambourn, Berkshire); and both as unworked boulders and finely-dressed blocks in churches (such as at Clyffe Pypard and East Kennet, Wiltshire).

This flexibility is also evident in its role in surfacing, whether as cobble pitchings, road metal or shaped street furniture. For example, Marlborough's older sarsen cobble streets were contrasted favourably with the unsatisfactory gravelled turnpike road by Benjamin Merriman, writing to Sir James Long in 1784 (WSHC 2943B/2/50). When Wiltshire County Council Roads and Bridges Committee moved to bring the formerly turnpiked road up to modern standards following the First World War, sarsen was one of numerous road metals ordered including tarred macadam, basalt, flint, limestone and gravel (WSHC F1/100/6/6). Later 19th century use of shaped sarsen setts, kerbstones and channelling is associated with the provision of new road- and footways in expanding urban areas (Allen 2015), such as growing towns like Swindon (King 1968, 87) and communities across Buckinghamshire where sarsen-paved crossings to poor-quality roads were appreciated by pedestrians until new tarred surfaces rendered them redundant (Bucks

Herald, 7 October 1911). As late as 1912, Councillor Fisher recommended that Aylesbury Urban District Council lay sarsen paths in Walton Green (Bucks Herald, 17 February 1912), but in 1925 Amersham Parish Council sought to draw the County Surveyor’s attention to piles of sarsen setts that were inconveniencing pedestrians, presumably as pavements were re-surfaced with new materials (Bucks Herald, 3 October 1925).

SARSEN STONE STUDIES

Post-medieval sarsen stone exploitation is an under-researched hard-stone industry. Early 20th-century geological reports provide information about active family-run quarries in Buckinghamshire (Sherlock 1919, 1922; Sherlock and Noble 1912, 1922; Spicer 1905; Woodward and Herries 1905), on which Burtonwood’s (1995) short review is based. The history of Wiltshire’s family-run sarsen quarries is based largely on family and oral histories (Crook and Free 2011; Free 1948, 1950; King 1968). Sarsen building stone is mentioned in southern England (Osborne White 1907, 1909, 1912, 1925) but only in north-west Surrey is quarrying briefly referred to (Dewey and Bromehead 1915, 98; Le Neve Foster 1894, 546). Some regional church fabric and street furniture surveys include silcretes (Allen 2015; Cordiner and Brook 2017; Potter 1998). The only explicitly archaeological examination of post-medieval sarsen working concerns 18th-century megalith breaking during the dilapidation of prehistoric monuments at Avebury (Gillings *et al*. 2008).

It is not clear why this important regional trade has been neglected. In Buckinghamshire, extraction sites survive mainly in woodland and are less easily distinguished from other bulk mineral workings. The largest known extraction area, discussed here, is entirely redeveloped. Sarsen sources in the Berkshire-Hampshire-Surrey heathland are equally elusive, amongst extensive aggregates extraction and Ministry of

Defence firing ranges. These difficulties may have dissuaded research. Wiltshire quarry sites are readily accessed but, as alluded to above, sarsen exploitation has been characterised negatively as the destroyer of prehistoric landscapes: apart from Noel King's important paper (1968), the focus of sarsen research has been to elucidate prehistoric relations with the stone (such as Bowen and Smith 1977).

To remedy this deficit, this paper presents results of the first analytical earthwork surveys to be made at Wiltshire extraction sites. In Buckinghamshire, remotely-sensed data combined with other archive material are used innovatively to explore the extractive landscape. The resulting nuanced insights into working practices in the quarries are used to disrupt conventional industrial archaeological narratives of post-medieval quarrying, instead focussing on the role of materials, and material properties of sarsen stone, in the ways that the quarries developed.

POST-MEDIEVAL QUARRY STUDIES

The UK has a long tradition of surface extraction and underground mining for stone reaching back to prehistory. Post-medieval quarrying exploited many different rock types for products ranging from small items, such as slate hone stones, to dimension stone for construction projects. Extractive practices also produced many essential minerals to be transformed by pyrotechnic processes, including clays, ores and limestones (Crossley 1990).

Despite their variety and importance, bulk mineral industries have received limited archaeological attention (Newman 2016). Peter Stanier's (2000) *Stone Quarry Landscapes, the Industrial Archaeology of Quarrying* remains the only 'reasonably comprehensive presentation of quarry-related archaeology' (Thomas 2016, 67). Of particular relevance to this paper is scanty research into surface extraction sites (Thomas 2016, 74). Data issues contribute to these gaps. Progressive quarrying destroys earlier evidence; quarries become inaccessible through overgrowth, flooding or redevelopment; most quarries and quarrymen are invisible in documentary sources because of the limited regulation of all but the largest concerns (Samuel 1977; Stanier 2000).

The extractive industries are a topic of industrial archaeology, itself a strand of technology studies. Industrial archaeological studies often take a 'common-sense' position within the framework of the modern Standard View of technology, prioritising accounts of makers and inventors adapting to or controlling their environment (Conneller 2011; Dobres 2000; Orange 2008; Pfaffenberger 1992). In consequence, quarry surveys often produce technocentric descriptions of sites, equipment and products in the conventional industrial archaeological mode such as Gwynn's (1999) study of power systems in slate quarries or Trueman's (1992) analysis of the Langcliffe Limeworks. Emphasis is nevertheless placed on elucidating technical sequences: identifying geological sources, stone extraction methods, stone-working techniques, end products and their transportation off-site (Newman 2016; Stanier 2000). That approach is similar to the *chaîne opératoire* concept developed in prehistoric lithics analysis to understand such sequences, from stone procurement through tool manufacture, use and re-use, to eventual discard (Leroi-Gourhan 1993).

Technology research commonly focusses on innovation, framed in terms of linear evolutionary progress (Frieman, forthcoming; Ingold [2000] 2011, 362-366), but quarrying is typically depicted as traditional and resistant to change. A prevalent geological determinism constrains human agency, stating that quarrying techniques and products are determined by the bedding and jointing of quarried facies (for example Colfer 2010, 113; Stanier 2000, 10). Examined through an economic lens, the majority of quarries are characterised as under-invested, small-scale, seasonal and un-mechanised because land ownership was disassociated from control of the labour (Samuel 1977; Scott-Brown 2017), preserving a traditional industry. A key attribute of the sector is the deep time-depth of quarry tools and stone-working practices. Roman, medieval and later tools and techniques are largely similar, as are many quarries (Newman 2016, 59, 68, 72). In consequence, a nostalgic sense of timelessness pervades the literature, as direct connection is made across millennia via the small suite of hand-tools equally recognizable to a Roman as to a 20th-century quarryman (Stanier 2000, 21).

When innovation or change occur, they are commonly explained through external stimuli, such as improved transportation methods, labour-saving initiatives, urban development, or commercial growth (such as Greenwell and Elsden 1913; Newman 2016, 40; Scard 1989, 177-8; Stanier 2000, 17). Historical studies relying heavily, if not entirely, on documentary sources often characterise stone solely as a commercial commodity, underplaying both the technological context and varied properties of the materials themselves. For example, in her study of 19th-century stone-built housing in rural Wales, Alfrey (2006) uses solely reports of the *Royal Commission on Land in Wales and Monmouthshire*, concluding that the forms of the region's vernacular architecture were determined by geological constraints and variable access to economic leverage and construction skills. Born (1988) draws largely on historical sources to describe the south Devon slate trade, concluding with the Victorian investment value of the business. Linsley (1990, 178) even goes so far as to state that identifying the location of Brockholm millstone quarry in Northumberland 'is less important than the information on its products and customers that can be gleaned from a surviving account book'.

Conventionally nostalgic, economic or technocentric accounts may be challenged, however, by multi-scalar analyses of the technical actions of quarrying – from individual tool traces, to the whole quarry and its products – which, interwoven with archive sources, can reveal the complexity of practices. Detailed attention to the morphology and sequences of tool-marks in rock-cut architecture (Lamesa 2017) and architectural sculpture (Rockwell 1993), for example, reveal the interplay between geology, tradition and artisanal practice. Studies such as Morleghem's (2016) examination of sarcophagus production and Willies, Redvers-Higgins, and Wain's (2011) exploration of Combe Down stone mines demonstrate the importance of taking a more critical view of stone procurement and use.

Furthermore, more nuanced social archaeological and ethnohistorical approaches draw attention to impactful human agency and personal relations in working mineral resources (for example Knapp 1998; Mate 2013). These include the application of oral history and social anthropological methods exemplified by Samuel (1975, 1977), who depicts quarrymen at the intersection of labourer and artisan, exercising strength, skill and judgment in their work. Prehistorians such as Brück (2006), Conneller (2011) and Dobres (2000) have applied the lens of Science and Technology Studies to stone-working technology, understanding it not as a functional absolute but as a problem-solving process mediated by people's understanding of materials and how to use them. Different stone types offer different properties and affordances, and their procurement is hedged around by particular physical and historically-contingent contexts. Although the suite of quarrymen's tools may be relatively small, the materials to which they are applied are diverse, resulting in stone-specific techniques. The close examination of materials and technologies to 'reveal the complexity of person-material-technological relationships' encouraged by Conneller (2011, 25) is just as relevant to post-medieval stone use as it is to prehistoric.

AIMS AND METHODOLOGY

This work aims to describe and interpret the archaeology of the English post-medieval sarsen industry. The great majority of workings were shallow surface pits falling out-with regulatory powers, rarely appearing in Home Office Mines Inspectorate reports. Consequently, a multi-scalar approach is taken in three case study areas, including a close examination of material and technological evidence interpolated with an eclectic variety of archive sources. This paper focusses on the field archaeology results and evidence gathered from remotely-sensed data.

As a component of superficial deposits, sarsen is not mapped by the British Geological Survey (BGS): thus, potential geological sources cannot easily be targeted. Proxies at varying scales locate and map the presence of sarsen boulders, providing the geological context for the industry. The case studies were selected on the basis of this new mapping combined with existing historical accounts: an area in south Buckinghamshire and two locations in north Wiltshire.

The survival of archaeological evidence is substantially different between the study areas, requiring that different, complimentary, methodologies be employed. Surface sarsen spreads exploited in Wiltshire are in areas now largely protected by environmental legislation. Quarry archaeology is thus well-preserved, but distributed across a huge area. An intensive approach was taken to record extractive features at two locations where different quarrying techniques were used: Piggledene, worked traditionally before 1907; and Hursley Bottom, a mechanised road-stone quarry operational in 1920 (King 1968) (Fig. 2). Level 3 analytical earthwork survey was carried out to industry standards (Bedford *et al.* 2016; Jamieson *et al*. 2017) in a representative sample of each landscape. The surveys included detailed metrical analysis of extant stone-working traces on individual boulders, informed by Stanier's (2000, 36-38) schedule for investigating quarries but drawing explicitly on the methodological framework of the *chaîne opératoire* to document, where possible, specific quarrying processes and their sequential technical actions with a focus on stone selection and reduction. The measured surveys were augmented by walk-over surveys of the surrounding quarried areas.

On Buckinghamshire's Chiltern Hills, sarsen stones are found both singly and in tightly-defined clusters of hundreds of tons of stone buried in Plateau Drift. Extractive features were digitised from historical Ordnance Survey maps in a 210km^2 survey area (Fig. 3). Albeit arbitrary, given sarsen dispersal, the boundary was defined by the intensity of existing sarsen stone records (Davies and Baines 1953; Prestwich 1854; Sheahan 1872; Sherlock 1922; Sherlock and Noble 1912, 1922; Spicer 1905; Woodward 1881). The resulting dataset provides the overall context of extractive industry within which sarsen was exploited, in more detail than Mines Inspectorate reports that are limited to regulated quarries: Ordnance surveyors mapped *all* features that made a definite impact on the landscape (Oliver 1993, 98).

Analytical earthwork survey could not, however, easily be applied there. Dispersed pits survive in woodland but are largely ploughed out elsewhere. An intense sarsen aggregation at Walter's Ash (Bovill 1903) was worked from thick superficial deposits that fill numerous dolines (Lim, Clark, and Linares-Matás 2020, 6). Unfortunately, the northern part of that quarry was returned to arable whilst the southern part was developed by the Ministry of Defence after the Second World War (Freeman 2001, 16). The pits were, however, left open prior to re-development. It is reasonable to assume that 1940s aerial photographs, and in particular coverage of Walter's Ash flown in 1942, captured the quarry as close as possible to its final pre-development form. An extensive approach was taken, therefore, to record the extractive landscape of a 48km^2 study area centred on

Walter's Ash (Fig. 3). Digitising and interpreting features from a combination of aerial photographs and Lidar data, to National Mapping Programme standards (Evans 2019; Truscoe 2017, 9-15), provides an innovative solution to the problem of covering the area in detail.

Both the methodology applied and the interpretation of the mapped landscapes is influenced by Ingold's (1993) 'dwelling perspective', from which landscape is seen as a record of life lived over time, the landscape forms incorporating and arising from processes including the geological, technological and human (discussed in more detail below). This is important to the attempt to move beyond the narrowly technocentric tendencies of many quarry studies, which detailed mapping and survey could otherwise encourage. However, archive material from numerous sources contributed to the selection of the study areas and is essential to understanding each. That underlines the contention of both Johnson (2007) and Hicks (2016) that archaeological knowledge is constituted by the sources upon which we choose to draw, by the investigative work done in a landscape, and by the archive resulting from the documentation practices selected for that fieldwork. An outcome of taking different approaches to the study areas is that each locality is addressed at a different interpretative scale.

BUCKINGHAMSHIRE

INTRODUCTION

> 'There are no major resources of building stone in Buckinghamshire'
>
> (Benham *et al*. 2003, 9).

Buckinghamshire is not renowned for hard-stone quarrying. From 1895 to 1920, on average 22 quarries were worked each year in the county, employing on average 112 workers between them (Table 1). It is likely that all the quarried sandstone was sarsen, known by locality names including Denner Hill Stone, Wycombe Stone and Hampden Stone (Burtonwood 1995; Woodward 1905). Those names indicate an area around Hughenden parish where superficial geology including substantial deposits of Plateau Drift and Clay-with-Flints mantle the largely wooded Chiltern Hills (Coppack 1962; Davies and Baines 1953; Ellis and Jamison 1925, 57).

Southern Buckinghamshire remained a largely rural area, less affected by later 19th-century industrialisation and the rural depopulation of the agricultural depression, because its farmers served nearby London markets (Reed 1979, 227-28). Hughenden's later 19th-century population was quite stable, on average 1,765 people from 1881 to 1901, before rising to 2,523 in 1921 (GB Historical GIS Project 2009-2017). The parish's heathland enclosure was completed late-on, in the mid 19th century, impacted by the small proprietorship that characterised Chiltern Hills' landholding (Reed 1979, 199-205); a factor important to the management of the sarsen trade, as discussed below.

Sarsen pits on Denner Hill were worked until just before the First World War (Sherlock 1922, 55; Woodward and Herries 1905) and must have been exploited since much earlier for the locality name to have developed. Expertly split, shaped and dressed sarsen was being used in local construction by the beginning of the 19th century, if not before. Examples include Wyatt's remodelling of Wycombe Abbey, *c.* 1803-04 (Pevsner and Williamson 1994, 391); the rear wing extension of Denner Hill Farmhouse, *c.* 1800, and its barns dated 1803-04 (NHLE, 1160234, 1332051); Marlow Town Hall, 1806 (Pevsner and Williamson 1994, 458). In earlier instances, local stone-cutters appear in legal documents including Thomas Watts of Chipping (High) Wycombe, leasing property in 1736 and 1740 (BA, CH 1/T/24, D-CN/9/5/1/21). The industry was largely at a close by the Second World War, the 'last stone mason' working in 1950 (SWOP, RHW:50634).

Identifying sarsen pits is problematic for a number of reasons. There is no bedrock quarry because boulders are scattered in the superficial deposits. As well as chalk and marl the locality provided clays, sand and gravel, resulting in numerous extractive features. Brickearth was a useful by-product of the sarsen trade (Whitaker 1864), complicating the identification of stone pits. A broad assessment of late 19th- and early 20th-century bulk mineral extraction in the survey area demonstrates this variability.

EXTRACTIVE INDUSTRIES

Within the survey area 217 pits and quarries (both active and 'old'/'disused') are recorded on first edition Ordnance Survey maps (1867-81) – on average one per 1km^2 – indicating the prevalence and local significance of bulk mineral extraction (Fig. 3) (Table 2). The majority are identified as chalk pits (105, 49%), indicating chalk's importance for various purposes, common to other counties (Allen 2017). Twenty-six clay pits (12%) include those at brickworks such as at Hyde Heath, where sarsens were also present (see Sherlock [1922, 41]). There are fewer gravel pits (sixteen, 7%) and sand pits (three, 1%), although the area opened up for gravel extraction was bigger than that for clay (1.59ha compared with 0.94ha). Twenty-two sites (10%) are called quarries: fourteen are in chalk whilst eight cut superficial deposits. At Stony Green and to the south-west of Naphill Farm, two quarries are at sarsen-producing areas. In fact, six quarries are within 1km of a sarsen location named in geological literature. Although fewer pits are recorded by the Epoch 2 re-survey (1897-99), the numbers of clay pits and unidentified extractive pits increase on Epoch 3 maps (1918-24) when, for the first time, pits appear to the east of Walter's Ash Main Road.

Although the Ordnance Survey had not identified any marl pits in the survey area, marling was significant on the Chiltern Hills after the First World War, described in detail by Sherlock (1922, 55). Thus, the landscape was further marked by pits supplying alkaline soil improvers applied over acidic superficial deposits. They result in well-defined sub-circular depressions usually located in the centre of fields, with a characteristically regular distribution. In the Walter's Ash study area, 435 marl pits exhibiting these characteristics were mapped from remotely-sensed data (Table 3).

Dating these marl pits is difficult with no phase relationships to other features. Priest (1810, 268) reports that soil improvement was prevalent across Buckinghamshire by the end of the 18th century, associated with the management of enclosed land. Some 145 (33%) marl pits in the study area are associated with 18th- and 19th-century enclosures as identified through Historic Landscape Characterisation (Green and Kidd 2006) (Table 4). In all likelihood some, perhaps many, were being opened throughout the period of post-medieval Improvement and into the early 20th century.

WALTER'S ASH QUARRY

At Walter's Ash, a cluster of pits in Plateau Drift provided sarsen boulders weighing on average 40 tons each (Catt 2010, 87; Sherlock and Noble 1912, 201; 1922, 35; Spicer 1905). It is not yet clear when this area was first quarried. The fields are adjacent to Walter's Ash Farm, where John Hall worked sarsen from the 1840s (Burtonwood 1995). The works were reopened following the First World War hiatus (Sherlock 1919, 191; 1922, 55), comprising Bristow's Stone and Brickyard to the north and Brown's (Wells) Brickfield to the south (BA, D-X/935). Bristow family members were stone-cutters from at least the mid 19th century perhaps also providing this service for James Brown's neighbouring brickfield. A small number of the same families living in the neighbourhood provided the workforce throughout the time the pits were operational (Whitaker, in preparation).

Spicer (1905) (who also noted clay as a by-product of sarsen extraction) describes one of the Bristow's Yard pits, around 36m diameter and 12m deep containing brickearth and sarsens (Fig. 4). When Clay-with-Flints were encountered, known by the quarrymen as 'rock', the limit of 'profitable operations' for each stone pit had been reached (Spicer 1905, 40). Bovill (1903, 368) reports that the stone-cutters paid landowners a royalty for quarrying rights, based on the quantity of extracted stone, or bought land outright.

Processes employed in the quarry can be reconstructed from a combination of geological accounts and archive photographs. Quarrymen prospected by probing the surface with metal rods called 'snipers.' Locating and hand-excavating individual boulders produced lobed pits on plan, with steep sides. Those irregular shapes and near-vertical sides were maintained as the pits were extended downwards, following the deposit. Simple scaffolding, sheer-legs with block and tackle and windlasses were used to access the pits and raise material. Primary reduction occurred *in situ* using flat wedges to split large boulders into pieces. Above ground, secondary reduction included further subdivision into blocks (Fig. 5). Tertiary reduction produced setts, kerbstones and building blocks, some of which were dressed for a more precise shape and finer finish (Green 2016, 356-7; Whitaker 2019, 105-7) (Fig. 6). Such simple infrastructure contributes to the ephemeral nature of the dispersed sarsen quarry and difficulty of identifying stone pits in the landscape. The intensity of the Walter's Ash site and coverage by aerial photography, however, uniquely enables the further analysis of the layout of the extractive area and pit forms.

Towards the end of its life, Brown's Brickfield included a maximum of 60 pits ranging from 15.1m^2 to 2,242.2m^2, 34 (57%) of which were under 150m^2. Also close to closure, Bristow's Yard included up to 53 pits between 18.8m^2 and 3,889.0m^2 (Fig. 7). Although including by far the single largest extractive feature before its back-filling was completed by August 1961, the majority of Bristow's Yard pits were also under 150m^2 (37, 69%). By 1942 some of the pits included scrub, indicating that they had not been worked for a few seasons, but a few were newly-opened after the Second World War on Brown's Brickfield for the final years of brick production.

Despite interior overgrowth, in the 1940s the pits still had crisply-defined edges and steep sides with no obvious access ramps visible. There is no evidence in the aerial photographic coverage for mechanised excavation. The smallest pits (defined as $<150m^2$) were on the whole single or two-lobed on plan, only those at the larger end of that size class becoming more complex. The largest pits, however, were highly irregular in plan form, multi-lobed and with irregular bases, giving the impression that sarsens and brickearth were 'chased' until individual pits were worked out. The land between the Brown's Brickfield buildings and Courns Wood was very thoroughly quarried, whereas the pits on Bristow's Yard were more dispersed. Significantly, although ten pits were extended to more than 500m^2, ground was not unnecessarily dug away in extensive open-area excavations. In Bristow's Yard in particular substantial open ground remained between some of the pits (Fig. 8).

The limited number of spoil heaps is noticeable. Aside from two smaller and one large clay pile beside Bristow's Yard hack ground (brick-drying area), there were seventeen small, low spoil heaps closely associated with pits in the quarried area. Brown's Brickfield also kept clay piles beside its hack ground, but there is only one identifiable spoil heap associated with three pits in the quarried area. An additional spoil heap was later built up to the south-east side of the quarried ground, in place by May 1954 when only bricks were being made. That suggests the economical nature of the industry during the most active extraction periods, with perhaps limited overburden, abundant brickearth and sarsens removed by careful hand-digging, and waste sarsen returned to pit bases or further broken up for road-stone (as Bristow's advertised, see *Kelly's Directory of Buckinghamshire* [1911, 41]).

The aerial photographic transcription also reveals the full extent of Howard's Brickworks on Honor End Lane (BHER, 0505600000), providing a valuable comparison (Fig. 9). Opened by Samuel Howard in 1895 some 4km to the north-east of Walter's Ash and worked until the 1960s, the site was developed in superficial deposits on the chalk plateau above Hampden Bottom. Although recorded only as a brickworks it is geologically and topographically similar to Walter's Ash and Denner Hill, and sarsens were noted by Sherlock (1922, 41) at the brickworks and Nanfans Farm just to the south.

At its fullest extent, the extractive area included 115 pits ranging from 5.5m^2 to 7,105.1m^2, of which 62 (54%) were under 150m^2. The largest feature comprised a highly irregular pit already overgrown by the 1940s: smaller pits, including both simple single-lobed and more complex features, were scattered predominantly to its south and west up to 50m apart separated by areas of unexcavated ground. The open pits commonly exhibit the same irregular plan forms and bases as at Walter's Ash. Although the scrub growing in some pits shows that most were at the end of their working lives, their sharp edges and steep sides are still well-defined in photographs of 1946-47. The exception is an area of probable pits on the north of the site showing as cropmarks on photographs dating to 1948. Closely clustered and highly irregular in plan form, they had been backfilled and reverted to agriculture. Only one pit in that group showed as a slight earthwork depression in photography of the previous year, suggesting that the ground had been under cultivation for some time. That contrasts to the final workings on the site visible in aerial photographs dating to 1969 in which a dragline is in operation in a large open pit to the west of the cropmark site.

The proliferation of pits scattered across the site separated by large areas of unexcavated ground, and the range of their plan forms with steep sides, well-defined edges and no ramps, suggest that similar extractive practices were in use on Howard's Brickworks before the Second World War as the Walter's Ash yards. Given the similar superficial geology and topography, it is likely that sarsens were also encountered. Honor End Lane did not develop a reputation for the stone, but it is conceivable that local sarsen-cutters living in Honor End and nearby Prestwood (Whitaker, in preparation) were involved in removing sarsens from those fields.

WILTSHIRE

INTRODUCTION

Similarly rural to south Buckinghamshire, Wiltshire parishes where sarsen is prevalent have nevertheless a very different history. Landholding is dominated by large medieval ecclesiastical estates running huge flocks of sheep on open chalk Downland, transformed by 18th-century Improvement and early 19th-century Enclosure into large, secular, farms (Fowler and Blackwell 1998, 138-143). In West Overton parish, the location of the two study areas described in this paper, between 1881 and 1901 the population was on average 643 people, approximately one-third smaller than its early 19th century population; numbers continued falling, to only 515 people in 1921 (BG Historical GIS Project 2009-2017).

Hard-stone quarrying has nevertheless been more significant economically to Wiltshire than Buckinghamshire. Between 1895 and 1920, on average 42 quarries were worked each year in the county, employing on average 225 workers between them (Table 1). Around 1900, sarsen-cutters produced annually some 300 tons of prepared stone (King 1968, 88); but the county's total recorded sandstone volume is unlikely to include sarsen, because the surface quarries were unregulated. Sarsen is today most prevalent on the Downs to the north and south of the Kennet Valley (Fig. 2).

Allegedly, Wiltshire's sarsen was known to be impervious to working with iron tools, knowledge originating with Rastell (1530) and repeated by later commentators: the conventional view is that, prior to *c.* 1850, sarsens were shattered by thermal shock as described by antiquaries Aubrey (Britton 1847, 44) and Stukeley (1743, 15) to produce rubblestone and roughly squared building blocks (Geddes 2000, 80; King 1968, 85-6). From 1847, members of Buckinghamshire stone-cutting families moved to the Kennet Valley to take advantage of easily accessed surface sarsen spreads. They revolutionised the industry by introducing specialist metal tools and superior techniques to produce evenly split and finely dressed blocks, teaching the skills to a small number of local men (Crook and Free 2011; Free 1948, 1950; King 1968).

According to Douglas Free (1948) (member of a Buckinghamshire stone-cutting dynasty) and King (1968), the technique involved digging a gully around a boulder on which lightly-chiselled guide-lines marked the desired primary splits (Fig. 10a). The guides would normally be aligned to natural cracks. Along the lines, wedge-pits from 2.5cm to 3.75cm deep were cut out every 30cm using a pecker and finished with points (Fig. 10b, c). Flat wedges inserted between thin iron strips were placed into each wedge-pit and sledged until the stone split. Secondary reduction involved further subdivision by perpendicular splits, followed by tertiary reduction using a slicing chisel held in a twisted hazel wand, struck with a tracing hammer, to cut setts, kerbs and building blocks (Fig. 10d, e, f). If necessary, dressing was completed using a pecking hammer.

Other methods were used, however, to quarry sarsens. King (1968, 86-7) also describes, in less detail, a road-stone operation using explosives and a mechanical crusher to quarry and break sarsens in Kennet Valley's West Woods. The excellent preservation of that area, and the survival of sarsen extraction pits amongst the Downland sarsen spreads, provides the circumstances to examine these workings and quarrying practices.

PIGGLEDENE

Piggledene in West Overton is a dry chalk valley, a northern re-entrant of the Kennet Valley cutting the Downland dip slope. The valley bottom includes Head deposits and an extensive surface spread of sarsens scattered across the pasture in its southern end. A photograph of 1908 shows stone-cutters at work in Piggledene immediately to the west of Pickledean Barn, and the Cartwright family quarried sarsen in the valley in 1912-15 (King 1968), but it is not known when sarsen-cutting began there. The National Trust owns some 3.8ha, purchased by public subscription in 1907-08 following a campaign to protect areas from being completely worked out (Anon. 1908). In consequence, areas including surviving boulders, partially-worked stones and empty stone pits are well-preserved. A 0.24ha measured survey transect was located across the valley bottom to record in detail the range of surviving quarry features (Fig. 11). The transect was bounded on the steep west slope of the valley by a fence-line on a substantial lynchet, and to the east by a fence-line butted up against a bank and hedge at the base of the opposite slope. The valley bottom slopes gradually from west to east. The measured survey was complimented by a larger walk-over survey (Fig. 12).

The transect includes numerous earthwork quarry features and worked and unworked sarsens. Fourteen well-defined shallow, oval, stone extraction pits range from 2m to 5.3m in length and 0.1m to 0.3m in depth. Most of the pits are in the western part of the transect. Pits [A], [B] and [N] have clearly defined sides, but the remainder tend to have a steeper western side petering out to the east. Eight pits contain or have adjacent sarsen cutting debris. The smallest pits [E] and [H] are empty, but are within the range of boulders in the valley bottom and may be extraction pits for smaller sarsens. The irregular form of pits [K] and [L] may have resulted from different disturbance, such as flint digging or tree throws, but again they are within the range of the smaller boulders. Some split sarsens are enclosed by shallow gullies, such as stones [122] and [144]. Other split boulders have no gully, including stones [20], [34], [106], [107], [143] and stone groups [83]/[84] and [89]/[100].

Gently sloping linear features extending north-south along the valley bottom are probably natural scarps of superficial deposit resulting from sediment movement in periglacial conditions (Clark, Lewin, and Small 1967, 23; Murton and Ballantyne 2017, 542). To the north-east side of pit [G], however, a slight bank is possibly an area of spoil, as is the more substantial bank to the north of stone [74] which may comprise mounded and overgrown debris near split and unsplit boulders [75] to [80]. That broader, flatter platform was perhaps prepared for the location of tertiary reduction and finishing, completed in the open air under the shelter of propped hurdles (King 1968, Plate VIIa), a practice used in Buckinghamshire and other stone quarries (Greenwell and Elsden 1913, Figure 18).

The transect includes 156 boulders and stone pieces. All are pale grey sarsen containing a very few examples of visible flint clasts and the occasional natural crack. Forty-eight have unequivocal working evidence including split faces and wedge-pits.

Thirty-one are unworked boulders. The remaining 77 are too well buried or overgrown with moss and lichen for conclusive examination, although some, like the small angular blocks in pit [B], are probably splitting debris. A less cautious estimation including probable debris suggests a total of 80 worked pieces. In terms of a simple count, more split sarsen pieces remain in the eastern part of the survey transect. Unworked sarsens and those which cannot with certainty be identified as worked are fairly evenly distributed across the transect.

Evidence for the Buckinghamshire technique of splitting with flat wedges is abundant. Sixty-one trapezoidal wedge-pits for wedges are present, commonly visible as scars in split stone surfaces (Fig. 10b); only seven wedge-pits are whole and unused. The wedge-pits are usually slightly asymmetrical, one end a little shallower and straighter than the opposite steeper, sometimes slightly convex, end. The opening in the stone surface is always longer and wider than the base. Whilst the origins of splitting stone with flat wedges in variably-shaped wedge-pits are Roman, the method was applied to many different stone types across England from the medieval period (Stanier 2000, 21-3). There is also one cylindrical plug-hole for plug-and-feather splitting in stone [69] (Fig. 13). Plugs are cylindrical, tapered wedges flanked by two semi-cylindrical feathers, fitting into bored or chiselled holes. They were introduced from the early 1800s (Greenwell and Elsden 1913, 293-4; Stanier 2000, 43).

Although regular in form, wedge-pit dimensions vary (Fig. 14). The mean length of wedge-pit openings is 90.9mm but they range from 71mm to 120mm. The majority (34, 57%) are between 80mm and 100mm long but eight cluster around 75mm long. Measurable wedge-pit bases are on average 47.2mm long with a similarly broad range; the majority (28, 52%) are between 40mm and 50mm long, with a cluster of seven around 60mm long. In the majority of instances, it is not possible to measure wedge-pit width, because only one half survives as a scar on a stone face. Depth, measured on the scar centre line, is on average 43.9mm but, as the range of 14mm to 74mm indicates, it is difficult to identify the top of each wedge-pit consistently in uneven stone surfaces. Whilst it is possible that clusters of wedge-pits around certain sizes could represent the work of individuals, the suggestion should be treated with caution. Wedge-pits and wedge-pit scars in each of the ranges are evenly distributed across individual boulders and across the survey transect, rather than clustered discretely on specific boulders. Furthermore, variations in the order of ±10mm could be ascribed to simple factors including the way stone splintered and spalled during cutting, or variability in recording dimensions in the field.

There are three variants in the treatment of boulder surfaces around the wedge-pits. Stone [6] has the only example of a guide-line lightly chiselled along the course of an intended split, with two wedge-pits cut into the surface on its route (Fig. 10a). The stone surface around two wedge-pits in stone [34] is pecked away forming two rectangular depressions (Fig. 15a). In numerous instances, small flakes of stone spalled around wedge-pit openings during the shaping process; but on stone [84], the loss of a large flake ruined the first wedge-pit and a second was made approximately 15cm further over (Fig. 15b).

Wedge-pit positioning is also variable (Fig. 16). Of eighteen sarsens with one split surface, wedge-pits are pecked into the upper surface of thirteen. Three boulders were split from the side; they were broader at the base than the top, broken with wedges inserted close to the ground towards the thickest part of each boulder. Stones [28] and [34] have wedge-pits in the top and one side. Wedge-pit arrangement is more complicated in sarsens with multiple perpendicularly spilt faces, and can indicate splitting sequences. In stone [12], for example, at least one wedge was used in the top of the boulder to remove the northern part. A second, perpendicular, split was made with one wedge in the top of the stone and another in the middle of the freshly split face, positioned between the thinnest and thickest parts of the remaining material. Only five boulders have faces split by more than two wedges: stones [28], [91], [97] (three wedges); stone [34] (four wedges); and stone [147] (six wedges). The distance between these wedge-pits is highly variable (Table 5).

Splitting sequences of two of the most complex stone groups serve to illustrate the importance of precise perpendicular splits to the stone-cutters' approach to reducing boulders into regular units. In a large tabular sarsen broken into stone group [89]/[100], primary north-south splits produced blocks which were then reduced by secondary east-west splits. Smaller pieces were then made by further north-south splits. Each division is perpendicular to the previous one. In stone group [131]/[136], derived from a large, more irregular, pillowy boulder, the two rounded ends were split away first, then broken in half by perpendicular splits. The group was then abandoned prior to any further reduction, probably because the split dividing stone [136] from [134] failed: instead of travelling straight from the surface to the base of the stone, it ran out to the side in a deep curve, probably diverted by interrupting flints embedded in the boulder's sand matrix which are now visible in the split faces.

Stone [47] offers a further example of sarsen stone's occasional intransigence. Its eastern portion was removed first and the remaining part divided perpendicularly east-west, but it did not conform to expectations and that second split curved out to the south, removing the top surface rather than perfectly halving the block. The southern-most end was then removed from the damaged boulder and the remainder was abandoned.

Similar quarry features are distributed throughout the rest of Piggledene, observed during the contextual walk-over survey. The quarrying continues to the southern-most extent of the valley where it is cut off from the River Kennet by the embanked A4 road.

An earthen ramp leads out of the valley's southern end up to the road, banked up against the northern side of the road embankment. In addition to the single plug-and-feather example in the survey transect, there are four more instances of that splitting method elsewhere in the valley bottom: two boulders to the south of the transect and two to its north, containing eight measurable plug-holes between them. One boulder includes two rusted-in plug-and-feather sets. The precisely-shaped blocks of the 19th century monumental sarsen wall partially enclosing the modern sheds at Pickledean Barn are predominantly split by plug-and-feather. Fifty-one plug-holes are visible in the outer wall faces contrasted with only one certain, and four possible, wedge-pit scars.

HURSLEY BOTTOM

Hursley Bottom is a southern re-entrant of the Kennet Valley. The dry chalk valley dissects the *c.* 370ha West Woods, cutting south-west to north-east from *c.* 220m OD falling to *c.* 150m OD (Fig. 2). A Clay-with-Flints cap mantles the wooded high ground and the base of the valley includes Head deposits. Sarsen stones and extractive pits are scattered throughout West Woods but are most dense in the northerly wood compartments (Amadio 2011). In Hursley Bottom the boulders tend to lie on the gentler slopes as described in other asymmetrical chalk valleys by Clark, Lewin, and Small (1967); the valley must once have appeared much like Piggledene and other sarsen-rich coombes either side of the River Kennet.

Although King (1968, 93) notes that sarsen-cutters worked just outside West Woods, including land at Boreham cleared by the Cartwrights between 1907 and 1912, and Shaw worked-out in the later 19th century, he attributes the clearance of Hursley Bottom to a road-stone quarry operated by Thacker and Johnson during 1920. At that time, West Woods was owned by the Olympia Agricultural Company (WSHC, 1225/73). Thacker and Johnson contracted to supply cubical sarsen and sarsen chips for the London-Bath trunk road (now the A4) at 17s 3d per yard and 18s 3d per yard respectively (WSHC, F1/100/6/6). Using explosives and mechanical stone-crushing equipment, they cleared sarsens from the *c.* 3.5ha of Stony Copse within Hursley Bottom until the unsuitability of sarsen for road metalling led to their bankruptcy (Free 1948, 338-9; King 1968, 86-7).

The extent of the road-stone operation centred on Stony Copse is identified by Amadio (2011), whose walk-over survey includes areas of stone pits, a large concrete machinery base, an underground store and causeways possibly for hauling material onto the woodland ride network. The 1.6ha measured survey (Fig. 17) reported on in this paper was sited to include those key features in the southern portion of Stony Copse, bounded to the west by modern fences and to the south and east by trackways and the principal woodland ride. Its northern limit was determined by the extent that could be covered by the survey team within the fieldwork period, successfully encapsulating a large quarried area. Including a small area of the valley’s eastern slope enabled the measured survey of the quarry’s underground store.

The survey is dominated by stone pits, ranging from simple single-lobed pits with one base to complex multi-lobed features with bases divided by scarps or low banks. They have well-defined, smooth sides. Simple pits are sub-circular or oval on plan ranging from 1.3m to 7.2m in diameter. Some of these are shallow crescentic hollows between 0.25m and 0.35m deep with better-defined western sides, such as pits [p], [r] and [w], but many are steeply-sided features almost conical in profile up to 0.9m deep, including pits [b] (19.8m^2), [g] (10.8m^2) and [j] (26.7m^2). The irregular, complex, pits tend to be elongated or sinuous on plan, ranging from 5.2m to 16.8m long, largely clustered in the northern and eastern parts of the survey area. They include shallower gully-like features such as pits

[M] (20.5m^2) and [N] (37.1m^2) but on the whole are deep and steep-sided such as pits [H] (66.1m^2) and [L] (36.7m^2). The bottoms of those latter pits descend to the east, appearing to have been worked from north-west to south-east, as do pits [E], [U], [V] and [Y]. Pit [E] is 0.4m deep in the pocket at its south-east end whilst pit [U] reaches a depth of 0.65m over a distance of 8.9m.

Pit [v] is cut by pit [w], but digging sequences on the whole caused the extension of pits into multi-lobed features resulting in considerable variety of plan-form and structure. In contrast to the linear arrangement of basal hollows in pits [E], [H], [L], [V] and [Y], for example, the base of pit [G] is stepped down from either end into a deep hollow in the centre. Pits [D] and [F] are more rectangular on plan, comprised of clusters of pits grouped around deep central hollows whilst pit [K] includes a 0.8m deep pit to its southern side. The largest and most complex extractive features are pit [T], formed of five lobes, and [X] formed of six. Pit [T], partially overlain by a later straight embanked track, is 80.5m^2 on plan, containing banks and spurs of spoil dividing hollows up to 0.75m deep. Pit [X], 77.7m^2 on plan, descends from west to east in stages demarcated by internal scarps. The north-eastern side of its narrow, steep-sided, eastern arm is partially overlain by linear feature [10].

Simple pits are scattered amongst the more complex and the pits commonly abut with limited evidence for inter-cutting. No pits have extraction ramps and despite the number of pits there are no large discrete spoil heaps in the survey area, only a few small, well-defined stony mounds. Only one surface sarsen survives, with occasional sarsen pieces earth-fast in the sides of pits [j], [t], [u], [X] and [AA]. There are areas of flat open ground, firm underfoot and stony into which it is very difficult to push pegs and surveyors' arrows. These include the south-west part of the survey area around the concrete block, *c.*

25m^2 between pits [F] and [H], *c.* 35m^2 between pits [L] and [M] and *c.* 180m^2 immediately to the north of the straight embanked track.

In addition to the extraction pits, the survey area includes five finger-dumps running into the quarry from the main woodland ride. Overall there are fourteen finger-dumps in Hursley Bottom, some better formed and more substantial than others, interpreted by Amadio (2011, 39) as causeways for transporting stone out of the quarried area. Their eastern ends meeting the main woodland ride are slightly splayed and the surfaces are approximately level with the ride. Within the measured survey, finger-dumps [14] and [10] are most clearly defined. Finger-dump [13] is similar to [14] but its southern edge spreads imperceptibly into the ground surface. The terminals of finger-dumps [12] and [11] also merge with the ground surface and both include chunks of dumped masonry and concrete. Finger-dump [10], in contrast, is a well-defined embanked feature with high, steeply-sloping sides. Occasional bricks are visible eroding from its sides and there are some large concrete and masonry blocks on and just beyond its northern scarp. Finger-dumps [10], [11] and [12] overly earlier pits, yet the terminal of [12] and southern edge of [11] are also cut by pits.

A 79.9m-long straight embanked track runs perpendicularly from the main woodland ride towards Forest Lodge to the west. It provides a *c.* 4.3m-wide level carriageway with sloped sides. It overlies at least six quarry pits. Although it does not appear to continue into the gardens of Forest Lodge, it is aligned to the sarsen-built house which was described as ‘newly erected’ in 1866 (WSHC, 2027/2/1/911/13). An unmade path to the east of the woodland ride extends the alignment up the steep valley side. The track appears to have been part of the landscaping associated with the house and indicates that previously undocumented quarrying pre-dates the road-stone quarry of 1920.

Two important quarry structures survive in the southern part of the survey area. The first is a partially cement-rendered block made of poor-quality concrete including numerous voids, standing 1.4m tall (Fig. 18a). Its upper south-east corner is cut back. The upper surface has two shallow parallel ridges, 0.3m wide, in which are set four round-section iron pins, 35mm in diameter. King (1968, 86) identifies this feature as the base for a mechanical stone crusher, which accords with illustrations of such equipment in manufacturers' advertisements and photographed at work in road-stone quarries (for example Stanier 1995, 10, 87). The second structure is a small building cut into the valley side, made of precisely similar concrete covered at ground level by a flat corrugated iron and concrete roof (Fig. 18b). The L-shaped space is accessed by a flight of steps to the south-west, leading down to a former doorway providing a baffled entrance to the main chamber, 1.2m x 1.1m on plan. It is interpreted by Amadio (2011, 39) as a magazine or explosives store. Unfortunately, no licence permitting Thacker and Johnson to store explosives survives in Wiltshire County Council archives, but the underground space would have met the requirements for a magazine as specified in Order in Council 5 of the Explosives Act (1875), including its distance *c.* 95m from the quarry's powered machinery and the nearest dwellings in the valley bottom below.

A wider walk-over survey along Hursley Bottom (Fig. 12) revealed that Thacker and Johnson had worked from south to north, clearing sarsens from the valley floor. The portion of Stony Copse to the north of the measured survey is very similar, fully worked out with five finger-dumps extending from the main woodland ride into the heavily quarried area. One small group of sarsens survives at Stony Copse's northern edge, including one split boulder surrounded by an extraction gully and displaying a wedge-pit scar. That stone also has a cylindrical hole cut centrally in its upper surface. The next wood parcel to the north comprises 0.92ha of well-quarried ground including three finger-dumps. However, numerous large sarsens survive throughout that parcel, including a group of unsplit boulders with extraction gullies and sub-circular or sub-triangular cylindrical holes cut in the centre of their upper surface (Fig. 19). In some examples the stone surface around the holes is interrupted by small flake scars where material spalled off during the chiselling process, similar to scars around wedge-pit openings in Piggledene. The northernmost sarsens in this wood parcel are also encircled by deep extraction gullies. At least one is split including wedge-pit scars, as is a group of at least seven split blocks close to the main woodland ride. Each block in that group, however, also includes a cylindrical hole cut into its upper surface.

The northern-most part of the walk-over survey comprises a 0.42ha parcel including a short finger dump with numerous un-worked, earth-fast, sarsens. That parcel thus preserves part of Hursley Bottom's natural sarsen spread.

A metrical record of a sample of 15 of the cylindrical holes cut into boulder surfaces shows that they cluster into two groups (Fig. 19). The narrower holes are shallower (n=7, mean width 42mm, mean depth 134mm), contrasting with the wider, deeper ones (n=8, mean width 64mm, mean depth 213mm), but the sectional form is distributed across both groups. The ratio of width to depth of all these holes is 1:3 (calculated using the mean values). They are interpreted as charge-holes, intended for setting an explosive charge and fuse to blast each boulder apart.

Contrasting with those wood parcels to the north of the measured survey, the little quarrying evidence in the parcel to its south-west is limited to a few small, shallow, pits and some sarsens split using the 19th century wedging technique. Scattered amongst unworked sarsens, these split boulders were abandoned following primary reduction which includes examples of perpendicular splitting sequences similar to those observed in Piggledene.

DISCUSSION

TASKSCAPE

It is helpful to take a ‘dwelling perspective’ and think of the sarsen quarrying locales as different ‘taskscapes’ (Ingold 1993, 152-3), because although the same stone type was being worked, each developed in different contexts. Ingold defines taskscape as the human and social context in which actors complete their tasks, characterising the landscape in which that plays out as emergent through those activities (Ingold 1993, 155, 162; [2000] 2011, 325). The concept thus provides the interpretative flexibility in which to explore lived landscapes which, in the case of sarsen working, include multiple dispersed sites of differing technical action occurring at different times.

In this way, archaeological features in the study areas observed in the field and through archive sources are proxies for patterns of activities, including sarsen use, by which taskscapes developed. Rather than seeing quarry features conventionally as economic interventions inscribed onto a static landform to take advantage of a taken-for-granted geological resource, they arise from a network of processes. The form of their landscape incorporates practices of land-ownership, agricultural management and varied industrial behaviours, for example, as well as the geologically-determined properties of bulk minerals more commonly valorised in industrial archaeological studies.

UNDERSTANDING EARTH MATERIALS

In south Buckinghamshire, a landscape approach to recording and interpreting sarsen extraction using remote survey methods provides a small-scale view in which quarry features, digitised from historical Ordnance Survey maps, reveal an intensely extractive landscape. The variety in that landscape is under-served by the economic history of the area, in which aggregates and brick-making dominate the narrative of useful bulk minerals (Moir 2006, 4; Benham *et al*. 2003). In the third quarter of the 19th century when the first Ordnance Survey maps were produced, chalk extraction (5.73ha), gravel pits (1.59ha) and quarries (1.30ha) were more significant in the survey area than clay (0.94ha) by total pit area. The balance between materials derived from these mapped extraction sites changes over the period to the inter-war years, albeit complicated by the increasing numbers of unidentified pits and gaps in map revision coverage. Yet, the significance of these features in the landscape remains, with 135 pits observable in the early 20th century (Table 2); on average one pit per square kilometre in the area mapped at that time.

Bulk mineral extraction intensifies when marling is also considered. There are on average nine marl pits per square kilometre in the Walter's Ash study area. Although these undated features were not necessarily all open concurrently, they nevertheless remind us that materials were very commonly sought from underground to play a part in sustaining the land and the people living with it. Pits in farmland, woodland, at roadsides and even amidst settlements – such as at the Winchmore Hill pottery (BHER, 0203000000) and the Kiln Lane brickworks (BHER, 0219300000) – would have been a familiar, quotidian, sight. Farmers and minerals workers were negotiating a complex geology, applying knowledge of topography, soils, underlying deposits and bedrock in their daily lives.

Sarsen exploitation occurred in this active extractive landscape. The proximity of pits and quarries to named sarsen-producing locations highlights the complexity of the varied deposits, and the likelihood that people seeking specific products nevertheless encountered mixed materials through their work. Sarsens could be exposed in agricultural contexts including ploughing and marling, or industrial contexts including clay extraction for pottery and brick-making. They were also intentionally prospected for. The growth in the numbers and area of clay pits thus named by the Ordnance Survey in the early 20th century is due in part to the extension of works around Walter's Ash (Table 2). Yet, those pits were opened up principally for sarsen stone.

Stepping aside from the conventional, anthropocentric, industrial archaeological mode in which rock is a natural resource to be exploited is important, because on the Chiltern Hills sarsen boulders are largely unseen. They are not a clear and present material naturally available to the application of an out-of-the-box technology, the stone-cutting tool-set. Rather, the buried boulders themselves indicate where to dig when encountered either accidentally through plough-strike, for example, or purposefully through prospection. Legal relations were then formed between quarrymen and landowners, and between quarrymen and the land including the outright purchase of fields. The latter approach, requiring additional finance, must have been risky given the dispersed nature of the invisible boulders. It further emphasises the specialist knowledge and skill involved in identifying sources.

Evidence at Walter's Ash indicates that sarsen extraction pits on the Chiltern Hills are likely to be irregular, steep-sided features in the Plateau Drift where the boulders are imbricated with brickearth. By the time the Bristow and Brown's works were heading towards closure after the Second World War, their mean pit sizes had reached 245m^2 (N=113) but the majority were under 150m^2 (71, 63%), indicating likely sizes of similar pits on other chalk spurs of the dip-slope. Their area and range of simple to complex lobed plan forms are two-dimensional expressions of the, often deep, solution features in the chalk bedrock in which sarsens are found (Catt 2010, 88). These pit forms and their irregular placement - some closely adjacent, others spread apart - indicate the quarrymen's intimate understanding of the buried deposits. During prospection they relied on the buried boulders to act back: resisting the auguring snipers with which the ground was probed, communicating their presence and extent through information felt, not seen, by the quarrymen. Experiencing and responding to different textures and colours was important throughout the extractive process. Having excavated and removed both sarsens and sandy, clayey brickearth, quarrymen knew that ‘rock’, the pebbly, dark, sticky Clay-with-Flints lining solution pipes (Catt 2010, 87-9) marked the extent of the useful, workable, deposit.

It was, therefore, neither necessary nor useful to make use of mechanised open-area excavation. The sarsen quarry conforms to Samuel’s (1977) characterisation of 19th- and early 20th-century mineral workers operating discrete pits traditionally, using labour-intensive, hand-operated machinery. It was not, however, that the quarrymen went unaffected by external technological developments such as powered excavation in which they could not invest, or that they were constrained by long-standing traditions of hand-tool use not to innovate with new technology. On the contrary, they used their ‘knowledgeable practice and practical knowledge’ (Dobres 2000, 50), their bodies as much a part of the mechanism as the tools (Ingold [2000] 2011, 304-6, 316, 319), to maintain working traditions that enabled sarsens from pockets of deposits to be transformed into desirable products for both private and public markets.

The movement from 1847 onwards of members of Buckinghamshire stone-cutting families to Wiltshire is conventionally framed in terms of risk, enterprise and innovation. A few young men in their teens and twenties took a chance, seeking the Marlborough Downs’ more easily and cheaply worked surface sarsens: ‘One can hardly imagine the challenge that faced them in a totally new environment where they would have to kick-start an old industry with new methods, and find new markets to sell their stone.’ (Crook and Free 2011, 17).

Despite the supposed economic attractions of Wiltshire's sarsens, however, the presumed more difficult and less remunerative industry continued in Buckinghamshire. Furthermore, the results of the detailed analytical survey in Piggledene disrupt aspects of the conventional narrative. A range of features within the Piggledene survey transect indicate that the linear, stadial, sequence of sarsen extraction and cutting described by Free (1948) and King (1968) was not always followed exactly. For example, extraction gullies were not always dug to fully encircle boulders in Piggledene. The sloping valley floor comprises sediments which present particular circumstances to be negotiated in extracting boulders. Subtle variations in boulder surface treatments also contradict the conventional account of the process, especially the lack of chiselled guide-lines on any boulders in the survey transect except stone [6].

Wedge-pit placement further indicates choices in technical action to reduce individual stones. Before discussing the details, it is necessary to touch on the *burden* (de Kalb 1900) of a sarsen boulder. The burden is the line of least resistance to a splitting force: for example, the shortest distance necessary to determine the position of an explosive charge relative to the outer free face of the rock in a quarry wall. The more free faces there are, the smaller the amount of energy required to split a rock or boulder (de Kalb 1900, 91), explaining why an extraction gully might be advantageous to breaking up an earth-fast boulder. In addition to burden, stone splits most easily along its *rift* (usually the bedding plane), and relatively easily through its *grain* (at right angles to the rift). Recognizing these planes informs choices for reduction sequences, requiring a line of wedges along the rift and, against the rift, wedges that continue down the sides of the stone (Greenwell and Elsden 1913, 80-1, 214-8). Sarsen stone, however, is typically homogenous with very poorly-defined bedding structures (Geddes and Walkington 2005, 62; Summerfield and Goudie 1980, 74). Through its homogeneity, it affords the capability to split in a controlled and even way in potentially any direction.

Gully excavation and wedge placement evident in the Piggledene survey transect contribute to diminishing each boulder's burden. For example, one wedge placed in the side of stone [28], at its thicker and partially-excavated end, assisted two wedges placed in the upper surface to split this otherwise relatively thin, tabular, boulder. No excavation gully was required around stone group [89]/[100] because the parent boulder was perched on a linear earthwork. The quarrymen's skill and judgement are also exhibited by stone [34], a large, rounded, boulder also unexcavated, split by four wedges all placed in its eastern side. Three were placed close together and low down to the ground, one further away and higher up. The arrangement conforms in part to Greenwell and Elsden's (1913, 214-6) instruction to use multiple wedges, but shows how an intimate knowledge of the properties and behaviour of sarsen reduced the need for any more than were necessary to propagate a split.

A key feature of Wiltshire's Downland sarsen spreads is the amount of surviving material despite the proliferation of stone exploitation since prehistory. Around 20% of the stone present in the Piggledene survey transect is untouched. The boulders may have been more easily accessible than in Buckinghamshire, but that is not to say that all were suitable for splitting. Many were not selected by the stone-cutters. The abandonment of some partially-split boulders indicates the significance of sarsen's role in the quarry as well as the judgement exercised by the quarrymen, illustrated by stone [47] and also stone group [131]/[136]; a further example of the stone acting back when small flints inside the matrix spoiled the quarrymen's intentions and ended in the pragmatic leaving of the partially broken boulder.

Throughout this reduction process, developed in Buckinghamshire and translocated to Wiltshire, both the tools and the materials influenced the actions of the quarrymen. Information was gathered from the way each split occurred during reduction, visually, aurally and hapticly, enabling the stone-cutters to apply know-how and make choices to achieve their objectives (and see Nunez-Garcia 2019). Beatrice Searle (2019), for example, writes of the role of listening in the process of stone-splitting,

> The stone says what is about to happen and whether it will be cooperative, or not…The stone ceases to make a speak [sic] when it has settled around the plug and feathers and is ready to continue. If I ignore this communication and resume the process too soon, the stone will almost certainly rip out a chunk of itself along the path of least resistance.

The archaeological features demonstrate that decisions in Piggledene were made in relation to the burden and the matrix of each sarsen boulder. Attending to the burden was more important than following a prescribed working method, as shown by surface treatments, wedge-pit placement and the choice whether or not to excavate gullies. In some instances, such as stone group [89]/[100], the quarrymen took advantage of the lie of the land to assist them. The homogeneity of the matrix played a part in how predictably and cleanly each sequence of perpendicular splits would execute. These are subtle features, but close examination of such details reveals the complexity of the relationship between material, quarryman and technology.

Accounts of the revolutionary introduction to Wiltshire of specialist sarsen-cutting tools and techniques from Buckinghamshire only describe the wedging method of stone-reduction. Yet plug-and-feather holes cut into sarsens in Piggledene are noted by Stanier

(2000, 43) and were recorded during the survey. By the time Buckinghamshire stone-cutters were established in Wiltshire after 1847, the use of plug-and-feather had become widespread in stone quarrying. There are no phase relationships between boulders in Piggledene split by different methods, but the probably 19th-century walls enclosing the northern yard to Pickledean Barn comprise sarsen blocks predominantly split by plug-and-feather, with very few examples of wedged stone.

The possible contemporaneity of wedging and plug-and-feather, or perhaps earlier use of plug-and-feather before the 1840s, also contradicts the conventional narrative of Buckinghamshire innovators introducing a tool-set uniquely designed to split sarsen stone. It is important to bear in mind that descriptions of stone-cutting in Wiltshire originate with Douglas Free (1948, 1950), grandson of a stone-cutter who moved from Buckinghamshire, and are augmented a generation later by King (1968) who drew on local oral history. That published narrative privileges the knowledge of a few individuals without reference to local practices of sarsen use pre-dating the 1840s. Furthermore, the generalisations in those accounts, brought into question by this fieldwork, obscure the potential for experimentation, innovation and change by the skilled quarrymen.

The same selectivity revealed in Piggledene is evident in Hursley Bottom, where the distribution of sarsens with wedge-pit scars across the overall walk-over survey area now provides evidence for traditional splitting pre-dating the road-stone quarry of 1920. The activity may date to as early as the 1860s and the creation of Forest Lodge. As in Piggledene, some boulders were left untouched whilst some partially split boulders were abandoned. Charge-holes were later chiselled out of some of the partially split sarsens lying to the north of the Hursley Bottom measured survey area, suggesting that the earlier stone-cutters had taken their pick of boulders along the valley before Thacker and Johnson began their less discriminate extraction.

On the face of it, Thacker and Johnson's completely different approach to sarsen exploitation was driven by the need to produce large volumes of consistently sized rubble for road-stone. There is, it seems, no artisanal skill involved in making the stone chunks and chips, only chemically-assisted brute force to shatter the boulders in primary reduction, powered machinery to crush the fragments, and a set of procedures to follow to meet the legislated requirements for operating with explosives. To an extent this is borne out, by the almost complete clearance of sarsens from Stony Copse and details such as the buried magazine carefully placed at distance from the working area and nearby residences. Nevertheless, even though the road-stone quarry was mechanised, evidence in Hursley Bottom indicates that objectives were as, if not more, important than rules in conditioning extractive practices, making this a taskscape in Ingold's sense ([2000] 2011, 325).

The mix of simple and complex lobed pits dug out of Head deposits in the valley bottom are reminiscent of the, albeit generally larger, sarsen and clay pits at Walter's Ash in Buckinghamshire. The Hursley Bottom measured survey results suggest that the superficial deposits tend to lie thickest to the eastern side, indicated by the greater complexity and depth of numerous pits and the downslope linear arrangement of extractive pits. That would be consistent with geological sections observed in test pits dug across nearby Clatford Bottom by Clark, Lewin, and Small (1967, 27-30), which also exposed solution pipes containing sarsens. The base of Hursley Bottom may be similar, and it should be noted that none of its quarry pits contain standing water in the Winter and must be freely draining, presumably in the underlying Chalk.

The size, complexity and distribution of the extraction pits has, however, as much to do with quarrying decisions as the mere geological presence of available stone. Although boulder reduction was mechanised, pit forms in the worked-out area of Stony Copse indicate that excavation was not. Steep pit sides and multi-lobed shapes including internal scarps give the impression that sarsens were chased through the deposit, but that was not an indiscriminate exercise resulting in a fully open-area excavation. The well-defined pit edges show that digging stopped when no more sarsens were clustered in the deposit. The absence of extraction ramps suggests that while simple lifting gear may have been required to remove material from the deepest, steep-sided pits, much of the movement of broken sarsen out of the pits must have been carefully by hand onto vehicles (whether barrows or carts) on the finger-dumps for transport to the stone crusher.

The use of extraction gullies and placement of charge-holes further indicates choices that were made to prepare the ground and reduce individual boulders. Numerous sarsens remaining to the north of the measured survey area were released from enclosing deposits by encircling gullies, firstly reducing the burden and secondly assisting the removal of broken stone. The group of closely-positioned boulders treated in this way which also have charge-holes indicate that only as many boulders as could be shattered in one session were prepared, reducing the amount of risky rubbish and water that might enter the holes before use.

The aim of primary reduction by blasting is to shatter rock such that it can be collected and moved on to the next processing stage. The correct amount of charge required to shatter a particular type of rock can be found by experiment and then reduced in proportion to the number of free rock faces: assuming a boulder with a gully has in effect five free faces, then two-fifths of the charge required to break sarsen will be sufficient per boulder, set in a centrally-placed charge-hole that roughly equalises the burden (de Kalb 1900, 91-5; Greenwell and Elsden 1913, 299). If the stone is homogenous, then the weight of the necessary charge will be proportionate to the cube of the burden (Burgoyne 1895, 16) and a suitably-sized charge-hole can be cut out to take the explosive, tamping and fuse. ‘When done judiciously’ Burgoyne writes, ‘the report will be trifling, and the mass will be seen to be lifted, and thoroughly fractured, rent, or thrown over, without being forcibly projected' (1895, 8). Hursley Bottom charge-holes vary in width and depth but the relationship between these dimensions is regularly in the ratio 1:3, demonstrating the knowledge born of experience that Thacker and Johnson had accrued during their clearance of Stony Copse as they worked through Hursley Bottom.

In order to transport shattered sarsen to the stone crusher, finger-dumps were built up from the main woodland ride into the quarried area. Thacker and Johnson's intentionality is demonstrated by finger-dump placement at fairly regular intervals including in wood parcels where boulders had yet to be prepared for clearance, and the carefully built-up eastern ends having splayed approaches to the ride. The irregularity of the plan forms of, for example, finger-dumps [11] and [12] as they were expanded and used indicates a more haphazard process over the duration of tasks in the quarry. The relationship between these two finger-dumps and adjacent extraction pits reveal that Thacker and Johnson did not clear sections of the wood parcels systematically. Finger-dump [11] was made in two spurs to access pits being opened up towards the middle of the wood parcel, and pit [K] was extended back into the embanked feature as sarsens were removed. Again, the quarrymen's objectives were important factors in shaping the landscape forms of the valley bottom, rather than pursuing a scientific approach to the most efficient exploitation of its natural resources.

The shattered sarsen was moved to the stone crusher, elevated on its concrete base and standing in a relatively open part of Stony Copse. The base's cut-back south-east corner indicates where a belt passed from the crusher to a small wheel driving the trommel, a kind of cylindrical sieve into which crushed stone dropped out of the raised crusher jaws. The trommel assisted the separation of differently-sized stone pieces, and allowed too large items to be returned to the crusher for further processing. Both the construction of the concrete base and the positioning of the crusher and trommel are expedient yet calculated: the concrete mix is poor, the trommel position is towards the southern access track permitting crushed stone to be easily removed off-site, whilst the area behind the base is flat enough for a portable engine to stand, powering the machinery.

In this taskscape, the context of sarsen exploitation includes not only rules arising from the Explosives Act (1875), treatises on how to blast rock and the demands of a commercial contract. The messy business of dealing with the valley deposits and the quarrymen's knowledge of the behaviours of sarsen stone are also part of the pattern of technical actions which this landscape incorporates. Unlike at Walter's Ash, the immediate presence of boulders is obvious from the surface spread populating the valley bottom. Yet the thick Head concealed further valuable material which would only have become apparent in the process of removing the visible boulders. Each extractive event embodied what Ingold (1993, 157) identifies as both something of the past and a potentiality for the future: removing one boulder perhaps to reveal another, until a cluster was worked out in an objective-led task-orientation. The proliferation of sarsen was thus revealed through the technical actions adopted in the quarry.

CONCLUSION

In each of these quarries, the same type of stone was exploited to make very different products. Properties of sarsen stone afforded this flexibility. The size, volume and frequency of the boulders provided quantities of material to support an albeit short-term road-stone contract, but also to service longer-term quarrying to make carefully proportioned setts, kerbs, dimension stone, ashlars and other shaped products. Sarsen's homogeneity, hardness and brittleness enabled both precise and controlled splitting into those regular forms, and reduction into rubble and chips, as though it was a different material depending on the technical action applied to it. Quarrymen using dissimilar reduction methods nevertheless experienced some of the same behaviours of the stone: its tendency to flake and spall when wedge-pits or charge-holes were chiselled into boulder surfaces, for example, or its propensity to cluster in superficial deposits revealed through excavation, reminding us of sarsen's identity as 'breeding stone'.

The different methodologies adopted in this study are complimentary, enabling the exploration of relations between people, materials and technology at different scales. Both the intensive and extensive approaches taken to recording and analysing these separate quarries shows that a great deal of information can be gleaned even from sites of surface extraction. It is worth paying attention to the smallest of details which analytical earthworks survey and metrical recording of tool-marks can capture.

In Piggledene, an interplay between skilled human action, the sarsen-cutting toolset and material properties of sediments and stone is revealed, through subtleties in how the reduction process was applied to individual boulders. Plug-and-feather stone-working practices are identified in the valley, hinting at an alternative or more complex story obscured by the conventional narrative of a uniquely-successful sarsen-working technique introduced to Wiltshire by outsiders. A landscape approach using remotely-sensed data and other archive material throws light on quarry practices at Walter's Ash despite the redevelopment of the yards. There, experience and knowledge of deposits contributed to the maintenance of traditional quarrying methods. In Hursley Bottom the use of explosives and mechanised stone-breaking still involved making objective-led decisions about technical actions based on understanding of materials. Thacker and Johnson were 'coping with machines' (Ingold [2000] 2011, 332), learning how charge-holes needed to be cut based on the burden of individual sarsens and laying out their infrastructure partly because of regulation and partly for convenience but then adapting it, for example re-working their finger-dumps in response to the actualities of the valley's deposits. Landscape forms recorded in the survey arose from the execution of tasks towards objectives, showing the interplay between a commodity perspective directed towards the market for stone and a dwelling perspective focussing on skilled social agents at work (Ingold [2000] 2011], 332-3).

The complexity of the relationships between people, materials and technology which concerns Conneller (2011) is revealed through close attention to the materials and technical actions of all three taskscapes. Despite the contrasting methodological scales employed in the study areas, the significance of bodily engagement with the materials encountered in the landscape is evident. That worked at both the macro level of engagement with the particular deposits in which sarsens can be found, and at the micro level of engagement with individual boulders as choices were made in reduction processes. Although all three sites made commercial products, to view them through a purely economic lens or to treat these stone-working technologies as functional absolutes would be to diminish the roles of both active human agents and the materials with which they worked.

ACKNOWLEDGEMENTS

I thank Dr Elaine Jamieson and Dr Krystyna Truscoe for their invaluable fieldwork assistance, and Forestry England and The National Trust for access, in Wiltshire. Fieldwork equipment including Total Station and GNSS were kindly provided by the University of Reading. Members of the Historic England Archaeological Investigation and Mapping Team, in particular Fiona Small, enabled me to complete the Buckinghamshire transcription. Historic England Archive kindly provided access to aerial photography.

Access to other archive material and records was enabled by British Geological Survey, Buckinghamshire County Museum, Buckinghamshire Archives and both the Buckinghamshire and Wiltshire Historic Environment Records. I would also like to thank the two anonymous reviewers whose encouraging and useful comments enabled me to make improvements to my original manuscript.

REFERENCES

MANUSCRIPT SOURCES

1225/73, Conveyancing papers relating to West Woods estate in West Overton, Fyfield and Preshute including sale particulars with plans 1928 and 1931.

2027/2/1/911/13, Merriman, Porter and Long solicitors (Marlborough), sales particulars, Cottages in Angel Yard, Marlborough and at Fosbury and Lockeridge Dean in Overton, and Clatford Park in Preshute, 1866.

2943B/2/50, Letters to James Long, 7th baronet later Sir James Tylney Long.

CH 1/T/24, Lease (with counterpart) for 54 years commencing 1736, 21 Oct 1730.

D-CN/9/5/1/21, Counterpart Lease for fifteen years, 10 Jun 1740.

D-X/935, Copy photographs of Brown Brothers and Bristows brickyards at Walter's Ash in Lacey Green, 1930-1956.

F1/100/6/6/, Wiltshire County Council Roads and Bridges Committee.

RHW:50634, View of a stone-mason, Mr Ralph Turner, at work on a small block of stone supported on an upturned drum (1950).

DATABASE SOURCES

BHER 0203000000, Winchmore Hill Pottery [accessed January 14, 2021] https://heritageportal.buckinghamshire.gov.uk/Monument/MBC6006.

BHER 0219300000, Kiln Lane Brickworks [accessed January 14, Jan 2021] https://heritageportal.buckinghamshire.gov.uk/Monument/MBC6444.

BHER 0505600000, Honor End Lane, Prestwood [accessed January 14, 2021] https://heritageportal.buckinghamshire.gov.uk/Monument/MBC13141.

GB Historical GIS Project. 2009-2017. “Hughenden AP/CP through time. Population Satistics. Total Population.” *A Vision of Britain Through Time* (University of Portsmouth) [accessed 28 July 2021]

https://www.visionofbritain.org.uk/unit/10065320/cube/TOT_POP

GB Historical GIS Project. 2009-2017. “West Overton CP/APthrough time. Population Statistics. Total Population.” *A Vision of Britain Through Time* (University of Portsmouth) [accessed 28 July 2021]

https://www.visionofbritain.org.uk/unit/10410824/cube/TOT_POP

NHLE 1060234, Denner Hill Farmhouse. Historic England [accessed May 1, 2017]

https://www.historicengland.org.uk/listing/the-list/list-entry/1160234.

NHLE 1332051, Pair of Barns Adjoining to West of Denner Hill Farmhouse. Historic England [accessed May 1, 2017] https://www.historicengland.org.uk/listing/the-list/list-entry/1332051.

“Notes and News: Local and General,” *Bucks Herald*, 7 October 1911,

https://www.britishnewspaperarchive.co.uk

“Aylesbury Urban District Council,” *Bucks Herald*, 17 February 1912,

https://www.britishnewspaperarchive.co.uk

“Amersham,” *Bucks Herald*, 3 October 1925, https://www.britishnewspaperarchive.co.uk

PUBLISHED SOURCES

Adams, J. 1870. "Sarsens." *Transactions of the Newbury District Field Club* 1: 104-109.

Alfrey, Judith. 2006. "The Language of Its Builders: Stone in the Vernacular of Rural Wales During the Nineteenth Century." *Vernacular Architecture* 37 (1): 54-60. https://doi.org/10.1179/174962906X158255.

Allen, J.R.L. 2015. *Kerbside Geology in Reading, Berkshire. Aspects of historical archaeology in the explanding town, c1840-1914.* BAR British Series 619. Oxford: Archaeopress.

Allen, J. R. L. 2017. "Geological resources and their exploitation in the Berkshire chalklands of the later nineteenth century: a first survey." *Landscape History* 38 (1): 67-80. https://doi.org/10.1080/01433768.2017.1322271.

Amadio, L. 2011. *West Woods, Wiltshire. An Archaeological Survey.* Devizes: Wiltshire Archaeological and Natural History Society. https://doi.org/10.5284/1018072.

Anon. 1908. "The Grey Wethers Preservation Fund." *Wiltshire Archaeological Magazine* 35 (109): 497-501.

Bedford, J., T. Pearson, B. Thomason, and A. Oswald. 2016. *Traversing the Past. The Total Station Theodolite in Archaeological Landscape Survey.* Swindon: Historic England.

Benham, A.J., A.N. Morigi, A.J.M. Barron, D.G. Cameron, N.A. Spencer, M.H. Shaw, A.J. Bloodwirth, D.J. Evans, G.K. Lott, and D.E. Highley. 2003. *Mineral Resource Information in Support of National, Regional and Local Planning. Buckinghamshire and Milton Keynes.* British Geological Survey/Office of the Deputy Prime Minister (Keyworth: HMSO). https://www.bgs.ac.uk/mineralsUK/planning/resource.html.

Born, A. 1988. "Blue Slate Quarrying in South Devon: An Ancient Industry." *Industrial Archaeology Review* 11 (1): 51-67. https://doi.org/10.1179/iar.1988.11.1.51.

Bovill, W. 1903. "The Buried Stones on the Chilterns." *The World's Work* September 1903: 367-369.

Bowen, H.C., and I.F. Smith. 1977. "Sarsen Stones in Wessex: the society's first investigations in the Evolution of the Landscape Project." *The Antiquaries Journal* 57 (2): 185-196.

Brentnall, H.C. 1946. "Sarsens." *Wiltshire Archaeological and Natural History Magazine* 51: 419-439.

Britton, J., ed. 1847. *The Natural History of Wiltshire by John Aubrey F.R.S. written between 1656 and 1691*. Newton Abbot: David and Charles.

Brück, J. 2006. "Fragmentation, Personhood and the Social Construction of Technology in Middle and Late Bronze Age Britain." *Cambridge Archaeological Journal* 16 (3): 297-315.

Burgoyne, J.F. 1895. *A Treatise on the Blasting and Quarrying of Stone for Building and Other Purposes*. London: Lockwood and Son.

Burtonwood, G. 1995. *Denner Hill Stone.* Halton: Buckinghamshire County Museum Archaeological Service.

Catt, J. 2010. "Neogene deposits and early landscape development." In *Hertfordshire Geology and Landscape*, edited by J. Catt, 79-117. Welwyn Garden City: Hertfordshire Natural History Society.

Clark, M. J., J. Lewin, and R. J. Small. 1967. *The Sarsen Stones of the Marlborough Downs and their Geomorphological Implications.* Southampton: Department of Geography, University of Southampton.

Colfer, N. 2010. "Between the sea and the land: coastal limestone quarries on the Hook Peninsula, Co. Wexford." *The Journal of Irish Archaeology* 19: 113-130.

Conneller, C. 2011. *An Archaeology of Materials: Substantial Transformations in Early Prehistoric Europe.* Abingdon: Routledge.

Coppack, J.T. 1962. *The Chilterns. A Description of the O.S. One-inch Sheet 159*. Sheffield: The Geographical Association.

Cordiner, R. J., and A. Brook. 2017. *Building Stone Atlas of Sussex*. Worthing: Verite

Crook, M.L., and I.E.T. Free. 2011. *Grey Wethers. The Free family in Marlborough and the Upper Kennet Valley c1847-1998.* Privately published.

Crossley, D. 1990. *Post-Medieval Archaeology in Britain*. Leicester: Leicester University Press.

Davies, A., and Arnold H.J. Baines. 1953. "A preliminary survey of the sarsen and puddingstone blocks of the Chilterns." *Proceedings of the Geologists' Association* 64 (1): 1-9.

de Kalb, C. 1900. *Manual of Explosives: a Brief Guide for the use of Miners and Quarrymen*. Toronto: The Ontario Bureau of Mines.

Dewey, H., and C.E.N. Bromehead. 1915. *The Geology of the Country Around Windsor and Chertsey*. London: HMSO.

Dobres, M.-A. 2000. *Technology and Social Agency. Outlining a Practice Framework for Archaeology*. Oxford: Blackwell.

Ellis, Grace A., and C. Jamison. 1925. "Hughenden." In *The Victoria County History of the County of Buckingham*, edited by W. Page, 57-62. London: The St Catherine Press.

Evans, S. 2019. *Historic England Archaeological Investigation and Mapping (formerly National Mapping Programme) Standards Technical Review.* Swindon: Historic England.

Fowler, Peter, and Blackwell, Ian. 1998. *The Land of Lettice Sweetapple.* Stroud: Tempus.

Free, D.W. 1948. "Sarsen stones and their origin." *Wiltshire Archaeological and Natural History Magazine* 52: 338-344.

Free, D.W. 1950. *Marlborough and District: An Original Peep Into the Past*. Marlborough.

Freeman, R.A. 2001. *Bases of Bomber Command Then and Now*. London: Battle of Britain International.

Frieman, C.J. Forthcoming. "Innovation, continuity and the punctuated temporality of archaeological narratives." In *Everywhen: Knowing the Past Through Language and Culture*, edited by A. McGrath, L. Rademaker and J. Troy. Lincoln, NE: University of Nebraska Press.

Geddes, I. 2000. *Hidden Depths. Wiltshire's Geology and Landscapes*. 2nd ed. Trowbridge: Ex Libris Press.

Geddes, I., and H. Walkington. 2005. "The Geological History of the Marlborough Downs." In *The Avebury Landscape. Aspects of the Field Archaeology of the Marlborough Downs*, edited by G. Brown, D. Field and D. McOmish, 58-65. Oxford: Oxbow Books.

Gillings, M., J. Pollard, D. Wheatley, and R. Peterson. 2008. *Landscape of the Megaliths. Excavation and Fieldwork on the Avebury Monuments, 1997-2003.* Oxford: Oxbow Books.

Green, C. 2016. "The exploitation of silcretes (sarsen and puddingstone) in England and Normandy since Stonehenge." *Proceedings of the Geologists' Association* 127 (3): 349-358. https://doi.org/10.1016/j.pgeola.2015.12.002.

Green, D., and S. Kidd. 2006. *Buckinghamshire and Milton Keynes Historic Landscape Characterisation.* Aylesbury: Buckinghamshire County Council.

Greenwell, A., and J.V. Elsden. 1913. *Practical Stone Quarrying. A Manual for Managers, Inspectors, and Owners of Quarries, and for Students.* London: Crosby Lockwood and Sons.

Gwyn, D. 1999. "Power Systems in Four Gwynedd Slate Quarries." *Industrial Archaeology Review* 21 (2): 83-100. https://doi.org/10.1179/iar.1999.21.2.83.

Hicks, D. 2016. "The Temporality of the Landscape Revisited." *Norwegian Archaeological Review* 49 (1): 5-22.

Ingold, T. 1993. "The Temporality of the Landscape." *World Archaeology* 25 (2): 152-174.

Ingold, T. (2000) 2011. *The Perception of the Environment*. Abingdon: Routledge.

Jamieson, E., S. Ainsworth, M. Bowden, D. McOmish, and T. Pearson. 2017. *Understanding the Archaeology of Landscapes. A Guide to Good Recording Practice.* 2nd ed. Swindon: Historic England.

Johnson, M. 2007. *Ideas of Landscape*. Oxford: Blackwell.

Jones, M., and C.F. Green. In press. “A Romano-British Puddingstone Quarry in the Hertfordshire Chilterns.” *Proceedings of the Geologists’ Association.*

Kelly’s Directory of Buckinghamshire. 1911. London: Kelly’s Directories.

King, N.E. 1968. "The Kennet Valley Sarsen Industry." *Wiltshire Archaeological and Natural History Magazine* 63: 83-93.

Knapp, A.B. 1998. "Social approaches to the archaeology and anthropology of mining." In *Social Approaches to an Industrial Past. The Archaeology and Anthropology of Mining*, edited by A.B. Knapp, V.C. Piggott and E.W. Herbert, 1-23. London: Routledge.

Lamesa, Anais. 2017. "If techniques help to date a monument…three case studies." In *Cappadocia - Hypogea 2017. Proceedings of the International Congress of Speleology in Artificial Cavities*, edited by M. Parise, C. Galeazzi, R. Bixio and A. Yamac, 58-64. Kapadokya: Dijital Dusler.

Le Neve Foster, C. 1894. *A Textbook of Ore and Stone Mining*. London: Charles Griffin.

Leroi-Gourhan, André. 1993. *Gesture and speech*. Translated by Anna Bostock Berger. Cambridge, MA: MIT Press.

Lim, J., J. Clark, and G. Linares-Matás. 2020. "Subsurface delineation of doline features associated with Pleistocene clay-with-flints deposits in the Chilterns: Implications for British Palaeolithic archaeology." *Journal of Archaeological Science: Reports* 34: 102665. https://doi.org/https://doi.org/10.1016/j.jasrep.2020.102665.

Linsley, S.M. 1990. "Millstones from Brockholm Quarry, Northumberland." *Industrial Archaeology Review* 12 (2): 178-184. https://doi.org/10.1179/iar.1990.12.2.178.

Mate, G. 2013. "Mount Shamrock: A Symbiosis of Mine and Settlement." *International Journal of Historical Archaeology* 17 (3): 465-486.

Moir, J.. 2006. *Chilterns Building Design Guide. Chilterns Brick. Supplementary Technical Note.* Chinnor: Chilterns Conservation Board.

Morleghem, D. 2016. "Production et diffusion des sarcophages de pierre de l'Antiquité tardive et du haut Moyen Âge dans le Sud du Bassin parisien." PhD diss., University of Tours.

Murton, J.B., and C.K. Ballantyne. 2017. "Periglacial and Permafrost Ground Models for Great Britain." In *Engineering Geology and Geomorphology of Glaciated and Periglacial Terrains*, edited by J.S. Griffiths and C.J. Martin, In Engineering Geology Special Publications, 501-597. London: The Geological Society.

Nash, David J., and J. Stewart Ullyott. 2007. "Silcrete." In *Geochemical Sediments and Landscapes*, edited by David J. Nash and S.J. McLaren, 95-143. Oxford: Blackwell Publishing.

National Heritage List for England (Historic England), https://historicengland.org.uk/listing/the-list/.

Newman, P., ed. 2016. *The Archaeology of Mining and Quarrying in England: A Research Framework*. Matlock: The National Association of Mining History Organisations.

Nunez-Garcia, Alicia. 2019. "'Crafting Agency': An Inquiry into Symmetrical Human-Thing Assemblages." *Archaeological Review from Cambridge* 34, (2): 26-43.

Oliver, R. 1993. *Ordnance Survey Maps. A Concise Guide for Historians*. London: The Charles Close Society.

Orange, H. 2008. "Industrial Archaeology: Its Place Within the Academic Discipline, the Public Realm and the Heritage Industry." *Industrial Archaeology Review* 30 (2): 83-95. https://doi.org/10.1179/174581908X347292.

Osborne White, H.J. 1907. *The Geology of the Country around Hungerford and Newbury.* London: His Majesty's Stationery Office.

Osborne White, H.J. 1909. *The Geology of the Country around Basingstoke.* London: His Majesty's Stationery Office.

Osborne White, H.J. 1912. *The Geology of the Country around Winchester and Stockbridge.* London: His Majesty's Stationery Office.

Osborne White, H.J. 1925. *The Geology of the Country Around Marlborough.* London: His Majesty's Stationery Office.

Pevsner, N., and E. Williamson. 1994. *The Buildings of England. Buckinghamshire*. London: Penguin.

Pfaffenberger, Bryan. 1992. "Social Anthropology of Technology." *Annual Review of Anthropology* 21: 491-516.

Potter, John F. 1998. "The distribution of silcretes in the churches of the London Basin." *Proceedings of the Geologists' Association* 109 (4): 289-304. https://doi.org/https://doi.org/10.1016/S0016-7878(98)80022-9.

Prestwich, J. 1854. "On the Structure of the Strata between the London Clay and the Chalk in the London and Hampshire Tertiary Systems. Part II: the Woolwich and Reading Series." *Quarterly Journal of the Geological Society* 10: 75-138. https://doi.org/10.1144/GSL.JGS.1854.010.01-02.10.

Priest, St J. 1810. *General View of the Agriculture of Buckinghamshire*. London: Richard Phillips.

Rastell, J. 1530. *The Pastyme of People: the cronycles of dyuers realmys and most specyally of the realme of Englond*. London: John Rastell.

Reed, M. 1979. *The Buckinghamshire Landscape*. London: Hodder and Stoughton.

Rockwell, Peter. 1993. *The Art of Stoneworking: a Reference Guide*. Cambridge: Cambridge University Press.

Rupert Jones, T. 1886. "History of the Sarsens." *Wiltshire Archaeological and Natural History Magazine* 23 (68): 122-154.

Samuel, R. 1975. "“Quarry Roughs”: Life and Labour in Hedington Quarry, 1860-1920. An essay in oral history." In *Village Life and Labour*, edited by R. Samuel. London: Routledge.

Samuel, R. 1977. "Mineral Workers." In *Miners, Quarrymen and Saltworkers*, edited by R. Samuel, 3-97. London: Routledge and Keegan Paul.

Scard, A.M. 1989. "The Development and Changing Organisation of Shropshire's Quarrying Industry: 1750-1900." *Industrial Archaeology Review* 11 (2): 171-186. https://doi.org/10.1179/iar.1989.11.2.171.

Scott-Brown, S. 2017. "The Secret Life of Headington Quarry. People’s History in the Field." In *The Histories of Raphael Samuel, A Portrait of the People’s Historian*, edited by S. Scott-Brown, 131-162. Canberra: ANU Press.

Searle, Beatrice. 2019. "Learning a Stone." *The Clearing* December 3, 2019. https://www.littletoller.co.uk/the-clearing/essay/learning-a-stone-by-beatrice-searle/.

Sheahan, J.J. 1872. *History and Topography of Buckinghamshire*. London: Longman, Green, Longman and Roberts.

Sherlock, R.L. 1919. "Excursion to Walter's Ash, Buckinghamshire, Saturday, July 26th, 1919." *Proceedings of the Geologists' Association* 30: 191-3.

Sherlock, R.L. 1922. *The Geology of the Country around Aylesbury and Hemel Hempstead.* London: His Majesty's Stationery Office.

Sherlock, R.L., and A.H. Noble. 1912. "On the Glacial Origin of the Clay-with-Flints of Buckinghamshire and on a former course of the Thames." *Quarterly Journal of the Geological Society* 68: 199-208. https://doi.org/doi:10.1144/GSL.JGS.1912.068.01-04.13.

Sherlock, R.L., and A.H. Noble. 1922. *The Geology of the Country around Beaconsfield.* London: His Majesty's Stationery Office.

Spicer, E.C. 1905. "Sarsen-Stones in a Claypit." *Quarterly Journal of the Geological Society* 61: 39-41. https://doi.org/10.1144/GSL.JGS.1905.061.01-04.07.

St John Hope, W.H. 1913. *Windsor Castle: an Architectural History*. London: Country Life.

Stanier, P. 1995. *Quarries of England and Wales. An Historic Photographic Record*. Truro: Twelveheads Press.

Stanier, P. 2000. *Stone Quarry Landscapes. The Industrial Archaeology of Quarrying*. Stroud: Tempus.

Stukeley, W. 1743. *Abury - A Temple of the British Druids, with some others, described, etc*. London: n.p.

Summerfield, M.A., and A.S. Goudie. 1980. "The sarsens of southern England: their palaeoenvironmental interpretation with reference to other silcretes." In *The Shaping of Southern England.*, edited by David K.C. Jones, 71-100. London: Academic Press.

Thomas, I. 2016. "Bulk Minerals." In *The Archaeology of Mining and Quarrying in England. A Research Framework for the Extractive Industries in England*, edited by P. Newman, 33-83. Matlock: The National Association of Mining History Organisations.

Trueman, M.R.G. 1992. "The Langcliffe Quarry and Limeworks." *Industrial Archaeology Review* 14 (2): 126-144. https://doi.org/10.1179/iar.1992.14.2.126.

Truscoe, K. 2017. *Silchester Iron Age Evirons Project: Aerial Photography and Lidar Survey Results.* Swindon: Historic England.

Ullyott, J. Stewart, David J. Nash, Colin A. Whiteman, and Rory N. Mortimore. 2004. "Distribution, petrology and mode of development of silcretes (sarsens and puddingstones) on the eastern South Downs, UK." *Earth Surface Processes and Landforms* 29: 1509-1539. https://doi.org/10.1002/esp.1136.

Whitaker, Katy A. 2019. "Sarsen stone quarrying in southern England: an introduction." In *Mining and Quarrying in Neolithic Europe. A Social Perspective*, edited by A. Teather, P. Topping and J. Baczkowski, 101-113. Oxford: Oxbow Books.

Whitaker, Katy A. In preparation. “Sarsen stone cutters in Buckinghamshire and Wiltshire: investigating communities of practice through Census records.”

Whitaker, W. 1864. *The Geology of Parts of Middlesex, Hertfordshire, Buckinghamshire, Berkshire and Surrey*. London: HMSO.

Willies, L., N. Redvers-Higgins, and I. Wain, eds. 2011. *'Finished Labour of a Thousand Hands'. The Archaeology of the Combe Down Stone Mines, Bath, Somerset*. Oxford: Oxford Achaeology.

Woodward, H. B., and R. S. Herries. 1905. "Excursion to the Chilterns: Saturday, June 3rd, 1905." *Proceedings of the Geologists' Association* 19 (3): 147-149. https://doi.org/https://doi.org/10.1016/S0016-7878(05)80035-5.

Woodward, H.B. 1881. "Note on a Greyweather at Bayswater." *Geological Magazine* 8 (3): 119-121. https://doi.org/10.1017/S0016756800186261.

Woodward, H.B. 1905. "Geology." In *The Victoria County History of the County of Buckingham.*, edited by W. Page, 1-24. London: James Street.

ABBREVIATIONS

BA, Buckinghamshire Archives

BHER, Buckinghamshire Historic Environment Record

NHLE, National Heritage List for England

SWOP, Sharing Wycombe's Old Photographs (High Wycombe Library)

WSHC, Wiltshire and Swindon History Centre

Reports on the fieldwork carried out in Piggledene and Hursley Bottom are deposited at the Wiltshire Historic Environment Record. Data (all features, all periods) transcribed in the Walter's Ash study area are deposited at the Buckinghamshire Historic Environment Record.

107 Pavenhill, Purton, Wiltshire SN5 4DB, UK

[k.a.whitaker@pgr.reading.ac.uk]

This paper is published with financial assistance from the University of Reading. This work was supported by the Arts and Humanities Research Council (grant number AH\L503939\1) through the South, West and Wales Doctoral Training Partnership.

TABLES

TABLE 1

	mean number of working quarries/year (all materials)	mean number of quarry employees/year (all materials)	mean tonnage of sandstone quarried/year
Wiltshire	42	225	6,577
Buckinghamshire	22	112	420
Britain	6,474	84,496	3,891,775

TABLE 2

	Epoch 1 (1867-81)		Epoch 2 (1897-9)		Epoch 3 (1918-24)‡	
Type	**Pits**	**Total area (ha)**	**Pits**	**Total area (ha)**	**Pits**	**Total area (ha)**
Chalk	105	5.73	79	5.15	31	2.41
Clay	26	0.94	2	0.38	32	1.32
Gravel	15	1.59	4	0.36	0	0
Sand	3	0.03	0	0	0	0
Quarry	22	1.30	4	0.25	3	0.20
Extractive*	45	2.72	60	4.45	69	5.29
TOTAL	217	12.31	149	10.59	135	9.22

TABLE 3

Pit types	**N**	**%**
Chalk	10	<1
Clay	212	18
Marl	435	37
Lime-works	1	<1
unidentified	524	44
Total	1182	100

TABLE 4

Historic landscape type	Marl pits	%
Medieval-C17 Assarted enclosure	55	13
Pre-C18 enclosure	92	21
C18/C19 Parliamentary enclosure	65	15
Private C19 enclosure	80	18
C20 land division	107	25
Other	36	8
Total	**435**	**100**

TABLE 5

	Distance 1 (mm)	Distance 2 (mm)	Distance 3 (mm)	Distance 4 (mm)	Distance 5 (mm)
three wedges					
Stone [28]	480	75			
Stone [91]	240	330			
Stone [97]	40	180			
four wedges					
Stone [34]	63	20	240		
six wedges					
Stone [147]	180	25	90	50	85

FIGURE CAPTIONS

FIG. 1

Sarsens to the north of Delling Copse on Totterdown, Marlborough Downs, Wiltshire (photograph © author).

FIG. 2

Map showing the location of the Piggledene and Hursley Bottom surveys in relation to topography, with sarsen stone spreads as recorded by Ordnance Survey up to the Second World War (includes data derived from EDINA Digimap, Ordnance Survey data © Crown copyright and database rights 2021, 90m STRM courtesy of CGIAR http://srtm.csi.cgiar.org and 2m photogrammetry © Bluesky International Ltd/Getmapping Plc).

FIG. 3

Map showing the location of the Buckinghamshire survey area and Walter's Ash study area in relation to topography, with sarsen stones recorded by Davies and Baines (1953) (includes data derived from EDINA Digimap, Ordnance Survey data © Crown copyright and database rights 2021, 90m STRM courtesy of CGIAR http://srtm.csi.cgiar.org and 2m photogrammetry © Bluesky International Ltd/Getmapping Plc).

FIG. 4

Two sarsen-cutters standing either side of a partially cut boulder in the bottom of a pit at Bristow's Stone and Brickyard, early 20th century. This is not the pit observed by Spicer (1905), but is on the same site which he visited (source: The Geologists' Association).

FIG. 5

The Walter's Ash sarsen quarry: (a) scaffolding and a windlass suspended over a pit, surrounded by split sarsen blocks and waste, 1915 (P250215); (b) a pile of partially-prepared sarsen blocks intended for Windsor Castle, 1919 (P250214) (courtesy of the British Geological Survey http://geoscenic.bgs.ac.uk).

FIG. 6

Buckinghamshire sarsen products: (a) setts and kerbstones in Market Place, Aylesbury; (b) a corner-stone at Holy Trinity Church, Prestwood retaining two wedge-pit scars (photographs © author).

FIG. 7

Transcription from aerial photographs of archaeological features of all dates in the environs of Bristow's Stone and Brickyard and Brown's (Wells) Brickfield, Walter's Ash, Buckinghamshire (includes data derived from EDINA Digimap, Ordnance Survey data © Crown copyright and database rights 2021).

FIG. 8

Bristow's Stone and Brickyard and Brown's (Wells) Brickfield, Walter's Ash, 14 February 1942 (RAF/HLA/403 V 25) (with permission from Historic England Archive/RAF Photography).

FIG. 9

Transcription from aerial photographs of archaeological features of all dates in the environs of Howard’s Brickworks, Honor End Lane, Buckinghamshire (includes data derived from EDINA Digimap, Ordnance Survey data © Crown copyright and database rights 2021).

FIG. 10

Wiltshire sarsen quarry evidence, tools and products: (a) stone [6] in Piggledene marked by a chiselled guide-line (below scale bar) and cut with two wedge-pits; (b) a wedge-pit scar in stone [12], Piggledene; (c) five pecker heads for working sarsen (DZSWS/GB236/2, Wiltshire Museum, Devizes); (d) a slicing chisel for working sarsen (DZSWS/GB236/1, Wiltshire Museum, Devizes); (e) a sarsen kerbstone retaining a wedge-pit scar, Purton, Wiltshire; (f) sarsen kerbstones, Wroughton, Wiltshire (photographs © author).

FIG. 11

Measured survey showing earthworks, stone pits and hollows, partially split sarsens and surviving whole sarsen boulders in Piggledene, Wiltshire.

FIG. 12

Map showing walk-over survey extents in the Wiltshire sarsen quarries: (a) Piggledene; (b) Hursley Bottom. Walk-over survey areas are hatched, analytical earthworks survey areas are cross-hatched (includes data derived from EDINA Digimap Ordnance Survey data © Crown copyright and database rights 2021 and 50cm Digital Surface Model LiDAR data © Environment Agency copyright and database right 2015 [Multi-lit Hillshade visualisation made using the Relief Visualization Toolbox]).

FIG. 13

A plug-and-feather scar in stone [69], Piggledene (photograph © author).

FIG. 14

Range and distribution of wedge-pit sizes in Piggledene: (a) length of wedge-pit openings; (b) length of wedge-pit bases; (c) wedge-pit depth.

FIG. 15

Stone surfaces in Piggledene: (a) two sub-rectangular depressions removed from the surface of stone [34], each above a wedge-pit in the stone face; (b) a large flake scar in the surface of stone [84] originating from a wedge-pit (parallel to the scale card) (photographs © author).

FIG. 16

Split sarsens in Piggledene with wedge-pit positions marked by scale cards: (a) stone [28] with three wedge-pits visible in the split face; (b) stone [12] with half a wedge-pit in the north face and two wedge-pits in the west face; (c) stone [34] with four wedge-pits in the split face (photographs © author).

FIG. 17

Measured survey showing earthworks, stone pits and hollows, sarsen quarry infrastructure features, sarsen waste and other debris including concrete and masonry waste in Hursley Bottom, Wiltshire.

FIG. 18

Sarsen quarry infrastructure features in Hursley Bottom, West Woods: (a) the concrete base on which a stone crushing machine was mounted, including a small inset positioned for a wheel to drive a trommel; (b) the underground store cut into the valley side for storing explosive materials (photographs © author).

FIG. 19

Charge-holes chiselled into sarsen boulders in Hursley Bottom, West Woods: (a) smaller (top) and larger (bottom) sub-circular and sub-triangular charge-holes; (b) distribution of charge-hole dimensions and sectional forms (photographs © author).

TABLE CAPTIONS

TABLE 1

Home Office Mines Inspectorate Reports data for working quarries from 1895, the first reporting year under the Quarries Act (1894), to 1920 when the Reports series ended and became a Board of Trade (Mines Department) internal report. Sarsen is not identified in these reports except in the Buckinghamshire inspection for 1905-07, when all the sandstone raised in the county was noted to be sarsen.

TABLE 2

The number of extractive pits mapped by the Ordnance Survey on County Series 1:2,500 maps in the survey area SU 810 950 (south-west corner) to SP 930 060 (north-east corner). *pits mapped by the OS but not identified by material type. ‡This partial map revision did not include 60.1km^2 of the north-east quarter of the survey area.

TABLE 3

Pits mapped in the Walter’s Ash study area by extracted material.

TABLE 4

Distribution of marl pits mapped in the Walter’s Ash study area by Historic Landscape Characterisation land-use.

TABLE 5

Distances between wedge-pits placed in the same plane in sarsens in the Piggledene survey transect, in boulders where more than three wedges were used.

FIG. 1. Sarsens to the north of Delling Copse on Totterdown, Marlborough Downs, Wiltshire (photograph © author).

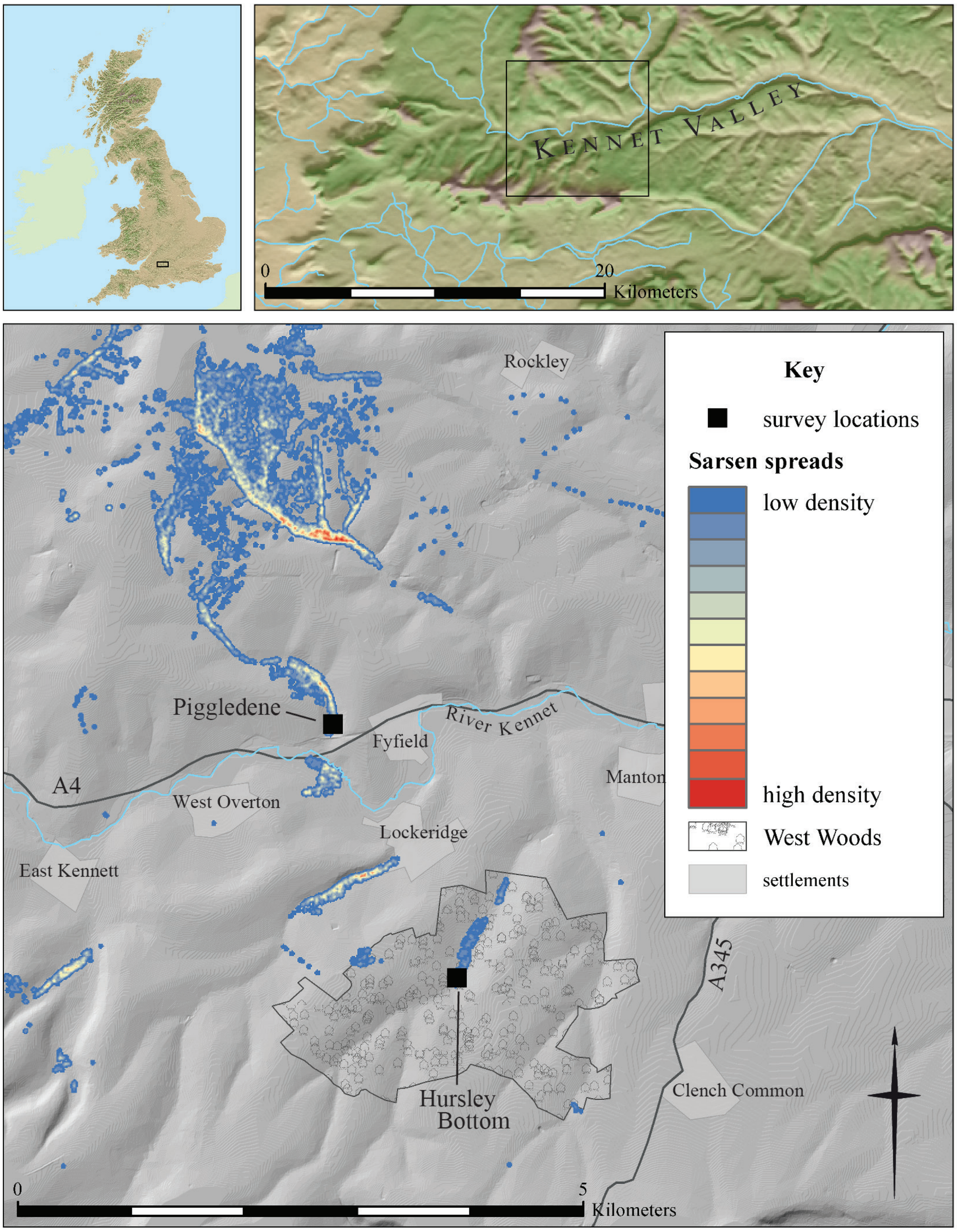


FIG. 2. Map showing the location of the Piggledene and Hursley Bottom surveys in relation to topography, with sarsen stone spreads as recorded by Ordnance Survey up to the Second World War (includes data derived from EDINA Digimap, Ordnance Survey data © Crown copyright and database rights 2021, 90m STRM courtesy of CGIAR http://srtm.csi.cgiar.org and 2m photogrammetry © Bluesky International Ltd/Getmapping Plc).

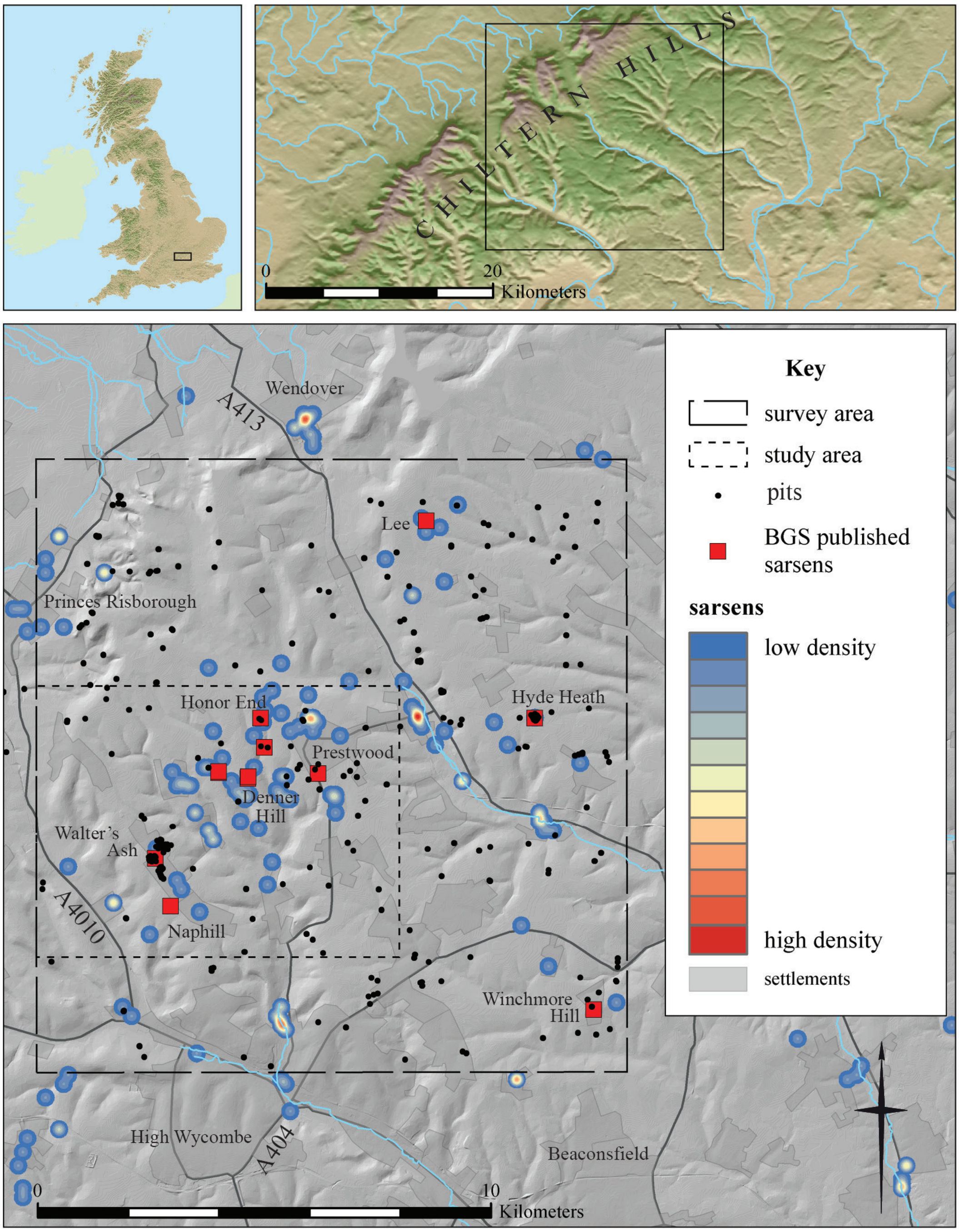
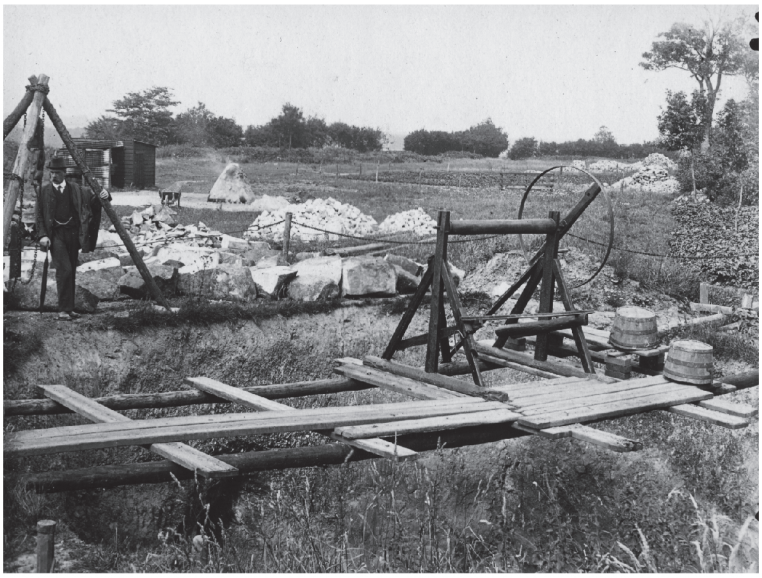


FIG. 3. Map showing the location of the Buckinghamshire survey area and Walter's Ash study area in relation to topography, with sarsen stones recorded by Davies and Baines (1953) (includes data derived from EDINA Digimap, Ordnance Survey data © Crown copyright and database rights 2021, 90m STRM courtesy of CGIAR http://srtm.csi.cgiar.org and 2m photogrammetry © Bluesky International Ltd/ Getmapping Plc).

FIG. 4. Two sarsen-cutters standing either side of a partially cut boulder in the bottom of a pit at Bristow's Stone and Brickyard, early 20th century. This is not the pit observed by Spicer (1905), but is on the same site which he visited (source: The Geologists' Association).

(a)



(b)

FIG. 5. The Walter's Ash sarsen quarry: (a) scaffolding and a windlass suspended over a pit, surrounded by split sarsen blocks and waste, 1915 (P250215); (b) a pile of partially-prepared sarsen blocks intended for Windsor Castle, 1919 (P250214) (courtesy of the British Geological Survey http://geoscenic.bgs.ac.uk).

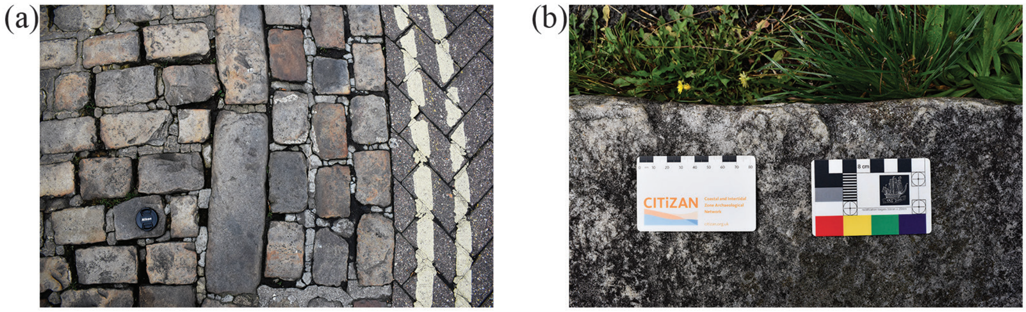


FIG. 6. Buckinghamshire sarsen products: (a) setts and kerbstones in Market Place, Aylesbury; (b) a corner-stone at Holy Trinity Church, Prestwood retaining two wedge-pit scars (photographs © author).

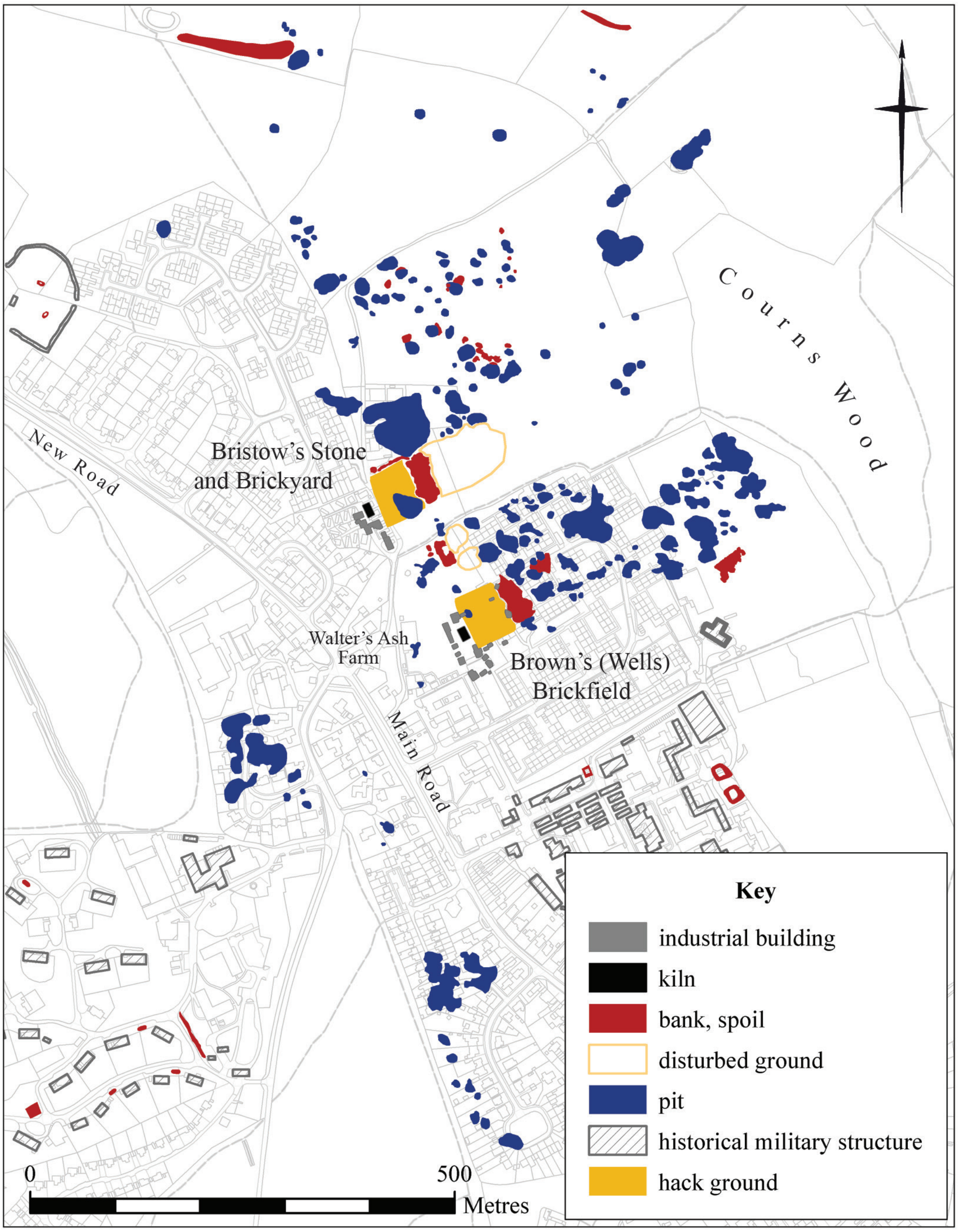


FIG. 7. Transcription from aerial photographs of archaeological features of all dates in the environs of Bristow's Stone and Brickyard and Brown's (Wells) Brickfield, Walter's Ash, Buckinghamshire (includes data derived from EDINA Digimap, Ordnance Survey data © Crown copyright and database rights 2021).

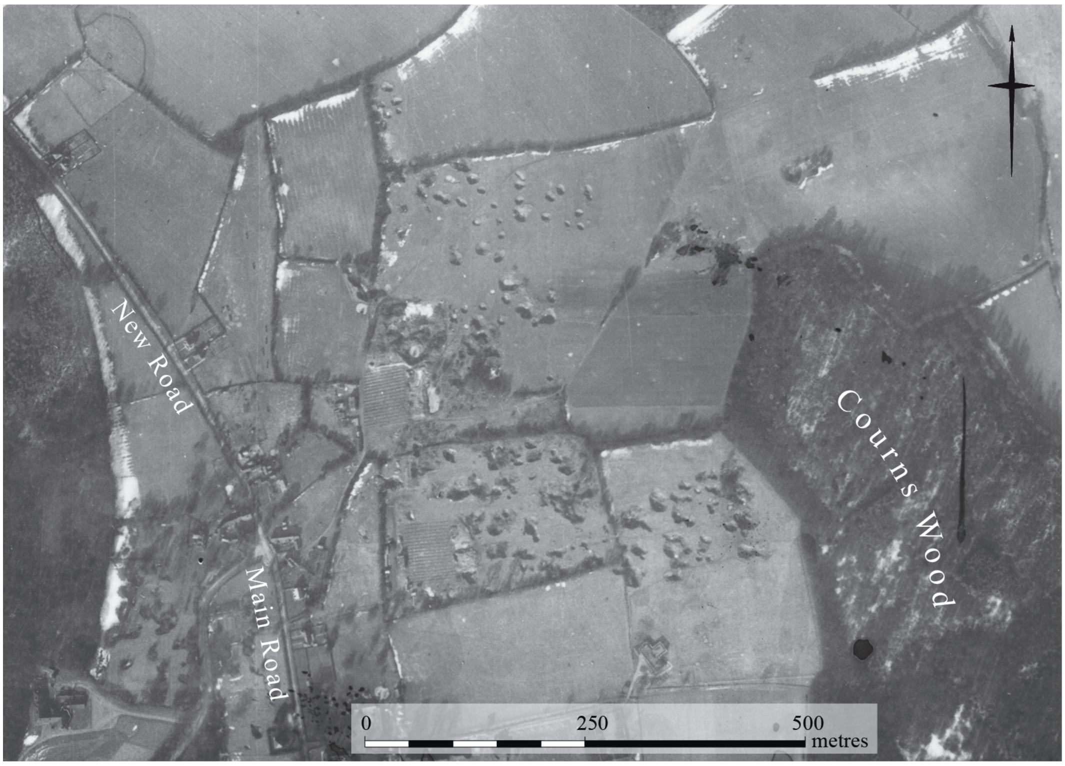


FIG. 8. Bristow's Stone and Brickyard and Brown's (Wells) Brickfield, Walter's Ash, 14 February 1942 (RAF/HLA/403 V 25) (with permission from Historic England Archive/RAF Photography).

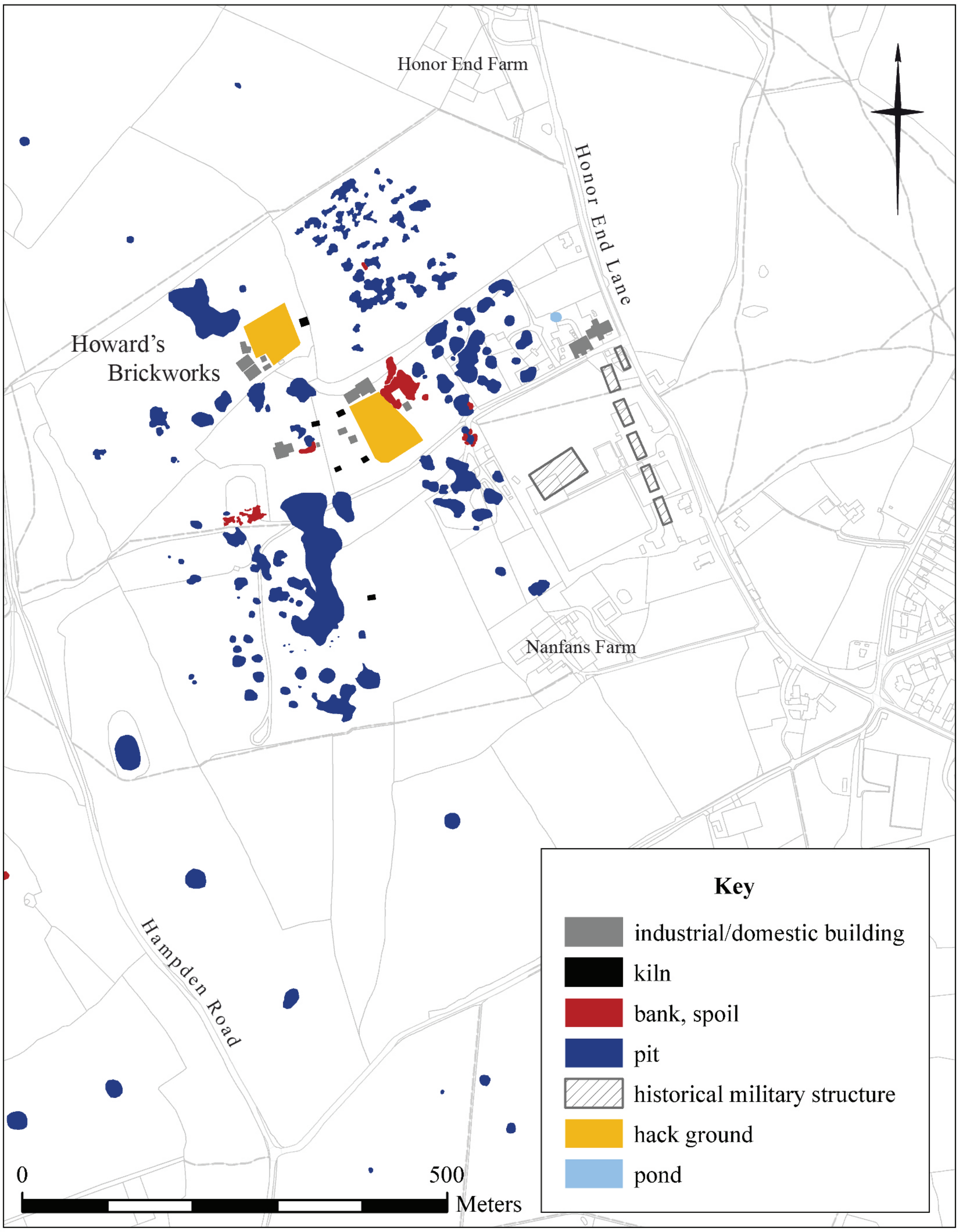


FIG. 9. Transcription from aerial photographs of archaeological features of all dates in the environs of Howard's Brickworks, Honor End Lane, Buckinghamshire (includes data derived from EDINA Digimap, Ordnance Survey data © Crown copyright and database rights 2021).

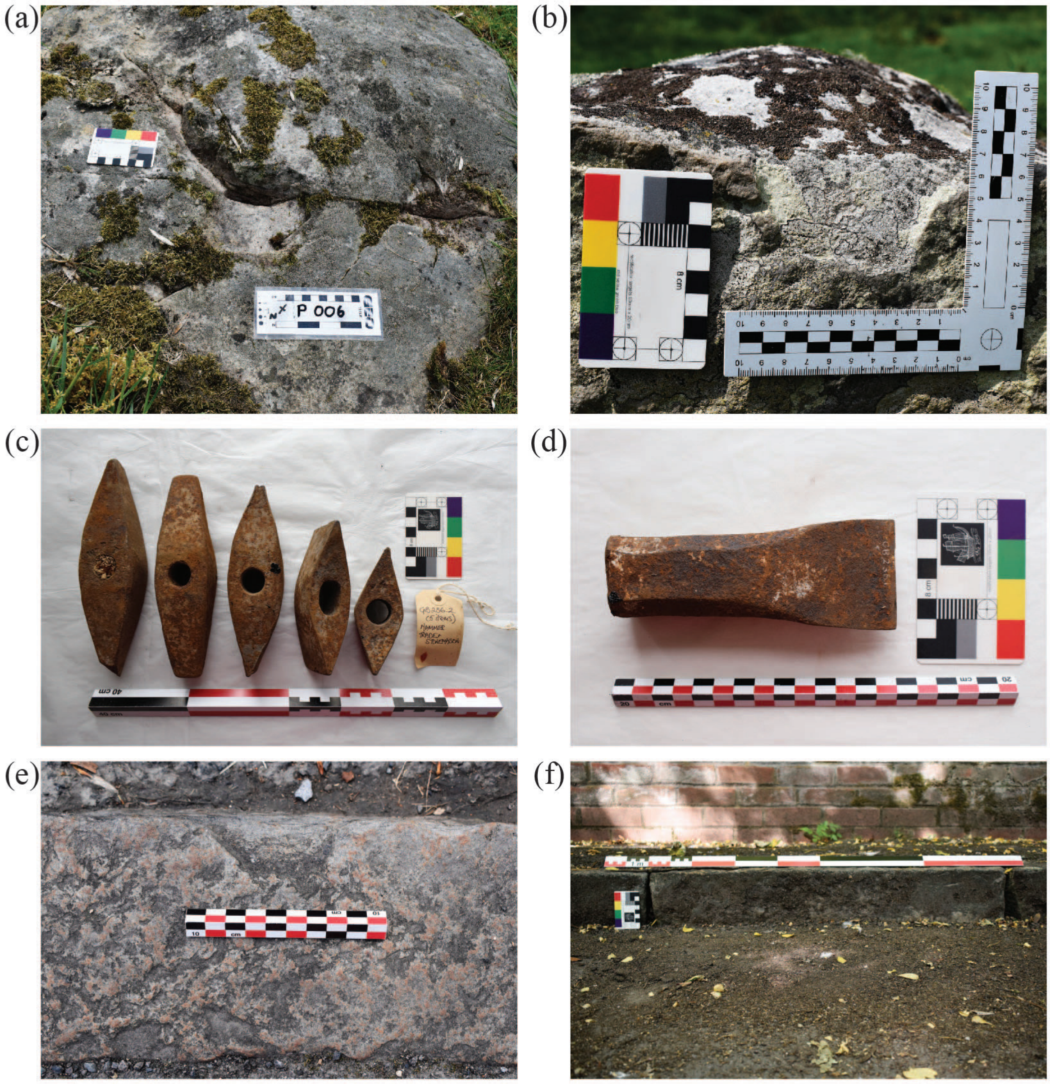


FIG. 10. Wiltshire sarsen quarry evidence, tools and products: (a) stone [6] in Piggledene marked by a chiselled guide-line (below scale bar) and cut with two wedge-pits; (b) a wedge-pit scar in stone [12], Piggledene; (c) five pecker heads for working sarsen (DZSWS/GB236/2, Wiltshire Museum, Devizes); (d) a slicing chisel for working sarsen (DZSWS/GB236/1, Wiltshire Museum, Devizes); (e) a sarsen kerbstone retaining a wedge-pit scar, Purton, Wiltshire; (f) sarsen kerbstones, Wroughton, Wiltshire (photographs © author).

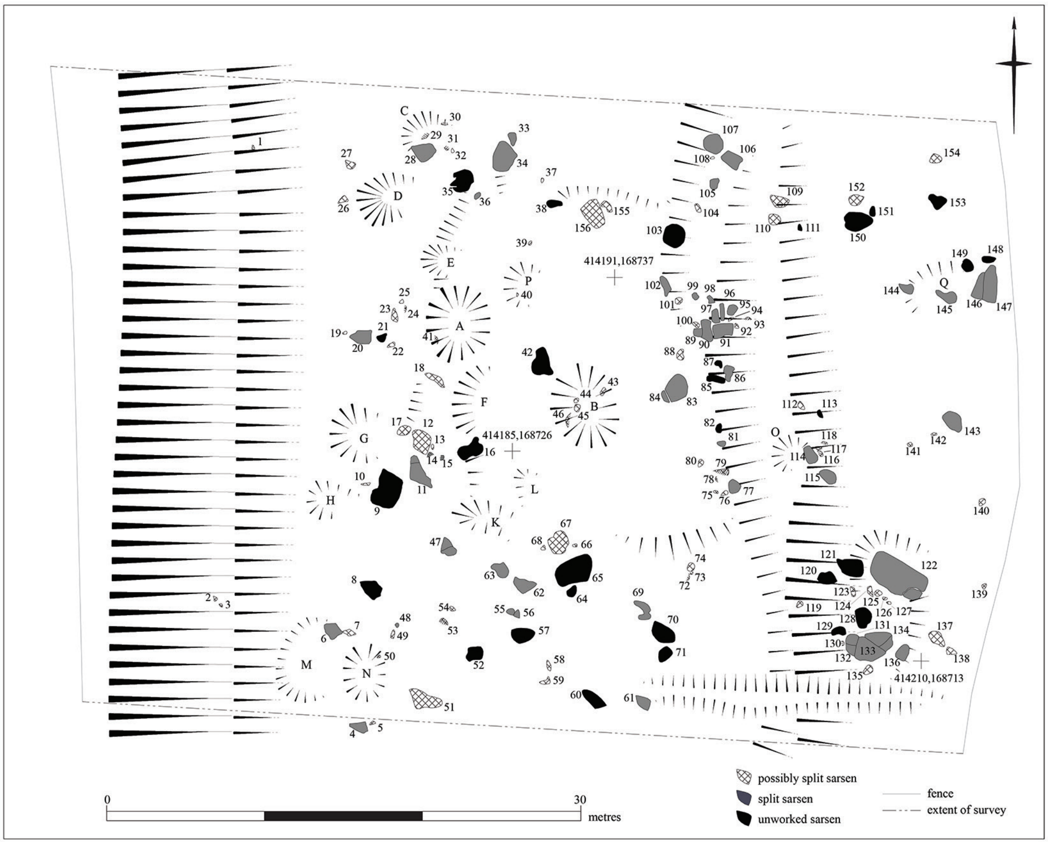


FIG. 11. Measured survey showing earthworks, stone pits and hollows, partially split sarsens and surviving whole sarsen boulders in Piggledene, Wiltshire.

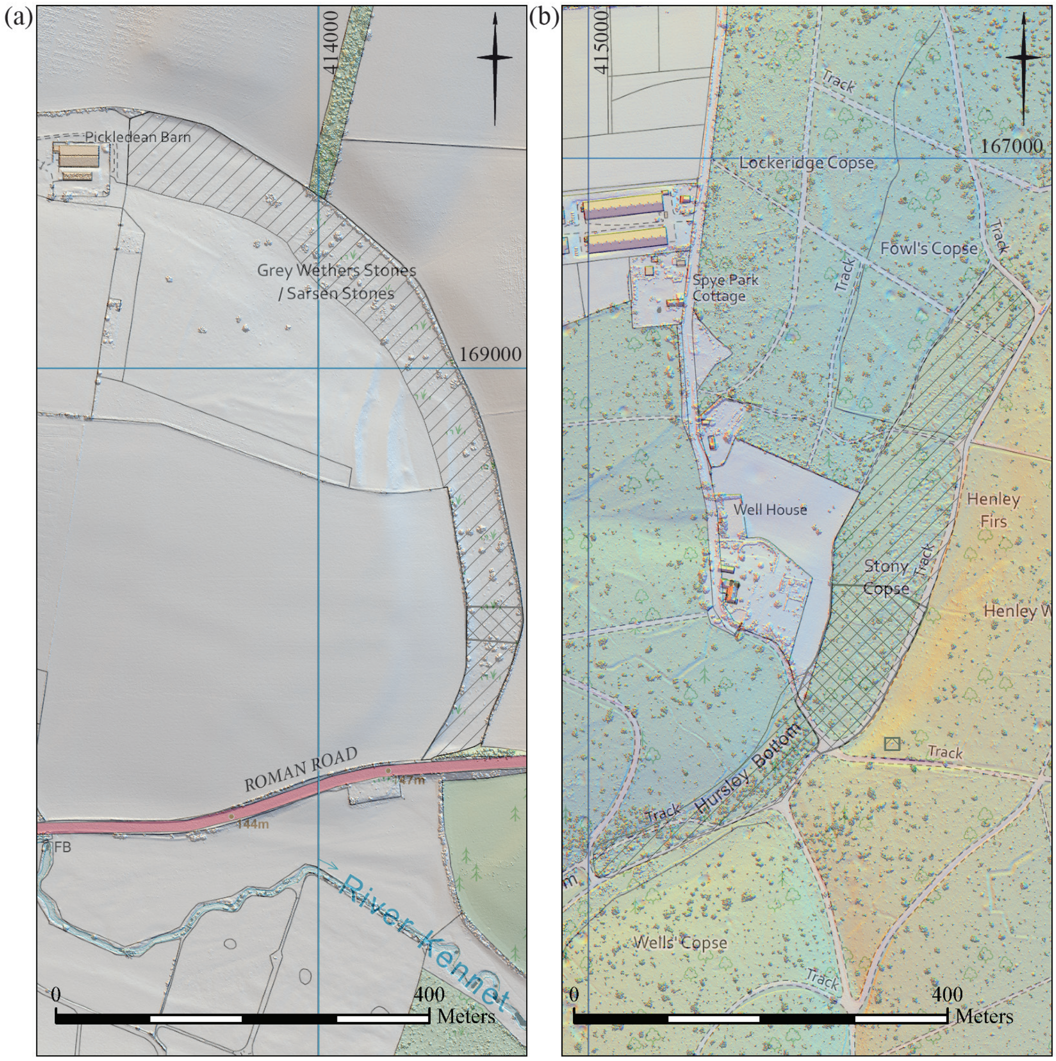


FIG. 12. Map showing walk-over survey extents in the Wiltshire sarsen quarries: (a) Piggledene; (b) Hursley Bottom. Walk-over survey areas are hatched, analytical earthworks survey areas are cross-hatched (includes data derived from EDINA Digimap Ordnance Survey data © Crown copyright and database rights 2021 and 50cm Digital Surface Model LiDAR data © Environment Agency copyright and database right 2015 [Multi-lit Hillshade visualisation made using the Relief Visualization Toolbox]).

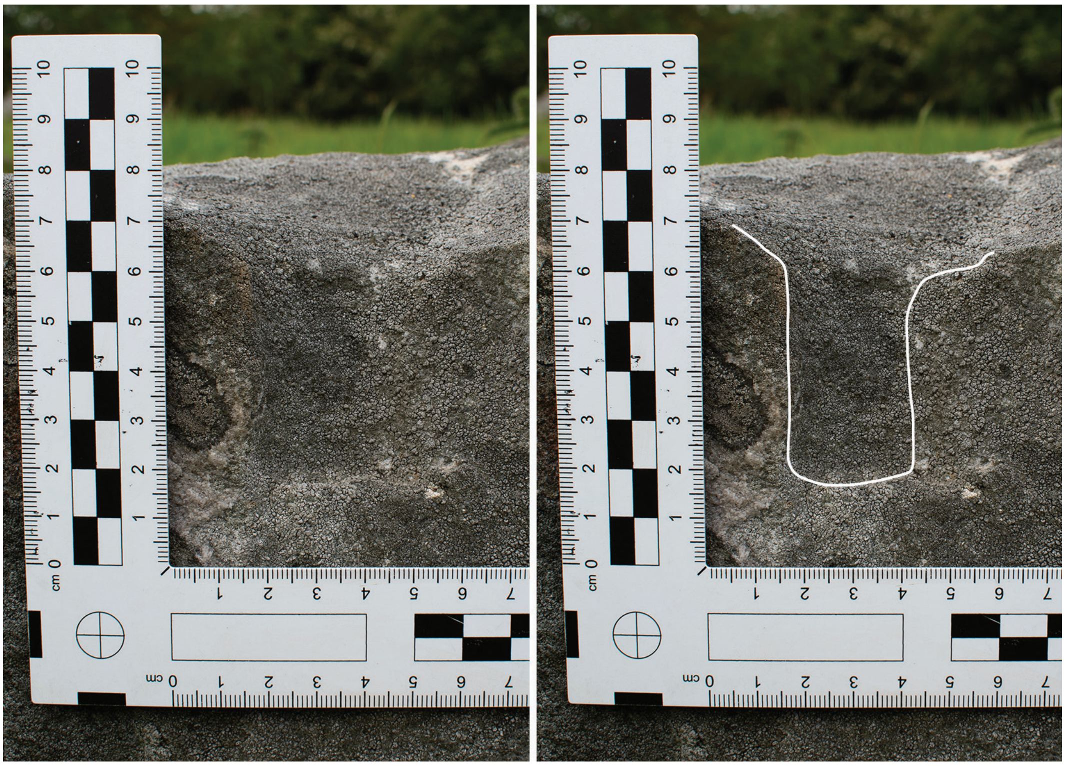


FIG. 13. A plug-and-feather scar in stone [69], Piggledene (photograph © author).

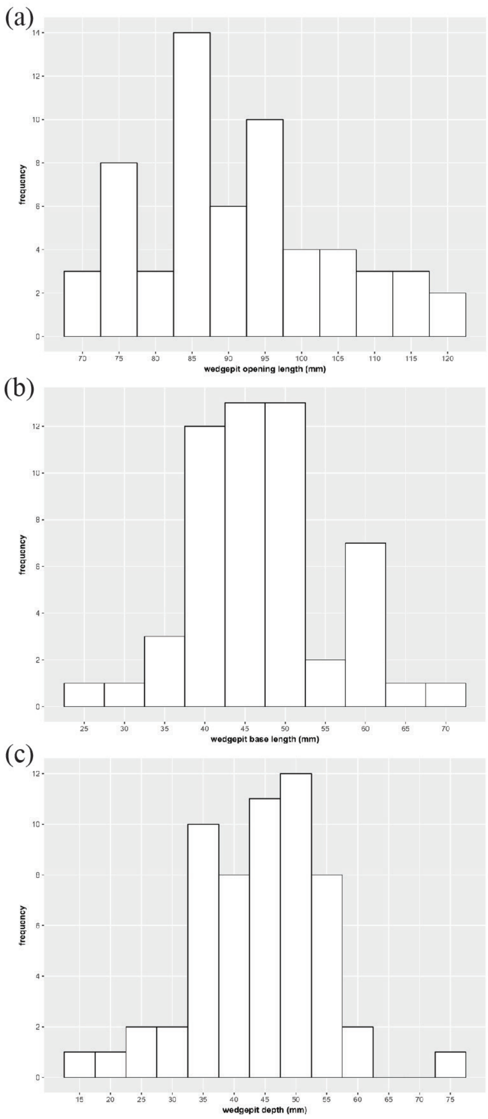


FIG. 14. Range and distribution of wedge-pit sizes in Piggledene: (a) length of wedge-pit openings; (b) length of wedge-pit bases; (c) wedge-pit depth.

(a)

(b)

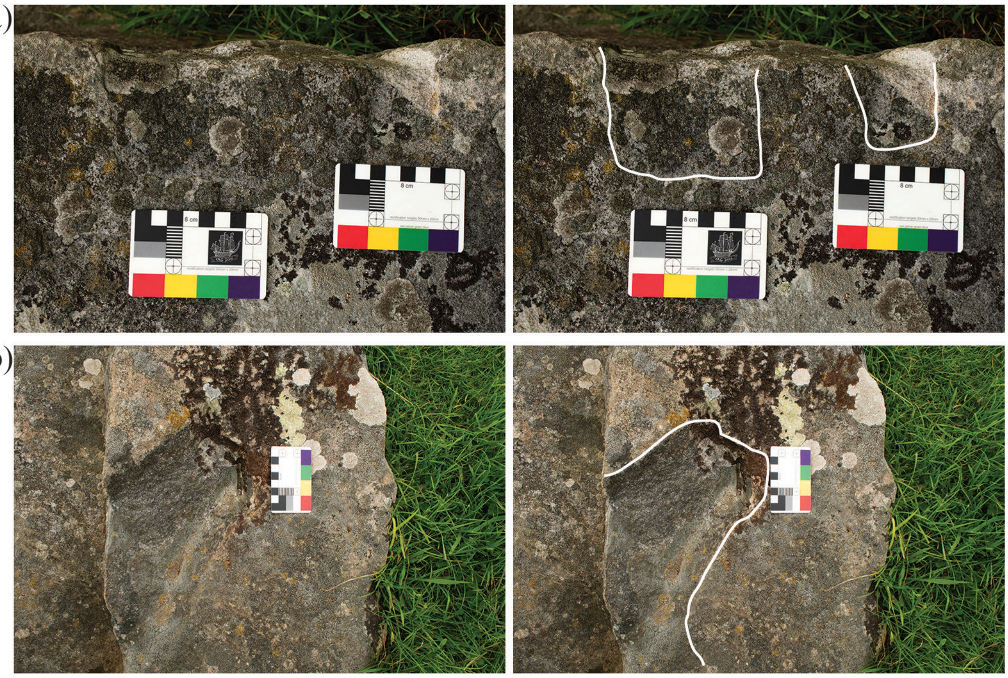


FIG. 15. Stone surfaces in Piggledene: (a) two sub-rectangular depressions removed from the surface of stone [34], each above a wedge-pit in the stone face; (b) a large flake scar in the surface of stone [84] originating from a wedge-pit (parallel to the scale card) (photographs © author).

(a)
(b)
(c)

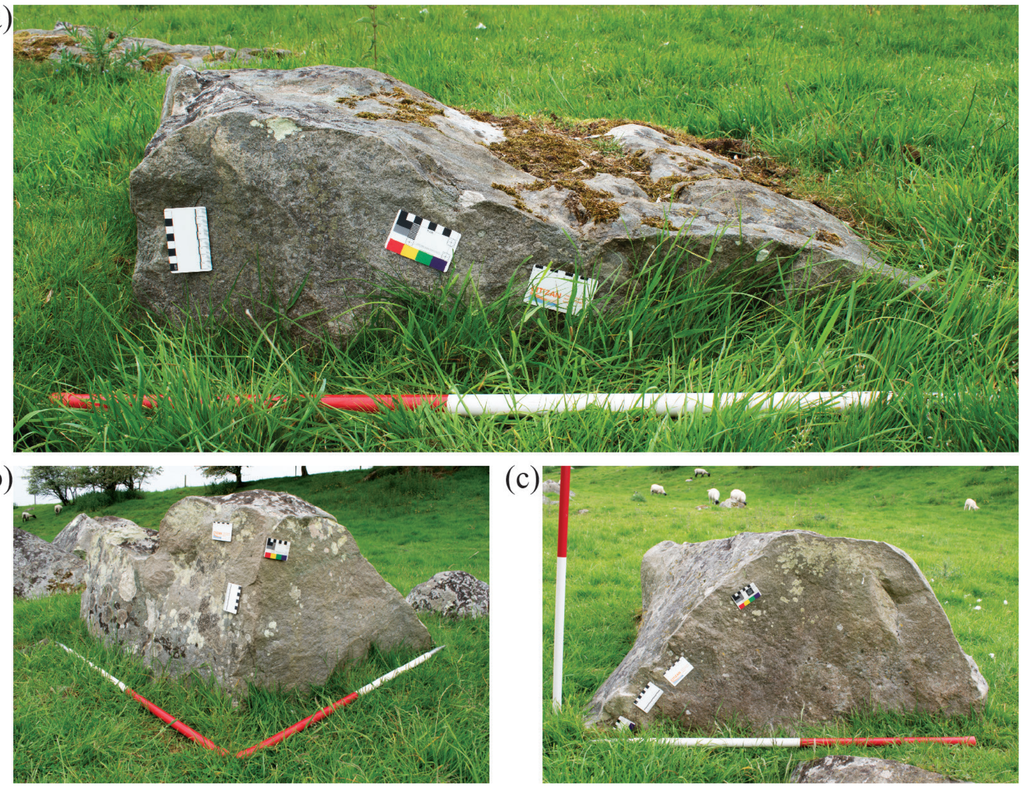


FIG. 16. Split sarsens in Piggledene with wedge-pit positions marked by scale cards: (a) stone [28] with three wedge-pits visible in the split face; (b) stone [12] with half a wedge-pit in the north face and two wedge-pits in the west face; (c) stone [34] with four wedge-pits in the split face (photographs © author).

FIG. 17. Measured survey showing earthworks, stone pits and hollows, sarsen quarry infrastructure features, sarsen waste and other debris including concrete and masonry waste in Hursley Bottom, Wiltshire.

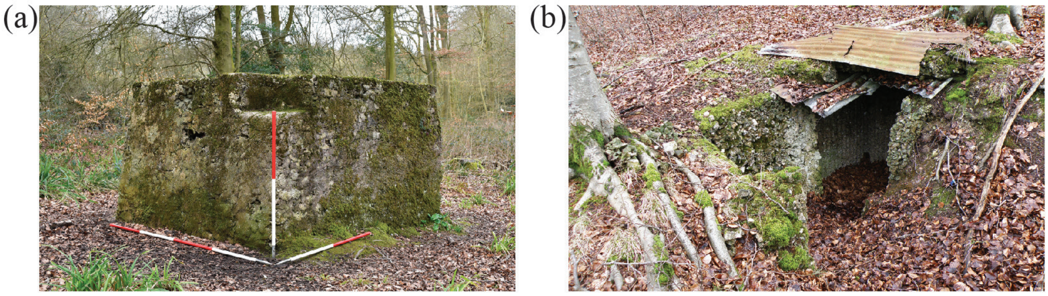


FIG. 18. Sarsen quarry infrastructure features in Hursley Bottom, West Woods: (a) the concrete base on which a stone crushing machine was mounted, including a small inset positioned for a wheel to drive a trommel; (b) the underground store cut into the valley side for storing explosive materials (photographs © author).

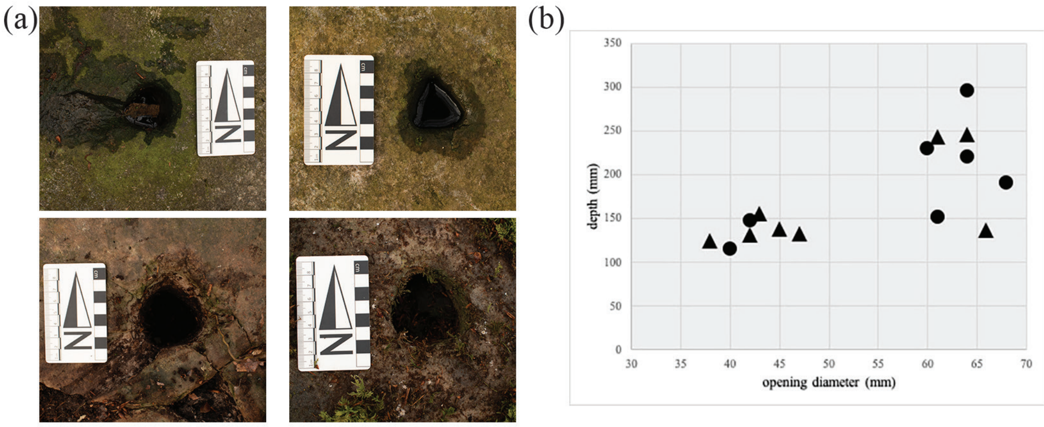


FIG.19. Charge-holes chiselled into sarsen boulders in Hursley Bottom, West Woods: (a) smaller (top) and larger (bottom) sub-circular and sub-triangular charge-holes; (b) distribution of charge-hole dimensions and sectional forms (photographs © author).

Foreword, paper 6

Whitaker, K.A. (in press) 'Connoisseurs of Stone': Everyday sarsen stone in Neolithic Britain. *Proceedings of the Prehistoric Society*

In the Summer of 2021, Wiltshire Museum presented *Ways of Seeing Wiltshire*, an exhibition curated by social historian Brian Edwards (Wiltshire Museum 2021). I had booked my visit for an early morning, wondering if it was the right thing to do: I was yet to receive my full Covid-19 vaccination and in that context, the museum's small, domestic rooms were unappealing spaces in which to spend time. Yet with only a few other visitors, I could take my time to enjoy 'Kennet and Avon Canal at Honeystreet Wharf', a large painting of a rural industrial scene by J Barnard Davis dating to 1873/8. The view is dominated by the bright sky and distant pale green horizon of high downland hills marked by Adam's Grave and the Alton Barnes' White Horse hill-figure, but the interest lies in the foreground of timber yards, boat-building sheds and industrial buildings either side of the canal. This was where Wiltshire sarsen-cutters brought their products destined for more distant markets, carting setts and building-blocks down from the hills to the small canal wharf for transhipment as far afield as London. The museum's Director, David Dawson, walked by. The first time we had seen one-another face-to-face since before March 2020, it was good to talk. 'I'd have been here last year looking at some of those sarsen assemblages we talked about,' I said, 'but it's too late now. Thank goodness for the Marden and West Kennet Avenue material.'

I am very grateful for support from Martin Bell, Jim Leary and Josh Pollard for access to excavated sarsen stone assemblages from the *Vale of Pewsey* and *Between the Monuments* projects. Material collected during excavations at Marden henge enclosure and the West Kennet Avenue occupation site respectively is currently retained by the excavators. Recording, analysing and writing-up the assemblages has enabled me to address sarsen use in prehistory from a non-monumental perspective (see Appendix 5 and 6 for my post-excavation reports). As the following paper explains, there are few such assemblages in museum collections, for various reasons: worked sarsen fragments are hard to recognise and may simply go uncollected; bulk stone assemblages are often poorly recorded and not marked for retention in disposal policies. If it were not for Covid-19, I would have been able to work on some of the few available collections including those in the Wiltshire Museum well within my university registration period: but perhaps it has been better to concentrate on the new, well-excavated, assemblages. I am also in debt, as are so many researchers, to Josh Pollard for his detailed unpicking and publication of historical Windmill Hill causewayed enclosure data (Whittle *et al.* 1999).

In the final paper comprising this thesis, I draw on data from those three sites in Wiltshire to paint a picture of sarsen use spanning the Neolithic. It continues the theme from the previous paper of how it is that people know and understand materials. The paper's significance lies in two main areas. First, the use of a new methodology to facilitate analysis of worked and unworked sarsen items; secondly, demonstrating the importance of attending to the variety of sarsen stone's use and treatments so as to understand human relations with this fundamentally important material of Neolithic life in southern Britain.

The methodology that I have developed for recording and analysing small sarsen pieces is based on work conducted for my Master's thesis (University of Exeter, 2010), which examines sarsen hammerstones excavated from contexts at Stonehenge and is published in Parker Pearson *et al.* (2020). Adapted from that focus on hammerstones for application to all small pieces of sarsen encountered in archaeological contexts, it enables the collection of a range of data in order to address multiple research questions. I was able to present this at the Chartered Institute for Archaeologists' conference in 2022 and hopefully greater awareness of its advantages will be picked up by the sector. Nevertheless, I was in the end unable to include in this research project an experimental archaeology phase to create sarsen assemblages under controlled conditions: that would have helped me to refine the methodology further and direct it towards distinguishing specific breakage patterns, a project that I would like to return to in the future.

The approach outlined in the following paper recognises that sarsen is a versatile material. The use of (sometimes huge) boulders to make megalithic stone settings is arguably one of sarsen's least-common uses in prehistory. Given the amount of culturally-heated sarsen from contexts in the following paper's three case studies, one of the most important Neolithic applications for sarsen was in pyrotechnologies such as cooking and heating. In fact, where sarsen stone is commonly found in the landscape, it crops up in many of the daily activities that we might imagine people doing in the Neolithic. That has prompted me to question the inevitability that sarsen (or, stone in general) spoke to deep time and ancestral pasts as expressed by, for example, Cooney (2008). While I do not doubt the likelihood that stone things from megaliths and walling material to worked artefacts could play a part in Neolithic memory-making, myth and forms of rootedness, Conneller (2011) in particular emphasises the significance of context, and especially technical context, to learning about and understanding what materials were and could be. As Ingold (2007, 14) writes, 'the properties of materials…are neither objectively determined nor subjectively imagined but practically experienced.' Is sarsen stone inherently durable in the way that Parker Pearson and Ramilisonina (1998) argue? Not when it has been broken into small pieces and laid as a road surface, as the previous paper showed, and as the builders of Stonehenge working those huge boulders must have known through their daily experiences of sarsen in multiple, varied, circumstances.

One of this paper's reviewers suggested that it could include a more detailed exploration of the ontological relationship between monumental and non-monumental sarsen stone, and an acknowledgment of the affordances or agency of stone that are independent of human interventions. Although a very welcome proposition, I declined the first suggestion: the fruitful ground to explore sarsen ontologies through a contextual archaeology of its myriad uses deserves a more thorough treatment in a paper of its own. I agree with the reviewer that materials can have affordances without human interaction. Sarsen likely has multiple affordances for others. Take, for example, the home that sarsen provides for a rich lichen flora including, surprisingly, the acid-loving, maritime lichens *Anaptychia runcinata* and *Rinodina atrocinera*. Piggledene, where I surveyed post-medieval quarrying remains, enjoys Special Site of Scientific Interest status in part because those lichens are found in this inland, alkaline landscape Moreover, the lichen *Buellia saxorum* is unique to sarsens (Natural England 1986). We can observe the sustaining relationship between sarsen and lichen, but we are unable to experience precisely what it means to the lichen to find a home there. The point of the following paper is to attend to various human engagements with a range of sarsen in different circumstances, addressing in particular the large volume of often un-regarded archaeological assemblages that can speak to embodied experiences of this stony matter. It is that *practical experience* foregrounded by Ingold that I draw to the reader's attention in this instance.

In the foreword to this thesis's first paper, I mention the conceptual arc (of thinking differently about sarsen and sarsen technologies) that links the six sections. This final paper does not draw the arc into a closed circle. It invites us to think differently about human relationships with sarsen, beginning with a more expansive *chaîne opératoire* situated in a stony landscape; calling for a more attentive and imaginative approach to sarsen stone specifically and, by implication, other types of hard stone found in archaeological contexts.

References

Conneller, C. 2011. *An archaeology of materials: substantial transformations in early Prehistoric Europe.* Abingdon: Routledge

Cooney, G. 2008. Engaging with stone: making the Neolithic in Ireland and Western Britain. In H. Fokkens, B.J. Coles, A.L. Van Gijn, J.P. Kleine, H.H. Ponjee & C.G. Slappendel (eds) *Between Foraging and Farming*, 201-214. Leiden: University of Leiden

Ingold, T. 2007. Materials against materiality. *Archaeological Dialogues* 14, 1-16

Natural England. 1986. Site of Special Scientific Interest Citation: Piggledene, Wiltshire [online] https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1001843.pdf [Accessed 6 August 2022]

Parker Pearson, M., Pollard, J., Richards, C., Thomas, J., Tilley, C. & Welham, K. (eds) 2020. *Stonehenge for the Ancestors: Part 1. Landscape and Monuments.* Leiden: Sidestone Press

Parker Pearson, M. & Ramilisonina. 1998. Stonehenge for the ancestors: the stones pass on the message. *Antiquity* 72, 308-326

Whittle, A., Pollard, J. & Grigson, C. 1999. *The Harmony of Symbols. The Windmill Hill Causewayed Enclosure, Wiltshire.* Oxford: Oxbow Books

Wiltshire Museum. 2021. *Ways of Seeing Wiltshire* [exhibition] Devizes: Wiltshire Museum. https://www.wiltshiremuseum.org.uk/?exhibition=ways-of-seeing-wiltshire [Accessed 2 June 2022]

‘CONNOISSEURS OF STONE’: EVERYDAY SARSEN STONE IN NEOLITHIC BRITAIN

Katy A. Whitaker

ABSTRACT

Sarsen stone boulders are familiar components of numerous British Neolithic megalithic monuments. Non-monumental uses of sarsen stone are, however, less well understood. This paper focuses on non-megalithic sarsen and its roles for communities, using case studies from three sites spanning the Neolithic in Wiltshire. Published data from Windmill Hill causewayed enclosure and analysis, using a new methodology, of recently excavated material from the West Kennet Avenue occupation site and Marden henge enclosure are used to explore the varied ways in which sarsen was used. Rather than being an expedient ‘mundane’ stone this analysis demonstrates that non-megalithic sarsen could be just as meaning-laden as other more ‘attractive’ (larger, exotic) material. Daily encounters with sarsen stone, for different purposes and in varied quotidian contexts, afforded it with values which likely contributed to its use in monumental contexts. The importance of attending to sarsen in its multiple forms and contexts is thus made clear.

KEY WORDS Sarsen stone, Neolithic, settlement, Windmill Hill, West Kennet Avenue, Marden henge.

Whitaker, Katy A. ‘CONNOISSEURS OF STONE’: EVERYDAY SARSEN STONE IN NEOLITHIC BRITAIN

INTRODUCTION

Sarsen might be described as a signature stone type of the British Neolithic, capturing geological and archaeological imaginations largely inspired by the Stonehenge and Avebury World Heritage Site (Migoń 2020). So potent is it, that its name has been adopted by present-day businesses such as Sarsen Technology Ltd (producing high-specification computer hardware). The construction of sarsen-built Neolithic monuments, like the chambered barrows of Coldrum (Kent), Wayland’s Smithy (Oxfordshire) or the Grey Mare and her Colts (Dorset), likely comprised a suite of events including the selection of story-filled boulders to anchor personal and group relationships in changing landscapes (Field 2005; Richards 2013; Gillings and Pollard 2016). The permanence and solidity of sarsen stone underpinning such associations are part of its attraction to people appropriating some of its aura today and dominate contemporary archaeological narratives of its Neolithic use (eg, Whittle 1997; Parker Pearson and Ramilisonina 1998).

This totemic material has, however, a long use history. Examples include a possible Palaeolithic biface from Winterbourne Monkton, Wiltshire (Young 1960), Mesolithic mace-heads and perforated pebbles (Rankine 1949), a wide range of Bronze and Iron Age portable and non-monumental funerary uses (eg, Cunnington 1923; Dacre *et al*. 1981; Gingell 1992) and Romano-British and early-medieval construction (Peers and Clapham 1928; Potter 1998; Fowler 2000). Deployed in medieval and modern low- and high-status architectural settings ranging from rubblestone barns to Windsor Castle (Whitaker in press), this persistence and variety suggests that sarsen has significance in people's lives beyond the solely megalithic.

Sarsen stone in prehistoric and modern Britain is in fact a quotidian material. Thousands of tonnes go unnoticed under our feet every day in urban areas across southern England in the form of street furniture (King 1968; Allen 2015). Prehistoric engagement with sarsen was highly varied but non-monumental uses are thus far poorly-addressed in the literature. In part this is due to limited recording and analysis of excavated assemblages. Accordingly, this paper focusses on non-megalithic sarsen and its roles for communities, using case studies from three sites spanning the Neolithic in Wiltshire: Windmill Hill causewayed enclosure, the West Kennet Avenue occupation site and the Marden henge enclosure (Smith 1965a; Wainwright *et al.* 1971; Whittle *et al.* 1999). I take an approach informed by Conneller (2011) and Sillar (1996), intending to draw out some of sarsen stone's varied affordances as they are revealed during technical action. My focus is on moments of human-material interaction in order to show the possible variability of sarsen's meanings to communities in the Neolithic.

RESEARCHING SARSEN USE IN NEOLITHIC BRITAIN

Sarsen stone is distributed discontinuously across southern England and parts of north-western Europe. It is a silcrete formed when near-surface lenses of quartz sands were cemented underground by silica-rich groundwater passing through Tertiary sedimentary deposits. Following subsequent erosion, periglacial action left the dense, hard, masses (called 'sarsens') on denuded land surfaces and amongst superficial deposits including Clay-with-

Flints (Summerfield and Goudie 1980; Ullyott *et al*. 2004; Nash and Ullyott 2007). Sarsens range from pebbles to boulders, some in excess of 9 m long (Hepworth 1998). Although it has a reputation for conchoidal fracture (Pitts 2000, 215-6), sarsen's homogeneity ensures that boulders can be split in straight lines in most directions (Whitaker in press).

Sarsen's distribution and association with bedrock geologies, including chalk, from which it clearly could not have originated, drove early research interests. Nineteenth and early-twentieth century preoccupations lay in recording its distribution, both nationally (for example Rupert Jones 1886; 1901) and regionally (Smith 1884; Bennett 1913). More recent projects tackling the anonymity of sarsen in British Geological Survey mapping, in which it is subsumed in superficial deposits, include the geologically-informed Chilterns survey (Davies and Baines 1953) and archaeologically-driven Sarsen Stones of Wessex survey, a landscape-scale study focussed on early agriculture and Neolithic sarsen use (Bowen and Smith 1977; Whitaker 2020a).

Sarsen was not used solely in megalithic contexts, yet exceptional monuments overshadow exploration of people's engagements with it. Archaeological research concerning sarsen is dominated by stone settings at Stonehenge and Avebury, Wiltshire. Too numerous to cite here, the vast literature on those monuments rarely addresses sarsen stone as a material and, when it does, tends to focus on a restricted range of topics. For example, discussion of where Stonehenge's huge boulders were sourced, how they were worked and transported is legion (examples include Atkinson 1956; Abbott and Anderson-Whymark 2012; Parker Pearson 2016; Nash *et al*. 2020). A far smaller body of literature addresses sarsen tools (Gowland 1902; Pitts 1982; Cleal *et al*. 1995, 386-390; Chan 2020; Whitaker 2020b). Stone types at Stonehenge seem not to matter to Parker Pearson and Ramilisonina (1998), only that stone can be understood as generically suitable to personify ancestors because of its 'durability and enduring nature' (Parker Pearson and Ramilisonina 1998, 310).

Earlier work on monumental sarsen privileging its hardness and resistance to change has importantly drawn more attention to sarsen stone, showing how in the Neolithic it may have had ontological significance through some of its metaphorical capabilities (Parker Pearson and Ramilisonina 1998). The development of sarsen's indurate nature as a persistent trope has origins at least as far back as the sixteenth century in Rastell's (1530) report of the common belief that sarsen may not be cut easily with iron tools, elaborated by Aubrey's note that weathered sarsens 'are so hard that no toole [*sic*] can touch them' (Britton 1847, 44). Sarsen stone is certainly connected to the Neolithic dead through a variety of funerary structures, including sarsen-capped pits in north Wiltshire and chambered barrows across much of its geological range (eg, Smith 1884, 84-85; Whittle 1991). Pollard and Gillings (2010, 34), however, in drawing attention to the inclusion of sarsen pieces amongst the West Kennet long barrow's mortuary deposits, suggest that 'a close and very physical association with bodies might imply a degree of ontological equivalence ('stone-people')' based on possible apotropaic properties of sarsen.

Tilley *et al.* (2007) and Whittle (1997) also make a notable exception to the focus on sarsen's hardness by discussing some of its other properties, including how a rhythmical contrast of stone colour and surface texture makes patterns across Stonehenge's sarsen settings. More work in the Avebury landscape is engaged with sarsen in its own right, influenced by the presence of surface spreads (Field 2005) and interests in sarsen biography and ontology, drawing attention towards Neolithic use of a range of worked and unworked sarsen (Gillings and Pollard 1999; Pollard and Gillings 2010). Furthermore, Gillings and Pollard (2016) challenge the characterisation of sarsen as inert petrous matter, emphasising ways that sarsens were active, capricious participants in Neolithic world-creation. They suggest the potential significance to Neolithic people of other sarsen properties, such as the locations from whence smaller pieces were moved to be incorporated in deposits (Pollard and Gillings 2010, 34-37).

Routine or daily experiences of sarsen stone are obscured in consequence of the focus on megaliths. In part a result of scholarly focus on large, impressive structures (Pollard and Gillings 2010, 30), the issue is affected by further factors. First is the difficulty of recognising artefactual sarsen during field-walking (Whittle *et al*. 1999, 341) and secondly, sarsen's treatment as a 'mundane' stone in the sense of Cooney (2010): ubiquitous, locally-available stone that often appears unworked or expediently-used, and may not even be retained in archaeological archives.[1] 'The purpose of the pieces of sarsen is unclear' write Powell *et al*. (2005, 265) of small boulders carefully arranged in middle Neolithic pits near Old Sarum, Wiltshire. Nowhere is the apparent mundanity of sarsen pieces so clearly expressed than by the failure to record large deposits of culturally-heated sarsen from the fills of late Neolithic pits at White Horse Stone, Kent (Hayden and Stafford 2006, 74).

SIGNIFICANT STONE

Stone is the pre-eminently durable material of archaeological investigation (Hurcombe 2007) and has long been the subject of archaeologists' typologies at artefactual and monumental scales. Yet stone and stones are also a physical focus for action, a locus of social meaning and source of cosmological and political powers (Boivin and Owoc 2004; Pollard and Gillings 2010; Cummings and Richards 2021). People go to considerable lengths to access stone that possesses key properties, a trait that is not unique to any one period. Examples include the transport of limestone from Dundry in Somerset across the Irish Sea to construct the twelfth-century Dublin cathedral (Moss 2000) and the incorporation of stones from war-torn Ypres into English First World War memorials at both Winchester College and Cathedral, Hampshire (Historic England 2022).

The significance for Neolithic communities of different types of stone has received considerable scholarly attention. Much research concerns ‘exotic’ material, commonly defined by its great distance travelled from source to final resting place whether in megalithic form, such as Stonehenge’s Welsh bluestones (first characterised by Thomas 1923) or smaller objects, such as jadeitite axe-heads that were moved across Europe (Petrequin *et al*. 2012). ‘Local’ stone was, however, just as important, exemplified in early Neolithic dolmen construction to display arrangements of huge *in situ* boulders (Cummings and Richards 2021). Cooney *et al*. (2019) argue that riebeckite felsite quarried for tools at North Roe (Shetland) was essential to the creation there of Neolithic identity, while Greaney (2019) proposes that the chalk of Cranborne Chase (Dorset) was a powerful material during the middle Neolithic. Later Neolithic examples include the use of triboluminescent quartz at the Hendraburnick propped stone (Cornwall), sourced from the nearby River Camel streambed (Jones and Goskar 2017). The importance of collages of multiple stone types, shapes and sizes drawn from varied sources is evident at sites including the Ring of Brodgar (Orkney) (Downes *et al*. 2013, 105-7), the burial mound complex at Knowth (Ireland) (Corcoran and Sevastopulo 2017) and indeed Stonehenge (Whitaker 2019).

Clearly what matters is not solely the stone source, but a suite of properties afforded by each stone or rock type. Cooney (2008) reminds us of the range of scales at which stone was experienced in Neolithic life, from post-packing and floor-stone to walls, cairns and monuments, continuously forming human-stone relationships with each daily encounter. He nevertheless obscures stone’s variety – and thus its potential to be part of different ontological relationships – in an ancestor-narrative reliant on one attribute only, its presumed permanence (Cooney 2008, 210). On the contrary, stone can be a mutable substance, its varied properties revealed contextually through bodily and technical engagement with it (Ingold 2007; Conneller 2011). That is especially true of small, portable stone: different technical processes applied to the material make it possible for different properties to come to the fore including impermanence, fragility, utility for different tasks (Conneller 2011, 82).

Sarsen stone, for too long treated as a mundane material, need not be reduced to one role as a signifier of ancestral pasts (Pollard and Gillings 2010, 40) if the variety of its usage and treatments are considered in appropriate detail.

CASE STUDIES

Sarsen stone is prolific in numerous areas of southern-central and south-east England (Summerfield and Goudie 1980). Worked, modified and unmodified sarsen is encountered in Neolithic settlement contexts such as the pits at Middle Farm (Dorset) (Butterworth and Gibson 2004) and White Horse Stone (Kent) (Hayden and Stafford 2006) and is abundant in Wiltshire. There, the breadth of sarsen's availability, *contra* Atkinson's assertion that it is found only near the upper Kennet River (1956, 111), indicates the potential for routine engagement with sarsen during the Neolithic across a wide area (Fig. 1). As well as highly variable surface sarsens encountered in the landscape, people could find boulders, cobbles and frost-shattered pieces in tree throws, when gardening, collecting water from streams, digging for clay and gathering flint, excavating pits and ditches and so on.

Neolithic settlement contexts with sarsen in north Wiltshire include modified blocks in the Hemp Knoll pit group (Robertson-Mackay 1980, 135); tools in pits on Waden Hill (Thomas 1955, 167) and under barrow Avebury G55 (Smith 1965b, 36); culturally-heated sarsen from Neolithic deposits at West Overton (Evans *et al*. 1993, 188), in pits and ditch fills at Cherhill (Evans *et al*. 1983, 55) and amongst late Neolithic occupation material filling Horslip long barrow's ditches (Ashbee *et al*. 1979, 218). In south Wiltshire, it has been found in pits (for example Stone and Young 1948; Powell *et al*. 2005; Wessex Archaeology 2016; Roberts *et al*. 2020) and amongst artefact scatters (Richards 1990, 109-123). Assemblages are, however, rarely retained. Here, three case studies are drawn from published data from the early Neolithic Windmill Hill enclosure (Whittle *et al*. 1999) and two newly-excavated assemblages from the middle Neolithic West Kennet Avenue occupation site and late Neolithic Marden henge enclosure, analysed using a methodology adapted from Whitaker (2020b) (Table 1).[2]

Windmill Hill

Windmill Hill causewayed enclosure, on a knoll of Holywell Nodular Chalk at *c*. 195 m OD approximately 2 km north-west of Avebury, was constructed over a period of perhaps two generations in the mid-37th century cal BC. Although close in date, its construction order is likely the Inner enclosure followed by the Outer and then Middle circuits. Over the following centuries its ditches provided spaces for deposits until, in the mid-34th century cal BC, those practices changed and the monumental focus shifted. During perhaps a generation immediately prior to the construction of the enclosure's circuits the hill had been a place for pit digging and filling (Whittle *et al*. 2011, 91, 95). Substantial quantities of material culture deposited in those pits and lower ditch fills of the enclosure indicate that this was a significant early Neolithic place. The location's importance stimulated a community to circumscribe part of the hill as a site for activities using materials gathered from everyday life and death, and into the early Bronze Age remained a key location for settlement in the region (Smith 1965a; Whittle *et al*. 1999; Whittle *et al*. 2000).

Sarsen stone was one of those materials featuring in the composition of pit and ditch deposits over time. Smith (1965a) and Whittle *et al*. (1999) ascribe its source to the Winterbourne valley, just over a kilometre to the east; but that need not have been the only source. Sarsens probably lie amongst superficial deposits that ring Windmill Hill a similar distance to the south and west. Around two decades ago groups of sarsens, some fairly substantial, were observed around the edges of the field north of Windmill Hill, apparently having been ploughed up (Rosamund Cleal pers. comm.). Prehistoric and more recent structural use of whole boulders and rubblestone at locations across and below the Lower Chalk plateau further to the north hint at their former wider availability in the landscape, reduced by intensive cultivation since later prehistory (Whittle *et al*. 1999, 1, 13-16) (Fig. 2). There may have been a cluster of boulders on the hill itself, eroded out of the Tertiary formations that formerly covered the chalk; of which small unused sarsens remarked upon by Smith (1965a, 120) might be the last sign. In a glade on rising ground, the setting, amidst special sarsen landscapes (Gillings and Pollard 1999, 182-183; Field 2005, 88-89), was the likely inspiration to visiting groups for story-telling and place-making.

Sarsen tools include saddle querns, rubbers, pounders (hammerstones and mauls), 'discs' (oblate hand-stones with ground edges, perhaps used to process minerals or as sanding rocks for hide processing), hearthstones and burnt sarsen pieces likely used as pot-boilers or in other culinary practices. There are also undiagnostic tool fragments and large quantities of miscellaneous sarsen from archaeological contexts, including more than 14,600 small boulders, cobbles and broken pieces weighing approximately 1.2 metric tons (Smith 1965a, 121; Whittle *et al.* 1999, 24-72, 338; Whittle *et al.* 2000) (Table 2). That figure probably under-represents the total amount of sarsen, thought to have been poorly recorded during excavation seasons before Keiller took personal charge of fieldwork part-way through 1927. If similar quantities were encountered during 1925-7 as are recorded from 1928-9 (when *c*. 107 m and *c*. 202 m of the ditch circuits were excavated respectively), then the sarsen total might be nearer 22,000 pieces.[3]

The large number of saddle querns prompted Smith (1965a, 121) to infer that querns were being manufactured on the hill, noting 65 fragmentary and two whole sarsen saddle querns and 61 fragmentary and 28 whole rubbers in Keiller's catalogue. Although it is difficult to reconcile the available data, up to 61 sarsen querns and 90 rubbers can now be accounted for from all twentieth century excavations (Table 2). The volume of sarsen waste combined with the quern forms also contributed to Smith's reasoning: querns were made on large sarsen pieces spilt from boulders, flaked to shape before finishing with a pecked grinding surface. Many of the excavated hammerstones, of which up to 100 can be accounted for (Table 2), may have been used in that work and to rejuvenate grinding surfaces.

A number of pre-enclosure features contain sarsen. They include pits cut by Inner Ditches VIII to X, but which are not radiometrically dated, and features under or very close to the edges of the Outer Bank that pre-date it by perhaps no more than a generation (Whittle *et al*. 2011, 95). Pits outside the enclosure to its south are associated with the similar features atop the hill on the basis of their comparable early Neolithic assemblages (Whittle *et al*. 2000, 141, 146). Four features are described here, selected on the strength of their phased relationship to enclosure circuits or for the specific sarsen use that they illustrate.

A hearth constructed of two layers of heavily burnt sarsen pieces in a shallow, circular depression lay under or very close to the northern-most edge of Outer Bank V. The hearth's chalk packing included a few flint flakes and crumbs of early Neolithic bowl pottery. Two similar pieces of sarsen were recovered from adjacent Pit 44, suggesting it was contemporary with or slightly later than the hearth. Its fill also included some undecorated pottery, flints and a piece of oolitic limestone. Pit 44 was covered by bank material. Also under the bank, at its interface with the chalk bedrock, finds from Outer Bank IV comprised sherds from up to 13 plain bowls, a flint assemblage including broken leaf-shaped arrowheads, approximately 4kg of animal bone, a small sarsen rubber, a partial sarsen rubber or quern and three other sarsen fragments (Smith 1965a, 25-27). The fill of Pit 8, one of eight features truncated by Inner Ditch IX, included two plain pottery sherds, bone fragments, flints, a sarsen pounder and seven sarsen pieces (Smith 1965a, 22).

Sarsen tools and tool fragments are unevenly distributed in the ditch circuits: 61 (19.2%) from Outer Ditch segments, 173 (54.6%) from the Middle Ditch and 83 (26.2%)

from the Inner Ditch. Although the quantities are partly a function of the relative volume of excavated segments, patterns do emerge. The greatest concentration is amongst segments of the Middle Ditch, where sarsen items conform imprecisely to asymmetrical patterns of deposits noticed by Whittle *et al*. (1999, 369) whereby more material is deposited in ditches to the right-hand side of circuit entrances. For example, while Middle Ditch II contains a far greater proportion of all other types of material culture, Middle Ditch I to the *left* has a higher density of sarsen: at the Inner Ditch entrance, however, greater sarsen density to the right in segment VII than in segments XVI and XV to the left parallels the relative volumes of other material culture (Fig. 3a).

Proportions of types of sarsen tool vary from segment to segment but ditches most often have a mix. Very few contain none and all ditches are likely to include some type of sarsen tool, given that poorly-recorded culturally-heated sarsen was found across the site and may well be ubiquitous. The Inner Ditch includes on the whole more miscellaneous tool fragments, suggesting that they are well-broken pieces that are just too small for firm identification. Too little of the Outer Ditch has been excavated to compare confidently with the other circuits, but a variety in sarsen use between its segments is indicated. Sarsen deposits in the Middle Ditch, however, have a rhythm: high numbers and similar proportions of tools in Middle Ditch IX to V change markedly from VI to IV, then increase in volume again, although with different proportions, in X and XI (Fig. 3b).

The generalization of that plan view obscures the temporally-distinct detail of grouped sarsen items and placed deposits incorporating sarsen in ditch layers. Four are described here, selected from primary fills to illustrate early practices involving sarsen across the circuits. A whole quern and rubber were placed together in Outer Ditch I layer 6 (*c*. 1.5-1.8 m deep). In Middle Ditch X, one quern fragment was placed in each half of layer 4 (*c*. 0.9-1.2 m deep), with antler pieces, pottery, charcoal and cattle bones amongst the layer's deposits. Sarsen played an important role throughout Middle Ditch I, but in primary fills the bone deposit on and close to its base included pieces of burnt sarsen and three large, cleanly-broken, quern fragments placed near the base of its northern end. A placed deposit in the west terminal of Inner Ditch I included a large piece of sarsen, flints, a pottery sherd, animal bones and a human humerus and ulna. (Whittle *et al*. 1999, 34-36, 40-41, 47, 51).

Some of the sarsen tools had a more complicated history than others. From Keiller's catalogue, Smith (1965a, 123) notes 15 pounders made from broken querns and three made by re-using rubbers. A piece of quern in Outer Ditch V was worn and abraded (Whittle *et al*. 1999, 338), implying a different life-history to the fresh pieces placed in Middle Ditch I. This taken with the high proportion of broken tools overall, including the miscellaneous tool fragments so important to the Inner Ditch but present throughout the circuits, mirrors the enclosure's broken pottery, processed animal bone, utilized flint and fragmented human remains.

Sarsen stone distribution in the wider area may have been part of the attraction drawing visitors to the environs of Windmill Hill. It would have been sourced nearby and perhaps on the hill itself to make the numerous tools used there before and during the life of the early Neolithic enclosure. The raw material was transformed into important tools for everyday life. Some tools were themselves turned into different types of tools, with many ending up as broken pieces selected for deposit in cut features on the hill. The tools themselves were used to transform other materials, such as grains into meal or flint nodules into flakes. As querns and rubbers, hearthstones and pot-boilers, sarsen was essential to nourishment. The sheer quantity of grinding tools implies the scale of plant processing (Whittle *et al*. 1999, 341), whilst the frequency of culturally-heated sarsen speaks to complex pyrotechnology used at the site and nearby.

West Kennet Avenue occupation site

An occupation site pre-dating the West Kennet Avenue, Avebury, represented by a prolific artefact scatter, was identified during Keiller's 1934 excavation of the northern third of the later Neolithic stone settings (Smith 1965a). At the east-facing foot of Waden Hill, the scatter extends over *c.* 70 m north-south roughly from Avenue stone pair 27 to 31 (the full east-west extent remains undefined). In addition to characteristic tools such as chisel arrowheads, finely-knapped scrapers and serrated flakes, the predominantly Peterborough Ware pottery assemblage indicates that most of the material accumulated during the middle Neolithic (*c*. 3400-2900 BC). The ceramics and high proportion of tools amongst the un-patinated flint assemblage indicate the presence of an *in situ* artefact spread largely at the base of the subsoil, resulting from settlement activity. Some tools, such as grouped scrapers, had been placed amongst the spread. Recent excavation by the Between the Monuments project (2013-15) extends understanding of the site including the nature of the artefact spread and various cut features (Keiller and Piggott 1936; Smith 1965a; Gillings *et al*. 2015).

The site lies at *c*. 160 m OD on thick Coombe rock deposits overlying bedrock chalk, gently sloping into a now dry shallow valley to the east. For clarity, I call this un-named valley 'Falkner's Coombe' after the stone circle standing at its heart. Coombe rock is a granular Head deposit, here incorporating sarsens, resulting from periglacial solifluction (Clark *et al*. 1967; Murton and Ballantyne 2017, 530). A former sarsen spread has been removed largely during agricultural clearance (Colt Hoare 1819, 8; Smith 1965a, 208 fn1; Pollard and Gillings 2010, 39) but many cobbles and boulders remain in the Pleistocene deposits and buried early prehistoric soils (Gillings *et al*. 2008, 135, 146). Molluscan evidence from early to middle Neolithic feature fills at Rough Leaze, *c*. 800 m to the north, and from a middle Neolithic pit F409 adjacent to the Avenue between Rough Leaze and the occupation site, indicates that open woodland persisted here into the middle Neolithic (Allen and Davis 2009; Pollard *et al*. 2012) (Fig. 4). The combination of tree-throw and boulder extraction pits revealed by geophysical survey and excavation of the occupation site hints at the mid-fourth millennium BC appearance of Falkner's Coombe's slopes, trees standing amidst a former sarsen spread as depicted in the forthcoming site report from which much of the following information is drawn (Gillings *et al*. in preparation).

Here, the focus is on three features revealed in the recent trenches (Fig. 5a). In Trench 3, F.6 is a sub-circular, bowl-shaped pit 1.0 x 0.8 m on plan and 0.3 m deep (Fig. 5b). It lies to the south side of F.12, a later Neolithic sarsen extraction pit (Gillings and Pollard 2016). The single fill (020) of dark grey-brown clay loam with charcoal flecks contained burnt antler fragments, small patches of darker soil and 130 pieces of flint including two chisel arrowheads, four scrapers and a notched flake. Its nine sarsen fragments are small, angular, sub-equant to equant pieces, none with characteristics diagnostic of percussion. Five are burnt and a further three friable, abraded, pieces may also have been (Table 3). That is consistent with the interpretation that (020) is a mix of hearth sweepings, knapping waste and soil. Radiocarbon measurement SUERC-59896 on a piece of short-life *Pomoideae* charcoal from the fill provides a date of 3311-2918 cal BC (95.4% probability) (Gillings *et al*. 2015, 8).

In Trench 4, a steep-sided, sub-rectangular pit F.55, 0.80 x 0.45 m on plan, had a large sarsen cobble in the top of its upper fill and another beside the pit. At 0.37 m deep, it is a re-cut of a larger pit [425]. Its upper fill (414) was a dark olive-brown, charcoal-flecked, clay loam containing more clayey patches whilst the lower (417) was a dark brown clay loam (Fig. 5c, 5d). Both fills included substantial flint assemblages, including eight chisel arrowheads, and sarsen: 13 small pieces in (414) weighing on average 48.8 g and four, slightly smaller (on average 39.3 g) in (417). Approximately half are burnt and those from (417) are more angular and less equant than the upper fill, hinting at different breakage causes (Table 3). Radiocarbon measurement SUERC-70784 on a piece of hazel charcoal from (414) gives a date of 3083-2902 cal BC (95.4% probability).

The top of F.35, a dished, oval, scoop in Trench 2, was ringed by a 0.65 x 0.42 m 'collar' of sarsen and flint blocks (072). The 0.2 m deep pit fill (077) included three small pieces of sarsen and ten pieces of flint debitage. Only one piece of sarsen from the 'collar' is available for analysis, an angular sub-equant block weighing 212 g, probably heated. Pieces from (077) are heated, one possibly part of a hammerstone broken prior to deposit (Fig. 6). These characteristics are commensurate with the interpretation of F.35 as a hearth.

Sarsen stone was prolific in the area when people were visiting Falkner's Coombe during the middle Neolithic, lingering on the east-facing slopes long enough for a mix of daily clutter and placed items to accumulate. The range of their tools hint at the breadth of the community's 'productive activities' (Pollard and Reynolds 2010, 124). Sarsen was being used in various ways, which although appearing more ephemeral because of the nature of the site, nevertheless include culinary practices and as hammerstones, querns and their rubbers. Cobbles were available to construct features such as F.35, a probable hearth. Pits such as F.6 were dug to take a mix of knapping waste, soil and hearth debris including bits of heated sarsen. Further material gathered from the surface – incorporating sarsen both burnt and broken possibly by different methods – was combined with flint to fill F.55 which was additionally marked by large sarsen cobbles.

Marden henge enclosure

Marden henge enclosure in the Pewsey Vale is an exceptionally large monument within which are a smaller henge and the site of a monumental mound called the Hatfield Barrow. The *c*. 11 ha enclosure is defined to the north and east by ditches with external banks and by the River Avon to the west and south. All of late Neolithic date, the broadly contemporary features were constructed at *c*. 105 m OD beside the watercourse on soliflucted Pleistocene deposits and Upper Greensand. Subsequent cultivation has significantly reduced the features' monumentality but excavations in 2010 and the recent Vale of Pewsey project (2015-17) investigated areas of the main henge enclosure bank and a complex construction sequence at the inner henge including a Neolithic building (Wainwright *et al*. 1971; Field *et al*. 2009; Leary and Field 2012; Leary 2017; 2018) (Fig. 7).

Without megalithic settings, the enclosure is not normally associated with sarsen stone. Nevertheless, sarsen is present in the Pewsey Vale, its distribution affected by extensive later cultivation in the fertile valley (Fig. 1). During his investigations at the enclosure in 1806, Cunnington (reproduced in Field *et al*. 2009, 75) noticed a number of sarsen boulders in the river. Old buildings in Vale settlements make structural use of sarsen, for example at Stanton St Bernard where its prevalence may be the derivation of the place-name '*stan tun*' (Knowles 2007, v). Numerous instances of field-edge boulders and small natural clusters were recorded during the Sarsen Stones of Wessex survey, including examples at Marden and nearby villages (Bowen and Smith 1977; Whitaker 2020c). Sarsens continue to be ploughed up to the south of the northern Vale scarp (Field *et al*. 2009, 59). Many are likely to be amongst the soliflucted deposits observed by Wainwright *et al*. (1971, 178-179, 233) and valley gravels (Jukes-Browne 1905, 45). Some boulders were perhaps available in formerly more substantial spreads, intimated by a farmer's report that, before they were removed, many were visible in a large field to the south of Hilcott (Whitaker 2020c, W203).

In total 901 small boulders, tool fragments and pieces of broken sarsen were excavated from archaeological contexts during the Vale of Pewsey project. The practice of retaining the stone from bulk samples wet-sieved through a 4mm mesh provides unrivalled insight into the roles that sarsen played at the site: here, the focus is on material from deposits associated with the demolition of a Neolithic building at the site of the inner henge (Trenches A/A*/A**) and broken sarsen incorporated into the bank of the main henge enclosure (Trench J) (Fig. 7).

Trenches A/A*/A** placed over the north-western arc of the inner henge bank enabled the investigation of a late Neolithic building and associated deposits. These included midden material overlying both the old ground surface and the building's postholes, and abutting the building's central packed chalk floor, to its south-west side. Post-dating the deconstruction of the building's walls yet respecting the floor surface, the large quantities of animal bone (some burnt), Grooved Ware sherds and sarsen pieces in the undisturbed deposit are the likely remains of a single cooking and feasting event (Leary and Field 2012, 62). To the north-east side of the building, a heavily burnt external hearth and charcoal-rich spread of burnt material included substantial quantities of sarsen as well as further Grooved Ware sherds, animal bone and other material culture. The deposits were quickly covered by the construction of the bank of the inner henge (Leary 2018, 16-22). The midden and burnt spread contexts include in total 441 sarsen pieces, 45.6% of the total sarsen excavated from the site.

The assemblage of 341 largely angular pieces from the burnt spread are quite small (mean weight 21.4 g). Of these, 261 (76.5%) have distinctive colouration and cracking resulting from burning and the high angularity of the rest suggests that they too resulted from the same pyrotechnic process. They are on the whole equant with a mean Maximum Projection Sphericity (MPS)[2] of 0.67. 168 pieces (49.3%) are however slightly more elongate or platy in form than pieces from the midden (Table 4, Fig. 8a), including numerous crescentic pieces, only five of which display possible percussion characteristics: most are likely to have resulted from exfoliation due to temperature change. The assemblage includes three possible quern or polisher fragments and two possible rubber fragments, all small, of which two and one respectively are burnt (Table 4).

The 70 angular pieces of sarsen from the midden are quite equant chunks with a mean MPS of 0.76; only 15 (21.4%) are more elongate or platy in form although none are mechanically flaked. The majority are larger than those in the burnt spread (mean weight 60.0 g) and burnt (58, 82.9%) with sharp, cleanly fractured faces (Table 4). The mottled interior colour of the largest piece (1277 g) is shared by other pieces from the context, suggesting that much is from the same boulder. Eight pieces conjoin to make three re-fitting groups, supporting Leary and Field's (2012, 62) suggestion that the midden material derives from one cooking event (Fig. 8b).

Trench J provided the opportunity to excavate the sequence of Neolithic bank deposits forming the east side of the main outer henge enclosure. Cutting primary bank material and a thin sandy colluvial layer, two small pits contained three large sarsen assemblages, SF615, SF613 and SF614. The pits were sealed by a sequence of deposits ending with (2203), the final surviving bank layer (Leary 2017, 15). These pit fills account for 36.6% of all the sarsen excavated from the site, in total 330 pieces (Table 4).

SF615 in fill (2226) comprises 41 sarsen pieces from pit [2227], only 0.1 m deep and 1.0 x 1.2 m in plan. The majority of the largely angular pieces are burnt (39, 95.1%), including one fragment of possible quern or polisher and one fragment of possible rubber. Three pieces re-fit and although other refits were not observed, some fragments of stone have similar colouration and texture and may be parts of the same parent cobbles. Although on the whole relatively equant, 20 (48.8%) of the pieces are more elongate and platy fragments (Table 4, 5) (Fig. 9a).

Although a small feature (1.0 x 1.3 m in plan and 0.22 m deep), fills of pit [2219] contain 289 sarsen pieces. The majority of largely sub-angular, quite equant, pieces in SF614 from primary fill (2224) are burnt (117, 80.7%). SF613 in secondary fill (2218) has a similar profile, although on the whole its pieces are smaller weighing on average 40.6 g compared with 54.9 g in the primary fill. Some 55 (37.9%) pieces in SF613 and 64 (44.4%) in SF614 are more elongate and platy in form. These occasionally crescentic pieces, which do not have platforms or signs of percussive crushing damage, probably resulted from exfoliation due to temperature change (Fig. 9b, 9c). SF614 includes one piece of possible hammerstone and SF613 includes one small piece of possibly dressed sarsen and two possible quern fragments (Table 4, 5).

Although less visible in today's landscape, sarsen stone was available from the environs to provide a range of tools for the people constructing the monuments at the Marden henge enclosure. They include hammerstones and saddle querns with their rubbers. Whilst querns hint at plant processing and food preparation, significance also lies in the heated and highly fragmented nature of much of the sarsen. It seems that a large quantity was heated just outside the Neolithic building where much was left amongst the burnt spread. Depending on their contemporaneity, a proportion of mostly larger, easier to gather, pieces may have been transferred from there along with other material to the midden, leaving behind the smaller fragments and tiniest spalls including 124 pieces weighing under 1 g (Table 4). Alternatively, sarsen pieces in the burnt spread could result from a different pyrotechnic activity. Experience from published (Willies 2002) and unpublished experimental work demonstrates how hot sarsen splashed with cold water cracks and exfoliates: the higher proportion of more elongate, platy pieces from the burnt spread, including crescentic pieces, may be commensurate with preparation of hot rocks used in the building as a sweat lodge (Leary and Field 2012, 61) (Fig. 10).

Large quantities of culturally-heated sarsen were also collected up to be deposited in pits amongst the main henge enclosure bank construction layers. Although they cannot be linked precisely in date to events at the inner henge, the two pits' sarsen assemblages have similar characteristics to the material from the midden and burnt spread and were perhaps created by similar processes. On average, the tool fragments and broken pieces are slightly larger than those from the burnt spread and include far fewer of the very tiniest spalls (only three weighing under 1 g in SF613, Table 4), suggesting that rather than being a dump of cleared waste, sarsen was selected from a burning location for deposit in the pits, to be enveloped inside the bank.

DISCUSSION

O'Connor (2010) and Cooney (2010) remind us that dismissive archaeological attitudes to 'mundane' stone risk misunderstanding its social and cultural significance. Local stone that is part of daily life can be just as meaning-laden and have as much semiotic potential as other more 'attractive' (larger, exotic) material. As Conneller (2011, 81) points out, the daily use of a type of stone must have informed people's understanding of it in other situations. Here I argue that sarsen stone was a material so present in Neolithic lives that it could not fail to be wrapped up in ways of doing, knowing and being. Ordinary relationships with non-megalithic sarsen would have informed extraordinary, megalithic, sarsen encounters.

These case studies draw attention to varied sarsen stone use by Neolithic communities. They include the 'everyday' by which I mean quotidian encounters with this ubiquitous, useful hard-stone including finding and collecting material suitable to make tools; habitually preparing cobbles and large flakes; dressing and re-dressing surfaces; and expertly managing 'hot rock' technologies. Sarsen offered numerous properties, all revealed through the performance of different tasks. Walking the landscape, exploring upland and woodland, gathering water from streams, digging pits and ditches, all exposed sarsen's general availability in different forms. Cobbles provided hammers, anvils, hearthstones and packing stones. Sarsen could be changed by hammering, pecking, grinding and heating to make tools with which to transform other substances. That versatility derives from sarsen's ubiquity; from its homogeneity, allowing it to be shaped in different ways; from its textures and fabric giving different surface effects; from its density and toughness; and its capacity for roles in pyrotechnologies (Fig. 11).

At Windmill Hill, sarsen was part of the suite of materials necessary for various functions, subsequent deposits and pattern-making across the hill. It was being used early on to construct hearths and provide those useful tools that would be placed with other pieces in pits and on the ground surface prior to building the causewayed enclosure. For people digging and filling the enclosure's ditch segments, it was an essential element of varied deposition 'styles' (Whittle *et al*. 1999, 368). The sarsen conforms to the profile of the enclosure's flint identified by Bye-Jensen (2019): pieces whose manufacture- and use-history were known, including re-purposed items such as pounders made from quern fragments. Bye-Jensen (2019, 311) emphasises the 'normal-ness' of the flint, a description that can be extended to the sarsen. Material from familiar sources was already imbricated in activity that monumentalised a place.

Sarsen tools that could be characterised as 'domestic' were necessary components of that behaviour, including when suitably altered. High degrees of tool fragmentation stand out in the Inner Ditch, a theme that continues throughout the duration of ditch-filling with, for example, placement of freshly-broken quern pieces in segments such as Middle Ditch I. Although similar incorporation of broken tool fragments in deposits at Marden henge could be accidental, most of those pieces are also very small. Watts (2012, 121) comments that querns in particular are unlikely to break accidentally. The intentional destruction of querns in the Neolithic has been noted elsewhere, such as at the LBK site of Geleen-Janskamperveld: there, the highly fragmented quern pieces suggests the ritual 'killing' of those tools (Verbaas and Van Gijn 2007). Quern fragmentation is implicated in other ritualised behaviours in Neolithic contexts (eg, Graefe *et al.* 2009; Tsoraki 2018). Small sarsen tool fragments may be seen in this light.

The sheer volume of sarsen in Windmill Hill's Middle Ditch touches on just how much was regularly being used there by communities. Throughout the segments they made technological associations between food stuffs and sarsen, such as the burnt material in the Middle Ditch I bone deposit, perhaps remains of the cooking that transformed meat into food. In numerous ditch segments, sarsen's associations include pottery that also has a role in feeding, sustaining people who in Inner Ditch I may be represented as beneficiaries by the fragments of human bone in the placed deposit. Living practices were quoted in specific placed deposits involving sarsen, such as the paired quern and rubber in Outer Ditch I. Technological associations between heating sarsen and refreshment (whether by cooking food or refreshing the body by cleansing) are also apparent at the Marden henge enclosure, with so much sarsen amongst the burnt spread and midden deposits.

Culturally-heated rock, important at all three sites, is essential to a wide range of activities: as well as hearthstones, cooking stones are used in different roasting and baking methods; boiling stones are necessary to produce food, drinks, medicines, dyes, soap, processed hide and plant fibres; hot water and steam for personal cleansing, woodworking and ceremony are generated with hot rocks (see Shantry 2020 for a recent review of hot-rock technology). Such activities involving sarsen were likely part of people's routines at occupation sites, which fixed it at the heart of everyday life. Whittle *et al*. (1999) and Bye-Jensen (2019) invoke the role of domestic material culture at Windmill Hill in building community identity through the way it cites the recent past, which would include the knowledge and memories of sourcing, preparing and using sarsen. Culturally-heated sarsen was also necessary in substantial quantities for the main Marden henge enclosure bank. Leary and Field (2012, 63) comment on the inner henge bank's mixed materials, ascribing the 'power and the evidence of what went before' to the material culture placed amongst its construction layers. A similar, biographical, narrative may have been cemented when the south-east section of the main henge enclosure bank was built, by the inclusion of sarsen collections SF613, SF614 and SF615 – transformed by fire, either from some previous event or specially made for the purpose.

At the West Kennet Avenue occupation site, behaviours involving sarsen may have been targeted at communicating information into the future. The site's pits along with pit F409 *c*. 300 m to the north have similarities with other middle Neolithic pits like those at King Barrow Ridge (Wiltshire). There, a mix of everyday and specially-made items including large numbers of flint tools, Peterborough Ware sherds and modified and natural sarsen were deposited by over-wintering pastoralists, who may have left each pit's chalky up-cast as markers to return to (Roberts *et al*. 2020). Falkner's Coombe would have presented a similarly attractive place, the occupation site's archaeology perhaps resulting from the accumulated residues of a seasonally-frequented locale. The durable flint and sarsen of the midden-like artefact spread, characterised by Pollard (2005, 111) as a technology of remembering, both transmitted information to visitors that reinforced connection to the place (see Pope and Roberts 2005) and provided material with which to compose markers for the future, such as pit F.55 ensigned by its prominent sarsen cobbles. We might imagine a family, or the young people of a kin group, hustling pigs amongst Autumn pannage or caring for over-wintering cattle in the valleys; stopping in Falkner's Coombe, a place they might be reluctant to leave; who at the necessary time dug a pit (F.6) in the lee of a sarsen boulder in which they placed certain collected materials perhaps to commemorate their departure or to ensure a safe return next season.

Mixes of 'natural' and 'cultural' sarsen speak to the material's social significance. O'Connor (2010) questions the line drawn between 'artefactual' and 'natural' stone, drawing attention to significant meanings afforded to unworked stone in numerous settings. The hybridity expressed in archaeological contexts such as Neolithic pits containing worked and unworked sarsen appears also above-ground. Both Beckhampton Road and South Street long mounds near Avebury include modified and unmodified non-structural sarsens (Ashbee *et al*. 1979; Pollard and Gillings 2010). Teather (2008) shows how sarsen *polissoirs* incorporated with other boulders into chambered tombs were not merely expediently-used rocks but 'active social media in their own right' (2008, 179). Falkner's Circle combines erected sarsens and naturally-recumbent boulders from the adjacent spread (Gillings *et al*. 2008, 151). In these places, distinctions between worked and unworked sarsen, natural and cultural, break down.

The significance of the everyday is further revealed in sarsen’s capacity to develop grinding surfaces, worn out and regenerated by repeated cycles of use and re-pecking, clearly important throughout the Neolithic. Such surfaces would have had multiple uses not limited to milling but including processing other plants and minerals, grinding edge-tools, shaping bone and antler tools and so on. Highlighting this expedience is not meant to imply an economic determinism in the selection of sarsen as a necessity of daily life. Rather, it emphasises the importance of technical contexts of sarsen uses and their affordance to provide technical representations (Sillar 1996); metaphorical understandings of the world, generated through experience of technological practice, that can be applied to other technical arenas. In the context of selecting, shaping and dressing sarsen for those productive, lively, activities, the shaping and dressing of Stonehenge’s sarsens by the same techniques can be seen as a life-giving process of making and renewing the world for nourishment and sustenance necessary to guarantee the future.

CONCLUSION

In the Neolithic, sarsen’s ubiquity in certain landscapes ensures that it could not fail to be wrapped up in daily life, the arena in which relationships, identities, responsibilities and beliefs are habitually learned, worked through and developed. Regular experience of sarsen stone included relations with landscapes, soils and technologies. Sarsen was central to a wide range of productive practices, sitting at the intersection of an entangled assemblage of numerous other materials and creative activities in a way that perhaps no other substance – other than the human body itself – did. Used for flaking and polishing other stone, perhaps grinding clays and tempers or burnishing ceramics, processing plant and animal products, cooking food, hammering in stakes and posts, heating and cleaning people, it also marked places, contained bodies, created and supported structures. Accordingly, sarsen’s routine use must be considered to understand its monumental use.

That is not to say that non-megalithic and megalithic sarsen, or worked and unworked material, necessarily had the same ontological relationship with people living in sarsen landscapes across the span of the Neolithic. Sarsen spreads could have been strange and mysterious places full of mythologised boulders (Field 2005; Pollard and Gillings 2009) whilst sarsen in different forms held other significances: for Neolithic ‘connoisseurs of stone’ (Adams 2022), sarsen clearly could be many things, including a key material in ‘aesthetics of depositional practice’ (Pollard 2001, 316). Detail from the three case studies presented here contradicts conventional and uniformly-applied tropes of an indurate material that metaphorically petrifies people’s pasts. Neolithic engagement with sarsen was varied and its meanings likely contingent to the context of use. Its different properties become apparent in its many different tasks, through which it was afforded values; here, I have foregrounded strands including nourishment, transformation and place-making. Examining non-megalithic sarsen stone casts light on communities’ encounters with this versatile material, emphasising that it should be afforded scholarly attention in the same way as other stone types, situated as it was at the heart of Neolithic technologies.

ENDNOTES

1. It is difficult to identify a suitable collective term for the range of small, worked and un-worked sarsen pieces that this paper addresses. ‘Non-megalithic’ is too cumbersome to use in every instance. Sometimes I use ‘sarsen tools’ or ‘sarsen pieces’ depending on context. Where I use ‘artefactual sarsen’ I do not mean to ignore that fact that megaliths are also artefacts; and although I sometimes use ‘portable’ to refer to smaller, more easily moved sarsen items, I do not mean that sarsen boulders are not portable.
2. Broken sarsen pieces are invariably chunky and irregular, making them difficult to describe and categorise consistently. Terminology derived from knapped flint analysis is less applicable: describing items as ‘flakes’, for example, risks implying mechanical action which may not be relevant. The key attributes recorded to address research questions thus include a proxy for form using Maximum Projection Sphericity (MPS) (Blott and Pye 2008). MPS avoids a process-based classification of form based on assumptions about mechanical fracture, and deals with the continuum of shapes which are not easily divided into hard and fast classes. It describes how a shape deviates from equancy on a scale from 0 (least equant) to 1 (equant) and can be combined with form factors to describe, for example, how platy, elongate or blade-like a piece of stone is.
3. For example, Keiller went to some trouble to count and record sarsen from ditch segments excavated in 1927. His field notes show how often large quantities of sarsen were encountered and how commonly the material showed signs of heating and burning. As well as tools and associations with other materials, he recorded fabric similarities and differential burning on sarsen pieces; hinting at the analytical potential had more detail been recorded, or more material retained in the site’s collections (Historic England Archive, ALK01/02).

ACKNOWLEDGEMENTS

With thanks to Josh Pollard, Jim Leary and Martin Bell for supporting analysis of and providing access to excavated sarsen assemblages from the West Kennet Avenue occupation site and Marden henge enclosure. I am grateful to this paper’s reviewers for their helpful comments and observations on the text. This research was supported by the Arts and

Humanities Research Council (grant number AH\L503939\1) through the South, West and Wales Doctoral Training Partnership. This paper is published with financial assistance from the University of Reading.

BIBLIOGRAPHY

Manuscript Sources

Historic England Archive. ALK01/02, A copy of a notebook belonging to Alexander Keiller, which contains notes on sites of archaeological interest, including those in A. Keiller and O.G.S. Crawford's 1928 publication "Wessex from the Air"

Database Sources

Historic England 2022. The National Heritage List for England. Historic England [accessed 22 April 2022] https://historicengland.org.uk/listing/the-list/

Whitaker, K. A. 2020c. *Sarsen Stones in Wessex*. University of Reading: University of Reading Research Data Archive, https://doi.org/10.17864/1947.249

Published Sources

Abbott, M. & Anderson-Whymark, H. 2012. *Stonehenge Laser Scan: Archaeological Analysis Report.* Swindon: English Heritage Research Report 32-2012

Adams, T. 2022. How science is uncovering the secrets of Stonehenge. *The Guardian*, 30 January 2022

Allen, J.R.L. 2015. *Kerbside Geology in Reading, Berkshire. Aspects of historical archaeology in the explanding town, c1840-1914.* Oxford: BAR British Archaeological Report 619

Allen, M.J. & Davis, B. 2009. A Middle Neolithic Pit in the West Kennet (Stone) Avenue, Avebury, 2005. *Wiltshire Archaeological and Natural History Magazine* 102, 12-21

Ashbee, P., Smith, I.F. & Evans, J.G. 1979. Excavation of three long barrows near Avebury, Wiltshire. *Proceedings of the Prehistoric Society* 45, 207-300

Atkinson, R.J.C. 1956. *Stonehenge.* London: Hamish Hamilton

Bennett, F.J. 1913. Coldrum Monument and Exploration 1910. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland* 43, 76-85

Blott, S.J. & Pye, K. 2008. Particle shape: a review and new methods of characterization and classification. *Sedimentology* 55, 31-63

Boivin, N. & Owoc, M.A. (eds). 2004. *Soils, Stones and Symbols: Cultural Perceptions of the Mineral World.* London: UCL

Bowen, H.C. & Smith, I.F. 1977. Sarsen Stones in Wessex: the society's first investigations in the Evolution of the Landscape Project. *The Antiquaries Journal* 57, 185-196

Britton, J. (ed.). 1847. *The Natural History of Wiltshire by John Aubrey F.R.S. written between 1656 and 1691.* London: Wiltshire Topographical Society

Brown, G., Field, D. & McOmish, D. (eds). 2005. *The Avebury Landscape. Aspects of the Field Archaeology of the Marlborough Downs*. Oxford: Oxbow Books

Bunte, K. & Abt, S.R. 2001. *Sampling Surface and Subsurface Particle-Size Distributions in Wadable Gravel- and Cobble-Bed Streams for Analyses in Sediment Transport,* *Hydraulics, and Streambed Monitoring.* Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station

Butterworth, C. & Gibson, C. 2004. Neolithic Pits and a Bronze Age Field System at Middle Farm, Dorchester. *Proceedings of the Dorset Natural History and Archaeological Society* 126, 15-25

Bye-Jensen, P. 2019. *Causewayed enclosures under the microscope.* Unpublished PhD thesis, University of Southampton

Chan, B. 2020. Sarsen from the sarsen-dressing area in Trench 44 and the Stonehenge Avenue in Trench 45. In M. Parker Pearson, J. Pollard, C. Richards, J. Thomas, C. Tilley & K. Welham (eds) *Stonehenge for the Ancestors. Part 1: Landscape and Monuments*, 311-329. Leiden: Sidestone Press

Clark, M.J., Lewin, J. & Small, R.J. 1967. *The Sarsen Stones of the Marlborough Downs and their Geomorphological Implications.* Southampton: Department of Geography, University of Southampton

Cleal, R., Walker, K. & Montague, R. (eds). 1995. *Stonehenge in its Landscape.* London: English Heritage

Colt Hoare, R. 1819. *The Ancient History of Wiltshire.* London: Lackington, Hughes, Harding, Mavor, and Jones

Conneller, C. 2011. *An archaeology of materials: substantial transformations in early Prehistoric Europe.* Abingdon: Routledge

Cooney, G. 2008. Engaging with stone: making the Neolithic in Ireland and Western Britain. In H. Fokkens, B.J. Coles, A.L. Van Gijn, J.P. Kleine, H.H. Ponjee, & C.G. Slappendel (eds). *Between Foraging and Farming,* 201-14. Leiden: Analecta Praehistorica Leidensia 40

Cooney, G. 2010. Mundane Stone and its Meaning in the Neolithic. In O’Connor *et al*. 2010, 64-74

Cooney, G., Megarry, W., Markham, M., Gilhooly, B., O’Neill, B., Gaffrey, J., Sands, R., Nyland, A., Ballin, T., Murray, J. & Sheridan, A. 2019. Tangled up in blue: The role of reibeckite felsite on Neolithic Scotland. In Teather *et al*. 2019, 49-65

Corcoran, M. & Sevastopulo, G. 2017. Provenance of the Stone Used in the Construction and Decoration of Tomb 1. In G. Eogan & K. Cleary (eds). *Excavations at Knowth 6, 505-68.* Dublin: Royal Irish Academy

Cummings, V. & Richards, C. 2021. *Monuments in the Making: Raising the Great Dolmens in Early Neolithic Northern Europe.* Oxford: Oxbow Books/Windgather Press

Cunnington, M.E. 1923. *The Early Iron Age Inhabited Site at All Cannings Cross Farm, Wiltshire.* Devizes: George Simpson and Co

Dacre, M., Ellison, A., Everton, R.F., Smith, I.F., Davies, S. & Richards, J. 1981. A Bronze Age Urn Cemetery at Kimpton, Hampshire. *Proceedings of the Prehistoric Society* 47, 147-203

Davies, A.M. & Baines, A.H.J. 1953. A preliminary survey of the sarsen and puddingstone blocks of the Chilterns. *Proceedings of the Geologists’ Association* 64, 1-9

Downes, J., Richards, C., Brown, J., Cresswell, A.J., Ellen, R., Davies, A.D., Hall, A., Mcculloch, R., Sanderson, D.C.W. & Simpson, I.A. 2013. Investigating the Great Ring of Brodgar, Orkney. In C. Richards (ed.) *Building the Great Stone Circles of the North,* 90-118. Oxford: Windgather Press

Evans, J.G., Limbrey, S., Mate, I., Mount, R., Davies, S., Fitt, J., Griffiths, I., Jarrett, C., Milles, A., Ringwood, V. & Whittle, A. 1993. An Environmental History of the Upper Kennet Valley, Wiltshire, for the Last 10,000 Years. *Proceedings of the Prehistoric Society* 59, 139-195

Evans, J.G., Smith, I.F., Darvill, T., Grigson, C. & Pitts, M.W. 1983. Excavations at Cherhill, North Wiltshire, 1967. *Proceedings of the Prehistoric Society* 49, 43-117

Field, D. 2005. Some observations on perception, consolidation and change in a land of stones. In G. Brown *et al*. (eds). 2005, 87-94

Field, D., Martin, L. & Winton, H. 2009. *The Hatfield Earthworks, Marden, Wiltshire. Survey and Investigation*. Swindon: Historic England Research Report 96-2009

Fowler, P.J. 2000. *Landscape Plotted and Pieced. Landscape History and Local Archaeology in Fyfield and Overton, Wiltshire.* London: The Society of Antiquaries of London

Gillings, M., Allen, M.J., French, C., Cleal, R., Snashall, N., Pike, A. & Pollard, J. 2015. Living on the Avenue: investigating settlement histories and other events at West Kennet near Avebury. *PAST. The Newsletter of the Prehistoric Society* 81, 6-9

Gillings, M., Chan, B., Cleal, R., Snashall, N. & Pollard, J. in preparation. *The West Kennet Avenue occupation site, and the Middle Neolithic of the Avebury Region and Beyond*

Gillings, M. & Pollard, J. 1999. Non-portable stone artefacts and contexts of meaning: the tale of Grey Wether (www.museums.ncl.ac.uk/Avebury/stone4.htm). *World Archaeology* 31, 179-93

Gillings, M. & Pollard, J. 2016. Making Megaliths: Shifting and Unstable Stones in the Neolithic of the Avebury Landscape. *Cambridge Archaeological Journal* 26, 1-23

Gillings, M., Pollard, J., Wheatley, D. & Peterson, R. 2008. *Landscape of the Megaliths. Excavation and fieldwork on the Avebury monuments, 1997-2003.* Oxford: Oxbow Books

Gingell, C. 1992. *The Marlborough Downs: A Later Bronze Age Landscape and its Origins.* Devizes: Wiltshire Archaeological and Natural History Society

Gowland, W. 1902. Recent Excavations at Stonehenge. *Archaeologia* 58, 37-118

Graefe, J., Hamon, C., Lidström-Holmberg, C., Tsoraki, C. & Watts, S. 2009. Subsistence, social and ritual practices: quern deposits in the Neolithic societies of Europe. In S. Bonnardin, C. Hamon, M. Lauwers and B. Quilliec (eds) *Du matériel au spirituel: Réalités archéologiques et historiques des « dépôts » de la Préhistoire à nos jours, XXIXe Rencontres Internationales d'Archéologie et d'Histoire*, 87-96. Antibes: Éditions APDCA

Greaney, S. 2019. A whiter shade of pale: powerful relationships between Neolithic communities and the underworld at Monkton Up Wimborne, Dorset. In Teather et al. 2019, 193-206

Hayden, C. & Stafford, E. 2006. *The Prehistoric Landscape at White Horse Stone, Aylesford, Kent*. Oxford: Oxford Wessex Archaeology Joint Venture unpublished typescript report

Hepworth, J.V. 1998. Aspects of the English silcretes and comparison with some Australian occurrences. *Proceedings of the Geologists' Association* 109, 271-288

Hurcombe, L. 2007. *Archaeological Artefacts as Material Culture*. London: Routledge

Ingold, T. 2007. Materials against materiality. *Archaeological Dialogues* 14, 1-16

Jones, A.M. & Goskar, T. 2017. Hendraburnick 'Quoit': recording and dating rock art in the west of Britain. *Time and Mind* 10, 277-292

Jukes-Browne, A.J. 1905. *The Geology of the Country South and East of Devizes. Explanation of Sheet 282.* London: HMSO

Keiller, A. & Piggott, S. 1936. The Recent Excavations at Avebury. *Antiquity* 10, 417-427

King, N.E. 1968. The Kennet Valley Sarsen Industry. *Wiltshire Archaeological and Natural History Magazine* 63, 83-93

Knowles, V. 2007. *A History of Stanton St Bernard.* Salisbury: The Hobknob Press

Leary, J. 2017. *Vale of Pewsey Project, Season 2, 2016. Marden Henge and Wilsford Henge. Archaeological Assessment Report, Stratigraphy*. University of Reading: Unpublished typescript report

Leary, J. 2018. The Vale of Pewsey Project, Season 1, 2015. *Marden Henge and Wilsford Henge. Archaeological Assessment Report (Stratigraphy).* University of Reading: Unpublished typescript report

Leary, J. & Field, D. 2012. Journeys and Juxtapositions. Marden Henge and the View from the Vale. In A. Gibson (ed.) *Enclosing the Neolithic. Recent Studies in Britain and Europe*, 55-65 Oxford: BAR International Series 2440

Migoń, P. 2020. Sarsens—The Maker of Upland Scenery of Southern England: From Mid-Cenozoic Gravel Plains to Neolithic Landscapes. In A. Goudie & P. Migoń (eds). *Landscapes and Landforms of England and Wales*, 317-29. Cham: Springer International Publishing

Moss, R. 2000. A Medieval Jigsaw Puzzle: The Ancient Stones of Christ Church. *Archaeology Ireland* 14, 20-23

Murton, J.B. & Ballantyne, C.K. 2017. Periglacial and Permafrost Ground Models for Great Britain. In J.S. Griffiths & C.J. Martin (eds). *Engineering Geology and Geomorphology of Glaciated and Periglacial Terrains,* 501-97. London: The Geological Society

Nash, D.J., Ciborowski, T.J.R., Ullyott, J.S., Pearson, M.P., Darvill, T., Greaney, S., Maniatis, G. & Whitaker, K.A. 2020. Origins of the sarsen megaliths at Stonehenge. *Science Advances* 6, eabc0133

Nash, D.J. & Ullyott, J.S. 2007. Silcrete. In D.J. Nash & S.J. Mclaren (eds). *Geochemical Sediments and Landscapes,* 95-143. Oxford: Blackwell Publishing

O'Connor, B. 2010. Re-collected objects: carved, worked and unworked stone in Bronze Age funerary monuments. In B. O'Connor *et al*. (eds). 2010, 147-60

O'Connor, B., Cooney, G. & Chapman, J. (eds). 2010. *Materialitas. Working Stone, Carving Identity.* Oxford: Prehistoric Society Research Paper 3

Parker Pearson, M. 2016. The sarsen stones of Stonehenge. *Proceedings of the Geologists' Association* 127, 363-9

Parker Pearson, M. & Ramilisonina 1998. Stonehenge for the ancestors: the stones pass on the message. *Antiquity* 72, 308-326

Peers, C.R. & Clapham, A.W. 1928. St Augustine's Abbey Church, Canterbury, before the Norman Conquest. *Archaeologia* 77, 201-218

Petrequin, P., Cassen, S., Errera, M., Klassen, L., Sheridan, A. & Petrequin, A.-M. (eds). 2012. *JADE. Grandes Haches Alpines du Néolithique Européen, V au IV millénaires av. J.-C.* Besancon: Presses Universitaires de Franche-Comte de Rescherche Archaeologique de la Vallee de l'Ain, Cahiers de la MSCH C.N. Ledoux (17)

Pitts, M.W. 1982. On the Road to Stonehenge: report on the investigations beside the A344 in 1968, 1979 and 1980. *Proceedings of the Prehistoric Society* 48, 75-132

Pitts, M.W. 2000. *Hengeworld.* London: Century

Pollard, J. 2001. The Aesthetics of Depositional Practice. *World Archaeology* 33, 315-333

Pollard, J. 2005. Memory, Monuments and Middens in the Neolithic Landscape. *In* G. Brown *et al*. (eds). 2005, 103-14

Pollard, J., Allen, M.J., Cleal, R., Snashall, N., Gunter, J., Roberts, V. & Robinson, D. 2012. East of Avebury: tracing prehistoric activity and environmental change in the environs of Avebury henge (excavations at Rough Leaze, 2007). *Wiltshire Archaeological and Natural History Magazine* 105, 1-20

Pollard, J. & Gillings, M. 2010. The World of the Grey Wethers. In B. O'Connor *et al*. (eds). 2010, 29-40

Pollard, J. & Reynolds, A. 2010. *Avebury. The Biography of a Landscape.* Stroud: The History Press

Pope, M. & Roberts, M. 2005. Observations on the relationship between Palaeolithic individuals and artefact scatters at the Middle Pleistocene site of Boxgrove, UK. In C. Gamble & M. Porr (eds). *The Hominid Individual in Context: Archaeological Investigations of Lower and Middle Palaeolithic Landscapes, Locales and Artefacts.* London: Routledge

Potter, J.H. 1998. The distribution of silcretes in the churches of the London Basin. *Proceedings of the Geologists' Association* 109, 289-304

Powell, A.B., Allen, M.J., Chapman, J., Every, R., Gale, R., Harding, P., Knight, S., McKinley, J.I. & Stevens, C. 2005. Excavations along the Old Sarum Water Pipeline, North of Salisbury. *Wiltshire Archaeological and Natural History Magazine* 98, 250-280

Powers, M.C. 1953. A New Roundness Scale for Sedimentary Particles. *Journal of Sedimentary Research* 23, 117-119

Rankine, W.F. 1949. Stone 'maceheads' with Mesolithic associations from south-eastern England. *Proceedings of the Prehistoric Society* 15, 70-6

Rastell, J. 1530. *The Pastyme of People: the cronycles of dyuers realmys and most specyally of the realme of Englond* London: John Rastell

Richards, C. (ed.) 2013. *Building the Great Stone Circles of the North.* Oxford: Windgather Press

Richards, J. 1990. *The Stonehenge Environs Project.* London: English Heritage

Roberts, D., Barclay, A., Bishop, B., Bronk-Ramsey, C., Campbell, G., Canti, M., Dobie, J., Dunbar, E., Dunne, J., Evershed, R.P., Forward, A., Last, J., Lamb, S., Linford, N., Linford, P., Linscott, B., Madgwick, R., Marshall, P., Mays, S., McParland, H., Payne, A., Pelling, R., Pike, A., Price, K., Quinn, P., Radini, A., Reimer, P., Russell, M., Seager Smith, R., Soutar, S., Speller, C., Vallender, J., Valdez-Tullett, A., Van Heekeren, V. & Worley, F. 2020. Middle Neolithic pits and a burial at West Amesbury, Wiltshire. *Archaeological Journal* 177, 167-213

Robertson-Mackay, M.E. 1980. A 'Head and Hooves' Burial beneath a Round Barrow, with other Neolithic and Bronze Age Sites, on Hemp Knoll, near Avebury, Wiltshire. *Proceedings of the Prehistoric Society* 46, 123-176

Rupert Jones, T.R. 1886. History of the Sarsens. *Wiltshire Archaeological and Natural History Magazine* 23, 122-154

Rupert Jones, T.R. 1901. V.-History of the Sarsens. *Geological Magazine* 8, 115-125

Shantry, K. 2020. The selection of boiling stones from a heterogeneous supply. *Journal of Archaeological Science: Reports* 29, 102030

Sillar, B. 1996. The Dead and the Drying. Techniques for transforming people and things in the Andes. *Journal of Material Culture* 1(3), 259-289

Smith, A.C. 1884. *Guide to the British and Roman Antiquities of the North Wiltshire Downs.* Marlborough: The Marlborough College Natural History Society

Smith, I.F. 1965a. *Windmill Hill and Avebury: Excavations by Alexander Keiller 1925-1939.* Oxford: Clarendon Press

Smith, I.F. 1965b. Excavation of a Bell Barrow, Avebury G.55. *Wiltshire Archaeological and Natural History Magazine* 60, 24-46

Stone, J.F.S. & Young, W.E.V. 1948. Two pits of grooved ware date near Woodhenge. *Wiltshire Archaeological and Natural History Magazine* 52, 287-306

Summerfield, M.A. & Goudie, A.S. 1980. The sarsens of southern England: their palaeoenvironmental interpretation with reference to other silcretes. In D.K. Jones (ed.) *The Shaping of Southern England*, 71-100. London: Academic Press

Teather, A.M. 2008. *Mining and materiality in the British Neolithic.* Unpublished PhD thesis, University of Sheffield

Teather, A.M., Topping, P. & Baczkowski, J. (eds). 2019. *Mining and Quarrying in Neolithic Europe. A Social Perspective.* Oxford: Neolithic Studies Group Seminar Papers 16

Thomas, H.H. 1923. The source of the stones of Stonehenge. *The Antiquaries Journal* 3, 239-60

Thomas, N. 1955. A Neolithic Pit on Waden Hill, Avebury. *Wiltshire Archaeological and Natural History Magazine* 56, 167-171

Tilley, C., Richards, C., Bennett, W. and Field, D. 2007. In M. Larsson and M. Parker Pearson (eds) *From Stonehenge to the Baltic. Living with Cultural Diversity in the Third Millennium BC,* 183-204. Oxford: BAR International Series 1692

Tsoraki, C. 2018. The ritualisation of daily practice: exploring the staging of ritual acts at Neolithic Çatalhöyük, Turkey. In I. Hodder (ed.) *Religion, History and Place in the Origin of Settled Life*, 238-262. Louisville: University of Colorado Press

Ullyott, J.S., Nash, D.J., Whiteman, C.A. & Mortimore, R.N. 2004. Distribution, petrology and mode of development of silcretes (sarsens and puddingstones) on the eastern South Downs, UK. *Earth Surface Processes and Landforms* 29, 1509-1539

Verbaas, A. & Van Gijn, A.L. 2007. Querns and other hard stone tools from Geleen-Janskamperveld. In P. Van De Velde (ed.) *Excavations at Galeen-Janskamperveld 1990/1991*, 191-204. Leiden: University of Leiden/Sidestone Press

Wainwright, G.J., Evans, J.G. & Longworth, I.H. 1971. The Excavation of a Late Neolithic Enclosure at Marden, Wiltshire. *The Antiquaries Journal* 51, 177-239

Watts, S.R. 2012. *The structured deposition of querns: the contexts of use and deposition of querns in the south-west of England from the Neolithic to the Iron Age.* Unpublished PhD thesis, University of Exeter

Wessex Archaeology. 2016. *Greentrees School, Bishopdown, Salisbury, Wiltshire. Post-excavation Assessment and Updated Project Design*. Wessex Archaeology: Unpublished typescript report

Whitaker, K.A. 2019. What if none of the Building Stones at Stonehenge Came from Wiltshire? *Oxford Journal of Archaeology* 38, 148-163

Whitaker, K.A. 2020a. ‘Sarsen Stones In Wessex’: A Society of Antiquaries Project Contextualised and Renewed. *The Antiquaries Journal* 100, 1-25

Whitaker, K.A. 2020b. Sarsen Working at Stonehenge. In M. Parker Pearson, J. Pollard, C. Richards, J. Thomas, C. Tilley & K. Welham (eds). *Stonehenge for the Ancestors. Part 1: Landscape and Monuments,* 334-354. Leiden: Sidestone Press

Whitaker, K.A. in press. Sarsen stone quarrying in southern England. *Post-Medieval Archaeology* 56

Whittle, A. 1991. Wayland’s Smithy, Oxfordshire: excavations at the Neolithic tomb in 1962-63 by R.J.C. Atkinson and S. Piggott. *Proceedings of the Prehistoric Society* 57(2), 61-101

Whittle, A. 1997. Remembered and imagined belongings: Stonehenge in its traditions and structures of meaning. In C. Renfrew & B. Cunliffe (eds) *Science and Stonehenge*, 145-166. Oxford: Proceedings of the British Academy 62

Whittle, A., Davies, J.J., Dennis, I., Fairburn, A.S., Hamilton, M.A. & Pollard, J. 2000. Neolithic activity and occupation outside Windmill Hill causewayed enclosure: survey and excavation 1992-93. *Wiltshire Archaeological and Natural History Magazine* 93, 131-180

Whittle, A., Healy, F. & Bayliss, A. (eds). 2011. *Gathering Time. Dating the Early Neolithic Enclosures of Southern Britain and Ireland.* Oxford: Oxbow Books

Whittle, A., Pollard, J. & Grigson, C. 1999. *The Harmony of Symbols. The Windmill Hill Causewayed Enclosure, Wiltshire.* Oxford: Oxbow Books

Willies, L. 2002. The wedge-effect in firesetting of a sarsen stone at Overton, near Avebury, Wiltshire. *Mining History* 15, 49-51

Young, W.E.V. 1960. Sarsen implement of Palaeolithic form from Winterbourne Monkton. *Wiltshire Archaeological and Natural History Magazine* 57, 400

Figure captions

Figure 1

Location map of the three case study sites. Modern sarsen stone distribution is indicated by three datasets. Contains data © Environment Agency copyright and/or database right (2022).

Figure 2

Windmill Hill enclosure location map. Contains OS data © Crown copyright and database rights 2022 Ordnance Survey (100025252), Geological Map Data BGS © UKRI (2022).

Figure 3

Excavated features at Windmill Hill enclosure: (a) sarsen density in ditches, (b) proportions of sarsen tools.

Figure 4

West Kennet Avenue occupation site location map. Contains OS data © Crown copyright and database rights 2022 Ordnance Survey (100025252), Geological Map Data BGS © UKRI (2022).

Figure 5

West Kennet Avenue occupation site excavated features: (a) trench plan, (b) north-west corner of Trench 3, (c) central area of Trench 4, (d) F.55 section drawing. After Gillings *et al.* (in preparation).

Figure 6

Culturally-heated sarsen pieces from F.35 (077), West Kennet Avenue occupation site.

Figure 7

Marden henge enclosure location map. Contains OS data © Crown copyright and database rights 2022 Ordnance Survey (100025252), Geological Map Data BGS © UKRI (2022), survey data © Historic England Archive.

Figure 8

Sarsen pieces from Marden henge enclosure contexts: (a) six chunks (left) and six 'flakes' (right) from the burnt spread, (b) typically crazed and cracked burnt conjoining pieces from the midden.

Figure 9
Sarsen pieces from Marden henge enclosure contexts: (a) four 'flakes' (left) and four chunks (right) from SF615, (b) a sample from SF613, (c) a sample from SF614.

Figure 10
Experimental sarsen flake created by exfoliation due to temperature change compared with excavated examples. See text for context details.

Figure 11
A simplified *chaine opératoire* for sarsen uses described in this paper.

Author's address

107 Pavenhill, PURTON, Wiltshire, SN5 4DB, UK

Table captions

Table 1: Summary of attributes recorded for excavated pieces of sarsen stone. For full descriptions of variables including use wear, use location, use degree, burning and percussion see Whitaker (2020b).

Table 2: Sarsen tools (whether whole or fragmentary), total undiagnostic tool fragments and total recorded unworked sarsen pieces from Windmill Hill enclosure and pit contexts excavated during the twentieth century. Based on data collated by Pollard in Whittle *et al*. (1999, 24-72, 338), Smith (1965a, 121) and Whittle *et al*. (2000, 154). * minimum number is calculated by summing identified fragments in discrete layers. † total number of identified complete and fragmentary items. ‡ not including sarsen pieces mentioned but unenumerated by the authors.

Table 3: Characteristics of sarsen pieces from selected features, West Kennet Avenue occupation site. *actual figures of this single piece.

Table 4: Characteristics of sarsen from midden and burnt spread deposits beneath the Marden inner henge bank, associated with the end of the Neolithic building's life, and from pit fills in the eastern arm of the henge enclosure bank. * and 22 unrecorded pieces weighing less than 1 g. † and 124 unrecorded pieces weighing less than 1 g. ‡ and three unrecorded pieces weighing less than 1 g.

Table 5: Characteristics of sarsen tool fragments from the burnt spread (Marden inner henge) and pit fills (Marden main henge enclosure bank).

TABLE 1

Attributes	Description
Site code, trench number, square number, context number, feature number, small finds number	Identifiers allocated during excavation by the fieldwork project.
Phase	The phase to which contexts have been allocated as a result of post-excavation analysis.
UID	A unique identifier allocated to each sarsen piece during analysis comprising context number/sequential number (e.g. 1004/001).
L, I, S	The longest, intermediate and shortest dimensions (mm) of a piece of sarsen, measured orthogonally using a pebble-box (Bunte and Abt 2001).
MPS	Maximum Projection Sphericity, a means to describe stone form in terms of deviation from equancy. Calculated using L, I and S. Sub-equant to equant pieces of stone score 0.6-1.0. Items scoring <0.6 fall into a variety of more elongate or platy form categories (Blott and Pye 2008).
Roundedness	A descriptor for relative roundedness or angularity from a standard visual comparison scale (Powers 1953).
Description	A form factor descriptor based on MPS, ranging from ‘blade’ to ‘equant block/equant spheroid’ (Blott and Pye 2008, 49).
Weight	(g). Pieces <1 g counted but not recorded in more detail.
Colour 01, colour 02	Colouration of two opposing sides of a sarsen piece, using a Munsell chart. Colour 01 is the cortex, if present.
Stone type	Saccharoid, quartzitic or conglomeratic.
Cortex	Present or absent.
Cementation	Not friable, friable.
Condition	Broken fragment or complete pebble/cobble.
Use-wear, use location, use degree	The type of use-wear if present, its location and degree of use.
Tool type	The identification of tools and tool fragments in an assemblage.
Burning	Evidence that a sarsen piece has experienced heating.
Percussion	Evidence for percussion.

TABLE 2

Windmill Hill	minimum*	maximum†	total
Pounders/discs	63	100	-
Querns	40	61	-
Rubbers	58	90	-
Miscellaneous tool fragments			68
Other sarsen pieces‡			14,689

TABLE 3

WKA	count	% burnt	mean weight (g)	modal roundedness	mean MPS
F.6					
(020)	9	55.5	101.9	sub-angular	0.75
F.35					
(072)	1	100.0	212*	angular*	0.78*
(077)	3	33.3	115	= angular, sub-rounded	0.73
F.55					
(414)	13	46.2	48.8	angular	0.79
(417)	4	50.0	39.3	very angular	0.63

TABLE 4

	midden (93031) (1026)	burnt spread (93003) (1006) (1035) (1038) (2111)	pit [2227] SF615	pit [2219] SF613	pit [2219] SF614
count	70*	341†	41	145‡	144
% burnt	82.9	76.5	95.1	80.7	83.3
mean weight (g)	60.0	21.4	54.9	54.9	40.6
modal roundedness	angular	angular	angular	sub-angular	angular = sub-angular
mean MPS	0.76	0.67	0.67	0.71	0.69

TABLE 5

context and fragment uid	tool type	condition	weight (g)	form
Burnt spread				
1006/010	quern/polisher	burnt	10	sub-equant
1006/028	quern/polisher	un-burnt	4	blade
93003/011	quern/polisher	burnt	13	equant
1006/003	rubber	burnt	4	sub-equant
1006/038	rubber	un-burnt	14	sub-equant
SF613				
2218/024	quern/polisher	burnt	42	sub-equant
2218/052	quern/polisher	burnt	72	sub-equant
2218/042	dressed stone	burnt	79	sub-equant
SF614				
2224/076	hammerstone	burnt	136	flat block
SF615				
2226/001	quern/polisher	burnt	12	sub-equant
2226/002	rubber	burnt	92	sub-equant

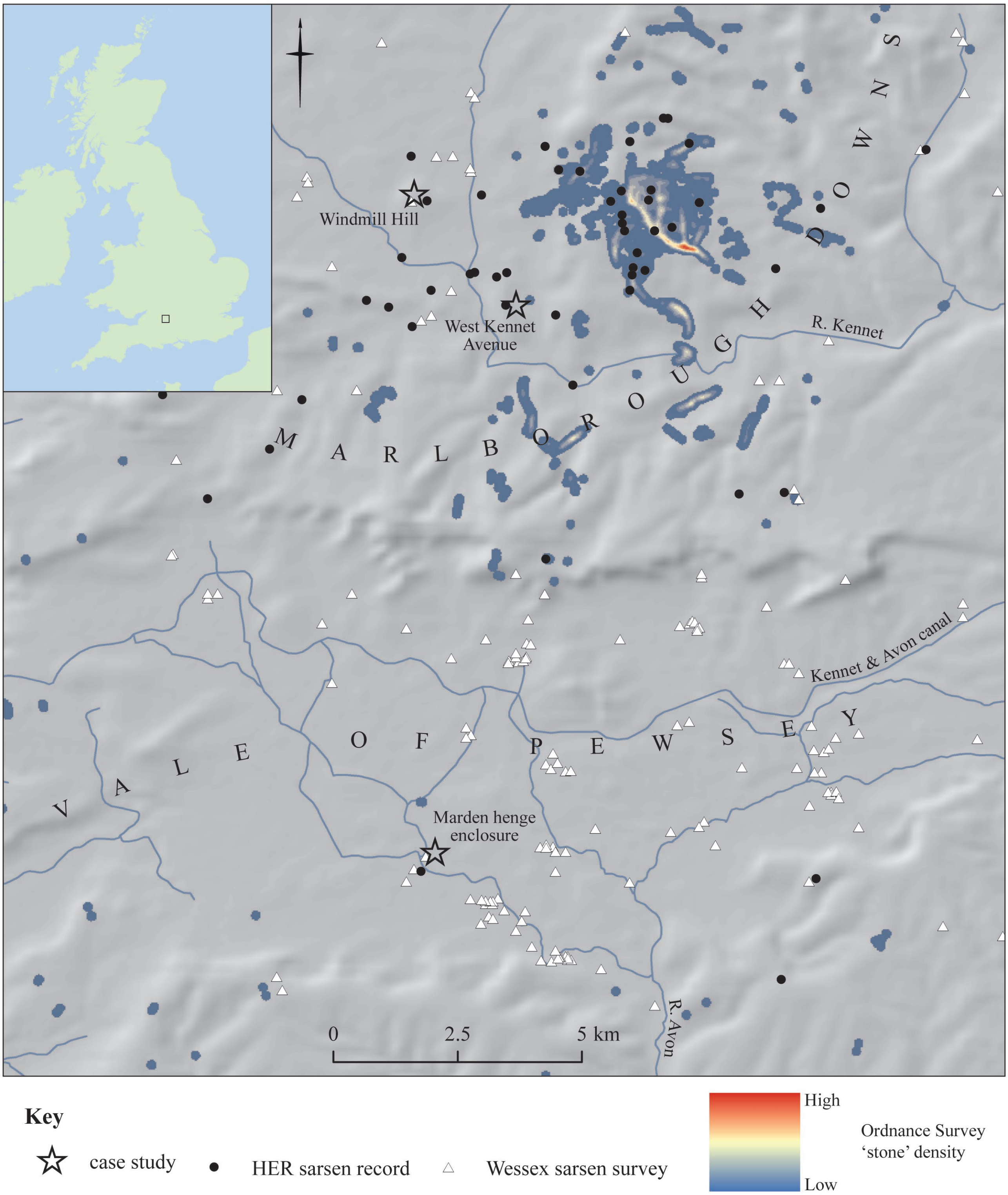


Figure 1. Location map of the three case study sites. Modern sarsen stone distribution is indicated by three datasets. Contains data © Environment Agency copyright and/or database right (2022).

Figure 2. Windmill Hill enclosure location map. Contains OS data © Crown copyright and database rights 2022 Ordnance Survey (100025252), Geological Map Data BGS © UKRI (2022).

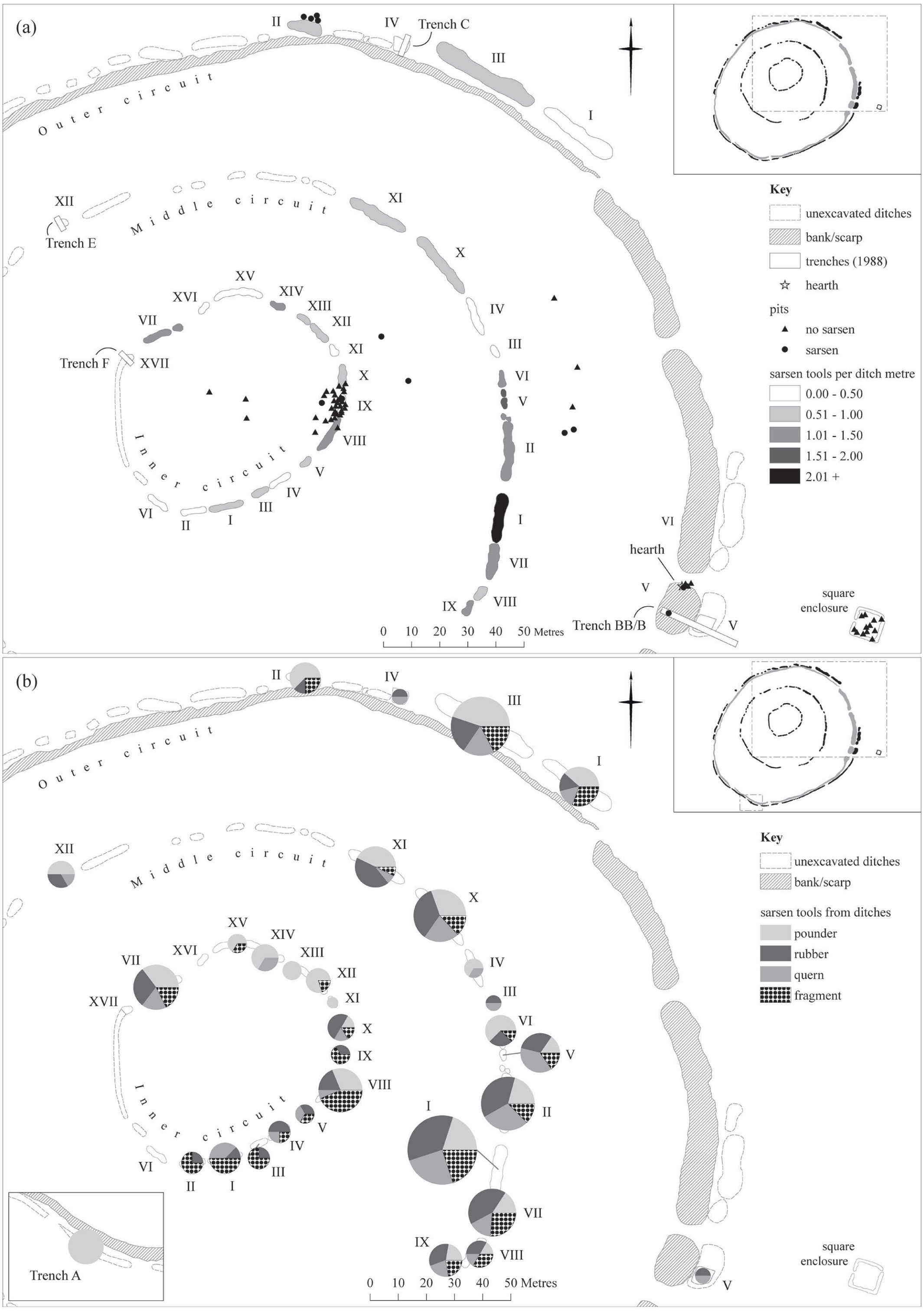


Figure 3. Excavated features at Windmill Hill enclosure: (a) sarsen density in ditches, (b) proportions of sarsen tools.

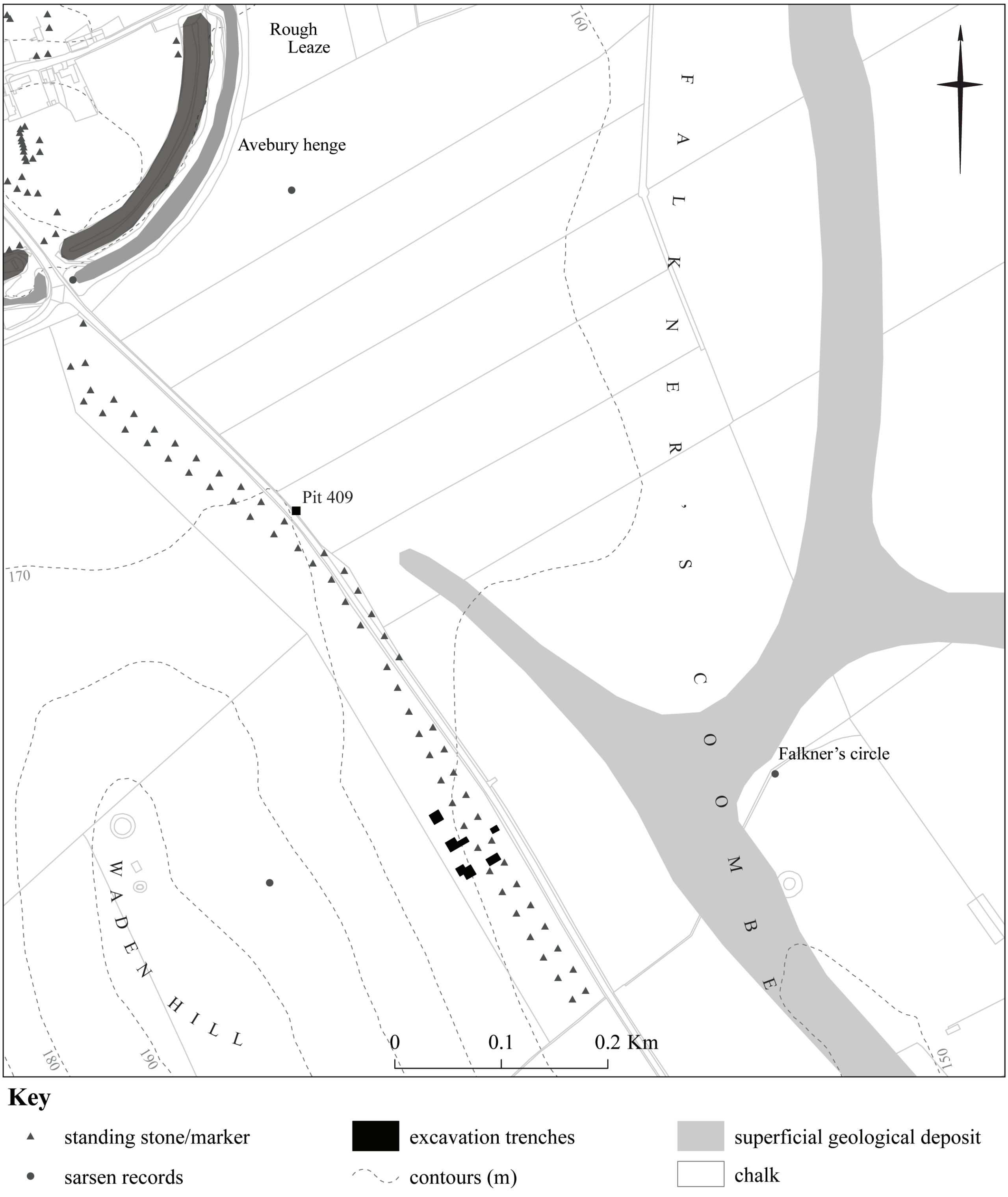


Figure 4. West Kennet Avenue occupation site location map. Contains OS data © Crown copyright and database rights 2022 Ordnance Survey (100025252), Geological Map Data BGS © UKRI (2022).

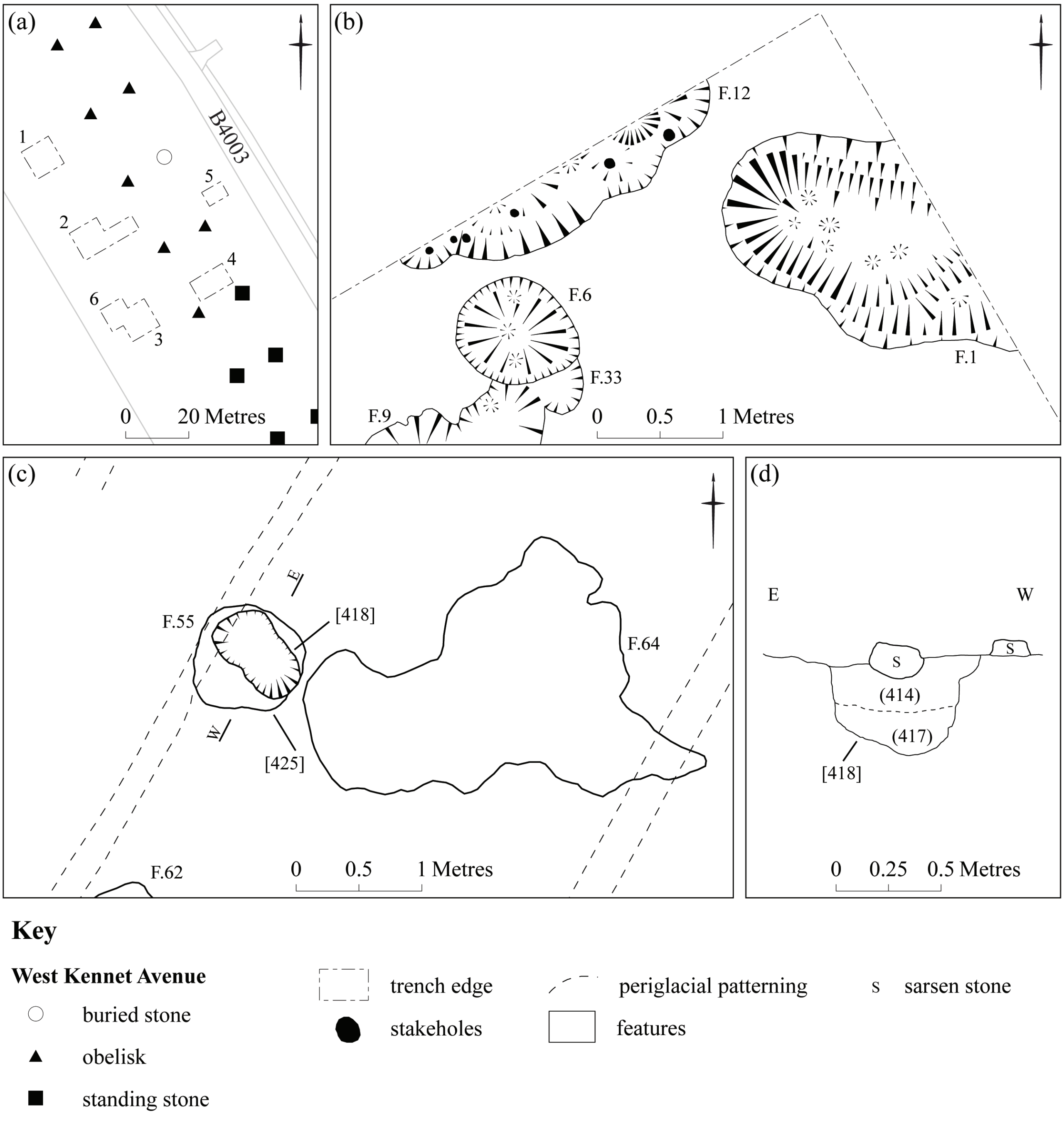


Figure 5. West Kennet Avenue occupation site excavated features: (a) trench plan, (b) north-west corner of Trench 3, (c) central area of Trench 4, (d) F.55 section drawing. After Gillings *et al.* (in preparation).

Figure 6. Culturally-heated sarsen pieces from F.35 (077), West Kennet Avenue occupation site.

Figure 7. Marden henge enclosure location map. Contains OS data © Crown copyright and database rights 2022 Ordnance Survey (100025252), Geological Map Data BGS © UKRI (2022), survey data © Historic England Archive.

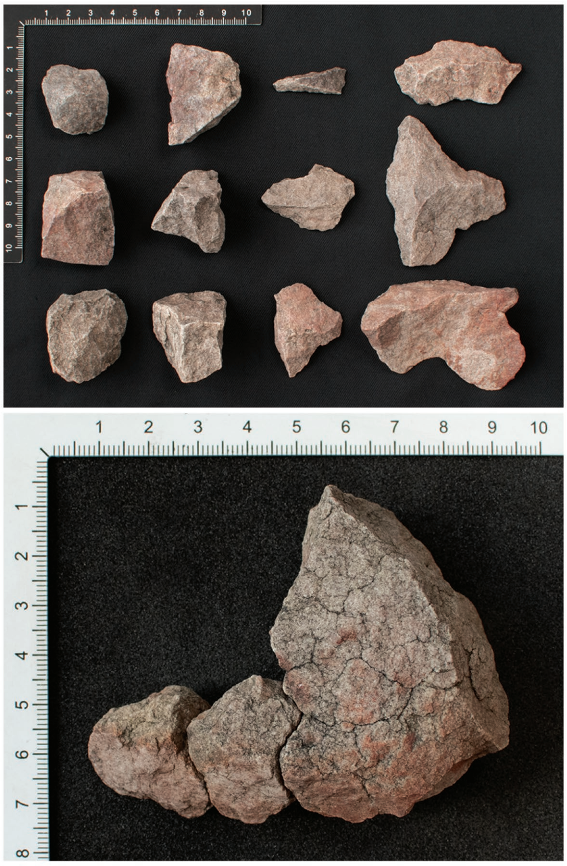


Figure 8. Sarsen pieces from Marden henge enclosure contexts: (a) six chunks (left) and six 'flakes' (right) from the burnt spread, (b) typically crazed and cracked burnt conjoining pieces from the midden.

Figure 9. Sarsen pieces from Marden henge enclosure contexts: (a) four 'flakes' (left) and four chunks (right) from SF615, (b) a sample from SF613, (c) a sample from SF614.

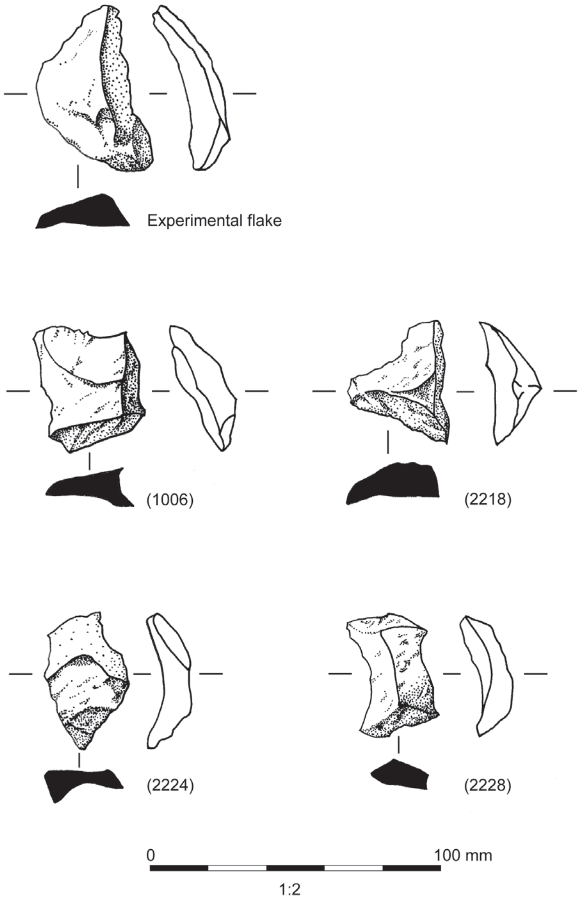


Figure 10. Experimental sarsen flake created by exfoliation due to temperature change compared with excavated examples. See text for context details.

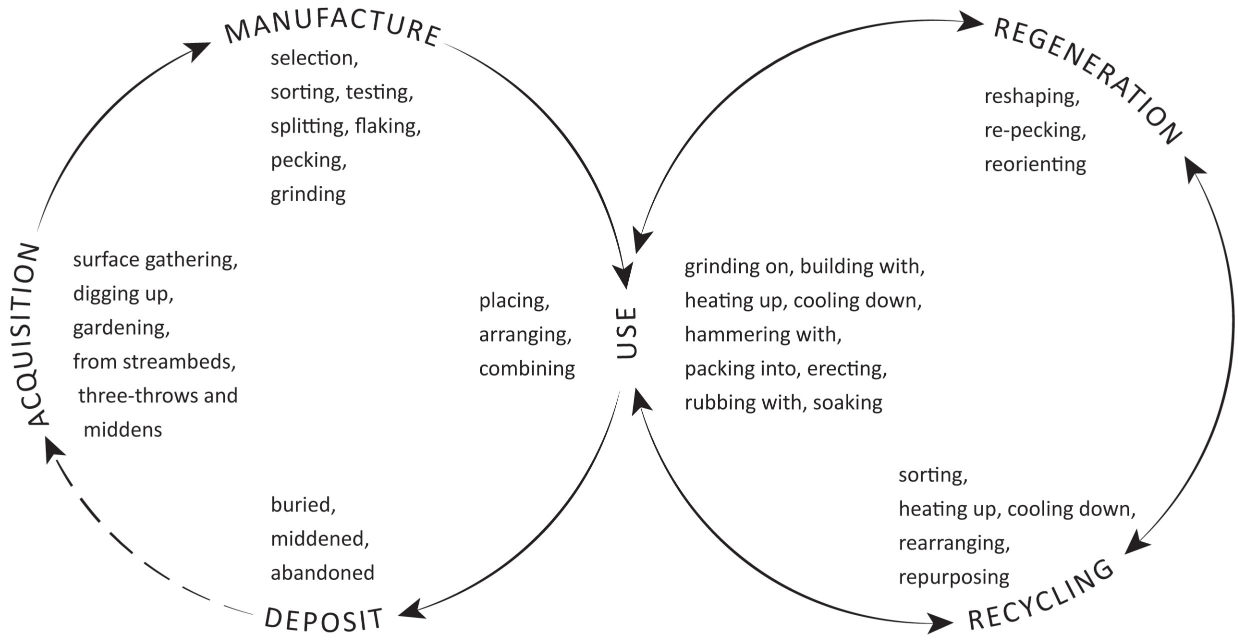


Figure 11. A simplified *chaîne opératoire* for sarsen uses described in this paper.

CLOSING SECTION

This closing section provides a recap of the preceding thesis sections and papers, followed by a short concluding discussion written from my inter-disciplinary research perspective.

Recap

A theme running through this thesis is how sarsen stone is understood and perceived by researchers and practitioners in different fields. In the Introduction, I contrasted the plain simplicity of sarsen's quartz-dominated mineralogy with the living, mutable material conjured by artists such as the sculptors Henry Moore and Roger Leigh and author Vita Sackville-West. Sarsen has been couched in terms of a special type of stone since at least the early Modern period, because of its alien appearance in certain landscapes and its prehistorical associations. Yet sarsen has also provided communities with a livelihood and it is by no means always seen as a sacrosanct material requiring protection. That disparity is highlighted by the different ways that sarsen appears in the nineteenth century popular press of Wiltshire and Buckinghamshire; and in the contrast between the craft work of the stone-cutters in Piggledene and conservationists' attempts there to repair split sarsens. In the archaeological literature, exploration of sarsen usage has been shaped on the one hand by the long-lived practice of 'sarsenalia' and, on the other, by the consequences of a 'local' stone failing to attract a level of investigation commensurate with its importance to communities through time.

Sarsen was understood by *Sarsen Stones in Wessex* project members in anthropocentric or environmental terms as a resource to be exploited or a challenge to adapt to. The project's empiricism, aimed at collecting a large dataset to address landscape-scale questions, is a grand extension of 'sarsenalia' and perpetuates the elevation of all sarsen, whether utilised or not, as of peculiar interest in the geo-scape articulated so clearly by Smith (1884) [Paper 1]. Despite that significance of sarsen when considered in the round, it has at times been taken for granted as a 'local' stone in the context of Neolithic and early Bronze Age archaeology in southern Britain. This is in contradistinction to types of stone clearly transported over greater distances that have attracted more intense research interest in their own right. Distance from source is not, however, stone's only property. Furthermore, the variety of rocky materials at Neolithic sites – by no means limited to Stonehenge but well-illustrated there – begs questions about the selection and meaning of the mineral assemblage, as scholars such as Jones (2004), Richards (2013) and Scarre (2004) ask of megalithic sites in Scotland and France [Paper 2].

A detailed geological understanding of silcrete has led David Nash and colleagues to use immobile trace element geochemistry to 'fingerprint' sarsen. That is the first example of this kind of analysis targeted at archaeological questions about sarsen, since Hilary Howard's small but significant investigation carried out more than 40 years ago (Pitts 1982). One location in the environs of West Woods (Wiltshire) is the probable source for 50 out of the 52 surviving sarsen orthostats at Stonehenge [Paper 3]. People have taken sarsens from around West Woods and the surrounding Kennet Valley area since the Neolithic, including removing significant quantities to provide split building stone in the nineteenth century (King 1968, 93). It is essential to consider the implications of later exploitation for the survival and recognition of prehistoric sarsen extraction, and for designing methodologies to prospect and explore sites. The multiple ways in which sarsen has been extracted and worked are obscured by scholarly preoccupations with early Modern accounts of fire-setting at Avebury and, to an extent, the family history-based narratives of Victorian stone-cutters [Paper 4].

Detailed analysis of post-medieval extraction sites, however, demonstrates variability in sarsen exploitation and situates it as a normal quarrying activity. In intensively extractive landscapes in Buckinghamshire and Wiltshire, people developed understandings of earth materials through their technical and embodied practice. Examining *chaîne opératoires* reveals that people made choices about technical actions as they applied their knowledge of topography, soils, underlying deposits and bedrock to daily extractive tasks. Materials including sarsen had their own role to work with, but also 'act back' against, human energy, communicating through the tools of the trade and other cues [Paper 5]. Similarly, sarsen was encountered and used in multiple ways during the Neolithic. Non-megalithic uses may have been more common than megalithic ones. Just as different sarsen properties were brought to the fore by different post-medieval methods of stone-working, so the myriad tasks in which Neolithic people used sarsen also revealed its many different characteristics. Values were afforded by those properties and must have informed each different context of sarsen stone's use [Paper 6].

Discussion

I

The lithological properties of sarsen stone have been explored over the course of *c*. 200 years of geological and geochemical investigations. That continuing work is targeted at the precise definition of rock types in terms of Western Earth Science's definitions of minerals, their forms, structures and chemical constituents. The apparently objective, measurable properties of sarsen, such as its proportion of quartz and its fraction of other oxides, are derived from that specific intellectual context. Those properties, established through practices including microscopy and chemical analyses of minerals in laboratory settings, do not necessarily bear relation to characteristics of sarsen arising in other contexts where different practices are applied. Neither people in the prehistoric past nor Victorian quarry workers can have understood sarsen in terms of *grain-supported fabric of optically-continuous overgrowth silcrete,* for example. Those sarsen properties are known only through engagement with modern geological epistemology.

Chantal Conneller (2011, 4-7) takes that Western way of knowing materials to task, analysing the issue at length in relation to various substances including, for example, gold, a metal understood in incommensurably different ways by Amerindians and conquistadors in Mesoamerica. She shows how material properties are not immutable or universal. Aligned with a large body of literature in Science and Technology Studies, including for example Lemonnier (1993) and Pinch and Bijker (1984), arguing that relationships between materials and technology are not solely functional, Conneller contends that different material properties arise during technical action and that 'the properties of "the same" materials vary in different situations when different qualities come to the fore' (2011, 22 and see also 8-9, 103-104). For example, in cortically-engraved items such as the flint core from Holmegård V, Zealand (Denmark), the soft, chalky cortex that could be incised, as well as the predictable fracture of the brittle flint that enabled the core's later knapping, were separately brought to the fore during the technical interactions between the material and its worker. Through this combination of the senses and applied techniques, detailed understanding of stone is developed (Ferraby 2015, 213). It is what something does, as well as what it is, that matters when people interact with it.

Influenced by Conneller (2006; 2011, 47), my studies of both post-medieval and Neolithic encounters with sarsen stone have initiated closer, situationally-specific, readings of contingent actions and relationships that comprise parts of different *chaînes opératoires* of sarsen working. Although moving further forward than previous research, I do not claim to have exhausted the complexity of detail in technical acts involving sarsen through which, as Ingold (2011 [2000], 321) puts it, something of people's worlds is revealed. Nevertheless, sarsen stone appears to be a different type of material in different technical contexts. It is both hidden underground and exposed on the surface; it comes in numerous forms, sizes, colours, shapes; large boulders provide sure foundations and monumental structural integrity whilst small pieces make a myriad of domestic tools and ritual deposits possible; it can be fashioned into geometrically refined blocks and coarse chunks and chips. This raises the possibility that sarsen does ontologically different work in different circumstances, in the sense of Shanks (1998, 27) and as Emily Banfield (2016) interprets of sarsen packing stones and megaliths at Avebury; the former, supporting, holding and constraining the latter 'vital and mercurial' boulders (2016, 8).

II

Scholarship on Neolithic sarsen use has, with a few notable exceptions, focussed on one metaphoric arena in which sarsen is proposed to have played a role in the creation and maintenance of identity through concepts of ancestorship. As a post-medieval industry, sarsen exploitation traditionally represents a type of enterprising economic activity in rural settings. However, rather than being limited to these narrow horizons, sarsen stone has the potential to provide multiple modes of technical representation (in the sense of Sillar 1996), for people working with it in different situations throughout each day and season.

By highlighting the range of sarsen's Neolithic technical contexts, I suggest that its ontological status was not necessarily centred on one perceived set of properties to do with the hardness, durability and strength of large boulders. Sarsen was implicated in numerous technologies, including transformation of itself and other materials. As Brück (2006) suggests for other materials in similar technical acts in Bronze Age contexts including pyrotechnologies, productive activities involving sarsen may have provided metaphors for other modes and subjects of construction, including the self, community and kin, place-making and conceptualising the future.

Working and reducing sarsens by alternative methods reveals some of its different properties. Striking the angular edges of large pieces trims off smaller flakes, similar to flaking flint. But the broken, sandy surface can also be pecked to produce broad grinding areas. In this way, querns may be formed. Heating sarsen and combining it with substances such as water, meat or starchy plant matter, say, reveals both its facility in cooking but also its fragility as it changes colour, breaks and exfoliates into small, angular pieces as described in Paper 6. When split using a carefully-assembled and knowledgeably-wielded suite of traditional masonry tools, sarsen was an homogenous material. Emergent properties include its suitability to be worked down into geometrically-regular, finely finished orthogonal blocks for high-status buildings, and its strength and durability for surfacing pavements and yards. In the road-stone quarry, sarsen was a prolific, hard material which could be shattered by chemical and mechanical means, falling into irregular chunks and chips that met the County Surveyor's requirements for a trunk road re-surfacing scheme. But when actually applied to the road, tamped and driven over, its weakness and susceptibility were revealed as it further diminished under continued pressure into its constituent grains of sand as described in Paper 5.

These examples of human interaction with sarsen demonstrate how the environment does not simply comprise resources ready for the taking using efficiently-applied technology; rather, in interpreting their embodied experiences of the world, people learn, work, fail and succeed in arenas constituted of cultural traditions and practices (see for example Dobres 2000; Lemonnier 1989; 1993; Pfaffenberger 1992; Orlikowski 2000). Technical practices inform and develop what a material can be by showing what it does, and technology can be appropriated and used differently (Orlikowski 1992), reasons for paying close attention to tool use and the know-how of the tool user (Ingold 2011 [2000], 367-371). That is not to deny non-human agency or to claim that materials only have meaning in relation to humans and human interaction, but to foreground – in the context of making and doing – that sarsen has never been one thing alone.

III

Adopting a broad definition of technology as 'traditional efficacious acts' (Conneller 2011, 17), Conneller embraces actions such as magic; powers of non-human, supernatural forces that can transform materials; and the agency of materials themselves that also plays a role in their own transformation. Jacquetta Hawkes (1959 [1951]) describes that agency interacting with sculptor Henry Moore when 'the stone may be so assertive of its own qualities that he has to battle with it, strive against the hardness of its shells and the softness of adjacent pockets' (1959 [1951], 94). We see sarsen's agency, 'temporally emergent in practice' (Orlikowski 2005, 185), hinted at in the stony mix assembled at Stonehenge described in Paper 2 and playing out in different ways in Papers 5 and 6: for example, in those boulders in Piggledene containing flint pebbles that caused stone splitting to fail and prompted the stone-cutters to abandon their work; in the buried boulders in the Chiltern Hills acting back against the probing rods of prospecting quarrymen; and, perhaps, in the bricolage of worked and unworked sarsen in Neolithic pit deposits, the enmeshing of natural sarsen spreads with orthostats at Falkner's stone circle, or the incorporation of small boulders in earthen mounds at South Street and Beckhampton Road.

Jeffrey Cohen (2015) draws on the multitude of traditionally efficacious natures of stones described by medieval writers to consider the *virtus* of stone, the 'non-miraculous, nonsupernatural [*sic*] force that inheres in gems, metals, and rocks, made evident through material, sensory, cognitive and affective consequences' (2015, 233). While sometimes rock could be a metaphor for the inanimate, for medieval authorities it was also like 'a kind of inorganic organism' (Cohen 2015, 227) behaving like animals and plants: in motion, reproducing, affective, changeable, acting in the world. Medieval lapidaries explicate Jane Bennett's (2010) 'Vibrant Matter' in myriad ways, describing for example how corallus staunches bleeding wounds, chryselectrum reduces fever when held by a sufferer, draconites combats poison, sapphire dispels envy and fear and optallius improves a thief's vision while obscuring that of their victim (Cohen 2015, 220, 232, 234). Diamonds, which live in male and female forms, grow together and reproduce, sustained by drinking dew; they counteract poison and nightmares, embolden the wearer, protect from wild animals, bring about justice and foster peace (Cohen 2015, 246-248). In the Introduction I have recounted some of the *virtus* of vital sarsen: like diamond, it is a reproductive breeding stone; like optallius it can be a nuisance, a troublesome stone to Improving farmers and landowners; sarsens respond to stimuli, move about the landscape, drink water in a Hampshire village stream; as Grey-wethers they shape-shift in and out of ovine form and confuse the onlooker.

Cohen (2015, 91) describes stone and stone-made things as 'polychronic agents, participants within an unfolding world.' Living in relation in networks of organic and inorganic beings, stone and stone-made things are no longer inanimate, but have capacities for ontological difference (Cohen 2015, 159). Dynamic stone helps us to become human in very practical ways, through the tools we make, the buildings we raise, the roads we travel, the minerals we ingest, the work we do. Sarsen stone is found throughout these technological contexts, worked in historically-contingent ways in acts of co-creating the world that reveal sarsen's multiple characteristics. As road-stone it is brittle, friable, short-lived. Combined with heat and water, its culinary facility nourished Neolithic communities who then deposited large quantities of culturally-heated sarsen in different contexts. Its construction blocks form long-lived bastions of the nation's defence at Windsor Castle and the elegant dressings of parish churches. Human and animal feet pound sarsen pavements in Aylesbury Market. Quartzitic sarsen hammers pecked out both quern grinding surfaces and the once sparkling faces of Stonehenge's saccharoid sarsen orthostats. Renowned landscape archaeologist Collin Bowen, fascinated by sarsen as described in Paper 1, was prompted to wonder of the sarsens encountered by Neolithic people exploring chalk Downland, 'Did they attract?' They surely did.

IV

Unique human skill and knowledge are essential components in the hands-on craft processes of working sarsen described in papers in this thesis. While acknowledging the relational associations of tools, worked materials and humans in crafting, Núñez-García (2019) demonstrates how a practitioner's understanding and skill influence this assemblage. Craft necessarily involves human choice and creativity in response to possibilities and difficulties presented by the worked material and the situational context of crafting. Sarsen blocks in Windsor Castle's walls and sarsen fragments in Marden henge's bank are each collectives that incorporate geology and tools ranging from chisels to fire, 'imbued with human attributes of memory, perception, abstraction, creativity and choice' (Núñez-García 2019, 38). I have attended to the 'crafting process collective' (Núñez-García 2019, 34) of different post-medieval sarsen quarries and suggest that a similarly detailed approach to Neolithic sarsen engagements is necessary to explore the ontological possibilities of sarsen stone in prehistory, because studying crafting processes – or, to put it another way, Conneller's (2006) thick *chaîne opératoire* – can illuminate these collectives as Núñez-García demonstrates in relation to blacksmithing.

Technical action, technological adoptions and innovations do not arise from thin air. They are historically and contextually rooted, forged in the interpersonal social relations in which teaching and learning occur (Frieman 2021). Catherine Frieman (2021) depicts such networks of relations as 'constellations' of people and groups that can be adaptive, but also in which continuity of practice is maintained through 'active re-invention' (2021, 115). Traditional sarsen-working methods were sustained in the Buckinghamshire taskscape not because quarrying families were resistant to innovation, but because they were maintaining their knowledge, skills and community of practice. In Wiltshire, a new web of constellations is seen in the complex archaeological record of Piggledene's sarsen quarry where boulders, sediments, local workers, technological variation, new people with their skills and tools, and changing land ownership intersect. For too long dominated by megaliths, Neolithic sarsen crafting process collectives are in fact wide-ranging in their technological variety and, by inference, the social constellations with which they meshed. Attending to the crafting process collectives in which sarsen stone is situated affords the potential to explore these constellations; without diminishing the roles of materials and tools, myths and stories, but showing ways in which people come to know sarsen experientially.

V

To return to the beginning and the start of the Introduction. In the last episode of *Star Trek: Deep Space 9*, Constable Odo returns to his home planet, where now the population of his fellow Changelings is terminally ill (Behr and Beimler 1999). Odo hopes to cure them by joining The Great Link, the mass of intermingled Changelings that spreads, ocean-like, over the planet. Since his first visit, when he explored what it was like to become a boulder on the beach, Odo's *virtus* has been augmented by a cure for the disease. Like corallus, chryselectrum, draconites and other powerful, healing stones, Odo has the opportunity to interact in productive, regenerative relation with the world. As he walks down the foreshore into the gently moving, blue-grey liquid of The Great Link, his healthy, golden, gelatinous matter ripples out into the sick mass like a vaccination suffusing a body.

Human-thing mixtures are not always as intimate as The Great Link. Sarsen dust inhaled by its workers, inducing silicosis (Crook and Free 2011, 22) in a deadly aspect of its *virtus*, is one exception. Nevertheless, by outlining different ways that people have engaged with sarsen stone during parts of its long human allyship, I show ways through which sarsen's natures have been revealed and encourage future researchers to attend in more detail to this type of stone, enmeshed in multi-generational constellations that continue to sparkle.

References

Banfield, E. 2016. Sticky Notes: Some Thoughts on the Use of Clay in the Neolithic Deposits within the Avebury Megalithic Complex. *Norwegian Archaeological Review* 49(2), 99-112

Behr, I. S. & Beimler, H. 1999. *Star Trek: Deep Space 9. What You Leave Behind.* I.S. Behr (Producer), Paramount Domestic Television

Bennett, J. 2010. *Vibrant Matter: a Political Ecology of Things.* Durham, NC and London, UK: Duke University Press

Brück, J. 2006. Fragmentation, Personhood and the Social Construction of Technology in Middle and Late Bronze Age Britain. *Cambridge Archaeological Journal* 16, 297-315

Cohen, J. J. 2015. *Stone: an Ecology of the Inhuman.* Minneapolis: University of Minnesota Press

Conneller, C. 2006. The Space and Time of the Chaine Operatoire: Technological Approaches to Past Landscapes. *Archaeological Review from Cambridge* 21, 38-49

Conneller, C. 2011. *An Archaeology of Materials: Substantial Transformations in Early Prehistoric Europe.* Abingdon: Routledge

Crook, M. L. & Free, I. E. T. 2011. *Grey Wethers. The Free Family in Marlborough and the Upper Kennet Valley c1847-1998.* Privately published

Dobres, M.-A. 2000. *Technology and Social Agency. Outlining a Practice Framework for Archaeology.* Oxford: Blackwell

Ferraby, R. 2015. *Stone Exposures: A Cultural Geology of the Jurassic Coast.* University of Exeter, unpublished PhD thesis

Frieman, C. J. 2021. *An Archaeology of Innovation: Approaching Social and Technological Change in Human Society.* Manchester: Manchester University Press

Hawkes, J. 1959 [1951]. *A Land.* Harmondsworth: Penguin Books (Pelican editions)

Ingold, T. 2011 [2000]. *The Perception of the Environment.* Abingdon: Routledge

Jones, A. 2004. Natural Histories and Social Identities in Neolithic Orkney. In E.C. Casella & C. Fowler (eds) *The Archaeology of Plural and Changing Identities. Beyond Identification*, 233-259. New York: Springer

King, N. E. 1968. The Kennet Valley Sarsen Industry. *Wiltshire Archaeological and Natural History Magazine,* 63, 83-93

Lemonnier, P. 1989. Bark Capes, Arrowheads and Concorde: on Social Representations of Technology. In I. Hodder (ed.) *The Meanings of Things: Material Culture and Symbolic Expression,* 156-177. London: Unwin Hyman

Lemonnier, P. (ed.) 1993. *Technological Choices: Transformation in Material Cultures Since the Neolithic.* London: Routledge

Núñez-García, A. 2019. ‘Crafting Agency’: An Inquiry into Symmetrical Human-Thing Assemblages. *Archaeological Review from Cambridge* 34, 26-43

Orlikowski, W. J. 1992. The Duality of Technology: Rethinking the Concept of Technology in Organizations. *Organization Science* 3, 398-427

Orlikowski, W. J. 2000. Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organizations. *Organization Science* 11, 404-428

Orlikowski, W. J. 2005. Material Works: Exploring the Situated Entanglement of Technological Performativity and Human Agency. *Scandinavian Journal of Information Systems* 17, 183-6

Pfaffenberger, B. 1992. Social Anthropology of Technology. *Annual Review of Anthropology* 21, 491-516

Pinch, T. J. & Bijker, W. E. 1984. The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other. *Social Studies of Science* 14, 399-441

Pitts, M. W. 1982. On the Road to Stonehenge: Report on the Investigations Beside the A344 in 1968, 1979 and 1980. *Proceedings of the Prehistoric Society* 48, 75-132

Richards, C. (ed.) 2013. *Building the Great Stone Circles of the North.* Oxford: Windgather Press

Scarre, C. 2004. Choosing Stones, Remembering Places. Geology and Intention in the Megalithic Monuments of Western Europe. In N. Boivon & M.A. Owoc (eds) *Soils, Stones and Symbols. Cultural Perceptions of the Mineral World,* 141-152. London: UCL Press

Shanks, M. 1998. The Life of an Artefact in an Interpretive Archaeology. *Fennoscandia Archaeologica* 15, 15-30

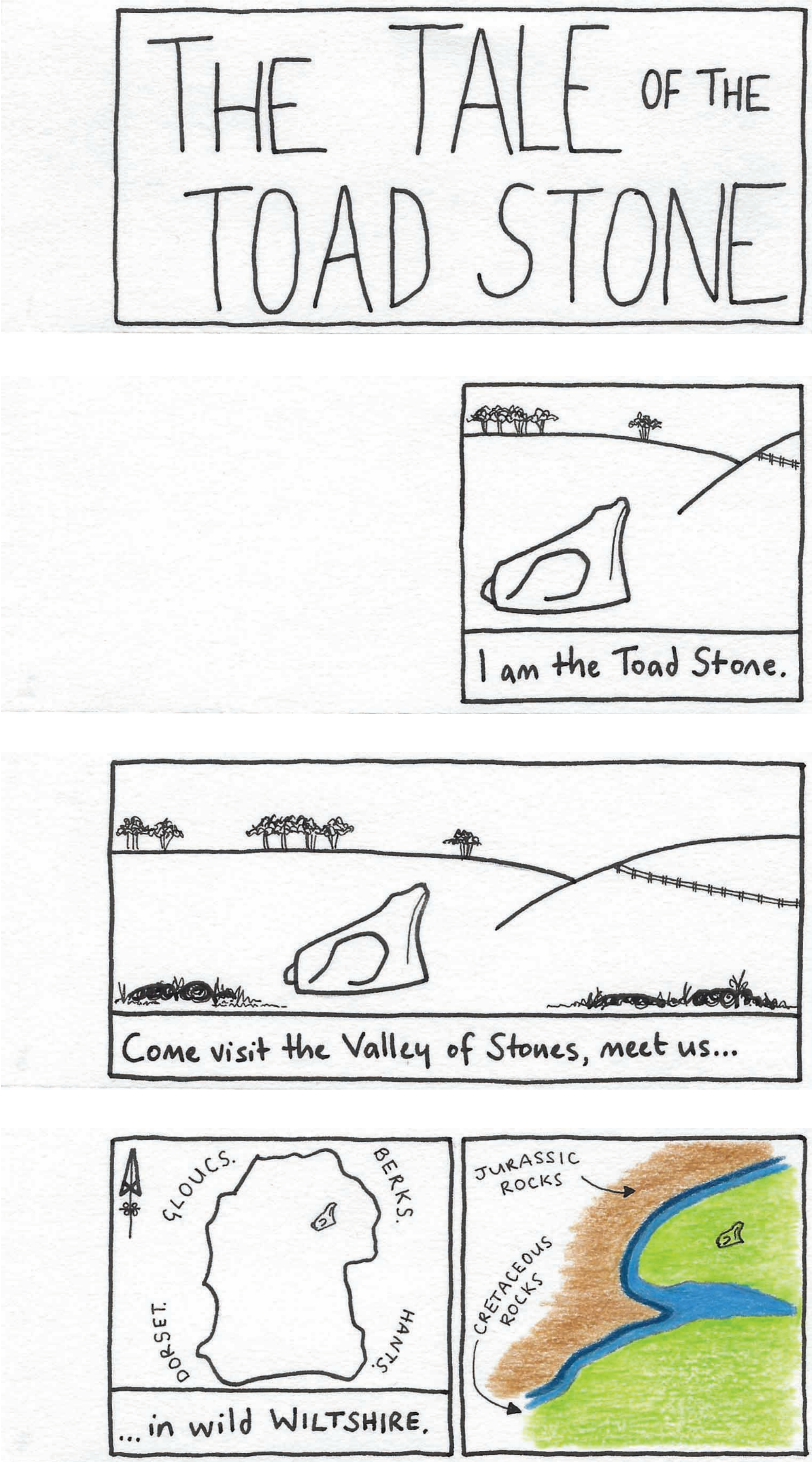
Sillar, B. 1996. The Dead and the Drying: Techniques for Transforming People and Things in the Andes. *Journal of Material Culture* 1, 259-289

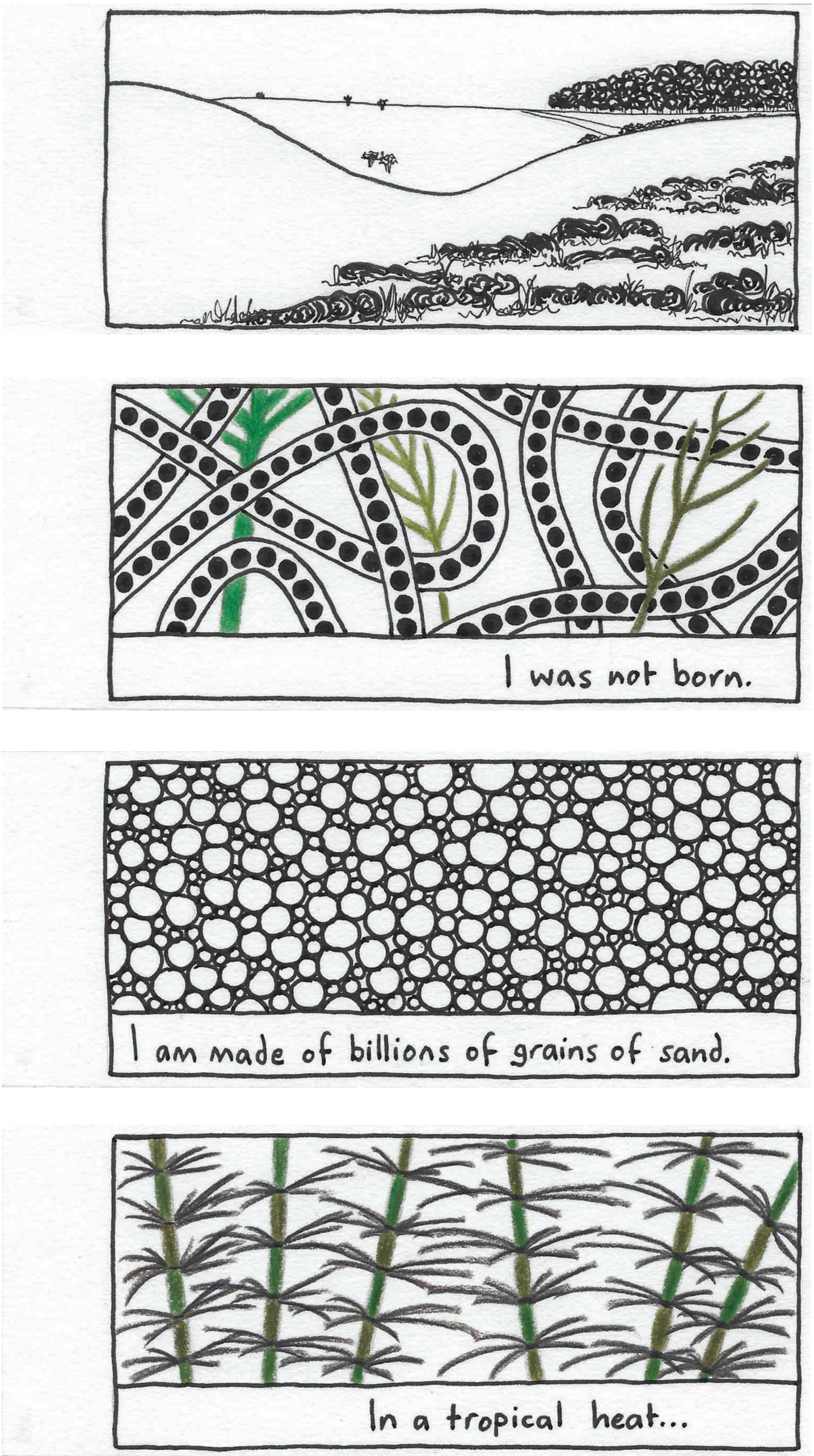
Smith, A. C. 1884. *Guide to the British and Roman Antiquities of the North Wiltshire Downs.* Marlborough: The Marlborough College Natural History Society

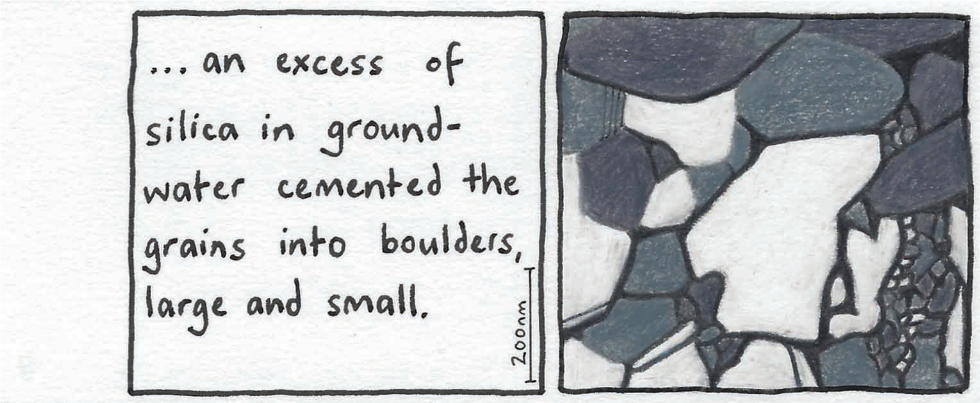
AFTERWORD

The Tale of the Toadstone

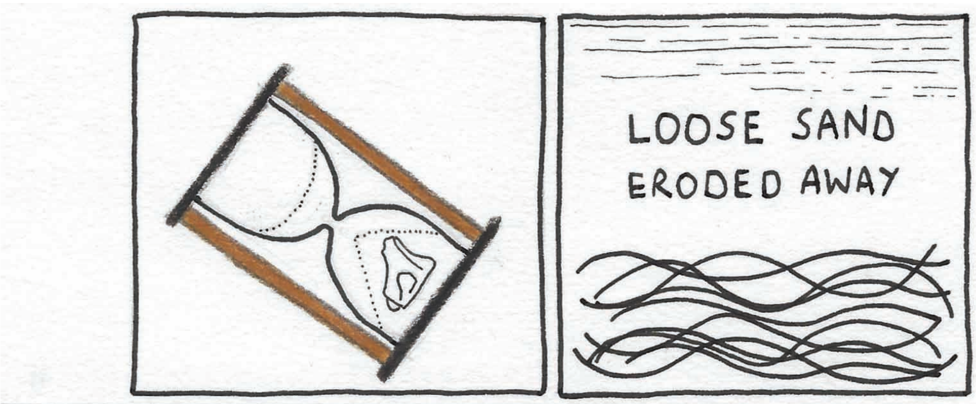
February 2017


THE TALE OF THE TOAD STONE
I am the Toad Stone.
Come visit the Valley of Stones, meet us...
GLOUCS.
BERKS.
DORSET.
HANTS.
...in wild WILTSHIRE.
JURASSIC ROCKS
CRETACEOUS ROCKS

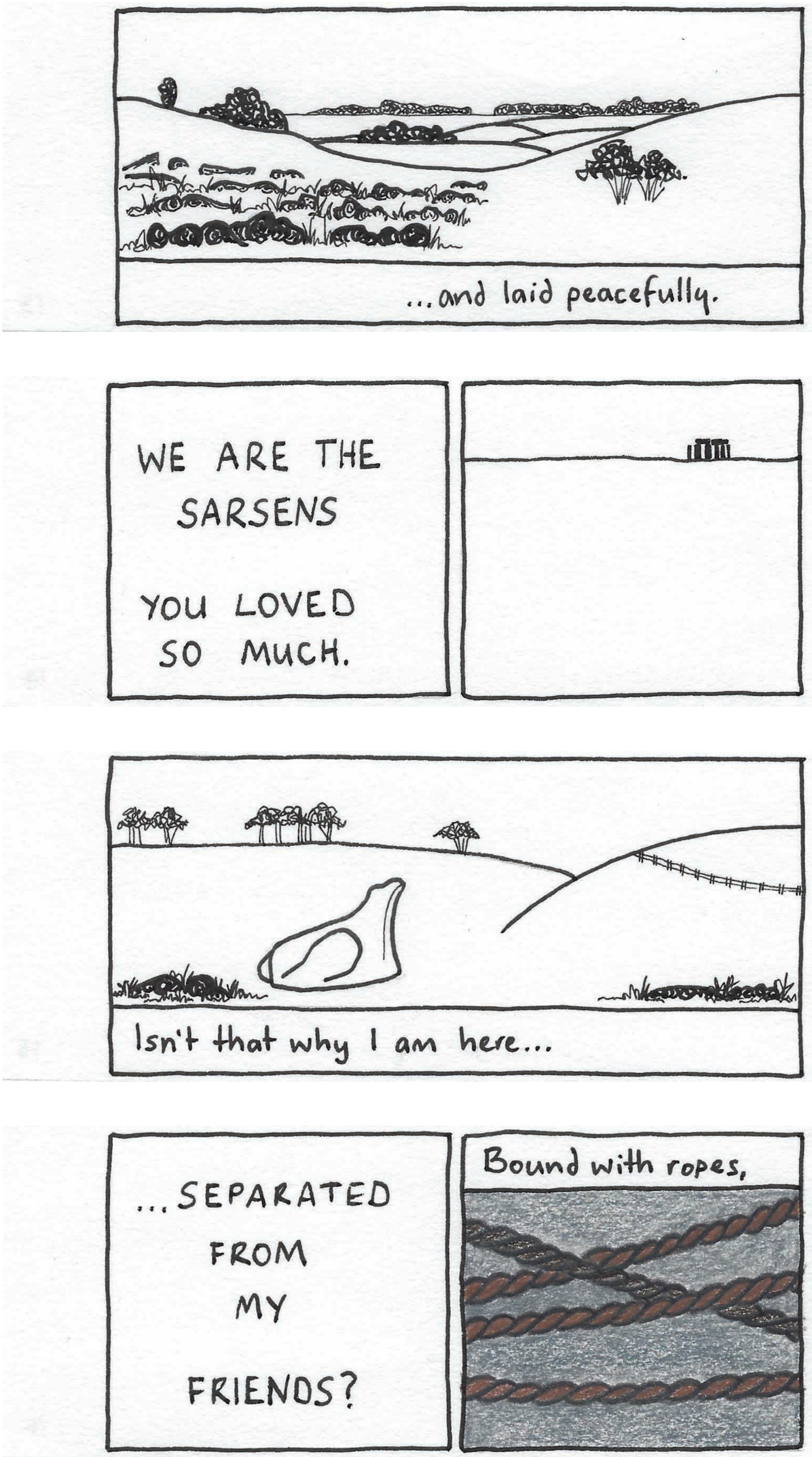

I was not born.
I am made of billions of grains of sand.
In a tropical heat...

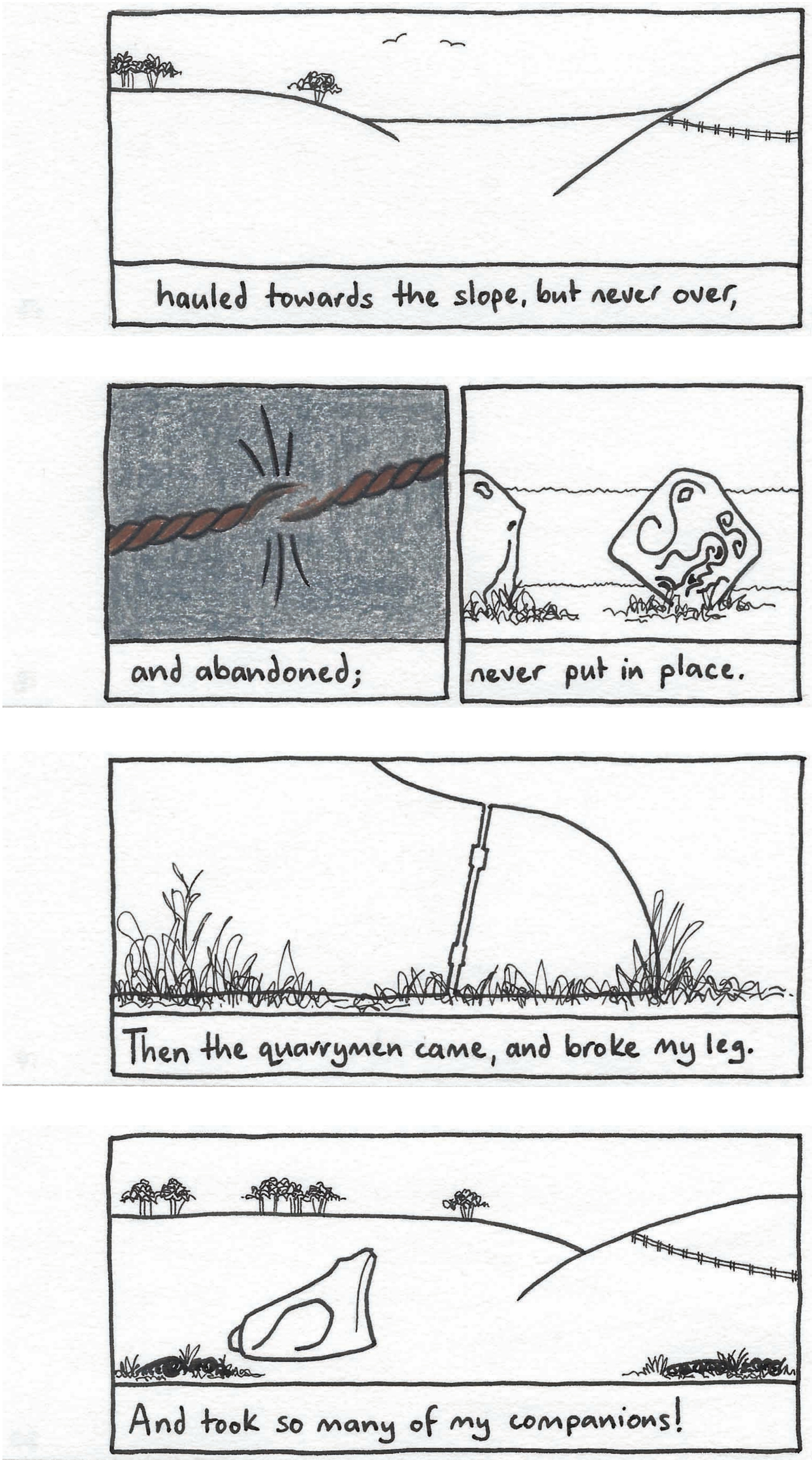

... an excess of silica in ground-water cemented the grains into boulders, large and small.
200nm


TIME PASSED
today
Holocene
~ice~
Pleistocene
1,640,000 years ago
Pliocene
Miocene
Oligocene
Eocene
Palaeocene
MY SANDS WERE LAID DOWN
65,000,000 years ago

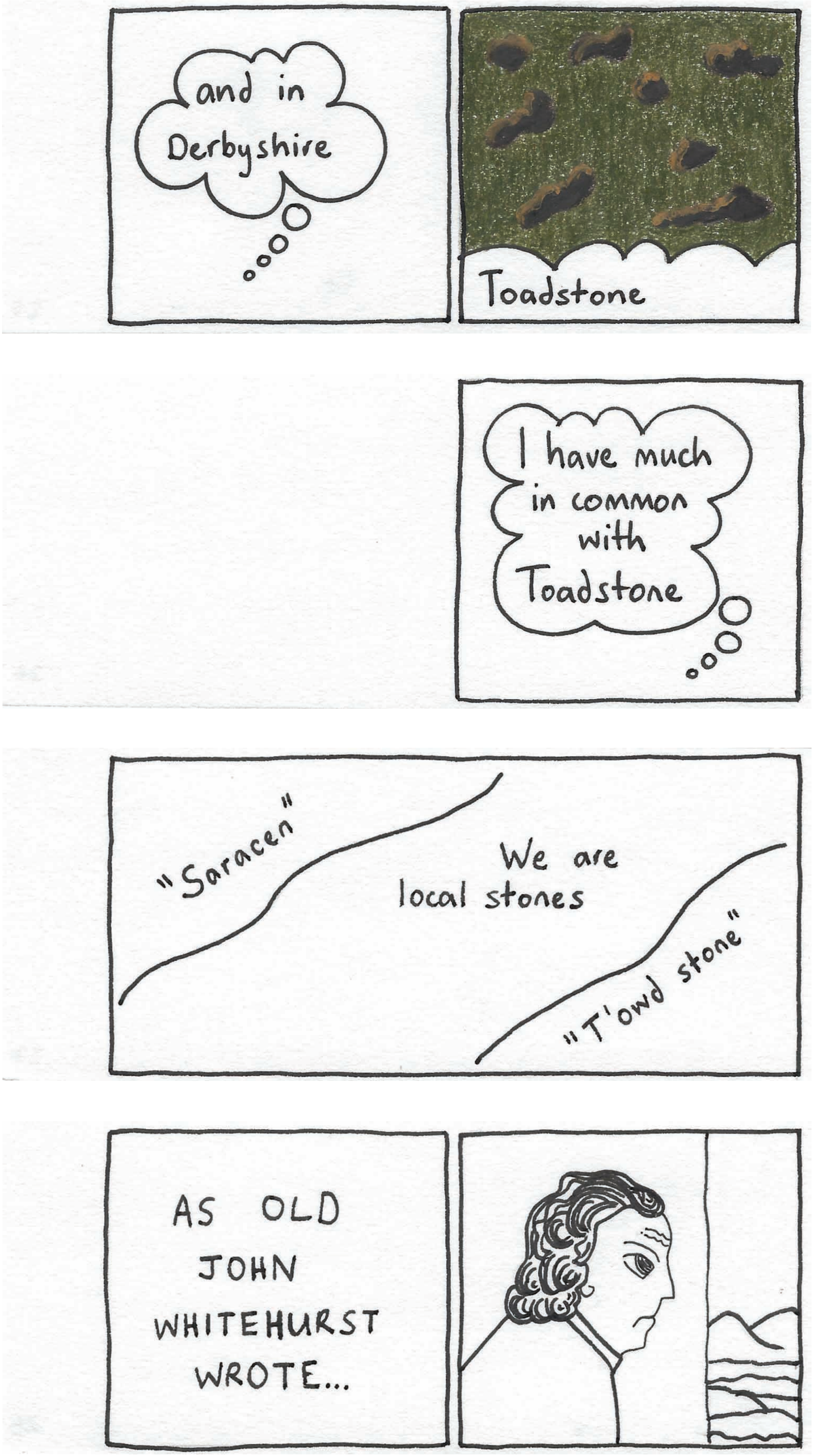

LOOSE SAND ERODED AWAY


ICE AND SNOW CAME
AND WENT
We slipped and slid...

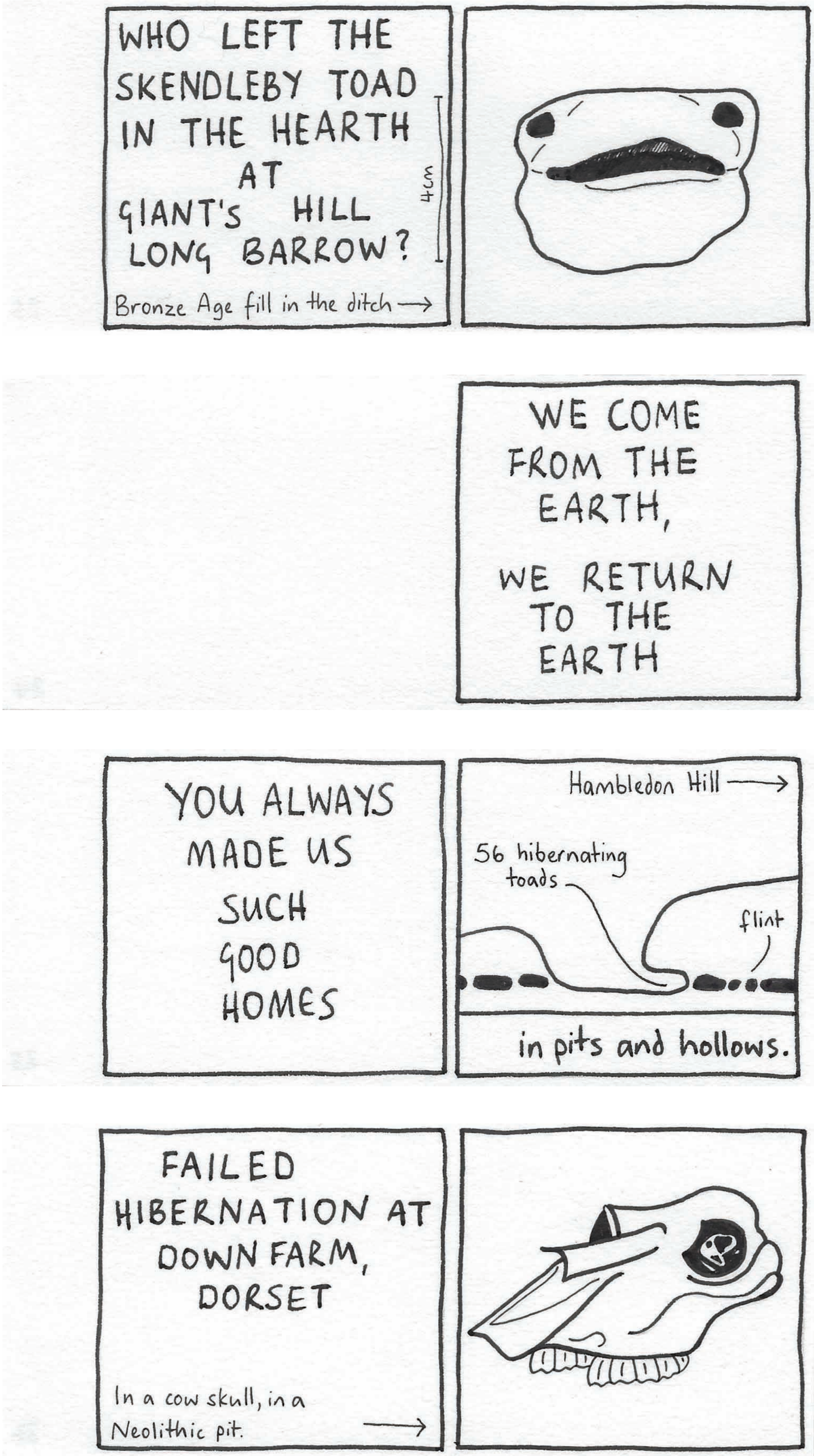

...and laid peacefully.
WE ARE THE SARSENS
YOU LOVED SO MUCH.
Isn't that why I am here...
...SEPARATED FROM MY FRIENDS?
Bound with ropes,


hauled towards the slope, but never over,
and abandoned;
never put in place.
Then the quarrymen came, and broke my leg.
And took so many of my companions!

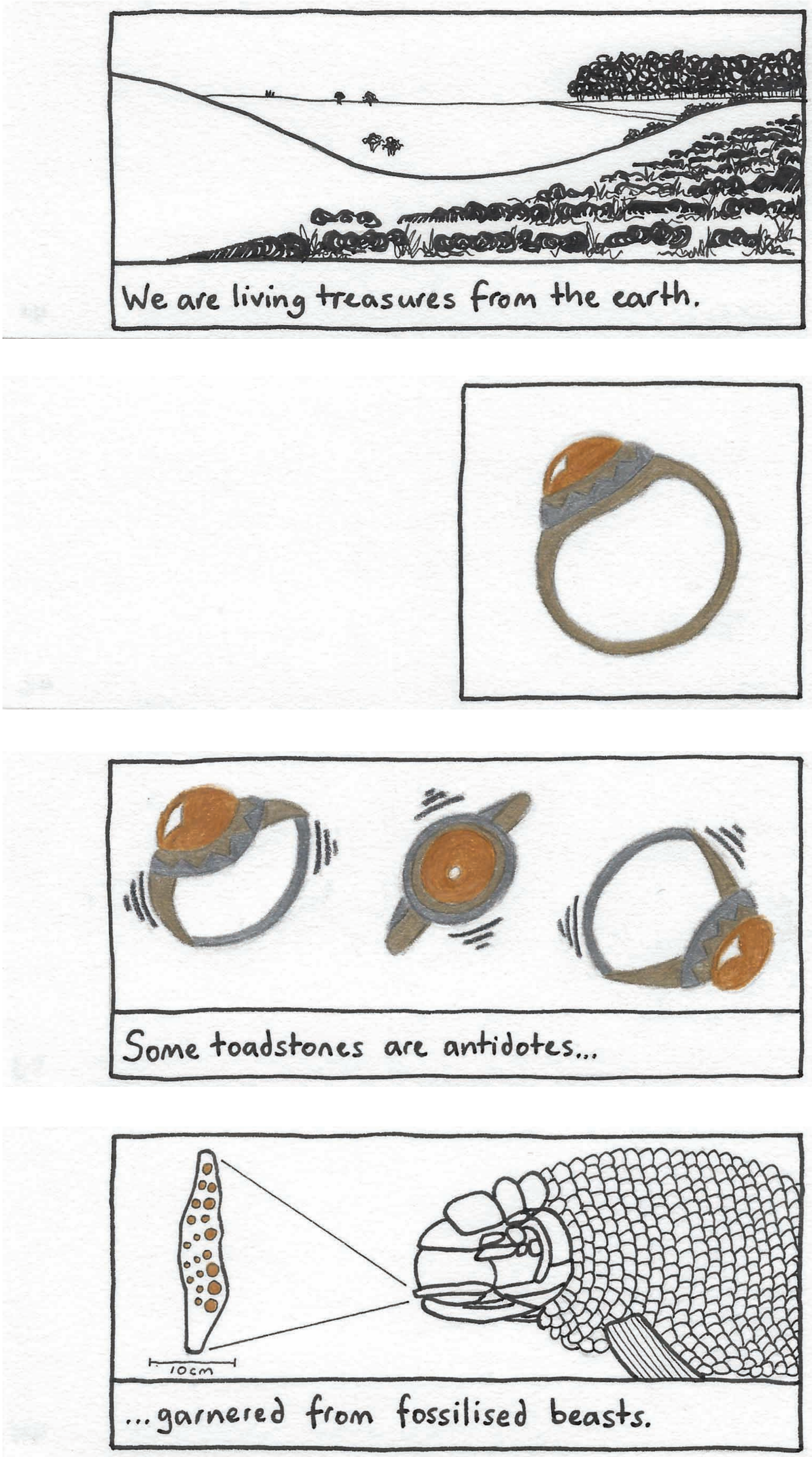

BUT I DO HAVE FAMILY...
My older sandstone sister, Toad Rock, at Rusthall
and the family eccentric, Toad's Mouth at Hathersage
and much older cousins in Spain
Toad's eye - ollo de sapo

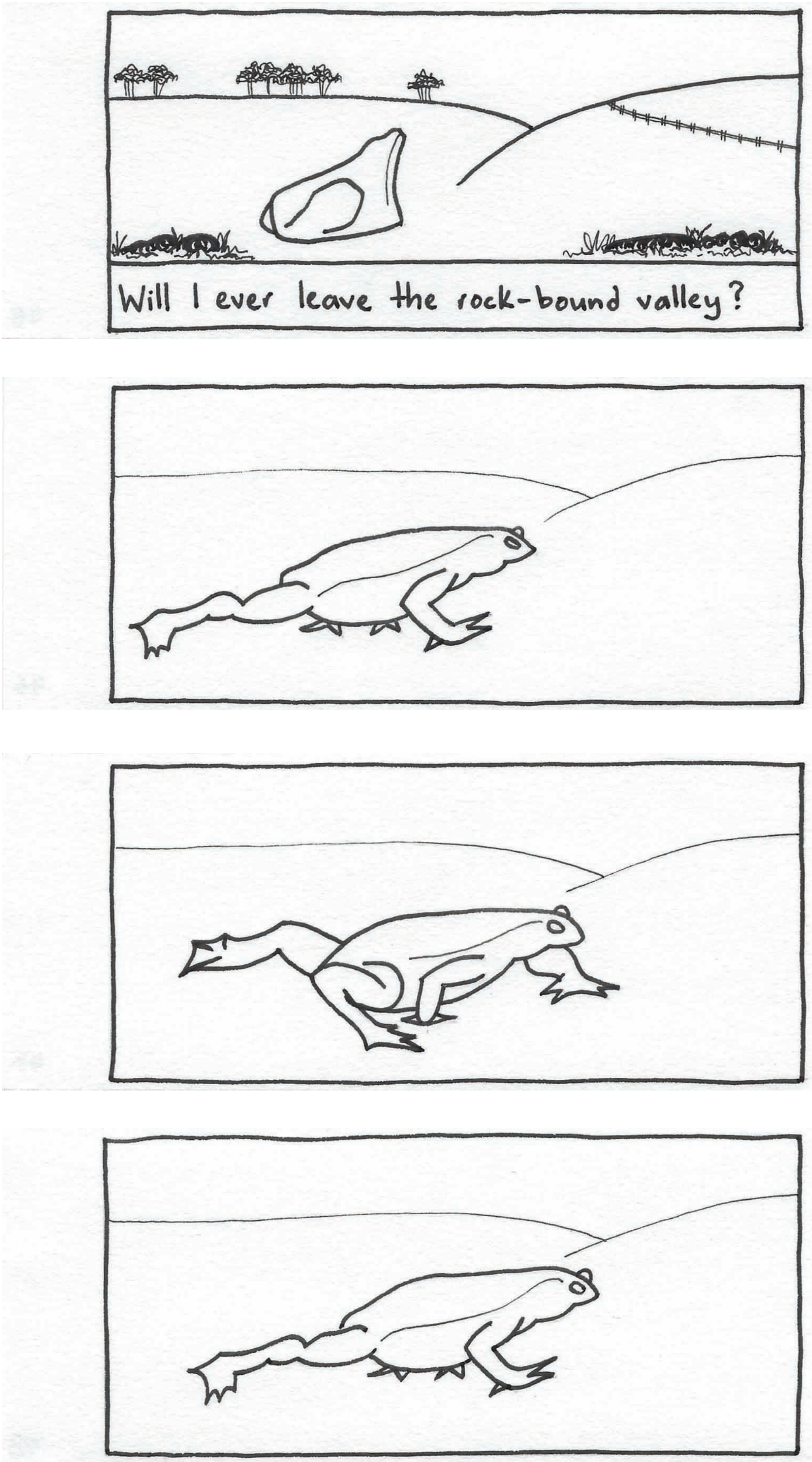

and in Derbyshire
Toadstone
I have much in common with Toadstone
"Saracen"
We are local stones
"T'owd stone"
AS OLD JOHN WHITEHURST WROTE...

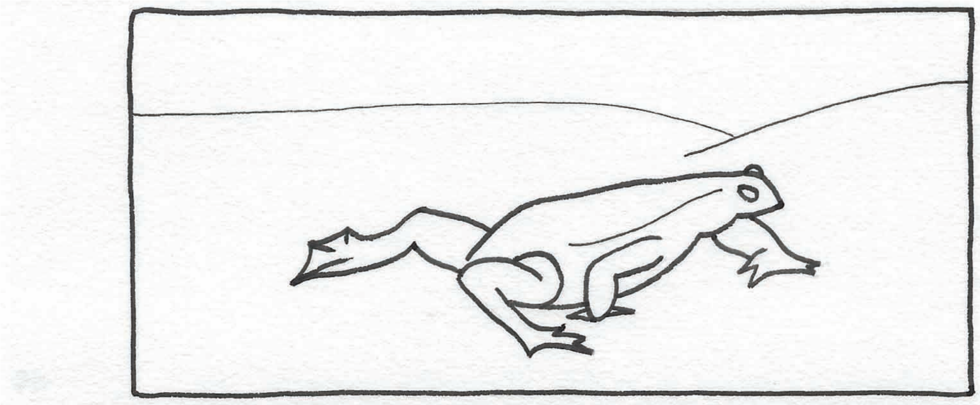

very hard
it does not universally prevail
it does not produce any minerals
resists acid
contains bladder-holes
the close texture of the toadstone will not filtrate water
is as much an UNIFORM MASS as any vitrified substance whatever can be supposed to be
He might as well have been writing about me
YOU SEEM TO HAVE BEEN INTERESTED IN US FOR A LONG, LONG, TIME

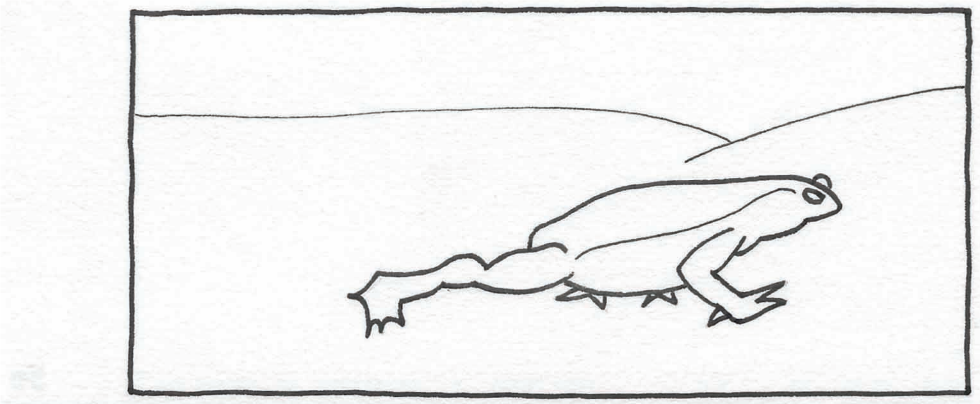

WHO LEFT THE SKENDLEBY TOAD IN THE HEARTH AT GIANT'S HILL LONG BARROW?
4cm
Bronze Age fill in the ditch →
WE COME FROM THE EARTH,
WE RETURN TO THE EARTH
YOU ALWAYS MADE US SUCH GOOD HOMES
Hambledon Hill →
56 hibernating toads
flint
in pits and hollows.
FAILED HIBERNATION AT DOWN FARM, DORSET
In a cow skull, in a Neolithic pit. →

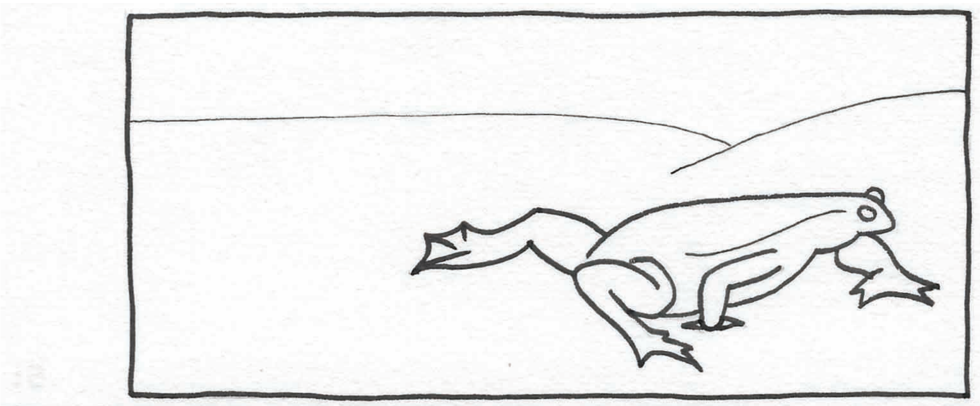

BUT HUSH! DO YOU DARE TO LOOK?!
In a flinty hollow...
...trapped by silica ghosts making bands of flint...
...formed at the bottom
of a warm, shallow, sea.
CAN YOU BELIEVE IT?!
BUT I AM NOT A TODTSTEIN

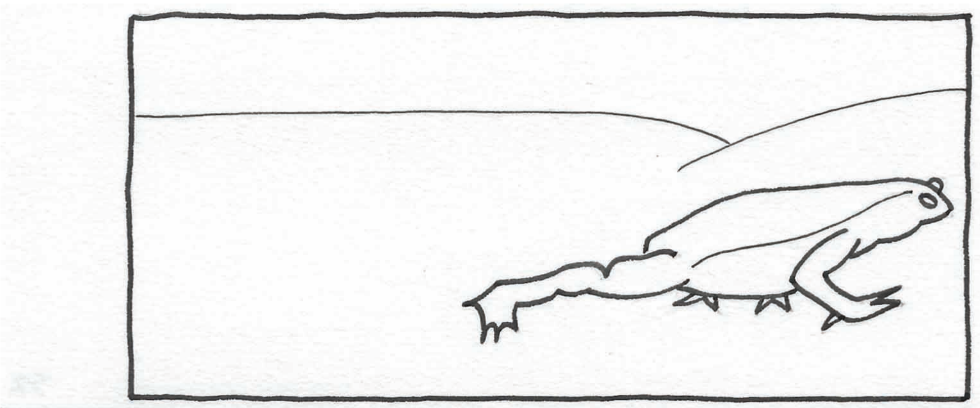

We are living treasures from the earth.
Some toadstones are antidotes...
10cm
...garnered from fossilised beasts.

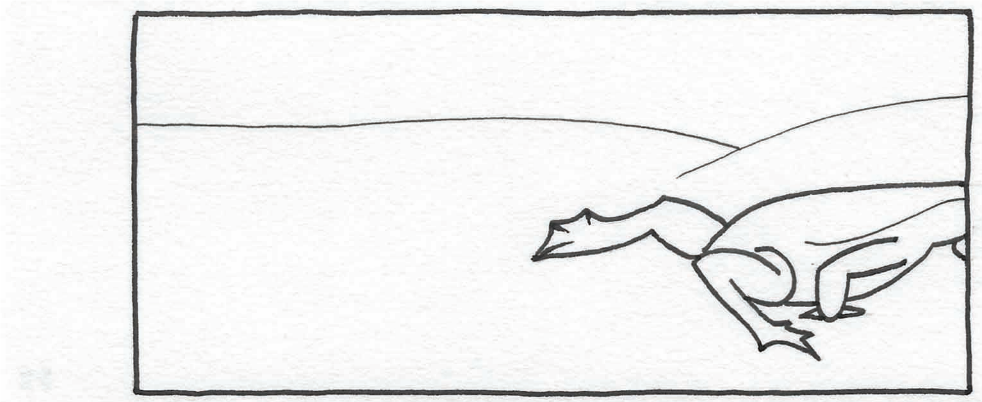

Will I ever leave the rock-bound valley?

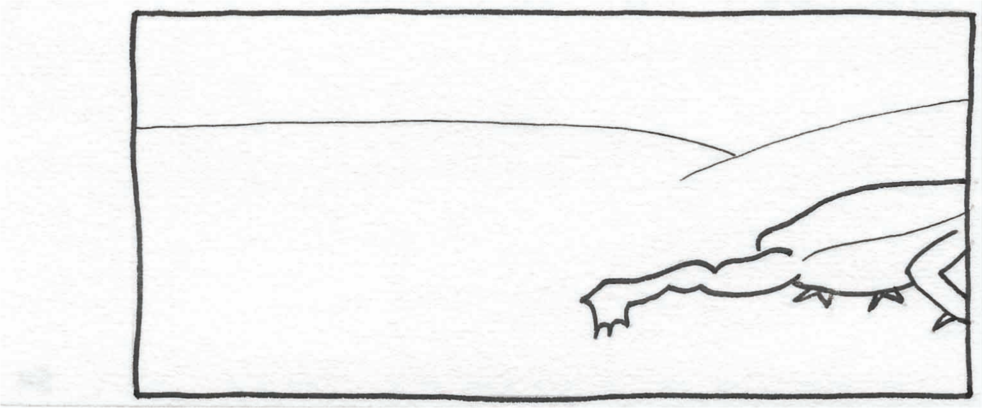


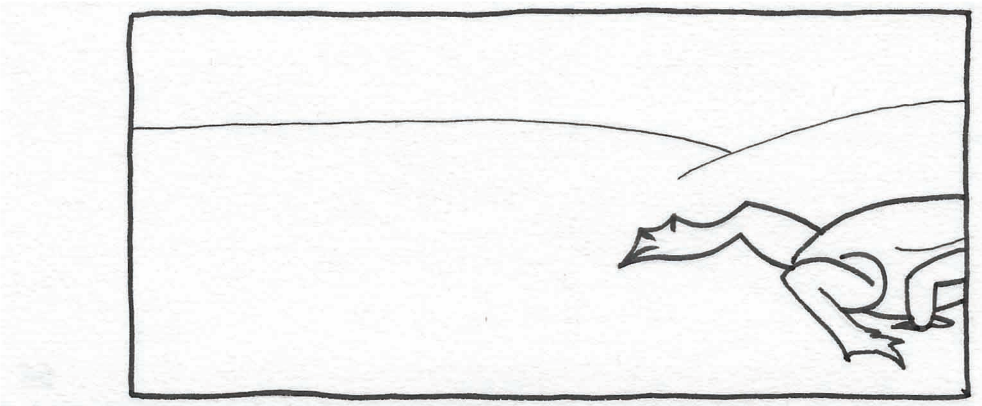


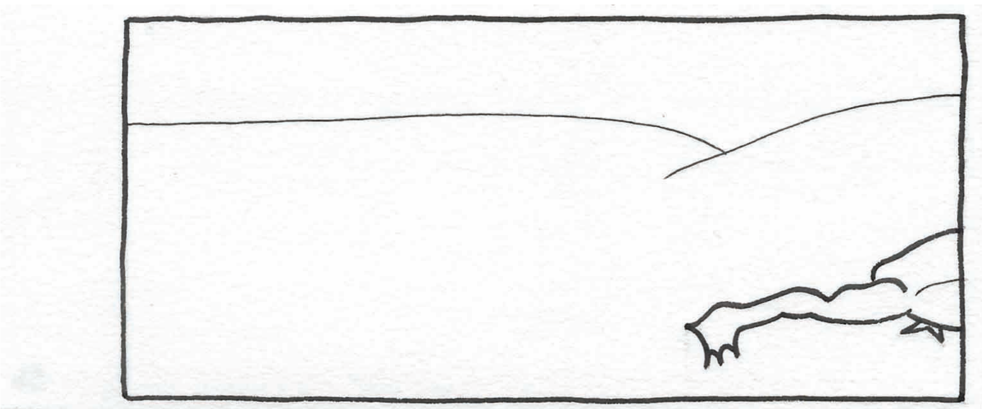


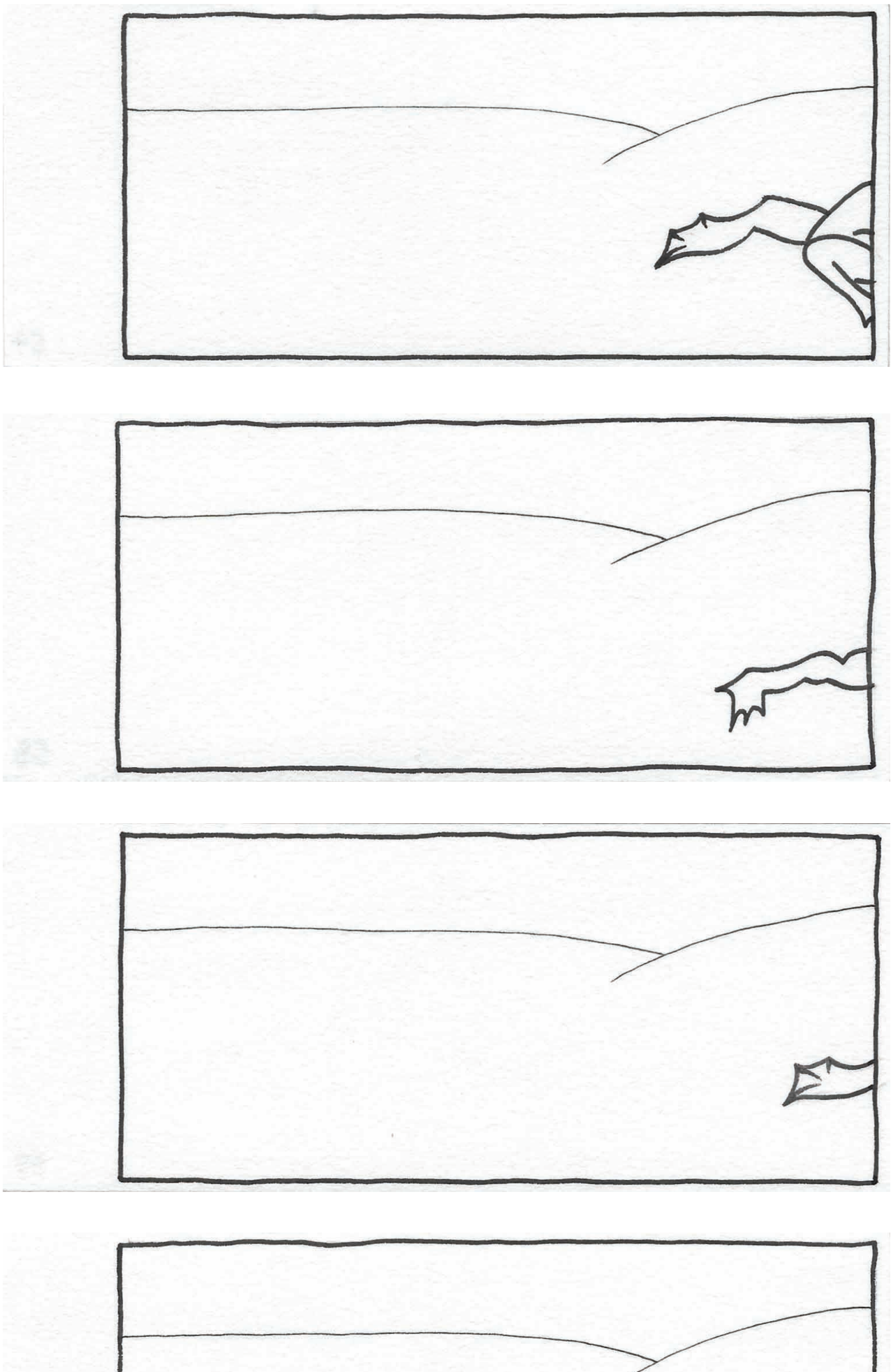


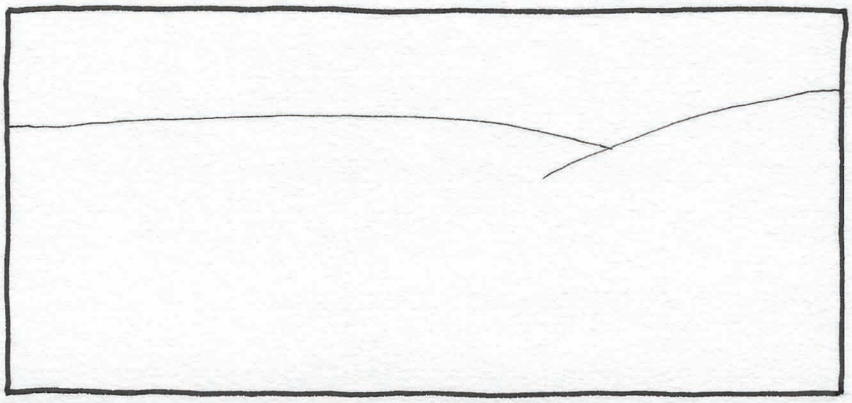


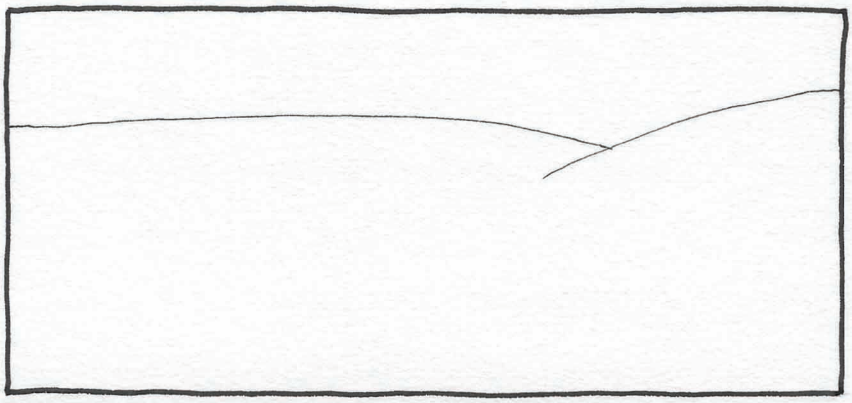












ARNOLD-BEMROSE, H.H. (1894) "On the microscopal structure of the Carboniferus Dolerites and Tuffs of Derbyshire." Quarterly Journal of the Geological Society 50: 630-644

ASHMOLEAN MUSEUM: Finger Ring Collection, WA1897. CDEF.F817.

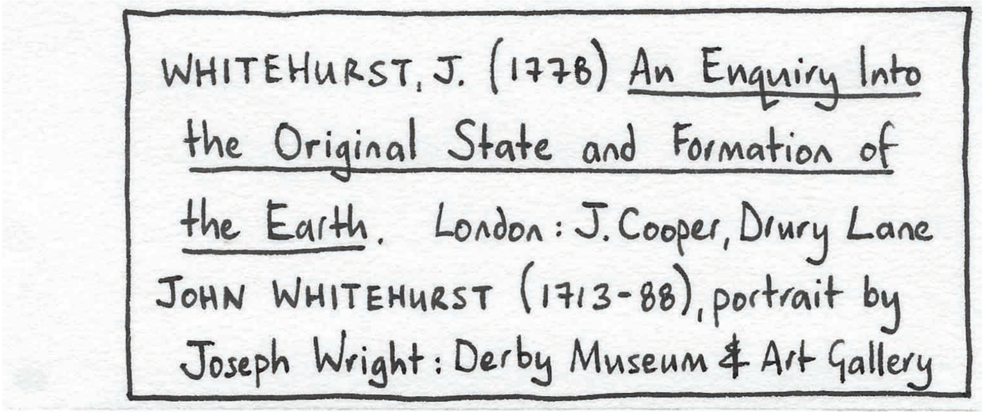
DOUGLAS, E. (31/7/2012) "Secrets of a limestone quarry." The Guardian [online] https://www.theguardian.com (viewed 15/1/2017).

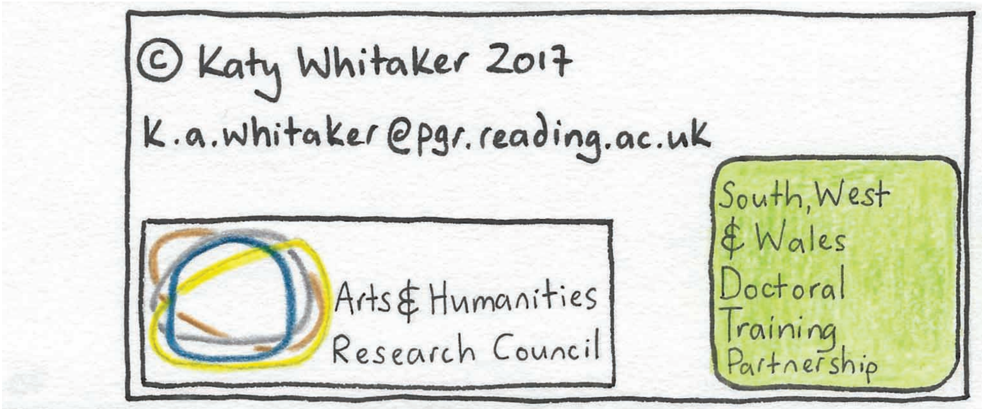
LEGGE, A. J. (1991) "Animal remains from six sites at Down Farm, Woodcutts" In BARRETT et al (eds) Papers on the Archaeology of Cranbourne Chase Oxbow Monograph 11: 54-100

MERCER, R. & HEALY, F. (2008) Hambledon Hill, Dorset, England. Excavation and survey of a Neolithic monument complex and its surrounding landscape. Swindon: English Heritage

MERCER, R. & HEALY, F. (2008) Hambledon Hill, Dorset, England. Excavation and survey of a Neolithic monument complex and its surrounding landscape. Swindon: English Heritage

PHILLIPS, C. W. (1936) "The excavation of the Giant's Hill Long Barrow, Skendleby, Lincolnshire." Archaeologia 85: 37-106





To see the Toadstone leave the Valley of Stones,
read the comic online at

https://figuresinthelandscape.wordpress.com/2017/02/27/the-tale-of-the-toad-stone/

and scroll down the page quickly to animate the last panels

or

print the comic, cut out panels 46 to 62 and turn them into a flick-book.

APPENDICES

1. *Sarsen Stones in Wessex* project

    a. The *Sarsen Stones in Wessex* Project Archive: Archive Report and ISAD(G) Fonds Level Description

    b. *Sarsen Stones in Wessex* Project: Data transcription strategy, methodology and protocols

2. Analytical Earthworks Survey in Piggledene, West Overton, Wiltshire (UK)

3. Analytical Earthworks Survey in West Woods, West Overton/Fyfield, Wiltshire (UK)

4. *Chilterns Sarsen and Puddingstone Survey* project

    a. The *Chilterns Sarsen and Puddingstone Survey*: Archive Report and ISAD(G) Fonds Level Description

    b. Chilterns Sarsen and Puddingstone Survey: Data transcription strategy, methodology and protocols

5. Marden henge excavations (2010) and Vale of Pewsey project excavations (2015, 2016). Sarsen stone report.

6. West Kennet Avenue occupation site excavations, ‘Between the Monuments’ project (2013, 2014, 2015). Sarsen stone report.

7. Public engagement diary.

THE SARSEN STONES IN WESSEX PROJECT ARCHIVE

Archive report and ISAD(G) Fonds Level Description

Katy A. Whitaker, January 2019 (archived May 2020)

k.a.whitaker@pgr.reading.ac.uk | 07769 712799 | @artefactual_KW
ORCID https://orcid.org/0000-0002-9391-8181

This report was authored during a *South, West, and Wales Doctoral Training Partnership* studentship held at the University of Reading, and is supported by the Arts and Humanities Research Council grant number AH:L503939:1.

Arts & Humanities Research Council

South, West & Wales Doctoral Training Partnership

University of Reading

CONTENTS

1. INTRODUCTION

1.1. The *Sarsen Stones in Wessex* survey

The *Sarsen Stones in Wessex* survey began in earnest at the Society of Antiquaries of London in early 1974, intended to be the first action of the Society's wider *Evolution of the Landscape* Project. A survey of sarsens in the counties of Wiltshire, Dorset, and Hampshire was proposed as a suitable pilot for the landscape investigation project, and fieldwork ensued. In 1977 Collin Bowen FSA and Isobel Smith FSA published a paper summarising progress to date, "Sarsen Stones in Wessex: the Society's first investigations in the Evolution of the Landscape Project." (Bowen and Smith, 1977).

1.2. The *Sarsen Stones in Wessex* Project Archive

The project archive relates primarily to the fieldwork carried out by volunteer participants in the three counties covered by the project; the synthesis of site and parish records to generate county-wide mapping; the production of map illustrations for publication purposes. There is a typescript hand-list. The archive is curated by the Society of Antiquaries of London, Burlington House, Piccadilly, London, W1J 0BE. It can be consulted on request at the Society's library (https://www.sal.org.uk/library/visiting-and-using-the-library/).

1.3. Scope

This report briefly describes the project and summarises its significance (it is not a critique of the *Sarsen Stones in Wessex* survey). A description of the physical format of its archive is based on a rapid survey of the collection at the Society of Antiquaries library carried out in October 2016, and with reference to the available hand-list. Key archival issues are highlighted but this does not constitute a full conservation assessment.

The report does not include reference to relevant Society of Antiquaries archive material such as meeting minutes or financial records relating to the project's management. Stone samples collected during the *Sarsen Stones in Wessex* project have not been seen. Locations curating duplicate copies of parts of the archive are noted, but not all have been consulted (where duplicate material has been seen, this is made clear in the text of this report).

2. THE *SARSEN STONES IN WESSEX* SURVEY

2.1. Project History

The Society of Antiquaries is a learned society, established by Royal Charter in the eighteenth-century. Its purpose is the study of antiquities and history, and its membership (currently c3,000 Fellows) includes scholars distinguished in fields including archaeology, architecture, art history, numismatics, palaeography and other branches of history. The Society is international in reach, and also has a remit to encourage public understanding of heritage and to support research (https://www.sal.org.uk/about-us/). One of the Society's committees is concerned with research: the Society has a track-record of supporting research projects since the late-nineteenth-century, such as the excavations at Silchester and Sutton Hoo (https://www.sal.org.uk/about-us/our-history/).

In 1972, the Research Committee convened a sub-committee with the purpose of promoting research into the long-term history of landscape organisation, choosing to focus on the extensive and dense archaeological and historical palimpsest of Britain's central-southern chalk Downland (Cunliffe et al., 1972, Bowen and Cunliffe, 1973). On 23 February 1974, the inaugural meeting of participants interested in the *Evolution of the Landscape* project was convened at the Society of Antiquaries (Society of Antiquaries of London, 1974).

Wessex was chosen to be the pilot study area, comprising the counties of Wiltshire, Dorset, and Hampshire. The meeting attendees discussed two research methodologies: intensive studies of targeted localities, concerned to explore the long time-depth of landscape change in particular places; and thematic studies over the whole study area, exploring a range of subjects (Bowen and Smith, 1977, 185).

Taking the latter approach, as its first themed study the *Evolution of the Landscape* project embarked on a survey of sarsen stones, known to be distributed across the three counties. Whilst a notional limit of one year was set for the survey phase, the initial results were not reviewed until May 1975 (Society of Antiquaries of London, 1975). By that time field survey in Dorset was "substantially complete" (Bowen and Smith, 1977, 185) and continuing in Hampshire and Wiltshire. By 1977 this work was almost finished, with acknowledged gaps in north-east Hampshire and in the militarily-restricted area of the Salisbury Plain Training Area.

Whilst further enquiries from anyone wishing to continue to contribute to the project were encouraged (Bowen and Smith, 1977, 185-6), two Fellows proceeded to synthesise the data collected by that time and published the results, in order to draw researchers' attention to the archive's existence (Bowen and Smith, 1977, 186). The archive material that had been assembled by 1977 was deposited in the Society's library, except the Hampshire survey material which was not deposited until 1993 (see HSS01 Hampshire Sarsen Survey, Historic England Archive). Microfiche copy of most of the project archive was made by RCHME in 1980; a set of these sheets is available in the Historic England Archive (uncatalogued, this includes copies of the Dorset and Wiltshire record sheets, maps annotated during the project, and maps/imagery produced for publication purposes, but not the Hampshire record sheets).

2.2. Project Aims and Methods

The *Sarsen Stones in Wessex* survey had been identified as a suitable investigation for the *Evolution of the Landscape* project because of the common characteristic of sarsens as surface boulders. Naturally occurring in surface spreads in the study area, sarsens were identified by the project participants as impediments to agriculture, a problem to be solved by early farmers. It should be noted that there is no evidence in the project archive or in related papers archived in the Historic England Archive (uncatalogued collection SOA/03) that the project organisers had surveyed the geological literature in advance, to establish the overall incidence of sarsen and other silcretes in southern Britain. The focus was to be three Wessex counties because of the significance of the surviving archaeological record there, for interpreting the development of agriculture in prehistory.

The study of these geological features, and prehistoric responses to them, was seen as a fundamental step towards interpreting landscape change in the study area: and, by enumerating those responses, would be revealing of technological issues (agricultural practices) and factors such as population pressure in prehistory (Bowen and Smith, 1977, 185, 189). Three project aims were identified:

- Establish the former incidence of sarsen stone in the study area;
- Describe how sarsen stones in the study area had been dealt with in the Neolithic, as a mineral resource or as impediments;
- Understand the effect of sarsen stones on underlying chalk bedrock.

An additional factor was that the survey methods be relatively simple, and amenable to analysis. Approximately 100 volunteers were involved in the fieldwork which was collated in Dorset by John Bailey, in Wiltshire by Isobel Smith, and in Hampshire by Peter Gallup and Arthur ApSimon. Participants were given information sheets describing what to look for, and record sheets ("Tally Cards") for completion. Extensive searches covering every parish were intended but whilst the results were felt to offer "a consistent statement of distribution" (Bowen and Smith, 1977, 186), differences between the counties were conceded: for example, the Dorset results included a record of the natural sarsen distribution, whilst in Hampshire, the volunteers were thought to have found only utilised sarsens in anthropogenic contexts.

The principal outputs were the distribution maps published, in black and white, as Figures 2 and 3 in Bowen and Smith (1977, 190, 192). Figure 2 shows the distribution of single natural sarsens, groups of natural sarsens, and utilised sarsen, identified in the Wessex area by the volunteer surveyors. Figure 3 shows this information for the Avebury-Stonehenge area of Wiltshire, breaking down the category of utilised sarsen by period (prehistoric, Romano-British, Saxon, medieval, and post-medieval). County maps showing these distributions but with coloured markers representing these period distinctions form part of the archive. It is notable that none of the records included the location of sarsen setts and other nineteenth- and twentieth-century street furniture, which can nevertheless be seen in many of the towns and villages visited by the volunteers.

In addition to the collation of “Tally Cards” recording the location and use of sarsen boulders, two small excavations were carried out on Overton Down (Wiltshire) to explore the physical relationship between surface sarsens and the underlying geology. The results were summarised (Bowen and Smith, 1977, 193-5). The archive collection MS953 includes only the publication drawings from the excavations, whilst black and white photographs and some notes about the excavations can be found in files in the uncatalogued collection SOA/03, Historic England Archive.

2.3. **Significance**

The *Sarsen Stones in Wessex* survey was not the first sarsen stone survey. Aside from the recording practices of earlier twentieth century geologists writing British Geological Survey *Memoirs* explaining map sheets in areas where sarsens are present (for example Osborne White (1907), Sherlock (1922)), which tended to be quite systematic, a project also carried out by volunteers was led in Buckinghamshire in the early 1950s (Morley Davies and Baines, 1953). The aim of that fieldwork was to find and map silcretes (both sarsens and puddingstones) in the general area of the Chilterns from south-east Oxfordshire to north-west Hertfordshire, although without the emphasis on human use of the stone and the landscapes in which it is found. The archive of that project is kept in the Bucks County Museum Resource Centre (Halton).

Earlier examples of ‘crowd-sourced’, volunteer-driven data-collecting in the historic environment include, for example, the *National Record of Industrial Monuments* (Buchanan, 1969, 1971) and, in a similar vein (although not specifically project-led), the RCHME and National Buildings Record use of local correspondents and photographers to capture information for the record (Sargent, 2001). Nevertheless, the Society of Antiquaries' project was unusual for its cross-disciplinary intent, with both archaeological and geological goals framed within the theoretical concept of 'landscape', and it stands out as an early attempt at a landscape archaeology project.

In this sense, the *Sarsen Stones in Wessex* survey epitomises developments of later-twentieth-century British archaeology, with its focus on resources and environmental constraints to human behaviour, inter-disciplinarity, and an aim to understand landscape rather than a single site or a class of monument. Although the brief publication of the project's results in 1977 did not answer to the aims discussed in 1974 (Society of Antiquaries of London, 1974) and 1975 (Society of Antiquaries of London, 1975), the mapping has formed the basis of subsequent general distribution maps of silcretes in southern Britain, such as Ullyot and Nash (2006). In addition to the location data, which could now be better handled in a GIS environment, the original record sheets contain more information about human interaction with sarsen and siliceous conglomerates in the project's study area. A digitised and critically-evaluated dataset derived from the original archive material, and including the unpublished content added after 1977, would be a substantial benefit to geological, archaeological, and historical studies of silcretes in southern Britain.

2.4. **Audiences**

Future audiences for the archive include a range of archaeologists and geologists who are engaged in sarsen stone research. In contrast to the interest in, for example, "exotic" stones such as the Stonehenge bluestones (for example, Bevins and Ixer, 2016, Bevins et al., 2016, Ixer and Bevins, 2010, Ixer and Bevins, 2011a, Ixer and Bevins, 2011b, Ixer and Bevins, 2013, Ixer et al., 2015, Ixer and Bevins, 2016, Parker Pearson et al., 2016, Thomas, 1923), or rock types other than flint used for Neolithic axe-heads (such as Clough and Cummins, 1979, Clough and Cummins, 1988 and including for example University College Dublin's Irish Stone Axe Project and Project JADE, National Agency for Research (France)), sarsen has previously attracted less sustained archaeological attention. This is now changing as sarsen's geological formation processes in particular, as well as its uses in the past, are being investigated (Banfield, 2016, Field, 2005, Gillings and Pollard, 1999, Gillings and Pollard, 2016, Green, 2016, Pollard and Gillings, 2009, Summerfield and Goudie, 1980, Ullyott et al., 2004, Ullyot and Nash, 2006, Ullyott and Nash, 2016). The *Sarsen Stones in Wessex* survey distribution maps form the basis of mapping re-drawn in later publications such as these, but the primary data have not yet been made available in formats that can be analysed in more detail.

In addition, sarsen stone attracts considerable interest from local and community groups in the areas of the stone's natural distribution. Whilst it is harder to document this interest, examples include the Wiltshire Archaeological Field Group survey of archaeological features, including sarsen spreads, features, and quarrying, in West Woods (Amadio, 2011); the popularity of guided walks in the Fyfield Down National Nature Reserve and upper Kennet Valley led by archaeologists and geologists to visit sarsen trains and structures; and local outrage at attempts to break a sarsen stone, using historical techniques, during an archaeological research project (Gillings et al., 2008, 355).

There is, therefore, a broad audience for the more detailed levels of data that are available from the *Sarsen Stones in Wessex* survey archive than was published in Bowen and Smith (1977).

3. THE *SARSEN STONES IN WESSEX* PROJECT ARCHIVE

3.1. Relationship to publications

The only publication arising directly from the project is Bowen and Smith (1977).

3.2. Current archive management and access

The project archive is managed by its creator institution, the Society of Antiquaries of London. Access is available according to the Society's advertised terms and conditions. The collection is not digitised but there is a typescript hand-list: the collection content is catalogued to file or item level within sub-fonds or series. Copies of the records relating to Hampshire were deposited in the Hampshire Record Office (where they are catalogued under collection number 113M93) and with the local authority planning department (Bowen and Smith, 1977, 186). Microfiche of the Dorset and Wiltshire record sheets, the project's maps, and publication images, is held by the Historic England Archive.

3.3. Archive organisation

The Society of Antiquaries' collection, numbered MS 953, comprises five boxes and two folders of material, organised into four series (Table 1). The content of each series is detailed in Annex A.

Reference	Title
953/1	General sarsen survey
953/2	Dorset sarsen survey
953/3	Hampshire sarsen survey
953/4	Wiltshire sarsen survey

Table 1 Series in the *Sarsen Stones in Wessex* project archive.

Series 953/2 does not include the stone samples that were collected by the project in Dorset (Bowen and Smith, 1977, 186), which may be in the Society's museum collection along with material collected by the Society from William Gowland's 1901 excavation at Stonehenge (Gowland, 1902).

The project's basic unit of record is the "Tally Card", sheets that were completed by the volunteers. For Hampshire and Dorset these are paper sheets normally including the following fields (not all fields were necessarily completed by each recorder):

- "Group or single"
- "Whether in situ"
- "Any name"
- "Position (marked on map and elaborated in sketch if necessary)"
- "NGR"
- "Bedrock"
- "Drift"
- "Height over OD"
- "Situation (e.g. hill-top, valley, under trees etc)"
- "Description: type of rock (if it includes pebbles, note whether rounded or angular; note particularly if very small pink or white quartz pebbles are included, and again note whether round or angular)"
- "Size and shape (noting if very large with sketch)"
- "If group, density"
- "Condition (e.g. apparent nature of bedding, weathering on surface, algae etc)"
- "Evidence for use"
- "Relationship (e.g. to fields ancient or modern)"
- "AP consulted"
- "Photographs taken (wherever possible)"
- "Additional notes"
- "Name of recorder (printed)"

- "Date"

A small number of original "Tally Cards" for records in Dorset have been found in the uncatalogued collection SOA/03, Historic England Archive. Images of these 23 sheets do not appear in the microfiche that was made by RCHME in 1980. These sheets have been returned to MS953 at the Society of Antiquaries of London.

Alternative versions of the basic "Tally Card" were used in Dorset, and occasionally home-made sheets were used by volunteers in all three counties. The Wiltshire records comprise mainly postcards, containing far less information than the Dorset and Hampshire "Tally Cards", with some additional data included on separate sheets. Whilst the Hampshire and Dorset records are organised by parish, those for Wiltshire are arranged by Ordnance Survey 1:25000 map sheet. Dorset, for example, has "Tally Cards" bundled into 50 parish files, with one or more "Tally Card" in each parish file. The Wiltshire records are bundled with each relevant published map sheet, sometimes annotated to indicate the location of the recorded sarsens. Annotated map sheets for Dorset and Hampshire are kept separately from those counties' "Tally Cards".

3.4. Storage, housings, and archive formats

The collection is stored in a number of small boxes and two folders of maps. The formats are varied (Table 2).

Primary housing	Secondary housing	Contents	Formats
Archival quality box, c40cm x c30cm x c12cm		953/1/1-6 and items from 953/2, 953/3, 953/4	Mixed paper sizes and microfiche
A0 map folder		Maps and plans	Mixed paper sizes
A2 map folder		953/2/3	Ordnance Survey sheets
Box file	Foolscap envelopes	953/2/1	Mixed paper sizes

Archival quality box, c40cm x c30cm x c12cm	Plastic and wooden slide boxes	953/2/4/1-2	35mm and 70mm colour transparencies
Box file	Foolscap envelopes	953/4/1-2	Postcards and mixed paper sizes, Ordnance Survey sheets
Box file		953/3/3/5	Ordnance Survey sheets

Table 2 *Sarsen Stones in Wessex* Archive storage.

3.5. Future accruals

The project was completed with the deposit of Hampshire archive material at the Society of Antiquaries of London in 1993. No future accruals are expected.

4. ARCHIVE ISSUES

4.1. Storage requirements and conservation

Current storage conditions are generally appropriate both for access and future security other than the three box files, the preponderance of non-archival paper envelopes to store “Tally Cards”, and the current slide and photograph housings.

Various maps in the collection, annotated with coloured sticky dots, are now compromised: the dots stuck onto the paper or drawing film sheets have lost their adhesion. Many of the dots are loose in the folders or lost entirely. The primary data are recorded on the “Tally Cards”, so it is possible to re-map the information: although such an exercise is unlikely to interpret the data in precisely the same way as in 1977 for the project publication. The publication drawings also record some of this data, although in black and white.

Some of the Wiltshire “Tally Card” postcards have in the past been bundled by rubber bands. These have perished, sticking some of the cards together and sticking some cards to the envelopes that house them.

4.2. Copyright and ownership

The collection is © The Society of Antiquaries of London. Archiving of the transcribed dataset *WessexSarsens.xlsx*[1] is by kind permission of the Society of Antiquaries of London.

[1] Available in the University of Reading Data Archive.

Annex A *Sarsen Stones in Wessex* archive hand-list

Society of Antiquaries: MS 953, “Wessex Sarsen Stone Survey”

Access to Archives record:
http://discovery.nationalarchives.gov.uk/details/rd/de4ca10e-d46d-415c-b06a-380932b780ca

Reference			Content
953/1			**General sarsen survey**
	953/1/1		Sarsen symposium, evolution of the landscape project: News Sheet No2, an account of a meeting held at the Society of Antiquaries, 10 May 1975.
	953/1/2		List of sarsens considered in the Evolution of the Environment Project, and arranged by county and parish.
	953/1/3		Map showing distribution of sarsen stones in southern England (Fig 1 in Bowen and Smith (1977))
	953/1/4		Map of sarsens in Wessex, plotted during the course of the evolution of the landscape project (Fig 2 in (Bowen and Smith, 1977))
	953/1/5		RCHM microfiche copy of sarsen survey material
	953/1/6		Tracing of aerial photographs made by NMR flights on 18, 25 and 30 July, and showing sarsen distribution in Gloucestershire
953/2			**Dorset sarsen survey**
	953/2/1		Tally cards giving details of Dorset sarsens; arranged in alphabetical order by parish
	953/2/2a		OS 1:100,000 map of Dorset, showing distribution of sarsens (much of the marking lost)
	953/2/2b		OS 1:100,000 map of Dorset, showing distribution of sarsens (reduced copy)
	953/2/3		OS 1:25,000 maps used in survey (10 maps)
	953/2/4		Transparencies
		953/2/4/1	140 35mm transparencies
		953/2/4/2	15 transparencies
953/3			**Hampshire sarsen survey**
	953/3/1		Reports and related material

		953/3/1/1	Report entitled "The Survey of Sarsen Stones – Hampshire", by Peter Gallup (1986)
		953/3/1/2	List of sarsens in survey (1986)
		953/3/1/3	Report entitled "The Survey of Sarsen Stones – Hampshire", by Peter Gallup (1993), including list of sarsens in survey
	953/3/2		Tally cards giving details of Hampshire sarsens; arranged alphabetically by parish
		953/3/2/1	Hampshire parishes A-L
		953/3/2/2	Hampshire parishes M-Z
	953/3/3		Maps
		953/3/3/1	OS 1:100,000 map of Hampshire and the Isle of White, showing distribution of sarsens (2 sheets)
		953/3/3/2a	Map showing distribution of sarsens on Hampshire, with surveyors' areas
		953/3/3/2b	Map showing distribution of sarsens on Hampshire (May 1975)
		953/3/3/2c	Map showing distribution of sarsens on Hampshire (May 1975)
		953/3/3/3	Map showing distribution of sarsens for which there is no clear history or purpose
		953/3/3/4a	OS SU42 NE, map of Winchester
		953/3/3/4b	Tracing of 953/3/3/4a showing distribution of sarsens
		953/3/3/4c	Tracing of 953/3/3/4a showing distribution of sarsens
		953/3/3/5	OS 1:25,000 maps used in survey (35 sheets)
	953/3/4		Photographs
		953/3/4/1	Album containing 7 photographs of sarsens and boundary markers
		953/3/4/2	Photographs of sarsens, and 3 index cards
	953/3/5		101 transparencies of Hampshire sarsens
953/4			**Wiltshire sarsen survey**
	953/4/1		Envelopes containing tally cards/index cards giving details of Wiltshire sarsens, maps, transparencies and other recorded information. Material is arranged by OS 1:25,000 reference number
		953/4/1/1-29	Envelopes numbered by OS map sheet, containing tally cards etc as above

	953/4/2		Additional information relating to Wiltshire survey, not found with tally cards in 953/4/1/1-29
	953/4/3a		OS 1:100,000 map of Wiltshire
	953/4/3b		Tracing of 953/4/3a showing distribution of sarsens
	953/4/3c		Tracing of 953/4/3a showing distribution of sarsens (reduced copy)
	953/4/4		Map of sarsens in the Avebury to Stonehenge area (Fig 3 in Bowen and Smith (1977))
	953/4/5		Drawings of test excavation of sarsens I and II at Overton Down, Wiltshire (Fig 4 in Bowen and Smith (1977))

ANNEX B ISAD(G) Fonds Level Description

B.1 Reference Code

MS 953.

B.2 Title

Wessex Sarsen Stone Survey.

B.3 Date

1974-1993.

B.4 Level of Description

Fonds.

B.5 Extent and medium

5 boxes, 2 map folders, stone samples (unknown number).

B.6 Creator

The Society of Antiquaries of London.

B.7 Administrative history

The Society of Antiquaries of London is a learned society founded in 1707 and established by Royal Charter in 1751. The Society exists to promote archaeological and historical research. Its objectives and Statement of Values are available at https://www.sal.org.uk/about-us/. A sub-committee of the Society's Research Committee was established in 1973 with the purpose of promoting research into the long-term history of landscape organisation. That sub-committee instituted the

Evolution of the Landscape Project, the first activity of which was the *Sarsen Stones in Wessex* project.

B.8 Archival history

The *Sarsen Stones in Wessex* project archive material for the counties of Dorset and Wiltshire was collated and archived at the Society of Antiquaries of London in 1977. The archive material for Hampshire was deposited in 1993.

B.9 Immediate source of transfer

n/a

B.10 Scope and content

This fonds consists of documentary and photographic archive relating to the *Sarsen Stones in Wessex* survey. It includes the project's initial period of data capture from 1974 to 1977; the results publication; and later data capture (in Hampshire) into the 1980s. The fonds contains MSS field records, typescript documentation, maps, transparencies, photographs, and publication drawings.

B.11 Appraisal, destruction and scheduling

n/a

B.12 Accruals

No future accruals are expected.

B.13 System of arrangement

The fonds is ordered in four series.

B.14 Conditions governing access

Conditions of access are described https://www.sal.org.uk/library/manuscripts-and-archives/

B.15 Conditions governing reproduction

Conditions of image supply and reproduction are described https://www.sal.org.uk/library/library-image-services/

B.16 Language

English.

B.17 Physical characteristics and technical requirements

Some material in the fonds requires rehousing in suitable archival storage, and conservation intervention is required on material damaged by inappropriate use of rubber bands to hold items together.

B.18 Finding aids

The fonds is referenced at series level in *Access to Archives* http://discovery.nationalarchives.gov.uk/details/rd/N13999634. A typescript hand-list is available.

B.19 Existence and location of originals

This fonds comprises original material.

B.20 Existence and location of copies

The fonds, except the Hampshire records MS953/3/2, has been microfiched and is available as a RCHME Microfiche in the Historic England Archive. Material in series 953/3 is duplicated in the Hampshire Record Office (113M93).

B.21 Related units of description

None known.

B.22 Publication note

Bowen and Smith (1977).

B.23 Note

n/a

B.24 Archivist's note

Description prepared by Katy A. Whitaker.

B.25 Rules or conventions

Description based on General International Standard Archive Description (Second Edition) "Rules for Archival Description (Fonds)".

B.26 Date of description

Description prepared January 2017, revised October 2017.

REFERENCES

AMADIO, L. 2011. West Woods, Wiltshire: An Archaeological Survey. *Wiltshire Archaeological and Natural History Society Report.* Devizes: Wiltshire Archaeological and Natural History Society.

BANFIELD, E. 2016. Sticky Notes: Some Thoughts on the Use of Clay in the Neolithic Deposits within the Avebury Megalithic Complex. *Norwegian Archaeological Review*.

BEVINS, R., ATKINSON, N., IXER, R. & EVANS, J. G. 2016. U-Pb zircon age constraints for the Ordovician Fishguard Volcanic Group and further evidence for the provenance of the Stonehenge bluestones. *Journal of the Geological Society*.

BEVINS, R. E. & IXER, R. A. 2016. Carn Alw as a source of the rhyolitic component of the Stonehenge bluestones: a critical re-appraisal of the petrographical account of H.H. Thomas. *Journal of Archaeological Science,* 40**,** 3293-3301.

BOWEN, H. C. & CUNLIFFE, B. 1973. The Evolution of the Landscape. *The Antiquaries Journal,* 53**,** 9-13.

BOWEN, H. C. & SMITH, I. F. 1977. Sarsen Stones in Wessex: the society's first investigations in the Evolution of the Landscape Project. *The Antiquaries Journal,* 57**,** 185-196.

BUCHANAN, R. A. 1969. The National Record of Industrial Monuments. *In:* COSSONS, N. & HUDSON, K. (eds.) *Industrial Archaeologists' Guide 1969-70.* Newton Abbot: David and Charles.

BUCHANAN, R. A. 1971. The National Record of Industrial Monuments. *In:* COSSONS, N. & HUDSON, K. (eds.) *Industrial Archaeologists' Guide.* Newton Abbot: David and Charles.

CLOUGH, T. H. M. & CUMMINS, W. A. (eds.) 1979. *Stone axe studies : archaeological, petrological, experimental and ethnographic.,* London: Council for British Archaeology.

CLOUGH, T. H. M. & CUMMINS, W. A. (eds.) 1988. *Stone axe studies, volume 2. The petrology of prehistoric stone implements from the British Isles.,* London: Council for British Archaeology.

CUNLIFFE, B., COLES, J. M. & BOWEN, H. C. 1972. Proposal for sponsorship of a scheme of research by The Society of Antiquaries of London. Society of Antiquaries of London archive: MS953/1/1: Society of Antiquaries of London.

FIELD, D. 2005. Some observations on perception, consolidation and change in a land of stones. *In:* BROWN, G., FIELD, D. & MCOMISH, D. (eds.) *The Avebury Landscape. Aspects of the field archaeology of the Marlborough Downs.* Oxford: Oxbow Books.

GILLINGS, M. & POLLARD, J. 1999. Non-portable stone artefacts and contexts of meaning: the tale of Grey Wether (www.museums.ncl.ac.uk/Avebury/stone4.htm). *World Archaeology,* 31**,** 179-93.

GILLINGS, M. & POLLARD, J. 2016. Making Megaliths: Shifting and Unstable Stones in the Neolithic of the Avebury Landscape. *Cambridge Archaeological Journal,* 26**,** 1-23.

GILLINGS, M., POLLARD, J., WHEATLEY, D. & PETERSON, R. 2008. *Landscape of the Megaliths. Excavation and fieldwork on the Avebury monumnets, 1997-2003.,* Oxford, Oxbow Books.

GOWLAND, W. 1902. Recent Excavations at Stonehenge. *Archaeologia,* 58**,** 37-118.

GREEN, C. 2016. The exploitation of silcretes (sarsen and puddingstone) in England and Normandy since Stonehenge. *Proceedings of the Geologists' Association,* 127**,** 349-358.

IXER, R. A. & BEVINS, R. E. 2010. The petrography, affinity and provenance of lithics from the Cursus FIeld, Stonehenge. *Wiltshire Archaeological and Natural History Magazine,* 103**,** 1-15.

IXER, R. A. & BEVINS, R. E. 2011a. Craig Rhos-y-felin, Pont Saeson is the dominant source of the Stonehenge rhyolitic 'debitage'. *Archaeology in Wales,* 50**,** NNN-NNN.

IXER, R. A. & BEVINS, R. E. 2011b. The detailed petrography of six orthostats from the Bluestone Circle, Stonehenge. *Wiltshire Archaeological and Natural History Magazine,* 104**,** 1-14.

IXER, R. A. & BEVINS, R. E. 2013. A re-examination of rhyolitic bluestone 'debitage' fromthe Heelstone and other areas within the Stonehenge Landscape. *Wiltshire Archaeological and Natural History Magazine,* 106**,** 1-15.

IXER, R. A. & BEVINS, R. E. 2016. Volcanic Group A Debitage: its Description and Distribution within the Stonehenge landscape. *Wiltshire Archaeological and Natural History Magazine,* 109**,** 1-14.

IXER, R. A., BEVINS, R. E. & GIZE, A. P. 2015. Hard 'Volcanics with sub-planar texture' in the Stonehenge Landscape. *Wiltshire Archaeological and Natural History Magazine,* 108**,** 1-14.

MORLEY DAVIES, A. & BAINES, A. H. J. 1953. A preliminary survey of the sarsen and puddingstone blocks of the Chilterns. *Proceedings of the Geologists' Association,* 64**,** 1-9.

OSBORNE WHITE, H. J. 1907. The Geology of the Country around Hungerford and Newbury. London: His Majesty's Stationery Office.

PARKER PEARSON, M., POLLARD, J., SCHLEE, D. & WELHAM, K. 2016. In search of the Stonehenge Quarries. *British Archaeology,* 146.

POLLARD, J. & GILLINGS, M. 2009. The World of the Grey Wethers. *In:* O' CONNOR, B., COONEY, G. & CHAPMAN, J. (eds.) *Materialitas. Working Stone, Carving Identity.* Oxford: Oxbow Books.

SARGENT, A. 2001. 'RCHME' 1908-1998. A History of the Royal Commission on the Historical Monuments of England. *Ancient Monuments Society,* 45**,** 57-80.

SHERLOCK, R. L. 1922. The Geology of the Country around Aylesbury and Hemel Hempstead. *Explanation of Sheet 238.* London: His Majesty's Stationery Office.

SOCIETY OF ANTIQUARIES OF LONDON 1974. Evolution of the Landscape, Wessex Pilot Scheme, News Sheet No.1 (23 February 1974). Society of Antiquaries of London.

SOCIETY OF ANTIQUARIES OF LONDON 1975. Sarsen Symposium. Evolution of the Landscape Project: News Sheet No. 2 (10 May 1975). Society of Antiquaries of London.

SUMMERFIELD, M. A. & GOUDIE, A. S. 1980. The sarsens of southern England: their palaeoenvironmental interpretation with reference to other silcretes. *In:* JONES, D. K. C. (ed.) *The Shaping of Southern England.* London: Academic Press.

THOMAS, H. H. 1923. The source of the stones of Stonehenge. *The Antiquaries Journal,* 3**,** 239-60.

ULLYOT, J. S. & NASH, D. J. 2006. Micromorphology and geochemistry of groundwater silcretes in the eastern South Downs, UK. *Sedimentology,* 53**,** 387-412.

ULLYOTT, J. S. & NASH, D. J. 2016. Distinguishing pedogenic and non-pedogenic silcretes in the landscape and geological record. *Proceedings of the Geologists' Association,* 127**,** 311-19.

ULLYOTT, J. S., NASH, D. J., WHITEMAN, C. A. & MORTIMORE, R. N. 2004. Distribution, petrology and mode of development of silcretes (sarsens and puddingstones) on the eastern South Downs, UK. *Earth Surface Processes and Landforms,* 29**,** 1509-1539.

SARSEN STONES IN WESSEX PROJECT: DATA TRANSCRIPTION STRATEGY, METHODOLOGY AND PROTOCOLS
for the creation of *WessexSarsens.xlsx*

Katy A. Whitaker, December 2017 (updated January 2019, archived May 2020)

k.a.whitaker@pgr.reading.ac.uk | 07769 712799 | @artefactual_KW
ORCID https://orcid.org/0000-0002-9391-8181

This work was authored during a *South, West, and Wales Doctoral Training Partnership* studentship held at the University of Reading, and is supported by the Arts and Humanities Research Council grant number AH:L503939:1.

Arts & Humanities Research Council

South, West & Wales Doctoral Training Partnership

University of Reading

Table of Contents

Summary

This document lays out decisions that were made in preparation for, and during, the transcription of record sheets from the Society of Antiquaries' *Sarsen Stones in Wessex* survey (archive collection MS953, Society of Antiquaries of London). It comprises the paradata for the transcription process resulting in the creation of the archived file *WessexSarsens.xlsx.*

It includes a brief introduction to that project and to the nature of the individual archive items that have been transcribed; general problems that applied to all of the archive records; and the methodology adopted to digitise the data by manual transcription.

This document is intended to be read in conjunction with the transcribed dataset with its ADS-compliant metadata table and alongside the ISAD(G)-compliant collection description, *WessexSarsensArchive.pdf.*

The Sarsen Stones in Wessex survey

The *Sarsen Stones in Wessex* survey was intended to be the pilot project of a more wide-ranging *Evolution of the Landscape* project, led by Fellows of the Society of Antiquaries of London (SAL). The purpose of the *Evolution of the Landscape* project as first sketched out was “to investigate the origins of the first organised landscape in Britain” (Bowen and Cunliffe, n.d., unpaginated memo). As the research proposal developed during 1972, the emphasis fell on “the emerging possibility of recovering the earliest patterns of regular land allotment”. The Wessex region had been identified as one of two possible study areas for the *Evolution of the Landscape* project because of its extensive, well-preserved, archaeological evidence for prehistoric land-use, including earthwork field systems with stratigraphic relationships. In addition, research already underway in the counties could support the essentially low budget, collaborative, approach espoused by the project’s proposers (Cunliffe et al., 1972).

As a pilot for what was intended to be the far broader landscape archaeology study, the *Sarsen Stones in Wessex* survey was planned as a detailed examination of one particular aspect of the landscape over the Wessex area. Beginning following a meeting held at Burlington House on 23 February 1974 (Society of Antiquaries of London, 1974b), the main objective was to record the location and characteristics of sarsens across Wiltshire, Dorset, and Hampshire (UK). This would enable, in theory, the mapping of sarsen distribution against evidence for neolithic and bronze age agriculture, alongside an assessment of the periods in which sarsens had been put to different uses. The overall aim was to understand what constraints these boulders had presented to the first farmers, and how they had been exploited as a mineral resource available in the (largely) chalk landscape of the three counties (Bowen and Smith, 1977).

An alternative proposal, discussed at the inaugural meeting, had been to study in detail all aspects of the historic and prehistoric landscape in one location of perhaps 40 square miles; but surveying the sarsen distribution presented the chance to evaluate the effectiveness of a volunteer workforce ‘crowd-sourcing’ data over the whole study area. This approach was espoused by Collin Bowen (Society of Antiquaries of London, 1974a), perhaps influenced by his experience of the long duration of investigation, by a necessarily small staff team, for the RCHME Dorset Inventory volumes on which he had worked for nearly 25 years.

It should be noted that there is no evidence in the project archive (MS953, Society of Antiquaries of London library) or in related papers kept in the Historic England Archive (SOA/03) that the project organisers had reviewed, in advance, the geological literature to establish the overall incidence of sarsen stone and other silcretes in southern Britain. Although in the first full iteration of the project proposal both Wessex and the Somerset Levels had been identified as suitable study areas in which to unpick the evolution of the landscape, by the time a pilot project was mooted Somerset had been dropped from the plans (Society of Antiquaries of London, n.d.). The choice of Wiltshire, Dorset, and Hampshire (but excluding the Isle of Wight) was driven not by the presence of sarsen and its use in prehistoric contexts (which reason might have encouraged the inclusion of other counties such as Kent, for example), but specifically because of the quality of the archaeological record in those three counties for thinking about prehistoric agriculture.

The recognition of this potential had been growing during the twentieth-century, in particular in the mind of the project's chief protagonist, Collin Bowen (Bowen, 1961), much of whose working life was focused on Dorset and who lived in Salisbury (Wiltshire). In addition, Bowen's co-convener Barry Cunliffe had started excavating at Danebury hill-fort (Hampshire), a project cited in the *Evolution of the Landscape* proposal as one of a number of active excavations in Wessex that might reasonably be expected to contribute relevant research results. Berkshire never seems to have been considered for inclusion, although in 1975 Leslie Grinsell wished that the sarsen survey be extended there, and to the Isle of Wight (Society of Antiquaries of London, 1975). The choice of three Wessex counties was for archaeological reasons, and perhaps also because of the particular familiarity with, and interests of, the organisers working in those areas. A sarsen stone survey was in effect a standalone project, but it was never meant to be one: the *Sarsen Stones in Wessex* survey was always intended to illuminate landscape change and in particular the development of farming.

Driven largely by Collin Bowen FSA, and reported on by him with Isobel Smith FSA (Bowen and Smith, 1977), the *Sarsen Stones in Wessex* fieldwork was carried out by volunteers from 1974. Interested parties were provided with blank recording forms, known as "Tally Cards", and brief instructions in the *Society of Antiquaries Evolution of the Landscape Project, Wessex. Information Sheet No.1* (Bowen and Smith, 1974). The volunteers then gathered information about silcretes – both sarsens and puddingstones – in areas of their choosing. County co-ordinators collected the completed forms and monitored overall coverage in their county. The data were on the whole gathered during field visits: but bibliographic references, personal communications, and other sources feature in the recording forms, providing records commonly for stones thought to have been sarsens but since lost (such as boundary markers, and stones mentioned in Anglo-Saxon charters). Not all the data were submitted on the project's "Tally Cards": homemade versions, postcards, and other documents were used not only by volunteers and the co-ordinators, but also by Bowen and Smith themselves (these are discussed in more detail below).

Initial results were reviewed in May 1975 at the *Sarsen Symposium* held in London: the fieldwork in Dorset was by then largely finished, whilst parts of Wiltshire and Hampshire were yet to be covered (Society of Antiquaries of London, 1975). By 1977 the organisers decided that enough data had been collected to warrant publication, resulting in a paper in the Society's journal (Bowen and Smith, 1977) and the deposit of archive material with the Society's library. This archive includes original "Tally Cards" and other records collected by the project volunteers; some of the transparencies and photographs that they took when making site visits; annotated maps; and publication archive such as the drawings, photographs, and small-scale mapping prepared for the paper.

Nevertheless, data collection continued in Hampshire. That county's records were returned to the co-ordinator, Reverend Peter Gallup, who continued to add information into the 1980s. He published a series of short reports in the Hampshire Field Club newsletter (including Gallup, 1975, 1977, 1994). The Hampshire archive material was not deposited in the Society of Antiquaries Library until 1993, transferred from the RCHME Salisbury Office by Mhairi Handley (see HSS01

Hampshire Sarsen Survey, Historic England Archive). The Dorset and Wiltshire records had been microfiched by RCHME, but although the Hampshire material had not been available for this copying process Bruce Eagles of RCHME ensured that a duplicate dataset was provided to Hampshire County Council. That is available in the county archive (reference 113M93) with data also copied to the planning department.

Brief timeline of the Evolution of the Landscape project and Sarsen Stones in Wessex survey

DATE	EVENT/DOCUMENT and archive source
Undated	*Proposal for a scheme to investigate the origins of the first organised landscape in Britain*, authored by HC Bowen and Professor Cunliffe. **MS953/1/1, Society of Antiquaries**
25 April 1972	*Proposal for sponsorship of a scheme of research by The Society of Antiquaries of London*, submitted by Professor Cunliffe, Dr Coles, and HC Bowen: a 6-page document sent by Bowen to FH Thompson, Assistant Secretary (SAL). **MS953/1/1, Society of Antiquaries**
9 August 1972	Memo to be sent by FH Thompson, Assistant Secretary (SAL) to attendees, forming a sub-committee of the SAL Research Committee "to consider the research project on the organisation of the landscape". **MS953/1/1, Society of Antiquaries**
March 1973	Bowen and Cunliffe (1973): a short paper in the *Antiquaries Journal* introducing two research projects sponsored by SAL; the Evolution of the Landscape project; and archaeological investigation of British churches.
20 December 1973	*Sarsens*: a memo from HC Bowen to Professor Atkinson, DJ Bonney, Dr R Bradley, GA Kellaway, and Dr IF Smith, proposing a project on sarsen stones in Hampshire, Wiltshire, and Dorset **SOA/03 File 18, Historic England Archive**
February 1974	*Society of Antiquaries Evolution of the Landscape Project, Wessex. Information Sheet No.1*: a sheet for distribution to volunteers to introduce the project, written by HC Bowen and IF Smith. **SOA/03 File 15, Historic England Archive**
23 February 1974	*Society of Antiquaries of London, Evolution of the Landscape, Wessex Pilot Scheme, News Sheet No.1*: the notes from the inaugural meeting of the Evolution of the Landscape project, including the proposal by HC Bowen to focus on sarsens in Wessex, the circulation of *Information Sheet No.1* and the first version of the sarsen recording form ("Tally Card"), with notes on other relevant projects and resources. **SOA/03 File 1, Historic England Archive**

10 May 1975	*Sarsen Symposium. Evolution of the Landscape Project: News Sheet No.2*: the notes from the Sarsen Symposium held at Burlington House, reporting on sarsen survey progress and issues/points of interest arising from the work completed by the date of the meeting. Outcomes included: archive material for three counties as the basis of a national sarsen record; a call to excavate sarsens; an exhibition of materials; a review of survey results; geological debate; folklore discussion; a proposal to move on to a parish boundary survey. **SOA/03 File 3, Historic England Archive**
May 1975	The Parish Boundary survey began in Dorset as the next volunteer-driven piece of work for the *Evolution of the Landscape* project.
30 November 1976	*Meeting with Dr Andrew Goudie and Mr Michael Summerfield at School of Geography, Oxford*: HC Bowen met with Goudie and Summerfield to discussion sarsen distributions in Britain and petrology (typescript notes). **SOA/03 File 6, Historic England Archive**
10 March 1977	*Wessex Linear Ditches*: HC Bowen provided a report on this sub-project of the *Evolution of the Landscape* project to the SAL Research Committee, including Parish Boundary survey progress. **MS953/1/1, Society of Antiquaries**
1977	Bowen and Smith (1977): Collin Bowen and Isobel Smith's report on the *Sarsen Stones of Wessex* project, published in the *Antiquaries Journal*.
29 November 1977	*Wessex Linear Ditches*: a memo from John Evans to FH Thompson, Assistant Secretary (SAL), describing outcomes of fieldwork and an account of the budget. **MS953/1/1, Society of Antiquaries**
before 28 February 1978	There had been a telephone conversation between HC Bowen and FH Thompson concerning the *Evolution of the Landscape* project. **MS953/1/1, Society of Antiquaries**
28 February 1978	Letter from HC Bowen to FH Thompson, requesting financial support for John Bailey (*Parish Boundaries project*, Dorset) and John Evans (*Wessex Linear Ditches project*), under the auspices of the *Evolution of the Landscape* project. **MS953/1/1, Society of Antiquaries**

10 March 1978	Letter from HF Thompson to HC Bowen and Barry Cunliffe communicating the results of the SAL Research Committee meeting held on 9 March 1978: expressing concern about the *Evolution of the Landscape* project; approving funding for John Bailey but not John Evans; and requesting clarity on the *Evolution of the Landscape* project. **MS953/1/1, Society of Antiquaries**
20 March 1978	Letter from John Bailey to FH Thompson, summarising the *Parish Boundary* project progress and outcomes. **MS953/1/1, Society of Antiquaries**
5 April 1978	Letter from HC Bowen to FH Thompson, summarising his views on the *Evolution of the Landscape* project. **MS953/1/1, Society of Antiquaries**
29 October 1981	Letter from John Bailey to FH Thompson, closing down the *Parish Boundary* survey. **MS953/1/1, Society of Antiquaries**
4 December 1981	Letter from FH Thompson to HC Bowen enquiring about methodology to analyse the *Parish Boundary* project data. **MS953/1/1, Society of Antiquaries**
30 December 1981	Letter from HC Bowen to FH Thompson recommending a short note be published in the *Antiquaries Journal* about the *Parish Boundary* survey. **MS953/1/1, Society of Antiquaries**
11 April 1983	Letter from John Bailey to FH Thompson including a two-page report on the Parish Boundary project and confirming that the dataset was archived locally in Dorset. **MS953/1/1, Society of Antiquaries**
1993	Bruce Eagles (RCHME) deposited a duplicate of the Hampshire archive material from the Sarsen Stones of Wessex project with Hampshire County Council, whilst his colleague Mhairi Handley returned the original material to the Society of Antiquaries. **HSS01 Hampshire Sarsen Survey, Historic England Archive**
1994	Gallup (1994) “The Sarsen Stone Survey” *Hampshire Field Club Newsletter*

Table 1 Key dates and archived documents, or published papers, for the Society of Antiquaries’ *Evolution of the Landscape* project.

Aim and objectives

AIM

To digitise data captured on paper record sheets by volunteers during the *Sarsen Stones in Wessex* survey, creating a digital dataset that is suitable for archiving and sharing through Open Access means (subject to any restrictions required by the data owner, the Society of Antiquaries), and which can form the basis of a future analytical dataset capable of being used in different contexts (for example, queried in a GIS environment or using a programming language such as R).

OBJECTIVE 1

Convert analogue, handwritten, data into digital data.

OBJECTIVE 2

Ensure that all datasets created are in an Archaeology Data Service (ADS) preferred file format with ADS-compliant metadata (http://www.archaeologydataservice.ac.uk/advice/guidelinesForDepositors.xhtml), and aligned with Research Council UK data management requirements for RCUK-funded research, http://www.rcuk.ac.uk/research/datapolicy/)

OBJECTIVE 3

Retain key identification data such that every digitised record can be mapped back to its originating analogue archive item in the *Sarsen Stones in Wessex* project archive (MS 953).

OBJECTIVE 4

Capture all of the information recorded by the project volunteers in order to reduce the handling demand on the original archive material.

Strategy

The data source: *Sarsen Stones in Wessex* "Tally Cards"

The item-level records for sarsens identified by the project's volunteers are "Tally Cards". These recording sheets contain the data collected by volunteers, predominantly during the 1970s. Although they are not catalogued to item-level within collection MS 953, those for Hampshire and Dorset are arranged by parish or place-name and have individual reference numbers, and in only a few instances has the same reference number been used more than once. The records for Wiltshire are organised differently, by Ordnance Survey 1:25,000 map sheet: hence groups of records are identified by the map sheet name and rarely by a unique identifier. The "Tally Cards" were drawn up specifically for the project, but the general concept and format of the paper field record, and the name, are likely to have been drawn from the RCHME practice of "Tally Cards" (described by Collin Bowen (1961, vii), Appendix B and C of *Ancient Fields*).

Each "Tally Card" records information about either a single sarsen, or a group of sarsens that for some reason were deemed by the recording volunteer to have an association. Examples of 'groups' include prehistoric monuments and sarsens in building fabric (commonly churches), but also small collections of sarsens used on verges or in garden features, for example. The few examples in the Hampshire and Dorset datasets in which one reference number was used for multiple records tend to be in areas with dense sarsen survivals, such as Portesham village (Dorset), where reference PRT6 was used to describe sarsens on the High Street, in buildings alongside and adjacent to the High Street, and in yards and gardens in the environs. Occasionally records were made for stones no longer extant, but thought to have been sarsens. Whilst a number of these examples are for stones recorded in Anglo-Saxon charters or other early documents recording boundaries, some volunteers speculated about the nature of monuments since replaced with more recent structures, such as Winchester's "Plague Stone" (MS953/3/2/1/W17f). This original data from the *Sarsen Stones in Wessex* project "Tally Cards" is required for digitisation.

None of the other archive material, such as committee meeting minutes, letters, notes, and so on, have been digitised: these remain in paper formats archived by the Society of Antiquaries including material in collections other than MS 953 (as do some duplicate and also original archive material, held by other repositories). Neither have the project's paper maps been digitised. These are in very poor condition and much of their information has been lost (see *WessexSarsensArchive.pdf*).

County	Tally Card: sarsens	Revised 5/74	Tally Card: sarsen JB	Handmade	Postcards	Other format	TOTAL
Hampshire	6	300	0	5	0	0	**311**
Dorset	41	5	86	0	0	1	**133**
Wiltshire	1	26	0	62	132	214	**435**
TOTAL	**48**	**331**	**86**	**67**	**132**	**215**	**879**

Table 2 Names given to the different formats of record sheet ("Tally Card") used by volunteers in the *Sarsen Stones in Wessex* survey, with frequency by type and county.

The project's "Tally Cards" come in a number of different formats (Table 2, Fig.1). There seems to have been an original version, called here "Tally Card: sarsens" after the title found towards the top left corner of each sheet. This recording form, on one side of paper, included eight broad categories of data collection. Each category was in fact comprised of a number of more-or-less discrete items of information, recorded by the volunteers in a semi-structured way without controlled language or mandatory fields. Data could be written anywhere on the sheet, with space for sketches and additional information on the reverse.

The "Tally Card: sarsen" sheet was replaced early on by a sheet called here "revised 5/74" (an additional title component added to the top left of the sheets). A substantial number of the records in the project archive are on this version of the sheet. It was a slightly more extensive recording form in which the broad recording categories had been broken down somewhat. Nevertheless, each category, apart from a few simple ones such as *county*, *parish*, *NGR*, still included information for a number of fields together. Neither did this sheet introduce controlled language nor mandatory data capture: and it was still on one page with small spaces to write in answers against the required headings.

Accordingly, information tended to be scattered over the page by the volunteers, including on the reverse or on continuation sheets. The problem of space on the sheets was raised on 16 June 1974 by John Bailey, the project's co-ordinator for Dorset, who wrote to Collin Bowen,

"As they are set out they leave no room for tidy entries relating to the different questions. Can I devise my own (using the exact wording of the original) but improving the spacing?"

In his reply of 20 June 1974, Bowen agreed. Bailey made a version with more space and used dotted lines to encourage volunteers to write information more consistently in the same location on the page, or even to use circles or strike-through to give specific replies to some of the questions. This version of the "Tally Card" is here called "tallycard:sarsensJB". As well as providing space in which to write answers more clearly against the required categories and headings, Bailey's version had the effect of controlling, to some extent, some of the possible answers. For example, under the heading 'Situation', seven options were given not as loose examples (as in the earlier record sheet) but as terms from which to select an answer, alongside a free-text "any other note" space.

None of these "Tally Cards" were supplied as copies duplicated from a Master document: each blank was typed to supply fresh sheets to volunteers. There are therefore some inconsistencies from sheet to sheet, with categories and questions missed out or placed in a slightly different location on the page. Occasionally the volunteer completing the sheet noticed a missing question and wrote it in themselves: at other times, not. Other versions of the recording forms include homemade sheets, on which the volunteer wrote out the required categories.

Postcards carrying small items of collected data, such as relevant bibliographic references, but no information for any of the other categories, are common especially in the Wiltshire dataset. Finally, "handmade" versions of the sheets (in which the headings were manually copied from typescript sheets onto other paper format), and other pieces of notepaper (both typed and manuscript) were collected. Needless to say, there is considerable variation in the visual quality of each record sheet – that is, the handwriting, ink, legibility, placement of text, and so on – as well as in the quality of the recorded content.

Available methodologies

Digitising this kind of archive material, beyond simply scanning sheets to create image files that can be saved and shared, presents such wide-ranging problems that these sorts of collections are rarely prioritised by Archive managers (Mike Evans pers.comm. 2017).[1] Handwritten documents are thus commonly under-utilised archive sources (Kearney and Wallis, 2015). Two general methodological approaches are available. The first is manual transcription of data from record sheets into a digital format such as a document file, spreadsheet, or database. The second is to scan pages (characterised as *off-line* handwriting, that is, having an analogue original source), process the resulting images using Optical Character Recognition (OCR) or Handwritten Text Recognition (HTR), ultimately creating a searchable file (see, for example, documents and books made available and searchable digitally through the Internet Archive, https://archive.org). An extension of HTR is to then apply an automated process to files, to identify and allocate discrete data packets into the fields of a spreadsheet or database.

OCR can be most readily applied to printed matter, converting an image of printed text into an editable text file. HTR is another form of pattern recognition using algorithms to convert the text image: as well as data-acquisition and pre-processing it requires *segmentation* (cropping to paragraphs, lines of text, or the individual words within) and *recognition* (feature extraction, and classification; that is, de-coding the visual features that match pre-learned forms of character shapes)

[1] This digitisation project was planned and undertaken before the Transkribus project (https://transkribus.eu/Transkribus/) platform for digital transcription of handwritten material became available. It would be highly instructive to trial transcription of *Sarsen Stones in Wessex* survey 'Tally Cards' with this new Handwritten Text Recognition system, given the records' variability and heterogeneity.

(Thorvaldsen et al., 2015, 10). Automatic processing of handwriting is fully reviewed by Plamondon and Srihari (2000), whilst a number of recent reviews deal with particular technological and computational approaches to HTR such as word-spotting in handwritten documents (Ahmed et al., 2017); evolutionary computing (Katiyar and Mehfuz, 2012); document image segmentation (Eskenazi et al., 2017); script identification (Sahare and Dhok, 2017). Despite recent research advances, off-line systems of handwriting recognition have limited accuracy for complex documents, and applications are more commonly restricted to texts with higher levels of prescription such as postal codes (Plamondon and Srihari, 2000). Transcription projects can of course be multi-modal, drawing on a mix of computerised and manually-completed tasks.

For a number of reasons, manual transcription was chosen to digitise the *Sarsen Stones in Wessex* project records. Reasons for this choice are outlined below.

Digitisation projects

Large-scale archive digitisation projects resulting in both digital images and searchable data have been possible for a number of years: examples such as the UK census records, maintained by The National Archives (2017) but made available digitally with commercial partners whose staff or contractors have transcribed the census entries, are widely familiar and well-used by, amongst others, family historians. Not only can images of original census pages be viewed online, but searches can be constructed through a public interface to locate individual census entries.

This ‘searchability’ is an essential element of the digitisation. Exercises that result in scanned images alone can at least make those images more widely available via the internet, but otherwise are extremely limited. An example is the scans of a set of record sheets compiled by Mike Pitts, recording morphological data and other characteristics of *c*2,000 neolithic stone axe heads and made available through the Implement Petrology Group website (http://implementpetrology.org/?page_id=3997). Whilst it is useful for researchers to be able to view these sheets without travelling to the Historic England Archive in Swindon (UK) where the originals are preserved, the online record does not include Pitts' coding or other metadata. This must therefore be accessed separately, from a pay-walled article (Pitts, 1996), in order to interpret the coding and understand the record for each axe head. The records are not searchable in any way online from the scanned images: master lists on the website provide a key to direct the researcher to each image file.

Projects analogous to the *Sarsen Stones in Wessex* survey, in which volunteer-completed, handwritten, record sheets had later been digitised to create searchable datasets, were sought to investigate possible approaches to transforming the "Tally Cards" into data that could be queried in different ways.

Defence of Britain Project

The Defence of Britain Project (DoB), led by the Council for British Archaeology from 1995, was a volunteer survey and recording project collecting data about surviving Second World War features in Britain (Archaeology Data Service, 2017). The project resulted in a large set of completed paper record sheets, accompanied by sketches and photographs, that are now archived in the Historic England Archive (DEB01), the archive of the Royal Commission in the Ancient and Historical Monuments of Wales, and of Historic Environment Scotland. Data from the sheets were transcribed by a small staff team based at the Imperial War Museum, Duxford. Like the *Sarsen Stones in Wessex* survey sheets, the DoB records are highly variable (Fig. 2) largely because of the limited training provided to volunteers. This variability extends to both the visual quality of each record (hand-writing, use of the recording sheet, inks, sketches and doodles, and so on) and the quality of the content (for example, errors in grid-referencing, more or less detailed descriptions, incorrect identifications of monument types).

It is this variability that required human intervention to digitise the records. For example, *Site Type* and *Place* were anticipated to be future researchers' likely main search criteria. The identification of *Site Type* by volunteers had been variable and, in some instances, unreliable. Without the introduction of controlled language, the digital records that would be sent to local authority Historic Environment Records as well as presented online as a national dataset, would not be searchable by *Site*

Type. To create the required consistency, *Site Type* was therefore indexed by the staff team from the nationally-accepted Historic England *Thesaurus of Monuments*. Accordingly, decisions had to be made about how to apply monument thesaurus terms from the controlled language list to the structures recorded by the volunteers (Archaeology Data Service, 2017). The transcription was therefore an iterative process, informed by the specialist knowledge and professional judgement of the staff team completing the work (Redfern pers.comm. 2017). Decisions had to be made on a record-by-record basis, interpreting the volunteers' descriptions of the sites that had been recorded to select the correct thesaurus term: something that a computer could not be trained to do.

War Memorials Register

The War Memorials Register, formerly known as the National Inventory of War Memorials, is maintained by the Imperial War Museum (IWM) (http://www.iwm.org.uk/corporate/projects-and-partnerships/war-memorials-register). Since 1989, volunteers have collected information about war memorials across the UK. The variation in war memorials is vast: as well as freestanding monuments on village and town High Streets and in churchyards, for example, they include an eclectic range of plaques and tablets, church furniture, buildings, parks and gardens, hospital wings and hospital beds, veterans' housing, and all manner of practical public and ecclesiastical amenities. There are thought to be *c*100,000 war memorials in the UK, of which *c*70,000 are recorded in the Register.

With such a wide geographical remit and having run for so many years, the project generated a large paper archive of volunteers' records, including photographs and ancillary material such as booklets, pamphlets, information about commemorated service personnel, dedication ceremony service sheets, and so on. The IWM needed to make this data publicly available, beyond welcoming visiting researchers to the museum's premises in London. The following account of how this was accomplished, and current practices, is based on information from Catherine Long, IWM (Long pers.comm. 2017).

At first an attempt was made to scan paperwork and apply OCR software to create digital documents: this “failed miserably” because so many different methods and formats had been used to record war memorials over such a long period of time. There are three variants of the memorial recording form, and over the years volunteers have also sent in notes on a variety of media. The next project involved mass scanning, and manual transcription of data from the resulting digital images by an overseas commercial provider. This had limited success and was cut short: again, the different types of record were problematical, and the transcribers’ unfamiliarity with the data caused problems. For example, when lists of personal names commemorated on war memorial surfaces were transcribed from the volunteers’ records, similar text from war memorial inscriptions and descriptions had been erroneously included: such as ‘A. Wreath’ interpreted as a personal name, from ‘…with a wreath carved on the front face of the plinth…’.

At the present time, digital records are created by manual transcription, with volunteers working both in the museum (using original paperwork) and at home (using scanned images). Decisions can be made about what data to transcribe, and which database fields to add this to. The quality of the data in the original records is deemed not good enough to relinquish control and use automated data capture processes: “the real difficulty is extracting the actual data required, and mapping it to the available fields” (Long, 2017 pers.comm.). Manual transcription also allows certain general principles to be applied to the process. These include, for example, not copying across data that are known to be wrong; and not digitising any irrelevant material (for example, the general history of the church at which a war memorial is located). In this way, greater consistency can be maintained in the digital database.

National Record of Industrial Monuments

The National Record of Industrial Monuments (NRIM) was created in the early 1960s when the Council for British Archaeology (CBA) engaged its members in a national industrial archaeology survey. Volunteers sent their completed record cards to either the CBA, or directly to Rex Wailes who was the Ministry of Works’ industrial archaeology consultant. By 1965 there was a pressing need to classify the data, copy the cards, and return the originals to the volunteers. The Bristol College of

Science and Technology (which became the Centre for the Study of History of Technology at Bath University of Technology, now the University of Bath) took on this co-ordinating role. Some 8,000 record cards were completed between 1963 and 1981: the policy was to return the originals to the volunteers whilst copies were kept by the CBA, RCHME, and the University. At the University, the cards were allocated unique reference numbers, and grouped and classified depending on the nature of the recorded feature(s) (Buchanan, 1969, 1971).

In 2011, the Historic England (then English Heritage) Archive started a project to capture data from the record cards, making new records (or supplementing existing records) in the National Record of the Historic Environment (NRHE) dataset. This involved creating both spatial data, to depict where possible the extent of the industrial feature(s) described on each card, and also textual information from the cards mapped to the existing fields of the digital monument recording system. A member of staff interpreted the record cards, with reference to existing NRHE records and to data from other sources such as published works. Each card was compared with the NRHE records to decide whether or not a new record was required, or if an existing record could be supplemented (Guiden, 2011).

This exercise also required human intervention, as described in the end-of-project report from which this summary is taken (Fitz-Gerald, 2012). Some sites recorded by the project volunteers were already recorded in the NRHE. In these instances, data might augment the record but the comparison had to be made first before deciding how to proceed. Other records did not qualify as monuments: volunteers had recorded features such as abandoned items of machinery in the countryside. These had to be weeded out of the exercise. Some records were so poor that it was impossible to understand what had been recorded, or where the feature was located, in order to verify the record. That was especially true of spatial data and the poor quality of national grid-reference recording, a problem that had been acknowledged by the University team at an early stage (Buchanan, 1971, 25). Finally, whilst the cards followed a standard format, both the visual quality and the quality of the recorded content varied considerably and a number of volunteers submitted additional information in non-standard formats (Buchanan, 1969, 12-13, 1971, 27). The cards therefore were not amenable to scanning, OCR/HTR, and automated capture of data into database fields, because of, for example, such a variety of handwriting and pen/ink weights, and the different ways that volunteers used the recording boxes in the cards (Fig. 3). This is despite the cards being more formally laid out than the *Sarsen Stones in Wessex* project record sheets.

In total, 1,995 new records were made and 1,607 existing records were amended, with reference to 6,097 cards. This illustrates an additional complication of the record cards. Some cards contained data that was transformed into more than one NRHE record, whilst other NHRE records were compiled from a number of separate cards. That each card did not map easily to one NRHE record was another factor requiring human intervention to complete the task.

National Bronze Implements Index

Although not compiled by volunteers working in the field, the British Museum's National Bronze Implements Index project has a number of similarities with the projects discussed above and the *Sarsen Stones in Wessex* survey records, and was therefore explored. The index is a large card catalogue recording textual information and sketches of British prehistoric metal artefacts. Arranged by drawers, the information recorded on the cards was recognised as an extremely important, but under-used, resource, only accessible at the British Museum until digitised through the *Micropasts* scheme (Bonnachi et al., 2015) (see for example http://crowdsourced.micropasts.org/project/flangedAxesA1/ to see examples of card images).

Despite the relatively regular layout of the index cards (like the NRIM cards), the decision was again made to manually transcribe the handwritten data: the *Micropasts* online platform has, however, been designed to crowd-source this activity from volunteers working remotely with reference to scanned images of the index cards. A number of factors contributed to this decision. The Index is *c*100 years old and has been added to and reclassified during that time, leading to a certain degree of variability in the records. The hand-writing, along with multiple annotations, small changes to the card layout, and different uses by the museum recorders over time, present problems for OCR. Human operation was therefore required to digitise the data, with people interpreting the cards and making decisions about how to transfer information to the structured fields made available on the *Micropasts* public interface. Each index card is transcribed more than once by different volunteers, so that comparisons can be made to resolve one final, acceptable, version of the data: until recently these duplicate datasets were compared manually by staff for every record, but some coding (using the programming language R) now makes it possible to compare line-by-line differences automatically, considerably reducing this laborious process (Wexler, 2017 pers.comm.).

Zooniverse

Created by a collaboration of UK and US organisations and managed by the Citizen Science Alliance, *Zooniverse*, like the British Museum's *Micropasts*, is a citizen-science platform (https://www.zooniverse.org). It was consulted because, amongst a wide range of projects, it allows archive-holding organisations to crowd-source data capture from older paper-based records. These records were, on the whole, created by official or scientific bodies, private individuals, or, in the case of ancient texts, authors of some of the earliest surviving documents in human history. Remote volunteers are encouraged to participate and at the time of writing (10 September 2017) there are 74 active projects online. Examples where volunteers are required to transcribed text and/or numeric data include:

Scribes of the Cairo Geniza
https://www.zooniverse.org/projects/judaicadh/scribes-of-the-cairo-geniza
Categorising c350,000 fragments of scrolls according to the script in which the text is written, prior to the future transcription of each surviving manuscript.

Weather Rescue
https://www.zooniverse.org/projects/edh/weather-rescue
Transcribing c2million textual and numerical data points from 3,500 printed record sheets of the Ben Nevis weather observatory (1883-1904).

Mutual Muses
https://www.zooniverse.org/projects/melissaagill/mutual-muses

Transcribing the manuscript correspondence of Lawrence Alloway and Sylvia Sleigh.

The range of *Zooniverse* projects enables a comparison to be made between manuscript and printed document digitisation. On the face of it, printed matter should be susceptible to automated digitisation through the application of OCR processes, yet there are *Zooniverse* projects working with such material that are nevertheless drawing on human intervention to manually transcribe the desired information: why is this? The *Weather Rescue* team, asking volunteers to transcribe numerals from printed pages, addresses this question head-on,

"We have tried some simple OCR and it has not worked well. Some of the images are quite distorted and humans are much better at reading those. We are also very concerned about accuracy and could not be confident that the OCR would be 100% accurate. We have successfully used OCR on some of the other details contained in the logbooks, but the weather observations need to be entered manually. If there are any OCR experts who would like to help us then we would be delighted - there are millions of other historical weather observations that need rescuing from all corners of the planet!" (Royal Meteorological Society, 2017b)[2]

The Getty Research Institute Special Collections Team managing the *Mutual Muses* project, which involves the transcription of the manuscript letters between critic Lawrence Alloway and artist Sylvia Sleigh that include sketches and mixed media, comment on the unsuitability of currently-available OCR processes for their material,

"At the moment, none of the OCR technologies available to us produce useful results from handwritten materials. The small number of typewritten documents in the archive also present difficulties for OCR because of their quality and the presence of handwritten annotations." (The Getty Research Institute, 2017b)

Illustrating some of the difficulties of working with manuscript material, the *Scribes of the Cairo Geniza* project asks its volunteers not (yet) to transcribe text from scroll

[2] New on Zooniverse in 2020, the *Rainfall Rescue* project is now requesting help from volunteers to manually transcribe handwritten records (https://www.zooniverse.org/projects/edh/rainfall-rescue/about/research)

fragments, but to recognise and categorise those fragments into Hebrew and Arabic script groups, in order to prepare for future transcription (University of Pennsylvania Libraries, 2017b). This activity is analogous to the sorting processes of archive projects described above, such as the *War Memorials Register* that requires the selection of appropriate curated items from which data are to be sourced; and the *National Record of Industrial Monuments* and *Defence of Britain Project* in which volunteers' records had to be compared with existing datasets and controlled language sets before data could be digitised.

Discussion

> "Even the neatest, most consistent handwriting resists OCR"
>
> (Kearney and Wallis, 2015)

Whilst this does not represent an exhaustive search of digitisation projects transforming manuscript archive material into digital data, the overwhelming message from conversations with archivists working with historic material in some of our national institutions is that current text recognition systems do not afford effective means to digitise handwritten material without considerable manual intervention at different stages in the process. Indeed, it has been difficult to find archive projects in which handwritten, highly variable, records have been digitised using solely computerised processes. Many recent projects to digitise historic data, from both handwritten and printed sources, have chosen to invest in manual transcription by staff and/or volunteers – such as the purpose-built *Micropasts* platform that enables organisations to present records for transcription by 'virtual volunteers' operating online.

It is notable that OCR, which for processing digitised printed text is "scientifically mature" (Thorvaldsen et al., 2015, 1), is mentioned by the archivists managing the projects described above (such as *Mutual Muses*, *Weather Rescue*, and the War Memorials Register) whereas HTR is not. Whilst this may be because of a conflation of these technologies in the minds of the project managers, HTR is nevertheless a younger data science tool which in the past ten years has at best been able to provide first draft transcriptions which must then be edited manually (Granell and Martinez-Hinarejos, 2017, 409).[3]

The projects described above share two principal characteristics: a great variety in the visual quality of the pages or index cards carrying desirable data, and variation in the quality of the content. The visual quality of volunteer-submitted material in the War Memorials Register caused problems during attempts to scan and apply OCR software to the variants of recording sheets and mixed media in the archive. This problem was also noted in the Defence of Britain project archive material, although in that instance an approach using OCR was not even considered. Although the layout of the index cards of both the National Record of Industrial Monuments and the Bronze Age Implements Index encouraged more regularised completion, both collections exhibit a similar visual variation with different scripts, pen/ink weights, occasional sketches, and other features requiring manual data transcription. Even typescript archive material, in the current *Weather Rescue* and *Mutual Muses* projects that might have been able to use the most up-to-date OCR/HTR software to create at least first digital drafts, has been subject to manual transcription because of problems caused by visual variability.

Whilst the visual quality of the archive material causes technical problems for digitisation, the variation in content quality is principally an issue for the correct allocation of reliable data to fields in a spreadsheet or database. Thus, both the Defence of Britain Project and the War Memorials Register required human intervention to select appropriate data from volunteers' records for the fields of their respective project databases. It is noteworthy that in both these examples, specialist knowledge had to be brought to bear on the records – it was not good enough, for example, to entrust digitisation of war memorial records to an outsourced data transcription company, whose staff did not understand the detail and context of the content.

Similarly, the requirement to integrate data from the National Record of Industrial Monuments index cards into an existing dataset (the National Record of the Historic

[3] Although now (2020) note the Trankribus project, see footnote 1.

Environment) required human intervention to interpret both the card content and existing NRHE records. In this instance, an approach using OCR/HTR was not considered and staff completed the transcription, using the appropriate expertise to interpret data and bring various corroborative sources (existing data, maps, bibliographic sources) to bear on the records. This interpretation is also necessary to recognise the difference between the Hebrew and Aramaic scrips being distinguished by the *Scribes of the Cairo Geniza* project. The variation in content within the sections of Bronze Age Implement Index cards, compared with the British Museum fields designed to capture data to make a new digital dataset from this historic material, also required human interpretation.

Conclusions

The *Sarsen Stones in Wessex* survey record sheets have a number of similarities with the recording sheets and index cards described above. The variability in visual quality of the project's "Tally cards" would make them very difficult to prepare for HTR by the necessary delimitation of specific fields for the software to locate data packets (segmentation), followed by the accurate extraction of characters that comprise the data required (recognition). This is true even for the slightly more regularised "tally card: sarsens JB" version of the record sheets. In far too few instances is the same class of data recorded in the same way, at the same location on the page, for this process to work. Combined with the variability in the content quality, including for example information not to be transcribed (personal data), and data requiring interpretation such as variably-recorded national grid-references (ranging from four- to ten-figure, recorded with and without 100km letter codes), these characteristics mean that manual transcription is the most viable option to digitise data from the "Tally cards".

Methodology and paradata

The *Sarsen Stones in Wessex* item level records – that is the "Tally Cards" in all their various formats – were selected for digitisation. The 311 records for Hampshire could be accessed either at the Society of Antiquaries of London library or through Hampshire County Council (HCC). The original sheets were chosen, and these were photographed during a day visit on 27 June 2017. Transcription was from these photographic images, and the Hampshire set was treated as a pilot exercise in order to identify problems and create protocols governing the transcription process.

The records for the Wiltshire and Dorset datasets had been microfiched by RCHME in 1980. The microfiche is kept by the Historic England Archive in Swindon (UK). As this location was more convenient for repeated visits than the Society of Antiquaries premises in London, the microfiche was used as the transcription source for those two counties. Additionally, this afforded access to uncatalogued RCHME archive material of relevance to the *Sarsen Stones in Wessex* survey, including, unexpectedly, 23 "Tally Cards" for Dorset found in the uncatalogued collection SOA/03: these had neither been microfiched nor returned to the Society of Antiquaries. Transfer of these 23 records to Society of Antiquaries has been arranged, so in anticipation that they will return to MS 953 the appropriate original reference numbers have been used here (Table 3).

SOA/03 File number	"Tally Card" type	Parish (name allocated by survey volunteer)	Allocated original reference number
25	tally card:sarsens	Winterbourne Whitechurch	MS953_2_1_WWH1
25	tally card:sarsens	Milbourne St Andrew	MS953_2_1_MSTA1
25	tally card:sarsens	Milbourne St Andrew	MS953_2_1_MSTA2
25	tally card:sarsens	Bere Regis	MS953_2_1_BR3
25	tally card:sarsens	Charlton Marshall	MS953_2_1_CHM2
25	tally card:sarsens	Charlton Marshall	MS953_2_1_CHM4
25	tally card:sarsens	Winterbourne Kingston	MS953_2_1_WKI1

25	tally card:sarsens	Wimbourne	MS953_2_1_WIM1
25	tally card:sarsens	Wimbourne	MS953_2_1_WIM2
25	tally card:sarsens	Wimbourne	MS953_2_1_WIM4
25	tally card:sarsens	Poole	MS953_2_1_POO2
25	tally card:sarsens	Sturminster Marshall	MS953_2_1_STM3a
25	tally card:sarsens	Sturminster Marshall	MS953_2_1_STM3b
25	tally card:sarsens	Kinson	MS953_2_1_KIN1
25	tally card:sarsens	Colehill	MS953_2_1_COH1
25	tally card:sarsensJB	Bournemouth	MS953_2_1_BTH1
25	tally card:sarsensJB	Bournemouth	MS953_2_1_BTH2
25	tally card:sarsensJB	Bournemouth	MS953_2_1_BTH3
25	tally card:sarsensJB	Bournemouth	MS953_2_1_BTH4
25	tally card:sarsensJB	Bournemouth	MS953_2_1_BTH5
25	tally card:sarsensJB	Bournemouth	MS953_2_1_BTH6
25	tally card:sarsensJB	Bournemouth	MS953_2_1_BTH7
25	tally card:sarsensJB	Corfe Mullen	MS953_2_1_CFM3

TABLE 3 Details of 23 *Sarsen Stones in Wessex* project original “Tally Cards” found in SOA/03 (Historic England Archive), showing the reference number allocated to each record during data digitisation.

It is acknowledged that “how a document is transcribed will depend on the intended audience and purpose of the transcription” (Kearney and Wallis, 2015). Digitising only a subset of the available data, with specific research questions in mind, would have been possible. A disadvantage of this approach is that the collection must be returned to and re-handled when those research questions develop, or if problems arise (problems of understanding and interpretation are especially likely given the complex and heterogeneous nature of the original project records). Furthermore, for a subset of data to be understood in context of the whole population, all the records and their observations are required. Dealing with these eventualities takes up time and affords further risks to the original archive materials.

The extremely heterogeneous nature of the original data makes it possible that future researchers may prefer to return to the original paper records for data to address their own research questions. Nevertheless, it is important to create data, paradata, and metadata in the spirit of Open Science for archaeology (Marwick et al., 2017) and to ensure that future researchers testing or re-using the digitised data can relate the records to the original paper archive held by Society of Antiquaries of London, as well as apply their own editing, data-cleaning, and analytical choices to a master dataset. Therefore, rather than transcribe only a limited number of fields, the general principle applied to all the transcription activity was to capture as much data possible in a master dataset intended for Open Access archiving (aligned with Research Council UK data management requirements for RCUK-funded research, http://www.rcuk.ac.uk/research/datapolicy/).

This decision was additionally influenced by both the Historic England Archive principle 'scan once, use many times' and also by Archaeology Data Service (ADS) principles (http://archaeologydataservice.ac.uk/advice/guidelinesForDepositors.xhtml). Excel was favoured over a text format, such as Microsoft Word, despite the text-heavy nature of the data, for a number of reasons. Excel worksheets can be saved and archived as .csv files which are more adaptable; both .xls(x) and .csv formats are preferred ADS formats; .csv files are usable with many applications (such as GIS) and in a number of programming languages for analysis purposes; and fields can be converted to text files if required for analysis by other digital humanities techniques.

A suite of digitisation protocols, outlined below, were established in the pilot exercise transcribing Hampshire data from the photographed sheets into Microsoft Excel format. These protocols were reviewed prior to transcription of the Dorset and then the Wiltshire data. However, such is the variability within each county dataset, depending on how the project's volunteers contributed their records, that an iterative process was taken. Accordingly, general principles applicable to all three components of the overall dataset were established, to govern the framework of the transcription process. Then, protocols specific to individual fields were established in response to the variation encountered within the archive collection.

On completion, the transcribed records were put through a quality assurance process to improve overall internal consistency in this highly heterogeneous data set (Fig. 4). The final dataset, *WessexSarsens.xlsx*, was then archived.

Whilst these paradata are presented in this document, metadata and paradata relating to the editing of the master dataset for later analytical purposes are archived and presented separately.

The resulting dataset is archived in the University of Reading Data Archive with kind permission of the Society of Antiquaries of London.

Digitisation protocols

The following sections describe the paradata of the transcription process. Various issues were identified when the *Sarsen Stones in Wessex* survey archive was assessed for digitising. These fall into two categories. **General** issues were common across the archived material and include problems about how to capture and present metadata about the records to future users. General principles to manage these issues were established and are outlined in Table 3 below. Specific problems concerned how to split the "Tally Cards" general categories into **individual fields**, and how to capture data in those fields. The issues, and the decisions that were made to solve problems or capture appropriate data/metadata, are outlined below in Table 4. These form the protocols that were followed in capturing data from all the project's archive records for Hampshire, Dorset and Wiltshire, regardless of the format/media in which they had been recorded by volunteers during the project's life. The protocols should be read in association with the metadata tables in file *WessexSarsens.xlsx*.

General

PROBLEM		**SOLUTION**
1	The project's records were made on a variety of "Tally Cards" and other media. This introduced considerable variability for the original volunteers to deal with, and results in variability in the data to be digitised.	Introduce a new field to the digitised dataset to indicate with what type of "Tally Card" or other media the record was made.

2	A number of information categories on each "Tally Card" are often left blank, but there is no indication why. For example, the answer to a question may have been 'no' but this was not actively recorded by the volunteer, or the required information may not have been available.	Always leave blank fields blank, rather than (mis)interpret the blank in a way that may not have been intended by the volunteer. Do not use <null> or other indicators in the Master dataset (empty cells can be identified in an analysis dataset, if required, during data cleaning and indicated there with an industry standard indicator such as NAN).
3	"Tally cards" may include more than one hand. It is often not clear who was responsible for which parts of the record, when data were added, or why.	Transcribe all the available text regardless of author.
4	There is considerable variation in the location of text on each "Tally Card". Sometimes recorded data matched to the required field, but at other times it is scattered over the page. Often data was recorded alongside one field despite looking like the answer to a different field.	The physical constraints of the project's "Tally Cards" are one of the principal reasons behind the inconsistency of the over-all record. Transcribe data into the field against which the text had been written, unless this makes no sense to later data analysis: for example, always transcribe an NGR to the NGR field, even if written by the volunteer in the Additional Notes field.
5	Occasionally, text written on a "Tally Card" has been crossed through. Reasons for the deletion are not given.	Respect the volunteer's intention to delete and do not transcribe this data.
6	Occasionally the "Tally Cards" include a sketch. These items cannot be transcribed into a dataset.	Introduce a new field to the digitised dataset to indicate the presence or absence of sketches.
7	Local authority data, when recorded, often pre-dates 1974 and current local authority boundary organisation. Some records were made and kept within one county although they belong to a different county.	Transcribe the county/parish/place-name information as given, and keep records grouped by the county given by volunteers/survey leaders (for example, records for Breamore and Dunbridge, in Hampshire, recorded from a bibliographic source in 'Wiltshire' dataset). New fields with present-day CDP data can be added to an edited analysis dataset if required.

8	NGRs were recorded by volunteers to varying degrees of tolerance. They are usually 6-figure and sometimes 8-figure, but can be only 4-figure or up to 10-figure. They often do not include 100km square letter pairs. Sometimes, when compared with other data in the record and OS mapping, the recorded NGRs do not appear to relate well to the described information.	There are numerous ways that recorded NGRs could be incorrect compared with the actual location of the stone(s) being described by the volunteers. It is inappropriate to try to second-guess volunteer intentions or recording accuracy. Transcribe the NGRs as given. New fields with cleaned absolute NGRs can be added to an analysis dataset, including a new field indicating the tolerance of the original NGR. Alternative NGRs may be added, if appropriate and necessary, to any given row, to an edited analysis dataset.
9	Mensuration is usually in Imperial measures that are difficult to analyse in digital formats.	Retain original measurements in the Master dataset. New fields with metric mensuration can be added to an edited analysis dataset if required.
10	Some individual "Tally Cards", postcards *etc* record not just a single sarsen or one group of sarsens, but groups of stones in more or less close proximity. They thus represent a type of multiple record with only one parish reference number (e.g. in Dorset, PRT6). Other volunteers would have recorded one group per "Tally Card", allocating a new parish reference number each time (as common in Hampshire). The records thus include data that should map to more than one row in a spreadsheet/database tables and cannot easily be digitised in one aggregated row.	Transcribe data such that one "Tally Card" has one spreadsheet row. If this is not possible, split the record but repeat the *original_ref* allocated by the Sarsen Stones in Wessex project. This will result in some duplicate references in this field, but provides a direct identifying link to the original archive material. Record these split records here: <u>Hampshire</u> MS953/3/2/1/F13h <u>Dorset</u> MS953_3_2_1_PRT6 MS953_3_2_1_PRT7 <u>Wiltshire</u> MS953/4/1/ST93 (Codford, Stockton) MS953/4/1/SU05 (Urchfont)

		MS953/4/1/SU06 (Vale of Pewsey, Avebury Trusloe, Beckhampton, Cherhill, Bishops Cannings) MS953/4/1/SU07 (Berwick Bassett, Cherhill, Yatesbury, Clyffe Pypard, Hilmarton, Winterbourne Bassett, Winterbourne Monkton) MS953/4/1/SU12 MS953/4/1/SU13 MS953/4/1/SU14 (Durrington, Bulford, Amesbury, Figheldean) MS953/4/1/SU14/78 (Amesbury) MS953/4/1/SU15/18, 19, 21, 22, 23 (Charlton) MS953/4/1/SU15/9, 12 (Wilsford) MS953/4/1/SU15/30 (Pewsey) MS953/4/1/SU16/75 (Alton) MS953/4/1/SU16/88 (Milton Lilbourne) MS953/4/1/SU16/155 (Fyfield) MS953/4/1/SU16/84 (Wootton Rivers) MS953/4/1/SU16/82, 92 (Wilcot; Draycot, Oare) MS953/4/1/SU17/163 (Chiseldon) MS953/4/1/SU18 (Chiseldon, Swindon, Wroughton, South Marston) MS953/4/1/SU16/102 (Woodborough) MS953/4/1/SU26/213 (Mildenhall) MS953/4/1/SU27 (Wanborough; Popplechurch) MS953/4/1/SU27/235 (Baydon) MS953/4/1/SU28 (Bishopstone/Wanborough) MS953/4/1/SU28/246 (Bishopstone; Hinton Parva) Allocate a new unique identifier field in an edited analysis dataset.

11	"Tally Card" categories include main questions and sub-questions, or required more than one separate items of information to be captured together (for example, "Shape and Size").	Split out individual fields. See Table 4.
12	The "Tally Card" category 'Group' [of sarsens] was often used by volunteers to indicate a number of stones in individual buildings (e.g. walls, foundations). This is an awkward use of the category more intended for spreads or scatters of stones, and often does not include a count of how many in the 'group'.	Create a new category 'building', with number of stones '1', to distinguish between the volunteers' use of the recording categories 'single' and 'group'. This new category can therefore be symbolised effectively in GIS visualisations and identified in general summaries of the overall project results.
13	Fields in the Master dataset must be based on the maximum range of categories in the "Tally Cards", but the variety in versions of "Tally Cards" mean that some fields were not available to some of the recorders. Nevertheless, some volunteers realised this and included relevant data on their sheets, commonly written in blank space on the page.	Transcribe data from shorter "Tally Cards" and other media into the relevant matched field. If notes are not a clear match, transcribe information about sarsen fabric to the 'other comments' field; and other information to the 'additional notes' field.
14	Occasionally personal data other than the volunteer's name was recorded, e.g. property owner and address, telephone numbers.	Do not transcribe personal data other than name. Only include property name/address (without owner) if this is the location information for the record.
15	Occasionally "Tally Cards" include text including speculation and reasoning explaining a sarsen's location/use.	Transcribe all data. This is relevant to the context and framing of the project, and may be amenable to textual analysis methods.
16	Transcription into a spreadsheet is not the best way to handle lengthy text elements. The variability of volunteers' recording on the page means that some text elements from different locations need to be transcribed to the same spreadsheet field. However, cells should contain only one data point.	Divide text elements sharing a cell with [;] (see Micropasts precedent). This will enable text elements to be split into separate columns in an analysis dataset if required.

17	Difference in the layout of the main “Tally Cards” used by the volunteers resulted in some classes of data being recorded on one area of a page in one county, but under a different heading in another county. In transcription, this means that the same classes of data may be put into different fields.	The physical constraints of the project’s “Tally Cards” are one of the principal reasons behind the inconsistency of the over-all record. Transcribe data into the field against which the text had been written, unless this makes no sense: for example, always transcribe an NGR to the NGR field, even if written by the volunteer in the Additional Notes field (see **[4]** above).
18	Some “Tally Cards” are duplicate records, where a volunteer submitted both interim and final sheets, or a final sheet with additional paperwork.	Where it is clear that there are duplicate records, combine data from the parallel sheets into one record identified by the project reference number for the uid. Record these here: Hampshire “Bydean” to Froxfield F13h as for Woodmancote
19	Some sarsens were recorded more than once, by different volunteers. There are thus two “Tally cards” with one reference number i.e. duplicate records but, unlike **[18]**, were created by different authors.	Where it is clear that there are duplicate records for the same reference number, combine data from the duplicate sheets into one record identified by that project reference number. Include the second author name in column ‘name02’ or ‘name03’ as appropriate. Record these here: Dorset MLH1 PDT3 PDT6 TUP1 Wiltshire MS953/4/1/SU06/106 MS953/4/1/SU13 (Amesbury, Durrington) MS953/4/1/SU14 (Fittleton; Haxton Down) MS953/4/1/SU18 (Wanborough)

		MS953/4/1/SU25 (Collingbourne Kingston; Fittleton) MS953/4/1/SU25 (Collingbourne Kingston; Fairmile Down, Collingbourne Ducis) MS953/4/1/SU25/208
20	Some text is illegible.	Indicate illegible text with […] (see Micropasts precedent).

Table 4 General issues arising from volunteer recording practices for the *Sarsen Stones of Wessex* survey.

Individual fields

The most frequent, and most extensive, of the *Sarsen Stones in Wessex* printed volunteer recording sheets were those identified here as “Revised 5/74” and “tally card: sarsensJB”. These versions included the greatest number of categories of information to be captured by the project volunteers and thus form the basis of the transcribed fields. The table below outlines how the categories were split into fields, and decisions made about which data to transcribe into these fields. It should be read in conjunction with the metadata tables in file *WessexSarsens.xlsx*.

	“Tally card” category	**FIELD NAME**	**PROTOCOL**	**FORMAT/allowed terms** (null cells allowed unless indicated otherwise)
1	[null]	original_ref	Reference numbers were allocated to Hampshire and Dorset “Tally Cards” during the *Sarsen Stones in Wessex* project. The Wiltshire records were collated in numerical sequence by each OS 1:25000 map sheet covering the county (e.g. SU35) with some, but not all, records additionally given a running number suffix. Records may have been placed in incorrect parishes or map-sheet groups. In archive terms these references are analogous to	e.g. <MS953_3_2_1_A2a> <MS953_2_1_WTA3> <MS953_4_1_SU35> <MS953_4_1_SU35_255> <no_reference>

			ISAD(G) item level references, although they are not necessarily unique identifiers. Use the Society of Antiquaries' collection, fonds, and series references with the allocated reference number to create an identifier for each data row. Any records without a reference, use <no_reference>.	
2	[null]	card_type	Indicate the type of "Tally card" on which the data was recorded	<revised5_74> <tallycard_sarsens> <handmade> <tallycard_sarsensJB> <postcard> <other>
3	County (Old/New)	county	Indicate which of the three counties the data is from. This location data relates to the dataset as organised by the volunteers and survey leaders, not necessarily the actual (old or present-day) administrative area boundaries. This means that records may be grouped into a county despite falling outside that county boundary.	<Hampshire> <Wiltshire> <Dorset>

4	Parish	parish	The parish name as identified by the volunteer.	transcribe the name
5	[null]	place_name	Occasionally a volunteer recorded a place-name in addition to a parish name. If a place was identified, transcribe this additional data.	transcribe the name
6	Utilised/Not Utilised	utilised_notutilised	Volunteers were required to indicate by deletion whether or not a sarsen had been used for something: record which phrase was not deleted. Sometimes neither phrase was deleted: if the record makes it clear, choose the appropriate phrase; otherwise, leave blank. Leave blank in records made on other “Tally card” versions that did not ask the question.	<utilised> <not_utilised>
7	1. Group or single	group_single	Record which word, if either, was selected by the volunteer. Where a building was recorded as ‘group’, or an artefact as ‘single’, use the appropriate new term.	<group> <single> <building> <artefact> this cell cannot be null

8	[null]	number	The number of sarsens in a group was not a required field on the “Tally cards” but volunteers made counts. Record the number in the count. If [7] = <building> use ‘1’. If [7] = an uncounted/innumerable group use ‘99’.	A numerical value: this cell cannot be null
9	Whether in situ (reason if not?)	in_situ	A text comment about the location, disposition, and use of the sarsen(s), often restricted to a Yes/No answer but sometimes more extensive or descriptive. Transcribe this information.	transcribe the text
10	2. Any name (block letters)	name	This appears to have been intended to capture folk names by which stones were known, but was most commonly used by volunteers to capture address elements describing a sarsen’s location. See [14] in Table 1: transcribe location information but not personal data.	transcribe the text

11	3. Position: to be marked on map and elaborated in diagram, overleaf	position	Commonly text describing an address or general location, but including descriptions and sketches. Use field **42** to indicate the presence of a sketch.	transcribe the text
12	NGR	NGR	National grid references, recorded to varying tolerances and accuracy, with often more than one NGR when groups of sarsens were being described (see [8] in Table 1 above). Transcribe NGRs as given, separate multiple NGRs with [;]	transcribe the text
13	Bedrock	bedrock	If recorded, a rock type, selected by the volunteer. Transcribe the text and do not correct to current BGS record for the location.	transcribe the text
12	Drift	drift	If recorded, a superficial deposit type, selected by the volunteer. Transcribe the text and do not correct to current BGS record for the location.	transcribe the text
13	Height above OD	height_OD	If recorded, a value given in feet or metres. Transcribe the information given and do not correct against OS mapping.	A numerical value

14	Situation (e.g. hill-top, valley; hedgerow, road verge; incorporated in wall or building etc)	situation	A textual description of the topographical situation of the recorded sarsen, but encompassing aspects of location and use. This was commonly used for further or duplicate location/address information. Transcribe the information given.	transcribe the text
15	Description: (i) type of rock	rock_type	Occasionally volunteers used a geological term to indicate a specific rock type for the recorded sarsen. If given, record the term in this field.	<puddingstone> <sarsen> <sandstone> and other rock-types allowed
16	(a) only sand grains visible	only_sand	This was probably meant to be a Yes/No record. It was little used by the volunteers and sometimes is no more than a tick. For a tick, use 'yes'. Transcribe any other text.	<yes> and other text allowed
17	(b) also contains small pink or white quartz pebbles: angular or rounded:	quartz_pebbles	An interest in the presence of quartz pebbles in sarsens seems to have come from Geoffrey Kellaway's interest in the project (see e.g. Society of Antiquaries of London, 1975). Volunteers were asked to look for quartz pebbles in the rock. This was rarely completed. For a tick,	<yes> <no> and other text allowed

			use ‘yes’. Transcribe any other text.	
18		quartz_form	Along with the presence of quartz volunteers were asked to indicate pebble form, presumably to inform Kellaway’s interpretation of southern British glaciation and sarsen formation processes. Transcribe the text. If this form descriptor is completed even though the volunteer did not indicate ‘yes’ for quartz presence [17], add ‘yes’ to [17].	<angular> <rounded> and other text allowed
19		flint_pebbles	Volunteers were asked to look for flint pebbles in the rock. This was rarely completed. For a tick, use ‘yes’. Transcribe any other text.	<yes> <no> and other text allowed
20	(c) contains flint pebbles: angular or shattered or rounded: colour of pebbles:	flint_form	Volunteers were asked to indicate flint form. Transcribe the text. If this form descriptor is completed even though the volunteer did not indicate ‘yes’ for flint presence in [19], add ‘yes’ to [19].	<angular> <shattered> <rounded> and other text allowed
21		flint_colour	Transcribe the text, if used.	transcribe the text

22	(d) other comments	other_comments	Volunteers could add extra notes about the rock being recorded. Transcribe the text, if used. Use this field to capture information on the nature of the rock that have been written out of position on the “Tally card”.	transcribe the text
23	(ii) size and shape (noting if over 6ft long, with sketch, overleaf; for a group, note size of largest)	size01	This was interpreted in a number of different ways by volunteers. Use this field to capture simple text descriptors (adjectives).	<small> <medium> <large> <boulder> and other text allowed
24		size02	This apparently simple category of information was interpreted in a number of different ways by volunteers. Use this field to capture metric dimensions, and other complex textual comments about size (for example, where groups are described).	transcribe the text
25		L	Sometimes volunteers recorded, or estimated, sarsen size. This is usually an Imperial measurement. Record the longest measurement, in inches.	A numerical value in inches
26		l	Sometimes volunteers recorded, or estimated, sarsen size. This is usually an Imperial measurement.	A numerical value in inches

			Record the intermediate measurement, in inches.	
27		S	Sometimes volunteers recorded, or estimated, sarsen size. This is usually an Imperial measurement. Record the shortest measurement, in inches.	A numerical value in inches
28		shape	Various terms were used to define shape. Transcribe the text, if used.	transcribe the text
29	(iii) if group, density	group_density	This information was very rarely recorded. The category was occasionally used to record how many sarsens were present in a group, but not a ratio of stones/area. Transcribe the text, if used. If a numerical value was recorded here describing a group, transfer the number to field [8].	transcribe the text
30	(iv) conditions (e.g. apparent nature of bedding; weathering of surface; covered with algae etc)	conditions	This category was interpreted in a number of different ways by volunteers, and not often used. Transcribe the text, if used.	transcribe the text
31	(v) evidence for use, splitting, smoothing, etc	use_evidence	This category appears to have been targeted towards identifying any prehistoric evidence for sarsen-working	transcribe the text

			beyond Stonehenge, but was not explained. Hence, volunteers tended to use it to indicate any possible signs of splitting. Although rarely used, information in this category sometimes contradicts the volunteer's use of [6]. Transcribe the text, if used.	
32	(vi) relationship (e.g. to fields, ancient or modern)	relationship	Intended to record any physical relationship, this category was rarely used, or duplicated/augmented address data. Transcribe the text, if used.	transcribe the text
33	5. Air photographs consulted	air_photos	This category was very rarely used. Transcribe any image reference numbers given. If ticked, use 'yes'.	<yes> and other text allowed
34	Photographs taken	photographs	Few images seem to have been taken overall by the volunteers and this category was used very variably. If ticked, use 'yes'. If a list of photographs was noted, use 'yes'. Transcribe other text, for example, image reference numbers, if used.	<yes> and other text allowed

35	6. Additional notes	additional_notes	This is a very heavily used category, with a multiplicity of information captured by the volunteers including opinion and surmise, bibliographic references and quotations, excavation data, more detailed descriptions and sketches etc. Transcribe the text, if used. Use this field for other information written onto the "Tally card" that is not clearly attached to another category (e.g. notes on card reverse).	transcribe the text
36	7. Name of recorder (printed)[4]	name01	The recorder name was not always noted. Transcribe the name noted here.	<surname> <initial_surname> <initial_initial_surname>… <organisation acronym>
37		name02	Sometimes volunteers worked together to make a record. Transcribe the second name here.	<surname> <initial_surname> <initial_initial_surname>…

4 Redacted from the archived dataset in compliance with GDPR.

38		Name03	Sometimes volunteers worked together to make a record. Transcribe the third name here.	<surname> <initial_surname> <initial_initial_surname>…
39	[null]	data_source	Volunteers made site visits, but also captured data from other sources. Where it is clear from the “Tally card”, indicate the source here. Use ‘knowledge’ when the volunteer was recording their reminiscence or local historical information. Leave blank if uncertain. Although this involves making some assumptions, it is useful when making a broad assessment of the course of the project.	<visit> <bibliographic> <perscomm> <knowledge>

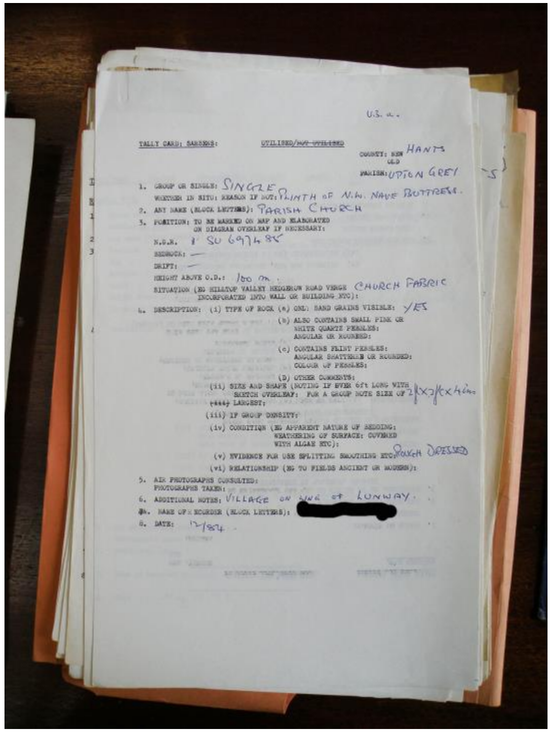
40	8. Date	date	The date that the record was made was not always noted, and if recorded is commonly month and year only. Whilst date should be recorded in a spreadsheet with its elements in separate columns, this Master dataset collates date and allocated a date-flag (because of this variability). Record date in the appropriate date format and use field [40] to indicate tolerance.	<DD/MM/YYY> <MM/YYYY> <YYYY>
41		date_qualifier	A date flag indicating the tolerance of the date recorded by the volunteer.	<1> = DD/MM/YYYY <2> = MM/YYYY <3> = YYYY <4> = no date recorded this cell cannot be null

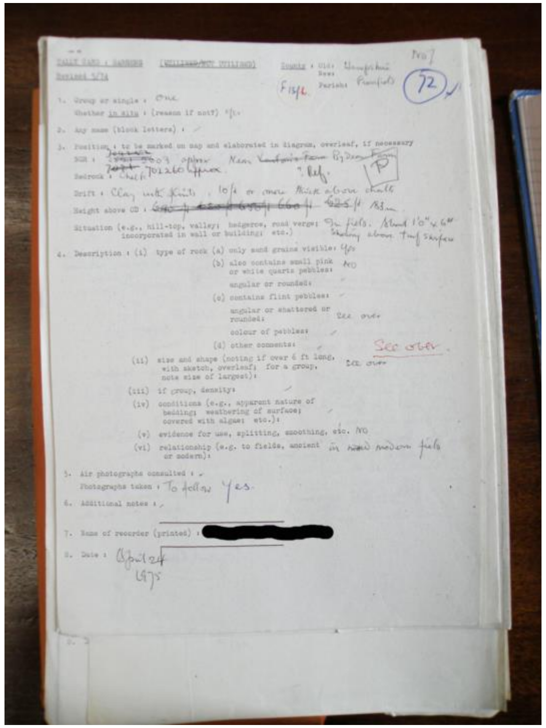
42	[null]	Extant	At the time of the record, was the sarsen(s) extant? Whilst not part of the original record, this new field is intended to be a quick way to indicate how many records related to extant stones, as opposed to records derived from reminiscence or e.g. charters, useful when making a broad assessment of the course of the project. For the few examples where the “Tally card” does not include enough information to know, leave blank.	<yes> <no>
43	[null]	sketch	Often volunteers drew sketches of boulders, or maps. Indicate whether or not the record includes a sketch.	<yes> <no> this cell cannot be null

Table 5 *Sarsen Stones of Wessex* “Tally card” data categories mapped to fields in *WessexSarsens.xlsx*, field description, protocol for completion, and permitted field content.

Figures

Figure 1 Examples of *Sarsen Stones in Wessex* survey "Tally Cards" (by permission, Society of Antiquaries of London)





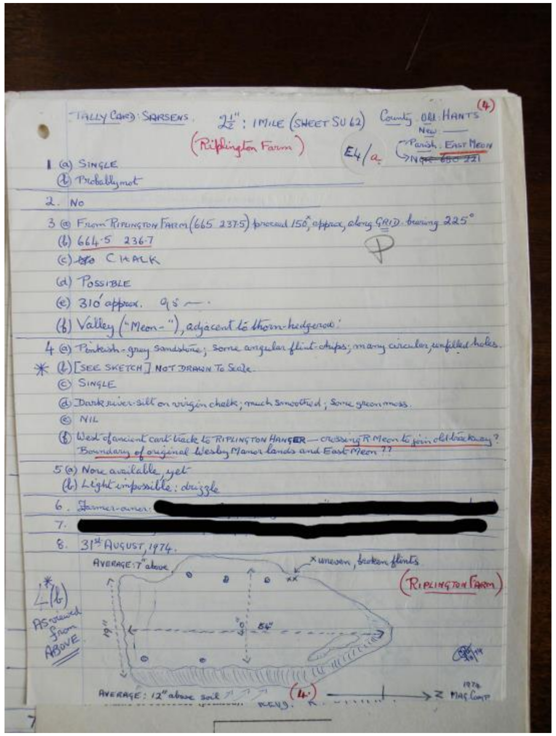
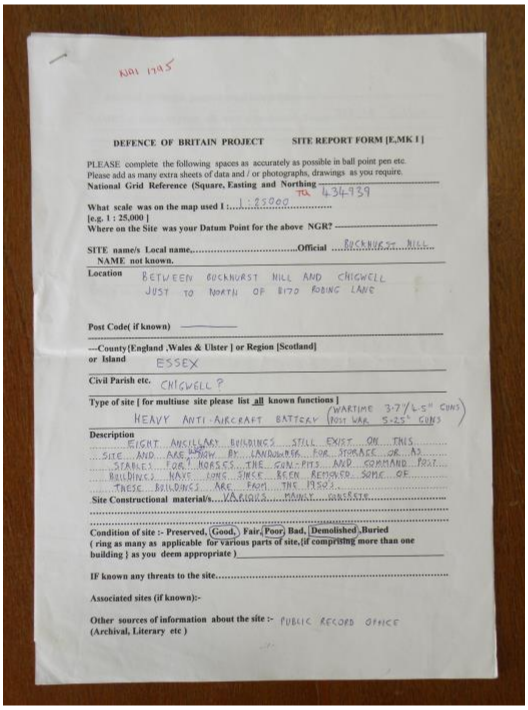


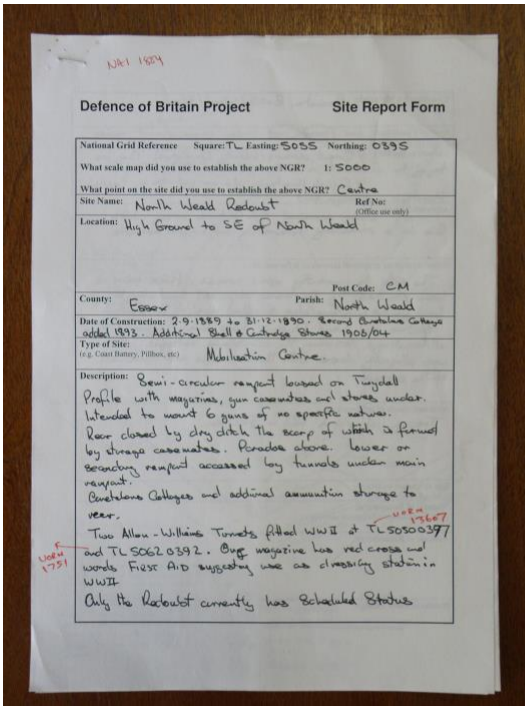
Figure 2 Defence of Britain project record sheets (Historic England Archive)



NAI 1795

DEFENCE OF BRITAIN PROJECT SITE REPORT FORM [E,MK I]

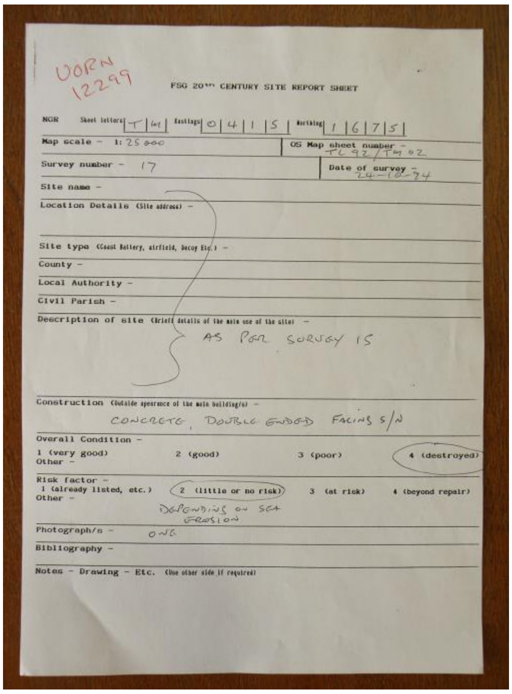
PLEASE complete the following spaces as accurately as possible in ball point pen etc.
Please add as many extra sheets of data and / or photographs, drawings as you require.
National Grid Reference (Square, Easting and Northing TQ 434939
What scale was on the map used I : 1:25000
[e.g. 1 : 25,000]
Where on the Site was your Datum Point for the above NGR?
SITE name/s Local name, Official BUCKHURST HILL
NAME not known.
Location BETWEEN BUCKHURST HILL AND CHIGWELL JUST TO NORTH OF B170 RODING LANE
Post Code(if known)
---County{England ,Wales & Ulster] or Region [Scotland] or Island ESSEX
Civil Parish etc. CHIGWELL ?
Type of site [for multiuse site please list all known functions] HEAVY ANTI-AIRCRAFT BATTERY (WARTIME 3·7"/4·5" GUNS POST WAR 5·25" GUNS)
Description EIGHT ANCILLARY BUILDINGS STILL EXIST ON THIS SITE AND ARE USED NOW BY LANDOWNER FOR STORAGE OR AS STABLES FOR HORSES. THE GUN-PITS AND COMMAND POST BUILDINGS HAVE LONG SINCE BEEN REMOVED. SOME OF THESE BUILDINGS ARE FROM THE 1950'S.
Site Constructional material/s VARIOUS MAINLY CONCRETE
Condition of site :- Preserved, Good, Fair, Poor, Bad, Demolished, Buried
(ring as many as applicable for various parts of site,{if comprising more than one building } as you deem appropriate)
IF known any threats to the site
Associated sites (if known):-
Other sources of information about the site :- (Archival, Literary etc) PUBLIC RECORD OFFICE



NAI 1884

Defence of Britain Project Site Report Form

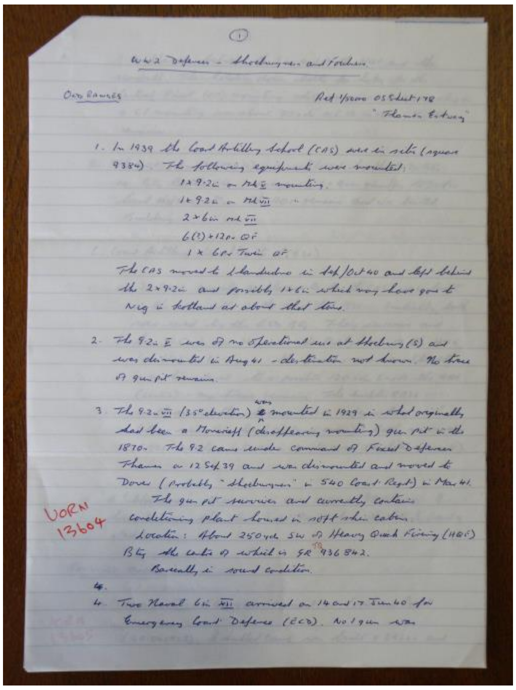
National Grid Reference Square: TL Easting: 5055 Northing: 0395
What scale map did you use to establish the above NGR? 1: 5000
What point on the site did you use to establish the above NGR? Centre
Site Name: North Weald Redoubt Ref No: (Office use only)
Location: High Ground to SE of North Weald
Post Code: CM
County: Essex Parish: North Weald
Date of Construction: 2·9·1889 to 31·12·1890. Second Caretakers Cottage added 1893. Additional Shell & Cartridge Stores 1903/04
Type of Site: (e.g. Coast Battery, Pillbox, etc) Mobilisation Centre.
Description: Semi-circular rampart based on Twydall Profile with magazines, gun casemates and stores under. Intended to mount 6 guns of no specific nature. Rear closed by dry ditch the scarp of which is formed by storage casemates. Parados above. Lower or secondary rampart accessed by tunnels under main rampart.
Caretakers Cottages and additional ammunition storage to rear.
Two Allan-Williams Turrets fitted WWII at TL50500397 (UORN 13607) and TL50620392 (UORN 1751). One magazine has red cross and words FIRST AID suggesting use as dressing station in WWII
Only the Redoubt currently has Scheduled Status



UORN 12299

FSG 20TH CENTURY SITE REPORT SHEET

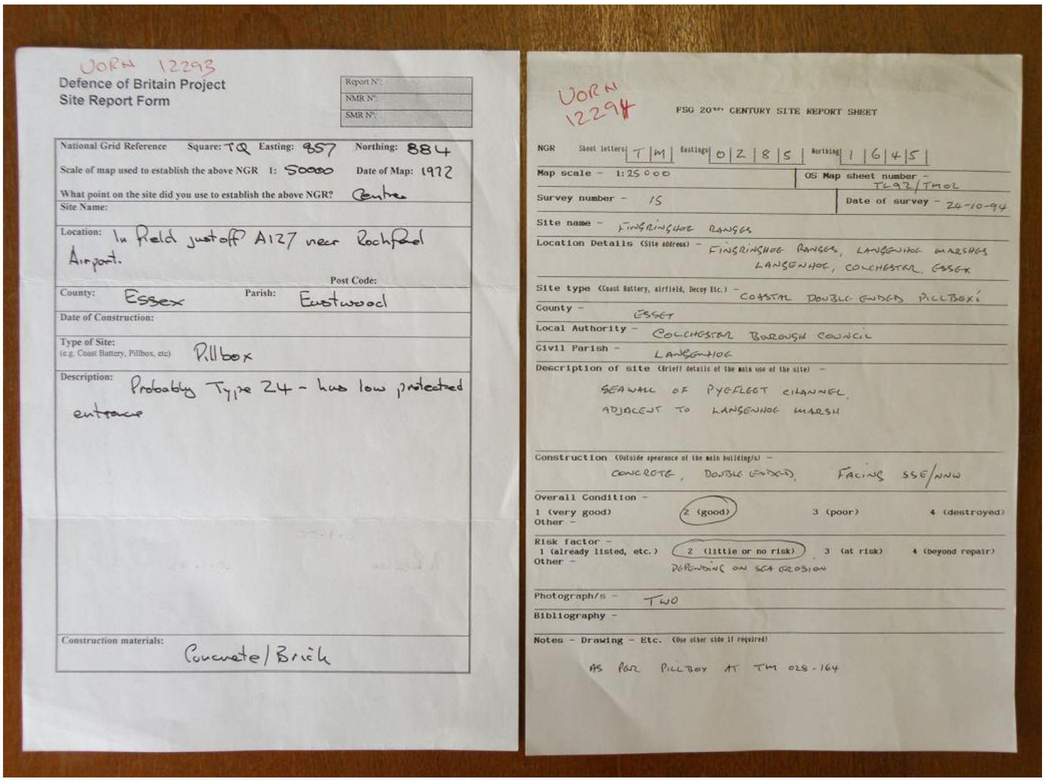
NGR Sheet letters T M Eastings 0 4 1 5 Northing 1 6 7 5
Map scale - 1: 25 000 OS Map sheet number - TL 92 / TM 02
Survey number - 17 Date of survey - 24-10-94
Site name -
Location Details (Site address) -
Site type (Coast Battery, airfield, Decoy Etc.) -
County -
Local Authority -
Civil Parish -
Description of site (Brief details of the main use of the site) - AS PER SURVEY 15
Construction (Outside apearance of the main building/s) - CONCRETE, DOUBLE ENDED FACING S/N
Overall Condition -
1 (very good) 2 (good) 3 (poor) 4 (destroyed)
Other -
Risk factor -
1 (already listed, etc.) 2 (little or no risk) 3 (at risk) 4 (beyond repair)
Other - DEPENDING ON SEA EROSION
Photograph/s - ONE
Bibliography -
Notes - Drawing - Etc. (Use other side if required)



1

1. In 1939 the Coast Artillery School (CAS) were in situ (square 9384). The following equipments were mounted:
2.
3.
4. Two Naval 6in VII arrived on 14 and 17 Jun 40 for Emergency Coast Defence (ECD).

UORN 13604



UORN 12293

Defence of Britain Project
Site Report Form

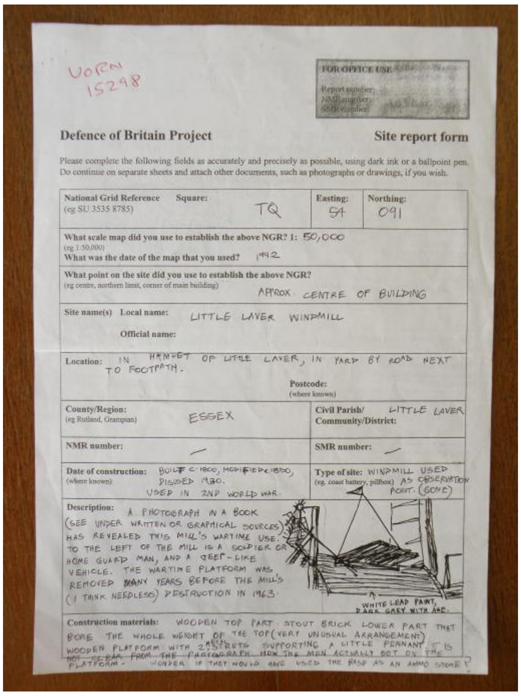
Report N°:
NMR N°:
SMR N°:

National Grid Reference Square: TQ Easting: 857 Northing: 884
Scale of map used to establish the above NGR 1: 50000 Date of Map: 1972
What point on the site did you use to establish the above NGR? Centre
Site Name:
Location: In field just off A127 near Rochford Airport.
Post Code:
County: Essex Parish: Eastwood
Date of Construction:
Type of Site: (e.g. Coast Battery, Pillbox, etc) Pillbox
Description: Probably Type 24 – has low protected entrance
Construction materials: Concrete / Brick

UORN 12294

FSG 20TH CENTURY SITE REPORT SHEET

NGR Sheet letters T M Eastings 0 2 8 5 Northing 1 6 4 5
Map scale – 1:25000 OS Map sheet number – TL92/TM02
Survey number – 15 Date of survey – 24-10-94
Site name – FINGRINGHOE RANGES
Location Details (Site address) – FINGRINGHOE RANGES, LANGENHOE MARSHES LANGENHOE, COLCHESTER, ESSEX
Site type (Coast Battery, airfield, Decoy Etc.) – COASTAL DOUBLE ENDED PILLBOX
County – ESSEX
Local Authority – COLCHESTER BOROUGH COUNCIL
Civil Parish – LANGENHOE
Description of site (Brief details of the main use of the site) – SEAWALL OF PYEFLEET CHANNEL ADJACENT TO LANGENHOE MARSH
Construction (Outside apearance of the main building(s)) – CONCRETE, DOUBLE ENDED, FACING SSE/NNW
Overall Condition – 1 (very good) 2 (good) 3 (poor) 4 (destroyed)
Other –
Risk factor – 1 (already listed, etc.) 2 (little or no risk) 3 (at risk) 4 (beyond repair)
Other – DEPENDING ON SEA EROSION
Photograph/s – TWO
Bibliography –
Notes – Drawing – Etc. (Use other side if required)
AS PER PILLBOX AT TM 028.164



UORN 15298

FOR OFFICE USE
Report number:
NMR number:
SMR number:

Defence of Britain Project Site report form

Please complete the following fields as accurately and precisely as possible, using dark ink or a ballpoint pen. Do continue on separate sheets and attach other documents, such as photographs or drawings, if you wish.

National Grid Reference (eg SU 3535 8785) Square: TQ Easting: 54 Northing: 091
What scale map did you use to establish the above NGR? 1: 50,000
What was the date of the map that you used? 1972
What point on the site did you use to establish the above NGR? (eg centre, northern limit, corner of main building) APPROX. CENTRE OF BUILDING
Site name(s) Local name: LITTLE LAVER WINDMILL
Official name:
Location: IN HAMLET OF LITTLE LAVER, IN YARD BY ROAD NEXT TO FOOTPATH.
Postcode: (where known)
County/Region: (eg Rutland, Grampian) ESSEX
Civil Parish/Community/District: LITTLE LAVER
NMR number: –
SMR number: –
Date of construction: (where known) BUILT c.1800, MODIFIED c.1850, DISUSED 1930. USED IN 2ND WORLD WAR.
Type of site: (eg. coast battery, pillbox) WINDMILL USED AS OBSERVATION POST. (GONE)
Description: A PHOTOGRAPH IN A BOOK (SEE UNDER WRITTEN OR GRAPHICAL SOURCES) HAS REVEALED THIS MILL'S WARTIME USE: TO THE LEFT OF THE MILL IS A SOLDIER OR HOME GUARD MAN, AND A JEEP-LIKE VEHICLE. THE WARTIME PLATFORM WAS REMOVED MANY YEARS BEFORE THE MILL'S (I THINK NEEDLESS) DESTRUCTION IN 1963.
WHITE LEAD PAINT, DARK GREY WITH AGE.
Construction materials: WOODEN TOP PART. STOUT BRICK LOWER PART THAT BORE THE WHOLE WEIGHT OF THE TOP (VERY UNUSUAL ARRANGEMENT) WOODEN PLATFORM WITH 2 METAL STRUTS SUPPORTING A LITTLE PENNANT. IT IS NOT CLEAR FROM THE PHOTOGRAPH HOW THE MEN ACTUALLY GOT ON THE PLATFORM. WONDER IF THEY WOULD HAVE USED THE BASE AS AN AMMO STORE?

Figure 3 National Record of Industrial Monuments Record card (Historic England Archive)

NATURE OF SITE (Factory, mine, etc.)			COUNTY	REF.No.
HORSE DRIVEN CLAY MILL.			HERTFORDSHIRE	Duplicate
Grid Reference or Location	Industry	Dating	Parish/~~Township~~	Date of Report
TL 373071.	BRICKMAKING & TERRA COTTA	19TH C.	BROXBOURNE	19 - 4 - 1973.

DESCRIPTION: dimensions; present condition; architectural features etc. JAMES PULHAM FOUNDED A TERRA COTTA WORKS ON THIS SITE IN 1845. THE CLAY MILL & SINGLE KILN HAVE BEEN RETAINED AS A FEATURE OF A CAR PARK.

TWO C.I. RIM GRANITE EDGE RUNNERS ARE ROTATED IN A PAN OF STONE & CONCRETE BY TWO HORSES. WOOD SHAFTS AND SUPPORTS.

(Further remarks or photo/sketch may be recorded on the back)

Machinery and Fittings

Danger of Demolition or Damage VANDALISM - FENCE SHOULD BE PADLOCKED.

Printed, Manuscript or Photographic Records PHOTOS. JKM. PAGE 80 I.A OF HERTFORDSHIRE - BRANCH JOHNSON.

Reporter's name and address:- [redacted]

Institution or Society:-

Return to:- [redacted]

C.B.A. Industrial Archaeology Report Card.

OVER

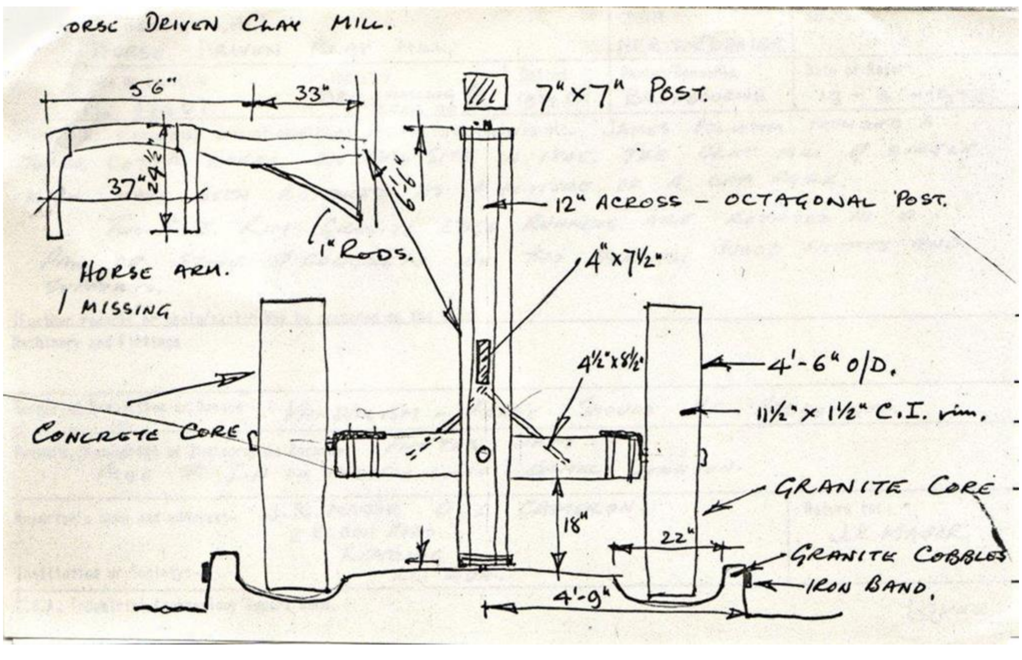
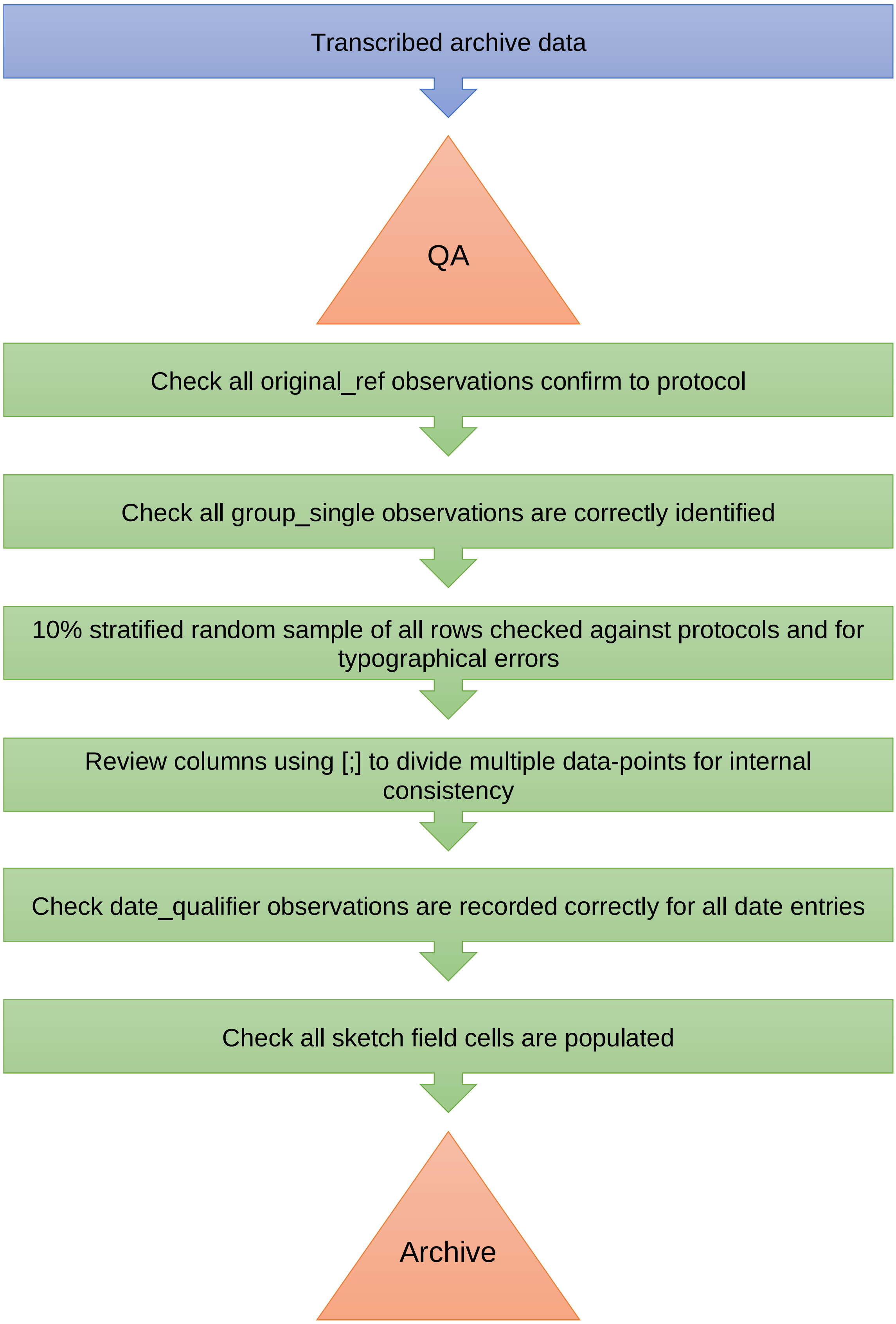


Figure 4 Quality assurance chart



References

AHMED, R., AL-KHATIB, W. G. & MAHMOUD, S. 2017. A Survey on Handwritten Documents Word Spotting. *International Journal of Multimedia Information Retrieval,* 6**,** 31-47.

ARCHAEOLOGY DATA SERVICE. 2017. *Defence of Britain Archive* [Online]. Available: http://archaeologydataservice.ac.uk/archives/view/dob/ [Accessed 7 September 2017].

BAILEY, J. 16 June 1974. *RE: Letter, 16 June 1974* to BOWEN, H. C., Historic England Archive SOA/03/49.

BAILEY, J. Letter, 20 March 1978. Parish Boundary Survey – Dorset. Society of Antiquaries of London MS953/1/1.

BONNACHI, C., BEVAN, A., PETT, D. & KEINAN-SCHOONBAERT, A. 2015. Crowd- and Community-Fuelled Archaeology. Early results from the Micropasts project. *In:* COSTA, L., DJINDJIAN, F., GILIGNY, P. & MOSCATI, P. (eds.) *Proceedings of the 42nd Annual Conference on Computer Applications and Quantitative Methods in Archaeology, CAA 2014.*

BOWEN, H. C. 5 April 1978. *RE: Evolution of the Landscape Project* to THOMPSON, F. H. Society of Antiquaries of London MS953/1/1.

BOWEN, H. C. 20 June 1974. *RE: Letter, 20 June 1974* to BAILEY, J., Historic England Archive SOA/03/49.

BOWEN, H. C. 1961. *Ancient Fields. A Tentative Analysis of Vanishing Earthworks and Landscapes.,* London, The British Association for the Advancement of Science.

BOWEN, H. C. 1976. Meeting with Dr Andrew Goudie and Mr Michael Summerfield at School of Geography, Oxford on Tuesday 30 November 1976. Historic England Archive SOA/03/6.

BOWEN, H. C. & CUNLIFFE, B. 1973. The Society's Research Projects. *The Antiquaries Journal,* 53**,** 9-13.

BOWEN, H. C. & CUNLIFFE, B. n.d. Proposal for a scheme to investigate the origin of the first organised landscapes in Britain. Society of Antiquaries of London MS953/1/1.

BOWEN, H. C. & SMITH, I. F. 1974. Society of Antiquaries Evolution of the Landscape Project, Wessex. Information Sheet No.1 (February 1974) (HE Archive SOA03/15). Society of Antiquaries of London.

BOWEN, H. C. & SMITH, I. F. 1977. Sarsen Stones in Wessex: the society's first investigations in the Evolution of the Landscape Project. *The Antiquaries Journal,* 57**,** 185-196.

BUCHANAN, R. A. 1969. The National Record of Industrial Monuments. *In:* COSSONS, N. & HUDSON, K. (eds.) *Industrial Archaeologists' Guide 1969-70.* Newton Abbot: David and Charles.

BUCHANAN, R. A. 1971. The National Record of Industrial Monuments. *In:* COSSONS, N. & HUDSON, K. (eds.) *Industrial Archaeologists' Guide.* Newton Abbot: David and Charles.

CUNLIFFE, B., COLES, J. M. & BOWEN, H. C. 1972. Proposal for sponsorship of a scheme of research by The Society of Antiquaries of London (MS953/1/1/). Society of Antiquaries of London.

ESKENAZI, S., GOMEZ-KRÄMER, P. & OGIER, J.-M. 2017. A Comprehensive Survey of Mostly Textual Document Segmentation Algorithms since 2008. *Pattern Recognition,* 64**,** 1-14.

EVANS, M. 7 July 2017. *RE: Problems with digitising complex handwritten archive documents.* Pers.comm. to Whitaker, K.

FITZ-GERALD, R. J. 2012. *End of Project Report: National Record of Industrial Monuments (NRIM)*. Swindon: English Heritage Archive (internal report).

GALLUP, P. W. 1975. The survey of sarsen stones. *Hampshire Archaeology and Local History Newsletter,* 2 (9/10)**,** 116-18.

GALLUP, P. W. 1977. The survey of sarsen stones. *Hampshire Archaeology and Local History Newsletter,* 5**,** 15-16.

GALLUP, P. W. 1994. The survey of sarsen stones. *Hampshire Field Club and Archaeological Society Section Newsletter,* 22**,** 11-13.

GRANELL, E. & MARTINEZ-HINAREJOS, C. D. 2017. Multimodal Crowdsourcing for Transcribing Handwritten Documents. *IEEE/ACM Transactions on Audio, Speech and Language Processing,* 25**,** 409-419.

GUIDEN, N. 2011. *National Record of Industrial Monuments project design.* Swindon: English Heritage Archive (internal report).

KATIYAR, G. & MEHFUZ, S. 2012. Evolutionary Computing Techniques in Offline Handwriting Character Recognition. *Procedings of the International Conference on Advances in Computer Science and Electronics Engineering***,** 333-7.

KEARNEY, N. & WALLIS, E. 2015. Transcribing between the lines: crowd-sourcing historic data collection. *Museums and the Web Asia 2015.* Melbourne, Australia.

LONG, C. 3 August 2017. *RE: The history and current practices of digitising War Memorials Register data from archive material to online database.* Pers. comm. To Whitaker, K.

MARWICK, B., D'ALPOIM GUEDES, J., BARTON, C. M., BATES, L. A., BAXTER, M., BEVAN, A., BOLLWERK, E. A., BOCINSKY, R. K., BRUGHMANS, T., CARTER, A. K., CONRAD, C., CONTRERAS, D. A., COSTA, S., CREMA, E. R., DAGGETT, A., DAVIES, B., DRAKE, B. L., DYE, T. S., FRANCE, P., FULLAGAR, R., GIUSTI, D., GRAHAM, S., HARRIS, M. D., HAWKS, J., HEATH, S., HUFFER, D., KANSA, E. K., KANSA, S. W., MADSEN, M. E., MELCHER, J., NEGRE, J., NEIMAN, F. D., OPITZ, R., ORTON, D. C., PRZYSTUPA, P., RAVIELE, M., RIEL-SALVATORE, J., RIRIS, P., ROMANOWSKA, I., SMITH, J., STRUPLER, N., ULLAH, I. I., VAN VLACK, H. G., VANVALKENBURGH, N., WATRALL, E. C., WEBSTER, C., WELLS, J., WINTERS, J. & WREN, C. D. 2017. Open Science in Archaeology. *The SAA Archaeological Record,* 17**,** 8-14.

PITTS, M. 1996. The Stone Axe in Neolithic Britain. *Proceedings of the Prehistoric Society,* 62**,** 311-371.

PLAMONDON, R. & SRIHARI, S. 2000. On-Line and Off-Line Handwriting Recognition: A Comprehensive Survey. *IEEE Transcations on Pattern Analysis and Machine Intelligence,* 22**,** 63-84.

REDFERN, N. 27 July 2017 *RE: Defence of Britain Project.* Pers. comm. To Whitaker, K.

ROYAL METEOROLOGICAL SOCIETY. 2017a. *Weather Rescue* [Online]. www.zooniverse.org. Available: https://www.zooniverse.org/projects/edh/weather-rescue [Accessed 10 September 2017].

ROYAL METEOROLOGICAL SOCIETY. 2017b. *Weather Rescue - FAQ* [Online]. www.zooniverse.org. Available: https://www.zooniverse.org/projects/edh/weather-rescue/about/faq [Accessed 10 September 2017].

SAHARE, P. & DHOK, S. B. 2017. Script Identification Algorithms: a Survey. *International Journal of Multimedia Information Retrieval,* 6**,** 211-232.

SOCIETY OF ANTIQUARIES OF LONDON 1974a. *Evolution of the Landscape, Wessex Pilot Scheme, News Sheet No.1* (23 February 1974), Historic England Archive SOA03/01.

SOCIETY OF ANTIQUARIES OF LONDON 1975. *Sarsen Symposium. Evolution of the Landscape Project: News Sheet No. 2* (10 May 1975), Historic England Archive SOA03/03.

SOCIETY OF ANTIQUARIES OF LONDON n.d. *The Organization of the Landscape. The Creation of the Project*, Society of Antiquaries MS953/1/1.

THE GETTY RESEARCH INSTITUTE. 2017a. *Mutual Muses* [Online]. www.zooniverse.org. Available: https://www.zooniverse.org/projects/melissaagill/mutual-muses [Accessed 10 September 2017].

THE GETTY RESEARCH INSTITUTE. 2017b. *Mutual Muses - FAQ* [Online]. www.zooniverse.org. Available: https://www.zooniverse.org/projects/melissaagill/mutual-muses/about/faq [Accessed 10 September 2017].

THE NATIONAL ARCHIVES. 2017. *How to look for census records.* [Online]. The National Archives. Available: http://www.nationalarchives.gov.uk/help-with-your-research/research-guides/census-records/ [Accessed 7 September 2017].

THORVALDSEN, G., PUJADAS-MORA, J. M., ANDERSEN, T., EIKVIL, L., LLADÓS, J., FORNÉS, A. & CABRÉ, A. 2015. A Tale of Two Transcriptions. Machine-Assisted Transcription of Historical Sources. *Historical Life Course Studies,* 2**,** 1-19.

UNIVERSITY OF PENNSYLVANIA LIBRARIES. 2017a. *Scribes of the Cairo Geniza* [Online]. www.zooniverse.org. Available: https://www.zooniverse.org/projects/judaicadh/scribes-of-the-cairo-geniza [Accessed 10 September 2017].

UNIVERSITY OF PENNSYLVANIA LIBRARIES. 2017b. *Scribes of the Cairo Geniza - FAQ* [Online]. www.zooniverse.org. Available: https://www.zooniverse.org/projects/judaicadh/scribes-of-the-cairo-geniza/about/faq [Accessed 10 September 2017].

WEXLER, J. 13 August, 5 September 2017. *RE: Bronze Age Index* Pers.comm. to Whitaker, K.

University of Reading

UNIVERSITY OF Southampton

UKRI Arts and Humanities Research Council

South, West & Wales Doctoral Training Partnership

Analytical earthworks survey in Piggledene, West Overton, Wiltshire (UK)

Katy Whitaker, Elaine Jamieson and Krystyna Truscoe

Analytical earthworks survey in Piggledene, West Overton, Wiltshire (UK)

Katy Whitaker,
Elaine Jamieson, Krystyna Truscoe

NGR: SU 141 687

2019

This document was authored during a *South, West, and Wales Doctoral Training Partnership* studentship held at the University of Reading, and is supported by the Arts and Humanities Research Council grant number AH:L503939:1.

Front cover image: *Leica Total Station Theodolite standing over Survey Station 1 in Piggledene, facing a prism placed over Survey Station 2, while members of the survey team discuss features in the south-east area of the survey transect.*

Summary

This fieldwork was carried out as part of a doctoral research project undertaken at the University of Reading, funded by the Arts and Humanities Research Council through the South, West and Wales Doctoral Training Partnership. The purpose of the research was to make a detailed record of sarsen extraction features and other archaeological evidence. The fieldwork in Piggledene, Wiltshire (UK) resulted in a detailed record of earthworks and quarried sarsen stones in a transect across the dry chalk valley. It identified two different methods of sarsen cutting, tentatively identified as contemporaneous. Earthwork features unmapped by previous air photograph and lidar transcription projects were identified and recorded. Three possible standing stones were also identified. The survey results have implications for understanding both the archaeology and the geomorphology of this dry chalk dip slope valley on the Marlborough Downs.

CONTRIBUTORS

Archaeological survey was undertaken by Katy Whitaker, Elaine Jamieson and Krystyna Truscoe. Professor Martin Bell (University of Reading) and Professor Josh Pollard (University of Southampton) made useful comments on the survey plan and the report. The report was written by Katy Whitaker.

ACKNOWLEDGEMENTS

Permission to carry out the survey in Piggledene was kindly granted by The National Trust. Natural England kindly confirmed that special consent was not required for earthworks survey within Piggledene SSSI. Gill Swanton of F Swanton and Sons (North Farm) not only provided access into Piggledene but also helped to transport equipment to and from the survey area: her unstinting support throughout this project is very gratefully acknowledged. Useful comments on the geomorphology of Piggledene were made by Professor David Nash (University of Brighton) and Dr Matt Pope (University College London).

All images are © author unless stated otherwise.

ARCHIVE LOCATION

Katy Whitaker, Department of Archaeology, University of Reading, Whiteknights, Reading, RG6 6AB. Additionally, this report has been provided to: The National Trust, Natural England, Wiltshire Historic Environment Record, F Swanton and Sons (North Farm, West Overton), The Historic England Library (Swindon).

DATE OF RESEARCH

Archaeological survey and investigation were carried out in February/March 2019, with further background research and additional photography during May/June 2019.

CONTACT DETAILS

Katy Whitaker, k.a.whitaker@pgr.reading.ac.uk, 07769 712799, @artefactual_KW

Table of Contents

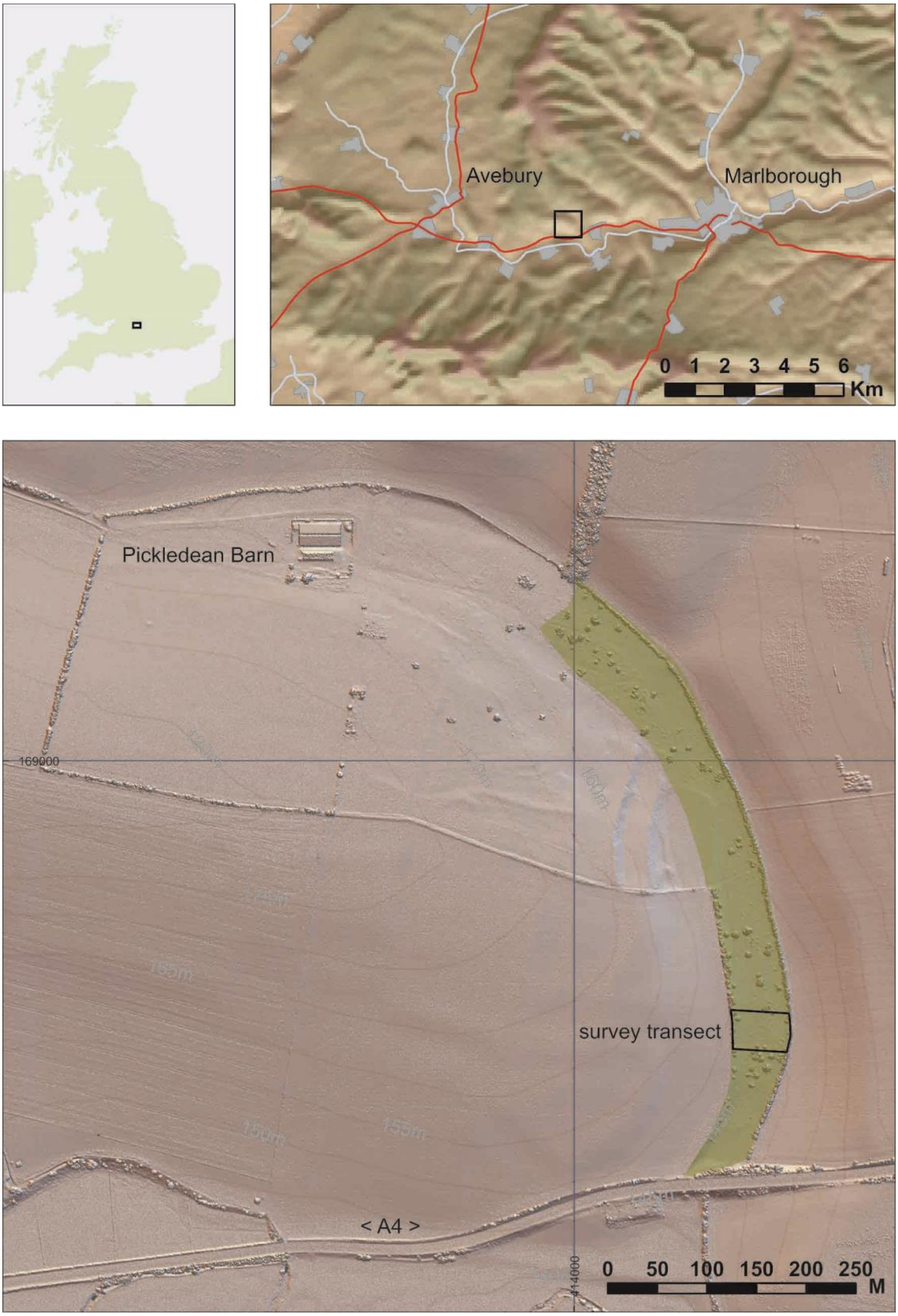


Figure 1 Piggledene, Wiltshire (UK). National Trust property shown in green in lower map. Digital surface model data derived from 90m STRM topography data CGIAR http://srtm.cgiar.org, 2m photogrammetry © Bluesky International Ltd/Getmapping PLC, rivers and roads data derived from OS data © Crown copyright, Environment Agency 50cm Lidar DSM (Multi-lit Hill shade).

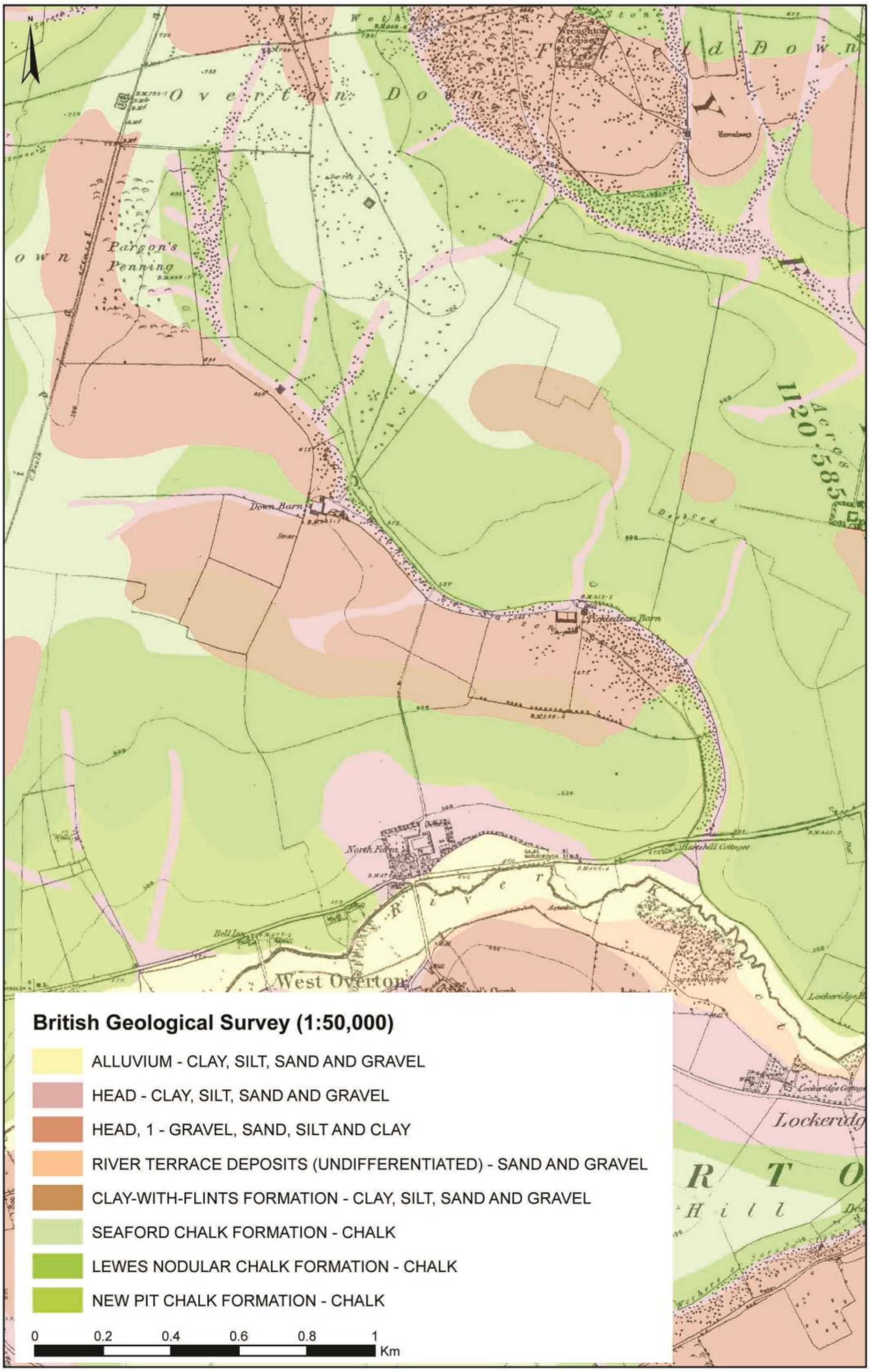


Figure 2 Solid and superficial geology of Piggledene and environs with the first edition 6" Ordnance Survey County Series map (Wiltshire, 1889). British Geological Survey shapefile and Ordnance Survey (Landmark Information Group) TIFF geospatial data, via EDINA Digimap Service.

Introduction

This report describes the results of analytical earthworks survey in a transect of Piggledene, a dry chalk dip slope valley of the Marlborough Downs to the north of the River Kennet. The fieldwork included the metrical recording of quarrying features on sarsen stones remaining in the survey transect, photographic recording, and a walk-over survey of the southern reaches of the valley. Following a general description and historical background that contextualises the survey area, the results are described and discussed, and recommendations for future research are made.

For the sake of consistency, this document refers to the valley of **Piggledene** throughout in preference over the alternatives ‘Piggledean’, ‘Pickledean’, or ‘Pickledene’. Other spellings are used, however, where they are being quoted from a source document. For the purposes of this report, the southern section of Piggledene from the environs of Pickledean Barn as far as the A4 is known as **lower Piggledene**. The walk-over survey covered lower Piggledene, and the survey transect was located in the southern reaches of the valley.

Location and geology

Piggledene is an asymmetrical dry chalk valley in West Overton parish, north Wiltshire (Figure 1). It is a northern re-entrant of the Kennet Valley, now cut off from the river to the south by the modern embanked A4 road. From the A4 boundary it runs approximately north before curving to the north-west beyond Pickeldean Barn and Down Barn, where the valley leads north onto Overton Down.

In lower Piggledene, a strip of land comprising c3.8 hectares is owned by the National Trust, bought by public subscription in 1908 following a campaign to purchase two areas of sarsen spreads to protect them from quarrying. The ground to the north-west and west of the National Trust property is in private ownership. That area of the valley includes Pickledean Barn, a former outfarm, which today comprises modern agricultural buildings partially enclosed by a sarsen-built wall (a former cottage and other small buildings having been demolished). The southern reaches of the valley are periodically used for grazing sheep.

The base of lower Piggledene, at c145m OD, is narrow and gently sloping down from west to east. The foot of the slope to both valley sides is steepest here, until opening out in the environs of Pickledean Barn. The valley sides are slightly shallower from Pickledean Barn and continuing north-west towards New Shed. Generally, however, Piggledene exhibits normal chalk dry valley asymmetry with steeper west and south-west facing slopes (Clark et al., 1967, 23), conforming to the lowland plateau landsystem described by Murton and Ballantyne (2017, 542-4). The valley gains height to c180m OD at Down Barn, and above 200m OD at Parsons Penning. Numerous small re-entrants join Piggledene from the chalk plateau, in particular on the north-eastern side which is the interfluve to the roughly parallel valley of Clatford Bottom c1.5km to the east.

The solid geology of lower Piggledene is the New Pit Chalk Formation (Clark et al., 1967, 7). The Lewes Nodular Chalk Formation is indicated at c160m OD up the valley sides. Head deposits are indicated to the valley floor (Figure 2). Within the survey area, British Geological Survey mapping suggests that Head deposits would be found below the eastern fence-line and in the eastern c15m of the National Trust property. Animal burrows in this line today are throwing up a reddish-brown soil, with small pieces of chalk, angular flints, and sarsen fragments: and in one instance observed in May 2019, a highly weathered partial pig's lower jaw (Figure 3). Further to the north-west, outside the survey area, Head 1 is indicated as extending throughout the valley and over its western slope, with a clay-with-flints cap covering the highest ground of the interfluve that divides the north-western part of the valley from the Kennet valley to the south-west.

Figure 3 Animal burrow spoil at the north-east boundary of lower Piggledene, including a partial lower pig jaw, chalk and flint pieces, and sarsen cobbles.

A detailed examination of nearby and likely analogous valley floor deposits is provided by Clark et al. (1967). Test pits dug by this team in the upper reaches of Clatford Bottom, just over 2km to the north of Piggledene, revealed superficial deposits in the valley bottom and on shallower slopes to be thicker than on higher ground. These comprised a sandy loam overlying a flinty loam and Coombe rock. The upper c0.6m to 1.2m of the flinty loam included pieces of sarsen and angular flints apparently not water-sorted, and large sarsens were encountered both in the loam and on its irregular junctions with the Coombe rock below. Solution pipes were recorded in the Coombe rock and into the underlying chalk, which in that location was not encountered until a depth of at least 2.8m, if not deeper (Clark et al., 1967, 27-30). The team suggested that in Clatford Bottom the Coombe rock with sarsens were a product of 'solifluction conditions…Rejuvenation followed this main phase of deposition, and fluvial outwash of fines produced the strong concentration of sarsens seen today' (Clark et al., 1967, 35), after which decalcification of Coombe rock produced the flinty loam.

Four cores in Piggledene augured by Mike Allen provide a little additional information about its superficial deposits (Fowler, 2000, 209). In the environs of the Down Barn enclosure, two attempts to core hit buried sarsens after a very short distance, and a third revealed a brown rendzina overlying chalk. The fourth provided a longer sequence although, hitting a sarsen at 1.38m depth, was considerably shorter than most of the test pits dug by Clark et al. (1967, 27-36) in Clatford Bottom. Below the rendzina this longer core showed that chalky colluvium had developed over a possible old land surface from which Beaker pottery was recovered. Molluscs from the Beaker horizon were species favouring a dry, short-grazed or trampled grassland, whilst those from the c0.4m of silty clay below this and above the sarsen were primarily woodland species (Fowler, 2000, 209-211). This suggests that the valley floor has at least in parts been lower in the past, with material created by human activity in the mid-third millennium BC that has since been buried by accumulation of deposits: possibly related to soil movement as the surrounding plateau and hillslopes were cultivated (Allen, 1988, Bell, 1992).

Despite the limitation of superficial deposits, in British Geological Survey mapping, to lower Piggledene's narrow valley bottom, the valley is nevertheless full of sarsens from the boundary formed by the A4 as far as Pickledean Barn. Formerly more numerous, these boulders are integral to the periglacial debris system operating on the east-facing slopes (Clark et al., 1967, 23). They are scattered across the pasture valley bottom and un-ploughed slopes, and gathered by clearance to the modern field boundaries of cultivated fields to either side. In drought conditions the positions of buried boulders are revealed when the vegetation on the thin overlying soils parches (Gill Swanton, 2020 pers.comm.). In the valley's north-western reaches, where fields are cultivated for arable well down the slopes towards the valley bottom, the sarsens become less frequent, becoming prolific on the highest ground of Overton Down and Fyfield Down. The Piggledene sarsen spread is similar to those either side of the River Kennet in Temple Bottom, Clatford Bottom, Monkton Down coombe, Lockeridge Dene, West and East Kennet coombes, and Hursley Bottom in West Woods. The sarsen boulders, cobbles, and fragments in these locations are found both exposed on the surface and buried in superficial deposits including Head and clay-with-flints (Osborne White, 1925, 80-3).

Sarsen is a sandstone, formed by the groundwater or pan-lacustrine silicification of near-surface Tertiary sands. During later processes of erosion and sediment movement including both gelifluction and solifluction, sarsen boulders were deposited in their present-day locations (Nash and Ullyott, 2007, Small et al., 1970). When during the Tertiary these rocks were formed, and the timings of the formation of the landsystems of which they are a part, are debated (Clark et al., 1967, Murton and Ballantyne, 2017, Ullyott et al., 2004). Nevertheless, in this study area they are a key feature of the Quaternary landscape and since the Neolithic have been used by people for a range of purposes, most notably as megalithic stone settings in monuments including the West Kennet long barrow and Avebury henge's stone circles.

Recent land-ownership and division

Piggledene lay in the area of Overton parish's open fields and chalk downland on the north side of Kennet valley. Until the Dissolution the manor was held by St Swithun's Priory, Winchester, becoming part of the estate of the Earls of Pembroke. Enclosure by private agreement had begun in the early eighteenth century (a detailed history of the changing field-name evidence is available in Ian Blackwell's summary Fyfod

Working Paper 54 (Blackwell, 1996) and is not rehearsed here). A major landmark was the sale of the manor in 1726 to the Trustees of John Churchill, Duke of Marlborough, when Piggledene became a part of the vast Marlborough estates (Baggs et al., 1980).

Figure 4 Lower Piggledene depicted in the West Overton Enclosure Award Map, 1815/16 (WSHC 1033/27). Buildings at North Farm are shown around parcel 190 (bottom left), some of which stand today, including sarsen-built structures. Pickledean Barn stands in plot 193, to the north side of plot 194. Agricultural buildings shown in black, domestic/residential buildings shown in red. Unscaled, north at top.

Pickledean Barn had been built by 1773 (it is identified as Old Barn on the Andrews and Dury map of that date) and lower Piggledene is shown enclosed into four main parcels of land on the Enclosure Award map of 1815/16 (Wiltshire and Swindon History Centre 1033/27, ‘Overton: Enclosure’) (Figure 4). The field barn appears to have become an outfarm, with the adjacent ancillary buildings depicted on the Enclosure Award map, at the time that the manor was divided into South and North

Farms. The first stone of the new North Farm was laid on 11 May 1801 (WSHC 1079/3, ‘Overton Parish Record Book’) (and see Edwards and Lake, 2014, 122, 125) but Pickledean Barn’s courtyard plan was not developed until after the Enclosure Award map was made (Figure 5). It was completely re-worked after 1914 when a pig unit was introduced to this part of North Farm (Gill Swanton pers. comm. 2019).

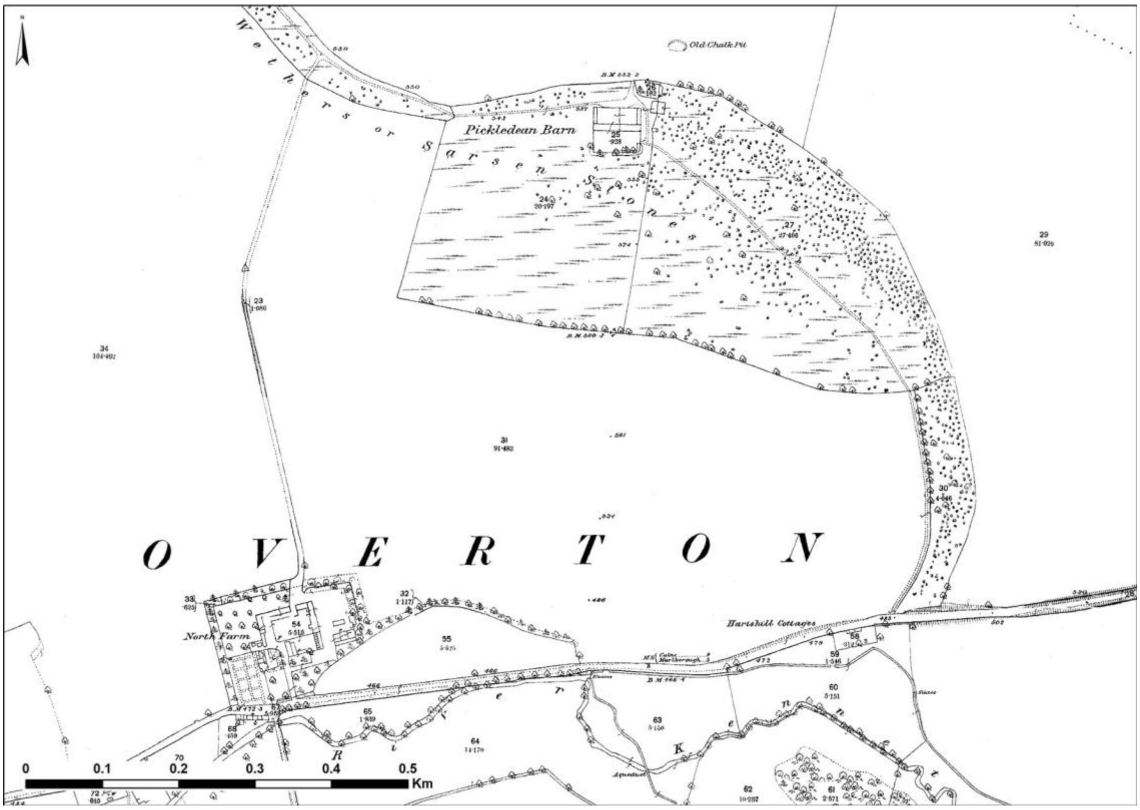


Figure 5 Lower Piggledene depicted in the first edition Ordnance Survey County Series 25" (1:2,500) mapping, Wiltshire sheets XXVII.11 and XXVII.15. Surveyed in 1885, published in 1887. Ordnance Survey (Landmark Information Group) TIFF geospatial data, via EDINA Digimap Service.

In 1866 Piggledene was part of the estate sold to RC Long, who sold on to the Trustees of Sir Henry Meux in 1870 (Baggs et al., 1980). The property was largely unchanged in plan at the time of the sale of the Meux estate in 1906, the boundary dividing the narrow southern-most reach of the valley into plots 198 and 200 having already been removed by 1819 as shown in Dymock’s estate map of that year (Wiltshire and Swindon History Centre 778/2L, ‘Map of East and West Overton, Shaw, Lockeridge and Fyfield’). Alexander Taylor of Manton House bought much of the Meux holdings, but in 1907 a campaign to purchase part of Piggledene and another sarsen spread in nearby Lockeridge Dene was initiated by members of the Wiltshire Archaeological and Natural History Society (Anon., 1907).

The Meux Estate Sale Particulars had advertised the estate's mineral rights, mentioning that "On many parts of the Downs the land is covered with Sarsen Stones, which are being remuneratively worked at the present time. The revenue from this source could be considerably increased" (Wiltshire and Swindon History Centre 106/1, 'Particulars, Reference Plans and Conditions of Sale of the Second Portion of the Meux Estates'). This threat to the sarsens galvanised a national fundraising campaign which led to the purchase of part of Piggledene, handed to the National Trust in 1908 (Anon., 1908). North Farm, including the area around Pickledean Barn, was bought by Frank Swanton in 1925/6 having been estate manager for the Olympia Agricultural Company (Gill Swanton, 2020 pers.comm.).

Previous investigations

The study area falls in the centre of Peter Fowler's extensive Fyfield and Overton Down Project area (Fowler, 2000). Unlike the environs of Down Barn, however, where excavations at the Down Barn enclosure revealed settlement evidence from the Mesolithic into the medieval period, lower Piggledene has received less archaeological attention.

The earliest recorded artefactual evidence is a small group of Neolithic flints (Wiltshire and Swindon HER SU 16 NW 125, Wiltshire Museum DZSWS:1979.84.1.1-2) including two scrapers and two waste flakes, found to the southern side of the valley sometime before 1979 in the environs of SU 139 689. A small number of Beaker sherds were recovered by Mike Allen during auguring in Piggledene in the later 1980s (Johnston, 2005). Round barrows surviving as upstanding earthworks, and undated ring ditches observable in remotely-sensed data, are scattered on the higher ground and slopes to the south-west and north-east of the southern part of the valley (Wiltshire and Swindon HER SU SU16 NW 648, 651-3, 783, and MWI72803).

The valley is surrounded by extensive field systems which date from later prehistory to the medieval period. Observed in the ploughed fields to the north and south of the valley, they have been transcribed from remotely-sensed data (Small, 1999, Stoertz, 1995). Lynchets have also been recorded in the environs of Pickledean Barn, along with traces of ridge and furrow (Wiltshire and Swindon HER SU 16 NW 687, 689, and MWI73044) (Figure 6).

Figure 6 Lower Piggledene depicted in a Local Relief Model visualisation of 50cm Lidar Digital Surface Model data (processed using the Relief Visualisation Toolbox). Survey transect in red. Environment Agency 2006-2010 composite DSM dataset from EDINA Digimap Service.

How the field system, and its use and development through time, intersects with the sarsen spread in the valley is unclear. On high ground to the north-east, on Fyfield Down, a lynchet of a later prehistoric field system trenched in 1961 was shown to include substantial sarsen stone revetting (Bowen and Fowler, 1962, 105). On Totterdown, c3km to the north, a section cut through the bank of a Late Bronze Age linear feature within a prehistoric field system also revealed sarsen revetting (Fowler, 2000, 72). These features suggest that sarsens are incorporated structurally throughout the extensive field systems straddling the River Kennet. This boundary-making practice may have begun as early as the later Neolithic, suggested by rows of sarsen boulders excavated in Narrow Meadow alongside the River Kennet (Evans et al., 1993, 163, 173).

Some further light on the likely necessities surrounding farming in sarsen spreads was cast by a geophysical survey carried out in 2008 on the north-east facing slope immediately south-east of Pickledean Barn (Linford, 2008). This is an area where north-south oriented linear earthworks had previously been identified in aerial photographs (Fowler, 2000, figure 2.1). The geophysical survey identified an east-west linear anomaly tentatively interpreted as part of the field system. Pit-like anomalies found scattered across the surveyed area were thought to be associated with sarsen quarrying, whilst linear negative responses were suggested to be possible ‘scour marks’ left by un-dated sarsen clearance as stones were dragged from cultivated plots into the valley bottom (Linford, 2008, 2-3).

The course of the Roman Road passing east-west through the southern end of Piggledene (Wiltshire and Swindon HER SU 16 NW 748) is to the south of the present-day A4. The modern road, depicted by Gough in the late seventeenth century, was turnpiked in the early 1740s (Critall, 1959). It is embanked to pass over the end of Piggledene where the valley joins the Kennet. A former chalk pit, marked on historical OS maps, lay to the north-east of Pickledean Barn cut into the south-facing slope. This shows as a dark sub-circular feature in the Local Relief Model visualisation and appears to cut a large lynchet on the side of the valley (Figure 6).

Noel King (1968) reported that Piggledene was quarried for sarsens by members of the Cartwright family from 1912 to 1915 (around the time that Frank Swanton was adapting Pickledean Barn), commenting that there is “[e]vidence here of earlier sarsen work in mid-19th century” (ibid 1968, 92). This suggests that specialist sarsen cutting techniques originating in Buckinghamshire, from whence the Cartwrights amongst others had moved to Wiltshire, were in use here. King also published a photograph of sarsen cutting in Piggledene dated 1908 (*ibid* 1968, Plate VIIa). This image was taken from approximately SU 1361 6924 looking eastwards, where the chalk pit, the west range of Pickledean Barn, and its cottages are visible. Periods of quarrying must have been conducted with the landowner’s permission or license, and the early twentieth century work by the Cartwrights must have been located in the part of the valley to the north-west and north of the area bought and given to the National Trust in 1908.

Figure 7 Left: an iron wedge trapped in a wedge-pit cut into a sarsen in Piggledene. The top of a piece of thin, flat, hoop iron, used as a feather, is visible on one side. Right: angular sarsen debris just under the turf in Piggledene, revealed by an animal scrape.

Multiple abandoned boulders and waste material do show the typical trapezoidal wedge-pits associated with nineteenth century sarsen extraction, and there are examples of iron wedges trapped in uncut stones (Figure 7). Archive photographs of sarsen cutters working in Piggledene show the typical tools and equipment that were also recorded in use in south Buckinghamshire. The scars of cylindrical holes can, however, be seen in sarsen walling blocks at Pickledean Barn and in split but abandoned stones in the valley, indicating that the plug and feather splitting technique had also been used here (Stanier, 2000). This suggests, perhaps, working by different teams or cutting at different dates and is described and discussed in more detail below.

The present survey

Fieldwork in Piggledene was planned to contribute to a comparative archaeology of sarsen extraction as part of a wider piece of work which hypothesises that sarsen stone extraction and working of different periods, using different techniques, have characteristic distinguishing features. This research seeks to test the premise that sarsen quarrying can be characterised through its archaeological field remains. Whilst three study areas in north Wiltshire were originally proposed (West Woods, Piggledene, and Totterdown), in the event timely access could not be arranged to Totterdown (later investigation has since suggested that the intended area to the north of Totterdown Wood has been extensively ploughed and only a very small area of north-facing valley slope may in fact retain sarsen extraction evidence).

Aims

The survey objectives in Piggledene were:

- to record and characterise the field archaeology in a targeted area that samples the dispersed sarsen quarry. This includes all features within the survey space, establishing where possible a relative chronology;
- to closely relate negative features (pits, hollows, scrapes), positive features (banks, mounds, spreads), cut/uncut sarsens, stone debris, tracks etc within the study area.

Field methodology

A detailed analytical earthwork survey at 1:200 was carried out using differential GNSS (Leica GS15 antenna with CS15 field controller) and Total Station Theodolite (Leica Robotic TS12 and field controller). The surveyed area comprises a c60m x c40m transect across lower Piggledene in the environs of SU 1418 6872 (Figure 1). The survey area was bounded to the west and east by the modern fence-lines. Representative of lower Piggledene as a whole, this transect was selected because of the range of sarsen quarrying evidence present here, including hollows and likely stone pits, partially split sarsens, and whole boulders.

A detailed survey plan of the archaeological features was produced in the field on polyester film using the electronically derived control plot, augmented with tape-and-offset techniques. The survey included fine detail of the earthwork and stone remains of the quarry workings and all other observed features. It was undertaken in Winter 2019 when the ground conditions were at their most favourable with minimal vegetation cover to ensure that the work was produced to the highest possible standard. Following the analytical earthwork survey, a digital hachured plan was produced in AutoCAD Map 3D 2019 and Adobe Illustrator 2019, using Historic England archaeological conventions and hachure set (Figure 8).

All the sarsens within the survey transect were inspected. Evidence for splitting and other characteristics were recorded. The locations of wedge-pits and other splitting features on stone faces were hand sketched in schematic reference diagrams, and all were measured to the nearest whole millimetre using digital callipers. Distances between wedge-pits were recorded using a hand tape. Accessible split stone faces were photographed. One large boulder, split into numerous pieces but abandoned, was planned at 1:50.

Photographs were captured in camera RAW and JPG formats using a Nikon D5600 DSLR with AF-P Nikkor 18-55mm lens, used both hand-held and tripod-mounted. Scale and direction information using equipment such as ranging rods, tapes, scale cards and North arrows were included, with grey cards to control for white balance in processing. A photograph record sheet was maintained. Photographs were processed using Adobe Bridge and Photoshop CC 2019 to produce an archive set in TIFF format in addition to the working set of camera JPG files. A set of photographs was taken to build a photogrammetric model of one of the split sarsen groups, captured using a tripod-mounted DSLR shooting on aperture priority with low ISO, to extend depth of field and reduce digital 'noise'. These were processed using Adobe Photoshop CC 2019 and Agisoft Metashape.

In addition to the analytical earthwork survey, a walk-over survey of part of lower Piggledene was carried out: this covered the ground from the A4 to just north of the former field boundary at SU 1416 6888. General observations on the topography and sarsen spread were made and sketched. Landscape photographs, and photographs of features of specific interest, were taken. These observations form part of the survey results and discussion below, contextualising features recorded in more detail in the survey transect. Following the identification and recording of sarsens split by the plug and feather technique (see below), the outer faces of the sarsen wall at Pickledean Barn were examined and evidence for splitting methods were recorded and photographed.

A day-book was kept, recording the survey process, notes, observations, and decisions made by the survey team.

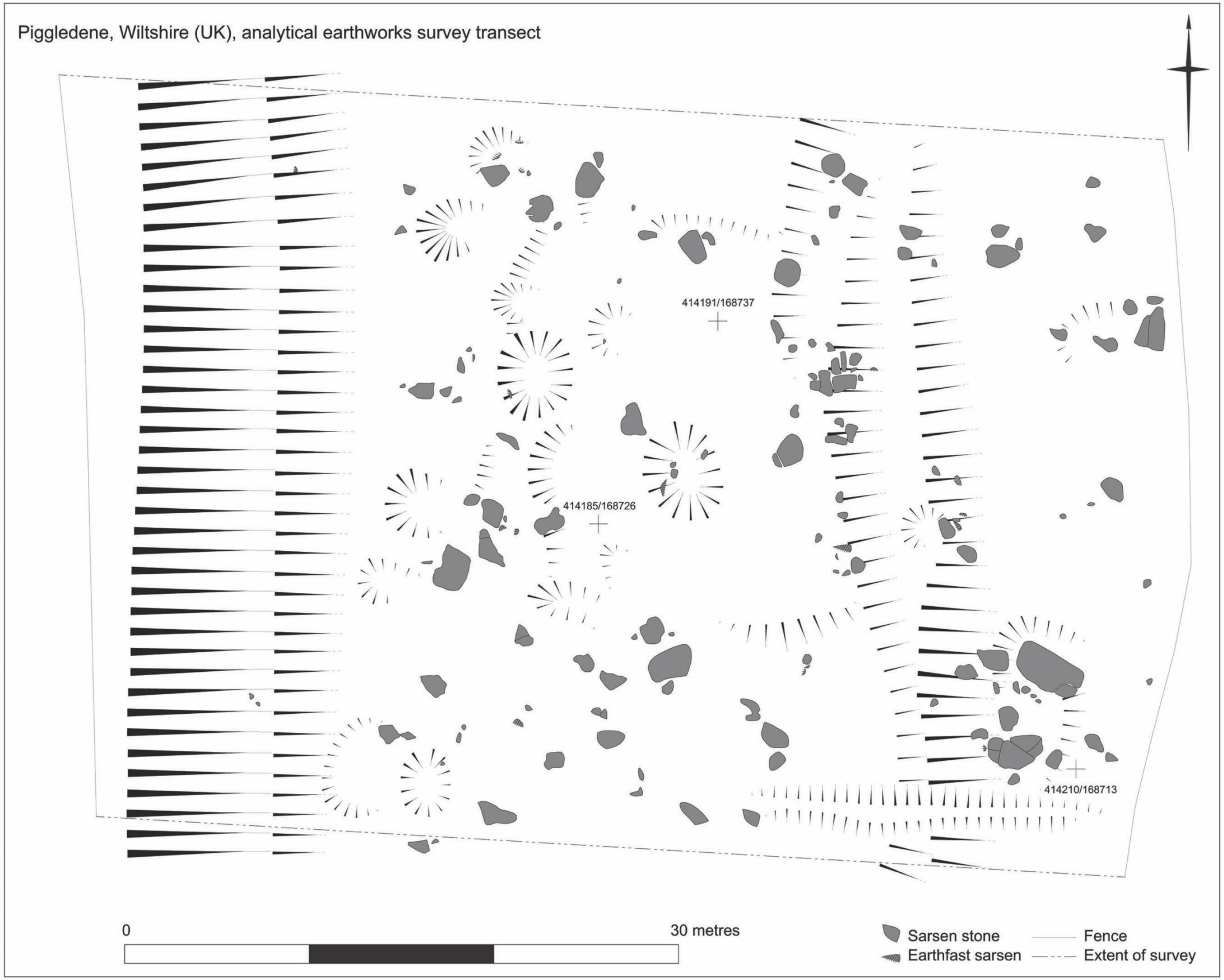


Figure 8 Piggledene, Wiltshire (UK). Surveyed at 1:200.

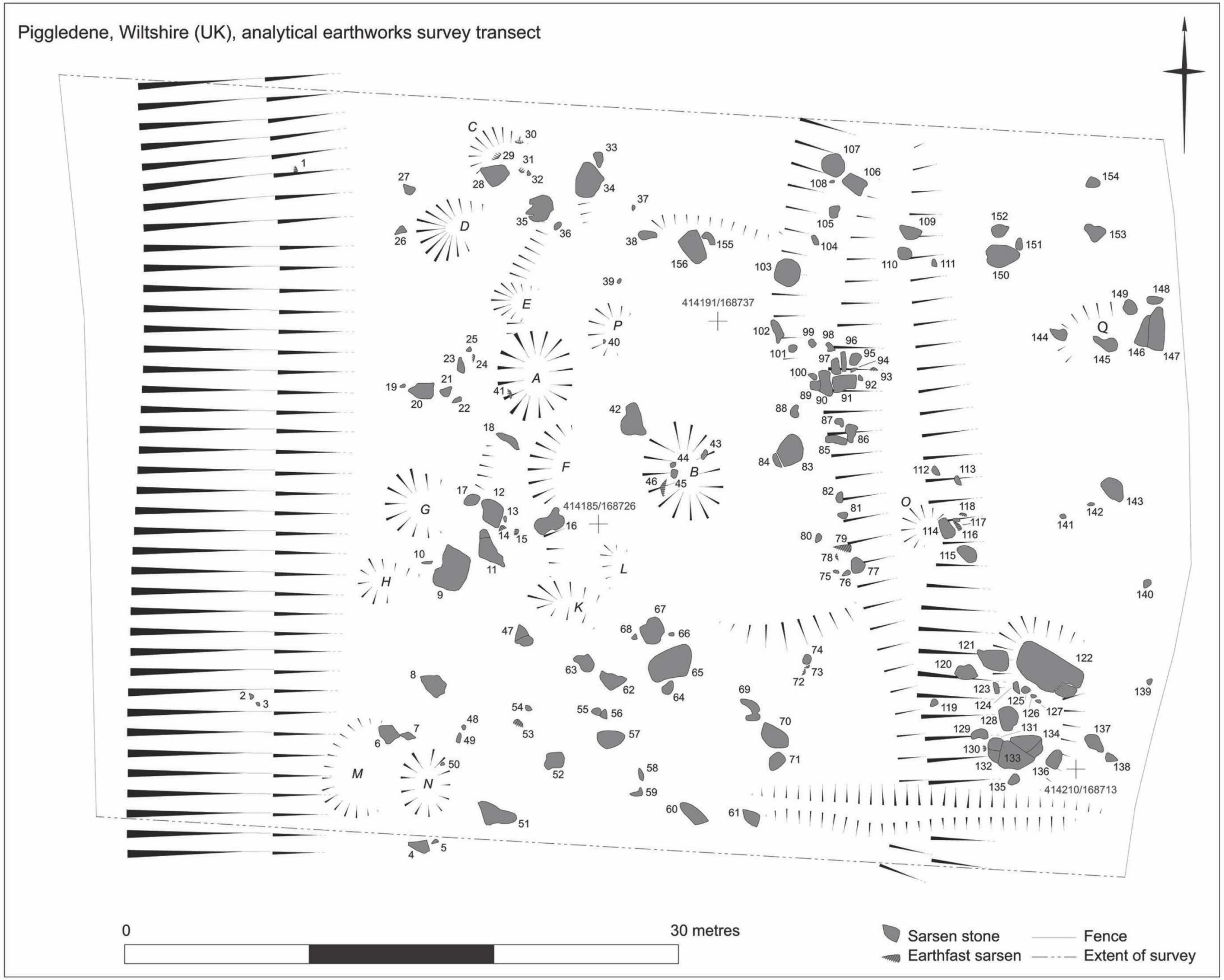


Figure 9 Piggledene, Wiltshire (UK). Surveyed at 1:200. Sarsen stones are numbered, extraction hollows are lettered.

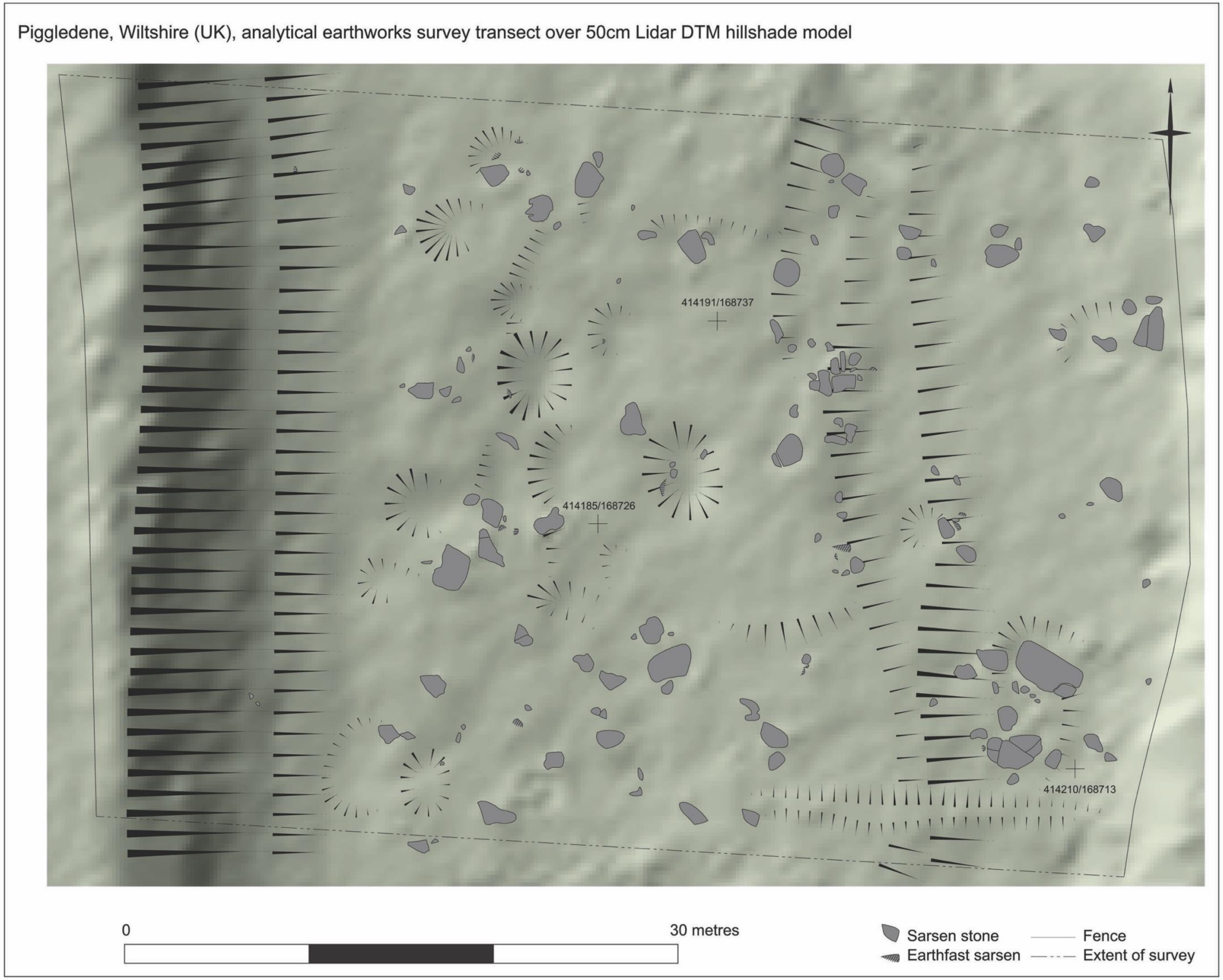


Figure 10 Piggledene, Wiltshire (UK). Surveyed at 1:200 and overlain on 50cm Lidar Digital Terrain Model, Hillshade visualisation (processed using the Relief Visualisation Toolbox). Environment Agency 2006-2010 composite DTM from EDINA Digimap Service.

Results

Throughout this report, stones in the survey transect are identified by number (e.g. stone [123]) or in groups of related stones thus: stone group [89]/[100]. Earthwork features are identified by letter. This section should be read with reference to Figures 8, 9 and 10[1].

Earthworks

The narrow southern reaches of Piggledene are dominated by the high fence-line and trees upslope to the west, and fence-line with hedge to the east running along the valley bottom (Figure 8). The western boundary of the survey transect is formed of a positive lynchet. Although not mapped by the Fyfield Down and Overton Down Mapping Project (Stoertz, 1995), it is clearly visible in the Lidar data now available for the area, and continues to the north parallel with two other linear earthworks that form part of the field system on the interfluve between the Kennet Valley and Piggledene (Figure 6, Figure 10). The modern fence-line runs along this feature, so it was not fully recorded by the survey. The lower slope of Piggledene's western side falls steeply from the lynchet, tapering into the valley bottom through a break of slope. There are very few sarsens on this steep slope. Those that can be seen (stones [1], [2] and [3]) are well-buried and it is not possible to judge their size.

The valley bottom, which falls gradually from west to east, is dominated by its scattered sarsen stones. Numerous hollows are visible amongst the boulders and split stones that lie on the surface. The whole area has been thoroughly worked over by the sarsen cutters. Irregular north-south linear features fall towards the lowest part of the valley. It is noticeable that the valley base on the eastern side of the transect appears to have had slightly fewer sarsens on the surface here, although this pattern is not continued at the same elevation throughout the valley. The hedge forming the east boundary is growing over a bank, also previously unmapped but

[1] In those measured survey drawings, 'earthfast sarsen' indicates a small portion of stone protruding from the turf where the bulk of the sarsen lay buried. All the sarsens in the survey transect are to an extent 'earthfast' – that is, they are partially buried in the turf – so the distinction is merely pragmatic, 'earthfast' indicating those stones whose planform could not be fully plotted.

visible in Lidar data. The present-day fence-line is generally butted up to this bank and so it was not recorded by the survey. Animal burrows in the bank are contributing to its spread and the formation of small fans of excavated debris on the valley bottom. The fields to either side of the fences delimiting lower Piggledene are ploughed.

Pits

There are 14 shallow, generally oval, pits in the valley bottom within the survey transect (Figure 9, Figure 10). The largest, pits A and B, are 4.6m and 5.3m long respectively, and just over 4m wide and 0.3m deep. Both have sarsen debris in their sides and bases. Pit N is smaller (3.7m long, 0.1m deep), but like A and B has clearly defined sides and contains sarsen debris. The remaining pits, although clearly defined, tend to have a steeper slope to the west which peters out on the eastern side, such as pit F. This is characteristic of the pits at the base of the valley's western slope, all of which are relatively shallow between 0.1m and 0.2m deep, as is pit Q in the valley bottom. The incipient development of a pit feature around the northern and western sides of stone [122], which was split once before being abandoned, indicates how these pits were developed during the stone cutting process.

In addition to pits A, B and N, pits C, M, O, Q and P contain, or have adjacent, sarsen cutting debris. Although shallow, ranging from 0.1m to 0.15m deep, they are most likely to be stone hollows left as a result of post-medieval quarrying. Pits D, F and G are similarly sized and although they do not contain stone debris on the surface are also likely stone hollows. Although the smallest pits E (2m wide, 0.15m deep) and H (2.3m wide, 0.13m deep) do not appear to contain sarsen debris, they are nevertheless within the range of numerous of the split sarsen stones in the valley bottom, such as stones [6] or [47]: they may have contained smaller sarsens that were entirely removed. The irregular forms of pits K and L may represent a different kind of disturbance. Both shallow features (0.1m and 0.15m deep respectively), they are far less regular than the more oval stone hollows and could conceivably represent some *ad hoc* digging for flints or other material. Ash and hawthorn trees grow in the valley bottom, so some tree throws might be expected. Pit K at least, at 2.3m long, could however had held a sarsen similar to stone [102], say.

Linear features

Pits E and A cut a gently sloping linear feature, approximately 6.4m long, in the north-west of the survey transect. There are other similar slight slopes in the western part of the valley bottom. Whilst the northern portion of stone [34] was removed by splitting, possibly leaving stone [33] as debris, both [35] and [16] are un-cut boulders which like [34] appear to lie over the tapering end of these slight slopes, which may be naturally formed slight benches of soil on and in which these sarsens lie. The slight south-facing slope above un-cut stones [38], [155] and [156] may also be natural, part of a slightly mounded area of ground around the large ash tree and clump of veteran hawthorns standing here on the northern edge of the survey transect. In contrast, to the north-east side of pit G a slight bank is more like an area of spoil to the side of the pit, as is the more substantial bank to the north of stone [74]. In that area, the cluster of split and possibly split stones [75]/[80] could represent the remains of a cutting episode with mounded and overgrown debris left in the environs. Alternatively, the raised area could be a location for the final reduction of sarsen blocks into the setts, kerbs, and building stone that the cutters were producing. The quarrymen worked in the open air, sheltered by propped hurdles and stacking their products nearby (King, 1968, Plate VIIa). This broader, flatter platform could have been prepared in one of the relatively few stone-free places, to provide a suitable workspace.

The three north-south linear features forming scarps that slope down from west to east into the lowest part of the valley bottom are an irregular but nevertheless strong feature in the survey transect. They are in part aligned to the gentle dip slope of the underlying bedrock which falls away to the south/south-east at between 2° and 3° (Clark et al., 1967, 5). Sarsens overlie these features and may well be buried in them. Pit O, developed during the splitting episode that left stone [114] and possibly stones [116] to [118], is cut into the top of the eastern-most slope. Each scarp is around 3m wide at its widest point, but, unlike the strongly defined lynchets to the north-west above the National Trust property, they do not provide broad, regular cultivation terraces and field boundaries.

The western of the three begins in the northern part of the survey transect. It runs to the north past the large ash tree and veteran hawthorns that stand on the transect boundary and continues beyond the limits of the survey area. The central linear feature tapers in from the north, becoming stronger and better defined in the environs of stone group [89]/[100]. There is no apparent gully or pit development around this originally large, tabular, sarsen and it may have been that the position of the boulder, slightly raised on the scarp, removed the need to dig away too much turf and topsoil prior to primary and secondary reduction. The linear feature passes to the south in a gentle curve. Narrowing, it becomes dominated by the eastern-most of the three scarps. This latter feature strongly delimits the edge of the lowest part of the valley floor.

Both it and the central linear appear to curve slightly to the south-west at the southern limit of the survey transect. Here, they are overlain by a narrow bank, approximately 0.3m high and 19.3m long, which passes from close to the present-day eastern fence-line into the valley. It appears to terminate close to stone [61]; although hawthorns grow in the environs of stones [60] and [61], obscuring the bank's true relationship with the sarsens. Continuing the line of the bank, a hawthorn between stones [51] and [52] hints at a former boundary running west-east across the valley at this point.

Sarsens and stone cutting evidence

Within the survey transect, 156 individual stones were recorded (Appendix A). This numbering system includes individual portions of split boulders; for example, stones [131], [132], [133], [134] and [136] are all pieces of what was one boulder in the south-east corner of the survey transect. Forty-eight stones showed unequivocal evidence of having been split, whilst 31 stones appear to be uncut natural boulders.

It was not possible to determine if the remaining 77 stones had been split or not: these sarsens are either too well buried or overgrown to permit conclusive examination, or the evidence is ambiguous. For example, a stone may appear to have a split surface, characterised by its even face, limited lichen growth, and a sharp edge meeting a more naturally undulating surface of an adjacent face; yet have no clearly visible wedge-pit scar or evidence of a point of percussion. Some of these 77 pieces of sarsen are likely to be cutting debris, such as the small angular blocks [43], [44], [45], and [46] in sarsen extraction hollow B. A less cautious estimation, including angular pieces and the small sarsens in extraction hollows, results in a count of 80 split pieces.

All the stones within the survey transect are pale grey saccharoid sarsen. There are very few examples of flints visible in the sarsens, and most boulders have extensive lichen growth over their surfaces. Soil has developed over low-lying stones, in pot holes on their surface, and in both natural cracks and splits left by past quarrymen. This has led to plant growth which in places obscures detail. Natural cracks or vents (a traditional quarry term for faults in rock, see Arkell and Tomkeieff (1953, 123), and used in relation to sarsen by Wiltshire stonemason Sam Fraser (pers.comm. 2019)) are occasionally visible.

Wedging

An early technique for dividing stone blocks or boulders involved cutting v-shaped wedge-pits in a line, each of which taking a wedge that is hammered to propagate a split. Whilst its origins are Roman, the method was applied to many different stone types across England from the medieval period (Stanier, 2000, 21-23). Clear evidence of sarsen stone cutting in the survey transect and along Piggledene more widely includes the scars of trapezoidal wedge-pits which were pecked out of stone surfaces to take flat splitting wedges, and holes chiselled into stone surfaces to take plug and feathers. Sixty-one wedge-pits, commonly visible as scars in split surfaces (although in some examples whole and unused), and one plug hole were recorded on the survey transect’s 48 clearly split stones.

The sarsen splitting technique was described by Free (1948), and amplified by King (1968) who was able to draw on the memories of Kennet Valley residents who retained some familiarity with the process. This description begins with a gully dug around selected sarsens, which were then marked with a lightly chiselled line to indicate where the main splits for primary reduction were desired. A series of pecking hammers – double-ended axe hammers – were used to cut out and enlarge wedge-pits along the marked line. The wedge-pits were finished using punches. A flat wedge, feathered with pieces of hoop iron (thin, flat pieces of metal strip) to prevent its bottom touching the base of the wedge-pit, was placed in each wedge-pit and struck with a 14lb sledge hammer until the stone split. The hoop iron was a safety measure: if a wedge has ‘bottomed’, it and the hammer will spring back when struck, possibly causing an injury. Wedges were then worked at right-angles to root holes, or in parallel with the plane in which the boulder originally formed (Free, 1948, 338, King, 1968, 90-1).

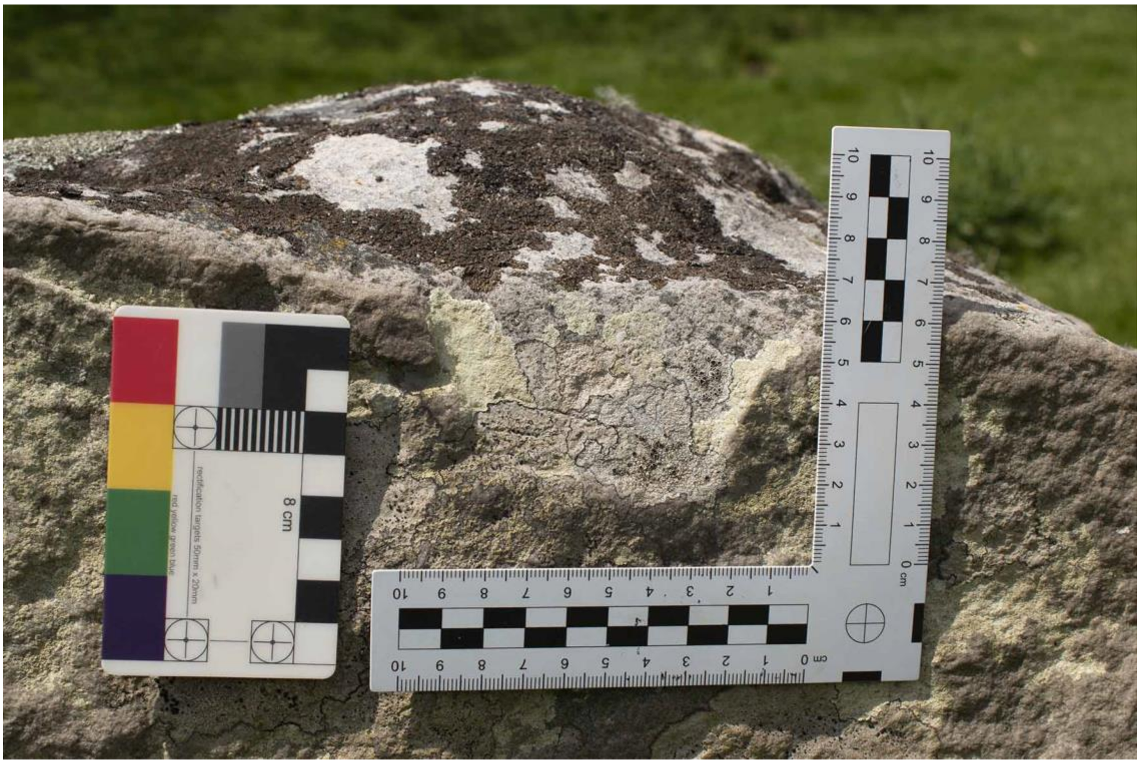


Figure 11 Wedge-pit scar 012_01 cut into the upper surface of stone [12] in the Piggledene survey transect.

The wedge-pits are trapezoidal in profile, usually slightly asymmetrical with one end a little steeper than the other. One end may also be slightly convex (Figure 11). The profile may indicate the direction from which the pit was cut. The opening of the wedge-pit in the stone surface is always longer and wider than the base. Wedge-pits are symmetrical in section, but this is harder to record and illustrate for a number of reasons. First, the majority of whole wedge-pits are now infilled with soil and plant growth, or were filled with mortar following the

Figure 12 The split, and two wedge-pits, between stones [146] and [147] in Piggledene survey transect, filled with mortar following the purchase of the National Trust property in 1908.

purchase of Piggledene in 1908 (Figure 12). Secondly, they very rarely split symmetrically through the very base of the wedge-pit: the majority of the wedge-pit including the base is left as a scar on one stone surface, with only the chiselled interior face of the other half on the opposite surface.

One wedge-pit opening and base (stone [12]) could not be measured in full because the scar was cut in half when a second piece of stone was removed from the boulder. Seven bases could not be measured, either because they had been removed by subsequent reduction or were inaccessible, for example because the wedge-pit included mortar or vegetation (stones [6], [12], [63], [131], [133]). All wedge-pit and plug hole measurements are detailed in Appendix B.

The mean **length of wedge-pit openings** in the survey area is 90.9mm (n = 60) (Table 1). Always the biggest dimension of a wedge-pit, it is also highly variable with a range of 49mm (SD = 12.46). Half of the wedge-pits in the survey transect are between c80mm and c100mm long (Figure 13). The group of eight wedge-pits with openings around 75mm long are not restricted to one stone working area, but distributed across the transect on stones [28], [36], [47], [61], [95], [96], [134] and [144]. The fourteen wedge-pits around 85mm long are similarly well-distributed across the stones and the survey transect, on stones [28], [61], [63], [83], [84], [89], [90] (three examples), [96], [97], [114], [131], and [136]. Ten wedge-pits form another group around 95mm long, on stones [28], [34], [62] (two examples), [63], [89], [91], [102], [144], and [147]. Wedge-pits with the longest openings, above 100mm, are found on stones [6] (two examples), [12] (two examples), [34] (two examples), [63], [91] (two examples), [97] (two examples), and [147] (three examples).

	minimum	maximum	range	mean	N
Opening length	71	120	49	90.9	60
Opening width	28	46	18	43.8	5
Base length	25	68	43	47.2	54
Depth	14	74	60	43.9	58

Table 1 Wedge-pit dimensions in surveyed stones, Piggledene (mm).

The length of **wedge-pit bases** could be measured in 54 examples (Table 1, Figure 14). Ranging from 25mm to 68mm (mean 47.2mm, SD = 8.39), 70% are between c40mm and c50mm (Table 2). The group of seven wedge-pit bases around 60mm long are on stones [12], [62], [91], [107] and [147] (three examples): they are distributed across the survey transect.

	min	Q1	Q2	Q3	max	SD	N
Opening length	71.00	83.00	89.00	93.00	120.00	12.46	60
Base length	25.00	42.00	46.50	51.75	68.00	8.39	54
Depth	14.00	37.00	44.00	50.75	74.00	10.56	58

Table 2 Quartiles of the principal wedge-pit dimensions in surveyed sarsens, Piggledene (mm).

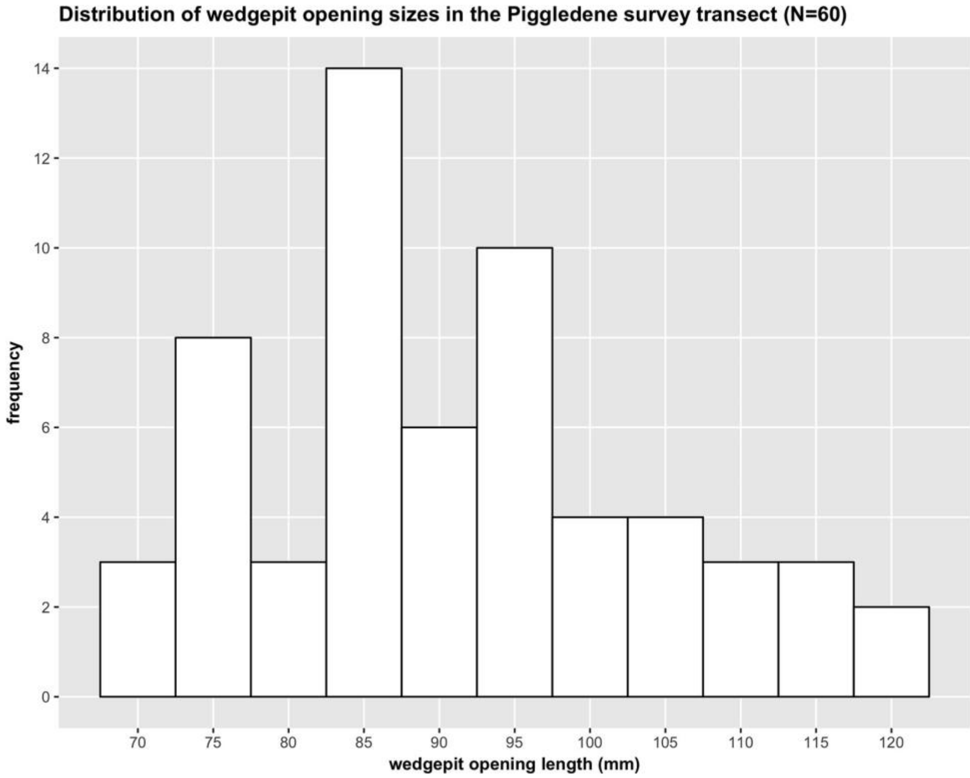


Figure 13 Histogram of wedge-pit opening lengths recorded on split sarsens in the Piggledene survey transect.

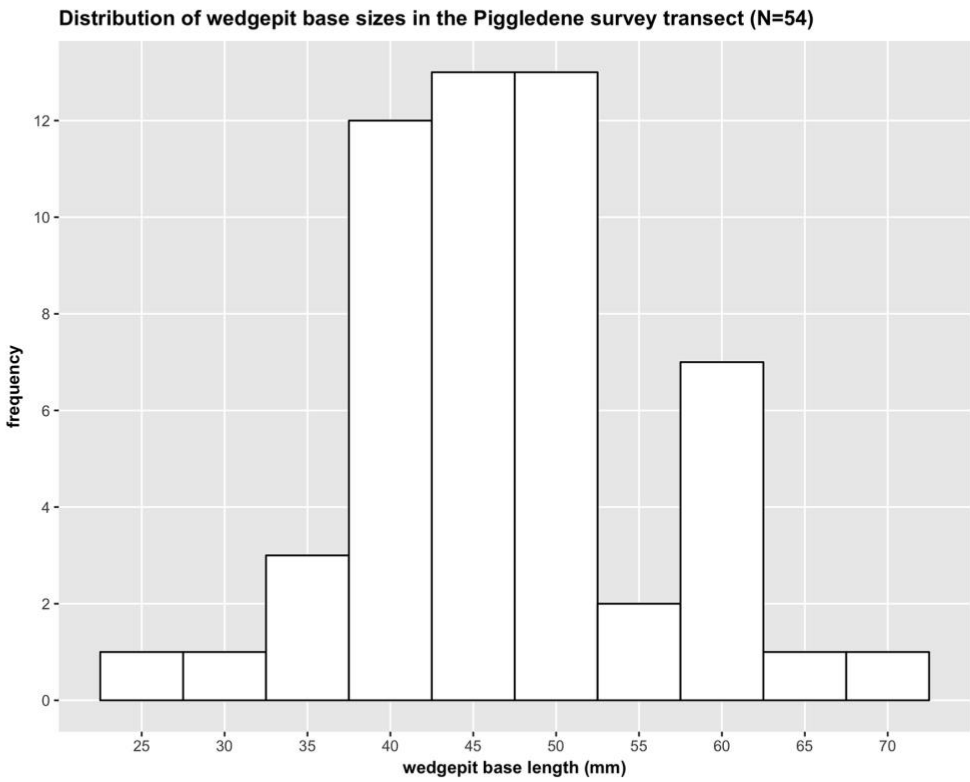


Figure 14 Histogram of wedge-pit base lengths recorded on split sarsens in the Piggledene survey transect.

Although variable, a comparison between wedge-pit openings and bases suggests that a wedge-pit with a larger opening will tend to have a correspondingly larger base (Figure 15).

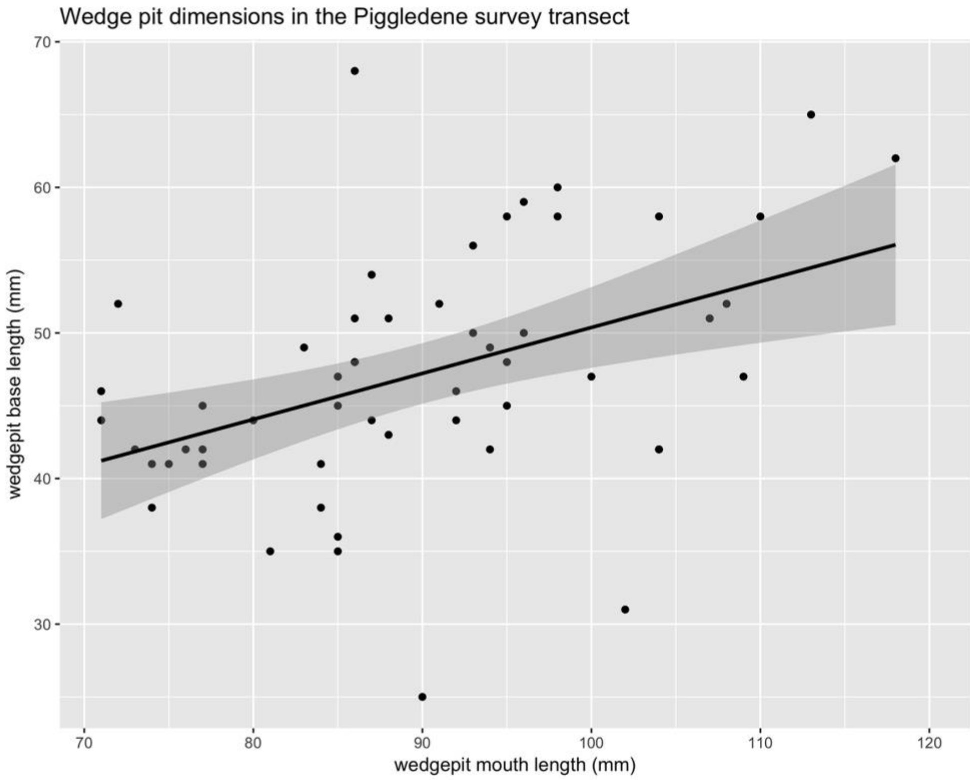


Figure 15 Scatter-graph of wedge-pit opening lengths and base lengths recorded on split sarsens in the Piggledene survey transect.

Wedge-pit depth (Table 1, Figure 16) was measured on the centre line of each scar, and is highly variable, ranging from 14mm to 74mm (mean 43.9mm, SD = 10.56, n = 58). This measurement should be treated with some caution, because of the difficulty of consistently identifying the top of the wedge-pit in uneven stone surfaces and because of variable treatment of the stone surface. This variability principally derives from the irregularity of boulder surfaces. The shallowest wedge-pit (14mm, stone [84]), was cut into a hollow on a stone surface which had already been deepened by a flake scar removed in the course of cutting an earlier, failed, wedge-pit. At 18mm deep, a scar on the east face of stone [97] is in all likelihood only a partial reflection of the original size of its wedge-pit: also cut into an irregular hollow on the surface of the boulder, the majority of the wedge-pit was removed on the missing piece of stone.

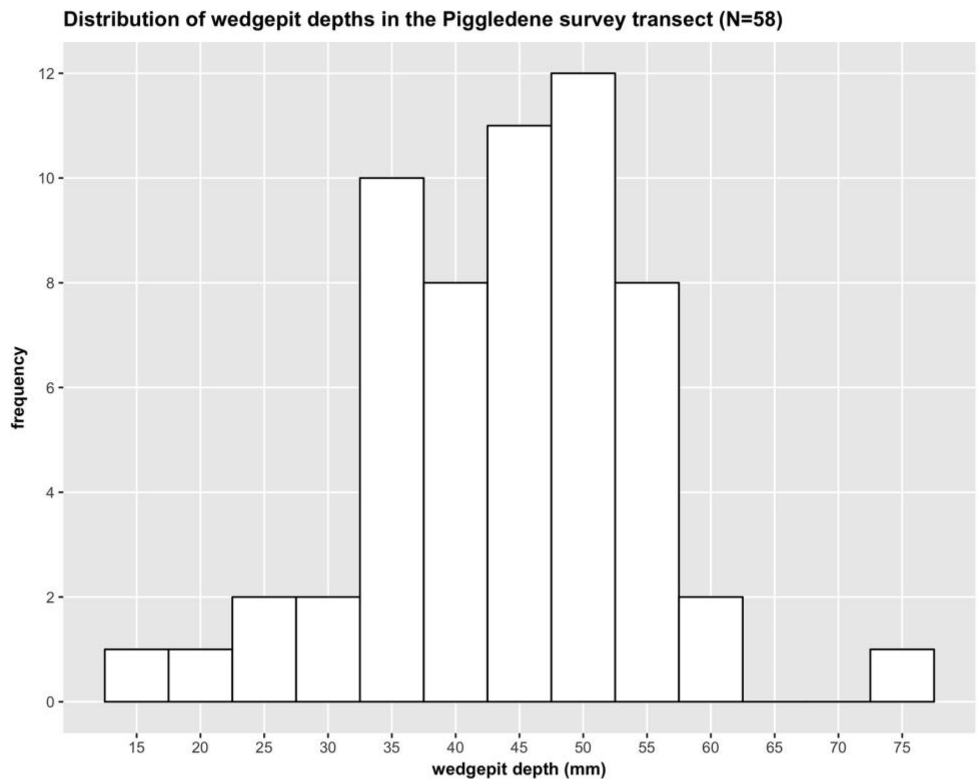


Figure 16 Histogram of the depth of wedge-pits recorded on split sarsens in the Piggledene survey transect.

The deepest (74mm, stone [6]) is one of the few whole wedge-pits in the survey transect, and in terms of depth is an outlier. This wedge-pit overall is a complex shape. Stone to the north side of the wedge-pit spalled during its preparation, leaving a large flake scar and lowering the surface compared with the south side. The depth measurement reflects the difference in height of the wedge-pit sides, rather than necessarily a need to make a deeper wedge-pit in this particular stone. In the event, stone [6] was left un-cut, possibly because a natural fault in the boulder adversely affected the intended split (see discussion below).

The next deepest wedge-pits are in stones [83] (61mm) and [91] (62mm). The whole of the eastern edge of stone [83] is irregularly flaked and damaged, with two possible wedge-pit scars and a third which, though measurable, is itself one of the least clearly defined in the survey transect and should be treated with caution. In contrast, the west face of stone [91] is a straight split surface with three well-defined wedge-pits. The deepest is placed towards the centre of the large sarsen boulder of which stone [91] was a part. Whilst wedge-pit depth displays the greatest range of all three principal wedge-pit dimensions, the majority of wedge-pits (71%, n=58) are between c35mm and c55m deep. King (1968, 90) reported that wedge-pits were cut to depths from 1” (25mm) to 1.5” (38mm), which would be well to the lower end of the range observed in the survey transect.

In the majority of instances, it is not possible to measure the **width of a wedge-pit** at its opening or base, because only one half survives as a scar (the other removed on a piece of stone that was further reduced by the quarrymen to make saleable products). Furthermore, where whole wedge-pits are present they are either difficult to record because of infilling material, or they survive as two halves on opposite pieces of stone that can be matched but which are now some distance apart. The width of five wedge-pit openings were measured (in stones [6], [63], [131] and [133], Table 1), but these figures should be read with caution because all included infilling material.

Figure 17 Stone [6] in the Piggledene survey transect, with two wedge-pits cut into the surface. A lightly chiselled line (visible below the 8cm scale card) can be seen running from the left-hand wedge-pit towards the edge of the boulder. The surface spalled to the south side of the left-hand wedge-pit during its preparation.

Three variants in treatment of boulder surfaces around wedge-pits were noted. Some sarsens in Piggledene have a line lightly chiselled along the course of the intended split prior to the pecking out of wedge-pits, a technique reported by King (1968, 90). Only stone [6] in the survey transect showed this unequivocally (Figure 17), although more examples may have been present here, yet destroyed in the reduction process. The stone surface around two wedge-pits in stone [34] had been prepared by slight cutting back to lower the stone surface. Although shallow, this was noticeable because of the regularity of the relatively straight edges where material had been pecked away (Figure 18). There are more examples, however, of irregular spalling around the mouths of wedge-pits where small flakes were removed during the initial stages of opening up the surface. These include stones [6] (Figure 17), [131], [132], [133] and the failed wedge-pit in stone [84]. In the example of stone [84], a large flake was removed during wedge-pit preparation which left too little material to support one side of the wedge. This wedge-pit was abandoned and another made c15cm further over.

Figure 18 The upper natural surface of stone [34] in the Piggledene survey transect, lightly pecked away over two wedge-pits.

Wedge-pit and plug and feather hole positioning on split stone faces varies. Sarsens in the survey transect with one split face had been divided either with wedge-pits pecked into the upper surface of the stone, or pecked into one side. The sole example of a plug and feather hole was positioned in the upper surface of stone [69].

In the survey transect, positions of wedge-pits are dominated by those pecked into the upper surface of a boulder (Table 3). This is on the whole expected; the upper surface of the generally tabular or pillowy boulders is the most accessible, and accords with anecdotal observation of split stones across the dispersed sarsen quarry on the Marlborough Downs, which tend to have been cut from above.

	Upper surface	**Side surface**	**Upper and side surface**
Stone number	4, 6, 36, 47, 55, 63, 84, 106, 107, 114, 144, 146, 147	61, 62, 102	28, 34

Table 3 Wedge-pit positions in sarsens with one split surface.

Figure 19 Stone [61] in the Piggledene survey transect, from the east. The split surface shows two wedge-pit scars low down on the right-hand side, marked by scale cards.

The three sarsens split with wedges from the side vary in profile. Stone [61] profile approximates a bell curve, and thus is much thicker from top to bottom than from side to side (Figure 19). Stone [62] is similar, although considerably wider (c0.7m). Two wedges low down in the western side of this sarsen appear to have been sufficient to split away the northern portion, although a bulge of stone in the middle of its base shows where this was not a perfectly clean fracture. Stone [102] in profile is a smaller version of stone [62]: one wedge-pit in the eastern side was enough to split away the south-east end.

Figure 20 Stone [28] in the Piggledene survey transect, from the north. The split surface shows three wedge-pit scars, marked by scale cards.

There are two examples where the wedge-pits had been located in both the top and the side of the stone on the plane of the intended split. Stone [28] is a tabular sarsen, c0.5m thick, lying at the edge of extraction pit C (Figure 20). There is no clear extraction gully around the stone, which is low-lying. The two wedges used in its upper surface may have required augmentation by the wedge placed in its eastern side to propagate a split to remove the northern portion. Stone [34], a large boulder close to the northern edge of the survey transect, is in contrast quite rounded and similar in profile to stone [62]. Three wedge-pits very close to one another, with the lowest very close to the present turf line, on the eastern side of the sarsen, are augmented by a fourth wedge-pit placed 240mm further along. Despite the distance from the wedges used in the side, this fourth wedge-pit is still not in the very top of the stone over the apparent thickest part as exposed by the successful split. It is perhaps only the bulkier form of stone [34] compared with stone [62] that meant it required four wedges to split it, arranged over a greater span.

Figure 21 Stone [12] in the Piggledene survey transect, from the north-east. The northern portion of the parent boulder was removed first (split face to right). When the eastern portion was removed (split face to left), using two wedges, a wedge-pit in the upper surface of the sarsen was split in half (indicated by the scale card with colour flashes).

Arrangement of wedge-pit locations becomes more complicated in sarsens with multiple perpendicularly split faces. Stone [12] is the simplest with two perpendicular split faces: here, at least one wedge was used in the top of the boulder to make the first split, removing the northern portion of the parent boulder. This was followed by a wedge-pit in the top and another in the side to make the second perpendicular cut through the more irregularly-shaped remaining southern portion, removing the eastern side (Figure 21). The side wedge was placed at approximately the mid-point of the edge. In this location, hammering force on this wedge would have been driving towards a point on the other side of the boulder between the thinnest and thickest parts: allowing the energy to pass through the rock but just close enough to the thickest material to ensure that the split ran true throughout the boulder.

	Distance 1 (mm)	Distance 2 (mm)	Distance 3 (mm)	Distance 4 (mm)	Distance 5 (mm)
two wedges					
Stone [06]	130				
Stone [61]	85				
Stone [62]	150				
Stone [63]	80				
Stone [89]	36				
Stone [90]	91				
Stone [96]	290				
Stone [96]	260				
Stone [107]	170				
Stone [133]	360				
Stone [144]	80				
three wedges					
Stone [28]	480	75			
Stone [91]	240	330			
Stone [97]	40	180			
four wedges					
Stone [34]	63	20	240		
six wedges					
Stone [147]	180	25	90	50	85

Table 4 Distances between wedge-pits on split sarsen stone faces.

Two groups of stones represent complex reduction episodes (the reduction sequences are described below, see *Splitting sequences*). In the first, stone group [89]/[100], all the wedge-pits used for primary reduction were placed in the upper surfaces of what had been a large, tabular, sarsen, approximately 2m x 2m in area and with c0.5m of stone above the turf line. The boulder had some root holes and surface irregularities towards the centre of the upper surface and some natural vents. Secondary reduction was also from above, with one side wedge-pit located in the middle of an edge to remove the northern portion of stone [90]. Secondary and tertiary reduction to produce stones [96] and [97] also appear to have been from above. The second group of stones, including [131]/[136] (although perhaps not [135]), are the split pieces of a large, more pillowy, sarsen that was originally more than 2m long. This boulder was highly irregular with a large pot hole in the upper surface and some natural vents. All the wedge-pits were placed in the upper surface of the stone, despite its thickness.

King (1968, 90) reported that wedge-pits were placed approximately 12” (305mm) apart. Although this is likely to have been a generalisation born of Noel King’s conversations with villagers some 40 years after sarsen quarrying ceased, it is not borne out by the examples observed in the survey transect. The distances between wedge-pits are varied (Table 4). In the 11 stone faces split by pairs of wedges, the distance between them varies from 36mm to 360mm. In the three faces split using three wedges, two wedge-pits were placed close together with a third further away to split stones [28] and [97]; whilst the wedges used to split stone [91] from material on its northern side were comparatively evenly spaced along the length of the intended break. The four wedges required to split stone [34] and six for stone [147] were placed at irregular distances. These details are discussed below.

Splitting sequences

Splitting sequences have been touched on above in the description of wedge-pit locations. Three stones illustrate the approach taken by the sarsen cutters working in the area of the survey transect. Each shows the importance of making perpendicular splits to reduce a boulder to pieces which could then be cut into regular kerbs, setts, and building blocks. This is demonstrated most simply by stone [12] which was split first from east to west to divide the boulder into two portions. The northern-most part of the parent boulder has been fully removed, but the southern-most part was split from north to south and its western portion remains in situ. Stones [13], [14] and [15] may be small pieces trimmed in the process.

Stone group [89]/[100] resulted from a more complex splitting sequence. In contrast to stone [12], the primary splits were from north to south, dividing stones [89] and [100] from stone [90], and stone [90] from stones [91] and [97]. Secondary reduction produced smaller pieces by east-west splits, dividing stone [89] from [100], stone [91] from stones [96] and [97], and removing the northern end of stone [90]. Yet smaller pieces were then cut with north-south splits, dividing stone [95], [96] and [97] from one another. Each split is perpendicular to the previous split. Stone [96] provides evidence for movement by the sarsen cutters. It has evenly spaced pairs of wedge-pits in two edges. There is not enough room between it and stone [97] for the western-most wedges to have been hammered from that side. The block must have been rotated to be split, before being abandoned.

Just to the east of stone group [89]/[100], stone [146] was divided from stone [147] by a long north-south split. Whilst stone [146], with its naturally-shaped outer surface, was left in situ, the eastern-most portion of the parent boulder was split from stone [147] by a parallel north-south split and removed. No further reduction occurred, but in analogy with stone group [89]/[100], secondary east-west splits might have been expected to produce sarsen pieces that could have been further reduced to blocks like stones [96] and [97], ready for preparation as street furniture or building blocks.

The parent boulder from which stone group [131]/[136] was split appears to have been more irregularly shaped than the tabular sarsen broken down into stones [89]/[100]. Its curving, rounded ends to east and west were split away first, breaking the sarsen into three blocks. The end blocks were then divided into two by perpendicular splits, forming stones [131] and [132] to the west and stones [134] and [136] to the east. The sarsen was abandoned before any further reduction proceeded to break down the large central section (stone [133]). This may have been because of the way the split dividing stone [136] from [134] had failed. Instead of running true from the upper surface of the sarsen through to the base of the stone, this split ran out to the east in a deep curve. Flints in the sandstone, divided in two by the split with halves remaining in the faces of stones [136] and [134], may have been the cause.

Plug and feather

Accounts of the sarsen quarrying industry that was developed in Wiltshire by specialists who moved from Buckinghamshire from 1847 only describe the wedging method (as described above) (Crook and Free, 2011, Free, 1948, 1950, King, 1968). Nevertheless, holes cut into sarsens in Piggledene for the purposes of splitting using the plug and feather method have been noted by Stanier (2000, 43).

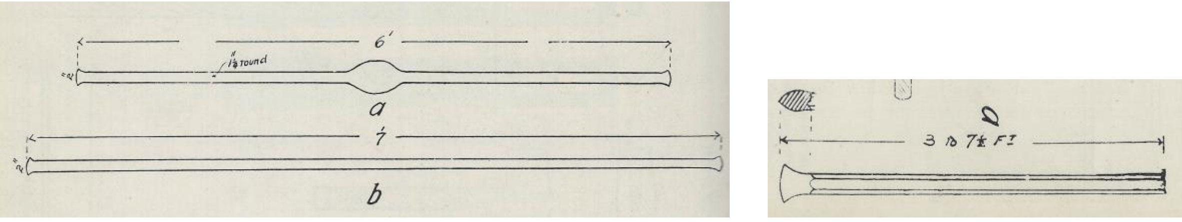


Figure 22 Left: Tools used in the Delabole slate quarry, illustrated in Greenwell and Elsden 1913, 216 (figure 161). A swell jumper (a) and a pitching jumper (b), their weights and dimensions designed for relatively soft slate. Right: a jumper bar, illustrated in Greenwell and Elsden 1913, 215 (figure 160).

Plug and feather splitting was introduced in stone quarrying from the early 1800s. Prior to the invention of pneumatic drills (which were not widely adopted until the early twentieth century), the plug hole was cut with a chisel-tipped borer or long jumper (Figure 22). Shorter plug holes can be cut with shorter narrow chisels called jumper bars. These iron tools were either hammered or 'jumped' (dropped with force) onto the stone surface, turned in between each stroke to create a cylindrical hole. Cutting plug or bore holes in hard rocks, such as granite, could also involve using a cross-bit chisel. The plug is a form of wedge, usually round or sub-octagonal in section, widest at the top where its flat head is to be hammered. A plug is placed between two feathers which, like the pieces of hoop iron used with flat wedges, stop the plug from touching the bottom of the hole. The feathers are half-round in section (Stanier, 2000, 43, Greenwell and Elsden, 1913, 293-4) (Figure 23).

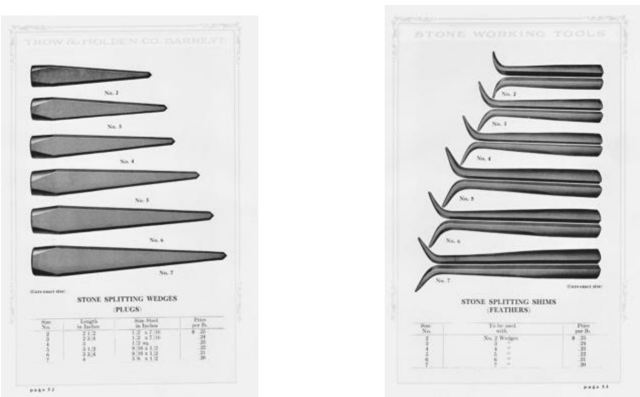


Figure 23 Sets of American factory-made plugs (left) and feathers (right) from Barre Stone-working tools advertised in Trow and Holden Catalogue 7, published in 1926.

One example of a plug hole was observed in the survey transect, in stone [69]. This is now an irregularly-shaped boulder lying low to the ground in the south of the survey transect. The hole – which is of course a half-cylinder because a proportion of the sarsen boulder was split away – is cut into the south-facing split surface (Figure 24). The exposed natural northern- and southern-most surfaces of the c0.5m wide boulder are rounded and no root holes or other likely faults are visible in the stone. Nevertheless, the boulder did not split true. Instead of splitting through the middle, the split 'ran out', removing a roughly lenticular piece of stone from the surface and leaving a bowl-shaped void. Soil development and plant growth in the void now obscures most of the split surface. The plug hole is 47mm deep, 43mm in diameter at the mouth, and 37mm wide at the base. What remains of its base is flat.

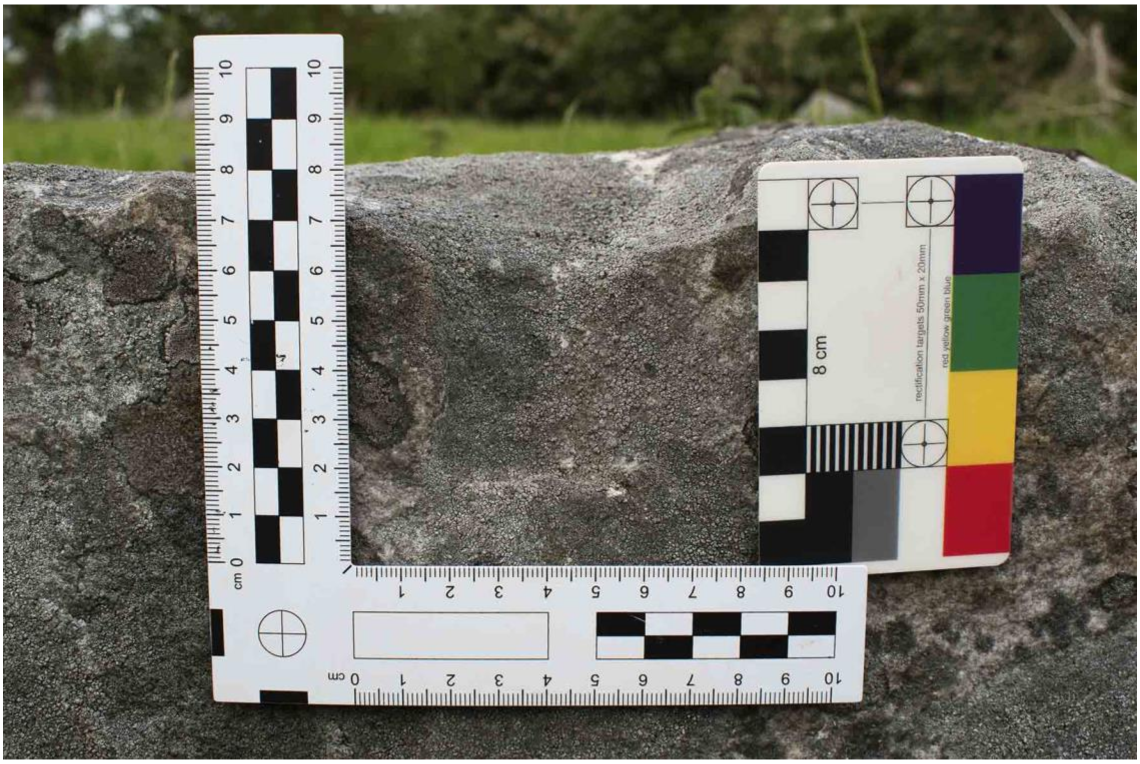


Figure 24 Stone [69] in the Piggledene survey transect. A half cylinder of a plug hole for use with plug and feathers, made more difficult to see in profile by lichen growth, is flanked by scale cards.

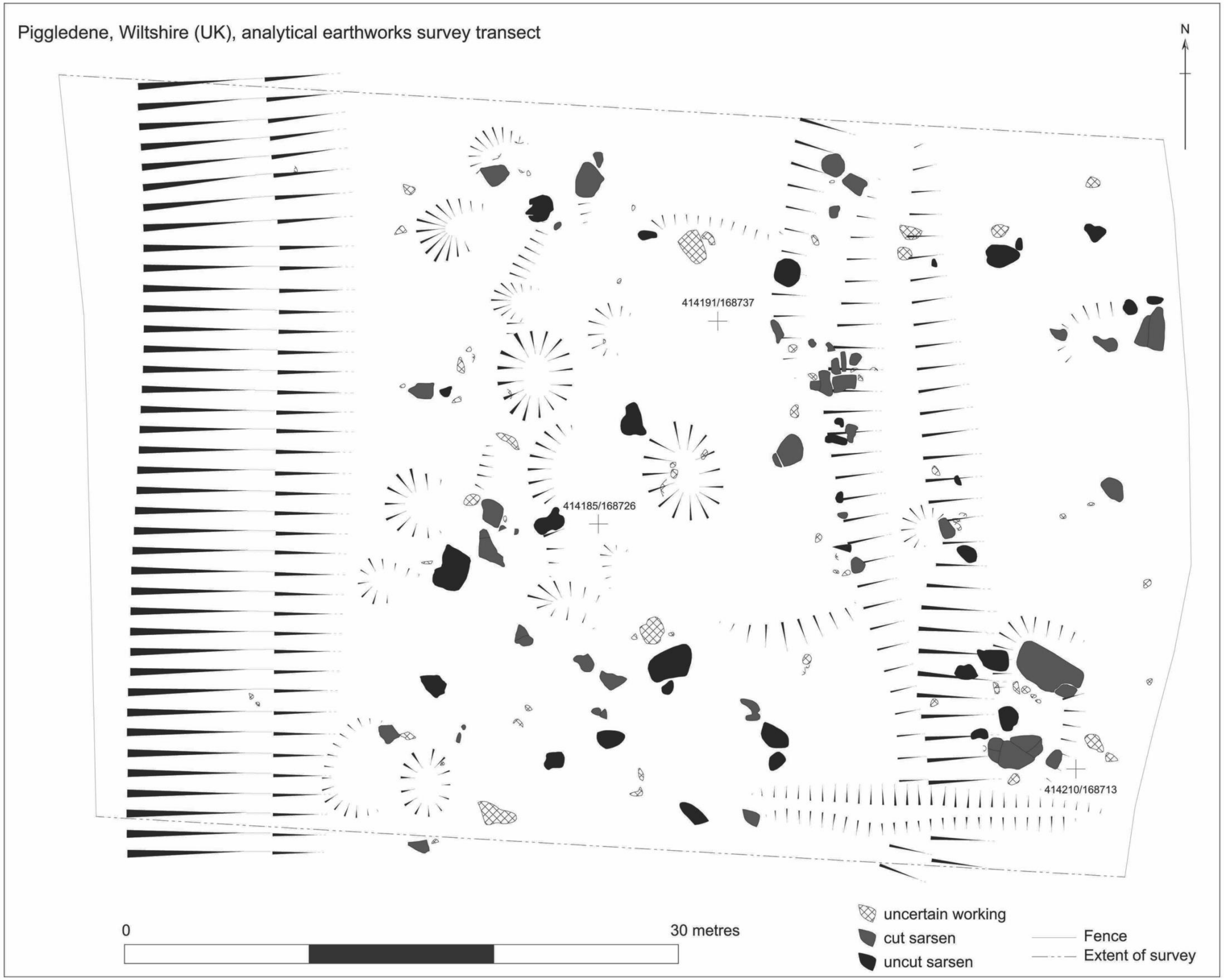


Figure 25 Piggledene, Wiltshire (UK). Surveyed at 1:200. Distribution of cut and uncut sarsens.

Distribution of sarsens over the survey transect

In terms of a simple count, more split sarsen pieces remain in the eastern part of the survey transect (Figure 25). There are more stone hollows in the western part, where all or almost all of the parent sarsens have been removed. Unworked ('uncut') sarsens are fairly evenly distributed across the survey transect, with slightly more in the eastern area. This distribution suggests that the quarrymen were working from west to east in the environs of the survey transect, abandoning some major partially-worked stone groups in the eastern part perhaps at the time of the 1908 land purchase.

Sarsens that cannot with certainty be identified as cut or uncut are scattered across the survey transect. As described above, the examples in stone hollows A, B, C and N could reasonably be inferred to be stone splitting debris. For example, in the southern edge of stone hollow C, stone [28] has a clearly split north-facing surface and thus stones [29] to [32] are very likely to be waste material from the parent sarsen. Similar material adjacent to stones [6], [77], [122] and stone group [89]/[100] probably bears a similar relationship to the parent boulders.

Mortar

The survey transect includes clear evidence of the attempts that were made after the 1908 purchase of the land to 'fix' split sarsens. Stones [63] and [84] and stone groups [89]/[100], [130]/[136] and [146]/[147] all exhibit mortar, filling wedge-pits and trying to hold together split faces (Figure 12). This represents a futile response to the remains left by the sarsen quarrymen. For a brief while in 1976 it perplexed Collin Bowen and the *Sarsen Stones in Wessex* project team who thought the material adhering to sarsens in the valley to be a natural phenomenon (Bowen, 1976) until corrected by Noel King, warden of the Fyfield Nature Reserve. Other examples were observed throughout lower Piggledene, especially in its southern-most reaches, during the walk-over survey.

Walk-over survey

Compared with available Ordnance Survey mapping from the nineteenth century, in which sarsens were surveyed and drawn right up the valley onto Overton Down, Piggledene overall today is a considerably less stony place. The concentration of surviving sarsens on the National Trust property attests to the success of the 1908 purchase in preserving the spread of stones. Walking down Piggledene from New Shed towards Pickledean Barn and onward to the A4 gives the firm impression that the stone cutters had worked from north-west to south-east, removing the majority of stones until they reached the narrowest part of lower Piggledene.

Sarsen clearance here has, however, not only been due to the quarrymen. Over the years, stones have been moved for agricultural reasons to the field boundaries, most notably the southern fence line running from SU 1376 6894 to SU 1413 6887. This includes an episode in 1978 when sarsens were cleared from an area to the south-east of Pickledean Barn (marked as field 0003 on the Ordnance Survey Wiltshire county series 1:2,500 map published in 1977) (Swanton, 1978). Despite the significance of the sarsen quarry, some of the present-day absence of stone in this locality is also due to agricultural clearance. Moreover, the location of different methods of sarsen splitting in the valley suggests a more complex sequence of exploration and exploitation by the quarrymen.

Earthworks

Whilst the earthwork field systems in the environs of Pickledean Barn are relatively slight, three substantial parallel banks on the western valley side dominate the narrowing valley at SU 1408 6893 (Figure 6, Figure 26). These cultivation terraces form a stark contrast to the lower valley bottom, strewn with stones but marked by access tracks and scarps that relate to the north-south linear features recorded in the survey transect. The shallow, gentle scarps in the valley bottom appear to begin – or at least, become most obvious – from a location around cSU 1408 6908, below a raised area of ground in front of a field gate in the eastern field boundary.

Despite being significant features, these north-south linears are not especially clear in models derived from 50cm Environment Agency Digital Terrain Model Lidar data, processed using the Relief Visualisation Toolbox. The Local Relief Model visualisation (Figure 26) provides the strongest hint of some these features, but still does not capture the way that the scarps taper in and out, forming the western slopes to the lowest part of the valley bottom. To the south of the survey transect, as suggested by the detail recorded in the analytical earthworks survey, the north-south linears curve to the south-west and appear to abut, or be overlain by, the sloping western valley side. The rounded platform thus formed at approximately SU 1418 6867 is slightly hollowed, with sarsens on the surface surrounding the central depression. Immediately to the south-west, a slump or fan of material including sarsens appears to cover part of the western valley side.

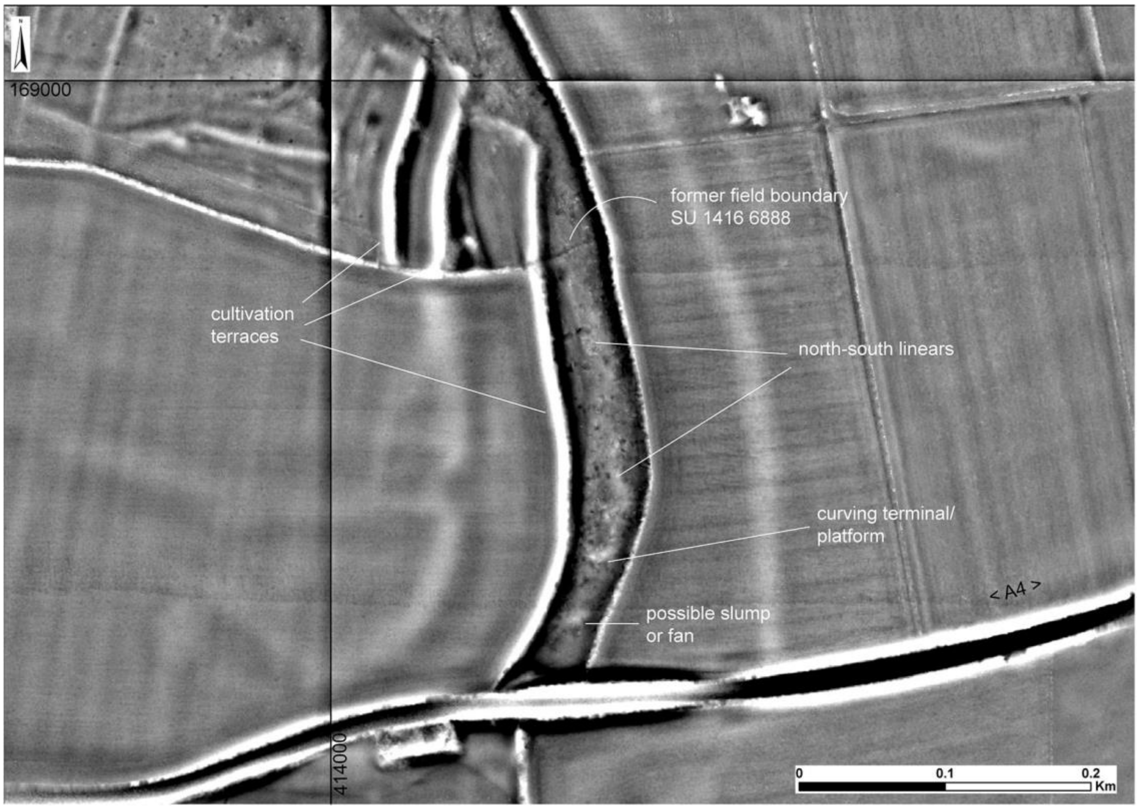


Figure 26 The southern reach of lower Piggledene depicted in a Local Relief Model visualisation of 50cm Lidar Digital Surface Model data (processed using the Relief Visualisation Toolbox). This is a re-scaled extract from the area shown in Figure 6. Substantial upstanding lynchets show as contrasting black and white stripes (cultivation terraces), while ploughed-out lynchets are more spread, grey linear features. Within the narrow southern reach of the National Trust property, north-south linear features show as paler areas including the curve into the western valley side, and the possible slump or fan of material on the west, just to the north of the A4. Environment Agency 2006-2010 composite DSM dataset from EDINA Digimap Service.

The former field boundary at SU 1416 6888 comprises a sarsen bank. A single sarsen gatepost at its eastern end marks the former gateway depicted on the estate map produced by Dymock in 1819 (WSHC 778/2). Two sarsen gateposts stand above the western end of the boundary line at SU 1413 6887, marking the end of a trackway that passes over strongly defined lynchets and into the ploughed field to the south. In contrast, the former boundary that passed from east to west halfway down the narrowest part of the valley is poorly defined. This fence or hedge line was depicted on the Enclosure Award map of 1815/16 but not on Dymock's map or any later mapping. Whilst it may be represented by the east-west bank within the survey transect, a similar linear feature runs parallel just to the south of that surveyed earthwork (outside the transect). Both features peter out in the middle of the valley and are obscured here by vegetation.

Where Piggledene is now overlain by the modern A4, the current field gate is in the same position as depicted on Dymock's map of 1819. An earthen ramp leads from the south-east corner of the valley bottom up to the gate in the south-west corner. The north-facing base of the embanked road is partially visible through plant growth. Although obscured, it is clear that the embankment is faced, if not actually built with, large squared blocks of sarsen. These are similar to the blocks in which the Pickledean Barn walls are constructed.

Sarsen distribution and quarrying

The present distribution of sarsens in lower Piggledene, concentrated on the long, thin National Trust property, is due to the preservation of this area in 1908. Immediately to the east of Pickledean Barn, most surviving sarsens are to be found on the lower ground. These include stones that were split but abandoned by the sarsen cutters, as well as uncut boulders. Linford (2008) suggested that at some point sarsens had been cleared from the higher ground to the south-east of Pickledean Barn down into the valley, but whilst this is plausible (and recorded elsewhere, see Gillings et al. (2008, 337)) there are no specific clusters of dumped sarsens: their general disposition in this part of the valley is similar to its southern-most reaches and to sarsen spreads elsewhere on the Marlborough Downs.

There is a concentration of sarsens in the valley bottom in the upper area of the narrowest part of the valley, in the environs of SU 1418 6885. Fewer of these boulders appear to have been split than amongst similar groups of the stones in the valley. They are well-buried, low lying to the turf, and on the whole pillowy and uneven, some with large potholes in their surfaces. There are correspondingly fewer stone hollows in this part of the valley.

Nevertheless, throughout the valley outside of the survey transect evidence for quarrying includes both splitting with flat wedges and by plug and feather. The majority of split stones show the trapezoidal wedge pits and scars of wedging. This includes examples of the lightly chiselled lines indicating the course of the intended split, preparatory chisel marks visible on sarsen surfaces around wedge-pits, and at least two wedges stuck in failed wedge-pits. Whilst evidence for wedging is most frequent and widely spread throughout the valley, three additional examples of splitting by plug and feather were also observed during the walk-over survey: two south of the survey transect and one further north. A fourth example in lower Piggledene is known, previously photographed by the author. In close proximity to stone [UN01], it was not picked out again during the walk-over survey, but is nevertheless brought into this section. For the purposes of this report it is numbered stone [UN04], but measurements of its single plug hole were not recorded in the project data sheet.

The two examples of plug and feather splitting south of the survey transect are part of complex sarsen splitting episodes. In stone [UN03], very close to the A4 at cSU 1415 6861, two pieces of sarsen split from a parent boulder remain on the valley floor. There is no clearly visible evidence on the smaller piece to indicate how all of its split sides were cut. On the larger surviving piece, a plug hole that had been chiselled out all the way through the stone is visible in the south-west facing split side (Figure 27) (Table 5). The underside of the boulder has flaked out where the plug hole exited the stone. On the top of this piece of stone a wedge-pit oriented north-east/south-west, now full of soil but approximately 70mm long and 12mm wide, had been cut into the upper surface. Had it been used, this wedge-pit would have cut the stone perpendicularly to the plug and feather split. The stone’s north-east facing surface also appears to be a split face, made using at least one flat wedge.

Figure 27 Stone [UN03] south of the Piggledene survey transect, looking north. A plug hole, marked by a scale card, is visible in the centre of the south-facing split face. The right-angled scale card, just visible on the top of the stone, marks the position of an unused wedge-pit.

The other sarsen in this area split by plug and feather, stone [UN02] was also reduced using flat wedges. Situated at cSU 1417 6864, it is a large and irregular boulder similar to stone group [131]/[134] in the survey transect. The parent sarsen has been split into at least seven pieces, with at least one piece of stone removed from its western side. The splits are perpendicular to one another and it is likely that they originated with a cut running from south-west to north-east across the middle of the boulder. Unfortunately, most of the splits are filled with soil and plant growth, obscuring evidence for how they were propagated. Nevertheless, three plug holes and two wedge pits were recorded. The two visible wedge pits, chiselled out of the upper surface of the boulder's northern end, had been intended to make a north-south split perpendicular to the primary cut, but which failed to run that far. Two of the plug holes had been used to split away the missing western portion of the parent boulder (and are thus half-cylinders). The third, unused, plug hole was chiselled into the upper surface of the southern-most part of the stone (Table 5). That third plug hole is clearly placed in relation to a chiselled line marking the intended course of the split, and to its south side there are some flake scars in the stone surface which spalled as the plug hole was being chiselled out.

Figure 28 Stone [UN01] in lower Piggledene, split using plug and feathers. Three cylindrical plug holes were cut for the removal of the eastern portion of the sarsen. Two plug holes in the upper surface contain rusted-in plugs and feathers.

To the north of the survey transect, stone [UN01] was also split using the plug and feather method. It stands amongst trees at cSU 1409 6901 and unlike [UN03] and [UN02] was cut by this method only. Its eastern split face includes three plug holes (Table 5) and two pairs of plugs and feathers are stuck in plug holes in the upper surface of the remaining western portion of the stone. These were perhaps placed after the first split, with the intention of removing additional material from its western side. The cylindrical plug holes and the, albeit corroded, tops of the plugs and feathers, make, however, a strong contrast to the rectangular wedge-pits and flat wedges seen elsewhere in the valley (Figure 28).

Stone [UN04], also split using plug and feathers, was unfortunately not picked out during the walk-over survey although it was photographed during a previous visit. It is a small, low, boulder in the environs of stone [UN01] north of the survey transect (Figure 29). Material from the eastern end has been removed. A single plug hole was cut into the upper surface; its general form and size conform to the others observed in lower Piggledene. The plug hole was cut in line with a vent. A line had been chiselled perpendicularly to the vent, indicating where the intended split would run. It did so, but instead of passing vertically through the boulder the split only just passed beyond the bottom of the plug hole before it ran out, breaking off irregular pieces from the surface and side. The position of the chiselled line, perpendicular to the vent rather than running with it, is in contrast to King (1968, 90) who describes primary splitting in line with natural faults.

Figure 29 Stone [UN04] in lower Piggledene, split using plug and feathers. One plug hole was cut for the intended, but failed, removal of the eastern portion of the sarsen.

Pickledean Barn

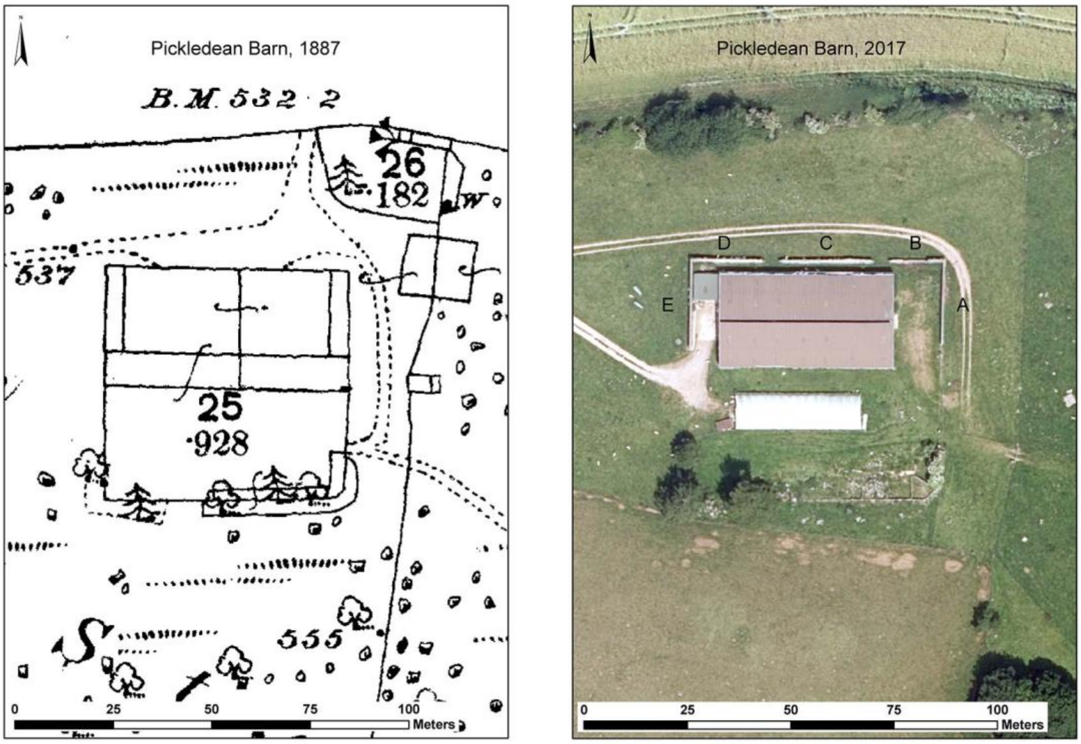


Figure 30 Pickledean Barn, Piggledene. Left: as depicted by the Ordnance Survey on the first edition County Series (Wiltshire) 25" map published in 1887. Right: as captured in High Resolution (25cm) Vertical Aerial Imagery (2017) (Getmapping). Sections of the sarsen wall are lettered (see text). Using EDINA Digimap Service.

The nearest sarsen stone constructions are the wall which partially encloses the modern agricultural buildings at Pickledean Barn (Figure 30), and the facing to the A4 embankment. It may reasonably be assumed that these sarsen blocks were cut from boulders in the valley, and that the specific splitting technique used to form them could thus be linked to a construction date. The A4 embankment is inaccessible and overgrown, so Pickledean Barn wall was examined for evidence of how its blocks had been cut. The exterior wall faces only were examined from the public path (the owner’s permission to enter the premises to see the whole wall had not been sought) (Figure 31). On the majority of blocks, final shaping and dressing had removed wedge-pit scars or plug holes, or these were hidden inside the wall. Nevertheless, observations are described here and discussed below.

Figure 31 Pickledean Barn, Piggledene, from the west (viewing wall section E).

Wall section A (c20.5m long) comprises courses of squared sarsen blocks with sarsen packing. Four possible wedge-pit scars were observed, but these were on faces that had been laid horizontally in the mortar bed and could not be confirmed with certainty. One plug hole was noticed in a sarsen block laid in the very lowest course of the wall. Wall section B (c12.9m long), which in part is half-height, comprises coursed sarsen blocks with sarsen packing, finished with cement coping.

This section includes a number of smaller blocks more like the size of sarsen setts. Four plug holes were observed. Wall section C (c21.6m long) is half-height along its whole length, comprising coursed sarsen blocks and is finished with sloped coping stones. No wedge-pits were visible, whilst 23 plug holes were recorded. Many of the blocks in this section have flake scars around their edges, showing where material was removed to trim each ariss and leaving bulbous material in the middle of the exposed face. This is likely to have had an effect on the survival of any wedge-pit scars, which are shallower than plug holes, but the large number of plug holes in these blocks show that the effect is not so detrimental as to remove all evidence.

Figure 32 Pickledean Barn, Piggledene. Left: a length of wall section D showing how large and regular most of the sarsen blocks are. Right: plug holes PB03 and PB04 in section D of the wall.

Wall section D (c17.0m long) is constructed as section C, mirroring section B at half-height until it its western end which is full height. No wedge-pits are visible whilst 23 plug holes were recorded. As in section C, some of the sarsen blocks are very large (Figure 32).

Figure 33 Pickledean Barn, Piggledene. Wedge-pit scar visible on a sarsen block in wall section E

Wall section E (c21.4m long) is full height coursed sarsen blocks, with one visible wedge-pit (base length 56mm, opening length 87mm, Figure 33) and no plug holes. The dimensions of this, the only clearly visible wedge-pit, place it within the range of those measured in the survey transect. At 87mm the length of its opening is close to the mean of 90.9mm, although at least one flake scar interrupting the wedge-pit scar suggests that it has been truncated by dressing and would have been longer, perhaps falling in the upper quartile of the range (Table 2). The unaffected wedge-pit base length of 56mm falls within the upper quartile of the survey transect sample (Table 2), adding weight to this suggestion. Wall sections A and E end in south-facing brick piers.

stone	plug hole	depth	opening diameter	base shape
Stone [69]	069_01	47	43	flat
	UN01_01	55	45	flat
Stone [UN01]	UN01_02	58	50	flat
	UN01_03	50	47	concave
	UN02_01	57	41	flat
Stone [UN02]	UN02_02	59	36	flat
	UN02_03	90	35	-
Stone [UN03]	UN03_03	190	42	-
wall section D	PB01	49	48	-
	PB02	49	41	-
	PB03	47	41	concave
	PB04	54	38	flat
	PB05	69	36	concave
	PB06	62	43	flat
	PB07	55	41	flat
	PB08	55	43	flat
	PB09	42	42	-
	PB10	54	43	concave
	PB11	42	41	concave
	PB12	64	42	concave
	PB13	56	45	concave
	PB14	57	44	flat
	PB15	66	49	concave

Table 5 Plug hole dimensions, Piggledene and Pickledean Barn (mm).

A sample of 15 of the plug holes in wall section D were measured for comparison with the measurable plug holes recorded in the survey transect and walk-over survey (Table 5).

	minimum	maximum	range	mean	N
opening diameter	36	49	13	42.4	15
depth	42	69	27	54.7	15

Table 6 Plug hole dimensions, Pickledean Barn wall section D sample (mm).

The depths of all of the plug holes in sarsens in the valley are within the range of the sample from wall section D (Table 6), except UN02_03 and UN03_03. The latter is the plug hole chiselled through the full thickness of stone [UN03]. Plug hole UN02_03 is problematic to measure, cut as it is into the sloping surface of the stone and including spalling to its south side. At its deepest, on its north side, it measures 90mm. The south side of the cylinder, however, measures 46mm deep, placing it firmly in range for the stone blocks used to construct the wall. It is likely that the depth of plug holes visible in the blocks has been affected by the final dressing that prepared them for walling, reducing their depth by at least a few millimetres if not more and thus affecting the recorded range which may originally have been more limited.

The plug holes are fairly consistent in diameter at their openings, with a difference of only 13mm between the narrowest (36mm) and widest (49mm) recorded in the barn wall sample (Table 6). The plug holes in sarsens in the valley all fall within this range except two, UN02_03 (35mm) and UN01_02 (50mm), but these are hardly significant outliers. The difference here of only 1mm either side of the range is just as likely due to the difficulties in recording measurements from the coarse stone surfaces.
The shape of observable plug hole bases seen in both the barn walls and the valley also varies, tending to be flat or concave (Table 5). This suggests that chisels with flat bits or possibly convex cross-bits were used (Greenwell and Elsden, 1913, 293-4). Bearing in mind that the depth of the plug holes in the barn wall stones are likely truncated by dressing, also affecting the opening diameter by moving this measurement further down the original plug hole, and the small sample size overall,

it is difficult to draw conclusions about this aspect of the splitting technology. There appears to be no consistent relationship between the base shape and the width of the plug holes to relate to chisel types or sizes. There are plug holes of different bases and widths in the same stone, for example, PB05 and PB06 in a block in the barn wall, which may indicate that different chisels and plug and feather sets were being used in tandem.

Standing stones

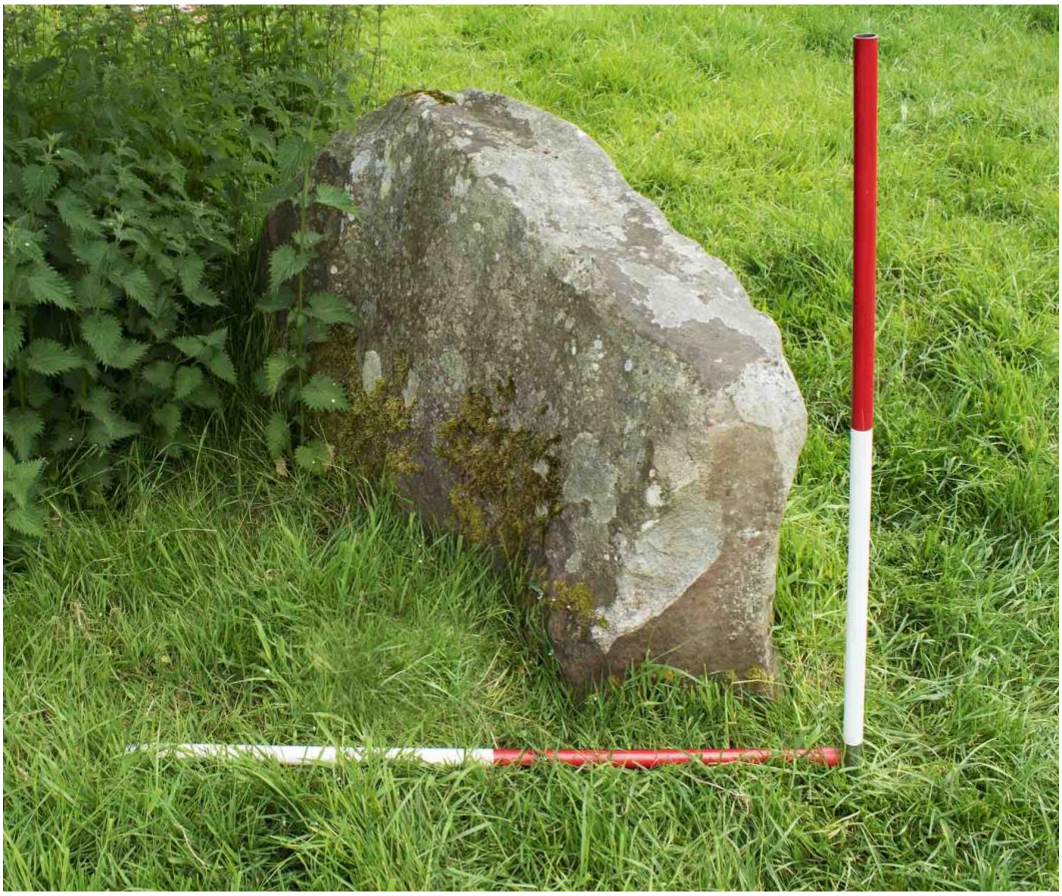


Figure 34 Stone [60], Piggledene survey transect, from the north-west. A possible standing stone.

In addition to stone [60] which stands in the survey transect aligned with a linear bank (see above) (Figure 34), two possible standing stones were identified during the walk-over survey (Figure 35). Both are located north of the survey transect. Given the movement of sarsens in the area these must be treated with a degree of caution. It is possible for boulders to be moved out of their ‘natural’ alignment by frost heave as well as through the agricultural and quarrying practices described in this report. These two examples are, however, more likely to have been erected by people, as discussed below.

Figure 35 Possible standing stones in lower Piggledene. Left: at cSU 1411 6898, from the south-east. Right: at cSU 1410 6905.

The first stone is at cSU 1411 6898. The visible stone, approximately 0.4m thick and 0.5m tall, is grey saccharoid sarsen with typical lichen growth on the irregular surface. It is sub-rounded to rounded in form with its upper surface facing to the south-west and the more irregular lower surface facing north-east. Lichen-filled hollows on the upper surface that at a first glance look like cup marks could alternatively be solution features which are common on the sarsens in the valley. The second possible standing stone, more lenticular in form, is nearby at cSU 1410 6905. This is also grey saccharoid sarsen, approximately 0.3m thick and 0.5m tall.

Discussion

Valley and earthworks

It is out of scope for this report to review the long-standing debates concerning southern England's chalk valley formation processes (for a thorough over-view of which see Whiteman and Haggart (2018)). Whilst the dominant form of Piggledene today arose as a result of incision and periglacial processes operating from the late Devensian onwards (Evans et al., 1993, 184-5, Geddes and Walkington, 2005), much of the valley's present-day appearance also stems from anthropogenic factors. The lynchets and field banks defining the western and eastern boundaries of lower Piggledene, and the sarsen extraction features in the valley bottom, represent the aggradation and removal of soils, sediments, and rocky materials over varied timescales by farming and quarrying practices. Other, subtler, features have less clear origins, in particular the slight east-facing scarps and the stronger north-south trending linear features sloping into the valley bottom, and the rounded platform and possible fan of material at the southernmost end of the valley noticed during the walk-over survey.

The presence of large sarsens on and in the north-south linears in lower Piggledene suggests that sediment movement in periglacial conditions has played a part in these earthworks' formation (Murton and Ballantyne, 2017, 542). Localised mass displacement by gelifluction initiated during thaws, active-layer slides, and sediment solifluction in alternating freeze-thaw conditions on slopes even as shallow as a few degrees, produce a range of surface forms including lobes and sheets (Giles et al., 2017, 316, 338, Karkanas and Goldberg, 2019, 40). The linears, which taper in and out along lower Piggledene's axis, could have resulted in part from the deposit at different times of sarsens amongst sediment moving from Piggledene's active east-facing slope (Clark et al., 1967, 23) into the valley bottom.

Alternatively, the formation of these linear features may have been influenced by water, during the times that a stream flowed down the valley. Clark et al. (1967, 21-5) debated the role of melt-water streams contributing to Clatford Bottom's asymmetrical form in phases of rejuvenation, concluding that at least one phase post-dated sarsen accumulation there (1967, 38). Similar water flows cutting down and back into geliflucted and solifluted material may be expected in Piggledene, perhaps as late as the early Holocene when the Kennet Velley had permanently running water prior to the development of swampy conditions around 8400 BP (Evans et al., 1993, 185). No investigation was made by this project in the analogous narrow, but now well-ploughed, southern reaches of Clatford Bottom to find comparative features that may have developed this way. It is worth noting that, in exceptionally wet conditions, surface water runs down the slopes to form a short-lived stream in the valley bottom (Gill Swanton, 2020 pers.comm.).

The identification of buried prehistoric soils further to the north in Piggledene in the environs of Down Barn indicates that colluviation has continued in temperate Holocene conditions. Similar deposition has been recorded at, for example, Kiln

Combe (East Sussex) (Bell, 1992, 25). The detail of the impact of soil erosion and sediment deposition on Piggledene as a whole is currently unclear, in the absence of wide-scale exploration through auguring or excavation. But cultivation of the higher ground to the west of lower Piggledene in particular, from later prehistory onwards, is clear from the field systems that survive in part as earthworks. These include both later prehistoric field systems and medieval strip lynchets. Similar erosion products would thus be expected in the valley (Bell, 1992, 23), deposited throughout time according to prevailing conditions and agricultural practices.

The combination of sequences of periglacial loams and erosion products in the valley bottom may have presented a fertile resource. An alternative explanation of the north-south linears following lower Piggledene's axis is that they are in effect small cultivation terraces. It is not clear to what period such features would date. Clearance and cultivation activities started in the Kennet Valley environs in the early Neolithic (Evans et al., 1993, 186, 188), but given the evidence from upper Piggledene and also from Narrow Meadow (West Overton) c0.5km to the west (Evans et al., 1993, 164), evidence for the earliest cultivation will be buried (and see Bell, 1983, 147). Even poorer land here was being brought into arable cultivation during the Middle Ages, and the strip lynchets to the south-east of Pickledean Barn show how the higher valley sides were being farmed (Fowler, 2000, 157, 233-4). But Evans et al. (1993, 190) propose that the Kennet Valley floor was being used for grazing and meadows at that time, and Fowler (2000, 148) suggests that the Overton estate enjoyed grazing along the Kennet. This makes the preservation of pasture in the bottoms of re-entrants like Piggledene, rather than small-scale gardening, more likely at this time.

On the other hand, greater quantities of larger flints might also be expected towards the dry valley centre (Bell, 1992, 27). This attractive resource was exploited in Itford Bottom (East Sussex), for example, a dip slope dry chalk valley quarried in its upper limits in a linear arrangement of pits (Bell, 1983). In addition to the exploitation of flint nodules and pebbles throughout prehistory, flints were being supplied by local contractors to Wiltshire County Council for road metalling in Marlborough District as late as the interwar years, costing the County Surveyor from 9s/6d to 10s/6d per cubic yard (see for example WSHC F1/100/6/7, ‘Wiltshire County Council: Roads and Bridges Committee Minutes 1921-5).

Although it is conceivable that the bottom of the valley has been lowered by similar excavations, this is surely unlikely. First, the linear features extend for c350m north-south along lower Piggledene’s axis. Secondly, extraction pits in locations including Itford Bottom, and similar, closer, locations where flints as well as brickearth and clays may have been taken such as Great Lodge Bottom (Savernake, Wiltshire) (Crutchley et al., 2009), are more commonly discrete, lobed pits rather than narrow, long, linear ditch-like features.

Finally, Piggledene has been a route for moving sheep between Overton Down and the Kennet Valley meadows, probably since at least the early medieval period when the trackway called *lamba peath* in a tenth century charter led this way. Medieval Overton was a very rich estate owned by the Bishops of Winchester, which in the mid-thirteenth century included a flock of more than 2,200 sheep (Fowler, 2000, 94, 156-7). The regular movement of large flocks could have caused some hollowing in the valley bottom, preserved in lower Piggledene where no metalled track was made unlike the valley course from Pickledean Barn to Down Barn, which is now accessed more regularly by large farm vehicles and in places is ploughed close to the trackway.

The slight slopes in the survey area, which may be natural features, and the linear features which extend both north and south of the survey area, remain enigmatic. The presence of lynchets at the valley edge and more widely in the landscape is indicative of widespread cultivation which is likely to be middle Bronze Age to medieval, attesting to long-term and often intensive land use in the area. Measured survey of the whole of lower Piggledene combined with auguring, test-pitting, and sectioning to reveal depositional sequences and permit sediment analysis would contribute to un-picking what is undoubtedly a more complex late Quaternary sequence. It is worth reiterating Allen’s (1992, 50) cautionary note in relation to both alluviation and colluviation on the Wessex chalk, that past events “are highly complex even within a single landscape unit and result in significant local diversity”.

Internal field boundaries

The east-west oriented bank in the south-east corner of the survey transect may be the remains of the boundary between plots 198 and 200 depicted on the 1815/16 Enclosure Award Map (Wiltshire and Swindon History Centre EA117, 'Enclosure Award for East Overton, West Overton, Lockeridge and Fyfield'). It is significant that stone [60] (Figure 34), on which the bank is oriented, is a standing stone. The natural orientation of sarsen stones can be difficult to ascertain, but in general their shortest axis is the thickness between the upper and lower surfaces of the silicified material (Summerfield and Goudie, 1980, 74, Ullyott et al., 2004, 1522). Stone [60] has clearly been set up on edge, with its undulose surface facing north-east and more irregular surface to the south-west.

When it was erected is uncertain. It may be an earlier, prehistoric, feature, on which the bank and possible field boundary were later aligned. Alternatively, it may be a contemporary component of the boundary, although no other surviving sarsens appear to have been deployed in this way to complete a more substantial structure. The nearby stone [61] was split, and stone [51] also on this line may have been split, so their positions in relation to the bank should be treated with caution as their overall dimensions and orientations are unknown. The ephemeral nature of the former division is in contrast to the more substantial boundary to the north, dividing plots 197 and 198 on the Enclosure Award Map, which is depicted on all the available historic mapping until the later twentieth century.

Although the bank identified in the survey transect is tentatively identified as the former field boundary, a similar bank was observed during the walk-over survey a few metres to the south. Whilst either feature may indicate the position of the historical field boundary, they could both be part of a feature such as a small enclosure or fold relating to animal husbandry on the valley's pasture.

Standing stones

In addition to stone [60], two other sarsens were identified as standing stones (Figure 35). Like stone [60], the two sarsens to the north of the survey transect appear to be standing perpendicularly to their likely bedding plane. Had this been brought about by periglacial processes, more of the nearby boulders might be expected to be up-ended or tilted. In fact, in this area of lower Piggledene the surviving stones are on the whole recumbent. Whilst Osborne White (1907) commented that small up-tilted sarsens at Snelsmore Common (Berkshire) may have been oriented by “movements in the body of the drift” (1907, 87), Clark et al. (1967, 21) concluded that frost heave had played little part in the attitude of sarsens in nearby Clatford Bottom.

It is clear, from the presence of wedge-pit scars and split faces, when individual sarsens are out of ‘true’ by virtue of cutting activities. The two possible standing stones are, however, uncut; neither is there any nearby splitting debris, nor stone hollows close by, to suggest that their orientation is due to post-medieval quarrying activities. Neither have they simply been moved for clearance purposes; other sarsens lie closer to the eastern field boundary where these two sarsens could more usefully have been moved. On these grounds it is concluded, albeit tentatively, that these are standing stones.

The date at which these stones were erected is uncertain. The two sarsens are smaller than stone [60] to the south, but are larger than many other British standing stones of various materials and in different settings, including ‘miniliths’ described by Gillings (2015), dating to the later third and second millennium BC. Putting aside, for a moment, the complex stone settings of the Avebury monuments in the Winterbourne valley to the west, and post-medieval racecourse posts on the Downs formed of sarsen pillars, there are various nearby standing stones with which comparison may be usefully made.

In upper Piggledene, two stones now stand in the fence-line c60m south of Down Barn. Possibly the two stones mentioned in the late-tenth century West Overton charter (Fowler, 2000, 62), they appear to have been moved to their present position perhaps in the nineteenth century. Whether or not they were originally prehistoric settings, incorporated into the early medieval boundary described by the charter, is a moot point. Long Tom is a sarsen similarly used by a boundary, standing c2.5km to the north of the lower Piggledene stones. Once one of a number of stones marking the Fyfield parish boundary, straightened here as a result of post-medieval enclosure, this is a tall and possibly dressed sarsen that may also be a re-used prehistoric setting (Fowler and Blackwell, 1998, 105), as is perhaps ‘Aethelferthe’s stone’ c3km to the north-west of Piggledene (Fowler and Blackwell, 1998, 35).

Further afield and in different landscape contexts, single standing sarsens include a large unworked boulder on the Lower Chalk of Fiddler’s Hill at cSU 1169 7568. Not mapped by the Ordnance Survey until the 1970s, and then depicted with another (now missing) stone approximately 55m to the south-west on the roadside, this large red-brown sarsen stands on a field boundary. Given its late appearance on Ordnance Survey mapping it may be a sarsen cleared to the field edge, having obstructed the plough; but unusually set up on edge with its flatter face to the north-east and, from that side, framing the view of Hackpen Hill’s scarp slope and the Victorian white horse hill figure. Meanwhile, the Hanging Stone to the south in the Pewsey Vale at cSU 0990 6050 (Wiltshire HER MWI72731) is another unworked sarsen, described as a rubbing stone for cattle, or boundary marker, but apparently set up on edge and possibly an earlier feature in the landscape.

Various sarsens have been set up in West Woods including a stone in the south-east corner of wood compartment J (Amadio, 2011, 59-61). Although a number of the standing sarsens in the woodland may be coupe stones (orthostats indicating individual wood parcels each at different stages in the coppicing rotation (Bowden et al., 2000, 22, 34)), prehistoric field systems survive as earthworks in the wooded area. Today, a long barrow (Wiltshire HER SU16NE102) is the earliest confirmed prehistoric sarsen setting in West Woods, but clearly in later prehistory this was an open landscape in which monuments may have been constructed including stone settings.

The degree of colluviation in the valley is a significant issue here for the visibility of prehistoric stone settings, given the possible buried Beaker horizon identified at Down Barn by Mike Allen (Johnston, 2005). Additionally, the precedents described above for nearby standing stones in simple settings all present issues in interpreting the possible standing stones in lower Piggledene. The majority of the analogous stones are associated with early medieval or later boundaries, even though they may have prehistoric origins. In the tenth century the boundary between East Overton and Fyfield and Lockeridge tithings followed Piggledean before passing along a hollow way and on to the River Kennet (Fowler, 2000, 180). It is possible, therefore, that there is an association between particular sarsens and the boundary here, as there was at other locations along its course (see Blackwell (1995) for a discussion of stones, amongst the northern sarsen spreads, mentioned in charter S449). Like the Fiddler's Hill sarsen, the Piggledene examples may have been placed on edge more recently although, amongst a sarsen spread and not shifted to the pasture edge, it is difficult to imagine what would have prompted this. And although there are now veteran hawthorns and mature ash trees in lower Piggledene, this area has not been managed in such a way as to require markers like those found in West Woods or, carved with landowners' initials, demarking estate holdings like the very different Meux boundary stones (Fowler, 2000, 189).

Sarsen extraction features

Post-medieval sarsen cutting has left clearly defined extraction pits in lower Piggledene, including some with closely associated sarsen debris. In the survey transect these include pits C, P and O which show how turf, soil and sediment to the western side of sarsens was removed as part of the splitting process. Other hollows are defined by a similar western arc, such as pits F, G and M (Figure 9, Figure 10). Pit M is similar in length to pits A and B (which are both oval-shaped and clearly show how whole sarsens could be dug around), suggesting that it had held a similarly long boulder. Nevertheless, pit M is shallower and defined only to one side.

The variety in pit forms within the survey transect suggests that the extraction gully described by Free (1948) and King (1968) and observed in excavation by Bowen and Smith (1977) was not always dug to fully encircle a sarsen, depending on the specific circumstances of individual boulders. Here in lower Piggledene, the gently sloping valley floor and possible accumulation of sediment against the western sides of sarsens contrast with the situation on the chalk plateau, where sarsens in and on clay-with-flints *sensu stricto* will have presented different challenges. Additionally, various split sarsens show no signs of any extraction gully or hollow. These include stones [20], [34], [106], [107], [143], and others distributed across the survey transect. This characteristic is discussed below in the context of wedge-pit placement.

Sarsen splitting

There is evidence for two methods of splitting sarsens in lower Piggledene, discussed here first in terms of variability in practices using flat wedges, and secondly in terms of the dating of these techniques.

Splitting sarsen stone with flat wedges

The variability of wedge-pits, recorded as scars on split sarsens in the survey transect, has been described above. Visually, the wedge-pits recorded in the survey transect are similar both to one another and to the scars left on split stones elsewhere in Piggledene and further afield in Wiltshire. Much of their variability can be ascribed to some simple factors:

- the stone itself, splintering and spalling as the wedge-pits were cut;
- the tool-set, which included larger pecking hammers and chisels removing more material at the start of wedge-pit shaping, compared with relatively greater precision of smaller punches finishing the wedge-pit bases;
- the variability in recording wedge-pit dimensions in the field.

This raises a question about the individuals working in lower Piggledene, and whether the work of individual cutters can be identified. During a recent discussion held in a nearby sarsen spread at Lockeridge Dene (Wiltshire, UK), local stonemason Sam McArthur intimated that larger wedge-pits can indicate an earlier date, or less skill in their shaping (MacArthur 2019 pers.comm.). This was in reference to the difference between the majority of wedge-pits in Lockeridge Dene which are similar to those in Piggledene, and a few that are at least twice the length if not more. Although ranging from 71mm to 120mm in length, none of the wedge-pits in the survey transect match the double-sized ones in Lockeridge Dene. The overall homogeneity of wedge-pits in the survey transect, and their essentially proportional sizing (see Figure 15) suggests that wedging was being carried out at a similar time and by a similarly skilled group of cutters.

King (1968) describes the small teams engaged in this work. Might the small groups of wedge-pits with openings clustering around 75mm, 85mm, and 95mm (Figure 13), represent the work of individual cutters using their personal sets of tools? Whilst this is possible, the suggestion should be treated with caution. Wedge-pits in each of these ranges are found on stones distributed across the survey transect, rather than clustered discretely on specific boulders. Furthermore, variation in the order of ±10mm could be ascribed to the factors outlined in the bullet points above.

The placement of wedge-pits indicates something of the sarsen cutters' choices and actions in reducing individual stones. Before discussing the details, it is necessary to touch on the *burden* of a sarsen boulder. The burden of a rock or boulder is its line of least resistance to a splitting force; for example, the shortest line between an explosive charge in a bore-hole and the outer free face of the rock in a quarry wall. The more free faces there are, the smaller the amount of energy required to dislodge material from the quarry wall – or to split boulders and large blocks of stone (de Kalb, 1900, 91).

In addition to burden, most rocks have a *rift* through which they will split most easily (usually the bedding plane) and a *grain* at right angles to the rift, through which they will split relatively easily. The recognition of these planes impacts on choices not only for primary and secondary reduction in particular in hand-splitting, but also in the further reduction of stone blocks into products such as setts. The arrangement of wedge-pits thus depends on the nature of the stone and the desired accuracy of the split, which along the rift will require a line of wedges. Against the rift, wedges must continue down the sides of the stone. A difficult split requires more closely placed wedges (Greenwell and Elsden, 1913, 80-1, 214-8).

Sarsen is a typically homogenous sandstone with very poorly defined bedding structures and a reputation for sub-conchoidal fracture (Geddes and Walkington, 2005, 62, Summerfield and Goudie, 1980, 74). Rift is hard to identify, although Free (1948, 338) describes a splitting sequence which began with wedging along vents followed by splitting perpendicularly to root holes or the bedding plane. Wedge placement and splitting sequences recorded in the survey transect bear this sequence out to a limited extent, in as much as most splitting began in boulder upper surfaces. However, the majority of subsequent divisions were also made from above, working perpendicularly in plan and thus diminishing the burden. This was continued until pieces of stone could be taken to a working shelter for final reduction into saleable products. On the basis of the splitting sequences in the survey transect, it is likely that cutting along the rift became important during this final stage; to form the geometrically regular building blocks and street furniture that comprised the principal goods of the nineteenth century trade.

Stone [61] is a good example of the apparent importance of burden over grain and rift in sarsen splitting. The two wedges used to divide this eastern part from a parent boulder were placed low down in its north side. This allowed hammering forces to pass through the stone’s shorter axis at this point, successfully splitting it; whereas hammering from above would have been cushioned and dissipated by the greater thickness of stone. Three wedges were used to split material from stones [28] and [97], two placed close together and one further away. For stone [28], one wedge was used in its side at the thicker end, assisting the two wedges used in the upper surface to split this otherwise relatively thin tabular sarsen. Stone [97], in contrast, was more evenly-shaped overall as part of the tabular stone group [89]/[100], requiring three wedges in its upper surface to divide it from material in the parent boulder to its west.

The sarsen cutter’s skill and judgement is shown clearly by stone [34], a large, rounded boulder split using four wedges, all of which were placed in its east side. Three were placed close together and low down (Table 4) with one higher up, conforming in part to Greenwell and Elsden’s (1913, 214-6) instruction, but showing how an intimate knowledge of the stone reduced the need for any more wedges than was necessary to make a split. Six wedge-pits alternating in depth were chiselled out along the upper surface of stone [147]. Two, both 50mm deep, are very close together (25mm apart), and may indicate that a slightly different position was chosen to replace the first-choice location for a wedge. For stone [147] it appears that directing energy through the shortest axis of this long stone, along the whole of the boulder's length, was most important to propagate the successful split. It would be useful to contrast stone [147] with a similarly shaped sarsen in the Valley of Stones to the north of Piggledene, that took 10 wedge-pits in a line to split.

The examples of relatively evenly-spaced wedges in the splits that reduced the tabular stone group [89]/[100], and the careful positioning of wedges to reduce stone [12] (see above), further add to the picture that each boulder was treated on its merits. Rather than following a formal reduction pattern including digging an extraction gully, and using regularly-placed wedges in evenly-sized wedge-pits, as described by King (1968, 90), decisions about how to split each sarsen appear to have been made in response to the burden of each boulder. In lower Piggledene, wedge-pit placement, combined with the partial oval hollows like pits F and M and the absence of any gully or hollow around nevertheless cut sarsens like stones [34], [106], and [107], indicates that this was as, if not more, important to successful splitting, as digging away turf and soil from a boulder's side to form an extraction gully.

Splitting sarsen stone with plug and feathers

There are too few examples in Piggledene of sarsens split using plug and feathers to contemplate an exploration of variability in the use of this method (all plug hole measurements made are detailed in Appendix B). Its presence in the valley has more significance in terms of dating sarsen cutting activity. Whilst wedging methods have earlier origins, plug and feather was introduced from the early 1800s (see above). Regardless of the method used, none of the splitting in the National Trust property, which includes the survey transect and the area of the walk-over survey, should post-date 1908.

Unfortunately, it is difficult to bring stones UN02 and UN03, split using both methods, to the question of relative date because they do not exhibit inter-cutting splits. For example, there is the possibility that the wedging in stone UN03 post-dated the plug and feather splitting, because an un-used wedge-pit on the stone's upper surface is perpendicular to the split propagated by plug and feather. It is feasible, however, that the wedging had already been attempted on this stone when, at a later date, plug and feather was used more successfully to break the boulder apart. Does the relationship between splitting methods and construction blocks have the potential to be more informative?

As described above, Pickledean Barn had been built by 1773 and later became an outfarm of agricultural buildings and a small cottage. The Enclosure Award Map of 1815/16 depicts a barn oriented east-west with a small perpendicular shed or structure and a yard to the north side. Another agricultural building stands to the east and the sarsen-built cottage[2] is shown in a small plot to the north. By the first decade of the nineteenth century the new buildings for North Farm on the Bath-London road included a barn built in roughly squared and coursed sarsen blocks, and another in cob. The configuration of the agricultural buildings at Pickledean Barn changed and grew over the years as documented in the 1819 estate map and later-nineteenth century Ordnance Survey mapping. The present-day sarsen wall does not conform to the layout and arrangement of yard gates depicted in 1819, but may comprise walls from the rectangular arrangement shown on the first edition County Series 25" map, surveyed in 1885. A photograph taken in 1908 (King, 1968, Plate VIIa) catches the north-west corner of the complex, showing that the whole west range was roofed at that time.

A reading of the date of these walls is further complicated by the re-working of this area in the early-twentieth century. Today, the east and west return walls end in brick piers, whereas in 1885 they would have continued into the agricultural buildings to either side of the central yard. Frank Swanton's changes at Pickledean Barn appear to have included the retention of the northern exterior walls of the masonry structures, but perhaps involved the reduction in some wall heights, and repairs or re-building. Alternatively, the demolition of the probably sarsen-built buildings forming the southern half of the U-shaped complex could have provided the building blocks used to form the wall in its present configuration although this is less likely given the photographic evidence from 1908.

[2] The cottage was demolished probably in the 1960s, the stone disposed of on site (Gill Swanton 2020 pers. comm.).

Consequentially, relating a building date to the sarsen splitting techniques is unfortunately problematic when considering Pickledean Barn in isolation. It was out of scope of this fieldwork to make a detailed examination of the rest of North Farm's nineteenth-century buildings, but it is notable that the new sarsen-built agricultural buildings around the yards constructed from 1801 onwards are each made of slightly differently shaped blocks with varied mortaring and galletting. The brick farmhouse was the last building of the road-side complex to be built, possibly after 1819[3], which is perhaps also when the wall revetting the garden was constructed. Like Pickledean Barn wall, this is a massive structure of large sarsen blocks, some of which appear to have plug holes in their split faces.

In drawing these threads together, different scenarios are theorised. First, plug and feather was being used here before flat wedges. Although wedging is the older method, in this scenario the technique, and its toolset, is that brought from Buckinghamshire to Wiltshire in 1847 (Crook and Free, 2011). Plug and feathers, available from c1800, are proposed to have been used by stone masons working in the earlier part of the nineteenth century for parts – but probably not all – of the new North Farm being constructed for the Duke of Marlborough's estate. They selected the stones they needed for the jobs, splitting them *in situ* in the field, and also trimming and dressing some of the split blocks in the new farmyard (Gill Swanton pers. comm. 2019). Later, cutters using the Buckinghamshire wedging technique had permission from the Meux estate to work Piggledene, producing bulk volumes of predominantly street furniture. This had a much greater impact on the sarsen spread and also cleared out most of any sarsens remaining with plug holes, bar the few that can be seen today. Both wedge-pit scars and plug holes are found in the Pickledean Barn wall because of the early-twentieth century re-working and re-use of varied materials.

Secondly, plug and feathers were being used later. The majority of split sarsen in Piggledene was wedged from the nineteenth century onwards, leaving the bulk of

---

[3] A building approximately in the position of North Farm's farmhouse is shown on the West Overton Enclosure Award map of 1815/16, but it is coloured in black. This indicates an unoccupied building, usually an industrial or working building, for a domestic dwelling should be coloured red. Surprisingly, no building is marked in this location on the slightly later estate map of 1819.

the rejected boulders and debris in the valley. This includes activities by the Cartwrights to the north-west of the National Trust property, working around the beginning of the First World War (King, 1968, 92). By the 1920s, traditional sarsen cutting was in decline (King, 1968, 89), so occasional newly-cut stone required for Frank Swanton's rebuilding and repairs on his newly-purchased farm was split using plug and feather sets readily available from numerous hand-tool manufacturers.

Neither of these two scenarios are satisfactory. The first begs an early adoption of plug and feather splitting, whilst the second requires quarrymen to take sarsen from the protected National Trust property, and also to produce a significant number of newly-split blocks for both Pickledean Barn and the farmhouse garden wall. The sarsen walls at Pickledean Barn and revetting the farmhouse garden in all likelihood date to the mid-nineteenth century, after the 1819 estate map was drawn up but before the first Ordnance Survey County Series map sheet for this area was surveyed during 1885. This raises the possibility that one or more of the sarsen-cutting teams was using plug and feather as well as wedging at that time.

The possibly contemporaneous use of these different methods raises interesting issues. The sarsen-cutting literature is dominated by the celebrated Buckinghamshire techniques employing wedging. But by the time members of the Free and Cartwright families had brought this to Wiltshire in the 1840s, the use of plug and feathers had become widespread in stone quarrying. Later-nineteenth and early-twentieth century tool catalogues commonly depict only plug and feather sets for sale (for example, in Anon., 1926, Anon., 1937). It is important to bear in mind that the only descriptions of Wiltshire's sarsen-cutting are those authored by Douglas Free (1948, 1950), augmented at a further generation's distance in 1968 by Noel King who also drew on local oral history including one man with experience of sarsen cutting. This published narrative privileges the experience and dominance of a few individuals without reference to local practices of sarsen use pre-dating the 1840s. Furthermore, the generalisations of those accounts, brought into question by this fieldwork, obscure the potential for experimentation, innovation, and change by the skilled quarrymen.

Final stone reduction

A photograph taken in 1908 (King, 1968, Plate VIIa) shows an area to the west of Pickledean Barn being used for final reduction, to turn split blocks into saleable products. A large area of open ground is in use. It is Winter, and three thatched hurdles are propped up to provide shelter from the south. Blocks of split sarsen awaiting final reduction are propped up in the middle of the area. Piles of squared sarsen pieces are visible in the distance and next to the three hurdles. Finished setts and kerbs are laid neatly awaiting transportation; perhaps the way these blocks are grouped shows to the expert eye the volume of stone and the area they will cover, in relation to specific orders for goods. A substantial area of ground is in use, more than is available on the slight platform in the survey transect that might have provided an open working area for trimming split sarsen blocks.

Was all the sarsen from lower Piggledene hauled to the barn area for finishing? The only options to take finished goods away from Piggledene and onto the nearest main road are the track south through North Farm, or via the valley itself and the sloping ramp providing access onto the Bath-London road (the modern A4). That photograph is a snapshot in time and, depending on when the quarrymen had permission to work in Piggledene, final reduction may not have been limited to this photographed area in the environs of the barn and cottage.

Failure

Do the remaining pieces of partially-split sarsens represent failure, careful leaving of unsuitable material, or the intervention of the 1908 purchase of the National Trust property when, as King (1968, Plate VIIa) shows, Piggledene was being worked? Stone [6] is an example likely to represent failure. The intended fracture line had been chiselled into the surface and two wedge-pits made along its course, but in the event the split did not run to plan and the stone was left. Stones [83] and [84] also seem to represent a failure: first, with the surface spalling that spoiled the wedge-pit in stone [84] and caused a new one to be cut; and secondly, with the then abandonment of the bulk of the sarsen in the form of stone [83]. The split propagated by plug and feather in stone [69] also ran out and the sarsen was abandoned, and it looks like something similar happened with stones [20] and [56] and, for example with stone [UN04] outside the survey transect.

In contrast, the regular split faces of stones [12], [106], [107], and [144], as well as the reduction of stone group [89]/[100] and [146]/[147], look more like good stone that split true in straight faces. These examples of sarsens, which in all likelihood should have been completely converted into saleable products, were probably abandoned in 1908.

Sarsens used in part, subject to knowledgeable choices made by the quarrymen, are harder to identify by an archaeologist who is not a stonemason. For example, the northern end of stone [11] was split and left in situ. The split is overgrown and thus provides no information about the quality of the stone, but perhaps the horizontal vent in the southern part of the sarsen could be seen to continue all the way through the boulder, diminishing the volume of useable material. A vent running through stone [34] from its south-west corner heading north-east in to the sarsen may well indicate why only the north-east portion of the stone was split away and removed. Peter Stanier (pers. comm. 2020) has suggested that the quarrymen were 'grazing' the sarsen spreads, taking the easiest and most productive boulders.

As much as possible of stone [47] seems to have been taken, but not without difficulty. The eastern part of its parent boulder was removed. Then the stone was split perpendicularly east-west but this ran out to the south, removing the top surface rather than dividing the sarsen in two. The very southern end was finally split off. Stone group [131]/[136] may also indicate a pragmatic, expert, choice. Although the parent sarsen was successfully divided into at least four pieces, the split intended to divide stone [134] from [136] passed through at least two flints in the matrix and ran out, rather than through, the boulder. Perhaps the rest of the boulder was left in the face of fears that more flints lurked in its interior. Something similar may have happened with stone [61] which has a small flint in its split face. Taken together, the sarsens in the survey transect paint a picture in which, occasionally, intransigent boulders got the better of the skilled quarrymen, who in the end had to leave when the land was bought for the nation in 1908.

Post-1908 treatment of sarsens

The mortaring of split sarsens observable throughout the National Trust property in lower Piggledene is an intriguing part of the stones' biography. Piggledene had been on sale as part of the large Meux estate divestment in 1906 (see above). By that time, the sarsen spreads on the Marlborough Downs had become firmly entangled, in both scholarly and popular imagination, with prehistoric monuments including the nearby Avebury stone settings and, further afield, Stonehenge. With its origins in the antiquarian idea that Stonehenge's sarsens came from a location in north Wiltshire (see amongst others Jones, 1725, Lambarde, 1730 Edn., Stukeley, 1740-3), this association had been further developed during the nineteenth century by enthusiastic collectors of 'sarsenalia' (such as Rupert Jones, 1886) and in particular by Reverend AC Smith (1884).

In his published study of the archaeology of the Marlborough Downs around Avebury, Smith explicitly associated its sarsen geoscape with the archaeological landscape (Smith, 1884, viii). As Colt Hoare (1819, 8) had done before him, Smith witnessed and bemoaned the loss of sarsens to agriculture and quarrying. These notions of the special prehistoric character of the sarsen spreads, and fear over their rapid reduction over recent time, were strong influences on the campaign to purchase and preserve Piggledene and Lockeridge Dene (Lansdowne et al, 1907, Anon., 1908). It is as though the desire to preserve the stones "for the future from all injury" (Anon., 1908, 497) included not only the removal of some area of the sarsen spreads from the quarry, but also the physical healing of broken stones themselves.

Conclusions

This analytical earthwork survey, the walk-over survey, and detailed recording of sarsens stones within the survey transect, has resulted in a detailed record of an area of post-medieval sarsen extraction. This includes earthwork features such as extraction hollows and the evidence for splitting practices on individual sarsens. It has recorded subtle features that were not recorded at the smaller scale of previous mapping from remotely sensed datasets. Some of those features are anthropogenic, including former field boundaries. Other earthworks may be geomorphological, relating to the periglacial history of the southern dip slope of the Marlborough Downs. Three possible standing stones have been identified.

The examination of sarsen extraction features confirms, following Stanier (2000), the use of two different splitting techniques in lower Piggledene, and for the first time records and described these in detail. It is possible that wedging and splitting sarsen with plug and feathers were used contemporaneously in the valley during the second half of the nineteenth century. It is proposed that, within the survey transect, the sarsen cutters worked from west to east, choosing sarsens to split, leaving others untouched, abandoning some boulders that did not meet their promise, and eventually having to leave the area when the land was sold in 1908. Supported by the examples of divergence from the generalised sarsen working described by Free (1948, 1950) and King (1968), this work demonstrates the potential to explore aspects of choice and the application of skill and know-how in a post-medieval quarry. If not able to isolate the work of an individual quarryman or team, it does demonstrate that it is possible to approach subtleties in the *chaîne opératoire* of stone working of a period that is more commonly taken for granted and described in generalised terms.

Furthermore, this work demonstrates the importance of including an analysis of buildings built with the stone products to understand the life of the quarry and the use of its stone. It is probably no longer appropriate to assume, as the previous literature does (for example Geddes, 2000), that sarsen rubble walling pre-dates 1850 whilst all cut and dressed sarsen is post-1850, without a more detailed understanding of a building's biography.

The work provides an effective methodology for working in a dispersed quarry, where stone working was distributed across a landscape rather than localised in a pit or mine.

The post-1908 treatment of sarsens in lower Piggledene illustrates contemporary views on sarsens in the north Wiltshire landscape. The mortaring of split boulders speaks to the wider attitude to nature/culture and ideas of what landscape should be, and is an important local episode in the early-twentieth century development of rurality and the 'rural-historic' (Watson, 2013).

Recommendations for future research

Whilst the methodology used to record this part of the dispersed sarsen quarry in north Wiltshire has been effective to meet the aims of the fieldwork, it nevertheless has some limitations. Further work is recommended:

- a detailed geomorphological survey of Piggledene, complementing and extending the work previously done in Clatford Bottom, to explore the Quaternary history of this dry chalk valley. This should include mapping and the analysis of deposits, tying together the re-entrant with earlier findings from the Kennet Valley to resolve details of the valley form and explore human use from the Mesolithic onwards;

- the excavation of one or more sarsen extraction pits to provide a more detailed understanding of the formation of these hollows, both in their initial excavation and subsequent infilling with sarsen debris and natural sedimentation;

- the recovery through excavation of nineteenth-century sarsen cutting debris to form a comparative sample to prehistoric assemblages curated in museum collections;

- a more detailed investigation of the possible standing stones, including excavation;

- a survey of a sample of sarsen-built buildings and structures, such as the embankments to the A4 (engineered as a toll road in 1743 (Fowler, 2000, 22)), agricultural, domestic, and ecclesiastical buildings. The purpose of this work would be to make a detailed analysis of walling, combined with evidence from archived documentary sources, to understand the use and date of different stone cutting and dressing techniques.

Appendix A

PIGGLEDENE SURVEY STONES – FIELD NOTES

STONE	NOTES	STATUS
[1]	Earth-fast in the W side of the coombe, covered in moss and lichen. The part visible is rounded, pinky pale grey.	unclear
[2]	Earth-fast in the W side of the coombe, lichen growth. Angular, possibly part of a split boulder. There is some slight disturbance in this area. Soil developing on the surface of the stone, some small chalky pebbles are visible. The soil is a mid-brown, fine, when wet it rolls well into a ball and sausage, cracks when bent.	unclear
[3]	Earth-fast in the W side of the coombe, lichen growth. Overgrown with grasses. Angular. Likely a cut piece of waste, but like [1] and [2] is overgrown. Pale grey.	unclear
[4]	A rounded boulder, lichen and moss growth. Cut on N side, one wedge pit visible, possibly the bottom of another. Pale grey stone. No sign of a gully around the stone.	cut
[5]	A small angular earth-fast sarsen, lichen growth, possibly cut waste. Has some rind, likely outer part of boulder, but no obvious wedge pits.	unclear
[6]	Large rounded bolder. Part of a chiselled line across the middle from NE to SW. Some flakes lost from the surface around wedge pit mouths. No sign of gully around the stone. Two wedge pits, with vegetation growth.	cut
[7]	Pale grey rounded sarsen, lichen growth. Not obviously split but possibly on edge/tilted? Uncertain.	unclear
[8]	Large irregular boulder, lichen and moss growth. Natural fracture line/vent running horizontally along S side, no signs of working: fault may be why not.	uncut
[9]	A large pale grey boulder. No sign of working. Irregular surface, and numerous vents.	uncut
[10]	Almost entirely buried/covered with moss and soil development. Impossible to say any more.	unclear
[11]	Large irregular pale grey boulder. A horizontal vent in S end, but the cutters have split and left in situ the N end. The split is completely filled with plant growth, so not metrically recorded. No obvious gully dug around the stone.	cut
[12]	A large irregular boulder with natural vents, split with two slides cleared away. No obvious gully dug around the stone. Slight hollow to NE where material removed. Two and a half wedge pits: the N face was cut first and removed, then the E section was split away, cutting through the earlier wedge pit.	cut
[13]	A small earth-fast piece, lichen and moss growth.	unclear
[14]	A small earth-fast piece, lichen and moss growth, split surface and rounded sides.	cut
[15]	A small earth-fast piece, moss and lichen growth, split surface and rounded sides. Has cortex (rind) on the curved face, likely material split from parent boulder. [13] [14] [15] possibly debris from the same stone/cutting episode.	cut
[16]	Irregular pale grey stone. N half is covered with soil development. No signs of cutting in the exposed area.	uncut
[17]	Irregular pale grey boulder, lichen growth. Possibly a wedge pit on the N corner but not clear: could simply be knocked off; does have some damage but very indistinct shapes and no certain sign of wedge pit forms remain.	unclear

[18]	Irregular stone. The S face is a natural surface, including a vent nearly splitting it in half E to W. Root holes. The N face may be split, but if so the wedge pit has been lost to flake scars.	unclear
[19]	Only a tiny bit of stone visible.	unclear
[20]	An irregular sarsen split in one, possibly two, planes, but overgrown so we missed this in the survey and drew it as one whole boulder. The W end is split all the way through, there is an additional N-S split in the middle of the boulder. The upper surface is possibly split also, but if so the cut ran out to S rather than to the bottom of the boulder: may indicate a failure that was abandoned. No wedge pits visible in what remains.	cut
[21]	A rounded pale grey stone, moss growth, with no signs of cutting. Some irregular, natural small hollows in the surface.	uncut
[22]	A small well-buried piece, may have a split surface at the E end but ambiguous. Two natural vents lead into the E end.	unclear
[23]	A well-buried boulder with soil development and plants covering much of the surface. Full size unclear. The only visible part is rounded.	unclear
[24]	Only a tiny part showing. Possibly the E end of [23].	unclear
[25]	Only a tiny part showing.	unclear
[26]	Angular well-buried pale grey stone. Upper face may be a cut surface but much soil development over the stone so unclear.	unclear
[27]	Well-buried stone with much soil development with grasses growing. The only visible part is pale grey, lichen growth, rounded.	unclear
[28]	A boulder in the edge of its quarry pit. The N and NE faces are split; three wedge pits in the N face. Pale grey, lichens, and moss covering the top of the stone so not possible to see if there are any more (unused) wedge pits. The NE side was split away first, then N side. No wedge pits in the NE side; either came away with the removed material, or were placed on the N side of the stone.	cut
[29]	Well-buried, only an edge is visible of this overgrown stone in the base of the hollow.	unclear
[30]	Tiny part of the stone showing. Well-buried and overgrown. The visible part is rounded.	unclear
[31]	Well-buried and overgrown angular piece of stone. Possibly cut debris.	unclear
[32]	Well-buried and overgrown angular piece of stone. Possibly cut debris.	unclear
[33]	A well-buried piece, lichen and moss growth, well rounded to NE and top but the SW face is cut. Soil and plants around it are well-developed, not possible to see any wedge pits, but likely off Stone [34]. Possible slight gully to NE side.	cut
[34]	A large, generally rounded sarsen with some irregular features. A natural vent from SW corner heading NE into the body of the stone. NE face is split, showing four wedge pits. Prepared surfaces to two wedge pit mouths.	cut
[35]	A large irregular stone, very pot-holed, no signs of cutting.	uncut
[36]	A small angular piece, well-buried. The NE face is possibly split, and there is a wedge pit in the SE face.	cut
[37]	A small rounded piece of well-buried overgrown stone.	unclear

[38]	A rounded pale grey sarsen with lichen. Well-buried, no sign of working.	uncut
[39]	Well-buried and overgrown, only a small part is visible.	unclear
[40]	Well-buried in the side of the hollow. The only bit showing is very angular, likely cut debris in the hollow.	unclear
[41]	Well-buried in the side of the hollow. The only part showing is pale grey, rounded, with a natural vent.	unclear
[42]	Large pale grey sarsen, irregular and pot-holed. Possible that the NE corner has been knocked off, because there is a flake scar with characteristic damage on the scar surface below possible point of percussion.	uncut
[43]	Well-buried, rounded, lichen growth. In the side of a hollow.	unclear
[44]	An angular lichen-covered piece, likely split waste but no wedge pits visible. In a hollow.	unclear
[45]	An angular lichen-covered piece, likely split waste but no wedge pits visible. In a hollow.	unclear
[46]	Well-buried in the side of the hollow and overgrown. What can be seen is rounded, no wedge pits. Some rind on the lower part of E facing side suggests that the visible part is a broken surface, although rounded.	unclear
[47]	Angular split boulder. The E face is overgrown but is a split surface, no wedge pits visible. A second split runs E-W along remaining part of the stone. The upper S surface of the stone is a split face: the cut ran out to the S, removing the upper stone material. This having gone, the very S end was split off. Two S-facing wedge pits visible. No obvious hollow or gully around the boulder.	cut
[48]	Highly angular pale grey stone, lichen and moss growth. With [49] may be two pieces of one broken boulder. No wedge pits, but clearly split surfaces.	cut
[49]	Highly angular pale grey stone, lichen and moss growth. With [48] may be two pieces of one broken boulder. No wedge pits, but clearly split surfaces.	cut
[50]	A small well-buried stone, rounded with one flat surface. This is possibly split waste in the hollow edge.	unclear
[51]	Irregular stone with a large hollow in the top. The SW face might be split, but if it is the wedge pit was lost in a big flake that came off. Slight ‘creasing’ in the top of the flake looks like the mouth of a wedge pit. No obvious hollow or gully dug around the stone.	unclear
[52]	Large rounded boulder, some irregularities in the surface. No signs of working.	uncut
[53]	Well-buried and overgrown, pale grey, lichen growth, the visible part is rounded.	unclear
[54]	Well-buried and overgrown, pale grey with lichen growth, the visible part is rounded.	unclear
[55]	A piece split from the same boulder as [56]. Stone [55] has a wedge pit in its S face. The split with [56] is too overgrown to see wedge pits.	cut
[56]	A piece split from the same boulder as [55]. The split with [56] is too overgrown to see wedge pits. The S/SW face of [56] is split but very curved, it looks like that failed so the stone was left.	cut
[57]	An irregular mossy uncut boulder.	uncut
[58]	Very overgrown with nettles.	unclear

[59]	Very overgrown with nettles.	unclear
[60]	This sarsen is standing on edge, the upper face to N and lower more irregular surface to S. It is in the line of the low E-W bank and hawthorns suggesting a prior boundary/division in the coombe. May be part of a boundary/division feature: potentially earlier, with a later division oriented on it/incorporating it. No signs of cutting.	uncut
[61]	The E face of this pale grey sarsen is cut and removed, two wedge pits are visible. It may have a gully cut around it but is overgrown with nettles so difficult to tell. No obvious reason to leave the rest; no root holes or vents for example. But one root hole is visible in the cut face (i.e. was revealed by splitting) and a small flint, did the cutters think it not worth it to proceed?	cut
[62]	A rounded sarsen, split N face with two wedge pits. It split irregularly leaving a large lump of stone in the bottom centre of the split face, with fractures around it.	cut
[63]	A split pale grey stone. The E face is split with one wedge pit visible. The remaining W part of the boulder is split E-W with two wedge pits visible in plan, but with mortar 'repairs' in wedge pit 063_02. Their mouths are poorly formed compared with e.g. the mortar repairs in Stone [146]/[147].	cut
[64]	A rounded pale grey stone, no signs of cutting.	uncut
[65]	Large grey lumpy sarsen. One obvious vent in the upper surface of SW quarter, with some flints showing in E end of the vent: reason to leave well alone?	uncut
[66]	A small rounded piece, well-buried.	unclear
[67]	Lumpy, rounded, grey-brown. No sign of cutting.	unclear
[68]	A small rounded piece, well-buried.	unclear
[69]	This sarsen has been cut using plug and feather. Highly irregular breakage: the attempt to split through the top of the stone has run out in one large bowl-shaped scoop. The middle of the boulder is now full of soil and plant growth. The natural exterior surface to NE/E contrasts with the split surface inside. One plug hole visible in split surface facing S.	cut
[70]	Untouched boulder. Irregular, rounded, pale grey sarsen. Large horizontal vent in the middle, a few small pot holes, moss and lichen growth.	uncut
[71]	Untouched boulder. Rounded with irregular ends. The SE surface is very knobbly.	uncut
[72]	May be a split part of the same stone as [73], but very overgrown so hard to tell. Nevertheless, can see angular surfaces suggesting that it is split debris.	unclear
[73]	May be a split part of the same stone as [72], but very overgrown so hard to tell. Nevertheless, can see angular surfaces suggesting that it is split debris.	unclear
[74]	This may have one split surface, but no wedge pits are visible. Otherwise, it is rounded; may be entirely natural with perhaps freeze-thaw leaving a flake scar?	unclear
[75]	Well-buried. The visible part is rounded.	unclear
[76]	Well-buried. The visible part is rounded.	unclear
[77]	This stone's W, NW and NE surfaces are split but no wedge pits are visible.	cut

[78]	Well-buried. The visible part is rounded.	unclear
[79]	A well-buried and overgrown stone. The N side is visible, it has a highly irregular surface with pot holes and root holes. Likely untouched.	uncut
[80]	Well-buried. The visible part is rounded.	unclear
[81]	This stone's SW and E faces are split, but no wedge pits are visible.	cut
[82]	A well-buried and overgrown stone. The only visible part is well rounded, pale grey, with some lichen growth. Untouched.	uncut
[83]	The larger part of a boulder split into [83] and [84]. Stone [83] is propped up on a buried sarsen to E side. It looks like flakes have been knocked off the E edge of Stone [83], having a rounding effect: there is one clear wedge pit in this side, two other possible (but ambiguous), and a flint is visible in the E edge, so splitting may not have gone well. The upper surface is really quite flat and smooth, the visible underside is more irregular and knobbly. This is visible because of animal burrowing and erosion.	cut
[84]	[84] is a smaller piece to W split from [83] but still in position. Stone [84] shows one wedge pit in its split NE face. The NW face is also split but no wedge pit present. No clear gully around these stones. There is a remnant of mortar in wedge pit 084_01, but the W side of Stone [83] has dropped since then, moving the mortar and exposing the wedge pit. Stone [84], detail of upper surface showing failed wedge pit (084_02) and large flake scar. The cutters tried to set up a split here first, but where the wedge pit was being prepared flaked out, leaving too little stone to support the wedge. They then moved slightly further into the parent stone, splitting it into [83] and [84] but abandoning them.	cut
[85]	A well-buried stone, the exposed surface is natural, no signs of cutting.	uncut
[86]	This stone has been split, although no wedge pits are visible. The E faces are split surface, the natural surfaces to W and N are irregular and pot holed.	cut
[87]	A buried and overgrown stone, the only visible part is rounded with a few root holes. No signs of cutting.	uncut
[88]	An irregular stone with rind. The W face may be split, but ambiguous.	unclear
[89]	Belongs to the group [89] – [100], a major cutting episode of a large boulder. Pale grey stone, some irregularities, root holes in the centre of the upper surface, and some natural vents. The N-S splits between [89]/[90] and [90]/[91] were made first. Then the W-E splits between [89]/[100] and [91]/[97], then the N-S splits between [97]/[96] and [96]/[95]. The N end of [90] was also split away. Stone [89] is the SW corner, two wedge pits in the N face and one in the E face.	cut
[90]	Belongs to the group [89] – [100], a major cutting episode of a large boulder. Pale grey stone, some irregularities, root holes in the centre of the upper surface, and some natural vents. The N-S splits between [89]/[90] and [90]/[91] were made first. Then the W-E splits between [89]/[100] and [91]/[97], then the N-S splits between [97]/[96] and [96]/[95]. The N end of [90] was also split away. Stone [90] is a large block with two wedge pits in the W face, one on the N face, and two in the E face. Edge pit 090_02 is filled with mortar (unmeasured). A large void in the stone in the N face	cut
[91]	Belongs to the group [89] – [100], a major cutting episode of a large boulder. Pale grey stone, some irregularities, root holes in the centre of the upper surface, and some natural vents. The N-S splits between [89]/[90] and	cut

	[90]/[91] were made first. Then the W-E splits between [89]/[100] and [91]/[97], then the N-S splits between [97]/[96] and [96]/[95]. The N end of [90] was also split away. Stone [91] is a large block with one wedge pit in the W face and three in the N face. Its S face and top is the natural surface. There is some mortar to the NW corner.	
[92]	This is a small rounded piece of sarsen with no evidence showing for cutting, possible part of the [89]-[100] group, but by proximity only.	unclear
[93]	Well-buried.	unclear
[94]	A small well-buried piece but highly likely split from the boulder [89]-[100] given location.	unclear
[95]	Belongs to the group [89] – [100], a major cutting episode of a large boulder. Pale grey stone, some irregularities, root holes in the centre of the upper surface, and some natural vents. The N-S splits between [89]/[90] and [90]/[91] were made first. Then the W-E splits between [89]/[100] and [91]/[97], then the N-S splits between [97]/[96] and [96]/[95]. The N end of [90] was also split away. The E face and upper surface of Stone [95] are split. It has a wedge pit horizontally in the upper surface; either it was split this way, or fell over/was moved.	cut
[96]	Belongs to the group [89] – [100], a major cutting episode of a large boulder. Pale grey stone, some irregularities, root holes in the centre of the upper surface, and some natural vents. The N-S splits between [89]/[90] and [90]/[91] were made first. Then the W-E splits between [89]/[100] and [91]/[97], then the N-S splits between [97]/[96] and [96]/[95]. The N end of [90] was also split away. The E, W, and upper surfaces of Stone [96] are all split, with pairs of wedge pits on the E face and horizontally on the upper surface. Presumably the piece has been rotated, because there isn’t enough space to use a hammer and chisel the make those horizontal wedge pits. The S side of wedge pit 096_04 is curved and angled, suggesting how the chisel with used to peck out the wedge pit.	cut
[97]	Belongs to the group [89] – [100], a major cutting episode of a large boulder. Pale grey stone, some irregularities, root holes in the centre of the upper surface, and some natural vents. The N-S splits between [89]/[90] and [90]/[91] were made first. Then the W-E splits between [89]/[100] and [91]/[97], then the N-S splits between [97]/[96] and [96]/[95]. The N end of [90] was also split away. Wedge pits on the E, S and W faces of Stone [97].	cut
[98]	This piece has both natural and split surfaces, but no wedge pits are visible. Very likely waste from boulder [89]-[100] given proximity.	cut
[99]	This piece has both natural and split surfaces, but no wedge pits are visible. Very likely waste from boulder [89]-[100] given proximity.	cut
[100]	Well-buried by nettles and not metrically recorded, but must be part of [89]-[100].	unclear
[101]	Well-buried and overgrown.	unclear
[102]	An irregular stone, but the SE end is split, one wedge pit is visible low to the ground.	cut
[103]	A natural boulder, rounded, irregular, with occasional knobbly areas.	uncut
[104]	Well-buried and overgrown.	unclear

[105]	The N face is split, but no wedge pits are visible.	cut
[106]	The SW face is split. There is one definite wedge pit, but evidence for the second is ambiguous because of damage to the stone (possibly why the stone was left?).	cut
[107]	The SW face is split. One definite wedge pit, one ambiguous.	cut
[108]	Well-buried and overgrown.	unclear
[109]	This stone has an irregular and lumpy surface. The N facing side is quite straight and may be split but very ambiguous, no clear wedge pits are visible, and this could be natural jointing?	unclear
[110]	Like [109]; the W face might be split because it is fairly straight, but there is no evidence for wedge pits or hammer damage. The rest is a rounded surface with a little pitting.	unclear
[111]	Well-buried, moss growth, no evidence for cutting, looks natural.	uncut
[112]	Well-buried. The W side is rounded, the E may be split but evidence for wedge pits is ambiguous; the surface is uneven and no classic signs of hammer damage.	unclear
[113]	Well-buried and overgrown. What's visible is rounded, pale grey sarsen. No evidence for cutting, looks natural.	uncut
[114]	This stone stands in the edge of a hollow. The W face is split, one wedge pit is visible. The N surface might be, but no wedge pits are visible, and tends to be knobbly. The E face may be split, with two possible wedge pit locations with creasing and damage but too irregular to make measurements. Looks like this stone split irregularly and was abandoned, although if the bulk was in the hollow to W, most of the stone was removed.	cut
[115]	A natural rounded pale grey sarsen. No cutting.	uncut
[116]	Well-buried, but given location/proximity, possibly a piece removed from [114] cutting episode?	unclear
[117]	Well-buried, but given location/proximity, possibly a piece removed from [114] cutting episode?	unclear
[118]	Well-buried, but given location/proximity, possibly a piece removed from [114] cutting episode?	unclear
[119]	Well-buried and rounded, looks untouched.	unclear
[120]	A rounded sarsen, natural and uncut.	uncut
[121]	Natural and uncut, irregular with numerous natural vents.	uncut
[122]	Very large well-potholed stone. Split at the E end but no evidence for how (no wedge pit or plug and feather hole(s)).	cut
[123]	Overgrown.	unclear
[124]	Overgrown.	unclear
[125]	Overgrown.	unclear

[126]	Overgrown.	unclear
[127]	Overgrown.	unclear
[128]	Well-rounded and even, natural, uncut.	uncut
[129]	Well-rounded and even, natural, uncut.	uncut
[130]	Well-buried, no information available.	unclear
[131]	Belongs to the group [131]-[136], a major cutting episode of a large boulder. Pale grey stone, some irregularities including a large depression in the centre of the upper surface, and some natural vents. The N-S split between [130]/[133] and the NW/SE split between [133]/134] were made first. Then the W-E split between [131]/[132] and the attempted split of [134] which ran out leaving [136]. Stone [131] is the NW portion, splits to S and E faces. Wedge pit 131_01 (E face) includes mortar and can't be measured fully, S wedge pit can't be measured at all. Slight spalling on both surfaces around this wedge pit mouth.	cut
[132]	Belongs to the group [131]-[136], a major cutting episode of a large boulder. Pale grey stone, some irregularities including a large depression in the centre of the upper surface, and some natural vents. The N-S split between [130]/[133] and the NW/SE split between [133]/134] were made first. Then the W-E split between [131]/[132] and the attempted split of [134] which ran out leaving [136]. Stone [132] is the SW portion, splits to N and E faces. N wedge pit can't be measured at all because of mortar, mortar also on E face. Some spalling on the stone surface of [132] at mouth of wedge pit.	cut
[133]	Belongs to the group [131]-[136], a major cutting episode of a large boulder. Pale grey stone, some irregularities including a large depression in the centre of the upper surface, and some natural vents. The N-S split between [130]/[133] and the NW/SE split between [133]/134] were made first. Then the W-E split between [131]/[132] and the attempted split of [134] which ran out leaving [136]. Stone [133] is split to W and E faces. Wedge pit 133_01 includes mortar infilling.	cut
[134]	Belongs to the group [131]-[136], a major cutting episode of a large boulder. Pale grey stone, some irregularities including a large depression in the centre of the upper surface, and some natural vents. The N-S split between [130]/[133] and the NW/SE split between [133]/134] were made first. Then the W-E split between [131]/[132] and the attempted split of [134] which ran out leaving [136]. Stone [134] has a wedge pit in the SE face. This was intended to split right through the E end of the boulder, but it ran out in a big curve, removing Stone [136] rather than properly cleaving. Fractured flints in the split surface are the likely weakness that caused the split to fail and run away; these are visible in [134] and [136].	cut
[135]	This is a well-rounded stone, the W face may be split but overgrown, so ambiguous.	unclear
[136]	Belongs to the group [131]-[136], a major cutting episode of a large boulder. Pale grey stone, some irregularities including a large depression in the centre of the upper surface, and some natural vents. The N-S split between [130]/[133] and the NW/SE split between [133]/134] were made first. Then the W-E split between [131]/[132] and the attempted split of [134] which ran out leaving [136]. The portion removed from Stone [134]. Fractured flints in the split surface are the likely weakness that caused the split to fail and run away; these are	cut

	visible in [134] and [136]. There is also a wedge pit in the S face, which either articulates with Stone [133] or shows that a piece was removed from the S end of [136] after it came off [134].	
[137]	Well buried and overgrown.	unclear
[138]	Well buried and overgrown.	unclear
[139]	Well buried and overgrown.	unclear
[140]	Well buried and overgrown.	unclear
[141]	Well buried and overgrown.	unclear
[142]	Well buried and overgrown.	unclear
[143]	The stone has been split in half SW-NE but the split is completely filled with plants so can't be recorded metrically.	cut
[144]	The N face of this irregular stone is split with two wedge pits visible.	cut
[145]	The N faces are split but overgrown with moss so wedge pits can't be seen.	cut
[146]	Stone [146] was split from [147] but remains in situ with mortar filling the split and wedge pits. Two wedge pits are visible, there may be more under the soil development.	cut
[147]	Stone [147] was split from [146] but remains in situ with mortar filling the split and wedge pits. Two wedge pits are visible, there may be more under the soil development. The E face of [147] was also split, and the material to the E removed. Six wedge pits are visible in the split face.	cut
[148]	A rounded sarsen with no signs of cutting.	uncut
[149]	A rounded sarsen with no signs of cutting.	uncut
[150]	A potholed natural boulder with no sign of cutting.	uncut
[151]	A potholed natural boulder with no sign of cutting.	uncut
[152]	The E face of this stone looks split but there are no wedge pits.	unclear
[153]	An uncut sarsen with a large pot hole in the upper surface.	uncut
[154]	Well-buried stone, the NW face looks split but is overgrown.	unclear
[155]	Well-buried. This may in fact be more than one piece. No signs of work on the exposed surface, the only parts that can be seen have rounded edges.	unclear
[156]	A large irregular boulder, lumpy, with very uneven surface. Some natural vents including a horizontal one in the top. The NE surface may be jointed.	unclear

Appendix B

Piggledene wedge-pits dimensions (mm)

stone_ID	wedgepit_ID	mouth_length	base_length	depth	mouth_width
PS004	004_01	71	46	44	na
PS006	006_01	113	na	74	na
PS006	006_02	120	na	45	33
PS012	012_01	108	52	51	na
PS012	012_02	118	62	55	na
PS012	012_03	na	na	50	na
PS028	028_02	74	41	33	na
PS028	028_01	85	45	43	na
PS028	028_03	96	50	44	na
PS034	034_02	88	51	46	na
PS034	034_01	94	49	36	na
PS034	034_04	109	47	40	na
PS034	034_03	113	65	43	na
PS036	036_01	74	38	40	na
PS047	047_01	73	42	48	na
PS047	047_02	92	44	37	na
PS055	055_01	72	52	44	na
PS061	061_01	76	42	34	na
PS061	061_02	85	47	43	na
PS062	062_02	95	48	42	na
PS062	062_01	95	58	56	na
PS063	063_03	86	48	41	na
PS063	063_01	93	na	48	39
PS063	063_02	113	na	na	28
PS083	083_01	85	35	61	na
PS084	084_01	86	48	14	na
PS089	089_02	84	41	52	na
PS089	089_01	93	56	47	na
PS090	090_03	83	49	50	na
PS090	090_01	84	38	48	na
PS090	090_04	87	54	37	na
PS091	091_02	96	59	40	na
PS091	091_01	104	42	54	na
PS091	091_03	104	42	62	na
PS095	095_01	77	42	36	na
PS096	096_03	77	41	36	na
PS096	096_01	81	35	35	na
PS096	096_02	85	36	42	na
PS096	096_04	88	43	23	na

PS097	097_01	80	44	18	na
PS097	097_04	86	51	30	na
PS097	097_03	90	25	25	na
PS097	097_05	100	47	50	na
PS097	097_02	102	31	51	na
PS102	102_01	93	50	53	na
PS106	106_01	71	44	36	na
PS107	107_02	92	46	53	na
PS107	107_01	98	60	44	na
PS114	114_01	86	68	36	na
PS131	131_01	83	na	na	28
PS133	133_01	81	na	na	46
PS134	134_01	75	41	57	na
PS136	136_01	87	44	41	na
PS144	144_01	77	45	42	na
PS144	144_02	94	42	32	na
PS147	147_02	91	52	50	na
PS147	147_01	95	45	53	na
PS147	147_04	98	58	51	na
PS147	147_05	104	58	54	na
PS147	147_06	107	51	45	na
PS147	147_03	110	58	50	na

Piggledene plug and feather hole dimensions (mm)

stone_ID	PandF_ID	mouth_width	base_width	depth
UN02	UN02_03	35	na	90
UN02	UN02_02	36	38	59
UN02	UN02_01	41	42	57
UN03	UN03_01	42	na	190
PS69	069_01	43	37	47
UN01	UN01_01	45	30	55
UN01	UN01_03	47	30	50
UN01	UN01_02	50	28	58

Pickledean Barn sarsen stone wall wedge-pit and plug and feather hole dimensions (mm)

measurement_ID	PandF_mouth	PandF_depth	wedgepit_mouth	wedgepit_base
PB11	41	42	na	na
PB09	42	42	na	na
PB03	41	47	na	na
PB02	41	49	na	na
PB01	48	49	na	na
PB04	38	54	na	na
PB10	43	54	na	na
PB07	41	55	na	na
PB08	43	55	na	na
PB13	45	56	na	na
PB14	44	57	na	na
PB06	43	62	na	na
PB12	42	64	na	na
PB15	49	66	na	na
PB05	36	69	na	na
PB16	na	na	87	56

References

ALLEN, M. J. 1988. Archaeological and environmental aspects of colluviation in south east England. *In:* GROENMAN-VAN WAATERINGE, G. & ROBINSON, M. (eds.) *Man-Made Soils.* Oxford: Archaeopress.

ALLEN, M. J. 1992. Products of Erosion and the Prehistoric Land-use of the Wessex Chalk. *In:* BELL, M. & BOARDMAN, J. (eds.) *Past and Present Soil Erosion. Archaeological and Geographical Perspectives.* Oxford: Oxbow.

AMADIO, L. 2011. West Woods, Wiltshire: An Archaeological Survey. *Wiltshire Archaeological and Natural History Society Report.* Devizes: Wiltshire Archaeological and Natural History Society.

ANON. 1907. The Fifty-Fourth General Meeting of the Wiltshire Archaeological and Natural History Society. *Wiltshire Archaeological Magazine,* 35**,** 181-190.

ANON. 1908. The Grey Wethers Preservation Fund. *Wiltshire Archaeological Magazine,* 35**,** 497-501.

ANON. 1926. *Barre Stone-Working Tools. Trow and Holden Catalog No.7,* Barre, Vermont, Trow and Holden Co.

ANON. 1937. *Brunner and Lay Stone and Concrete Working Tools Catalog No.31,* Chicago, Brunner and Lay.

ARKELL, W. J. & TOMKEIEFF, S. I. 1953. *English Rock Terms Chiefly Used by Miners and Quarrymen,* London, Oxford University Press.

BAGGS, A. P., CRITTALL, E., FREEMAN, J. & STEVENSON, J. H. 1980. Parishes: Overton. *In:* CROWLEY, D. A. (ed.) *A History of Wiltshire.* Oxford: Oxford University Press for the Institute of Historical Research.

BELL, M. 1983. Valley Sediments as Evidence of Prehistoric Land-use on the South Downs. *Proceedings of the Prehistoric Society,* 49**,** 119-150.

BELL, M. 1992. The Prehistory of Soil Erosion. *In:* BELL, M. & BOARSMAN, J. (eds.) *Past and Present Soil Erosioon.* Oxford: Oxbow.

BLACKWELL, I. 1995. Fyfod Working Paper 11. East Overton charter boundary S449. *In:* FOWLER, P. J. (ed.) *Fyfod Working Papers.* Archaeology Data Service: Archaeology Data Service.

BLACKWELL, I. W. 1996. Lockeridge and Overton Downs, and Down Barn Area. *Fyfod Working Papers.* Archaeology Data Service.

BOWDEN, M., LAX, A., GOODALL, I., DUNN, C., BLOOD, K., FALCONER, K. & LOFTHOUSE, C. 2000. *Furness Iron. The Physical Remains of the Iron Industry and Related Woodland Industries of Furness and Sourthern Lakeland,* Swindon, English Heritage.

BOWEN, H. C. 1976. Meeting with Dr Andrew Goudie and Mr Michael Summerfield at School of Geography, Oxford on Tuesday 30 November 1976. Historic England Archive: Sarsen Stone Papers [6]: Society of Antiquaries of London.

BOWEN, H. C. & FOWLER, P. J. 1962. The Archaeology of Fyfield and Overton Downs, Wiltshire (Interim Report). *The Wiltshire Archaeology and Natural History Magazine,* 58**,** 98-115.

BOWEN, H. C. & SMITH, I. F. 1977. Sarsen Stones in Wessex: the society's first investigations in the Evolution of the Landscape Project. *The Antiquaries Journal,* 57**,** 185-196.

CLARK, M. J., LEWIN, J. & SMALL, R. J. 1967. The Sarsen Stones of the Marlborough Downs and their Geomorphological Implications. Southampton: Department of Geography, University of Southampton.

COLT HOARE, R. 1819. *The Ancient History of Wiltshire.,* London, Lackington, Hughes, Harding, Mavor, and Jones.

CRITALL, E. (ed.) 1959. *A History of Wiltshire,* London: The University of London, Institute of Historical Research.

CROOK, M. L. & FREE, I. E. T. 2011. *Grey Wethers. The Free family in Marlborough and the Upper Kennet Valley c1847-1998.,* Privately published.

CRUTCHLEY, S., SMALL, F. & BOWDEN, M. 2009. Savernake Forest. A Report for the National Mapping Programme. Swindon: English Heritage.

DE KALB, C. 1900. *Manual of Explosives: a Brief Guide for the use of Miners and Quarrymen,* Toronto, The Ontario Bureau of Mines.

EDWARDS, B. & LAKE, J. 2014. Wiltshire and Swindon Farmsteads and Landscape Project. Forum Heritage Services.

EVANS, J. G., LIMBREY, S., MATE, I., MOUNT, R., DAVIES, S., FITT, J., GRIFITHS, I., JARRETT, C., MILLES, A., RINGWOOD, V. & WHITTLE, A. 1993. An Environmental History of the Upper Kennet Valley, Wiltshire, for the Last 10,000 Years. *Proceedings of the Prehistoric Society,* 59**,** 139-195.

FOWLER, P. J. 2000. *Landscape Plotted and Pieced. Landscape History and Local Archaeology in Fyfield and Overton, Wiltshire,* London, The Society of Antiquaries of London.

FOWLER, P. J. & BLACKWELL, I. 1998. *The Land of Lettice Sweetapple. An English Countryside Explored.,* Stroud, Tempus.

FREE, D. W. 1948. Sarsen stones and their origin. *Wiltshire Archaeological and Natural History Magazine,* 52**,** 338-344.

FREE, D. W. 1950. *Marlborough and District: An Original Peep Into the Past,* Marlborough.

GEDDES, I. 2000. *Hidden Depths. Wiltshire's Geology and Landscapes,* Trowbridge, Ex Libris Press.

GEDDES, I. & WALKINGTON, H. 2005. The Geological History of the Marlborough Downs. *In:* BROWN, G., FIELD, D. & MCOMISH, D. (eds.) *The Avebury Landscape. Aspects of the Field Archaeology of the Marlborough Downs.* Oxford: Oxbow Books.

GILES, D. P., GRIFFITHS, J. S., EVANS, D. J. A. & MURTON, J. B. 2017. Geomorphological framework: glacial and periglacial sediments, structures and landforms. *In:* GRIFFITHS, J. S. & MARTIN, C. J. (eds.) *Engineering Geology and Geomorphology of Glaciated and Periglaciated Terrains. Engineering Group Working Party Report.* London: The Geological Society.

GILLINGS, M. 2015. Betylmania? – Small standing stones and the megaliths of South-West Britain. *Oxford Journal of Archaeology,* 34**,** 207-233.

GILLINGS, M., POLLARD, J., WHEATLEY, D. & PETERSON, R. 2008. *Landscape of the Megaliths. Excavation and fieldwork on the Avebury monuments, 1997-2003.,* Oxford, Oxbow Books.

GREENWELL, A. & ELSDEN, J. V. 1913. *Practical Stone Quarrying. A Manual for Managers, Inspectors, and Owners of Quarries, and for Students.,* London, Crosby Lockwood and Sons.

JOHNSTON, R. 2005. Environmental Evidence. *Fyfod Working Papers.* Archaeology Data Service.

JONES, I. 1725. *The Most Notable Antiquity of Great Britain, Vulgarly Called Stonehenge, on Salisbury Plain Restored.,* England, Gregg International Publishers Limited.

KARKANAS, P. & GOLDBERG, P. 2019. *Reconstructing Archaeological Sites. Understanding the Geoarchaeological Matrix,* Oxford, John Wiley and Sons Ltd.

KING, N. E. 1968. The Kennet Valley Sarsen Industry. *Wiltshire Archaeological and Natural History Magazine,* 63**,** 83-93.

LAMBARDE, W. 1730 Edn. *Dictionarium Topographicum et Historicum,* London, printed for F. Gyles.

LANSDOWNE ET AL. 1907. The "Grey Wethers" Marlborough Downs. *The Times*, 5 July 1907, p.4.

LINFORD, N. 2008. Piggledene, North Farm, Overton, Wilts. Report on Geophysical Survey, September 2008. Portsmouth: English Heritage.

MACARTHUR, S. 2019. *RE: Sarsen cutting.* Type to WHITAKER, K.

MURTON, J. B. & BALLANTYNE, C. K. 2017. Periglacial and Permafrost Ground Models for Great Britain. *In:* GRIFFITHS, J. S. & MARTIN, C. J. (eds.) *Engineering Geology and Geomorphology of Glaciated and Periglacial Terrains.* London: The Geological Society.

NASH, D. J. & ULLYOTT, J. S. 2007. Silcrete. *In:* NASH, D. J. & MCLAREN, S. J. (eds.) *Geochemical Sediments and Landscapes.* Oxford: Blackwell Publishing.

OSBORNE WHITE, H. J. 1907. The Geology of the Country around Hungerford and Newbury: explanation of Sheet 267. London: His Majesty's Stationery Office.

OSBORNE WHITE, H. J. 1925. The Geology of the Country Around Marlborough: explanation of Sheet 266. London: HMSO.

RUPERT JONES, T. 1886. History of the Sarsens. *Wiltshire Archaeological and Natural History Magazine,* 23**,** 122-154.

SMALL, F. 1999. The Avebury World Heritage Site Mapping Project. Swindon: English Heritage.

SMALL, R. J., CLARK, M. J. & LEWIN, J. 1970. The periglacial rock-stream at Clatford Bottom, Marlborough Downs, Wiltshire. *Proceedings of the Geologists' Association,* 81**,** 87-98.

SMITH, A. C. 1884. *Guide to the British and Roman Antiquities of the North Wiltshire Downs.,* Marlborough, The Marlborough College Natural History Society.

STANIER, P. 2000. *Stone Quarry Landscapes. The Industrial Archaeology of Quarrying,* Stroud, Tempus.

STOERTZ, C. 1995. Fyfield Down and Overton Down Mapping Project. *National Mapping Programme.* Swindon: RCHME.

STUKELEY, W. 1740-3. *Stonehenge: a temple restor'd to the British druids [and, Abury, a temple of the British druids].* London, W. Innys and R. Manby.

SUMMERFIELD, M. A. & GOUDIE, A. S. 1980. The sarsens of southern England: their palaeoenvironmental interpretation with reference to other silcretes. *In:* JONES, D. K. C. (ed.) *The Shaping of Southern England.* London: Academic Press.

SWANTON, G. May 2019. *RE: Conversation about the history of North Farm, West Overton, Wiltshire (UK).* Type to WHITAKER, K.

SWANTON, G. 29 January 2020. *RE: Piggledene.* Type to WHITAKER, K.

SWANTON, R. T. Letter, 21 February 1978 (HE Archive SOA03/03).

ULLYOTT, J. S., NASH, D. J., WHITEMAN, C. A. & MORTIMORE, R. N. 2004. Distribution, petrology and mode of development of silcretes (sarsens and puddingstones) on the eastern South Downs, UK. *Earth Surface Processes and Landforms,* 29**,** 1509-1539.

WATSON, S. 2013. Country Matters. The rural-historic as an authorised heritage discourse in England. *In:* STAIFF, R., BUSHELL, R. & WATSON, S. (eds.) *Heritage and Tourism. Place, Encounter, Engagement.* Abingdon: Routledge.

WHITEMAN, C. A. & HAGGART, B. A. 2018. Chalk Landforms of Southern England and Quaternary Landscape Development. *Proceedings of the Geologists' Association*.

University of Reading

UNIVERSITY OF Southampton

UKRI Arts and Humanities Research Council

South, West & Wales Doctoral Training Partnership

Analytical earthworks survey in West Woods, West Overton/Fyfield, Wiltshire (UK)

Katy Whitaker, Elaine Jamieson and Krystyna Truscoe

Analytical earthworks survey in West Woods, West Overton/Fyfield, Wiltshire (UK)

Katy Whitaker,
Elaine Jamieson, Krystyna Truscoe

NGR: SU 153 664

2020

This document was authored during a *South, West, and Wales Doctoral Training Partnership* studentship held at the University of Reading, and is supported by the Arts and Humanities Research Council grant number AH:L503939:1.

Front cover image: *Leica Total Station Theodolite on a tripod, standing over a Survey Station in Stony Copse, West Woods.*

Summary

This fieldwork was carried out as part of a doctoral research project undertaken at the University of Reading, funded by the Arts and Humanities and Research Council through the South, West and Wales Doctoral Training Partnership. The purpose of the research was to make a detailed record of sarsen extraction features and other archaeological evidence. The fieldwork in West Woods, Wiltshire (UK) resulted in a detailed record of earthworks and features in the sarsen quarry in Stony Copse and along Hursley Bottom. It identified two different methods of sarsen extraction and cutting associated with different periods of sarsen exploitation, one of which has not previously been documented in this area. Chronological relationships between features were observed, unexpectedly demonstrating pre-1900 sarsen exploitation in this area. The survey casts new light on inter-war period sarsen quarrying. In addition, a possible standing stone was identified. The survey results have implications for understanding both the archaeology and the geomorphology of this dry valley south of the River Kennet.

CONTRIBUTORS

Archaeological survey was undertaken by Katy Whitaker, Elaine Jamieson and Krystyna Truscoe. The report was written by Katy Whitaker. Professor Martin Bell (University of Reading), Professor Josh Pollard (University of Southampton) and Dr Jim Leary (University of York) made useful comments on the survey plan and the report. Dr Peter Stanier also kindly commented on the report and provided supporting information.

ACKNOWLEDGEMENTS

Permission to carry out the survey in West Woods was kindly granted by The Forestry Commission. The owner of Forest Lodge kindly gave the survey team permission to use open ground on their land to establish a survey station, which in the event was not required but is gratefully acknowledged. I am also grateful to members and friends of the Wiltshire Archaeology Field Group and CBA Wessex for informative discussions during visits to West Woods prior to this fieldwork, in particular to Dr Peter Stanier. During the writing-up period, members of the Association for Industrial Archaeology provided helpful information via social media including details on power sources in early twentieth century quarries. Datasets were kindly supplied by the Wiltshire Historic Environment Record. Lidar visualisations were processed by the author using the Relief Visualisation Toolbox 2.2.1 (https://iaps.zrc-sazu.si/en/rvt#v).

ARCHIVE LOCATION

Katy Whitaker, Department of Archaeology, University of Reading, Whiteknights, Reading, RG6 6AB. Additionally, this report has been provided to: The Forestry Commission, Wiltshire and Swindon Historic Environment Record, The Historic England Library (Swindon).

DATE OF RESEARCH

Archaeological survey and investigation were carried out in February/March 2019, with additional photography during May/June 2019.

CONTACT DETAILS

Katy Whitaker, k.a.whitaker@pgr.reading.ac.uk, 07769 712799, @artefactual_KW

Table of Contents

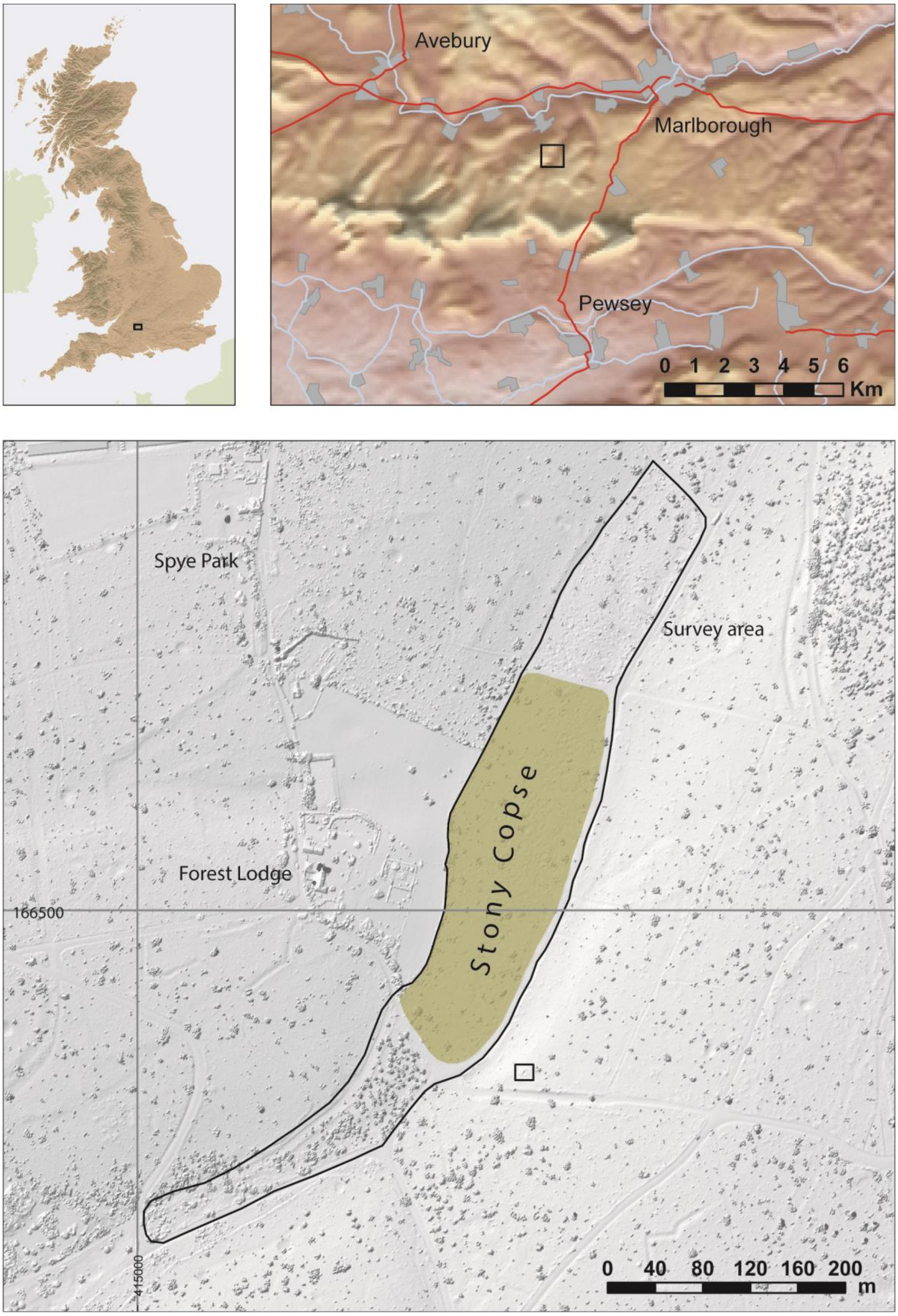


Figure 1 Stony Copse, Wiltshire (UK) shown in green in lower map. Digital surface model data derived from 90m STRM topography data CGIAR http://srtm.cgiar.org, 2m photogrammetry © Bluesky International Ltd/Getmapping PLC, rivers and roads data derived from OS data © Crown copyright, Environment Agency 50cm Lidar DSM (Hill shade model), via EDINA Digimap.

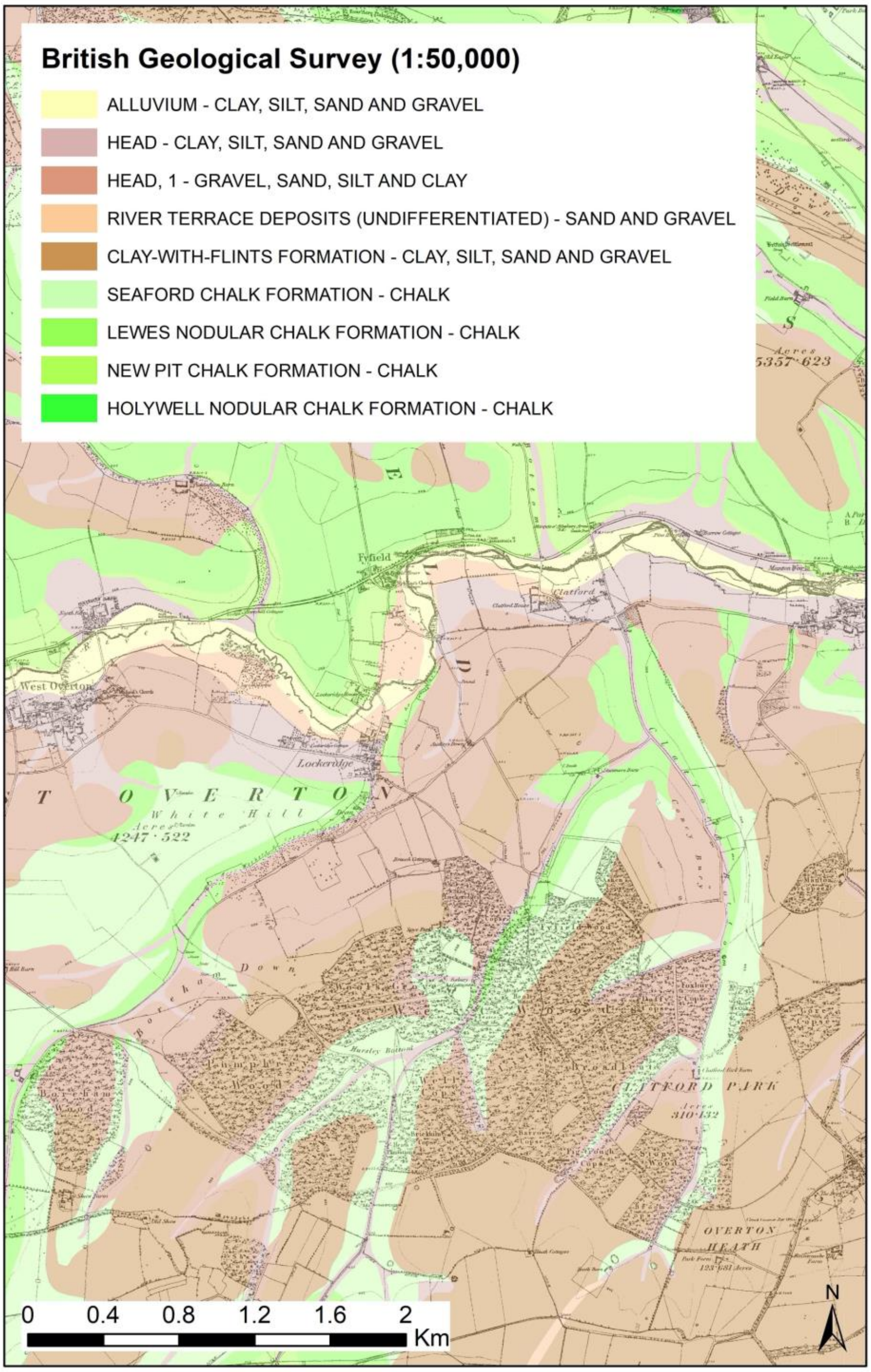


Figure 2 Solid and superficial geology of West Woods and environs with the first edition 6" Ordnance Survey County Series map (Wiltshire, 1889). British Geological Survey shapefile and Ordnance Survey (Landmark Information Group) TIFF geospatial data, via EDINA

Introduction

This report describes the results of analytical earthworks survey in Stony Copse, Hursley Bottom in West Woods (Wiltshire, UK). Hursley Bottom is a dry chalk dip slope valley of the Marlborough Downs to the south of the River Kennet. The fieldwork included mapping earthwork features, photographic recording, and a walk-over survey of a longer stretch of the valley. Following a general description and historical background that contextualises the survey area, the results are described and discussed, and recommendations for future research are made.

West Woods is divided by the Forestry Commission into irregular polygons called compartments, identified by letter. This report uses these identifiers, but also refers to 'parcels' to describe smaller plots of woodland, usually defined by surrounding tracks and paths, within compartments. This is an informal designation.

Location and geology

West Woods extend to approximately 370 hectares to the south of the River Kennet in north Wiltshire (UK), c5km south-west of Marlborough over parts of the modern parishes of West Overton and Fyfield (Figure 1). The woodland straddles Hursley Bottom, a re-entrant of the Kennet Valley, and is at its lowest on its northern edge at c150m OD in this dry coombe. Either side of Hursley Bottom the ground rises to the north-west and south-east, reaching just over 220m OD on the chalk plateau to the south-west. Mixed farmland and Downland dominate beyond the present-day bounds of the wood. The solid geology is predominantly the Seaford Chalk Formation, with Lewes Nodular Chalk depicted by the British Geological Survey at between c160m and 170m OD in the northern part of Hursley Bottom (Figure 2). Exposed chalk can be seen today (2020) at cSU 1554 6673 where trackways are cutting the valley side. The area is substantially covered, however, by the superficial deposits which mantle the higher ground and some valley slopes.

The clay-with-flints covering the interfluves in West Woods is part of the extensive formation of superficial deposits to the south of Marlborough including Savernake (Geddes, 2000, 127). The clay and brickearth were exploited for a brick kiln located just to the south of the wood and commemorated in the wood compartment name

‘Brick Kiln Copse’ (Amadio, 2011, 34, 49). A likely analogue for the deposits capping West Woods’ higher ground was observed approximately one kilometre to the east in a Victorian railway cutting. That exposed a sequence of brickearth, containing sarsens, overlying clay-with-flints approximately 2m thick. These deposits made contact with the underlying chalk on a highly irregular surface. The flints in the clay-with-flints there were unworn and accompanied by a few pebbles from Tertiary deposits (Osborne White, 1925, 80-1).

Dissecting West Woods, Hursley Bottom is an asymmetrical dry chalk valley cutting down from south-west to north-east. At its north-eastern end, at c140m OD, it joins Clatford Bottom (which runs north-south to the east side of West Woods), before meeting the River Kennet in the environs of Clatford hamlet. To the south-west the valley forks as it climbs, with headwaters in the environs of Shaw (c225m OD), Golden Ball Hill (c270m OD) and Gopher Wood (c215m OD).

Through much of the wooded area the base of Hursley Bottom is fairly wide, and within the survey area it is up to c60m across, gently sloping down from west to east. The valley has the shallower east-facing side and steep west-facing side of normal dry chalk valley asymmetry (Clark et al., 1967, 23), conforming to the lowland plateau landsystem described by Murton and Ballantyne (2017, 542-4). The British Geological Survey depicts Head deposits in the very base of the valley, but limited superficial material on the slopes either side of the survey area: Head is indicated only on the east-facing slopes of Fowls Copse and Wells’ Copse. In addition to flinty loam and Coombe rock, Head deposits in Hursley Bottom may perhaps include gravels similar to those observed in the nearby West Kennett and southern Clatford Bottom coombes (Osborne White, 1925, 88), although there are currently no available exposures to explore this possibility.

Sarsens, and probable sarsen extraction pits, can be found throughout West Woods, but apart from examples in Broom Copse and Pyles Copse near Clench Common they are most common in the northerly wood compartments (Amadio, 2011). They are present on both west- and east-facing slopes and the extent to which the surviving boulders here can inform an understanding of the periglacial debris system is tempered by the long history of woodland management and transfer of plots into and out of cultivation. In Hursley Bottom, sarsens tend to lie on the gentle slopes as described for other asymmetrical chalk valleys by Clark et al. (1967). The valley here must once have appeared similar to those containing sarsens either side of the River Kennet in Temple Bottom, Clatford Bottom, Monkton Down coombe, Lockeridge Dene, and West and East Kennett coombes.

Sarsen is a sandstone, likely formed by the groundwater or pan-lacustrine silicification of near-surface Tertiary sands. During later processes of erosion and sediment movement including both gelifluction and solifluction, sarsen boulders were deposited in their present-day locations (Nash and Ullyott, 2007, Small et al., 1970). When during the Tertiary these rocks were formed, and the timings of the formation of the landsystems of which they are a part, are debated (Clark et al., 1967, Murton and Ballantyne, 2017, Ullyott et al., 2004). Nevertheless, in this study area they are a key feature of the Quaternary landscape and since the Neolithic have been used by people for a range of purposes, most notably as megalithic stone settings in monuments including the West Kennet long barrow and Avebury henge's stone circles and avenues.

Recent land-ownership and management

West Woods was part of the Royal Forest of Savernake, the north-western boundary of which was the River Kennet in the limits recorded in 1244. People living in Lockeridge, to the north of West Woods, were subject to forest law in the late 1190s whilst Manton and West Overton are both identified as within the forest by 1263. The forest bounds, land-ownership, and changing cultivation regimes within the area have a complex history. Not only were game management and hunting important: wooded areas in the forest supplied timber, for example for Marlborough Castle; owners, tenants and other rights-holders could take timber, deadwood, bracken, fencing materials and so on; and various communities had pasturing rights. Thirteenth century assarts include areas around West Woods at Shaw and Lockeridge. The area subject to forest law was much reduced at the forest Eyre of 1330 and appears to have excluded West Woods at that time (Critall, 1956, 417-424, 448-451). There is every reason to believe that throughout the Middle Ages West Woods was a busy place (Fowler, 2000, 189-191), and its sarsen stones must have been as noted a feature as those in the more open chalk valleys and Downland to the north and west.

The present survey was carried out in Stony Copse (within Forestry Commission wood compartment G). Stony Copse was formerly known as Fosbury Coppice (Wiltshire And Swindon History Centre X6/53HC, ‘Map of the Manors of East Overton, Lockeridge, and Fyfield and Clatford in Preshute’), associated with an assarted area around Fosbury Cottages to the centre of West Woods. Fosbury is thought to have been a medieval farmstead in Lockeridge tithing. It may have been part of a small estate held by Richard de St Quintyn in the thirteenth century which, via various intervening changes of title and increasing in size by incremental land purchases, became part of the Duke of Marlborough’s holdings including the eastern half of West Woods by 1768 (Baggs et al., 1980, 190, Fowler, 2000, 141, 169-170). In the late eighteenth century, the unwooded lea in Hursley Bottom to the south-west of Stony Copse was known as Tenants Down, and the north-eastern reach of the valley ran through what was then known as Fowles Copse (Wiltshire And Swindon History Centre X6/53HC, ‘Map of the Manors of East Overton, Lockeridge, and Fyfield and Clatford in Preshute’).

Figure 3 Extract from the 1815/16 West Overton Enclosure Award map (WSHC 1033/27, 'Overton: Enclosure), showing an area that today is at the heart of West Woods. Unscaled, north to top.

On the 1815/16 West Overton Enclosure Award map (Wiltshire and Swindon History Centre 1033/27, ‘Overton: Enclosure’) Stony Copse is marked as plot 346 within a larger parcel of woodland allotted to General St John (Figure 3). Four years later, in 1819, Stony Copse is depicted as woodland whilst the formerly-wooded plot to the west is shown as open ground. Spye Cottage, to the north, is labelled ‘Keeper’s House’, reflecting the management of the area for sporting pursuits (Wiltshire and Swindon History Centre 778/2L, ‘Map of East and West Overton, Shaw, Lockeridge and Fyfield’) (Figure 4).

Figure 4 Extract from an 1819 estate map including the same area depicted in Figure 3, showing changes in ground cover including some tree clearance but also fields newly given over to woodland (WSCH 778/2L, ‘Map of East and West Overton, Shaw, Lockeridge and Fyfield’). Unscaled, north to top.

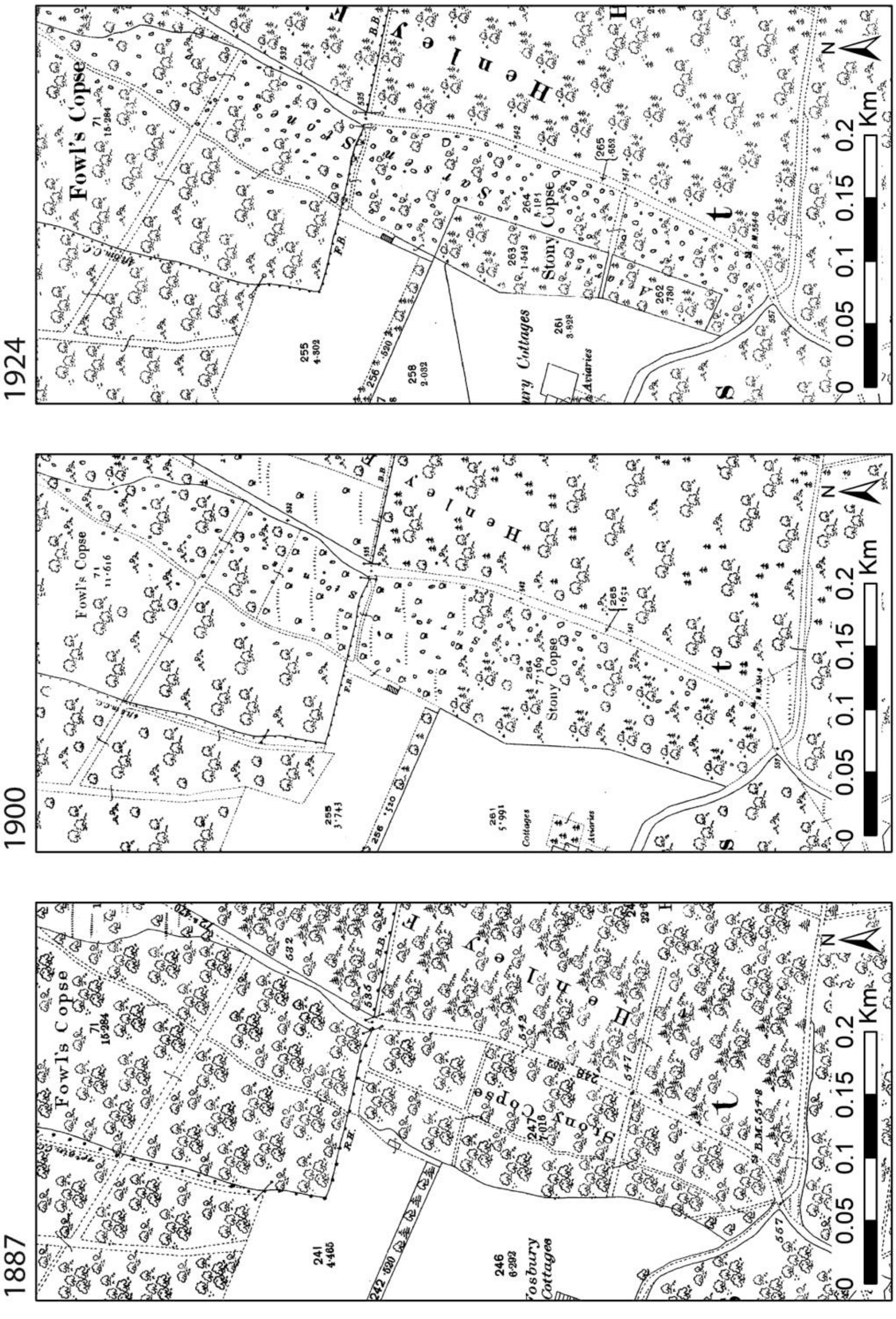


Figure 5 Extracts from historical Ordnance Survey County Series 25" maps showing Stony Copse and the northern part of the walk-over survey area. Open ground to the west of the copse is part of the Fosbury Cottages property, the buildings being to the extreme left of each image. (Ordnance Survey (Landmark Information Group) TIFF geospatial data, via EDINA Digimap Service.

Fosbury Cottages (now called Forest Lodge), south of Spye Cottage in the open ground to the west of Stony Copse, was built shortly before 1866, when the main property is described in estate sales particulars as a “newly erected house” (Wiltshire and Swindon History Centre 2027/2/1/911, ‘Sale particulars: cottages in Angel Yard, Marlborough and at Fosbury and Lockeridge Dean in Overton, and Clatford Park in Preshute, 1866’). The lot on offer in 1866, property of the late John Gundry, was advertised as “A Small Freehold Estate” including the recently built house and ancillary buildings in 20 acres of arable and coppice, “a rare opportunity for sportsmen, being well situated for preserving and holding Game.”

The development of areas within West Woods for producing and managing gamebirds is suggested in successive nineteenth and early twentieth century maps. A network of tracks and paths had been well-enough established within wood compartments to be depicted by the time the first Ordnance Survey County Series 1:2,500 map of the area was surveyed in 1886. As well as the main woodland ride running north-south along the east side of Stony Copse following Hursley Bottom’s lowest point, these included narrower, more sinuous, tracks into Stony Copse and a straight, wide, path striking off the ride perpendicularly towards Fosbury. Curiously, sarsen stones were not depicted on this first Ordnance Survey map, unlike on the sheets covering the Downland to the north and west. By the time of the first map revision in 1899 published in 1900, sarsen stones were clearly shown in Stony Copse and Fowl’s Copse (Figure 5).

Aviaries had been built in Stony Copse and at Fosbury Cottages, which by the time of the Meux estate sale of 1906 had become the principal gamekeeper’s residence (Wiltshire and Swindon History Centre 106/1/4-11, ‘Meux sale catalogues: West Woods and Fosbury Cottages in West Overton with various cottages and holdings…’) (Figure 6). Following the divestment of the Meux property which included the eastern half of West Woods (the former Duke of Marlborough’s property), the large aviaries in Stony Copse were removed although the smaller units at Fosbury were still in place at the time of the 1922 Ordnance Survey re-survey published in 1924. Parts of Stony Copse are depicted with rough wood pasture in the pre-First World War map; and sarsen stones are still depicted along the valley bottom and running to the north through Fowl’s Copse in the early 1920s (Figure 5).

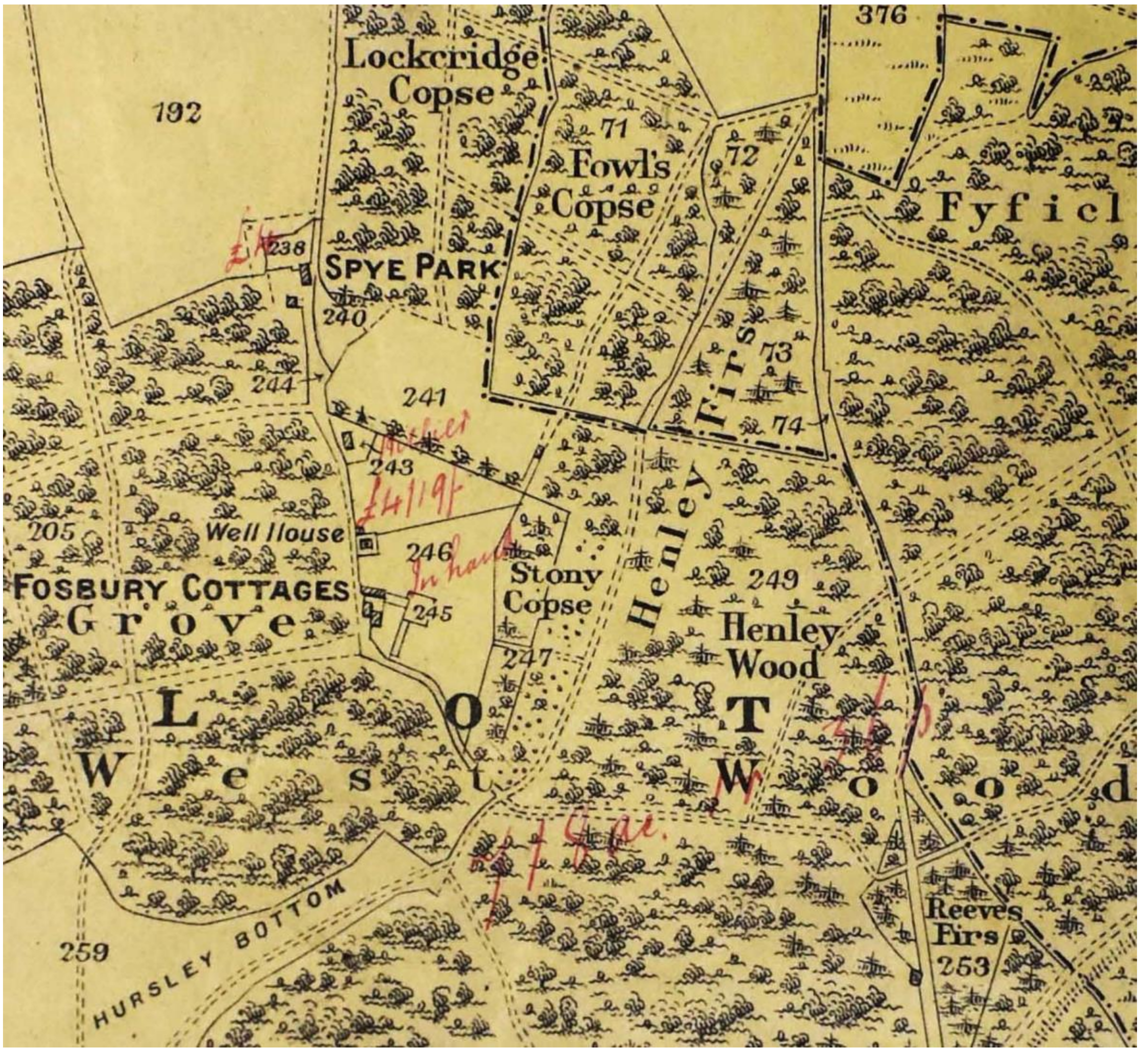
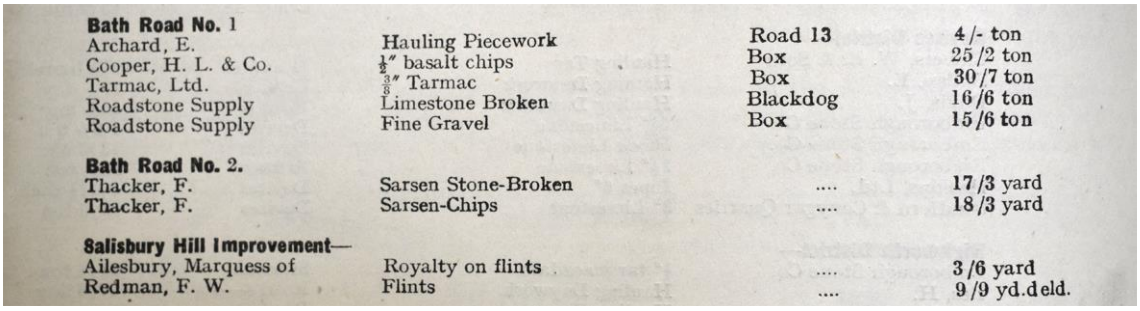


Figure 6 Extract from the Meux Estate Sale Particulars of 1906, including Stony Copse and the whole walk-over survey area, and the grounds of Fosbury Cottages (WSHC 106/1/4-11).

Via a succession of owners, the West Woods estate became the property of the Olympia Agricultural Company Ltd in December 1919 (Wiltshire and Swindon History Centre 1225/73, 'Conveyancing papers relating to the West Woods estate in West Overton…'). In addition to game and timber management, the Company let rights to sarsen stone quarrying to two men called Thacker and Johnson from at least 1920, if not before. King (1968, 86-7) records that this business, using explosives and mechanical stone crushing equipment, provided road stone to the local authority until the unsuitability of sarsen for this purpose became clear.

One F Thacker[1] appears in Marlborough Rural District Council's accounts of 4 October 1919, paid £19 6s 2d for 'materials', and again on 21 February 1920 for the same to the value of £37 0s 3d (Wiltshire and Swindon History Centre G8/100/4, 'Marlborough Council Minutes 1914-23'). On 23 January 1920 the County Surveyor had reported to Wiltshire County Council Roads and Bridges Committee that lengths of certain main roads were below standard, attributing this to the post-War unavailability of railway wagons to distribute road-stone – as a Class A product it could not be prioritised for transportation (Wiltshire and Swindon History Centre F1/100/6/6, 'Wiltshire County Council: Roads and Bridges Committee Minutes 1915-21'). Perhaps this made local sarsen desirable for road works. Thacker appears in Committee records of contracted road-stone suppliers in July and October 1920. He was paid to provide broken sarsen stone and sarsen chips for the Bath Road No.2 contract at 17s 3d and 18s 3d per yard respectively (Figure 7).



Bath Road No. 1			
Archard, E.	Hauling Piecework	Road 13	4/- ton
Cooper, H. L. & Co.	½" basalt chips	Box	25/2 ton
Tarmac, Ltd.	⅜" Tarmac	Box	30/7 ton
Roadstone Supply	Limestone Broken	Blackdog	16/6 ton
Roadstone Supply	Fine Gravel	Box	15/6 ton
Bath Road No. 2.			
Thacker, F.	Sarsen Stone-Broken	....	17/3 yard
Thacker, F.	Sarsen-Chips	....	18/3 yard
Salisbury Hill Improvement—			
Ailesbury, Marquess of	Royalty on flints	....	3/6 yard
Redman, F. W.	Flints	....	9/9 yd.deld.

Figure 7 An extract from Wiltshire County Council's Roads and Bridges Committee Minutes (1920), showing costs of road-stone materials for accepted tenders on different road contracts. The variety of materials and their different prices is clear. Sarsen stone is the most expensive of the products in this section of the accounts (WSHC F1/100/6/6).

Although numerous other suppliers of different stone materials continued to be contracted for these works throughout the 1920s, Thacker and the sarsen stone contract does not reappear in the local authority accounts (Wiltshire and Swindon

[1] It has proven difficult to identify Thacker and Johnson in the archives, and until the 1921 census records are released for public access they will likely remain obscure. The F Thacker contracting for local authority highways business shortly after the First World War may be the F Thacker living at The Stables, Lockeridge, employed by a tarmac firm, summonsed by Marlborough Petty Sessions Children's Summary Court of Jurisdiction on 11 December 1920 at the request of the West Overton Overseers. The Overseers required him to pay a debt on a warrant of distress. Summonsed in his absence to appear in court on 8 January 1921, having been traced neither in London nor Brighton (where his wife rented a flat), the trail goes cold when the court records for that period do not include any further action against him (Wiltshire and Swindon History Centre B16/100/16, 'Petty Sessions, Minute Book of Justices sitting at Marlborough December 1917 – December 1924').

History Centre F1/100/6/6, ‘Wiltshire County Council: Roads and Bridges Committee Minutes 1915-21’). King (1968, 87) reports that the stone was not fit for purpose, and the business went bankrupt very quickly.

In 1928 the West Woods property was sold for £8,500 to Joshua Hosier, William Thomas, and William Arundell (Wiltshire and Swindon History Centre 1225/73, ‘Conveyancing papers relating to the West Woods estate in West Overton…’, and 2444/3, ‘Abstract of title…’). These business partners let the shooting estate and exploited the timber. The consortium is reported to have clear-felled the woodland at that time (Spender, 2005). Exactly how much timber was removed is unclear. When the 1,009-acre estate, including 569 acres of mixed hardwood and softwood woodland, was sold to the Forestry Commission in February 1931, the sale terms included that all timber must be felled by the purchaser within a specified number of years or else revert to the previous owners. The purchase price then was £5,500. Stony Copse, Lot 39 in the sales particulars, included 59 Oaks and numerous Birch trees. In contrast, Fowl’s Copse – to the north and just over twice the area of Stony Copse – included 378 large Oaks, numerous smaller Oaks, about 500 Spruce trees and also Ash and Birch trees (Wiltshire and Swindon History Centre 1225/73, ‘Conveyancing papers relating to the West Woods estate in West Overton…’). Stony Copse appears to have been a more open area than the northern wood Compartments at that time.

The local committee of the Council for the Protection of Rural England (CPRE) noted in March 1939 that picnicking in West Woods was a popular public activity (Wiltshire and Swindon History Centre 3223/65/1, ‘CPRE: Savernake Forest Local committees minute book 1938-70’), but military training in the estate during the Second World War must have severely curtailed public access. A woodland ride through West Woods running between Lockeridge and Clatford Bottom was part of the requisition of public and private roads in late 1943 for ammunition storage. It does appear to have been used briefly in this way, described in January 1944 by Captain Coles, the War Department Land Agent, as “no longer in use” for that purpose (Wiltshire and Swindon History Centre F4/500/22, ‘Savernake Forest: Ammunition Dump 1943-45’).

Later on, American Army troops were using the western part of the woods (formerly in the Duke of Pembroke’s ownership) for various activities: these included a

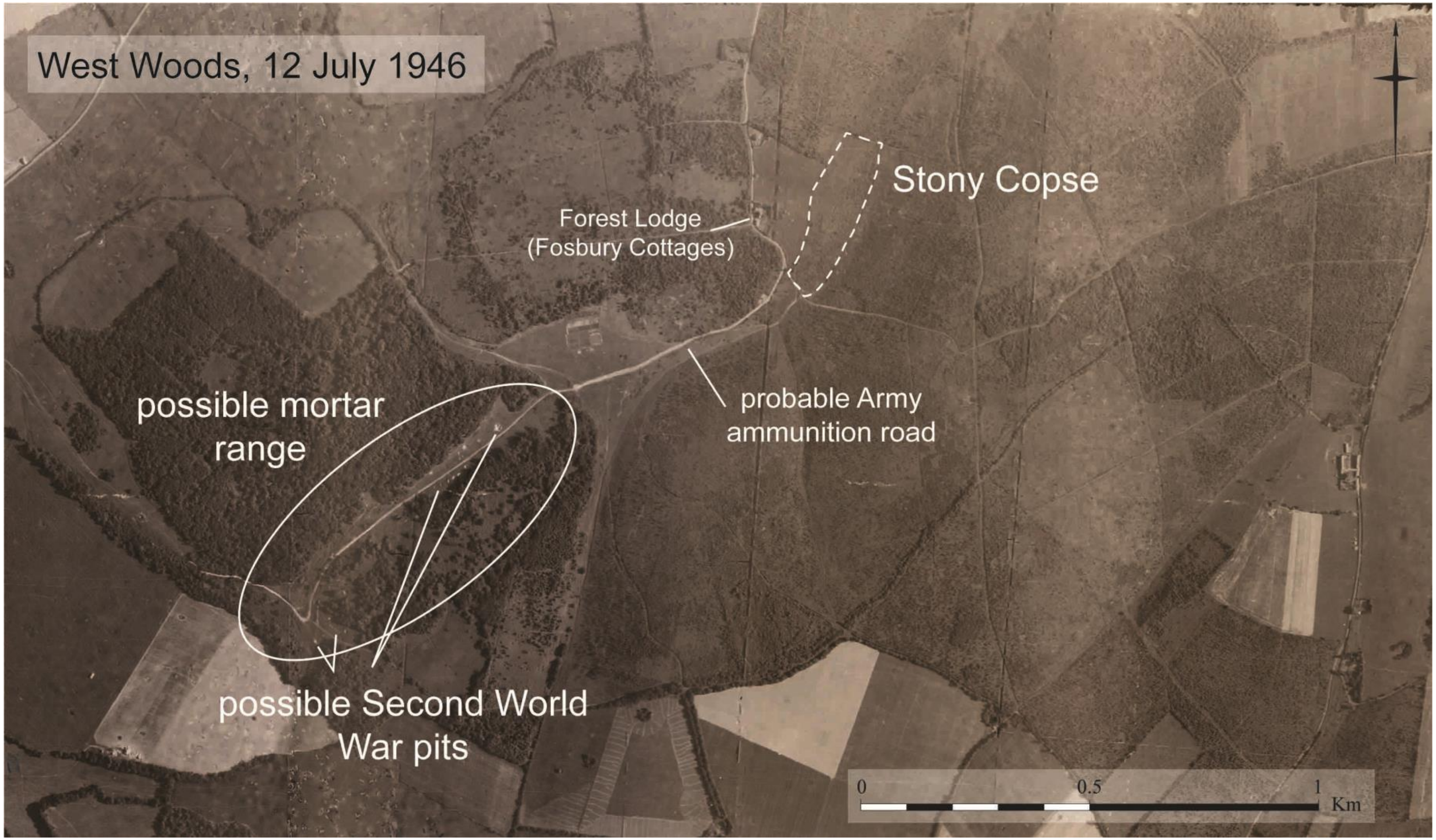


Figure 8 A mosaic of aerial photographs RAF/106G/UK/1661 frames 3115-9, flown on 12 July 1946, showing the southern and central areas of West Woods with probable Second World War features. Imagery: Historic England Archive (RAF Photography), 2.5D mosaic made in Agisoft Metashape (parallel lines appearing to run across the image from top to bottom are digital artefacts created by this process, caused by the appearance of the edges of the old RAF photographs.

possible mortar range (Dan Miles, 2018 pers.comm.) and to practice ‘sapping’ by laying charges on sarsens (King, 1968, 87). Into the 1950s the CPRE committee complained that it was taking far too long for the military to clear *matérial* from areas of Savernake Forest, but whilst this may have included West Woods, aerial photography of the late-1940s shows the more limited extent of the Army’s activity in the area (Figure 8).

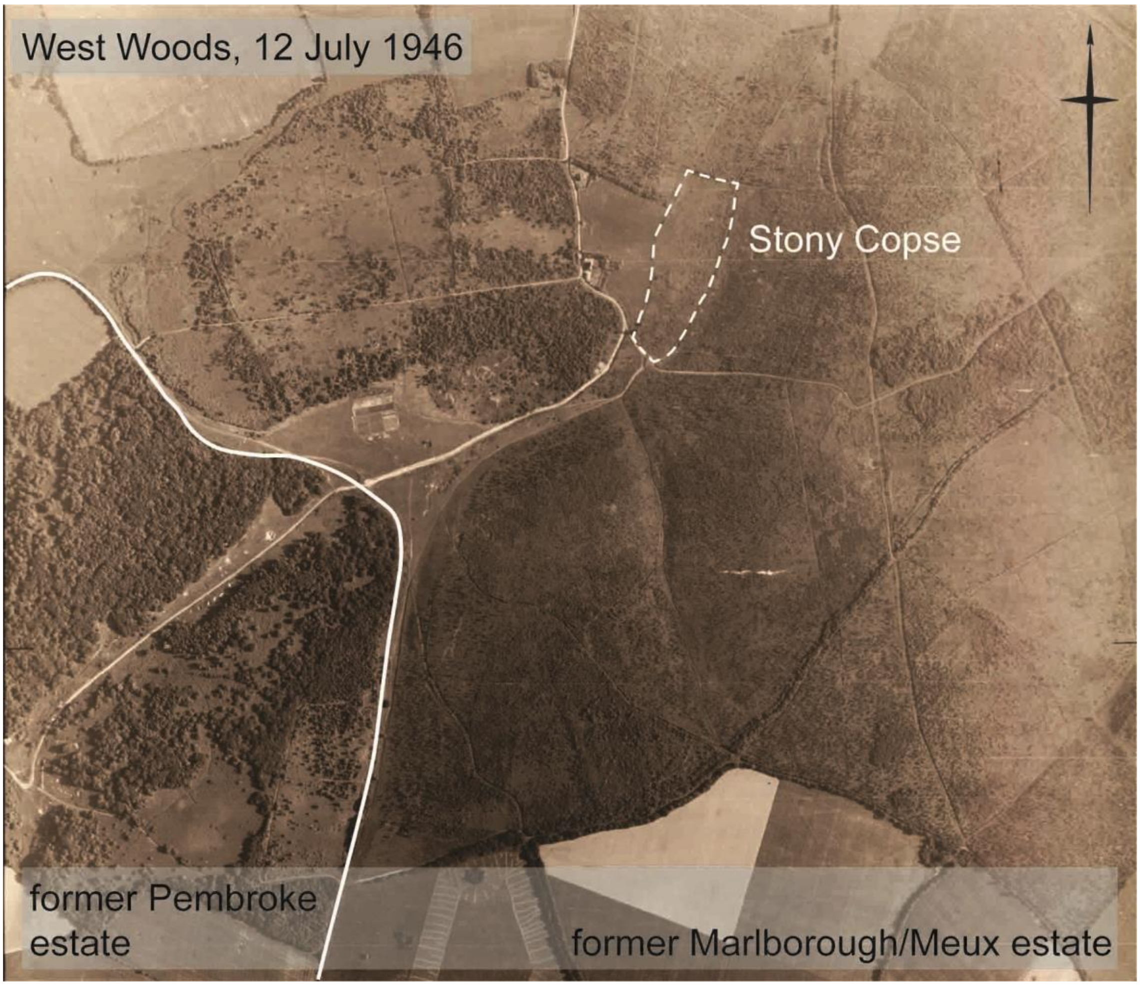


Figure 9 Extract from aerial photograph RAF/106G/UK/1661 frame 3117 (12 July 1946) indicating the boundary between the former Pembroke and Marlborough estates and showing differences in tree cover brought about by different management regimes under different owners. Unscaled. Imagery: Historic England Archive (RAF Photography).

The western part of the woodland had been purchased by the Forestry Commission in 1940 (Spender, 2005). Differences in tree cover across the formerly separately-owned areas of the woods are clear in Royal Air Force aerial photographs that immediately post-date the Second World War. In July 1946 the ex-Pembroke property was still wooded with mature trees, whilst the compartments of the former

Duke of Marlborough/Sir Henry Meux West Woods estate show patchy tree cover and numerous open areas (Figure 9). The reported late-1920s clear-felling, 1930s felling by the Forestry Commission, and likely Second World War felling for war supplies, had had a dramatic impact. Stony Copse had sparse tree cover. The Forestry Commission embarked on a re-planting programme across the estate, predominantly in Beech, which now dominates the area much enjoyed as a local public amenity.

Previous investigations and archaeological context

To provide archaeological context for the present survey area, this report takes the arbitrary bounds of the present wooded area and its immediate environs as shown in Figure 10 ff.

Whilst West Woods has in a general sense been associated with what archaeologists call 'the Avebury landscape' (see for example Brown et al., 2005), it has rarely formed the focus of investigations in its own right. The study area, for example, falls within Peter Fowler's extensive Fyfield and Overton Down Project area: the whole of West Woods were included but principally from documentary research and secondary sources, with some walk-over survey (Fowler, 2000, 33 and especially 182-192). Transcription of archaeological features from aerial photographs, which were an important research source for that project, did not benefit from Lidar coverage and so the woodland area was less-well served by remotely-sensed data in comparison to open Downland.

Unfortunately, West Woods falls between the limits of the National Mapping Programme projects for Avebury (Small, 1999) and Savernake (Crutchley et al., 2009) and currently remains unmapped by Historic England. It is clear from the use of Environment Agency Lidar coverage to examine Stony Copse that visualisations of the dataset reveal numerous archaeological features of various date within the woodland; but a complete transcription and interpretation project to fill the gap between the two NMP projects was beyond the scope of this survey. The small number of archaeological interventions recorded in the Wiltshire HER attests to the limited prior research here.

That West Woods has become a kind of edgeland to archaeological investigation based on Avebury is made clear in distribution maps that illustrate papers in the edited volume *The Avebury Landscape* (Brown et al., 2005). In illustration after illustration the area of the woods appears a blank, due no doubt in part to restricted access to the game estate and forestry land over the years, but also a feature of archaeological preoccupations. Josh Pollard's "persistent places" (Pollard, 2005, 108) in the region are in a way as much a reflection of the persistence of monument-focused research, as of prehistoric habits in the landscape. Nevertheless, a major survey of the whole of West Woods was carried out between 2007 and 2010 by the Wiltshire Archaeology Field Group (Amadio, 2011).

The Field Group team walked transects across the wood compartments, locating and recording features to create an inventory. From the second season onwards, the group walked the transects with reference to a hill-shaded visualisation of Lidar data, 'ground-truthing' features in those parts of the wooded area covered by the processed dataset. This work substantially enlarged the Wiltshire Historic Environment Record dataset for the whole of West Woods.

The environs of West Woods include various indicators of prehistoric life. Mesolithic activity in this area to the south of the River Kennet is represented by numerous flint scatters on cultivated ground around the wooded area (Figure 10). These include scatters in the environs of Bayardo Farm (Wiltshire HER SU 16 NE 055, 056) and above the northern edge of West Woods at Ox Bottom near Stanmore Farm (SU 16 NE 052), blades to the south-west at Shaw (SU 16 NW 059), and finds of possible cores in Lockeridge village gardens (SU 16 NW 053, 055). These hint at the likely extensive use of the mixed and changing landscapes of the upper Kennet Valley, including the higher ground, during the Holocene (Evans et al., 1993, 185-186) as characterised by, for example, Froom (2012, 326-327), Overton (2014, 213-214), and Allen (2005).

The earliest monuments include the long barrow in Long Barrow Copse on the south side of West Woods, which has not been scientifically excavated, and White Barrow, identified through aerial photography to the north of the wooded area (Fowler, 2000, 162). Nineteenth century exploration of the West Woods long barrow is reported by Passmore (1923) to have revealed a sarsen stone chamber covered by a sarsen

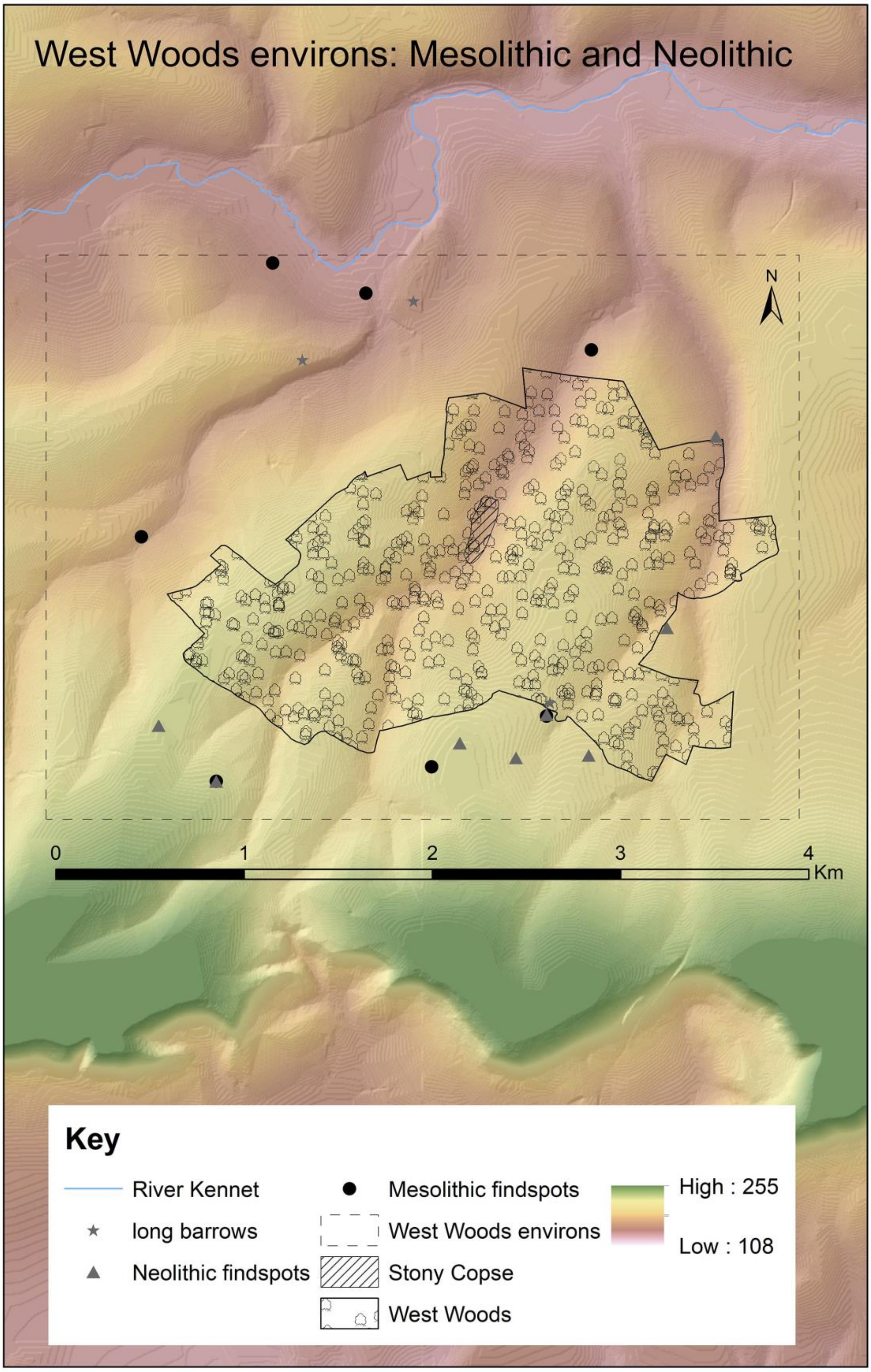


Figure 10 Mesolithic and Neolithic archaeology in the environs of West Woods. Data from the Wiltshire Historic Environment Record © Wiltshire Council. Includes OS 5m DEM and Strategi data.

cairn (Wiltshire HER SU 16 NE 102). Fowler (2011, 138-140) claims that sarsen *polissoirs* and a cup-marked stone are present in Pumphrey Wood, a northern part of West Woods. By analogy with similar features on the Downland to the north of the Kennet, these could be Neolithic in date but, in the absence of detailed published discussion, their identification must be treated with considerable caution. Similarly, a possible standing stone (MWI75609) in the south-east of West Woods requires further investigation.

These monuments aside, the record is dominated by scatters and chance finds of Neolithic stone tools around the edges of the woodland on cultivated ground (Wiltshire HER SU 16 NW 118, SU 16 NE 103, 108) (Figure 10). Like the Mesolithic material, there is a cluster in the environs of Bayardo Farm, including an arrowhead, whetstone and chisel (SU 16 NE 112), a discoidal flint knife (SU 16 NE 117), a group of finds including arrowheads and a polished axe fragment (SU 16 NE 118), and a scraper and assorted flakes (SU 16 NE 109). This focus around Bayardo is a function of archaeological investigation, resulting from both long-term collection by a local resident and the attention of a mid-1990s research project (Wiltshire HER Event Record EWI522). Fowler's (2000, 194) collection of flints and four Neolithic pottery sherds from plough-soil over part of Shaw DMV earthworks (SU 16 NW 136) suggests that deposits also survive under later earthwork features.

These find-spots are unsurprising given the well-documented Neolithic monumental landscapes to the north-west encompassed by the Avebury Word Heritage Site, and in the Pewsey Vale to the south. In contrast, less Bronze Age material culture has been recorded around West Woods (Figure 11). Finds include barbed and tanged arrowheads from the environs of Bayardo (Wiltshire HER SU 16 NE 152), and a flint knife and arrowhead found in Pickrudge Wood in 1848 (SU 16 NW 150). Ritual behaviour across the landscape is suggested by a hoard of palstave and socketed axes recovered to the east of West Woods at Manton Copse (SU 16 NE 150), and burials to the north-west, clustering on the hillside slopes and valley bottom of White Hill (SU 16 NW 153, 654, 655, 738, 739, 744, 745). Additionally, two undated ring ditches to the north-west above Clatford Bottom (SU 16 NE 628, 634), associated with a probably prehistoric field-system (SU 16 NE 621) and positioned on similar contours to barrows on White Hill, are possibly Bronze Age features.

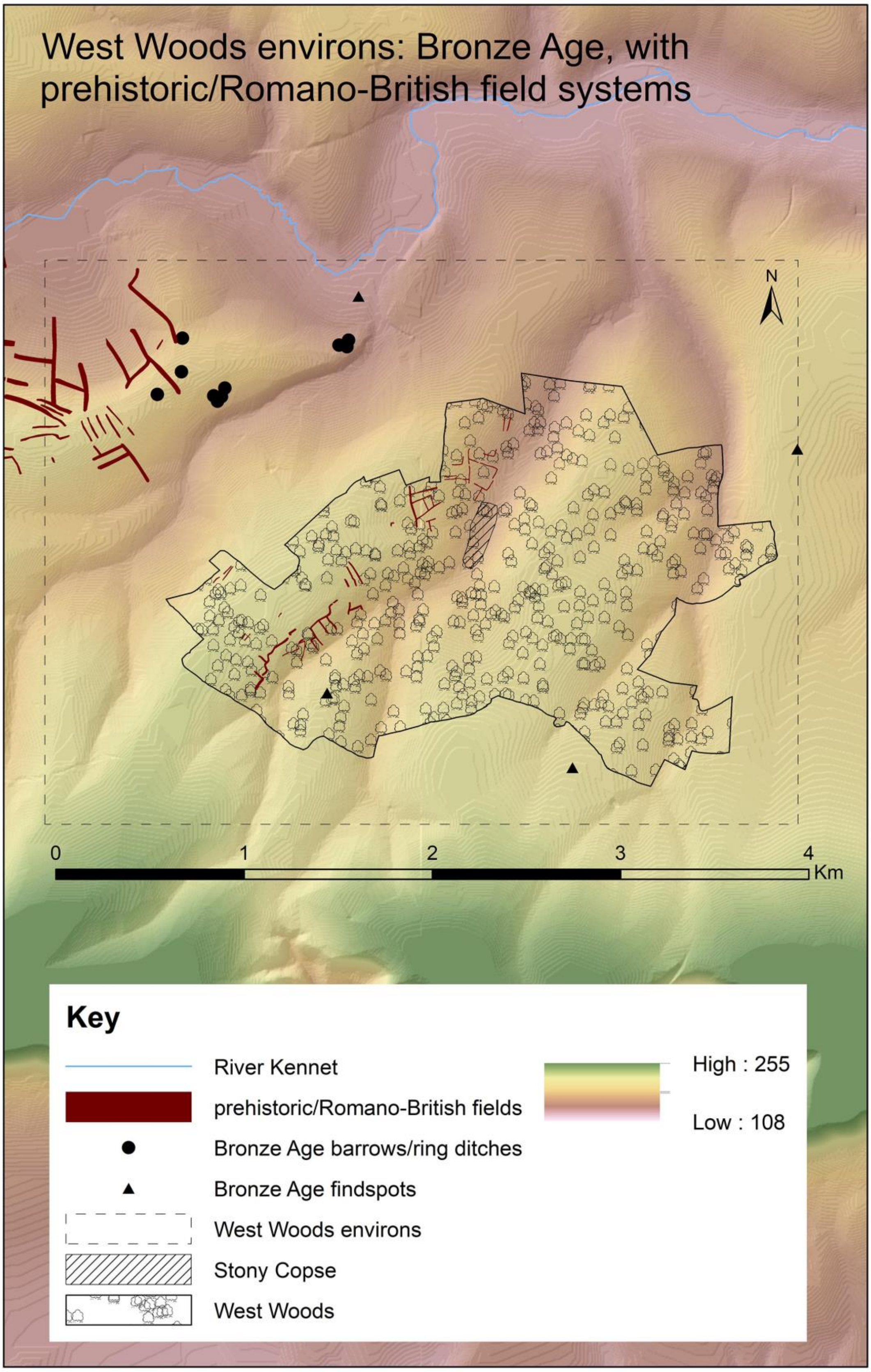


Figure 11 Bronze Age archaeology and later prehistoric field systems in the environs of West Woods. Data from the Wiltshire Historic Environment Record © Wiltshire Council. Includes OS 5m DEM and Strategi data.

Nevertheless, later prehistoric field systems, which may have their origins in the Bronze Age, do extend around and across parts of West Woods (Figure 11, Figure 12). Disjointed by the destructive impact of modern agriculture, these fragments suggest a once far more extensive cultivated area which, by corollary, must not have been wooded (Fowler, 2011). A now ploughed-out field system of c110 hectares (Wiltshire HER SU 16 NW 681) mantling the western extent of White Hill included some large fields, which contrast with smaller field enclosures within West Woods in Pumphrey Wood, Wools Grove and Fowl’s Copse (MWI73037).

On the basis of their similarity to Downland field systems to the north of the River Kennet, Fowler (2011, 140) suggests that these features will have their origins in the second millennium BC and could have been in use as late as the early centuries AD. The few find spots of Iron Age and Roman material culture may be contrasted with this landscape context of later prehistoric agricultural practice (Figure 12). These include the chance find of an Iron Age twisted wire bracelet at Levetts Farm to the east of West Woods (Wiltshire HER SU 16 NE 208), and a group of four Iron Age inurned cremations discovered c1930 in Broome Copse by a local farmer (SU 16 NE 202). This slight evidence plays into Mark Bowden’s (2005, 162) characterisation of the Marlborough Downs during periods of the Iron Age as a peripheral area; but the records are so few that it is unwise to place too much weight on them in this way.

Find-spots of Roman material culture are similarly scattered, suggesting chance losses and manuring with midden material: these include a coin found at Shaw House (Wiltshire HER SU 16 NW 309); a single pottery sherd collected from plough soil at Shaw DMV (SU 16 NW 333); two sherds, a coin and a quern fragment at Manton Copse (SU 16 NE 327); further pottery sherds recovered “from a field system” on Boreham Down (SU 16 NW 313); and C1 AD pottery collected from patches of soil including Neolithic flints and burnt sarsen, to the south of West Woods in the environs of Bayardo (SU 16 NE 310) (Burchard, 1966).

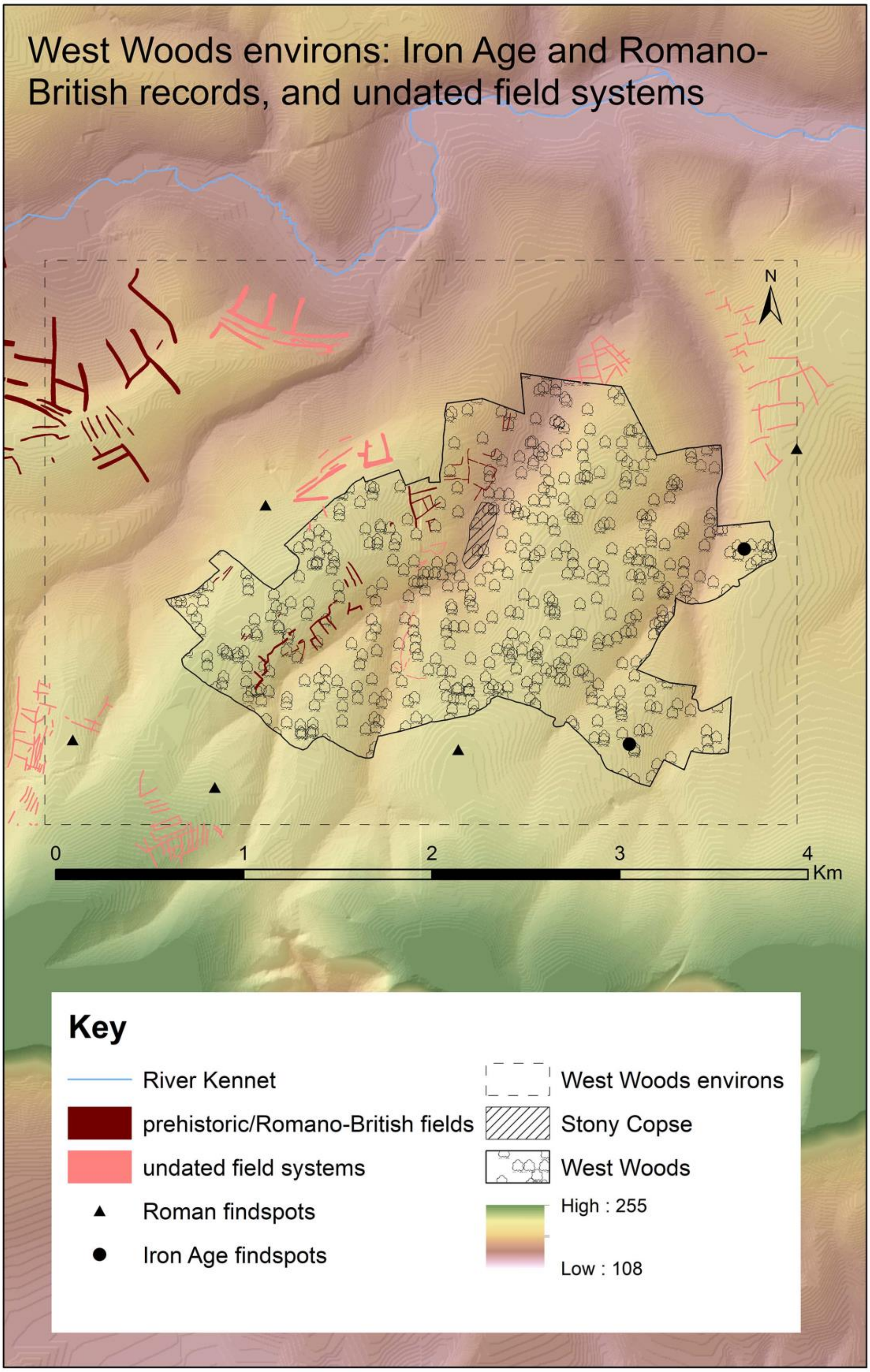


Figure 12 Iron Age and Romano-British archaeology and later prehistoric/undated field systems in the environs of West Woods. Data from the Wiltshire Historic Environment Record © Wiltshire Council. Includes OS 5m DEM and Strategi data.

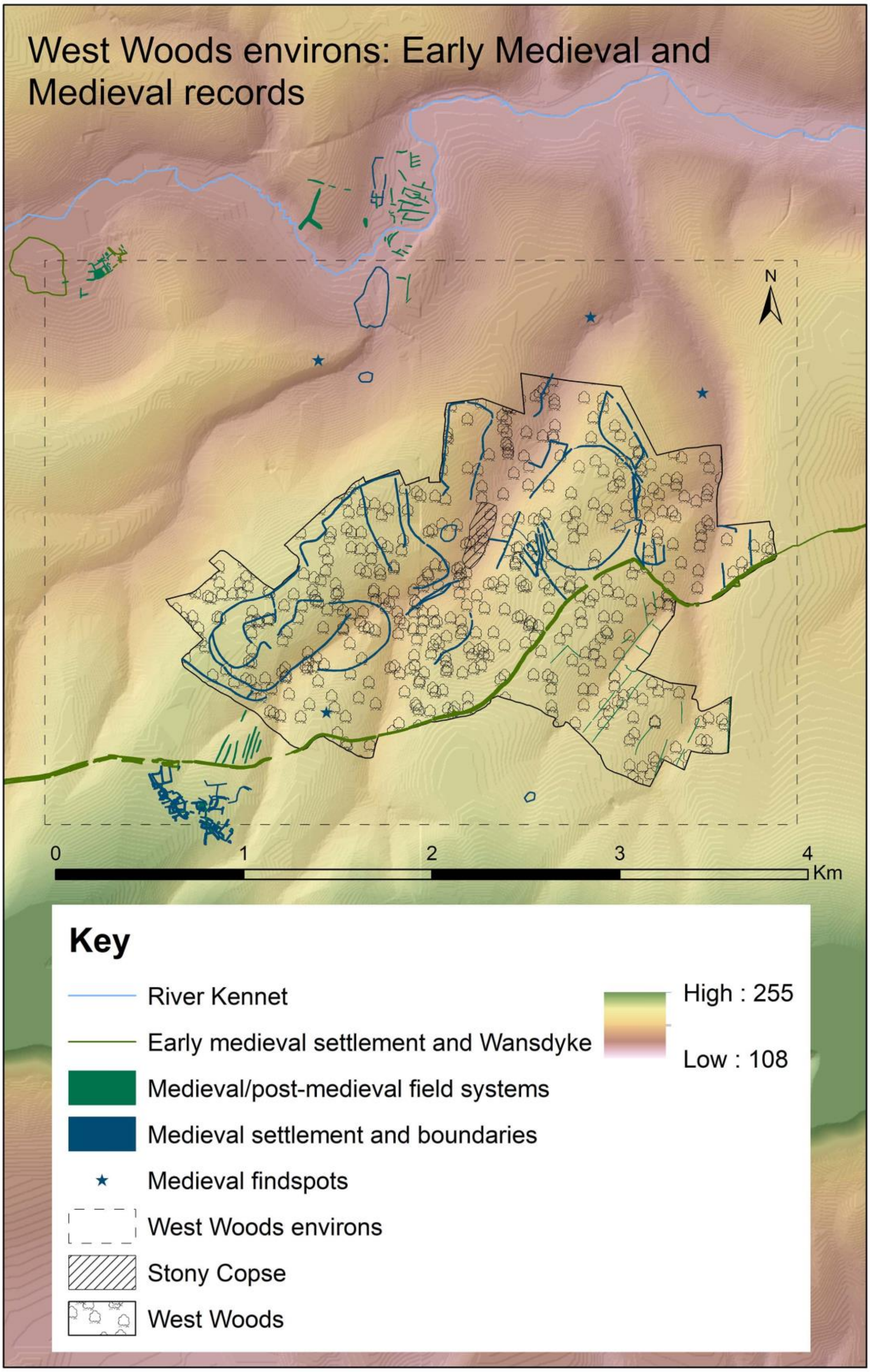


Figure 13 Early medieval and medieval archaeology and later prehistoric/undated field systems in the environs of West Woods. Data from the Wiltshire Historic Environment Record © Wiltshire Council. Includes OS 5m DEM and Strategi data.

Accounts of the area's early medieval past are dominated archaeologically by the Wansdyke, and historically by concerns with the development of the manorial estates, villages, tithings and parish boundaries that have persisted to the present day (for example, Reynolds, 2005). The administrative and settlement history covered in detail by Fowler (2000) is not rehearsed here (see above for aspects specific to the present study area). Part of the long post-Roman earthwork, Wansdyke, runs along the southern edge of West Woods before turning into the woodland (SU 16 NW 694) (Figure 13). It may date to the C6/C7 AD, although is possibly an eighth century boundary dividing Mercia and Wessex (Last et al., 2016, 70). Following a curving course along the watershed between Hursley Bottom and Clatford Bottom, it descends south-east to cross Clatford Bottom and exit the present-day woodland near Clatford Park Farm. The significance of Wansdyke to the present survey, along with the later prehistoric field systems, is for the implication that these hillsides were thinly- or un-wooded until relatively recently (Fowler, 2011, 141).

Whilst later medieval archaeology includes find-spots of pottery in Pickrudge Wood (ST 16 NW 466) and an iron spearhead at Lockeridge (SU 16 NW 458), the record is dominated by landscape features including the woods themselves. Of particular interest to the present survey are the extensive bank and ditch features within West Woods (MWI75600) (Figure 13). These curvilinear earthworks sometimes delimit named wood compartments, such as Lockeridge Copse, but also enclose other areas that have since been re-worked by later wood management. Stony Copse is not enclosed by a wood bank. The whole area around Fosbury in the centre of West Woods is notably open in this regard, possibly reflecting the settlement history here of a medieval farmstead likely to have been the focus of the thirteenth century St Quintyn estate (see above). That Stony Copse was dominated by a sarsen spread until into the twentieth century may also in part explain the lack of boundary features. Just as part of Hursley Bottom to the south-west appears to be a long-term open lea (Fowler, 2000, 191), the lower ground of the valley now occupied by Stony Copse may have been left as a stony, scrubby waste for some considerable time.

Despite the prevalence of sarsen stones in Hursley Bottom, they are missing from Reverend AC Smith's map (Smith, 1884, map section XVI) (Figure 14). This is unexpected because in his extensive and detailed survey over 30 years recording archaeological monuments in the environs of Avebury, Reverend Smith was very careful to include sarsen spreads. Smith marked both Wansdyke and the West Woods long barrow on the working base maps that he adapted from Ordnance Survey maps. He may not have known to look out for a sarsen spread in Hursley Bottom, as boulders are not depicted there until the first revision of Ordnance Survey mapping for the area, published too late for him, in 1900 (1:2,500 scale Wiltshire sheet XXXV.4, surveyed in 1889) (Figure 5).

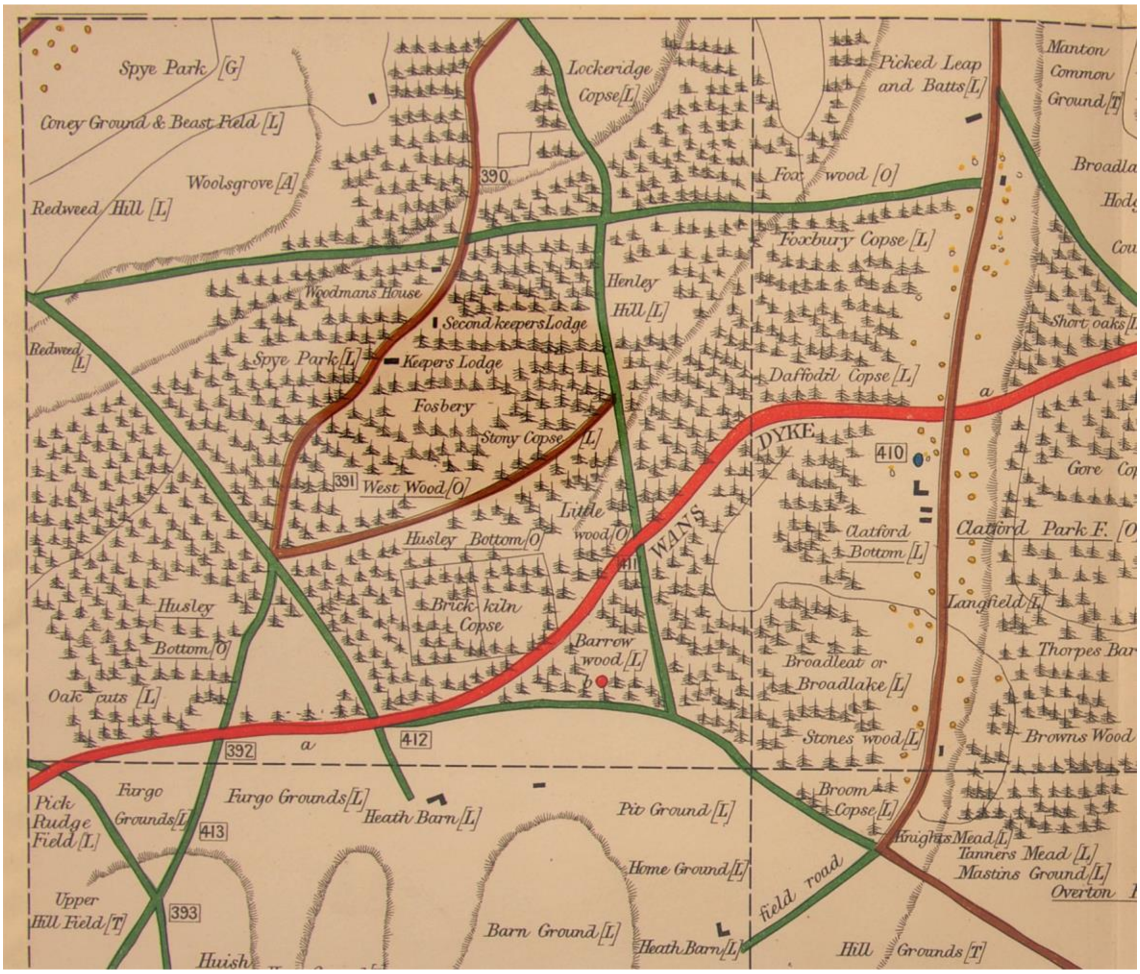


Figure 14 An extract from Reverend AC Smith's map of archaeological monuments in the Avebury environs. The area of Stony Copse and Fosbury is highlighted. Sarsen stones are depicted as yellow boulders. They can be seen to either side of the road in Clatford Bottom, but Smith does not show them elsewhere within the wood. Monuments shown in red include Wansdyke and the location of the West Woods long barrow.

Sarsens were never shown, however, by the Ordnance Survey in the southern arm of Clatford Bottom (despite Browne’s (1864, 26) earlier record that sarsens once extended southwards almost as far as Oare Hill); yet Smith drew them there, presumably having seen them during his perambulations. This contrast with Hursley Bottom suggests that he did not enjoy access throughout the woodland, perhaps limited by the game estates and their private roads.

Nevertheless, sarsens are scattered throughout West Woods, principally in the northern arm of Hursley Bottom from Stony Copse into Fowl's Copse, and on high ground and at wood compartment edges. As well as complete boulders, they include multiple abandoned boulders and waste material showing the typical trapezoidal wedge-pits associated with nineteenth- and early twentieth-century sarsen extraction. This industry was not, however, noted here by King (1968, 87, 92), who lists only quarrying and processing for road stone in 1920, and sapping practice on sarsens by American Army units stationed in the area prior to D-Day.

The previous extent of sarsens throughout West Woods is hinted at in the invaluable Wiltshire Archaeology Field Group survey (Amadio, 2011). Within Stony Copse, the survey describes twentieth century features relating to the inter-war road-stone quarry including a large concrete machinery base (Wiltshire HER MWI75627) and other concrete waste (Amadio, 2011, 38-41), an underground store (MWI75628), and a large area of sarsen extraction pits and possible ramps for hauling material onto the woodland ride network (MWI75629). These ramps or causeways for convenient vehicle access are mentioned by Field (2005, 93) as unexcavated material dividing the valley floor into compartments. Although West Woods includes a range of undated extraction pits where material including sarsen, clay and brickearth were likely sourced (Figure 15) the intense area of sarsen extraction within Stony Copse forms the focus of the present survey.

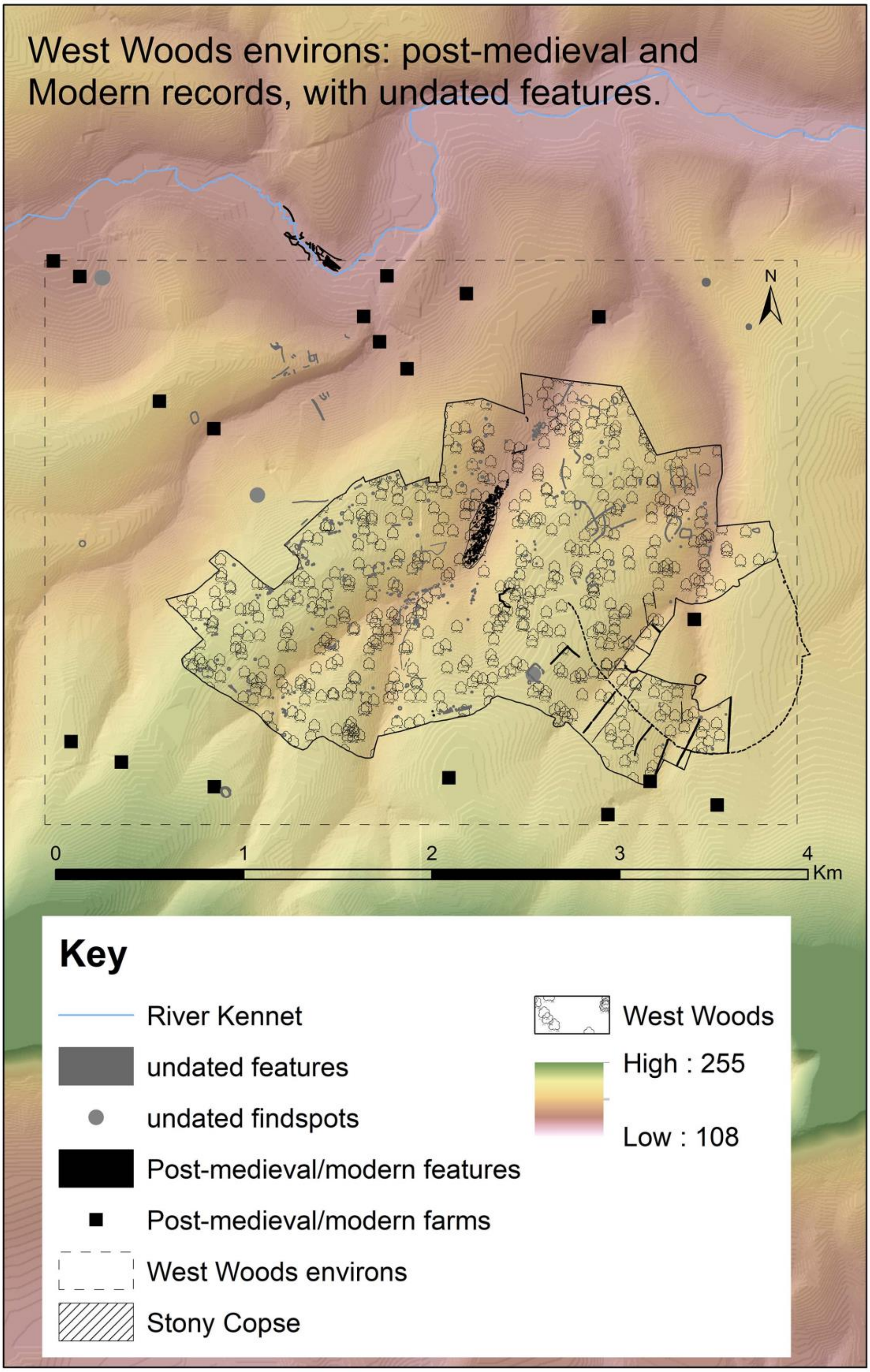


Figure 15 Post-medieval and modern archaeology and undated features in the environs of West Woods. Data from the Wiltshire Historic Environment Record © Wiltshire Council. Includes OS 5m DEM and Strategi data.

The present survey

Fieldwork in West Woods was planned to contribute to a comparative archaeology of sarsen extraction as part of a wider piece of work which hypothesises that sarsen stone extraction and working of different periods, using different techniques, have characteristic distinguishing features. This research seeks to test the premise that sarsen quarrying can be characterised through its archaeological field remains. Whilst three study areas in north Wiltshire were originally proposed (West Woods, Piggledene, and Totterdown), in the event timely access could not be arranged to Totterdown (later investigation has since suggested that the intended area to the north of Totterdown Wood has been extensively ploughed and only a very small area of north-facing valley slope may in fact retain sarsen extraction evidence).

Aims

The survey objectives in West Woods were:

- to record and characterise the field archaeology in a targeted area that samples the dispersed sarsen quarry. This includes all features within the survey space, establishing where possible a relative chronology;
- to closely relate negative features (pits, hollows, scrapes), positive features (banks, mounds, spreads), cut/uncut sarsens, stone debris, tracks etc within the study area.

Field methodology

A detailed analytical earthwork survey at 1:500 was carried out using differential GNSS (Leica GS15 antenna with CS15 field controller) and Total Station Theodolite (Leica Robotic TS12 and field controller). The surveyed area comprises c1.6 hectares of the southern part of Stony Copse, capturing the full range of physical quarrying features described by Amadio (2011) in the environs of SU 1529 6648. The survey area was bounded to the west by modern fence-lines and to the east by the principal north-south woodland ride. It extended to the north just beyond a substantial earthwork feature, interpreted by Amadio (2011) as a staithe or ramp to facilitate sarsen stone transport out of the quarry pits. The northern boundary was determined by the extent that could be covered by the survey team within the week available for fieldwork, providing an area that is representative of archaeological features within Stony Copse as a whole (Figure 16).

A detailed survey plan of the archaeological features was produced in the field on polyester film using the electronically derived control plot, augmented with tape-and-offset techniques. The survey included fine detail of the earthwork and stone remains of the quarry workings and all other observed features. Any sarsens within the survey area were mapped, as were the occasional blocks of masonry and cast concrete that are visible on the surface. The measured survey also included an underground feature at SU 15325 66372, just outside the main measured survey area (Wiltshire HER MWI75628). Two control points were positioned next to the feature using the Total Station, and the structural details were mapped by tape-and-offset.

The work was undertaken in Winter 2019 when the ground conditions were at their most favourable with minimal vegetation cover to ensure that the work was produced to the highest possible standard. Despite this, parts of the survey area were made difficult to work in by patches of thick old wood bramble. Here, smaller or subtler features may have been obscured. Following the analytical earthwork survey, a digital hachured plan was produced in AutoCAD Map 3D 2019 and Adobe Illustrator 2019, using Historic England archaeological conventions and hachure set.

Photographs were captured in camera RAW and JPG formats using a Nikon D5600 DSLR with AF-P Nikkor 18-55mm lens, both hand-held and tripod-mounted. Scale and direction information using equipment such as ranging rods, tapes, and scale cards were included, with grey cards to control for white balance in processing. A photograph record sheet was maintained. Photographs were processed using Adobe Bridge and Photoshop CC 2019 to produce an archive set in TIFF format in addition to the working set of camera JPG files.

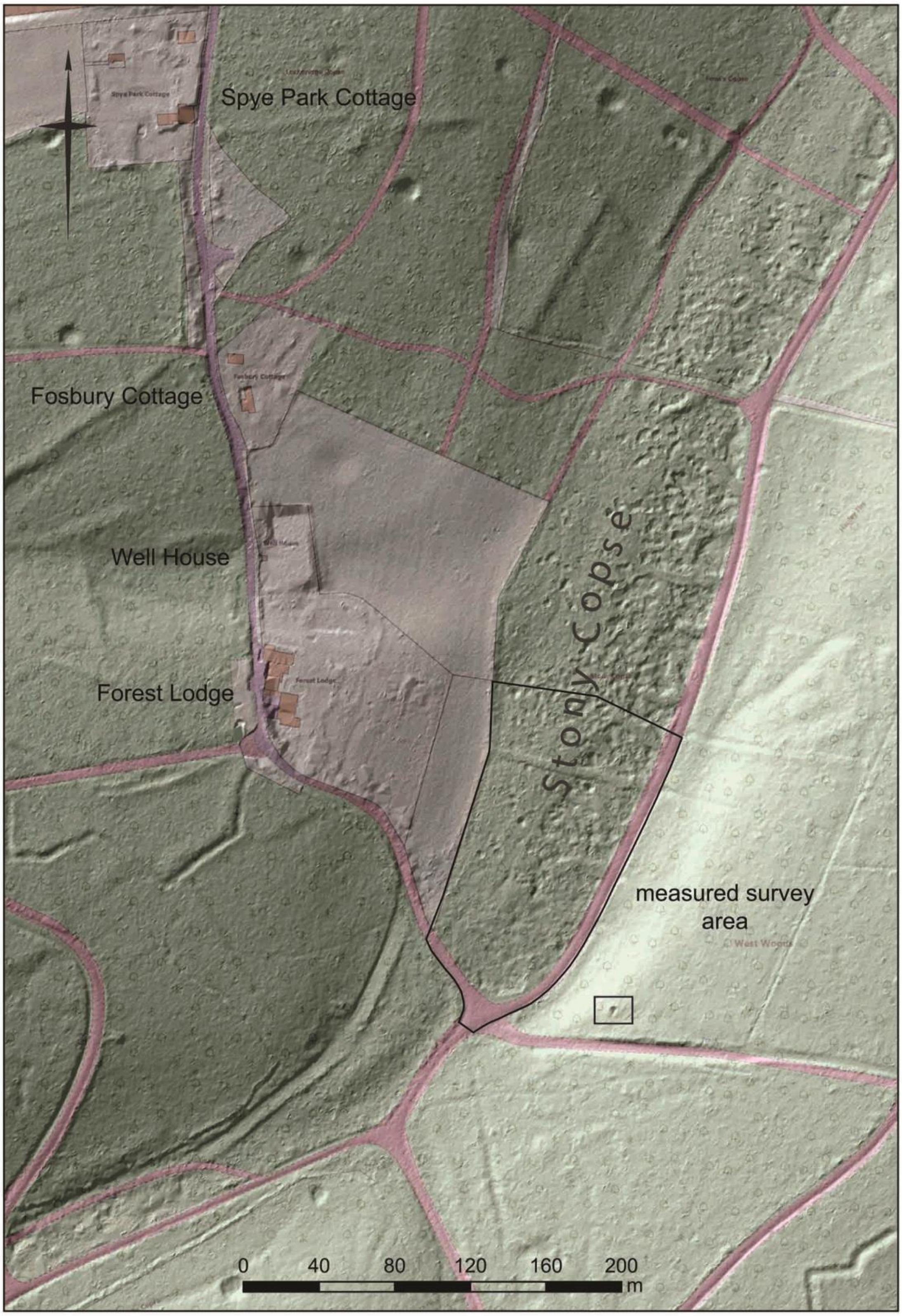


Figure 16 Map depicting the location of the measured survey area in the present-day context of Stony Copse in Hursley Bottom, West Woods. Modern building names and trackways are shown. Includes data OS data © Crown copyright, Environment Agency 50cm Lidar DTM Hill-shade model.

In addition to the analytical earthwork survey, the fieldwork included a walk-over survey of the lower reaches of Hursley Bottom from the west end of the lea (cSU 1500 5523) as far as the north-west arm of the main woodland ride (cSU 1545 6686) (Figure 1). This excluded the area of likely sarsen extraction to the north at cSU 1563 6714 and the sarsen wall and sarsen boulders in Fowl's Copse, features which had been visited and photographically-recorded on previous occasions but which are not discussed here. During the walk-over survey, general observations on the topography and sarsen spread were made and sketched. Measurements of landscape features in the walk-over survey given in this report are derived from Environment Agency LiDAR data Multi-lit Hillshade and Open Positive visualisations. Landscape photographs, and photographs of features of specific interest, were taken. Following the identification and recording of sarsens prepared for destruction using explosive charges, a sample of charge-holes were recorded using digital callipers and a hand tape. These observations form part of the survey results and are discussion below, contextualising features recorded in more detail in the measured survey area.

A day-book was kept, recording the survey process, notes, observations, and decisions made by the survey team.

Figure 17 Analytical earthworks survey of archaeological features in the southern end of Stony Copse, Hursley Bottom, West Woods. Survey scale 1:500 (reduced).

Figure 18 Analytical earthworks survey of archaeological features in the southern end of Stony Copse, Hursley Bottom, West Woods. Survey drawing overlaid on Open Positive visualisation of Environment Agency 50cm DTM data. Survey scale 1:500 (reduced).

Results

The principal survey drawing is shown at Figure 17. Annotated drawings identifying specific features described below are given in Figures 20, 21 and 22. These are extracts to help the reader to explore particular parts of the surveyed area, given the complexity of the recorded archaeological features. Throughout this report, features within the measured survey area are identified by letter, number, or name. Lower case letters are used for simple single-lobed pits, uppercase letters for complex multi-lobed pits. Numbers are used for finger-dumps. The wider walk-over survey is divided for convenience into four areas (Figure 32).

Measured Survey - earthworks

Figure 19 Looking east in Stony Copse. The relatively flat bottom of the valley contrasts with the steep west-facing side seen rising up behind the tripod and people who are standing on the main woodland ride.

Stony Copse is a relatively open area within West Woods compartment G. Its beech trees are well-spaced, affording glimpses up the gentle western slope to Forest Lodge (formerly called Fosbury Cottages). The eastern side is dominated by the steep west-facing valley side (Figure 19). The ground is firm underfoot with no obvious signs of animal burrowing. There are very few whole sarsens on the surface.

In the southern area of Stony Copse below the straight embanked track that divides the parcel there is a notable distinction between the western and eastern halves of the valley bottom. To the west, previously occupied by early twentieth century aviaries, the ground is relatively level and undisturbed with few archaeological features in comparison to the eastern half, where the ground as far as the main woodland ride is heavily disturbed. North of the straight embanked track this disturbance begins to extend across the whole of Stony Copse, until much of the base of Hursley Bottom is covered in quarrying features. North of the present survey area this distinction continues, the extent of disturbed ground sometimes covering the whole valley floor but always encompassing its eastern reaches (Figure 18).

Pits

The majority of the earthwork features are quarry pits. Morphologically, they fall into two general groups: simple single-lobed pits with one base, or more complex multiple-lobed pits with bases divided by scarps or low banks. They have well-defined, smooth sides. The simple pits are sub-circular or oval on plan ranging from 1.3m to 7.2m in diameter[2], whilst the complex pits are irregular but tend to be elongated or sinuous on plan, ranging from 5.2m to 16.8m long. Their size range, complexity and number suggest that they were hand dug (assuming that mechanised excavation would result in larger pits or indeed a fully excavated opencast quarry).

The pits are slightly less densely distributed and shallower to the southern end of the measured survey area, becoming more complex and deeper to the north. At their smallest and shallowest the pits are sometimes no more than shallow-sided scoops or crescentic hollows, for example in the area immediately to the west of the large concrete base in the southern end of Stony Copse (Figure 20). Here, the pits range from single hollows of 2.3m to 7.2m diameter and 0.25m to 0.35m depth (pits [o], [p],

[2] Throughout the text, maximum measurements are given unless stated otherwise.

[q], [r]), to more complex pits up to 9.8m in length and with two or more bases divided by slight scarps. The western sides of pits in this area tend to have deeper and steeper sides, the extraction hollow tapering out towards the east or south-east. Two inter-cutting hollows in this group of pits at SU 15283 66423, [v] and [w], represent a quarrying sequence, the slightly larger hollow to the east cutting the smaller to its west. In contrast, other digging sequences resulted in the extension of pits into multi-lobed features.

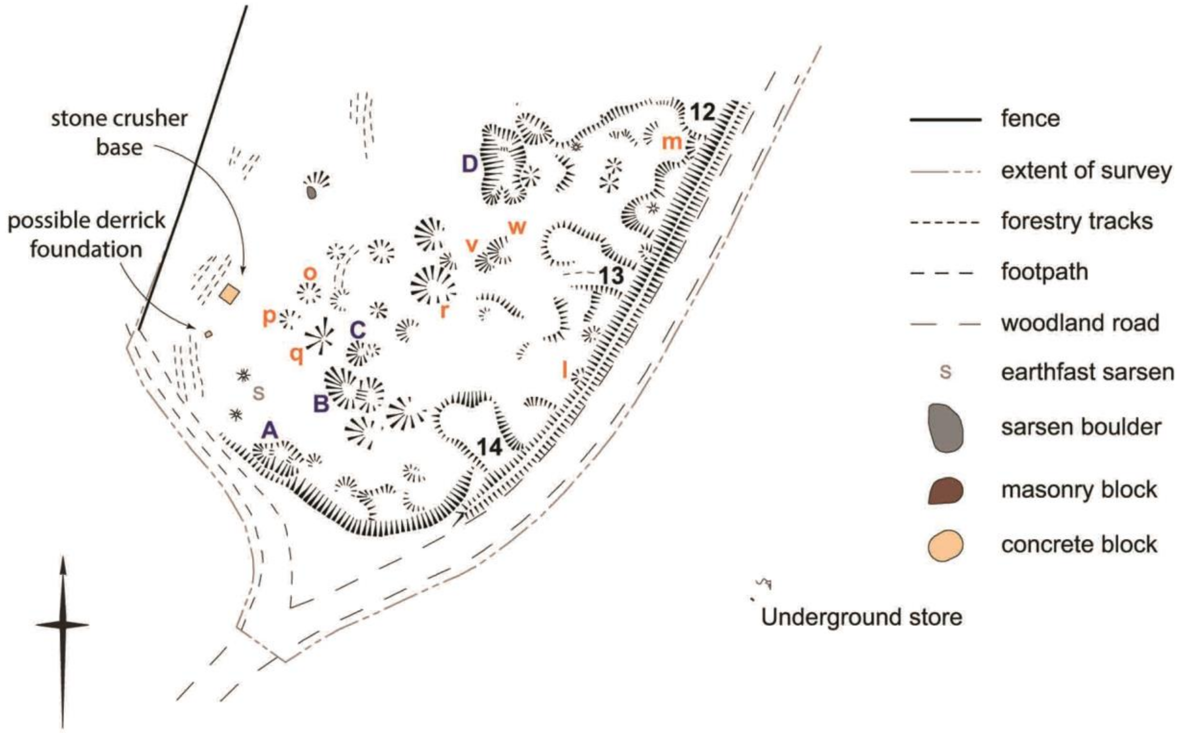


Figure 20 Annotated extract from the measured survey (see Figure 17) showing the southern section. Unscaled.

The central portion of the measured survey area includes simple, but often deep, pits and a number of the more complex extraction features (Figure 21). The deepest simple pits are single-lobed features, sub-circular on plan, with no extraction ramp or clearly shallower side that might be expected if whole sarsens were being hauled out in one piece. Neither are their steepest slides limited to their western edges. They are scattered across the valley bottom, including for example pits [a] to [h]. These well-defined features range from 0.55m deep (pit [e]) to 0.9m deep (pit [b]), tending to be relatively rounded on plan and almost conical in profile.

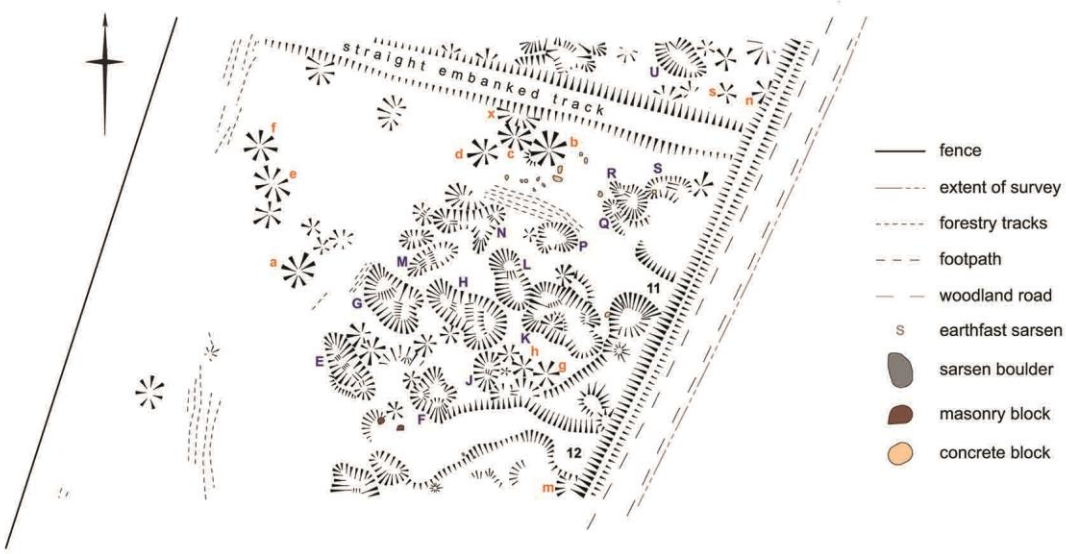


Figure 21 Annotated extract from the measured survey (see Figure 17) showing the central section. Unscaled.

The complex multi-lobed pits in this area are highly varied. They include examples with shallower sloping sides forming gully-like features, such as pit [M] (8.2m long, 3.2m wide) and pit [N], whose two narrow branches are each c2.6m wide. On the whole, however, these complex pits have steep sides and deep profiles such as pits [H] and [L] (Figure 21). On plan, these complex pits tend to be elongated with tightly-curving ends. Scarps and low earthwork banks in the pit bottoms demarcate more deeply-worked areas and stepped basal surfaces. Both pits [H] and [L] appear to have been worked from north-west to south-east, descending as their bottoms do in a generally westward direction. Pit [H] was perhaps then worked back, forming an approximately central gully in its base. Similar patterns appear in other complex pits, such as pit [E], 11.2m long and 4.4m wide, which descends from its north-west end towards the south-east, its deepest point (0.4m) in the pocket at the south-east end.

This has resulted in considerable variety. Pits [E], [H], and [L], for example, each include a sequence of hollows in a linear arrangement from end to end, whilst pit [G] is stepped down from either end into its deeper central basal area. Pits [D], [F] and [K], in comparison, are more rectangular on plan, comprised of clusters of pits grouped around the lowest area towards the centre or, in the case of pit [K], a 0.8m deep pit at its southern side. Simple pits are scattered amongst the more complex, including deep examples such as pit [g] (0.75m deep). The pits abut, but whilst internally a complex pit has intercutting features, there is limited evidence for intercutting between adjacent pits. Although the ground is highly disturbed, the pits are on the whole discrete. Additionally, there are areas of relatively level open ground, for example between pits [F] and [H], an area of c25m², and between pits [L] and [M], c35m². This ground is firm and very stony, attested to by the difficulty of using pegs and surveyors' arrows during the survey.

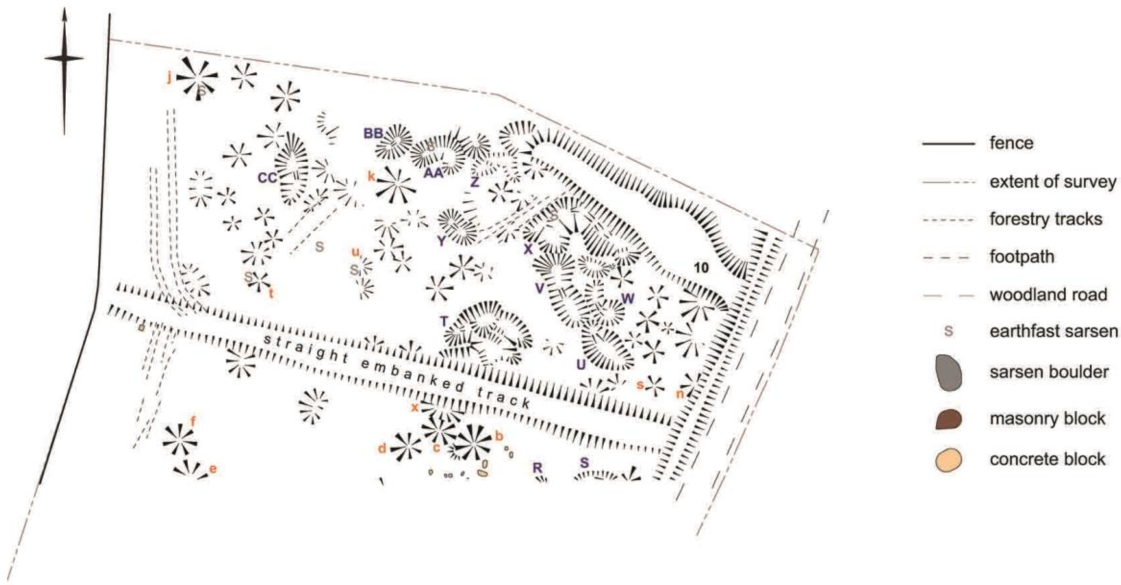


Figure 22 Annotated extract from the measured survey (see Figure 17) showing the northern section. Unscaled.

The northern third of the measured survey area, beyond the straight embanked track, includes a similar intensity of diverse extraction pits (Figure 22). The whole width of the valley floor, between the main woodland ride and the western property boundary, has been dug over. Here, simple single-lobed pits are scattered across the valley bottom including a number of well-defined features such as pit [j] to the north-west, 6.2m in diameter and 0.7m deep, pit [k] to the centre, 5.5m in diameter and 0.35m deep, and a cluster of pits immediately to the west side of the main woodland ride. That group includes slightly smaller but still well-defined, steep-sided, pits from 1.7m to 3.1m in diameter, although these are somewhat shallow; pit [s], for example, is 3.0m wide but only 0.3m deep. A length of square twisted rebar protrudes from this pit (Figure 23).

Figure 23 A length of square twisted reinforcing bar protruding from pit [s].

The more complex pits in the area include elongated examples, such as pits [U], [V], [W], [Y] and [CC], again with low internal banks demarcating pockets and more deeply worked areas. Pit [U], for example, similar to pits [E] and [H] to the south, descends across one internal scarp from north-west to south-east, reaching a depth of 0.65m over a distance of 8.9m. Pits [V] and [Y] are dug on a similar orientation, as is pit [W] although that is formed of two lobes divided by a central low bank. In contrast, pit [CC], of similar shape and size, appears to have been dug from south to north, with a low central scarp dividing the pit base into two lobes.

But what are arguably the two most complex pits recorded by the measured survey dominate this area. Pits [T] and [X] are both highly irregular and include low earthwork banks and scarps to their bases and deeply-dug internal features. Pit [T], 12.4m x 9.2m on plan, comprises five visible lobes. A narrow pit, 0.75m deep, to its western side is separated from a wider, 0.55m deep, pit alongside by a strongly-defined bank. From this bank a spur, to the south-east, defines two further quarried areas. The outer edges of the pit curve around to the south side, doubling back to enclose a further pit, slightly stepped up and partially overlain by the straight embanked track. Pit [X], 16.8m x 4.3m on plan, comprises six visible lobes. These are formed of a wider, slightly higher area of two pits at its western end, with subsequent descents demarcated by internal scarps dropping to the east and small banks dividing pockets in the pit's narrow, steep-sided eastern arm. The north-eastern side of the pit is partially overlain by linear feature [10].

Nevertheless, there is limited evidence in this area for intercutting between adjacent pits. Across this northern third of the measured survey area, at least forty-three single-lobed pits and ten complex pits are clearly demarcated. Pit edges tend to abut their neighbours and, like the parts of the survey area to the south, there are also patches of relatively level open ground. For example, a level and open area of c180m² is very noticeable immediately to the north of the straight embanked track.

Spoil and sarsens

Despite the number of pits there are no large discrete spoil heaps in the measured survey area. There are a few small, well-defined, stony mounds, including two at the southern end of the survey area at SU 15244 66405 and SU 15242 66398; one close to the main woodland ride at SU 15308 66431 and another nearby at SU 15296 66440 beside finger dump [12]; a fifth, slightly larger mound beside the main woodland ride at SU 15322 66460; and one small mound beside the end of pit [X] at SU 15332 66514. These evenly-shaped features, from 0.9m to 2.9m in diameter, give the impression of being tipped or dumped material. These small mounds are firm underfoot and clearly very stony including small pieces of broken sarsen and flints. Visible flint tends to be sub-angular, weathered, ranging in size from c1cm to c10cm, although larger broken nodules are also present. In contrast, the small oval mound at SU 15307 66424 is a loose dump of recently tipped material including non-local road-stone just beyond the roadside bank. The two similarly-shaped mounds at SU 15319 66452, appearing to fall from the roadside bank and in part overlying the base of finger-dump [12], may also be relatively recent features.

The only surviving surface sarsen stone in the southern-most part of Stony Copse is lying in the mouth of a crescentic hollow, at SU 15254 66433. This boulder is 1.9m long and 1.2m wide, with an excavated gully to its north side. A second piece of sarsen is visible nearby at SU 15246 66402, embedded in the ground surface. More sarsen pieces are visible in the northern third of the measured survey area (Figure 20). Five are embedded in the sides of extraction pits, including simple pits [j], [t] and [u], and complex pits [X] and [AA]. Both rounded, corticated surfaces, and also angular split surfaces, are visible, of what are likely a few uncollected sarsen chunks.

One piece is partially visible embedded in the ground surface at SU 15290 66517. Apart from a few boulders on the eastern edge of the main woodland ride at the bottom of the steeply-sloping valley side (just outside the measured survey extent), there is very little visible sarsen in the mapped area. This absence is striking and attests to how thoroughly this area of the sarsen quarry has been worked.

Linear features

Linear features within the mapped area include five finger-dumps, an embanked track, the main woodland ride and other trackways, and the roadside bank.

The five finger-dumps are part of a group of 14 such features in Hursley Bottom, all springing from the west side of the main woodland ride and extending into the wood parcels[3] (Figure 18). Some are more substantially formed and better defined than others. Their upper surfaces are approximately level with the main woodland ride, and thus their heights vary according to how disturbed is the surrounding ground. Although covered by leaf litter they are firm underfoot, and it is possible in some places to see the mixed materials of which the upper parts are made including rubble, bricks, and stony waste. Finger-dump [14], at the southern end of Stony Copse, is 15.1m long, 9.5m wide at its widest point towards its north-west end, and 7.1m wide where it meets the woodland ride. It is well-defined by low sloping sides, slightly more pronounced on the north, with a rounded terminal. Like the other finger-dumps in the measured survey area, the end meeting the woodland ride is slightly splayed. Finger-dump [13] is similar in size and plan form, 15.7m long and 6.0m wide where it meets the woodland ride. Its southern edge, however, is less clearly defined, spreading imperceptibly into the ground surface including an area defined by a few slight north- and east-facing slopes.

Finger-dumps [12] and [11] are substantial but less well-defined features. Their terminal ends spread into the ground surface within Stony Copse. Their bases, at the woodland ride, are similar in width; 8.3m and 8.2m respectively. Two chunks of

[3] This report's numbering system for the finger-dumps includes all such features observed during the analytical earthworks survey and walk-over survey. They are numbered from north to south, hence the five in the mapped area are numbers 10 to 14.

masonry are visible in the terminal of finger-dump [12], whilst two small concrete blocks are visible in the bank of its south side. Finger-dump [11], apparently much shorter and providing access into a slightly more open area, has three concrete blocks in the bank of its south side. In contrast, finger-dump [10] is a well-defined embanked feature with high, steeply-sloping sides. It is 37.9m long, 5.0m wide at the terminal and 7.4m wide at the base where it meets the woodland ride. It is relatively straight and evenly-built. Various different bricks are visible eroding from its sides, and some large concrete and masonry blocks are visible on and just beyond its northern scarp (Figure 24).

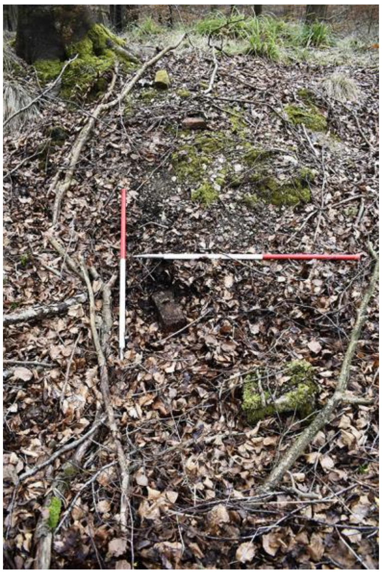


Figure 24 Left: bricks on the surface and eroding from the southern scarp of finger-dump [10]. Right: large concrete blocks on its northern scarp.

These finger-dumps all provide level access into the wood compartment at approximately the height of the main woodland ride. Amadio (2011, 39) describes them as causeways, left to aid stone extraction from the quarry pits. This interpretation is discussed, in relation to their form, stratigraphic relationships, and associated materials, below.

The southern two-thirds of the measured survey area is delimited by the straight embanked track that runs perpendicularly from the main woodland ride towards Forest Lodge (formerly Fosbury Cottages). This feature is 79.9m long and 5.9m wide, providing a level carriageway of c4.3m (Figure 17). Where it has been cut by a modern desire line it is possible to see that it is built of packed rubble and broken brick. It is considerably more even and regular compared with the finger-dumps. Loose bricks are visible on its surface, in particular at the western end, whilst a bottle for Stratton Sons and Mead Ltd mineral water (date range 1902 to the 1960s, (Stratton, 1994)) was observed lying on its northern bank (Figure 25). The sides of the bank's eastern end are quite strongly defined, whilst its western end peters out just before the modern fence line. Whilst it does not appear to continue into the open ground and gardens of Forest Lodge to the west, it is aligned to the house, described as "newly erected" in 1866 (see above) and appears to be a designed feature related to this property. To the east of the main woodland ride, the alignment continues up the steep valley side in the form of a 98.6m-long track which crosses another, perpendicular, path running approximately north-south through Henley Wood. The alignment continues for another 83.0m, until it meets one of the more recent forest tracks.

Figure 25 A Stratton Sons and Mead Ltd mineral water bottle lying on the side of the straight embanked track in the measured survey area.

The metalled main woodland ride delimiting the eastern side of the survey area is depicted on the 1815/16 West Overton Enclosure Award map (Wiltshire and Swindon History Centre 1033/27, 'Overton: Enclosure') (Figure 3). At that time, it was shown as a 30 feet-wide private road, running from cSU 1487 6603 at a boundary between holdings of the Duke of Pembroke and the Duke of Marlborough, through Hursley Bottom, to join another private road on the Savernake Park boundary at cSU 1557 6697. In the estate map made four years later (Wiltshire and Swindon History Centre 778/2L, 'Map of East and West Overton, Shaw, Lockeridge and Fyfield'), the end of this route alongside the northern edge of Stony Copse is marked 'To Fifield' (Figure 4). Today it is a made-up surface, on average 4.5m wide, raised above the wood compartment to the west. Its western side is defined by a low, loosely compacted roadside bank composed of soil, modern road-stone, and other recently-dumped material.

Numerous tracks and footpaths run off the metalled woodland rides in West Woods. The southern end of Stony Copse is distinguished by a triangular platform, raised above the level of the wood compartment. The northern side of the triangle slopes down steeply into the wood compartment. The triangle is formed of the junction of the main woodland ride and a track leading to Forest Lodge. The track is marked on the 1815/16 West Overton Enclosure Award map (Wiltshire and Swindon History Centre 1033/27, 'Overton: Enclosure') which shows it leading to Spye Park where, after a short distance, it terminates in a field just to the south of Lockeridge village (Figure 3). Whilst the section from the junction to Forest Lodge is now a footpath, the rest of this route from Forest Lodge heading north is a metalled lane joining a road in Lockeridge village. This may be the road temporarily used by the military during the Second World War for ammunition dumps (Wiltshire and Swindon History Centre F4/500/22, 'Savernake Forest: Ammunition Dump 1943-45').

Within Stony Copse, numerous disjointed sections of ruts disturb the ground surface (Figure 26). These are shown on in the measured survey as 'forestry tracks'. None are freshly made: moss colonies and lines of rushes grow on and alongside the raised soil pushed up to either side of each rut. Where both parallel ruts of the wheeled vehicle that made them are visible, they show a tyre thickness of c0.9m and a track of c2.5m, apart from a length of ruts in the surface to the west of finger-dump [11] with a narrower track of c1.6m. Amadio (2011, 38) recorded similar features elsewhere in wood compartment G, interpreting them as cart tracks or tracks left by a timber bob during the removal of felled trees.

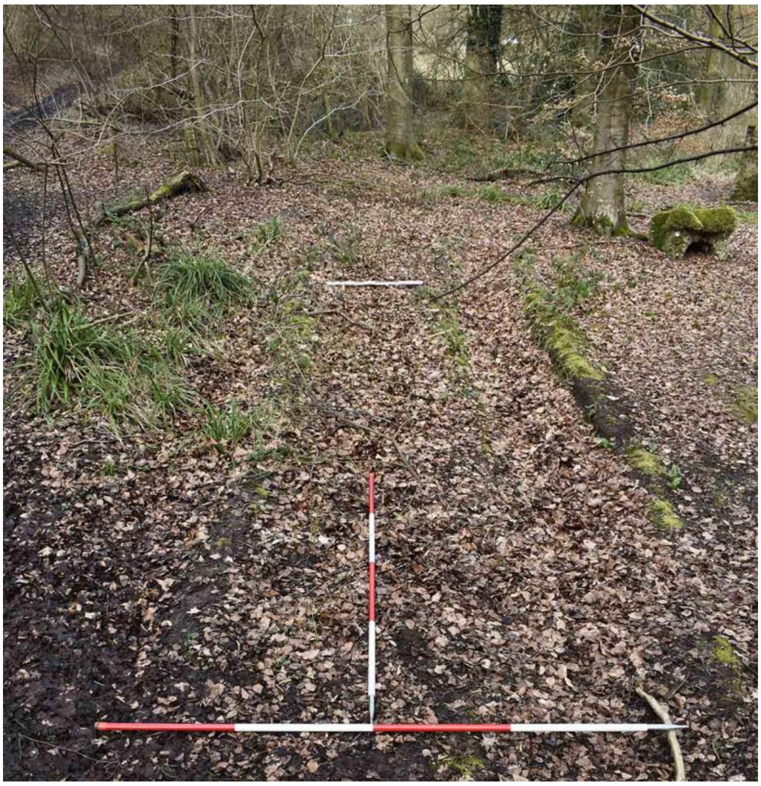


Figure 26 Ruts at the southernmost end of the measured survey area, leading from the Forest Lodge track into the wood compartment. A large piece of cast concrete visible in the top right of the image lies close to the concrete base.

Phasing

There are a number of relationships between features within the mapped area.

The narrow roadside bank to the main woodland ride, on average 3.4m wide, consistently overlies features within the wood compartment to its western side. These include the finger-dumps, the straight embanked track, and pits [l], [m] and [n] (Figure 17). The bank comprises loose material including soil, flints, and modern non-local road-stone, clearly dumped relatively recently at the roadside. The extent to which the earlier archaeological features extend further under the road is unclear. There are no visible quarry pits along the eastern side of the road, where the steep valley side makes a sharp junction with the main woodland ride. The 30 feet road width marked in the 1815/16 Enclosure Award map (Wiltshire and Swindon History Centre 1033/27, 'Overton: Enclosure') would have resulted, if actually established at that distance and maintained today, in a road some 9m wide. This would be approximately double the present-day width. This suggests that since that time the routeway has been narrowed (if it was ever that wide), probably from the western side, until it became a single carriageway abutting the valley's steep eastern side. It is possible that only the edges of these few features are overlain by the modern roadside bank.

Very few pits intercut one with another, as described above. Pit [w], a crescentic stone hollow, cuts pit [v], suggesting that one stone slightly to the west of another was removed first before its neighbour (Figure 20). As similar crescentic hollows in the southern area of Stony Copse show, there was clearly a need to remove topsoil from the western side of boulders here. Pit [v]'s western slope is only 2m long, and pit [w] is not much larger. They are similar to the hollow around the sarsen remaining at SU 15254 66433, and may have housed stones of similar size. Perhaps pits [v] and [w] were not developed into a more complex multi-lobed pit feature because there was an absence of sarsens to be dug from this Head – a possibility suggested by the prevalence of simple pits in this area (although see below).

There are more relationships between pits and the finger-dumps. The northern edge of finger-dump [12] overlies two pits, whilst its terminal is cut by one pit and either is cut by, or runs into, pit [F]. The southern side of the base of finger-dump [11] overlies a pit that was originally at least 4.3m wide. The northern edge of pit [K] may cut a scarp of material related to finger-dump [11], although this relationship is less clear and the features may be abutting. The eastern side of pit [K] also appears to be cut into embanked material of finger-dump [11], approaching as it does a well-defined east-facing scarp that curves around from the base of the finger-dump (Figure 21). Finger-dump [10] clearly overlies a number of quarry pits along its length. These include a partially buried pit underneath the southern side of the finger-dump's base, and pits at the terminal. The south-west facing scarp of this finger-dump overlies most of the north-east edge of pit [X] (Figure 22).

The straight embanked track overlies at least six pits, parts of which are visible to either side of the track (Figure 22). This includes the southern part of pit [T], which raises the possibility that pit [T] extends fully under the straight embanked track and is linked to pit [x]. The position of the track is not marked on the early nineteenth century enclosure or estate plans, but it is depicted by the Ordnance Survey on the 1:2,500 scale County Series sheet Wiltshire XXXV.4 surveyed in 1886 (published 1887) (Figure 5). By that time Fosbury Cottages (now Forest Lodge) had been built, likely shortly before 1866 (see above). The track appears to be aligned to those buildings and gardens to the west and is continued to the east by an unmade track leading directly up the steep valley side into Henley Wood. Given the development of Fosbury Cottages including a small-holding of 20 acres of arable and coppice (Wiltshire and Swindon History Centre 2027/2/1/911/13, 'Sale particulars: cottages in Angel Yard, Marlborough and at Fosbury and Lockeridge Dean in Overton, and Clatford Park in Preshute, 1866'), the track is perhaps a contemporary access or design feature of this small estate. This has a significant bearing on the date of quarrying activity which, along with the relationships between pits and finger-dumps, is discussed below.

Some of the forestry tracks plotted by the survey can be seen to overly the western end of the embanked straight track and to cut into the surface of finger-dump [11] (Figure 21). Whilst these tracks are likely to have been made by large plant during forestry activities, it is not clear whether this dates from a motorised or earlier horse-drawn age.

Measured survey - structures

Structural material comprises scattered broken masonry and concrete from former buildings; two features associated with inter-war period sarsen extraction; and the underground magazine.

Waste building material

Visible blocks of masonry and concrete were mapped following the mixed materials recorded by Amadio (2011). In addition to numerous loose bricks, chunks of masonry and cast concrete are visible on areas of more open ground within Stony Copse and forming – or dumped onto – the finger-dumps.

Figure 27 A selection of bricks observed during the survey. Top left: a standard brick with a handmade frog on the straight embanked track. Top right: part of a thinner brick without a frog on finger-dump [10]. Bottom left: a London Brick Company Phorpres brick with an impressed frog (finger-dump [10]). Bottom right: a standard brick without a frog (finger-dump [10]).

Individual bricks are varied (Figure 27). They include an example of a slightly thinner, and thus possibly earlier, red brick on the southern bank of finger-dump [10] at cSU 1533 6652; but are predominantly standard red or white stock bricks, most of which have a shallow frog or no frog at all. Only one of the more readily visible bricks included a manufacturer's name, a London Brick Company Phorpres brick; 'Phorpres' was trademarked in 1901 and these bricks were made throughout the twentieth century (Woodforde, 1976, 153). Unfortunately, none of the chunks of masonry comprising mortared bricks have visible manufacturers names in any of the partially-exposed frogs. Two masonry chunks at the end of finger-dump [12] are embedded in the surface, whilst a loose piece lies just outside the measured survey area at cSU1535 6651. Although leaf litter may be covering more such material, there is no other indication, on the surface at least, that these pieces of masonry are from *in situ* demolished buildings.

Broken concrete chunks are similarly scattered about Stony Copse. Two small pieces are embedded in the south bank of finger-dump [12], whilst a group of pieces lie on the surface to the north-west of finger-dump [11]. These are all made of relatively regular rounded aggregate in a sand and cement mix. Larger chunks lie on the northern bank of finger-dump [10] (Figure 24). Covered by leaf litter and deadwood, it is not quite clear whether these are eroding out of the bank or lying on it. These large pieces are made of mortared breeze blocks, pre-cast concrete hollow blocks, and shuttered concrete reinforced with round bars and twisted wire. Other lengths of rebar, both round bar and twisted bar, are semi-buried across Stony Copse, suggesting that more building waste is buried in the wood compartment. Examples include a length of square twisted bar protruding from pit [s] (Figure 23).

Sarsen extraction infrastructure

Figure 28 The large concrete block (Wiltshire HER MWI 75627) standing at SU 15241 66417 in the southern-most part of the measured survey area. Viewed from the south.

Figure 29 Left: the top of the concrete block. Right: one of the iron pins in the top of the concrete block.

Two concrete features standing in the south-west end of Stony Copse have been associated with the inter-war sarsen extraction industry. A large concrete block (Wiltshire HER MWI 75627) stands at SU 15241 66417 (Figure 28). Rectangular on plan (2.4m x 2.2m), it stands 1.4m tall. The concrete is very different to the smaller pieces elsewhere in Stony Copse. The partially cement-rendered block was probably made by shuttering, and the aggregate includes large, angular, flints and pieces of sarsen in a high proportion relative to the sand and cement component. Large voids are visible. This concrete mix is very poor quality compared with contemporary specifications recommended by, for example, the Ketton Portland Cement Co. (1934). This may indicate it was intended for short-term use. The upper south-east corner is cut back, forming a small ledge or foot-hold. The block’s upper surface has two parallel shallow ridges, 0.3m wide, in which are set four round-section iron pins, 35mm in diameter (Figure 29). This block was identified by Amadio (2011, 39) as a loading platform for transferring broken sarsen into vehicles to be taken out of the quarry. It is possibly the structure identified by King (1968, 86) as the base for a stone crusher.

There is a further cast concrete feature lying on the surface some 5.3m to the south-west of the large concrete block (Figure 30). Apparently lying on its side, its base of slightly spread concrete is facing south-east. Three shuttered sides are visible (0.98m long, 0.70m high), whilst the fourth side is in the form of a hollow cylinder. The upper surface is un-shuttered. The concrete matrix is similar to the large concrete block, including large angular flints.

Figure 30 The cast concrete feature lying close to the large concrete block in the southern-most part of the measured survey area. Left: viewed from the south showing the irregular form of the feature's base. Right: Viewed from the north, the more regular squared form of the shuttered casting.

Figure 31 The underground feature at SU 15325 66372 (Wiltshire HER MWI75628), viewed form the south-west. See figures 17 and 18 for its location in relation to the measured survey area and position in the valley.

The possible underground explosives store at SU 15325 66372 (Wiltshire HER MWI75628) was also recorded during the survey (Figure 31). This small feature is cut into the sloping valley side to the south-east of Stony Copse. It comprises an L-shaped space formed of shuttered concrete with a partially-surviving corrugated iron and concrete covering. The concrete matrix is very similar to the large concrete block in the valley below, including large, angular flints and sarsen pieces and numerous voids. The store was formerly approached from the south-west by a rake of shallow concrete steps, at least one of which remains *in situ*, at the bottom of which was a door into the store as shown by a partially-surviving reveal cast into the western wall stub. The entrance space accessed via this door is 1.2m wide. The main chamber is to the eastern side, providing a small space 1.2m x 1.1m on plan. The undulating interior surface of the walls was formed by shuttering with corrugated metal sheet, later removed. No fittings, for example for shelving, are apparent. The surviving covering over the main chamber is supported on a narrow iron beam. The identification of these three features is discussed below.

A short section of iron light rail, un-noticed in the brambles during the survey period, was made visible after storm damage to trees in late-2021/early-2022. Positioned at approximately SU 1528 6651 close to the west side of a desire line in the wood parcel, it is oriented almost exactly east-west and runs underneath a mature beech tree. A piece of earth-fast sarsen c. 0.75m to the north of the rail's western end suggests that, if a second length of rail had been parallel to this piece, it would have been on the south side. However, no accompanying pieces of rail that could have formed a length of track is visible within c. 3m of the surviving piece. The rail is t-shaped in section, 57mm high and 20mm wide (Figure 32).

Figure 32 The piece of light rail, underneath a beech tree, in Stony Copse.

Walk-over survey

The Ordnance Survey's depiction of sarsen stones in Hursley Bottom has always shown a less-dense spread than in other Wiltshire dry chalk valleys such as

Piggledene and the Valley of Stones. Surviving sarsens are today far less concentrated in West Woods than on the Downland. The walk-over survey covered the lower ground of Hursley Bottom between the eastern side of its open lea at cSU 1499 6623 and the main woodland ride at cSU 1546 6687. The aim was to review sarsen presence and contextualise the quarrying features mapped in detail during the analytical earthworks survey, which was by necessity a sample of the overall quarried area. The walk-over survey is divided into four areas (A, B, C and D in Figure 33). Measurements of earthwork features given below are derived from LiDAR data.

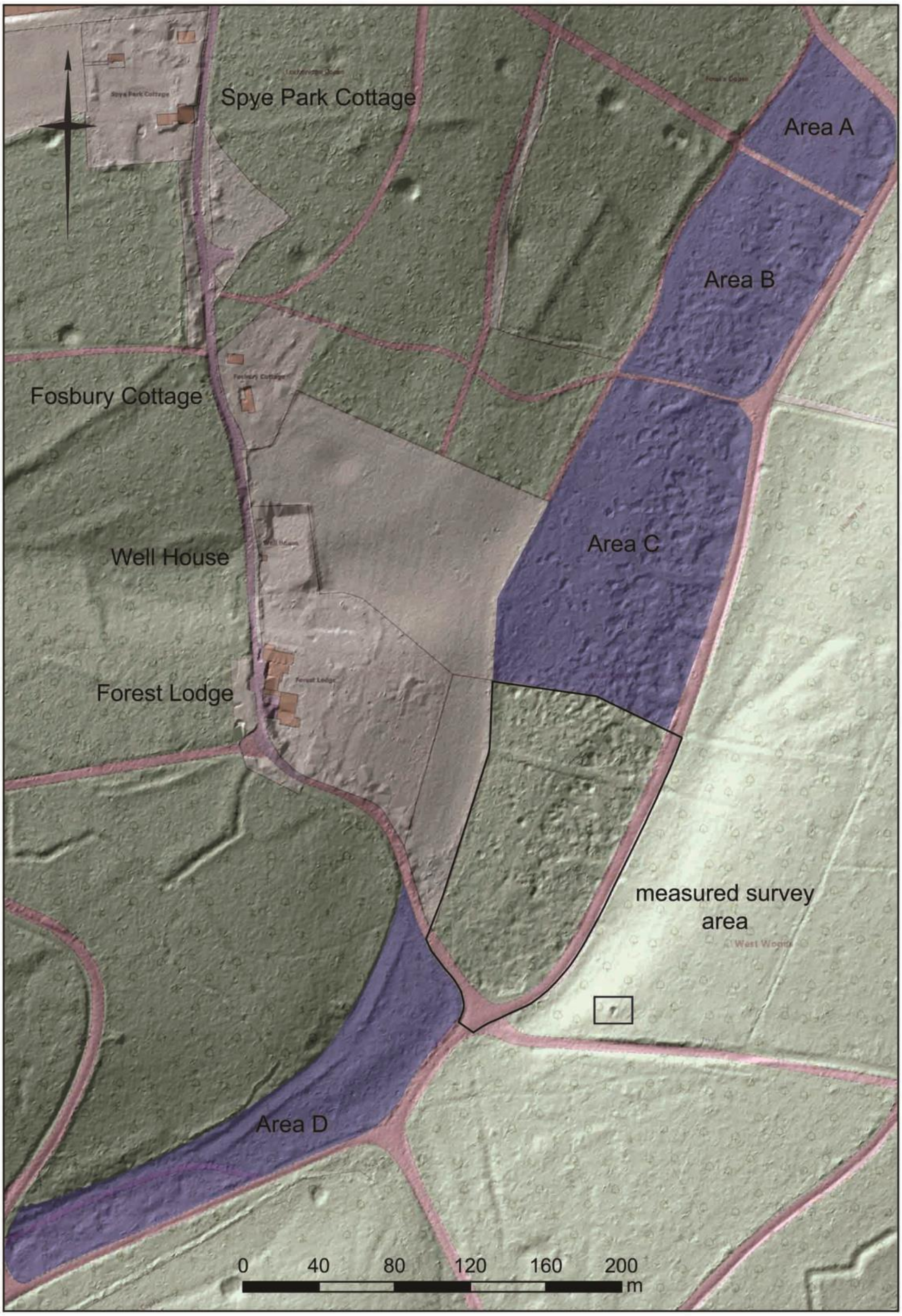


Figure 33 Location map showing the walk-over survey areas in relation to the measured survey. Includes data derived from OS © Crown copyright, Environment Agency 50cm Lidar DTM (Hill shade model), via EDINA Digimap.

Area A

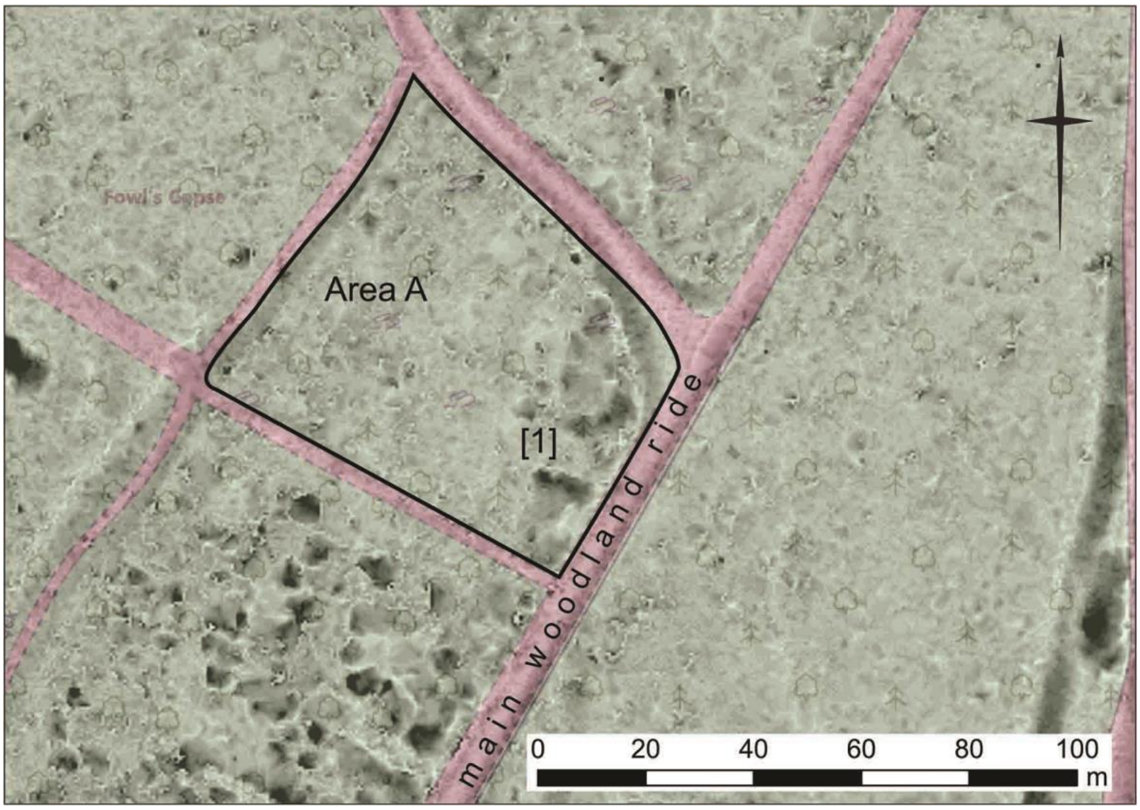


Figure 34 Walk-over survey Area A including finger-dump [1]. Includes data derived from OS © Crown copyright, Environment Agency 50cm Lidar DTM (Open Positive model), via EDINA Digimap.

Area A, 0.42 hectares at the northern end of the walk-over survey area, is delimited by the main woodland ride to the north and east and trackways to west and south (Figure 34). It is part of a larger plot depicted in the 1815/16 West Overton Enclosure Award map (Wiltshire and Swindon History Centre 1033/27, 'Overton: Enclosure') as unwooded ground owned by John Goodman. That was likely an arable or pasture field. This is not to say that no sarsens lay on the ground at that time; none of the sarsen spreads in the parish are shown on that map, despite clearly being present at the time. It was still unwooded four years later (Wiltshire and Swindon History Centre 778/2L, 'Map of East and West Overton, Shaw, Lockeridge and Fyfield'). By the time of the first Ordnance Survey County Series 1:2,500 map (surveyed 1886) the ground cover was deciduous wood, part of Fowl's Copse, and is depicted as such in subsequent map editions (with sarsens shown from the first revision published in 1900 onwards).

Now a parcel of beech trees, Area A includes numerous un-worked sarsens lying partially buried on the surface. These range from just over a metre in width to more than 2m. They are undisturbed with no indication of attempts to dig them out, such as extraction gullies. Nevertheless, there are a few small hollows alongside the main woodland ride at cSU 1547 6684, which could be sarsen extraction pits. Furthermore, finger-dump [1] leads perpendicularly from the main woodland ride into the parcel. The finger-dump is 15.1m long and 10.3m wide, petering out into the general ground surface of the plot. A sub-rectangular mound, 6.9m long and 3.1m wide, stands to the finger-dump's south side, parallel with the main woodland ride.

Figure 35 Possible sarsen standing stone in Area A, viewed from the north. Note the possible root hole running horizontally across the left-hand face.

Area A includes a possible standing stone identified during the walk-over survey (Figure 35). This is a small upright sarsen set perpendicularly to its likely bedding plane. Given the movement of sarsens in Hursley Bottom and West Woods more widely, this must be treated with caution. It is possible for boulders to be moved out of their 'natural' alignment by frost heave as well as through the agricultural and quarrying practices described in this report. The sarsen stands at cSU 1543 6682. The visible stone, approximately 0.4m thick, 1.0m long, and 0.6m tall, is a sub-rounded grey saccharoid sarsen. A possible root hole running through its shortest axis is visible in its north-east facing side, further adding to the suggestion that the stone is standing on edge.

Area A thus preserves part of Hursley Bottom's natural sarsen spread. A few sarsens close to the main woodland ride appear to have been removed, and a finger-dump was extended into the parcel.

Area B

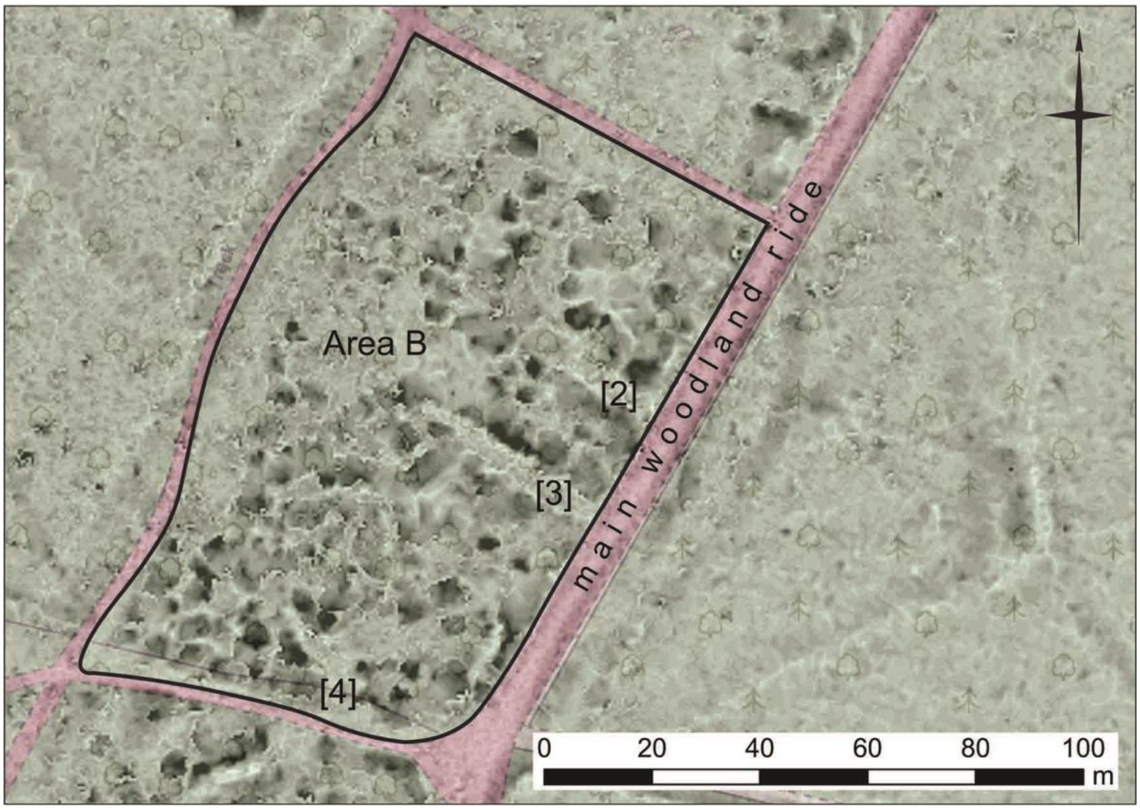


Figure 36 Walk-over survey Area B including finger-dumps [2], [3] and [4]. Includes data derived from OS © Crown copyright, Environment Agency 50cm Lidar DTM (Open Positive model), via EDINA Digimap.

To the south-west of Area A, Area B comprises a 0.92 hectare parcel of beech wood (Figure 36). The plot approximates the southern two-thirds of John Goodman's field as depicted in the 1815/16 West Overton Enclosure Award map (Wiltshire and Swindon History Centre 1033/27, 'Overton: Enclosure'). The main woodland ride delimits its eastern side, with trackways to north, west, and south. Just beyond, and parallel with, the western trackway are two south-west/north-east oriented linear earthwork banks, visible in Environment Agency LiDAR data visualisations and apparent on the ground. They appear to be part of a possible later-prehistoric/Romano-British field system on the east-facing slope of Hursley Bottom

(Wiltshire HER MWI73037). The northern bank is 4.8m wide and 79.4m long, whilst that to its south is 4.8m wide and 48.5m long.

Amongst the beech trees is a complex group of archaeological features. There are numerous sarsens throughout the parcel. Those towards the northern end of the parcel, some of which are very large, have a deep gully dug all the way around each boulder, often with spoil banks defining the outer edge of the encircling gully (Figure 37). The spoil banks and also the general ground surface are firm underfoot, composed of much broken sarsen and flints.

Figure 37 A large, partially excavated sarsen stone in the northern end of walk-over survey Area B, viewed from the north-west. Spoil banks surrounding the boulder are emphasised by moss growth and bluebells that are just starting to sprout. Other sarsens are visible in the side of the stone hollow and behind the partially excavated stone.

Three finger-dumps provide access into the parcel. Each has a relatively level surface with sharply sloping banks defining the sides. Finger-dumps [2] and [3] run perpendicularly from the main woodland ride into Area B, whilst finger-dump [4] enters the parcel diagonally from the trackway along its southern edge. Finger-dump [2], 22.3m long and 7.1m wide, is well made-up and straight, tapering into the ground surface at its western end. Finger-dump [3] is similarly straight and substantial, 38.4m long, widening to 8.5m just beyond the main woodland ride and narrowing to 3.7m at its tip. Both overly quarry pits. There are large concrete chunks with exposed plain round and twisted wire reinforcing bar (re-bar) on the northern scarp of finger-dump [3] (Figure 38).

Figure 38 The northern scarp of finger-dump [3]. Left: large concrete chunks and nearby sarsen stones. Right: a broken piece of reinforced concrete with exposed twisted wire rebar.

Finger-dump [4] is shorter (c19.2m long) and more variable in width. It includes a substantial dump of twisted chicken wire, and large masonry chunks including a piece of demolished building including a surface of ceramic floor tiles. Between finger-dumps [3] and [4] are short mounds standing alongside and parallel with the main woodland ride, and numerous sarsens including some very large boulders (Figure 39).

Figure 39 Large partially-excavated sarsens lying between finger-dumps [3] and [4] in walk-over survey Area B.

A large sarsen just to the north of finger-dump [2] at cSU 1542 6677 has been split using the nineteenth century wedging technique. Although this large boulder had been broken successfully in half, there was no further reduction (Figure 40). This splitting technique was described by Free (1948), and amplified by King (1968) who was able to draw on the memories of Kennet Valley residents who retained some familiarity with the process. A gully was dug around selected sarsens, which were then marked with a lightly chiselled line to indicate where the main splits for primary reduction were desired. A series of pecking hammers (double-ended axe hammers) were used to cut out and enlarge wedge-pits along the marked line. The wedge-pits were finished using punches. A flat wedge, feathered with pieces of hoop iron to prevent its bottom touching the base of the wedge-pit, was placed in each wedge-pit and struck with a 14lb sledge hammer until the stone split. Wedges were then worked at 90° to root holes, or in parallel with the plane in which the boulder originally formed (Free, 1948, 338, King, 1968, 90-1).

Figure 40 A large, split sarsen to the north of finger-dump [2] in walk-over survey Area B.

The wedge-pits are trapezoidal in profile, usually slightly asymmetrical with one edge a little steeper than the other. The shallower side may also be slightly convex. The opening of the wedge-pit in the stone surface is always longer and wider than the base. Wedge-pits are symmetrical in section, but this is harder to record and illustrate for a number of reasons. First, the majority of whole wedge-pits in sarsens are now infilled with soil and plant growth. Secondly, they very rarely split symmetrically through the very base of the wedge-pit: the majority of the wedge-pit including the base is left as a scar on one stone surface, with only the chiselled side face of the other half on the opposite surface.

Figure 41 Left: a sub-triangular, straight-sided hole cut into the upper surface of a sarsen stone in walk-over survey area B. Right: a sub-circular hole cut into a sarsen stone in walk-over survey area B, with irregular fractures in the surface.

Some of the sarsens in the environs of this split stone are earth-fast without a gully dug around. To the south and east of finger-dumps [2] and [3], however, there are numerous sarsens and most have been dug around, exposing their sides. Many of these sarsens have a sub-circular or sub-triangular cylindrical, straight-sided, hole cut towards the centre of each boulder's upper surface. Whilst the majority of the sarsens with these chiselled holes remain intact, at least one boulder has irregularly fractured surfaces to its southern and eastern sides and another shows irregular fractures in its upper surface (Figure 41).

A sample of 15 holes were recorded metrically (Table 1). In this sample, the holes cluster in two groups (Figure 42). Holes with narrower openings are more likely to be shallower in depth (n=7, mean width 42mm, mean depth 134mm), contrasting with a group of wider and generally deeper holes (n=8, mean width 64mm, mean depth 213mm). However, the two plan forms of these holes are not unique to either group; more of the smaller holes are sub-triangular than sub-rounded, but the larger holes include both shapes. Importantly, the ratio of width to depth, 1:3, is identical in the two groups (calculated using the mean values). These are interpreted as charge-holes, for setting an explosive charge and fuse to blast each boulder apart, and are discussed in more detail below.

Plan form	Opening diameter (mm)	Depth (mm)
Sub-circular	68	190
Sub-circular	64	296
Sub-circular	40	115
Sub-circular	61	151
Sub-circular	60	230
Sub-circular	64	220
Sub-circular	42	147
Sub-triangular	43	154
Sub-triangular	61	241
Sub-triangular	64	244
Sub-triangular	66	135
Sub-triangular	47	131
Sub-triangular	45	137
Sub-triangular	42	130
Sub-triangular	38	123

Table 1 Dimensions of sub-circular and sub-triangular cylindrical holes cut into sarsen surface on walk-over survey Area B. Sample of 15 stones.

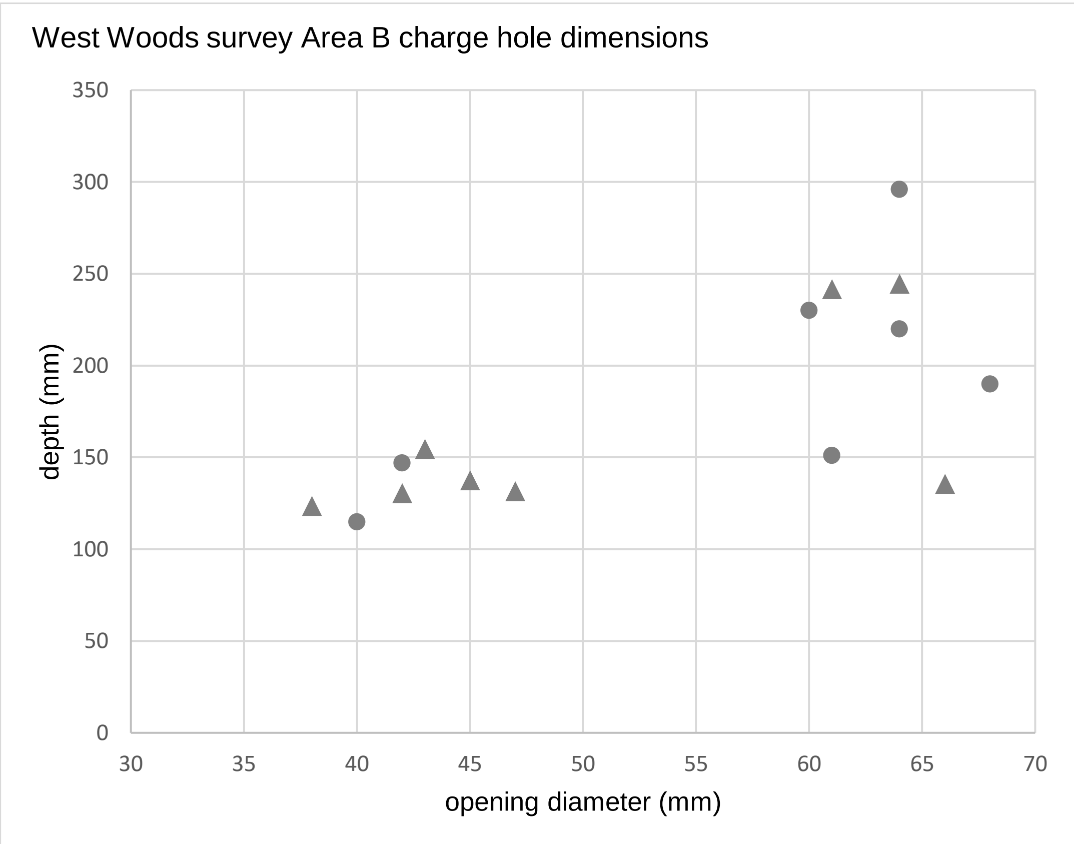


Figure 42 Scatter-graph of dimensions and forms of charge-holes cut into a sample of 15 sarsens in walk-over survey Area B. Triangles: sub-triangular holes. Circles: sub-circular holes.

Whilst there are no surface sarsens left in the quarry pits immediately to the west side of finger-dump [4], there is a notable group of at least seven split sarsen blocks to its east side at cSU 1539 6672. This group lies within a dug-out hollow enclosed by two crescentic spoil heaps. Two wedge-pit scars are visible in the split face of one of the stones, whilst five of the sarsens each have a charge-hole cut into their upper surfaces (Figure 43, Table 2)

Figure 43 Left: a group of seven split sarsen pieces lying in an extraction hollow in walk-over survey Area B. Right: the sub-circular charge-hole cut into the upper surface of one of the sarsen pieces in the group.

Plan form	Opening diameter (mm)	Depth (mm)
Sub-circular	40	126
Sub-circular	42	126
Sub-circular	36	101
Sub-triangular	40	143
Sub-triangular	41	135

Table 2 Dimensions of cylindrical holes cut into sarsen surfaces in the sarsen quarry group at cSU 1539 6672.

In comparison with the sample of 15 charge-holes taken from nearby sarsens, these five charge-holes all fall into the smaller group with a mean width of 40mm and mean depth of 126mm. These conform to the 1:3 ratio of width to depth. Whilst there are only two wedge-pits in this quarry group (Table 3), it is nevertheless useful to note that the length of their openings falls within the lower quartile of the 60 similar wedge-pits recorded in a survey of the sarsen quarry in Piggledene, a nearby dry chalk valley to the north of the River Kennet. The base of the first wedge-pit (59mm long) falls within the upper quartile of the Piggledene dataset, whilst that of the second (45mm long) is in quartile 2. These two wedge-pit scars are similar in both shape and size to the larger population observable across the north Wiltshire sarsen quarry.

	Opening length (mm)	Base length (mm)
Wedge-pit	85	59
Wedge-pit	80	45

Table 3 Wedge-pit dimensions in the sarsen quarry group at cSU 1539 6672.

In summary, Area B includes evidence for sarsen quarrying using the splitting technique used in Wiltshire since the mid-nineteenth century to produce building blocks and geometrically-shaped street furniture, as well as blasting for road-stone documented in the inter-war years. Most of the boulders in this area were prepared for extraction by the excavation of a surrounding gully, but were not removed. Accordingly, a high proportion of stones in the valley's sarsen spread survive. Some pieces of sarsens split with wedges were also prepared for blasting. Three finger-dumps, which in places overlie existing quarry pits, were extended into the parcel.

Area C

Area C comprises the northern 1.75 hectares of Stony Copse (Figure 44). It is bounded to the east by the main woodland ride and to the north by a trackway. The western side is delimited in part by another trackway and also by the modern fence line enclosing an area of open, east-facing, paddock associated with Forest Lodge (formerly Fosbury Cottages). The southern boundary is the limit of the measured survey area. This parcel was within General St John's wooded plot recorded in the 1815/16 West Overton Enclosure Award map (Wiltshire and Swindon History Centre 1033/27, 'Overton: Enclosure'), and which is depicted in the first Ordnance Survey County Series 1:2,500 map as deciduous woodland (surveyed 1886, published 1887). The south-west quarter of the area is shown as a fenced aviary in the later revision of the Ordnance Survey County Series 1:2,500 map (surveyed 1922, published 1924) (Figure 5).

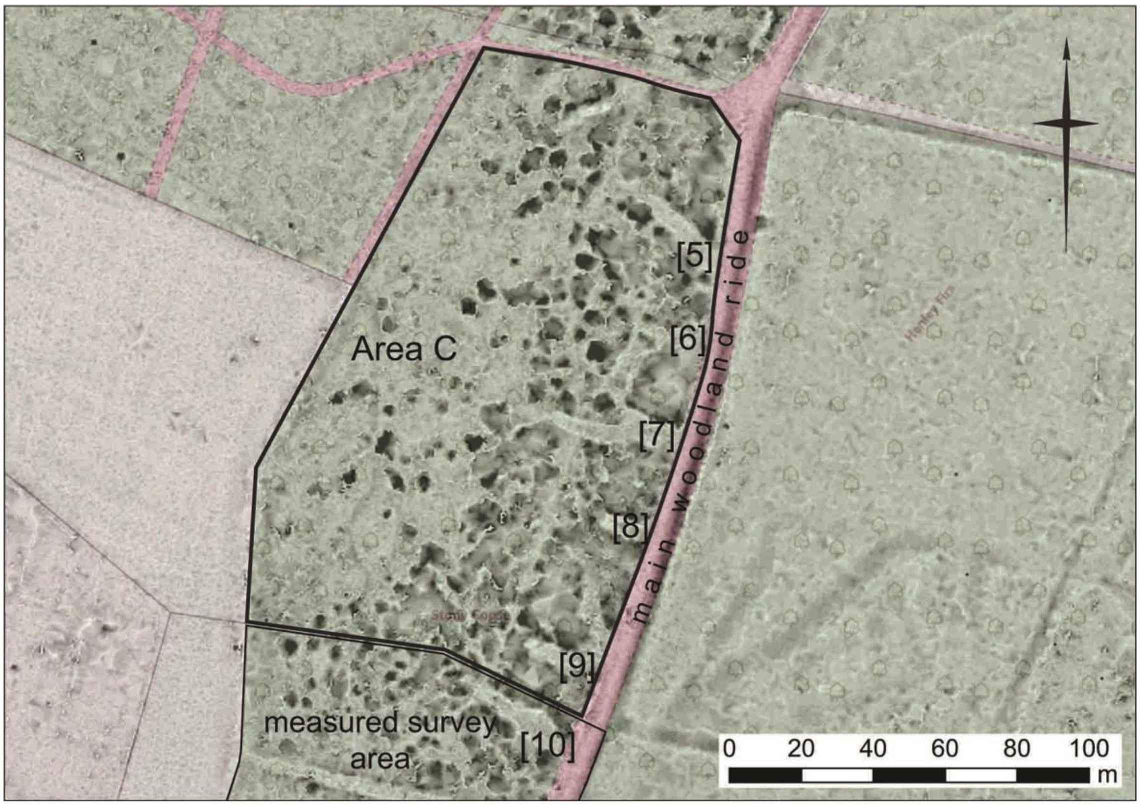


Figure 44 Walk-over survey Area C including finger-dumps [5], [6], [7], [8] and [9]. Includes data derived from OS © Crown copyright, Environment Agency 50cm Lidar DTM (Open Positive model), via EDINA Digimap.

Like Area B, this parcel of beech trees includes a complex group of archaeological features. These include finger-dumps [5] to [9], an extensive area of sarsen quarrying, and various examples of dumped building material. However, both Area C and the measured survey area contain very few sarsens.

Finger-dump	Length (m)	Width (m)
[5]	30.3	8.8
[6]	18.5	6.1
[7]	36.1	8.7
[8]	14.8	7.0
[9]	23.5	8.0

Table 4 Dimensions of finger-dumps in walk-over survey Area C (measurements derived from Environment Agency Lidar data).

The five finger-dumps are built up in a similar way to those in Area B and all run roughly perpendicularly from the main woodland ride into the quarried ground. Whilst tending to be straight, they vary in width and length (Table 4) and finger-dumps [7] and [9] have more irregular plan-forms including possible spurs from their northern banks. Finger-dumps [6] to [9] all include dumped building debris on their surfaces and banks, generally towards the ends of the banks closest to the main woodland ride. For example, a pile of masonry blocks and broken ceramic drain pipe has been scattered at the western end of finger-dump [6], including a well-worn half brick that is possibly another London Brick Company stock. Broken cast concrete slabs to the western end and southern bank of finger-dump [8] were previously noted and identified by Amadio (2011, 41 and figure 28, feature G052) as the base of a stone crusher reported by King (1968, 86).

A sub-rectangular mound measuring c11.8m long by c5.2m wide just within the northern end of Area C, at SU 15358 66691, is similar to some of the smaller earthwork features also noted close to the trackways and main woodland ride in Area B. Evenly made up of stony material, it has at least two pieces of metal sheeting nailed to wooden frames embedded in its surface. Adjacent to the mound's west end is a group of some of the few remaining sarsens in Stony Copse. As well as whole boulders, both with and without extraction gullies, this small group includes a split sarsen.

Figure 45 A partially-split and broken sarsen in walk-over survey Area C. Left: wedge-pit scar in the south-facing split surface. Right: irregularly-fractured upper and north-facing surfaces (the scale card is placed next to the charge-hole cut into the stone).

Like the group of seven split sarsens in Area B described above, this split sarsen in Area C provides interesting evidence relating to dating the sarsen quarry. The stone has an extraction gully. Its south-facing surface is split, in which a wedge-pit scar is visible. Clearly it had been split from above using the traditional nineteenth century sarsen wedging technique, and perhaps a third of the parent boulder was removed whilst the rest was left *in situ*. The remaining stone also has a charge-hole cut centrally into its upper surface. The upper and north-facing parts of the stone are angular and give the appearance of having been unsuccessfully broken up using an explosive charge (Figure 45). One of the other few sarsens in Area C also has a charge-hole cut centrally into its upper surface; it lies just outside the measured survey area, in the south-eastern corner of Area C close to finger-dump [10].

The extensive quarry pits within Area C are very similar to those in the measured survey area. They comprise both simple and complex pits of varying depths. As in the measured survey area, the ground is firm and stony underfoot, and, apart from the carefully-placed finger-dumps and the mound at the northern edge of the area, there are no large spoil heaps. Whilst patches of old-wood brambles obscure some of the archaeology, and may also hide sarsens, there is considerable continuity from the measured survey area to the south into Area C.

Area D

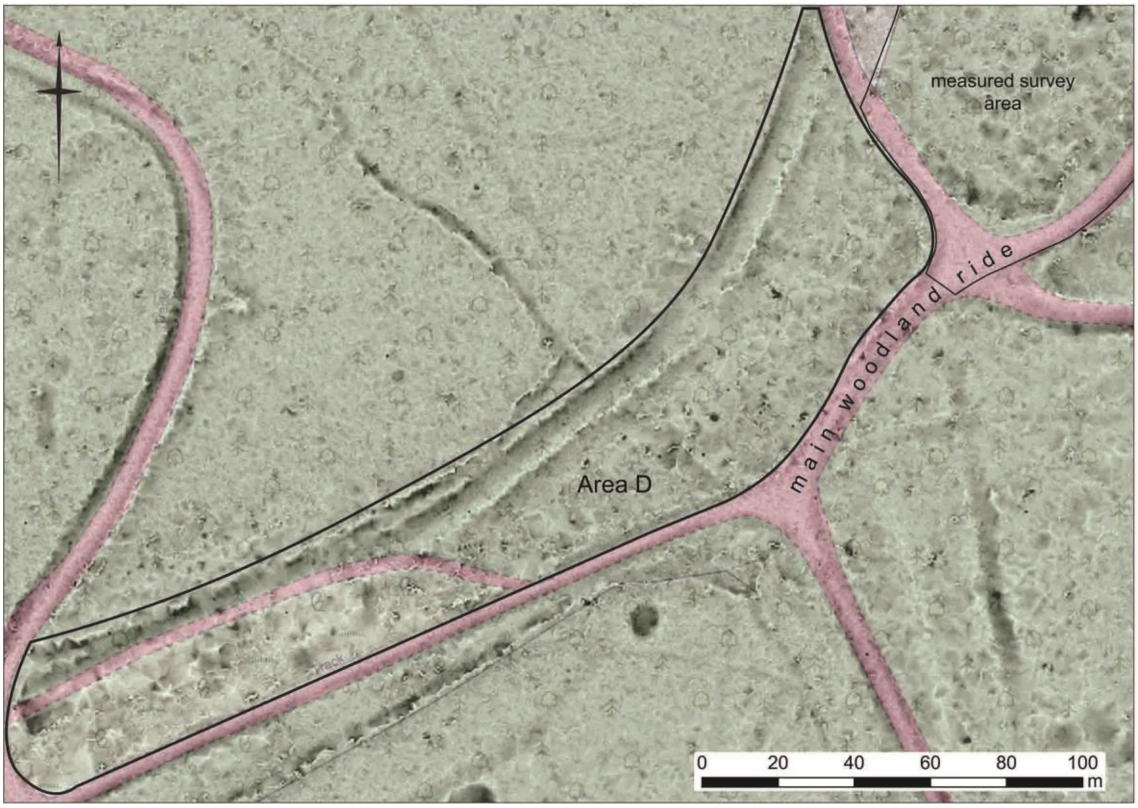


Figure 46 Walk-over survey Area D. Includes data derived from OS © Crown copyright, Environment Agency 50cm Lidar DTM (Open Positive model), via EDINA Digimap.

Area D is a wood parcel of 1.2 hectares to the south-west of Stony Copse (Figure 46). It is the narrow bottom of Hursley Bottom which, at its western end, opens out into the grassy lea formerly known as Tenants Down. The parcel is bounded to the north-east by the track leading to Forest Lodge, to the south-east by the main woodland ride, and to the south-west by a metalled woodland ride. Its north-western side is defined by a broad embanked trackway which curves from the path to Forest Lodge in a south-westerly direction. The north-eastern part of this parcel was wooded when the 1815/16 Enclosure Award map was drawn up (Wiltshire and Swindon History Centre 1033/27, ‘Overton: Enclosure’), whilst the rest was depicted as a narrow neck of open ground funnelling into the wider lea. The whole parcel is now wooded, including beech trees and some coppiced hazel.

Figure 47 The curving trackway in walk-over survey Area D, viewed from the south-east. Ranging-rods mark the edges of each scarp in the sequence of embanked track, berm, and lynchet that comprise this feature.

This curving trackway is a significant landscape feature, contouring the south-east-facing valley side. In profile from its lowest side it comprises a south-east-facing scarp leading up to a berm between 6m and 7m wide. The north-western side of the trackway is lyncheted with, slightly up-slope, a wood bank that in part runs parallel with the trackway (Figure 47). In places the wood bank appears to have slumped over, or been pushed onto, the trackway. The trackway cuts at least one narrow path that runs from south-east to north-west into Wools Grove.

Whilst the trackway dominates the parcel, at its northern end it loses definition, transitioning into the Forest Lodge path. At its western end it is cut by a metalled woodland ride. A large dump of concrete chunks obscures the intersection of the trackway with the woodland ride, and the ride is highly built up on a causeway crossing the base of Hursley Bottom at this point. The trackway does not feature on the early nineteenth century estate plans or pre-Second World War Ordnance Survey maps. It is, however, a very strongly-defined feature on Royal Air Force aerial photographs dating to 1946 (Figure 8).

There are numerous sarsens, including split boulders, in the north-eastern corner of Area D. The split examples have all been cut using the traditional nineteenth century wedging technique (Figure 48), but following this primary reduction were abandoned. Not all the boulders here were selected for cutting, some remaining whole and earth-fast in the ground. Whilst there are a few shallow pits consistent with sarsen extraction in the northern part of the parcel shown as wooded in 1815/16, there are only slight hollows in the part that was unwooded at that time.

Figure 48 A partially-split sarsen in walk-over survey area D, showing the regular breaks and locations of wedge-pits in split surfaces.

Area D includes evidence for sarsen quarrying using nineteenth century splitting techniques, but is very different in character to Stony Copse. The principal archaeological feature is the broad embanked trackway that had been in active use during the 1940s, likely associated with military activity in the western part of West Woods.

Discussion

Valley form and deposits

It is out of scope for this report to review the long-standing debates concerning southern England's chalk valley formation processes (for a thorough over-view of which see Whiteman and Haggart (2018)). Whilst the dominant form of Hursley Bottom today arose as a result of incision and periglacial processes operating from the late Devensian onwards (Evans et al., 1993, 184-5, Geddes and Walkington, 2005), much of the valley's present-day appearance also stems from anthropogenic factors. The lynchets and field banks to the higher slopes of Hursley Bottom, the medieval wood banks and post-medieval features including sarsen extraction features, represent the aggradation and removal of soils, sediments, and rocky materials over varied timescales by farming and quarrying practices.

At first sight the measured survey results suggest that superficial deposits filling Hursley Bottom tend to lie thickest to the eastern side, covering the lowest areas of the gentler slope. This is brought to mind by the absence of stone extraction hollows in much of the western part of the measured survey area; the general tendency to increased depth and complexity of the downslope quarried pits; and the linear arrangements of more complex pits suggesting extraction patterns working downslope, digging into progressively deeper deposits. This interpretation would be consistent with geological sections observed in test pits dug across Clatford Bottom by Clark et al. (1967, 27). There, up to four feet of loam, often containing a high proportion of angular flints and sarsen pieces and also whole large sarsens, overlay Coombe rock in the very bottom of the valley. The junction of the loam with the Coombe rock was irregular and numerous solution pipes including some containing sarsens were observed (Clark et al., 1967, 27-30). The base of Hursley Bottom may be expected to exhibit similar characteristics. It should be noted that none of its quarry pits, even the deepest, contain standing water in the Winter and must be freely draining.

Nevertheless, a degree of caution is warranted. Whilst most of the hollows and pits to the western side of the measured survey area are relatively shallow, some are deeper including pits [a], [e] and [j], for example. Pit [s], to the eastern side, is only 0.3m deep (although this may have some dumped building material filling it as suggested by the rebar to be found there), and there are other shallow pits to the south of finger-dump [10] where the superficial deposits containing sarsens might be expected to be thickest. Whilst it is tempting to interpret the distribution of superficial deposits in the valley from the archaeological evidence, there is likely considerable local variation (Clark et al., 1967, 27). Furthermore, the distribution of sarsen extraction pits by size and complexity has as much to do with quarrying decisions as the general presence of available stone.

Sarsen extraction and working

The intensity of sarsen quarrying, especially in the measured survey area and walk-over survey Areas B and C, hints at the likely density of sarsens that once populated this part of Hursley Bottom. The sarsen spread has been thoroughly worked out in Stony Copse, and survives partially in the northern extent of Hursley Bottom.

Wedging

Although not recorded by King (1968) as an area exploited by the sarsen cutters, there are sarsens split using wedges both south and north of Stony Copse. Quarrymen using traditional techniques had carefully selected these boulders for splitting, leaving many others untouched, and abandoning some partially split stones, as shown in particular in survey Areas B and D. The distribution of sarsens with wedge-pit scars across the whole survey area shows that this practice extended throughout the valley. Introduced to Wiltshire in 1847 (Crook and Free, 2011), this method persisted in use until the 1930s. That its use in West Woods is probably nineteenth century is suggested by three points.

The first is the association of early sarsen cutting with the south side of the Kennet Valley. Apart from the Fyfield Down sarsen spread, which he supposed had been worked in the 1850s and 1860s (King, 1968, 92), the quarried areas listed by King with certain or probable early working dates are all to the south of the River Kennet. These include the western end of Lockeridge Dean near Boreham worked in the 1880s; Shaw, worked out in the late nineteenth century; and Clatford Park Down worked since 1880. It is feasible to think that Hursley Bottom, situated roughly centrally in relation to these other locations, was also worked before 1900.

Secondly, some of the few surviving sarsens with wedge-pit scars in the survey area also were prepared for breaking with explosives. This includes those examples to the east of finger-dump [4], and the example at the northern edge of Area C on which the use of explosives appears to have been unsuccessful. Close by are numerous sarsens that were not split with wedges, but which were prepared for blasting by the excavation of surrounding gullies and chiselling out of charge-holes. These features suggest that sarsen cutters had taken their pick of various sarsens in Hursley Bottom before Thacker and Johnson began their less discriminate extraction in 1920.

In terms of phasing, it is highly significant that the straight embanked track in the measured survey area overlies a number of quarry pits. This appears to be a designed landscape feature contemporary with the development of the small Fosbury Cottages estate, the main house of which was described as new in 1866 (see above). The track was mapped by the Ordnance Survey in 1886. It is possible that its current form is more recent, built on an earlier alignment, but the presence of a twentieth century Stratton Sons and Mead Ltd mineral water bottle lying on its surface is hardly conclusive dating evidence given the history of picnicking in West Woods (see above). The estate's owner, John Gundry, was a local farmer living in Clatford, farming 1,200 acres on which he employed 46 workers at the time of the 1861 Census (The National Archives, 1861). The house is built in sarsen blocks with brick dressings. It is likely that its developer, possibly John Gundry himself, made use of the specialist sarsen cutters living in nearby Fyfield and Lockeridge Dean to produce the sarsen blocks for his new buildings. Whilst this interpretation remains to be tested with reference to contemporary archive material concerning the small estate (such as deeds), and a close examination of the fabric, it is possible that the earliest sarsen extraction in Stony Copse dates to the establishment of what is now Forest Lodge, around the early 1860s.

Blasting – primary reduction

That some ground to the western side of Stony Copse is generally clearer of quarry pits is possibly due to the presence of aviaries here between about the 1890s and perhaps the First World War. When mapped after the First World War, the aviary to the north of the straight embanked track was depicted with some sarsens in its interior, whilst that to the south had none (Figure 5). Assuming that this is an accurate reflection of how the aviaries were maintained, it is possible that some pre-1920 clearance can also be associated with game management. Nevertheless, the present appearance of this ground including the extremely stony surface and remaining structures is due principally to the work of Thacker and Johnson.

King (1968, 87) reported that in 1920 Thacker and Johnson had cleared around a quarter of a mile of Hursley Bottom of its sarsens, using explosives. That distance roughly equates to the area from the southern end of Stony Copse as far as survey Area A. The evidence for their work includes the structures and earthworks, discussed below, and holes chiselled into the upper surfaces of some surviving sarsens.

	Piggledene (mm)	West Woods (mm)
Opening diameter: minimum	36	38
Opening diameter: maximum	49	68
Depth: minimum	42	115
Depth: maximum	69	296

Table 5 Piggledene Barn plug hole dimensions (N=15) compared with West Woods charge-hole dimensions (N=15).

The holes, most of which were observed in sarsens in Area B, are interpreted as charge-holes for setting an explosive charge and fuse to shatter each boulder – the primary reduction of a sequence to produce suitably-sized road-stone. They are noticeably different to similar, but smaller, plug holes cut for plug and feather splitting elsewhere on the Marlborough Downs (Whitaker, 2020). Whilst cylindrical in form, charge-hole width and depth dimensions are in a ratio of 1:3, whereas the plug holes are on average only slightly deeper than they are wide (Table 5).

Some of these charge-holes have flake scars around their mouths in the sarsen surface, similar to the scars around wedge-pits in sarsens elsewhere, split by hand (Figure 49). Quarrymen using dissimilar reduction methods nevertheless experienced the same properties of sarsen as a material, its tendency to sub-conchoidal facture affecting the preparation of the holes required.

Figure 49 Left: spalling around a wedge-pit in a sarsen stone in Piggledene (Wiltshire), unsuccessfully split using the traditional nineteenth century wedging technique. Right: spalling on the surface of a sarsen stone in West Woods prepared for blasting.

The tendency for the openings of these charge-holes to appear either sub-circular or sub-triangular on plan derives from the way that the hole is chiselled out. Prior to the invention of pneumatic drills, quarrymen cut plug- and charge-holes using a long chisel-tipped borer or long jumper, or shorter chisels called jumper bars struck by hammer or sledge (Figure 50). These iron tools were either hammered or ‘jumped’ (dropped with force) onto the stone surface. They were turned 120° in between each stroke to create the hole. Cutting plug- or charge-holes in hard rocks, such as granite, could also involve using a cross-bit chisel. It is most likely that the West Woods charge-holes were hand cut using hammered jumping bars, because pneumatic drills were not widely adopted until the early twentieth century, and often not at all in small workings (Greenwell and Elsden, 1913, 293-4, Le Neve Foster, 1919, 61, Samuel, 1977, 41, Stanier, 2000, 43). The sub-triangular shape is a result of the 120° turn as the chisel is struck, whilst the sub-circular holes were more evenly produced.

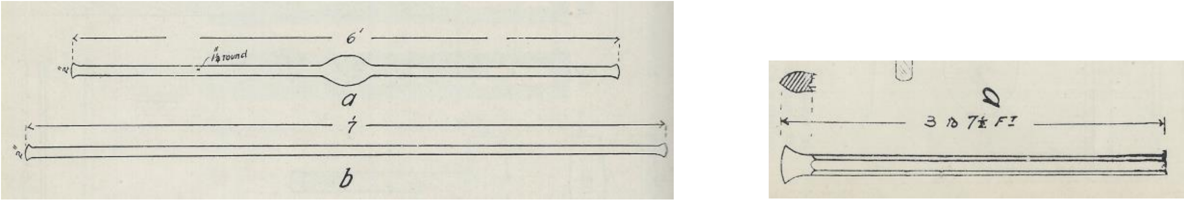


Figure 50 Left: Tools used in the Delabole slate quarry, illustrated in Greenwell and Elsden 1913, 216 (figure 161). A jumper (a) and a pitching jumper (b), their weights and dimensions designed for the relatively soft slate. Right: a jumper bar, illustrated in Greenwell and Elsden 1913, 215 (figure 160).

The placement of charge-holes indicates something of the quarryman's choices and actions in reducing individual stones. Before discussing the details, it is necessary to touch on the *burden* of a sarsen boulder. The burden of a rock or boulder is its line of least resistance to a splitting force; for example, the shortest line between an explosive charge in a charge-hole and the outer free face of the rock in a quarry wall. The more free faces there are, the smaller the amount of energy required to dislodge material from the quarry wall – or to split boulders and large blocks of stone (de Kalb, 1900, 91).

In addition to burden, most rocks have a *rift* through which they will split most easily (usually the bedding plane) and a *grain* at right angles to the rift, through which they will split relatively easily. The recognition of these planes impacts on choices not only for primary and secondary reduction in particular in hand-splitting, but also in the further reduction of stone blocks into products such as setts (Greenwell and Elsden, 1913, 80-1, 214-8). Sarsen, however, is a typically homogenous sandstone with very poorly defined bedding structures and a reputation for sub-conchoidal fracture (Geddes and Walkington, 2005, 62, Summerfield and Goudie, 1980, 74). Given that Thacker and Johnson were producing broken sarsen road-stone and chippings for the County Council, it is likely that their most important concern was to meet the specification given by the County Surveyor for stone size and shape, and for the volume they were contracted to produce.

Whether broken by hand splitting or explosives, surviving sarsens often have a gully dug around their base. This was described by Free (1948) and King (1968) (see above) as part of the wedging process, ensuring that hammering forces could pass through a stone to make a split. It has the effect of reducing the boulder's burden. Fieldwork in the sarsen quarry in Piggledene to the north of West Woods (Whitaker,

2020) has shown that this feature was not always excavated when sarsens were hand split. In contrast, most of the surviving sarsens in the West Woods survey area have been excavated in this way.

The one remaining sarsen stone in the measured survey area, partly surrounded by a crescentic hollow, illuminates an aspect of this surface working. At the very least, topsoil had been removed from one side of this stone before it was abandoned. Similar crescentic hollows scattered throughout Stony Copse likely held sarsens set high in the valley deposit with the bulk of the stone on the surface. Whether removed by earlier quarrymen or by Thacker and Johnson, these required little digging out to reduce their burden. As examples in Area B show, however, others had to have a fully encircling gully to release the boulder from enclosing deposits, firstly reducing the burden and secondly assisting the removal of broken stone.

The following interpretation of sarsen blasting draws principally on near-contemporary manuals of quarry working by Burgoyne (1895), de Kalb (1900) Greenwell and Elsden (1913) and Le Neve Foster (1919)[4]. The aim of primary reduction by blasting in a quarry is to shatter rock such that it can be collected and moved on to the next processing stage; if fragments are spread too far, this is an indication that the charge used was too great for the burden. Furthermore, road-stone must not be splintered, because cubical pieces are required. The correct amount of charge can be calculated once experiment has shown the minimum required to shatter the particular type of rock, and then reduced in proportion to the number of free rock faces in the quarry. Assuming that a sarsen with a gully dug around its base has in effect five free faces, then two-fifths of the charge required to break sarsen stone will be sufficient to shatter that boulder. A charge-hole cut centrally into the upper surface roughly equalises the burden (de Kalb, 1900, 91-5, Greenwell and Elsden, 1913, 299) (Figure 51).

[4] For consistency's sake in describing the prescribed quarrying practices, the Imperial measurements published in these and other related texts are used, rather than converted to metric from the figures given by the authorities. Those texts do not describe sarsen quarrying. The authors were writing manuals intended to be applied to quarrying any type of stone.

Figure 51 A sarsen stone in walk-over survey Area B, prepared for blasting by the excavation of an encircling gully and a centrally-placed charge-hole cut into the upper surface.

Numerous sarsens in the northern half of Area B have gullies dug around but apparently no charge holes cut into their surface, whilst those in the southern part of the parcel have both. This suggests that the area had been prepared for blasting in stages, first by excavation, then by starting to cut charge-holes in only a closely-positioned group of stones. Perhaps charge-holes were cut from only as many boulders as could be shattered in one session, reducing the amount of risky rubbish and water that might enter pre-prepared charge-holes in neighbouring sarsens before they could be used.

If the stone is homogenous, then the weight of the required charge will be proportionate to the cube of the burden. For example, if by experiment 4oz of powder was shown to shatter 2' of rock, the proportion is the cube of 2' to 4oz, that is, 8 to 4. Thus if the burden was 3', a charge of 13.5oz would be required (Burgoyne, 1895, 5-6). The charge-hole size must be determined in order to take the tamped charge and fuse. On average the West Woods charge-holes are 53.6mm in diameter (c2.1"), thus 1" depth of charge-hole would contain just over 1.7oz of powder (Burgoyne, 1895, 16). The charge-holes are on average 176.2mm deep, which is just under 7".

Assuming that the charge was reduced given the number of free faces presented by a semi-excavated sarsen, the short charge holes show that only a small amount of carefully tamped powder was necessary to shatter each boulder.[5]

The charging process involved drying the bottom of the charge-hole using a swab-stick; pouring in the required powder charge; inserting a pricker or needle around which wadding is placed followed by material such as waste stone dust, sand, or broken brick; tamping this down; and then adding damp clay to seal the top. The pricker is removed and a fuse of powder, perhaps contained in a paper straw or paper cartridge dipped in liquid paraffin, is inserted with touch paper or a slow match in its top. With say a 30 second burning time, the fuse is lit and the quarrymen retire to a safe distance (Burgoyne, 1895, 26-7, de Kalb, 1900, 42-9). This, Burgoyne observed, was common quarrying practice and might be imagined for Thacker and Johnson's business. "When done judiciously" Burgoyne wrote, "the report will be trifling, and the mass will be seen to be lifted, and thoroughly fractured, rent, or thrown over, without being forcibly projected" (1895, 8).

Nevertheless, this was to some extent an uncertain process in which misfires were common (Burgoyne, 1895, 27-8). That Thacker and Johnson were highly successful is suggested by the near-absence of sarsens from the southern two-thirds of Stony Copse. One sarsen in Area B and one, at the northern edge of Area C, are the only stones with cracked and split surfaces suggesting that blasting attempts had failed.

The complex, multi-lobed, elongated extraction pits give the impression that stones were chased and pits coalesced as more sarsens were removed. Adams (1870) reports this kind of activity, as more sarsens than expected are revealed by digging. In a field close to Hangmanstone Lane in the environs of Welford Woods (Berkshire), a c4m long sarsen that was impeding ploughing was uncovered, but could not be broken up. The decision was made to lever it out. A pit was dug to one side and the stone tilted over into it. This exposed three more adjacent sarsens in the clay

[5] Peter Stanier (pers. comm. 2020) comments that the charge holes are unusually wide compared with those cut into granite in Cornish quarries, and suggests that only the deepest of them were suited to successful blasting. Sarsen is tougher, but finer grained in comparison with the large mineral crystals of many granites. Experimentation could explore precisely how the charge-setting and blasting were carried out.

overlying the chalk, one of which was more than 3m long and 3m wide (Adams, 1870, 106). A similar more recent experience occurred on Totterdown (Marlborough Downs, Wiltshire) when an attempt to remove sarsens that interfered with ploughing resulted in the deep excavation by machine of a solution feature. Sarsens nearest the surface were cleared to the field edge, but a huge boulder revealed below them was eventually abandoned, re-buried in the filled-in pit (Hutchinson pers. comm. 2019).

If the sarsens in Area B prepared for destruction by explosives had been removed, an area of extraction pits would have been left, perhaps with new, deeper-buried sarsens revealed. That many empty extraction pits, even the complex ones, are well-defined is perhaps because digging stopped as soon as no more stone was visible in the deposit. The complex pits in the measured survey area are empty of boulders, with only a very few examples where sarsen pieces are visible in their sides. This suggests that they are the result of Thacker and Johnson's clearance with explosives. They could be less choosy, as they would crush all the sarsen they extracted for the road-stone contract. As survey in Piggledene shows, however, when sarsen was hand split to produce regularly-shaped and dressed street furniture and building blocks, discrimination was used to select the best material and leave numerous partially-split and un-split boulders behind (Whitaker, 2020).

None of the pits have extraction ramps, which is particularly noticeable in the deepest examples which today are difficult to get into and out of. Pits [b] and [j], for example, are sub-circular and evenly steep-sided. Whilst material could be removed relatively easily from the shallower hollows and pits, or perhaps via the more gently sloping sides of some of the complex pits, lifting gear may have been necessary on some occasions. This could have been a simple block and tackle used with an A-frame or sheer legs.

It is noticeable just how few are the occasional small spoil mounds across the site, comprising loose material perhaps tipped from a cart or barrow. There are few examples of spoil dumps overall. Unlike many open quarries the Wiltshire sarsen quarry did not require the removal of significant overburden, and stone extraction did not result in especially deep pits. This is in contrast to the Buckinghamshire sarsen quarry, where brickearth and clay-with-flints lie in much thicker deposits (Sherlock, 1919, Sherlock and Noble, 1912, Spicer, 1905). It seems that most of the spoil and waste sarsen generated by quarrying in West Woods is in the pit sides, spread about the firm, stony surface of the worked valley bottom, or used in the finger-dumps (see below).

Blasting – secondary reduction

Following primary reduction, the shattered stone had to be further reduced to produce the materials required for the road-stone contract. According to King (1968, 86), Thacker and Johnson used a mechanical crusher to which the broken pieces of sarsen would have to be moved (transportation in the quarry is discussed below), identifying the **large concrete block** at SU 15241 66417 as the base for such a machine (Figure 28). Amadio (2011) interprets this block as a platform used to load broken stone onto vehicles, identifying broken concrete slabs at SU 1537 6657 as the possible stone-crusher base. The present survey identifies the block as the base for a mechanical stone crusher[6], following Stanier (pers. comm. 2017).

Road-stone was produced by hand until mechanisation in the mid-nineteenth century made it possible to exploit even the hardest types of stone, although numerous engineers preferred hand-broken material into the twentieth-century. Stone-breaking machines first used mechanisms with crushing jaws which, fed from above, had to both sledge the stone fragments and also reduce them to a suitable cubical shape. Different types of jaw could be fitted to produce different products. Gyratory and roller mechanisms were also available (Greenwell and Elsden, 1913, 429-33, Powis, 1884, 118).

[6] Confusion may have been caused by Noel King's use of a six-figure grid-reference to locate the stone crusher base, giving a ±100m range within which the concrete block actually stands, resulting in the Wiltshire Archaeology Field Group's interpretations of concrete material in the locality.

Figure 52 Advertisements for makes of Blake's stone-crushers, manufactured by the Bramley Engineering Company (1950s) and HR Marsden (1872). Source: Graces Guide to British Industrial History https://www.gracesguide.co.uk/Main_Page

The height of the concrete block and the evidence for fixings in its upper surface suggest that it was the base for a stone-breaking machine with crushing jaws. These machines were elevated because the broken stone falls from the bottom of the jaws. The iron bolts and shallow ridges in the block's upper surface are where the machine would be fixed in place on timber baulks. Power would have been transmitted via a belt running from a portable steam engine or a traction engine, or oil engine, standing alongside; although there is no hard-standing beside the block, suggesting that a road vehicle was driven onto site for the purpose. Attached sieving apparatus (a trommel) could more quickly separate differently-sized material. Elevators can be incorporated to transport broken stone from the crusher elsewhere on site or into vehicles (Powis, 1884, 120-2) (Figure 52). I am grateful to Dr Peter Stanier for drawing my attention to photographs and advertisements for stone-crushers, which are highly evocative of how the concrete base in West Woods may have been used, and for his explanation of the type of cheap portable steam or oil engines available to small quarries.

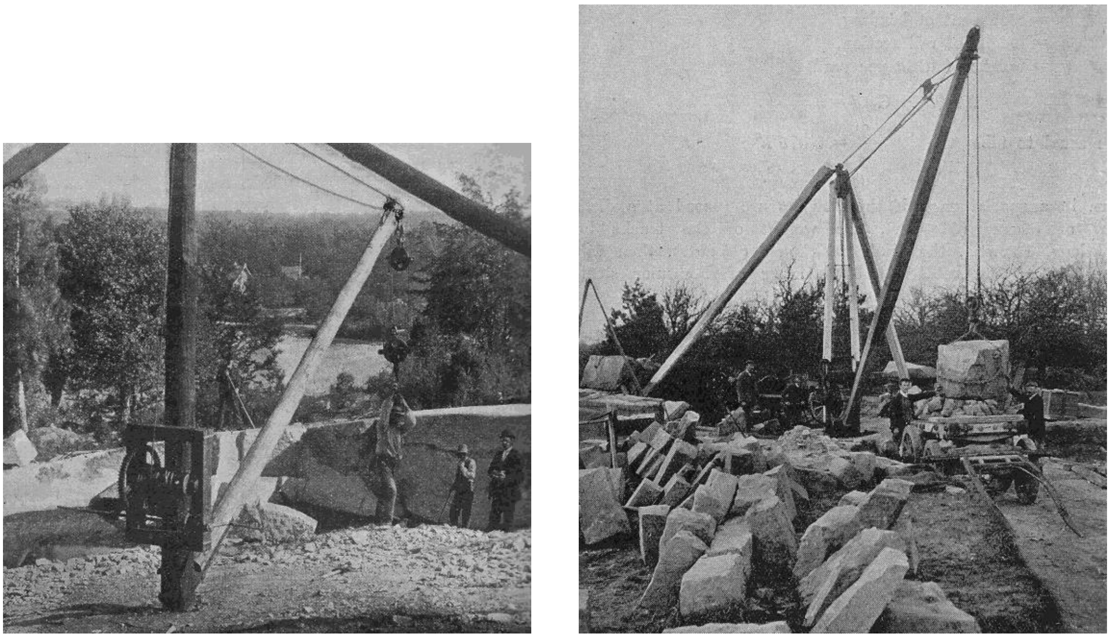


Figure 53 Examples of simple yet powerful derricks in operation in stone quarries. Left: a hand-operated derrick in a Swedish sandstone quarry. Right: a derrick used to lift stone blocks into waggons for onward transportation (Greenwell and Elsden, 1913, figures 235 and 288).

The further **cast concrete feature** lying on the surface some 5.3m to the south-west of the large concrete block (Figure 30), made of a similar concrete mix, may have been part of a contemporary feature. Lying now on its side, it is presumably not quite *in situ*, but when upright and with the base section buried, the central hollow cylinder could have formed a support for a vertical timber of a simple derrick (Figure 53). Hand-powered cranes could lift up to 10 to 12 tons of quarried stone (Greenwell and Elsden, 1913, 328), and one would have been useful to lift shattered sarsen into the crusher. However, what remains of the concrete piece is not definitive and there are no obvious anchors for the stays of such a device. A ramp for tipping trucks leading up to the stone crusher would have been more usual (Stanier pers. comm. 2020). The concrete mix used for these two features and in the underground magazine or store in the valley side (see below) is poor quality[7], hinting at the expedient use of inexpensive materials gathered largely from Hursley Bottom itself.

A focus on stone processing in the south-western end of Stony Copse may explain the generally flatter ground surface, fewer and shallower extraction pits and hollows, and occasional mounds of stony spoil. Following the earlier preparation of the area for its previous use for game-bird aviaries, the frequent activity, disposal of the smallest sarsen waste perhaps spread around the surface, and regular traffic in and out of this area, likely contributed to reducing the distinctiveness of excavated features. From here, processed stone could be taken north towards the A4 either along Hursley Bottom to meet the Lockeridge-Clatford road near to Audley's Cottages, or via Fosbury Cottages and Spye Park to Lockeridge village.

Blasting – infrastructure

It is not clear what type of explosive Thacker and Johnson were using. Coarse-grained blackpowder fired directly by fuse was deemed to be advantageous because of its slower action and reduced shattering effect, compared with more destructive quick-acting dynamite and high explosives (Greenwell and Elsden, 1913, 280-1, 299); although de Kalb (1900, 29) notes that dynamite was most commonly used in quarry operations. Whatever the material, the men had to be licensed by the Secretary of State via application to the Local Authority – in this instance, Wiltshire County Council – to store explosives. Unfortunately, neither the license nor the

[7] Although cement and concrete specifications for construction purposes had been developed prior to 1920, as late as the 1960s the codes and manuals emphasised the importance of workmanship as much as regulations (Somerville, 2001). In any event, Thacker and Johnson were not making public or domestic buildings.

registration with the County Council remain in the Wiltshire and Swindon History Centre archives to throw light on Thacker and Johnson's materials.

Nevertheless, a feature interpreted as a **magazine or explosives store** was located and recorded by Amadio (2011, 39) and included in the measured survey (Figure 17, Figure 31). According to Order in Council 5 made in relation to the Explosives Act (1875), gunpowder stores in a quarry had to be "well and substantially built" structures in brick or stone, or excavated into solid ground, separated from other buildings and highways. Depending on the amount of gunpowder being stored, the magazine had to be anything from 25 yards (c23m) to 200 yards (c182m) from other features including dwelling houses and the fire for a boiler of, say, a steam engine. Additionally, a store had to meet certain safety criteria, including that its interior be constructed and lined to prevent the exposure of iron or steel and the infiltration of any detached grit, iron or steel particle that could come into contact with the stored explosives. The building had to be secure. Cartridge-filling and assembling charges had to be done in a separate workshop, detached from, but close to, the magazine (Thomson, 1917, 28, 38-9, 47, 154-5).

De Kalb's (1900, 78-87) advice for local storage was to have a lightly constructed surface building which, in case of accidental explosion, would disintegrate rather than pose a great risk by throwing out substantial fabric. He recommended a weather-boarded timber structure, with suitable fixings and ventilation, and also noted that underground storage facilities cause problems through damp. Magazines should be for storing explosives only, with separate buildings for storing items such as fuses and detonators, and for opening containers and handling explosive material. He noted, however, that British practices required more substantial stores, to reduce the likelihood of theft.

The possible magazine or explosives store in West Woods is hidden away from the main quarrying and processing area. It is *c*95m away from the stone-crushing area and engine powering that machinery, dug into the elevated eastern valley side most likely into the Seaford chalk. Its small size suggests that its capacity was towards the lowest end of the regulations' requirements, making it suitably distant from the quarry working area and the nearest dwellings (Fosbury Cottages and Spye Park). To some extent the structure meets the requirements of the relevant legislation. Access down the flight of steps to the south side of the underground space led to the door. Inside, a small room cut into the chalk and covered at ground level provided storage. The right-turn from the bottom of the steps into the storage chamber may have provided an element of blast protection (Peter Stanier pers. comm. 2020).

Walls were made in shuttered concrete which appears to be the same type as, and thus contemporaneous with, the large concrete block in the valley bottom. There is no evidence for any other openings to present a security risk. The roof covering, however, is in corrugated iron supported on an iron beam. Unless these materials were covered by a boarded timber ceiling, the space would have broken the terms of the operating licence. The underground space would have been poorly ventilated, and possibly damp. Although the structure does not meet de Kalb's (above) ideal for a magazine, on balance this interpretation is probable, although closer investigation would be helpful.

Additionally, Thacker and Johnson should have had a separate detonator store and another workshop for handling and preparing their explosive materials, close to but separate from their magazine. Although small sheds are distributed around West Woods, probably associated with continuing game-bird management, no other over- or underground structure was observed in the overall survey area. It is possible that some of the dumped building material in Hursley Bottom represents the remains of an ancillary building. At the present time, however, there is not enough evidence in the recorded archaeology for a more detailed interpretation of the spatial arrangements of other structures that the quarry would have needed (also including fuel and water supplies), had Thacker and Johnson been operating both legally and to best practice.

The **finger-dumps** that reach from the main woodland ride into the wood parcels are interpreted by Amadio (2011) as platforms or staithes to assist the removal of sarsen. They have been described by Field (2005) as causeways left by the quarrying away of the valley floor. They clearly overlie pits in the valley bottom and are made up of dumped material, rather than being the natural deposit left behind as causeways.

Their stratigraphic relationships with pits close to the main woodland ride suggests that the finger-dumps started to be made up after stones had been extracted from the eastern-most side of the valley floor. That is not necessarily to say that the valley bottom was systematically worked from east to west and finger-dumps incrementally built as the quarry proceeded westwards: the irregularity in plan form of finger-dumps such as [11] and [12], and pits covered by the terminal of finger-dump [10], indicate a more haphazard process (and may indicate where nineteenth century sarsen extraction had previously occurred). That the wood parcels within Hursley Bottom were not necessarily cleared systematically by Thacker and Johnson is supported by the relationship between finger-dumps [11] and [12] and adjacent extraction pits. For example, it appears that finger-dump [11] had been made in two spurs to access pits being opened up towards the middle of the wood parcel. Pit [K] was then extended back into the dumped material as sarsens were taken out. The relatively regular sloping sides and even levels, and the splayed ends that give easier vehicular access from the wood parcels to the main woodland ride, support their interpretation as platforms associated with the early twentieth century quarry.

During earlier field visits, group discussions have included the suggestion that the finger-dumps date to 1940s military use of West Woods and I would like to take this opportunity, briefly, to address this issue. Finger-dumps overlie and thus post-date sarsen extraction pits in a number of locations, whilst finger-dump [1] in Area A is in an area where sarsens had not yet been prepared for extraction. Broken masonry and building materials are scattered on them or apparently eroding from their sides. At first sight these linear features could post-date the sarsen quarry by a number of years, perhaps providing locations for Second World War ammunition storage mentioned in correspondence between the War Department and the local authority (see above).

Unfortunately, there is too little diagnostic information in the visible bricks and rebar to date this material. But two key factors closely associate the finger-dumps with the sarsen quarry worked by Thacker and Johnson in 1920. First, there is the relationship between extraction pits cutting finger-dumps [11] and [12]. Secondly, there is no evidence in Royal Air Force aerial photographs immediately post-dating the Second World War for the creation of ammunition dumps in West Woods (Figure 8), unlike the extensive military storage in Savernake to the east (Crutchley et al., 2009, 40-4). Although the War Department appears briefly to have used part of West Woods for ammunition dumps (Wiltshire and Swindon History Centre F4/500/22, 'Savernake Forest: Ammunition Dump 1943-45'), this did not have a significant impact on the woodland archaeology. By the time of the first RAF reconnaissance flights over West Woods, young trees were growing in the sarsen quarry.

The short length of light rail identified in Stony Copse hints at the use of track to move broken sarsen around the quarry. Stone-cutters splitting sarsens in Stanley Copse to the south of the River Kennet between Lockeridge and West Overton villages are reported to have used a light railway line in the 1920s (King, 1968, 92). The section of track in West Woods may have been associated with sarsen quarrying, either splitting or blasting; or is another piece of dumped material along with the reinforced concrete chunks and other refuse building material. That it is trapped by a mature beech tree suggests it is not recent waste material.

Standing stone

Area A of the walk-over survey is noticeable for its 'natural' sarsens, that is, the prevalence of unworked boulders lying earth-fast in the ground. In contrast, the small sarsen described above as a possible standing stone is fixed perpendicularly to its bedding plane (Figure 35). Had this been brought about by periglacial processes, more of the nearby boulders might be expected to be up-ended or tilted. In fact, in this wood parcel the surviving stones are recumbent. Whilst Osborne White (1907) commented that small up-tilted sarsens at Snelsmore Common (Berkshire) may have been oriented by 'movements in the body of the drift' (ibid 1907, 87), Clark et al. (1967, 21) concluded that frost heave had played little part in the attitude of sarsens during their survey of Clatford Bottom to the north of West Woods.

It is clear, from the presence of wedge-pit scars and split faces on other boulders in Hursley Bottom, when stones are out of 'true' by virtue of quarrying practices. The possible standing stone is uncut and does not have a gully dug around it. Neither is there splitting debris close by to suggest that its orientation is due to the wood's post-medieval quarrying activity, although there are some possible extraction pits alongside the very edge of the parcel at the roadside. Standing towards the centre of the wood parcel, it does not appear to have been moved for clearance purposes. On these grounds it is concluded, albeit tentatively, that this is a standing stone.

The date at which it was erected is uncertain. The sarsen is considerably smaller than the nearby standing stones of the Avebury henge complex, but larger than many other British standing stones of various material and in different settings, including 'miniliths' described by Gillings (2015), dating to the later third and second millennium BC. Although some upright sarsens within West Woods are likely the result of track- and road-side clearance, there are various nearby standing stones with which comparison may usefully be made.

Approximately 0.4km to the north of Area A, near to a group of large recumbent sarsens, a rounded, bulky boulder at cSU 156 672 is striking for its contrasting orientation (Figure 54, left). As OS mapping and historical aerial photographs show, this area of West Woods was not planted with trees until the second half of the twentieth century. The stone stands alongside a footpath and may have been moved to accommodate this track. An upright sarsen in the heart of West Woods at cSU 1520 6628 is more clearly set on edge (Figure 54, right); this lenticular stone has been in place long enough for a beech tree to have grown up against the stone's north-west edge and although it is close to a woodland ride its orientation contrasts strongly with other boulders that have more obviously been cleared to the road-side.


Figure 54 Left: an apparently upright sarsen standing at cSU 156 672. Right: an upright sarsen at cSU1520 6628.

Amadio (2011, 58-61) records a standing stone to the south-east of the survey area, in Broom Copse at SU 1624 6528. This is just outside the boundary of Clatford Park and close to a post-medieval bank and ditch (Wiltshire HER MWI75633), 0.6km to the south-east of the West Woods long barrow. The location is in the headwaters of the southern arm of Clatford Bottom, in which the standing stone is on the south-east-facing side of the coombe at c200m OD. Smith (1884, map section XVI) depicts a sarsen spread here, extending northwards along the valley towards the River Kennet. There has been sarsen extraction in the area (Amadio, 2011, 58) and all but a few surface sarsens have been removed from the spread along Clatford Bottom.

Standing stones within West Woods may be medieval/post-medieval coupe stones, orthostats indicating individual wood parcels each at different stages in the coppicing rotation (Bowden et al., 2000, 22, 34). The degree of colluviation in the West Woods valleys such as Area A in Hursley Bottom, and its potential to have obscured earlier archaeological features, is unknown. Nevertheless, prehistoric field systems survive as earthworks in the wooded area which in later prehistory was considerably more open than today, and where monuments in addition to the Neolithic long barrow may have been constructed using stone settings. It is possible that the standing stone in Area A is a prehistoric feature, but, like all the standing stones mentioned in this discussion, it warrants further examination.

Summary

The intensive measured survey and extensive walk-over survey in Hursley Bottom have resulted in a more detailed picture of sarsen quarrying than envisaged by the previous literature. This summary draws together the archaeological threads to imagine how the valley quarry developed.

Prior to the establishment of West Woods as a managed woodland, Hursley Bottom was a relatively open area containing a large sarsen spread. Prehistoric and later farming was practiced in places on the valley sides. As evidence in Piggledene and on the Downland to the north of the River Kennet suggests, sarsens were likely incorporated in the earlier field boundaries and they were certainly used in early Neolithic funerary monuments, to both sides of the river. Some may even have been set up as standing stones. In the early medieval period the open ground saw the construction of part of a major linear earthwork, Wansdyke, running above two thick sarsen spreads in Hursley Bottom and Clatford Bottom before crossing Clatford Bottom and passing the sarsens beyond Wernham Farm.

Over time plots and fields throughout what would become West Woods had moved in and out of cultivation, in and out of Forest law, in and out of woodland bounds. By the mid-nineteenth century, when sarsen cutters with family and business roots in Buckinghamshire had moved to Fyfield and Lockeridge, the northern arm of Hursley Bottom had become a mixed and largely deciduous woodland. Separate landowners managed their woods for game, timber, and leisure. Stony Copse was part of a small estate of c20 acres, in which Fosbury Cottages were erected. Built in sarsen, the developer – perhaps John Gundry – contracted with the sarsen cutters to provide building stone from his land for the purpose. In addition to this work, the cutters were licensed by neighbouring landowners to work sarsens elsewhere in West Woods, including further south-west in Hursley Bottom, as well as in spreads on more open ground outside the wood such as Boreham Common and Shaw.

Those cutters carefully selected boulders for splitting. They removed some sarsens in their entirety, left behind parts of others, split but then abandoned whole boulders, and left many untouched. If necessary, they dug gullies around the sarsens that they worked, and they split the boulders using a traditional wedging technique. The quarrymen worked the dispersed sarsen quarry, leaving a significant number of boulders behind in West Woods. Many of these were well-buried in the superficial geological deposits in Hursley Bottom valley floor, but those on the surface would indicate where the stones could most frequently be found. By around 1900, Hursley Bottom probably looked much like Piggledene, Lockeridge Dene, or the Valley of Stones, look today.

At the end of the First World War, local resident Frederick Thacker became engaged in business supplying local authorities with materials and labour alongside other local families, such as Spackman and Sons and WE Free. With his business partner Mr Johnson, and an arrangement with the Olympia Agricultural Company Ltd, he contracted to provide Wiltshire County Council with sarsen road-stone for works to the London-Bath trunk road that runs through the Kennet Valley. They set up a working area in the southern end of Stony Copse where they excavated an underground store for their explosives, mounted a stone crusher, and installed an engine to power the equipment. Working down the valley, they dug out all the sarsens that they could find, shattering them with explosive charges. Periodically they used waste material to build up platforms for hauling out the broken stone that had to be passed through the crusher.

Working from south to north, Thacker and Johnson had cleared sarsens from just over seven acres of Hursley Bottom, and prepared another two acres for clearance, when the bad news came. Sarsen stone may have been conveniently local, but it wasn’t very good on the road. Gravel supplied by WE Free at 13 shillings per yard, or clean chippings from the Roadstone Supply Co at 18s1d per ton, were cheaper and more effective – these materials didn’t break down to sand grains that blew away in the wind. Thacker and Johnson lost their contract with the County Surveyor and went bankrupt. The machinery was removed. Some of the finger-dumps and the disturbed ground attracted tipping, convenient places to dispose of broken up masonry and other structural rubbish. This was the end of the quarry.

Conclusions

This analytical earthwork survey, and accompanying walk-over survey, have resulted in a detailed record of an area of post-medieval sarsen extraction. This includes earthwork features such as extraction hollows and pits, evidence for sarsen breaking practices, and features associated with land-management and landscape design relating to the Fosbury Cottages estate. The way that the sarsen quarry was worked has implications for understanding the geomorphology of Hursley Bottom. A possible standing stone has been identified. Whilst largely cleared of sarsens, the wide-ranging evidence in Hursley Bottom paints a picture of changing land-use and quarrying practices.

It is proposed that the sarsen spread in Hursley Bottom was a resource respected by, and perhaps utilised in, adjacent later prehistoric field systems, which, following the impacts of post-medieval game management and sarsen splitting, was by 1900 similar in appearance to nearby Piggledene or Lockeridge Dene today. The examination of sarsen extraction features confirms, following Amadio (2011), the extent of the brief but dramatic effects of Thacker and Johnson's sarsen road-stone business of 1920, and for the first time records and describes these in considerable detail. It clarifies the identification of features to do with the infrastructure of this business. However, the survey has also demonstrated previously unknown early sarsen splitting in the locality, dating to the second half of the nineteenth century.

Supported by the walk-over survey evidence, this work demonstrates the potential to explore the *chaîne opératoire* of early twentieth century operations in a dispersed quarry. It shows that it is possible to approach subtleties in modern stone working using explosives that is more commonly taken for granted, and described in generalised terms.

Recommendations for future research

Whilst the methodology used to record this part of the dispersed sarsen quarry in north Wiltshire has been effective to meet the aims of the fieldwork, it nevertheless has some limitations. Further work is recommended:

- a detailed geomorphological survey of Hursley Bottom and the dendritic dry chalk valley system in West Woods, complimenting and contrasting work previously carried out in Clatford Bottom (Clark et al., 1967) and along the River Kennet (Evans et al., 1993). This should include mapping and the analysis of deposits to reveal details of the valley form and explore human use from the Mesolithic onwards;

- a series of cores and/or test-pits to explore the valley floor make-up, depth and extent of quarry waste, made ground, and relationship with superficial geology in Hursley Bottom;

- the recovery through excavation of sarsen working debris to form a comparative sample to prehistoric assemblages curated in museum collections;

- the excavation of one or more sarsen extraction pits to provide a more detailed understanding of the formation of these features;

- sectioning or test-pitting a finger-dump to reveal construction details and potentially dating evidence to clarify their relationship to other quarry features;

- close examination of the area around the piece of light rail, and excavation to explore the potential survival of a length of light railway track;

- a more detailed investigation of the possible standing stone, including other possible standing stones in West Woods;

- an analytical earthwork survey of Areas A and B including detailed recording of individual sarsens, focussing on the distribution of and relationships between evidence for different sarsen breaking techniques;

- a close study of dumped building waste throughout the overall survey area examining concrete and re-bar types, with the potential to distinguish the type of structures that this material was derived from;

- extending the survey to include quarry pits to the north in the part of West Woods brought into arboriculture in the later-twentieth century, and examples selected from elsewhere in the wooded area identified by Amadio (2011).

References

ADAMS, J. 1870. Sarsens. *Transactions of the Newbury District Field Club,* 1**,** 104-109.

ALLEN, S. 2005. Mesolithic hunter-gatherer exploitation of the Marlborough Downs. *In:* BROWN, G., FIELD, D. & MCOMISH, D. (eds.) *The Avebury Landscape. Aspects of the field archaeology of the Marlborough Downs.* Oxford: Oxbow.

AMADIO, L. 2011. West Woods, Wiltshire: An Archaeological Survey. *Wiltshire Archaeological and Natural History Society Report.* Devizes: Wiltshire Archaeological and Natural History Society.

BAGGS, A. P., CRITTALL, E., FREEMAN, J. & STEVENSON, J. H. 1980. Parishes: Overton. *In:* CROWLEY, D. A. (ed.) *A History of Wiltshire.* Oxford: Oxford University Press for the Institute of Historical Research.

BOWDEN, M. 2005. The middle Iron Age on the Marlborough Downs. *In:* BROWN, G., FIELD, D. & MCOMISH, D. (eds.) *The Avebury Landscape. Aspects of the field archaeology of the Marlborough Downs.* Oxford: Oxbow.

BOWDEN, M., LAX, A., GOODALL, I., DUNN, C., BLOOD, K., FALCONER, K. & LOFTHOUSE, C. 2000. *Furness Iron. The Physical Remains of the Iron Industry and Related Woodland Industries of Furness and Sourthern Lakeland,* Swindon, English Heritage.

BROWN, G., FIELD, D. & MCOMISH, D. (eds.) 2005. *The Avebury Landscape. Aspects of the field archaeology of the Marlborough Downs,* Oxford: Oxbow.

BROWNE, H. 1864. *An Illustration: Stonehenge and Abury, in the County of Wilts, pointing out their Origin and Character, through considerations hitherto unnoticed.,* Salisbury, Bennett, Printer, Journal Office.

BURCHARD, A. M. 1966. Ancient Scrub Clearance (?) at Bayardo Farm, West Overton. *The Wiltshire Archaeology and Natural History Magazine,* 61**,** 98.

BURGOYNE, J. F. 1895. *A Treatise on the Blasting and Quarrying of Stone for Building and Other Purposes,* London, Lockwood and Son.

CLARK, M. J., LEWIN, J. & SMALL, R. J. 1967. The Sarsen Stones of the Marlborough Downs and their Geomorphological Implications. Southampton: Department of Geography, University of Southampton.

CRITALL, E. 1956. Royal Forests. *In:* CRITTALL, E. (ed.) *A History of the County of Wiltshire.* London: Victoria County History.

CROOK, M. L. & FREE, I. E. T. 2011. *Grey Wethers. The Free family in Marlborough and the Upper Kennet Valley c1847-1998.,* Privately published.

CRUTCHLEY, S., SMALL, F. & BOWDEN, M. 2009. Savernake Forest. A Report for the National Mapping Programme. Swindon: English Heritage.

DE KALB, C. 1900. *Manual of Explosives: a Brief Guide for the use of Miners and Quarrymen,* Toronto, The Ontario Bureau of Mines.

EVANS, J. G., LIMBREY, S., MATE, I., MOUNT, R., DAVIES, S., FITT, J., GRIFITHS, I., JARRETT, C., MILLES, A., RINGWOOD, V. & WHITTLE, A. 1993. An Environmental History of the Upper Kennet Valley, Wiltshire, for the Last 10,000 Years. *Proceedings of the Prehistoric Society,* 59**,** 139-195.

FIELD, D. 2005. Some observations on perception, consolidation and change in a land of stones. *In:* BROWN, G., FIELD, D. & MCOMISH, D. (eds.) *The Avebury Landscape. Aspects of the field archaeology of the Marlborough Downs.* Oxford: Oxbow Books.

FOWLER, P. J. 2000. *Landscape Plotted and Pieced. Landscape History and Local Archaeology in Fyfield and Overton, Wiltshire,* London, The Society of Antiquaries of London.

FOWLER, P. J. 2011. A Field Archaeology in West Woods, Fyfield and West Overton, Wiltshire. *Wiltshire Archaeological and Natural History Magazine,* 104**,** 135-141.

FREE, D. W. 1948. Sarsen stones and their origin. *Wiltshire Archaeological and Natural History Magazine,* 52**,** 338-344.

FROOM, R. 2012. *The Mesolithic of the Kennet Valley,* Newbury, Roy Froom.

GEDDES, I. 2000. *Hidden Depths. Wiltshire's Geology and Landscapes,* Trowbridge, Ex Libris Press.

GEDDES, I. & WALKINGTON, H. 2005. The Geological History of the Marlborough Downs. *In:* BROWN, G., FIELD, D. & MCOMISH, D. (eds.) *The Avebury Landscape. Aspects of the Field Archaeology of the Marlborough Downs.* Oxford: Oxbow Books.

GILLINGS, M. 2015. Betylmania? – Small standing stones and the megaliths of South-West Britain. *Oxford Journal of Archaeology,* 34**,** 207-233.

GREENWELL, A. & ELSDEN, J. V. 1913. *Practical Stone Quarrying. A Manual for Managers, Inspectors, and Owners of Quarries, and for Students.,* London, Crosby Lockwood and Sons.

KETTON PORTLAND CEMENT CO. 1934. *Notes on Cement and Reinforced Concrete,* Sheffield, Ketton Portland Cement Co. Ltd.

KING, N. E. 1968. The Kennet Valley Sarsen Industry. *Wiltshire Archaeological and Natural History Magazine,* 63**,** 83-93.

LAST, J., CARPENTER, E. & EVANS, S. 2016. West Wiltshire. National Archaeological Investigation Survey, Lowland Pilot Project Report. *Historic England Research Reports.* Swindon: Historic England.

LE NEVE FOSTER, C. 1919. *The Elements of Mining and Quarrying,* London, Charles Griffen and Co. Ltd.

MILES, D. 25 February 2018. *RE: Field trip to West Woods and discussion regarding American Army training in West Woods and Shaw.* Type to WHITAKER, K.

MURTON, J. B. & BALLANTYNE, C. K. 2017. Periglacial and Permafrost Ground Models for Great Britain. *In:* GRIFFITHS, J. S. & MARTIN, C. J. (eds.) *Engineering Geology and Geomorphology of Glaciated and Periglacial Terrains.* London: The Geological Society.

NASH, D. J. & ULLYOTT, J. S. 2007. Silcrete. *In:* NASH, D. J. & MCLAREN, S. J. (eds.) *Geochemical Sediments and Landscapes.* Oxford: Blackwell Publishing.

ORDNANCE SURVEY. 1887. *Wiltshire XXXV.4*, 1:2,500. Southampton: Ordnance Survey.

ORDNANCE SURVEY. 1900. *Wiltshire XXXV.4*, 1:2,500. Southampton: Ordnance Survey.

ORDNANCE SURVEY. 1924. *Wiltshire XXXV.4*. Southampton: Ordnance Survey.

OSBORNE WHITE, H. J. 1907. The Geology of the Country around Hungerford and Newbury: explanation of Sheet 267. London: His Majesty’s Stationery Office.

OSBORNE WHITE, H. J. 1925. The Geology of the Country Around Marlborough: explanation of Sheet 266. London: HMSO.

OVERTON, N. J. 2014. *Memorable Meetings in the Mesolithic: Tracing the Biography of Human-Nonhuman Relationships in the Kennet and Colne Valleys with Social Zooarchaeology.* PhD Traditional, Manchester.

PASSMORE, A. D. 1923. Chambered Long Barrow in West Woods. *The Wiltshire Archaeology and Natural History Magazine,* 42**,** 366-367.

POLLARD, J. 2005. Memory, Monuments and Middens in the Neolithic Landscape. *In:* BROWN, G., FIELD, D. & MCOMISH, D. (eds.) *The Avebury Landscape. Aspects of the field archaeology of the Marlborough Downs.* Oxford: Oxbow.

POWIS, M. 1884. *Stone-working Machinery and the Rapid and Economical Conversion of Stone. With Hints on the Arrangement and Management of Stone-Works,* London, Crosby Lockwood and Co.

REYNOLDS, A. 2005. From pagus to parish: Territory and Settlement in the Avebury Region from the Late Roman Period to the Domesday Survey. *In:* BROWN, G., FIELD, D. & MCOMISH, D. (eds.) *The Avebury Landscape. Aspects of the archaeology of the Marlborough Downs.* Oxford: Oxbow.

SAMUEL, R. 1977. Mineral Workers. *In:* SAMUEL, R. (ed.) *Miners, Quarrymen and Saltworkers.* London: Routledge and Keegan Paul.

SHERLOCK, R. L. 1919. Excursion to Walter’s Ash, Buckinghamshire, Saturday, July 26th, 1919. *Proceedings of the Geologists' Association,* 30**,** 191-3.

SHERLOCK, R. L. & NOBLE, A. H. 1912. On the Glacial Origin of the Clay-with-Flints of Buckinghamshire and on a former course of the Thames. *Quarterly Journal of the Geological Society,* 68**,** 199-208.

SMALL, F. 1999. The Avebury World Heritage Site Mapping Project. Swindon: English Heritage.

SMALL, R. J., CLARK, M. J. & LEWIN, J. 1970. The periglacial rock-stream at Clatford Bottom, Marlborough Downs, Wiltshire. *Proceedings of the Geologists' Association,* 81**,** 87-98.

SMITH, A. C. 1884. *Guide to the British and Roman Antiquities of the North Wiltshire Downs.,* Marlborough, The Marlborough College Natural History Society.

SOMERVILLE, G. 2001. Cement and concrete as materials: changes in properties, production and performance. *In:* SUTHERLAND, J., HUMMS, D. & CHRIMES, M. (eds.) *Historic Concrete. Background and Appraisal.* London: Thomas Telford Publishing.

SPENDER, M. 2005. *West Woods* [Online]. Available: https://www.upperkennetnews.co.uk/west-woods/ [Accessed 27 October 2019].

SPICER, E. C. 1905. Sarsen-Stones in a Claypit. *Quarterly Journal of the Geological Society,* 61**,** 39-41.

STANIER, P. 2000. *Stone Quarry Landscapes. The Industrial Archaeology of Quarrying,* Stroud, Tempus.

STRATTON, J. 1994. Stratton Sons and Mead Ltd. An Incomplete Record. (privately published).

SUMMERFIELD, M. A. & GOUDIE, A. S. 1980. The sarsens of southern England: their palaeoenvironmental interpretation with reference to other silcretes. *In:* JONES, D. K. C. (ed.) *The Shaping of Southern England.* London: Academic Press.

THE NATIONAL ARCHIVES 1861. Census Returns of England and Wales, 1861. Ancestry.com. 1861 England Census [database on-line]. Provo, UT, USA: Ancestry.com Operations Inc, 2005.

THOMSON, J. H. 1917. *Guide to the Explosives Act, 1875 (38 Vict. C.17), and to the Orders in Council and Orders of the Secretary of State made under that Act; with remarks upon the Explosives Substances Act, 1883 (46 Vict. C.3),* London, His Majesty’s Stationery Office.

ULLYOTT, J. S., NASH, D. J., WHITEMAN, C. A. & MORTIMORE, R. N. 2004. Distribution, petrology and mode of development of silcretes (sarsens and puddingstones) on the eastern South Downs, UK. *Earth Surface Processes and Landforms,* 29**,** 1509-1539.

WHITAKER, K. 2020. Analytical Earthworks Survey in Piggledene, West Overton, Wiltshire (UK). Unpublished report available from Wiltshire Historic Environment Record.

WHITEMAN, C. A. & HAGGART, B. A. 2018. Chalk Landforms of Southern England and Quaternary Landscape Development. *Proceedings of the Geologists' Association*.

WOODFORDE, J. 1976. *Bricks to Build a House,* London, Routledge and Kegan Paul Ltd.

THE CHILTERNS SARSEN AND PUDDINGSTONE SURVEY

Archive report and ISAD(G) Fonds Level Description

Katy Whitaker, October 2018

k.a.whitaker@pgr.reading.ac.uk | 07769 712799 | @artefactual_KW
ORCID https://orcid.org/0000-0002-9391-8181

This report was authored during a *South, West, and Wales Doctoral Training Partnership* studentship held at the University of Reading, and is supported by the Arts and Humanities Research Council grant number AH:L503939:1.

Arts & Humanities Research Council

South, West & Wales Doctoral Training Partnership

CONTENTS

1. INTRODUCTION

1.1. The *Chilterns Sarsen and Puddingstone Survey* Project

The *Chilterns Sarsen and Puddingstone Survey* project was led by Arthur Morley Davies and Arnold H.J. Baines from 1951 into 1952. The project aim was to map the distribution of silcretes in the Chilterns (UK). Parts of south Buckinghamshire, south Oxfordshire, and west Hertfordshire were covered. Further records were made during the mid-1950s, including some after the 1953 publication of a report on the work (Morley Davies and Baines, 1953).

1.2. The *Chilterns Sarsen and Puddingstone Survey* Project Archive

The project archive relates to the fieldwork carried out by volunteer participants in the study area. It comprises the card-catalogue referenced in the project report (Morley Davies and Baines, 1953, 7); five letters written by Baines to Morley Davies between 1954 and 1956; and an undated note written by R.I. Jones. The collection, accession number AYBCM:2018.97.1-183, is not catalogued and there is no hand-list. It is kept at the Buckinghamshire Museum Resource Centre, Tring Road, Halton, Buckinghamshire, HP22 5PN and can be consulted on request (http://www.buckscountymuseum.org/museum/about-the-museum/resource-centre-halton/).

1.3. Scope

This report briefly describes the survey and summarises its significance (but is not a critique of the project). A description of the physical format of its archive is based on a rapid survey of the collection at the Buckinghamshire Museum Resource Centre carried out in August 2018. Key archival issues are highlighted but this does not constitute a full conservation assessment.

2. THE *CHILTERNS SARSEN AND PUDDINGSTONE SURVEY* PROJECT

2.1. **Project History**

Building materials in the area of the Chilterns include limestones (such as Totternhoe stone and chalk clunch); timber; and clay, sands and gravels that have been extracted for aggregates and brick- and tile-making for many years. Silcretes are common and can be seen used in various buildings (Sherlock, 1922, Sherlock and Noble, 1922). They include sarsen and the conglomerates, Hertfordshire Puddingstone and Bradenham Puddingstone. Nevertheless, these Tertiary materials are not mapped by the British Geological Survey, which may have been the impetus for Morley Davies' project.

Sarsen is a siliceous sandstone (Nash and McLaren, 2007). The two puddingstones, also cemented by silica with their pebbles supported in a sarsen matrix, are distinguished by the size and morphology of the pebble clasts; those in Bradenham Puddingstone tending to be considerably larger and usually more irregular and poorly rounded, compared with the smaller rounded pebbles in Hertfordshire Puddingstone (Morley Davies and Baines, 1953, 2). The distinction, based as it is on locality names for the conglomerate, has not been made in more recent literature such as Huggett and Longstaffe (2016), Morigi et al. (2005). Boulders can be found which transition from areas of sarsen to areas of puddingstone; such as those displayed in the Regionally Important Geological and Geomorphological Site on the roadside of Castle Hill, Berkhamsted (Hertfordshire) (Hertfordshire RIGS Group, 2003, 28).

Arthur Morley Davies FRGS (1869-1959) was a noted palaeontologist and geologist at Imperial College, London (Anon., 1935). He began fieldwork in early Summer 1951, recording occurrences of sarsen and the puddingstones in south Buckinghamshire and parts of south Oxfordshire and west Hertfordshire. Unfortunately, he became unwell and the work was continued in partnership with Arnold Baines. Baines (1921-2001), a statistician at the

Ministry of Agriculture, Fisheries and Food, was a local politician and historian active in the Buckinghamshire Architectural and Archaeological Society (Derry, 2003). Both men lived in south Buckinghamshire, in the area where silcretes occur. Together they co-authored a paper, describing the fieldwork as a "preliminary survey" and reporting on the general findings (Morley Davies and Baines, 1953, 1).

The card-catalogue created by Morley Davies and Baines was photocopied in the early 1990s by John Cooper and Paul Jeffrey of the Natural History Museum (London). They transferred data from the index cards to 8"x5" record cards in the NHM system. Cooper and Jeffrey had also collected data from St Albans Museum, hoping "to publish all the records for sarsens and the varieties of Pudding Stones, with distribution maps, conclusions and interpretations etc" (Cooper and Jeffrey, 1993). Whilst the NHM staff had established a *Puddingstone Study Group* and issued some newsletters under its aegis during 1993 and 1994, these activities appear not to have resulted in any further publications. Copies of the newsletters are available in the Buckinghamshire Museum Resource Centre collections.

2.2. **Project Aims and Methods**

The project aims are not stipulated in the paper that resulted from the fieldwork. Nevertheless, it is clear that Morley Davies intended to map the distribution of silcretes in the Chilterns and in the resulting paper three types of silcrete were described and their distribution summarised. The principal outputs of the project were the published paper, which includes a small-scale sketch map, and the card-catalogue.

The survey was conducted with the help of 23 volunteers. Their names are listed on one of the title cards in the card-catalogue. Most of the records resulted from field visits and occasionally include information gathered in conversation with local residents; but some are bibliographic references and Morley Davies and Baines also acknowledged their use of 1:10,560 geological map sheets annotated by J.H. Blake (see British Geological

Survey collections of geologists' 6" Field Slips, (Paul Carter pers.comm. 2018)). Some negative searches were recorded.

Although the published paper concentrates on the distribution of the three silcrete types described above (2.1), six were recorded during the survey:

S = sarsen stones
HP = Hertfordshire Puddingstone
BP = Bradenham Puddingstone
SHP = transitional sarsen-Hertfordshire Puddingstone
SBP = transitional sarsen-Bradenham Puddingstone
BPHP = transitional Bradenham Puddingstone-Hertfordshire Puddingstone

In addition to these six coded categories, "Denham Puddingstone" was recorded in Denham parish and "Hampden stone" in Hartwell. A few records, however, simply record "conglomerate" without distinguishing which of the puddingstone variants was observed.

Details in the collection's letters suggest that Baines and Morley Davies also visited places recorded by their volunteers. Photographs were sometimes taken; these are mentioned on index cards, although there are none in the project archive. Some later additions to the index cards were made. For example, pencil annotations were made to some, indicating the type of superficial geology present in the areas of records (Fig. 1). A few of the records on the index cards include letter codes which may refer to annotations on Morley Davies' personal collection of 1:10,560 field maps (collection AYBCM 1985.117) (Fig. 2).

At the time of publication, the survey was acknowledged to be "incomplete" (Morley Davies and Baines, 1953, 7) but the authors hoped that gaps might be filled by others. In a letter dated 31 October 1955, Baines commented on the way that their records were restricted to places accessible to the public. Baines continued to gather references to silcretes, writing to Morley Davies with the details as shown by the five letters in the collection. Some records on the index cards post-date the 1953 publication; the latest date noted is 1956, for records made by Baines in Hughenden Park. Notes made by R.I. Jones (undated) and passed to the county museum in Aylesbury for archiving appear to represent additional new records.

2.3. **Significance**

The significance of this collection lies in three main areas. First, because the British Geological Survey does not map silcretes (although it has recorded their presence in both published and unpublished works) any study concerned with these rock types must locate them. This Chilterns survey has a place in the tradition of silcrete data collection that developed during the nineteenth century (for example, Smith (1884), Rupert Jones (1901)). It stands out from previous work, however, by virtue of its greater geographical extent and its more systematic fieldwork.

Unlike previous data collection by interested individuals, Morley Davies and Baines recruited a project team. This team operated over a relatively short period of time to make a focussed search in a defined area. The resulting dataset arose predominantly from field visits and therefore includes well-attested and new records, unlike the commonly bibliographic or anecdotal datasets previously gathered by silcrete enthusiasts. Furthermore, the search was more detailed than the coverage afforded by the then available British Geological Survey map sheet explanations (Sherlock, 1922, Sherlock and Noble, 1922), which tend to have been the previous best descriptions of silcrete presence in the study area.

Secondly, the decision taken by Morley Davies and Baines to involve volunteers, in the years immediately following the Second World War, has innovative characteristics. Both natural and historic environment studies have long and successful traditions of popular and volunteer-driven data-collection and this continues today in, for example, the profusion of digitally-enabled ‘citizen-science’ projects using platforms such as Zooniverse. The Chilterns survey is an interesting example of a group of largely amateur volunteers, engaging with the geology of their local area beyond the confines of a specific geological exposure or localised activity such as fossil collection (numerous examples of which can be found contributing to fieldwork reported in any of the geological journals). Furthermore, the project predates both Earthwatch (1971) (http://earthwatch.org/About/History-of-Earthwatch#history1970) and the UK National Scheme for Geological Site Documentation (1977) (Whiteley and Browne, 2013), by some 20 years.

Thirdly, the survey pre-dates extensive later-twentieth century suburban development on the fringes of Greater London. Considerable parts of the study area have since been developed, principally around the villages and towns, and new roads built (including the M40 and M1) or upgraded (such as the principal A-roads). Many of the stones recorded by the survey will have been lost in this process; thus, the index cards present a unique reference to the presence of silcretes at the time of the survey.

2.4. **Audiences**

Future audiences for the archive include a range of archaeologists and geologists who are engaged in silcrete research. The location data, which could now be better handled in a GIS environment, would comprise a significant addition to the general southern British silcrete distribution (see Ullyott et al., 2004) and provide historical context to studies such as those in the 2016 Geologists' Association special issue on puddingstone and related silcretes (*Proceedings of the Geologists' Association* volume 127, issue 3). The index cards also contain more information about human interaction with silcretes on the Chilterns. A digitised and critically-evaluated dataset derived from the original archive material would be a substantial benefit to geological, archaeological, and historical studies of silcretes in southern Britain.

In addition, these silcretes attract considerable interest from local and community groups in the areas of the stone's natural distribution, as mentioned by, for example, Tubb (2016, 322). Whilst it is harder to document this interest without a formal survey, examples include the recent Geologists' Association Presidential Field Trip including silcretes around Berkhamsted (https://geologistsassociation.org.uk/calendars/2018-presidential-field-trip-berkhamsted-and-potten-end/) and the East Hertfordshire Geology Club's focus on puddingstone (http://ehgc.org.uk/hertfordshire-puddingstone/).

3. THE *CHILTERNS SARSEN AND PUDDINGSTONE SURVEY* PROJECT ARCHIVE

3.1. Relationship to publications

The only publication arising directly from the project is Morley Davies and Baines (1953).

3.2. Current archive management and access

The project archive is managed by the Bucks County Museum, accession number AYBCM:2018.97.1-183. Access is available according to advertised terms and conditions. The collection is not digitised.

3.3. Archive organisation

The collection comprises 183 index cards, five letters, and a hand-written note (Table 1). A summary of the index cards is given in Annex A.

Material	Description
5”x4” Index cards	3 title cards 180 cards carrying records of puddingstone and sarsen in the Chilterns, arranged by civil parish (each card may include multiple records, three cards are duplicated) 54 blank cards
Letters	5 letters written by Arnold Baines to Arthur Morley Davies, 1954-56
Note	A handwritten note including record details, written by RI Jones

Table 1 *Chilterns Sarsen and Puddingstone Survey* Archive content.

The card-catalogue appears to be an edited compilation of the volunteers’ field notes; this is apparent from the consistent single author hand in which the records were made. Some index cards have hand-written field names, but the majority are pre-printed, indicating that they were specially made for the project. Each card carries one or more records, and each record is for one or multiple stones, including examples in buildings. Each card includes fields for NGR; County; Civil Parish; Exact Position; Number, type and size; Notes (Table 2).

Field name	Description
NGR	Ordnance Survey 6-figure grid reference, without leading 100km square letters.
County and civil parish	Pre-1963 (London Government Act) and pre-1972 (Local Government Act) names and boundaries.
Exact Position	A short text description of the location, such as “Opposite Waggon and Horses at roadside.”
Number, type and size	A letter code for the silcrete type(s) observed; and count (or estimate) of how many boulders present; boulder size in inches (or an average size, or the largest boulder, or not recorded).
Notes	Any comments or additional observations, such as the surface condition of sarsens. This field includes bibliographic references and other data, such as participant initials and record year.

Table 2 Data fields recorded in the *Chilterns Sarsen and Puddingstone Survey* index cards.

3.4. Storage, housings, and archive formats

All items are currently housed together in a small index card box.

3.5. Future accruals

No future accruals are expected.

4. ARCHIVE ISSUES

4.1. Storage requirements and conservation

The current temporary storage conditions are appropriate but new housings may be more suitable.

4.2. Copyright and ownership

The collection is owned by Buckinghamshire County Council.

FIGURES

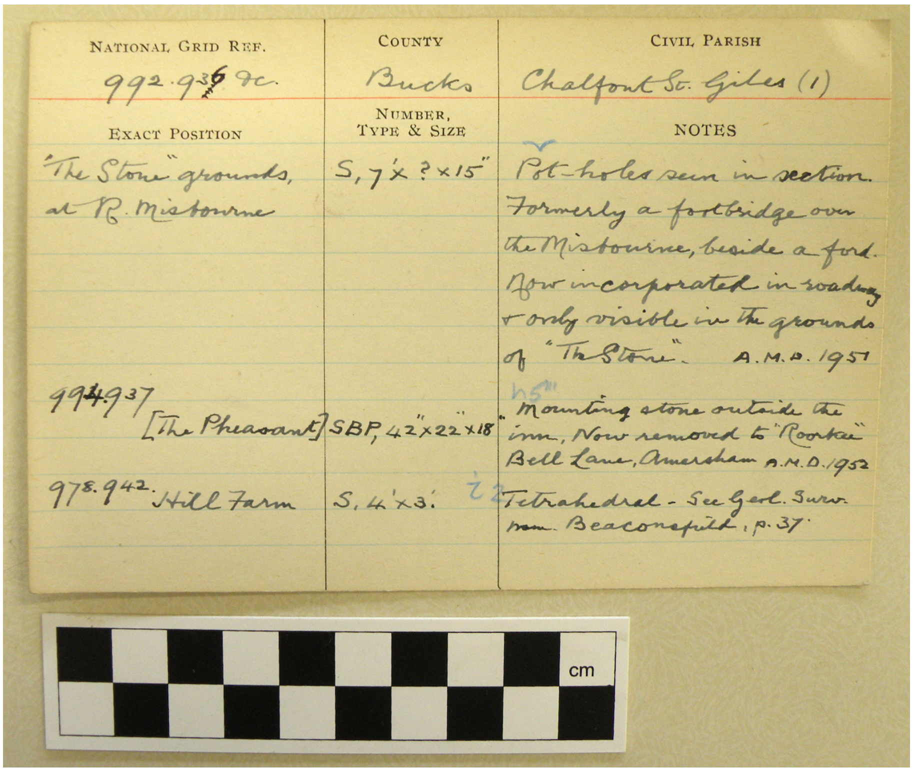


Figure 1 Index card *Chalfont St Giles 01*. The handwritten entries on the pre-printed card are augmented with symbols for superficial geology in blue pencil.

Figure 2 Index card *Princes Risborough 01* set alongside map sheet Buckinghamshire XXXVII SE (1:10,560) from Morley Davies' personal field map collection (collection AYBCM 1985.117). The letters 'B' and 'N' in pencil on the map appear to relate to two of the index card records.

Annex A Index Cards Summary

This summary of the index cards in the collection, and their records, is based on a preliminary count. Whilst the index card list giving parish name and number of cards is accurate, the number of records may change following a more detailed analysis and identification of duplicate records.

n.b. where records fell at or close to parish boundaries, the index cards were named with reference to both parishes, *e.g.* Bradenham-Saunderton.

Parish	Number of cards	Number of records
Amersham	3	10
Ashley Green	2	3
Aston Clinton	1	0
Aylesbury	1	2
Beaconsfield	1	1
Great Berkhamsted	1	0
Bix	1	2
Bledlow cum Saunderton	3	10
Bovingdon	2	5
Bradenham	2	3
Bradenham-Saunderton	1	1
Bradenham-West Wycombe	1	1
Buckland	1	0
Burnham and Hitcham	1	1
Chalfont St Giles	3	9
Chalfont St Peter	2	4
Chartridge	1	3
Checkenden	1	1
Chenies	2	7
Chesham	16	60
Chesham Bois	1	3
Chinnor	1	1
Cholesbury cum St Leonards	1	3
Chorleywood	2	7
Crowmarsh	1	1
Denham	1	2
Edlesborough	1	2
Ellesborough	1	2
Ewelme	1	1
Fingest and Lane End	7	17

Flaunden	4	14
Gerrard’s Cross	3	9
Halton	1	0
Hambledon	3	4
Great and Little Hampden	3	10
Hartwell	1	1
Hedgerley	2	6
Hemel Hempstead	2	7
Horsenden	1	1
High Wycombe	2	5
Hughenden	8	29
Hughenden-High Wycombe	1	5
Hughenden-Hampden	1	3
Hyde	1	1
Great Gaddesden	2	4
Little Gaddesden	1	1
Ibstone	1	2
Kidmore End	1	1
Great and Little Kimble	1	3
Kings Langley	1	1
Knebworth	1	2
Latimer	5	27
The Lee	3	7
Lewknor	2	3
Great and Little Marlow	2	0
Great Missenden	9	40
Great Missenden-Little Hampden	1	2
Little Missenden	5	11
Little Missenden-Penn	1	1
Monks Risborough	2	5
Nettlebed	1	1
Nettleden	2	8
Nettleden-Potten End	1	1
Nuffield	2	6
Penn	3	6
Pishill with Stonor	4	8
Princes Risborough	2	8
Quainton	1	1
Rickmansworth	1	1

Rotherfield Grays	1	2
Rotherfield Peppard	1	1
St Albans	2	8
St Michaels	2	6
St Stephens	1	1
Sarratt	3	6
Skirmett	1	1
South Stoke	1	1
Stokenchurch	2	4
Swyncombe	1	1
Thame	1	1
Turville	2	8
Watton at Stone	1	2
Wendover	4	15
West Wycombe	2	6
West Wycombe Rural	1	3
Whetstone	1	1
Wigginton	1	1
Wooburn	1	2
TOTAL	**183**	**477**

ANNEX B ISAD(G) Fonds Level Description

B.1 Reference Code

Accession number AYBCM:2018.97.1-183.

B.2 Title

Chilterns Sarsen and Puddingstone Survey.

B.3 Date

1951-1956.

B.4 Level of Description

Fonds.

B.5 Extent and medium

1 box containing 237 5”x4” index cards, five letters, one note (paper and card).

B.6 Creator

Arthur Morley Davies, Arnold Baines.

B.7 Administrative history

The collection was created during the *Chilterns Sarsen and Puddingstone Survey* project.

B.8 Archival history

The collection was archived with Buckinghamshire County Museum (Aylesbury) following the completion of field survey *c*1953. Some items have been added at later, unspecified dates, post-dating 1956.

B.9 Immediate source of transfer

n/a

B.10 Scope and content

This fonds consists of documentary archive relating to the *Chilterns Sarsen and Puddingstone Survey* project. The fonds contains aggregated geological field survey records organised by civil parish. It is derived from the project's initial period of data capture in the early 1950s, and includes later correspondence between the project managers.

B.11 Appraisal, destruction and scheduling

n/a

B.12 Accruals

No future accruals are expected.

B.13 System of arrangement

The fonds is not organised into series.

B.14 Conditions governing access

Conditions of access are described http://www.buckscountymuseum.org/museum/about-the-museum/resource-centre-halton/

B.15 Conditions governing reproduction

Conditions of image supply and reproduction are available on request http://www.buckscountymuseum.org/museum/about-the-museum/resource-centre-halton/

B.16 Language

English.

B.17 Physical characteristics and technical requirements

Some material in the fonds may require rehousing in more suitable archival storage.

B.18 Finding aids

No finding aids are available.

B.19 Existence and location of originals

This fonds comprises original material.

B.20 Existence and location of copies

n/a

B.21 Related units of description

None known.

B.22 Publication note

Morley Davies and Baines (1953).

B.23 Note

n/a

B.24 Archivist's note

Description prepared by Katy Whitaker.

B.25 Rules or conventions

Description based on General International Standard Archive Description (Second Edition) "Rules for Archival Description (Fonds)".

B.26 Date of description

Description prepared October 2018.

REFERENCES

ANON. 1935. Retirement of Prof. A. Morley Davies. *Nature,* 136**,** 59.

CARTER, P. 13 July 2018. *RE: BGS Memoirs, sheet explanations Old and New Series.* E-mail to WHITAKER, K.

COOPER, J. & JEFFREY, P. 1993. Letter to Dr Julian Scott, Buckinghamshire County Museum (17 February 1993) (Bucks Couny Museum Collections).

DERRY, B. J. 2003. Arnold H.J. Baines, 1921-2001. *The Statistician,* 52**,** 101-4.

HERTFORDSHIRE RIGS GROUP 2003. A Geological Conservation Strategy for Hertfordshire.

HUGGETT, J. & LONGSTAFFE, F. J. 2016. A brief account of new petrographic and isotopic insights into the Hertfordshire and Buckinghamshire Puddingstones of SE England. *Proceedings of the Geologists' Association,* 127**,** 327-336.

MORIGI, A. N., WOODS, M. A., REEVES, J. J., SMITH, N. J. P. & MARKE, R. J. 2005. *Geology of the Beaconsfield district - a brief explanation of the geological map*. Keyworth: British Geological Survey.

MORLEY DAVIES, A. & BAINES, A. H. J. 1953. A preliminary survey of the sarsen and puddingstone blocks of the Chilterns. *Proceedings of the Geologists' Association,* 64**,** 1-9.

NASH, D. J. & MCLAREN, S. J. (eds.) 2007. *Geochemical Sediments and Landscape,* Oxford: Blackwell.

RUPERT JONES, T. 1901. History of the Sarsens. *The Berks, Bucks and Oxon Archaeological Journal,* 7**,** 54-59.

SHERLOCK, R. L. 1922. *The Geology of the Country around Aylesbury and Hemel Hempstead. Explanation of Sheet 238.* London: His Majesty's Stationery Office.

SHERLOCK, R. L. & NOBLE, A. H. 1922. *The Geology of the Country around Beaconsfield. Explanation of Sheet 255.* London: His Majesty's Stationery Office.

SMITH, A. C. 1884. *Guide to the British and Roman Antiquities of the North Wiltshire Downs.,* Marlborough, The Marlborough College Natural History Society.

TUBB, J. 2016. Palaeogene conglomerates (puddingstones) in the Colliers End outlier, East Hertfordshire, UK – evidence for age. *Proceedings of the Geologists' Association,* 127**,** 320-326.

ULLYOTT, J. S., NASH, D. J., WHITEMAN, C. A. & MORTIMORE, R. N. 2004. Distribution, petrology and mode of development of silcretes (sarsens and puddingstones) on the eastern South Downs, UK. *Earth Surface Processes and Landforms,* 29**,** 1509-1539.

WHITELEY, M. J. & BROWNE, M. A. E. 2013. Local geoconservation groups – past achievements and future challenges. *Proceedings of the Geologists' Association,* 124**,** 674-680.

CHILTERNS SARSEN AND PUDDINGSTONE SURVEY: DATA TRANSCRIPTION STRATEGY, METHODOLOGY AND PROTOCOLS

for the creation of Chilterns_sarsen_survey_MASTER.xlsx

Katy Whitaker, October 2018

k.a.whitaker@pgr.reading.ac.uk | 07769 712799 | @artefactual_KW
ORCID https://orcid.org/0000-0002-9391-8181

This work was authored during a *South, West, and Wales Doctoral Training Partnership* studentship held at the University of Reading, and is supported by the Arts and Humanities Research Council grant number AH:L503939:1.

Arts & Humanities Research Council

South, West & Wales Doctoral Training Partnership

Table of Contents

Summary

This document lays out decisions that were made in preparation for, and during, the transcription of data from Index Cards from the *Chilterns Sarsen and Puddingstone Survey* project archive (accession number AYBCM:2018.97.1-183, Bucks County Museum). It comprises the paradata for the transcription process resulting in the creation of the archived file *Chilterns_sarsen_survey_MASTER.xlsx*.

It includes a brief introduction to the survey project and to the nature of the individual archive items that have been digitised and transcribed; general problems that applied to all of the archive records; and the methodology adopted to digitise the data by manual transcription. The methodology is based on that developed for the digitisation of the Society of Antiquaries' *Sarsen Stones in Wessex* archive collection and is only briefly referred to in this document: for full details, see Whitaker (2018a).

This document is intended to be read in conjunction with the transcribed dataset with its ADS-compliant metadata table (*Chilterns_sarsen_survey_MASTER.xlsx*), and alongside the ISAD(G)-compliant collection description (*Chilterns_Sarsen_and_Puddingstone_Survey_Archive_report_FINAL.pdf*).

List of tables

List of figures

The Chilterns Sarsen and Puddingstone Survey project

The *Chilterns Sarsen and Puddingstone Survey* project was led by Arthur Morley Davies and Arnold H.J. Baines from 1951 into 1952. The project aim was to map the distribution of silcretes (sarsen and puddingstone) in the Chilterns (UK): parts of south Buckinghamshire, south Oxfordshire, and west Hertfordshire were covered. A small project archive is curated by Bucks County Museum at its Resource Centre in Halton.

Sarsen is a siliceous sandstone (Nash and Ullyott, 2007). The two puddingstones found in the project's study area, distinguished by locality names, are silica-cemented flint pebble conglomerates. Clasts within Bradenham Puddingstone have been said to be considerably larger and are usually more irregular and poorly rounded, contrasting with Hertfordshire Puddingstone's smaller, rounded, pebbles (Morley Davies and Baines, 1953, 2). More recently, the distinction of these locality names has not been made (for example, Huggett and Longstaffe, 2016, Morigi et al., 2005). Boulders which transition from areas of sarsen to areas of puddingstone are common in the Chilterns, such as those in the Regionally Important Geological and Geomorphological Site at the roadside of Castle Hill, Berkhamsted (Hertfordshire) (Hertfordshire RIGS Group, 2003, 28).

Arthur Morley Davies FRGS (1869-1959) was a noted palaeontologist and geologist at Imperial College, London (Anon., 1935). He began fieldwork in early Summer 1951, recording occurrences of silcretes (sarsen and puddingstones) in south Buckinghamshire and parts of south Oxfordshire and west Hertfordshire. Unfortunately, he became unwell and the work was continued in partnership with Arnold Baines. Baines (1921-2001), a statistician at the Ministry of Agriculture, Fisheries and Food, was a local politician and historian active in the Buckinghamshire Architectural and Archaeological Society (Derry, 2003). Morley Davies lived in Amersham whilst Baines lived in Chesham, both towns within the silcrete area.

Morley Davies' motivation and aims are not stipulated in the paper that resulted from the fieldwork (Morley Davies and Baines, 1953). Nevertheless, it is clear that he intended to map the distribution of silcretes in the Chilterns and in the paper three types of silcrete were described and their distribution summarised. His motivation may have been a dissatisfaction with British Geological Survey (BGS) mapping in the region, including the absence of silcretes from the superficial and Tertiary deposits described by the relevant BGS map sheets. This is suggested by Morley Davies' personal field maps which are archived at the Bucks County Museum Resource Centre (accession number AYBCM:1985.117). His sketched and coloured annotations on these 1:10,560 scale map sheets indicate an interest in the boundaries of deposits (for example, sheet Buckinghamshire XXIIISE, Fig.1) and suggest the intention to research more detailed deposit formations (for example, sheet Buckinghamshire XXXIVSW, Fig.2).

The fieldwork to locate silcretes in the study area was conducted with the help of 23 volunteers. Their names are listed on one of the title cards in the project archive's card-catalogue. The volunteers were tasked to record all the examples of sarsen stone, Hertfordshire Puddingstone, and Bradenham Puddingstone that they could find. These include exposures of 'in situ' material (such as rocks found during excavation for building works or aggregates extraction), and humanly-modified examples such as building stone, mounting blocks, stones cleared to field edges, and so on. Most of the records resulted from field visits and occasionally included information gathered in conversation with local residents, or the volunteer's own personal memories. Some are derived from published bibliographic references and Morley Davies and Baines also acknowledged their use of 1:10,560 scale geological map sheets annotated by J.H. Blake (for example, Index Card *Nuffield*) (see British Geological Survey collections of geologists' 6" Field Slips, Paul Carter pers.comm. 2018).

Although Morley Davies and Baines (1953) described the distribution of the three silcrete types described above, six variants were noted during the survey, indicated by a letter code in the project's archived Index Cards (Table 1). In addition to these six coded categories, "Denham Puddingstone" was noted in Denham parish and "Hampden stone" in Hartwell. Denham Puddingstone was described as a conglomerate with “small subangular and rounded pebbles in rusty brown matrix, probably concretions in local gravel” (AYBCM:2018.97.1-183 Index Card *Denham*). The identification and description of the sarsen-like Hampden stone, observed at Hartwell Park, was derived from Morris (1867) and Druce (1926) (AYBCM:2018.97.1-183 Index Card *Hartwell*). A few records, however, simply record “conglomerate” without distinguishing which of the puddingstone variants was observed.

Silcrete type	**Letter code**
Sarsen	S
Hertfordshire Puddingstone	HP
Bradenham Puddingstone	BP
transitional sarsen-Hertfordshire Puddingstone	SHP
transitional sarsen-Bradenham Puddingstone	SBP
transitional Bradenham Puddingstone-Hertfordshire Puddingstone	BPHP

Table 1 Codes for silcrete types used in the *Chilterns Sarsen and Puddingstone Survey* Index Cards

The principal outputs of the project were the published paper, which includes a small-scale sketch map, and a card catalogue comprising 183 Index Cards recording the survey findings. The cards appear to be an edited compilation of the volunteers’ field notes, suggested by the single hand in which the records were written and their consistent layout. Some index cards have hand-written field titles but the majority are pre-printed, indicating that they were specially made for the project. Each card carries one or more records, and each record is for one or multiple stones. Some records, such as those for buildings, include information about a range of silcrete types within one entry. Each card includes fields for NGR; County; Civil Parish; Exact Position; Number, type and size; Notes (Table 2).

Field name	Description
NGR	Ordnance Survey 6-figure grid reference, without leading 100km square letters.
County and civil parish	Pre-1963 (London Government Act) and pre-1972 (Local Government Act) names and boundaries.
Exact Position	A short text description of the location, such as "Opposite Waggon and Horses at roadside."
Number, type and size	A letter code for the silcrete type(s) observed; and count (or estimate) of how many boulders present; boulder size in inches (or an average size, or the largest boulder, or not recorded).
Notes	Any comments or additional observations, such as the surface condition of sarsens. This field includes bibliographic references and other data, such as participant initials and record year.

Table 2 Data fields recorded in the *Chilterns Sarsen and Puddingstone Survey* index cards.

The 183 cards include records for 82 parishes and 7 areas at parish boundaries. Each parish/area has one or more Index Cards. Where there are multiple cards, they are distinguished by a running number. Each card carries one or more records, providing *c*477 records in total (although some may be duplicates). Chesham has the greatest number of cards (16) and individual records (60), probably reflecting Arnold Baines' activity in the area of his home. At least three of the cards are duplicates (AYBCM:2018.97.1-183 *Fingest and Lane End 6*, *Hambledon 2*, *Marlow*) (see Whitaker, 2018b, Annex A). The project archive includes five letters written by Baines to Morley Davies between 1954 and 1956, and an undated manuscript note written by R.I. Jones, "For Aylesbury Museum. Unclassified Sarsens." Jones' note includes five records, whilst Baines' letters to Morley Davies include 12 records.

Unfortunately, there is no information concerning the conduct of the field survey, the distribution of the volunteers' work, or extent of their searches. Although records on the Index Cards are initialled, only 19 individuals appear in these as primary recorders (compared with the 23 names noted on the Index Card of volunteers) and so cannot be used to reconstruct and evaluate the work completed by the whole project team of twenty-three. One of the volunteers was Dr K.P. Oakley FBA of the Natural History Museum, and another was Mr A.J. Arkell who was engaged in archaeology of Sudan and Egypt during his time as a colonial administrator. Their presence suggests that the team did have some archaeological expertise in addition to the primarily geological interests of the project.

At the time of publication, the survey was acknowledged to be “incomplete” (Morley Davies and Baines, 1953, 7), but the authors hoped that gaps might be filled by others. In a letter dated 31 October 1955, Baines commented on the way that their records were restricted to places accessible to the public. A few Index Cards explicitly record searches that found no silcretes but there is no indication of how conscientious the volunteers were in reporting negative searches in other parts of the study area. Details in the collection’s letters suggest that Baines and Morley Davies had visited the places recorded by their volunteers. Photographs were sometimes taken; these are mentioned on Index Cards, although there are none in the project archive.

Some later additions were made to the Index Cards. For example, pencil annotations on some indicate the type of superficial geology in the area. A few of the records on the Index Cards include letter codes which may refer to annotations on Morley Davies’ field maps. Although the principal fieldwork was conducted from 1951, further records were made during the mid-1950s. These include secondary additions to records or references to site visits made by the project leaders, and a number of records that post-date the 1953 publication (Table 3). Baines clearly continued to collect information, writing with the details to Morley Davies as the letters in the collection reveal. And R.I. Jones, not one of the original project volunteers, was nevertheless aware of the set of Index Cards, using a selection of their field titles to provide notes at a later, unspecified, date.

	1951	**1952**	**1953**	**1954**	**1955**	**1956**	**undated**
Number of records	67	242	22	1	13	11	25

Table 3 The number of *Chilterns Sarsen and Puddingstone Survey* sarsen records recorded with a note of the year (counting both primary and secondary dates indicated on Index Cards).

The card-catalogue created by Morley Davies and Baines was photocopied in the early 1990s by John Cooper and Paul Jeffrey of the Natural History Museum (London). They transferred data from the index cards to 8”x5” record cards in the NHM system. This activity is recorded in correspondence curated at the Bucks County Museum Resource Centre. Cooper and Jeffrey had also collected data from St Albans Museum, hoping “to publish all the records for sarsens and the varieties of Pudding Stones, with distribution maps, conclusions and interpretations etc” (Cooper and Jeffrey, 1993). Whilst the NHM staff had established a *Puddingstone Study Group* and issued some newsletters under its aegis during 1993 and 1994, these activities appear not to have resulted in any further publications. Copies of the newsletters are available in the Bucks County Museum Resource Centre collections.

Aim and objectives

AIM

To digitise sarsen data captured on Index Cards by volunteers during the *Chilterns Sarsen and Puddingstone Survey* project, creating a digital dataset that is suitable for archiving and sharing through Open Access means (subject to any restrictions required by the data owner, Bucks County Museum), and which can form the basis of a future analytical dataset capable of being used in different contexts (for example, queried in a GIS environment or using a programming language such as R).

OBJECTIVE 1

Digitise the Index Cards and convert analogue, handwritten, data into digital data.

OBJECTIVE 2

Ensure that all datasets created are in an Archaeology Data Service (ADS) preferred file format with ADS-compliant metadata (http://www.archaeologydataservice.ac.uk/advice/guidelinesForDepositors.xhtml), and aligned with Research Council UK data management requirements for RCUK-funded research, http://www.rcuk.ac.uk/research/datapolicy/)

OBJECTIVE 3
Retain key identification data such that every digitised record can be mapped back to its originating Index Card in the *Chilterns Sarsen and Puddingstone Survey* project archive (AYBCM:2018.97.1-183).

OBJECTIVE 4
Capture all of the information about sarsens recorded by the project volunteers in order to reduce the handling demand on the original archive material.

Strategy

The data source: Chilterns Sarsen and Puddingstone Survey Index Cards

The item-level records for sarsens and puddingstones identified by the project's volunteers are the Index Cards, accompanied by a small amount of additional data in the accompanying archive material described above. The cards contain the data collected by volunteers, predominantly during 1951-2, and collated by the project leaders. Some editing may have occurred in the collation process, but in the absence of documentation describing how the volunteers worked and passed their observations to Morley Davies and Baines, the data are taken at face value.

Although the Index Cards are not catalogued to item-level, they are arranged by parish and individual reference numbers can be created for each card using the name and consecutive numbering system allocated by Morley Davies and Baines. The Index Cards were designed with field titles pre-printed for the project. A few blank cards have hand-written field titles, but these precisely copy the printed masters and each card follows the same format. Information is recorded about silcrete occurrences, including either a single stone, or a group of stones that were deemed by the recording volunteer to have an association. Examples of groups include material in building fabric, rockeries, and stones in yards or on verges, for example. Each record relates to the structure or feature observed, so one record can include a single stone, numerous stones of one type, or multiple entries for a mix of the recorded silcretes. This is clearly illustrated by AYBCM:2018.97.1-183 *Amersham 1* (Fig. 3).

Occasionally records were made for stones no longer extant but thought to have been sarsens, or extant stones uncertainly identified as sarsens. Examples include, for example, a record of two stones marked on historical Ordnance Survey mapping interpreted as boulders referenced by the Missenden Cartulary, which could not be found on the ground when visited (AYBCM:2018.97.1-183 *Great Missenden-Little Hampden*); and five whitewashed stones, assumed to be sarsens, in the courtyard of the Greyhound public house (AYBCM:2018.97.1-183 *Chalfont St Peter 1*). This original data is nevertheless required for digitisation, in order to provide a full account of the material collected by the volunteers from a variety of sources.

The project's records are in a common format on one side of each Index Card, including five broad categories of data collection. Some of the categories, however, comprise a number of more-or-less discrete items of information, recorded by the volunteers in a semi-structured way without controlled language. The handwritten data are relatively well-constrained on each card, fitting into the areas denominated for each category. Nevertheless, some information extends beyond categories' printed boundaries, or is written between lines, or is difficult to line up with the relevant part of a record. The Index Cards are written up in one hand, almost exclusively in a blue or blue-black ink. However, there is some variation in the visual quality of each card – that is, the handwriting, ink, legibility, placement of text, and so on – as well as in the quality of the recorded content. Some cards include crossings out and pencil annotations or are written entirely in pencil; there are rare sketches; ditto marks were used occasionally to replicate information; and bracketed data could be written out once but intended to relate to all of a card's records. Examples include AYBCM:2018.97.1-183 *Chesham 6*, *Chesham 8*, *Great Missenden 8*, and *Hughenden 3* (Fig.4).

Methodologies

"Even the neatest, most consistent handwriting resists OCR"

(Kearney and Wallis, 2015)

Having previously described and discussed at length the available methodologies to digitise data from this type of archive material (Whitaker, 2018a), the subject is not rehearsed here. The overwhelming message from literature review, the conduct of contemporary projects, and conversations with archivists working with historic material in some of our national institutions, is that current text recognition systems do not afford effective means to transcribe handwritten material of this nature without considerable manual intervention at different stages in the process. As described in Whitaker (2018a, 24-6), it has been difficult to find archive projects in which handwritten, highly variable, data have been captured using OCR/HTR computerised processes. Many recent projects to digitise historic data, from both handwritten and printed sources, have chosen to invest in manual transcription by staff and/or volunteers – such as the purpose-built *Micropasts* platform that enables organisations to present records for transcription by 'virtual volunteers' operating online (Bonnachi et al., 2015, Wexler, 2017).

The *Chilterns Sarsen and Puddingstone Survey* Index Cards have a number of similarities with the Index Cards of the *National Record of Industrial Monuments* (NRIM) (Historic England) and the *National Bronze Implements Index* (NBII) (British Museum), in terms of both their format and content. Data captured from cards in these latter two archive collections were transcribed manually: the former by specialist Historic England staff, the latter by multi-keying by online volunteers with manual and semi-automated quality assessment by British Museum staff (Buchanan, 1969, 1971, Guiden, 2011, Fitz-Gerald, 2012, Wexler, 2017). Although the card layouts of all three of these card catalogue collections encouraged relatively regularised completion by the original writers, they exhibit a similar visual variation including variable scripts, pen/ink weights, occasional sketches, and other features. These characteristics required manual transcription of the NRIM and NBII cards.

Furthermore, only a subset of the records from the *Chilterns Sarsen and Puddingstone Survey* archive material are required. At this time, the sarsen data are prioritised over the complete silcrete dataset because of the limited time resource available and the digitisation requirements of the current research project (see below). The variability in visual quality of the cards would make it very difficult and time-consuming to prepare them for Handwritten Text Recognition by the necessary delimitation of specific fields for the software to locate data packets (segmentation), followed by the accurate extraction of characters that comprise the data required (recognition), given the mixed data on each card. Manual transcription is the most viable option to digitise data from the collection, for both technical and pragmatic reasons.

Methodology and paradata

The *Chilterns Sarsen and Puddingstone Survey* Index Cards and records noted in the other MSS items in the project's collection were selected for digitisation. All items in the collection were photographed during a day visit to Bucks County Museum Resource Centre on 10 August 2018. The photographs were supplied to Mike Palmer of the Bucks County Museum Record Centre as digital surrogates in the camera's JPG format, to accompany the analogue collection. The image files supplied were named by convention *authorSurname_authorSurname_cardReference.jpg* (for example, Davies_Baines_HighWycombe02.jpg), because at that stage the material had not been accessioned so no collection reference number was available.

Transcription was from these digital photographic images. It is acknowledged that "how a document is transcribed will depend on the intended audience and purpose of the transcription" (Kearney and Wallis, 2015). Out of all the silcrete records in the collection, the sarsen records are of primary interest for a number of reasons. First, the general distribution of sarsen stone in the study area as summarised and sketched at small scale by Morley Davies and Baines (1953, 9) is to be tested against the records collected by the project volunteers. Secondly, the sarsen data would provide the best available proxy for the geological distribution of the stone - albeit as it was at the time of the survey - and its availability for procurement by the post-medieval/modern sarsen cutting industry. A detailed distribution of this kind has not been possible prior to the digitisation and transcription of this dataset: the best published visualisations are the small-scale plots for southern Britain in Bowen and Smith (1977), and Ullyott et al. (2004). The sarsen subset of the available data was, therefore, transcribed in the first instance.

A disadvantage of this approach is that the collection must be returned to and re-handled if problems arise, and to add the puddingstone records, to complete the dataset as and when research questions develop. This affords further mechanical risks to the original archive materials, through re-handling. In this instance, the digital surrogate images provide a way to reduce the handling risk. The aim of this digitisation exercise is to capture the sarsen data for their relevance to a study of the stone cutting industry which did not make use of the other silcretes recorded by the 1950s project. Although it is acknowledged that the complete silcrete dataset may be required to inform geological research questions, this is not the focus of the present study. The transcription protocols and digital dataset are scale-able to permit later transcription of the puddingstone records when required, to complete the full dataset.

As part of this process, it is important to create data, paradata, and metadata to meet data standards, and in the spirit of Open Science for archaeology (Marwick et al., 2017); and to ensure that future researchers testing or re-using the digitised data can relate the records to the analogue archive held by Bucks County Museum, as well as apply their own editing, data-cleaning, and analytical choices to a master dataset. Therefore, rather than transcribe only a reduced number of the five original data fields, the general principle applied to all the transcription activity was to capture as much data possible in a Master dataset intended for Open Access archiving (aligned with Research Council UK data management requirements for RCUK-funded research, http://www.rcuk.ac.uk/research/datapolicy/).

This decision was additionally influenced by both the Historic England Archive principle 'scan once, use many times' and also by Archaeology Data Service (ADS) principles (http://archaeologydataservice.ac.uk/advice/guidelinesForDepositors.xhtml). Excel was favoured over a text format, such as Microsoft Word, despite the text-heavy nature of the data, for a number of reasons. Excel worksheets can be saved and archived as .csv files which are more adaptable; both .xls(x) and .csv formats are preferred ADS formats; .csv files are accepted by many applications (such as GIS) and in a number of programming languages for analysis purposes; and fields can be converted to text files if required for analysis by other Digital Humanities techniques.

A suite of transcription protocols were established, informed by a previous exercise to transcribe similar handwritten data created in the 1970s by the *Sarsen Stones in Wessex* project (Whitaker, 2018a). An iterative process was taken, however, to manage material differences between the two archive collections and the variability in the *Chilterns* survey Index Cards. Accordingly, general principles applicable to the overall dataset were established, to govern the framework of the transcription process. Then, protocols specific to individual fields were established in response to the variation encountered within the archive collection. The protocols are detailed below. On completion, the transcribed records were put through a quality assurance process in the Excel file (Fig.5) and in OpenRefine to improve overall internal consistency and remove transcription errors. The final dataset, *Chilterns_sarsen_survey_Master.xlsx*, was then archived.

Whilst these paradata are presented in this document, metadata and paradata relating to the editing of the Master dataset for analytical purposes, in a new .csv file, are archived and presented separately.

Digitisation protocols

The following sections describe the paradata of the transcription process. Various issues were identified when the *Chilterns Sarsen and Puddingstone Survey* project archive was assessed for digitising. These fall into two categories. **General** issues were common across the archived material and include problems about how to capture and present metadata about the records to future users. General principles to manage these issues were established and are outlined in Table 4 below. Specific problems concerned how to split the five Index Cards general data categories into **individual fields**, and how to capture data in those fields. The issues, and the decisions that were made to solve problems or capture appropriate data/metadata, are outlined below in Table 5. These form the protocols that were followed in capturing data from all the project's archive records regardless of the format/media in which they are presented in the archived collection: that is, the protocols apply to the 183 Index Cards, five letters, and the MSS note, in collection ATBCM:2018.97.1-183. The protocols should be read in association with the metadata tables in file *Chilterns_sarsen_survey_MASTER.xlsx.*

General

	PROBLEM	**SOLUTION**
1	The original Index Card numbering system does not provide a unique identifier for each row of transcribed data. This is further complicated by those Index Cards carrying multiple records.	Introduce a UID field for each record, based on the project name with a running number sequence (starts at Chilterns001).
2	A reference is required to link each row of transcribed data back to its originating material in the collection, including Index Cards, letters, and MSS note.	Introduce an archive_item field. Use the parish name and running number sequence recorded in the top-right area of the Index Cards (e.g. *Amersham01*); for data from the letters use the *author_author_date_page* naming

		convention of the digital image surrogates; for the MSS note use *R_I_Jones.*
3	Some information categories on the Index Cards were left blank, but there is no indication why.	Always leave blank fields blank, rather than (mis)interpret the blank in a way that may not have been intended by the volunteer. Do not use <null> or other indicators in the Master dataset (empty cells can be identified in an analysis dataset, if required, during data cleaning and indicated there with an industry standard indicator such as NAN).
4	Index Cards may include more than one hand. It is often not clear who was responsible for which parts of the record, when data were added, or why.	Transcribe all the available text regardless of author.
5	The location of text on each Index Card may vary.	Transcribe data into the field against which the text had been written, unless this makes no sense: for example, always transcribe an NGR to the NGR field, even if written in the Notes field.
6	Occasionally, text written on an Index Card has been crossed through. Reasons for the deletion are not given.	Respect the intention to delete and do not transcribe this data.
7	Occasionally an Index Card includes a sketch. These items cannot be transcribed into a dataset.	Introduce a new field to the digitised dataset to indicate the presence or absence of drawings.
8	Local authority data pre-dates current local authority boundary organisation. Some records were made and kept within one county although they belong to a different county.	Transcribe the county/parish/place-name information as given. New fields with present-day CDP data can be added to an analysis dataset if required.

9	NGRs were recorded without 100km square letter prefixes. Sometimes, when compared with other data in the record and OS mapping, the recorded NGRs do not appear to relate well to the described information.	There are numerous ways that recorded NGRs could be incorrect compared with the actual location of the stone(s) being described by the volunteers. It is inappropriate to try to second-guess original recording accuracy: transcribe the NGRs as given. New fields with cleaned absolute NGRs can be added to an analysis dataset.
10	Occasionally records have more than one NGR (e.g. describing a linear feature).	Transcribe multiple NGRs using [;] as a separator.
11	Some Index Cards have one NGR for multiple records.	Split the separate records into unique rows in the transcribed dataset, repeating the NGR each time.
12	Mensuration is usually in Imperial measures.	Retain original measurements in the Master dataset. New fields with metric mensuration can be added to an analysis dataset if required.
13	Occasionally the Index Card “Number, type and size” field includes information that describes completely different characteristics.	Transcribe unrelated data from the “Number, type and size” field into the “Notes” field.
14	Some Index Card categories required more than one item of information to be captured together (for example, “Number, Type and Size”).	Split out individual fields. See Table 5.
15	The Index Cards include records for a single heritage asset, such as a building, with multiple stones in the fabric.	Record the number of stones noted by the volunteer. In an analysis dataset, a new category ‘building’ can be used to enable GIS symbology indicating these kinds of structures.
16	Occasionally personal data other than the volunteer’s name was recorded, e.g. property owner and address.	Do not transcribe personal data. Only include property name/address (without owner) if this is the location information for the record.

17	Occasionally Index Cards include text including speculation and reasoning explaining a sarsen's location/use.	Transcribe all data. This is relevant to the context and framing of the project, and may be amenable to textual analysis methods.
18	Transcription into a spreadsheet is not the best way to handle lengthy text elements. Some original fields include more than one piece of information; however, cells should contain only one data point.	Divide text elements sharing a cell with [;] (see Micropasts precedent). This will enable text elements to be split into separate columns in an analysis dataset if required.
19	Some Index Cards are duplicates.	Do not transcribe the duplicate Cards.
20	Data may be duplicated between the three different types of archive material (Index Cards, letters, MSS note).	Transcribe all data for the compilation of the master dataset. This can be analysed and edited in a derived dataset.
21	Some text is illegible.	Indicate illegible text with […] (see Micropasts precedent).
22	Some records for one heritage asset include multiple silcrete records (for example, a building with both sarsen and puddingstone boulders in the fabric).	Extract the sarsen data. Introduce a new field to indicate whether or not the sarsen record was originally part of a mixed silcrete record, for reference purposes.
23	Occasionally a building name was recorded with more than one sarsen, but it is not clear if this indicates building fabric or freestanding stones at that address.	Record the number of stones.
24	Sometimes it is not clear that stones were actually sarsen, and were recorded as "S?".	Include these records (they can be discounted from an edited analysis dataset as required).
25	A few records were made that have no details other than to record the presence of a stone (for example, record for Stoke Row, Nuffield parish).	Include these records (they can be discounted from an edited analysis dataset as required).

Table 4 General issues arising from Index Card recording practices for the *Chilterns Sarsen and Puddingstone Survey* project.

Individual fields

The table below outlines how the Index Cards' five data categories were split into fields, and decisions made about which data to transcribe into these fields. It should be read in conjunction with the metadata tables in file *Chilterns_sarsen_survey_MASTER.xlsx.*

	Index Card category	**FIELD NAME**	**PROTOCOL**	**FORMAT/allowed terms** (null cells allowed unless indicated otherwise)
1	[null]	UID	A unique reference based on the project name followed by a running number of three digits' length.	ChilternsNNN (cannot be null)
2	[null]	archive_item	The parish name and card number from the 'Civil Parish' area of each Index Card. Where only one card was completed for a parish, no number is required. Occasionally the project team did not allocate a number to the first parish card, but started the numerical sequence (from 1) allocated from the second card. Use the numbering allocated on the Index Cards. For data from the letters use the naming convention of the digital image surrogates; for the MSS note use *R_I_Jones*. In archive terms these references are analogous to ISAD(G) item level references,	e.g. <Bix> <Amersham02> <Davies_Baines_08081956_02> <R_I_Jones> (cannot be null)

			although they are not necessarily unique identifiers.	
3	National Grid Ref.	NGR	Transcribe the 6-figure grid-reference given for each record. Where one NGR is given for multiple records, split the separate records into unique rows in the transcribed dataset, repeating the NGR each time. Divide multiple NGRs with [;].	NNNNNN (cannot be null)
4	County	county	Transcribe the data recorded in the field.	(cannot be null)
4	Civil Parish	parish	The parish name as identified by the volunteer. This cell is null for records described with two parishes to indicate the boundary location.	
5	Exact Position	position	The descriptive text added by the volunteer to amplify the NGR.	
8	Number, Type & Size	number	Record the number in the count. If an uncounted/innumerable group of stones was being recorded, use '99'.	(cannot be null)
9	Number, Type & Size	type	The silcrete code used by the project (this can be <null> only because a few records, usually derived from a bibliographic source, are implied to be a particular stone type but were not actually recorded as such).	<S> <HP> <BP> <SHP> <SBP> <BPHP>

10	Number, Type & Size	size01	This was interpreted in a number of different ways by volunteers. Use this field to capture simple text descriptors (adjectives).	<small> <medium> <large> <boulder> and other text allowed
11	Number, Type & Size	size02	This apparently simple category of information was interpreted in a number of different ways by volunteers. Use this field to capture multiple dimensions, and other complex textual comments about size (for example, where groups are described).	Transcribe the text, use [;] to divide information.
12	Number, Type & Size	L	Sometimes volunteers recorded, or estimated, boulder size. This is usually an Imperial measurement. Record the longest measurement, in inches.	A numerical value (inches).
		I	Sometimes volunteers recorded, or estimated, boulder size. This is usually an Imperial measurement. Record the intermediate measurement, in inches.	A numerical value (inches).
		S	Sometimes volunteers recorded, or estimated, boulder size. This is usually an Imperial measurement. Record the shortest measurement, in inches.	A numerical value (inches).

13	Notes	notes	This category included no data, or varied data captured by the volunteers including opinion and surmise, bibliographic references and quotations, excavation data, more detailed descriptions and sketches etc. Transcribe the text, if used.	
14		initials01	Usually a member of the project team's initials were written against records, with a year. More than one person could be included and a different year indicated. Divide these into individual fields.	e.g. <AMD> e.g. 1952
15		date01		
16		initials02		
17		date02		
18		initials03		
19		date03		
20		initials04		
21		date04		

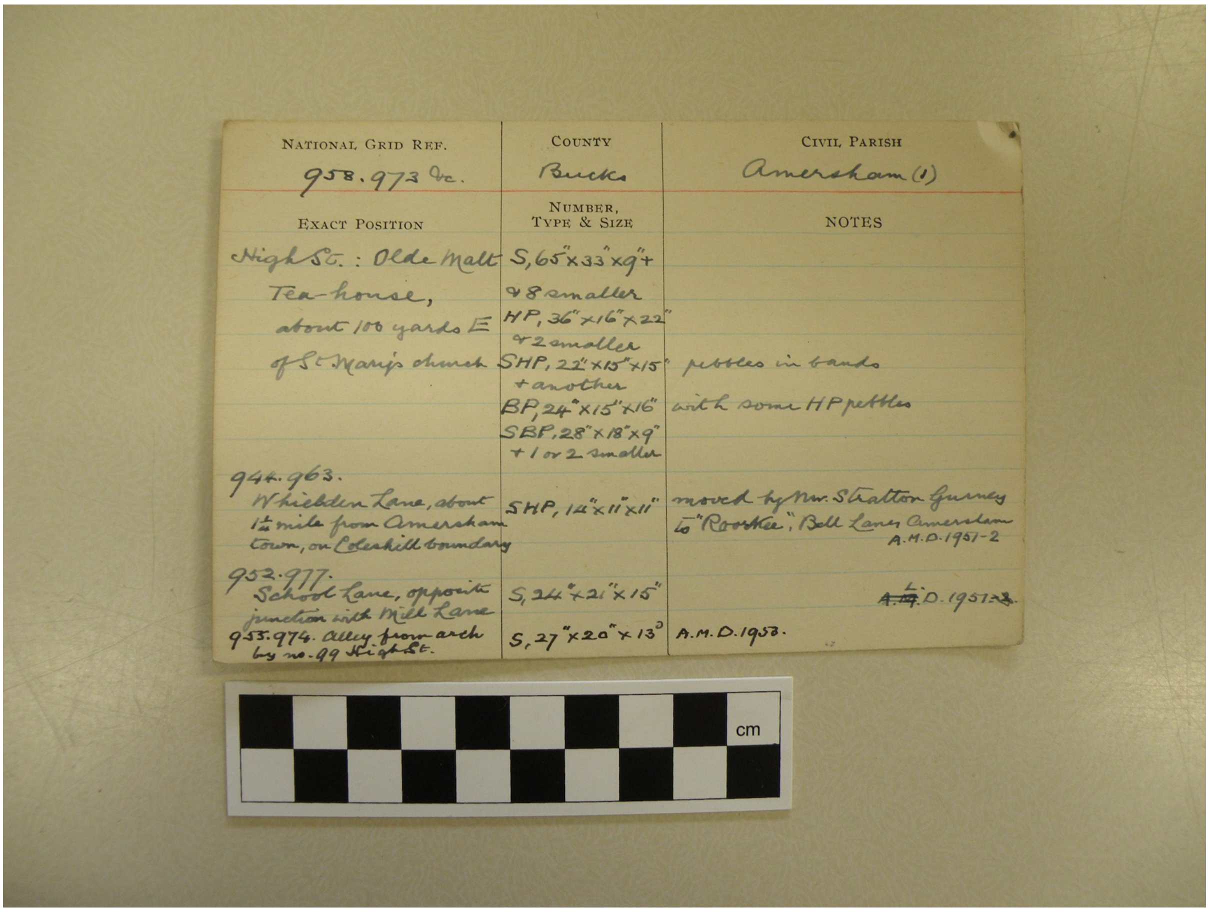
22		data_source	Volunteers made site visits, but also captured data from other sources. Where it is clear from the Index Card, indicate the source here. Use 'knowledge' when the volunteer was recording a reminiscence or local historical information. n.b. 'bibliographic' includes unpublished written sources. Leave blank if uncertain. Although this involves making some assumptions, it is useful when making a broad assessment of the course of the project.	<visit> <bibliographic> <perscomm> <knowledge>
23		mixed	This protocol document refers to a data frame that includes only the sarsen records from the total population of silcrete records in the archive collection. Some of the sarsen records were part of mixed silcrete records. Indicate whether or not the record was uniquely sarsen or mixed in the original.	<Y> <N> (cannot be null)
24		sketch	Rarely, small sketches appear on Index Cards. Indicate whether a sketch is present.	<Y> <N> (cannot be null)

Table 5 *Chilterns Sarsen and Puddingstone Survey* Index Card data categories mapped to fields in *Chilterns_sarsen_survey_MASTER.xlsx,* field description, protocol for completion, and permitted field content.

Figures

Figure 1 AYBCM:1985.117 Buckinghamshire XXIIISE

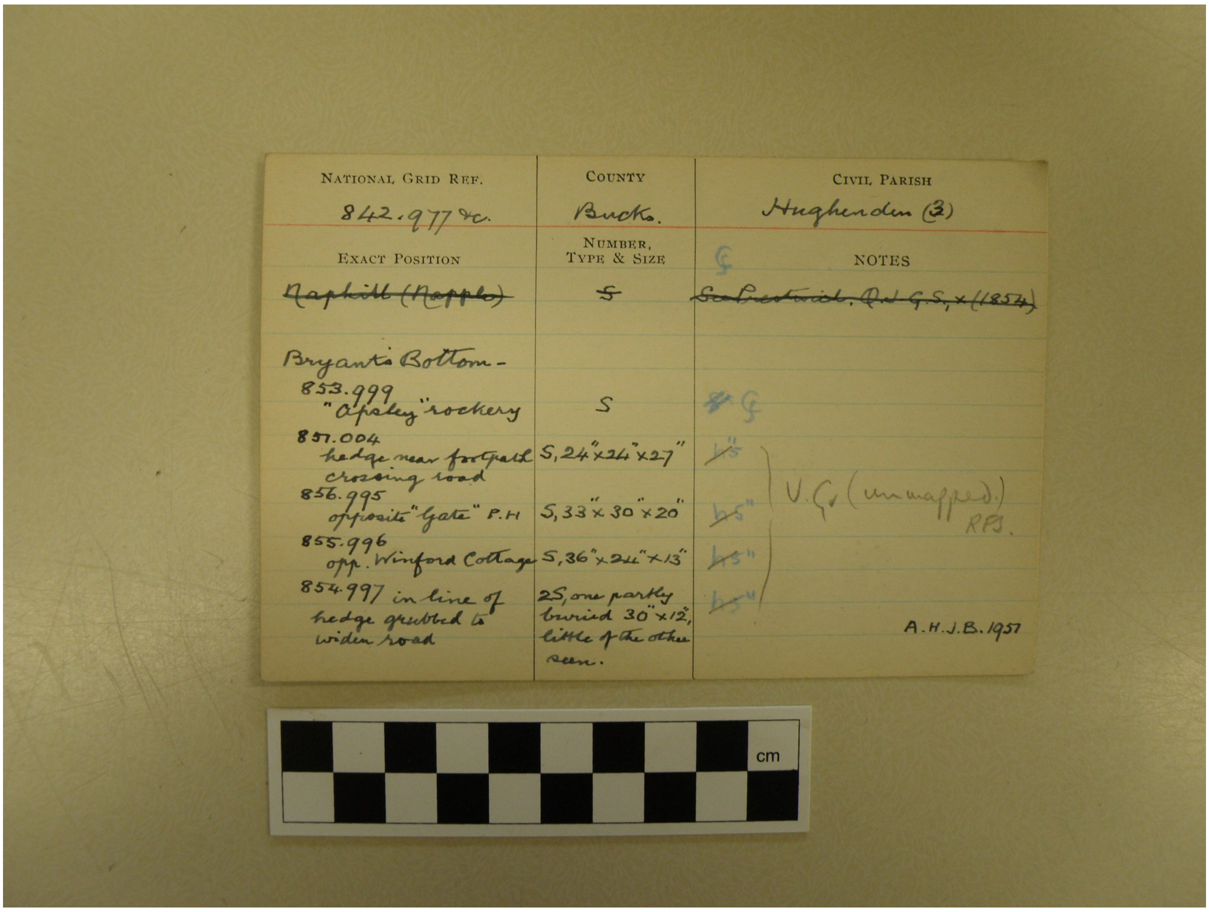
Figure 2 AYBCM:1985.117 Buckinghamshire XXXIVSW



National Grid Ref.	County	Civil Parish
958.973 &c.	Bucks	Amersham (1)

Exact Position	Number, Type & Size	Notes
High St.: Olde Malt Tea-house, about 100 yards E of St Mary's church	S, 65"x33"x9" + & 8 smaller HP, 36"x16"x22" & 2 smaller SHP, 22"x15"x15" + another BP, 24"x15"x16" SBP, 28"x18"x9" + 1 or 2 smaller	pebbles in bands with some HP pebbles
944.963. Whielden Lane, about 1¼ mile from Amersham town, on Coleshill boundary	SHP, 14"x11"x11"	moved by Mr. Stratton Gurney to "Roorkee", Bell Lane, Amersham A.M.D. 1951-2
952.977. School Lane, opposite junction with Mill Lane	S, 24"x21"x15"	~~A.M.~~ L.D. 1951-~~2~~
955.974. Alley from arch by no. 99 High St.	S, 27"x20"x13"	A.M.D. 1953.

Figure 3 AYBCM:2018.97.1-183 *Amersham 1*

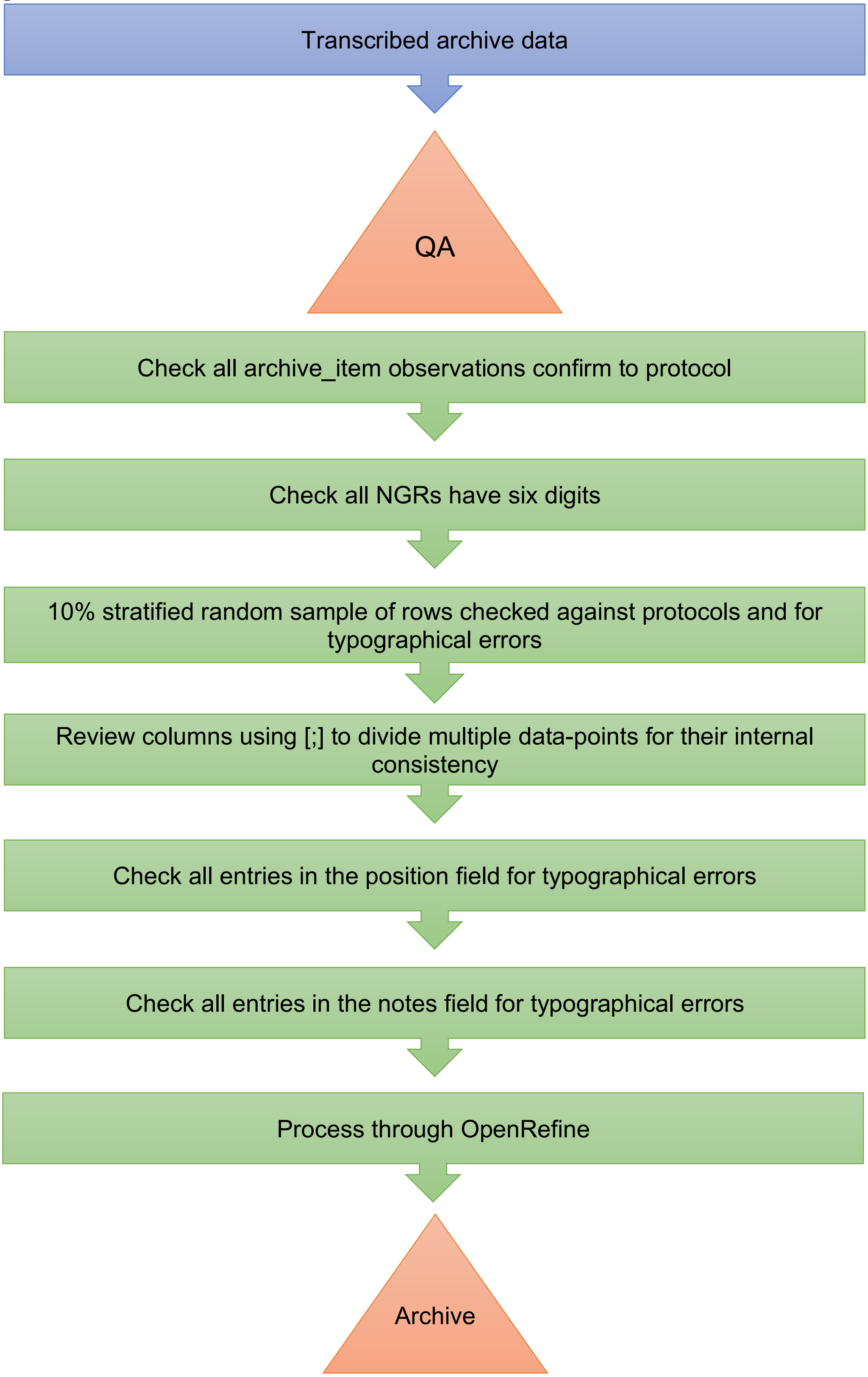


NATIONAL GRID REF.	COUNTY	CIVIL PARISH
842.977 &c.	Bucks.	Hughenden (3)

EXACT POSITION	NUMBER, TYPE & SIZE	G NOTES
~~Naphill (Napple)~~	~~S~~	~~Sa. Priestwick. O. d G. S., x (1854)~~
Bryant's Bottom -		
853.999 "Apsley" rockery	S	G
857.004 hedge near footpath crossing road	S, 24" x 24" x 27"	~~b5"~~ V. G. (unmapped.) RPJ.
856.995 opposite "Gate" P.H	S, 33" x 30" x 20"	~~b5"~~
855.996 opp. Winford Cottage	S, 36" x 24" x 13"	~~b5"~~
854.997 in line of hedge grubbed to widen road	2S, one partly buried 30" x 12", little of the other seen.	~~b5"~~ A.H.J.B. 1957

Figure 4 AYBCM:2018.97.1-183 *Hughenden 3*

Figure 5 QA flowline



References

ANON. 1935. Retirement of Prof. A. Morley Davies. *Nature,* 136**,** 59.

BONNACHI, C., BEVAN, A., PETT, D. & KEINAN-SCHOONBAERT, A. 2015. Crowd- and Community-Fuelled Archaeology. Early results from the Micropasts project. *In:* COSTA, L., DJINDJIAN, F., GILIGNY, P. & MOSCATI, P. (eds.) *Proceedings of the 42nd Annual Conference on Computer Applications and Quantitative Methods in Archaeology, CAA 2014.*

BOWEN, H. C. & SMITH, I. F. 1977. Sarsen Stones in Wessex: the society's first investigations in the Evolution of the Landscape Project. *The Antiquaries Journal,* 57**,** 185-196.

BUCHANAN, R. A. 1969. The National Record of Industrial Monuments. *In:* COSSONS, N. & HUDSON, K. (eds.) *Industrial Archaeologists' Guide 1969-70.* Newton Abbot: David and Charles.

BUCHANAN, R. A. 1971. The National Record of Industrial Monuments. *In:* COSSONS, N. & HUDSON, K. (eds.) *Industrial Archaeologists' Guide.* Newton Abbot: David and Charles.

CARTER, P. 13 July 2018. *RE: BGS Memoirs, sheet explanations Old and New Series.* Pers. comm. to WHITAKER, K.

DERRY, B. J. 2003. Arnold H.J. Baines, 1921-2001. *The Statistician,* 52**,** 101-4.

DRUCE, G. C. 1926. *Flora of Buckinghamshire,* Arbroath, T. Buncle and Co.

FITZ-GERALD, R. J. 2012. *End of Project Report: National Record of Industrial Monuments (NRIM)*. Swindon: English Heritage (internal report).

GUIDEN, N. 2011. *National Record of Industrial Monuments project design.* Swindon: English Heritage (internal report).

HUGGETT, J. & LONGSTAFFE, F. J. 2016. A brief account of new petrographic and isotopic insights into the Hertfordshire and Buckinghamshire Puddingstones of SE England. *Proceedings of the Geologists' Association,* 127**,** 327-336.

KEARNEY, N. & WALLIS, E. 2015. Transcribing between the lines: crowd-sourcing historic data collection. *Museums and the Web Asia 2015.* Melbourne, Australia.

MARWICK, B., D'ALPOIM GUEDES, J., BARTON, C. M., BATES, L. A., BAXTER, M., BEVAN, A., BOLLWERK, E. A., BOCINSKY, R. K., BRUGHMANS, T., CARTER, A. K., CONRAD, C., CONTRERAS, D. A., COSTA, S., CREMA, E. R., DAGGETT, A., DAVIES, B., DRAKE, B. L., DYE, T. S., FRANCE, P., FULLAGAR, R., GIUSTI, D., GRAHAM, S., HARRIS, M. D., HAWKS, J.,

HEATH, S., HUFFER, D., KANSA, E. K., KANSA, S. W., MADSEN, M. E., MELCHER, J., NEGRE, J., NEIMAN, F. D., OPITZ, R., ORTON, D. C., PRZYSTUPA, P., RAVIELE, M., RIEL-SALVATORE, J., RIRIS, P., ROMANOWSKA, I., SMITH, J., STRUPLER, N., ULLAH, I. I., VAN VLACK, H. G., VANVALKENBURGH, N., WATRALL, E. C., WEBSTER, C., WELLS, J., WINTERS, J. & WREN, C. D. 2017. Open Science in Archaeology. *The SAA Archaeological Record,* 17**,** 8-14.

MORIGI, A. N., WOODS, M. A., REEVES, J. J., SMITH, N. J. P. & MARKE, R. J. 2005. *Geology of the Beaconsfield district - a brief explanation of the geological map.* Keyworth: British Geological Survey.

MORLEY DAVIES, A. & BAINES, A. H. J. 1953. A preliminary survey of the sarsen and puddingstone blocks of the Chilterns. *Proceedings of the Geologists' Association,* 64**,** 1-9.

MORRIS, J. 1867. On the Ferruginous Sands of Buckinghamshire, with Remarks on the Distribution of the Equivalent Strata. *Geological Magazine,* 4**,** 456-462.

NASH, D. J. & ULLYOTT, J. S. 2007. Silcrete. *In:* NASH, D. J. & MCLAREN, S. J. (eds.) *Geochemical Sediments and Landscapes.* Oxford: Blackwell Publishing.

SOCIETY OF ANTIQUARIES OF LONDON 1975. Sarsen Symposium. Evolution of the Landscape Project: News Sheet No. 2 (10 May 1975), Historic England Archive SOA03/03.

ULLYOTT, J. S., NASH, D. J., WHITEMAN, C. A. & MORTIMORE, R. N. 2004. Distribution, petrology and mode of development of silcretes (sarsens and puddingstones) on the eastern South Downs, UK. *Earth Surface Processes and Landforms,* 29**,** 1509-1539.

WEXLER, J. 13 August, 5 September 2017. *RE: Bronze Age Index.* Pers.comm. to WHITAKER, K.

WHITAKER, K. 2018a. Sarsen Stones in Wessex Project transcription protocols. (unpublished report).

WHITAKER, K. 2018b. The Chilterns Sarsen and Puddingstone Survey: Archive Report and ISAD(G) Fonds Level Description. (unpublished report).

Marden henge excavations (2010) and Vale of Pewsey Project excavations (2015, 2016)

Sarsen stone report

Katy Whitaker

This document was authored during a *South, West, and Wales Doctoral Training Partnership* studentship held at the University of Reading, and is supported by the Arts and Humanities Research Council grant number AH:L503939:1.

Sarsen stone: Marden henge excavations 2010 and Vale of Pewsey Project seasons 2015 and 2016

1 INTRODUCTION and METHODOLOGY

In total, 107 pieces of sarsen stone were excavated during the 2010 excavation at Marden henge, with 396 pieces excavated during the Vale of Pewsey project 2015 season and 399 during the 2016 season. The majority of pieces show signs of having been burnt, through their combination of colouration, cracking, and high angularity. Twenty-one items are confidently or tentatively identified as worked artefacts; most of these had not been identified and allocated small finds numbers in the field. Fragments of other sarsen tools may be present, but rendered unrecognisable by the loss of their shaped and worked surface. In addition to the majority of broken pieces of stone, there are a few unworked cobbles and small boulders from various contexts.

	count
Total sarsen pieces	901
Burnt pieces	707
Total weight	125,572g
Weight range*	1g – 17,000g
Natural cobbles	11
Tools/possible tools	21

Sarsen stone summary
*items <1g were counted separately by context but not recorded in more detail

The key contexts containing the bulk of the assemblage are:

	count	**% of total assemblage**
Midden deposits [93031] [1026] and burnt spread deposits [93003] [1006] [1035] [1038] [2111]	411	45.6%
Marden henge bank contexts [2218] [2224] [2226]	330	36.6%

Items were measured using a pebble box to capture their longest, intermediate and shortest dimensions. The longest measurement of six items was too great to fit into the pebble box and were measured using a hand-tape (2119/001, 4039/001, 7005/001, 7005/002, 8104/001, 92001/001). The following attributes were also recorded: weight (g); roundedness (assessed visually using a standard geological roundedness index); colour (noted twice from opposing faces in reference to a Munsell colour chart, including a corticated face if present); stone type; presence/absence of cortex; cementation (a simple measure of friable/not friable); whether a broken fragment or complete cobble; type, location and degree of use-wear (if present); tool-type (if relevant); characteristics of burning (if present); evidence for percussion (if present). Some pieces were photographed for reference purposes, and free-text notes were made for every piece.

In this analysis form is defined in terms of deviation from equancy using a method developed by Whitaker (2020). Sarsen stone can break sub-conchoidally, but on the whole pieces are chunky and irregular making them difficult to describe and categorise consistently. Neither is terminology derived largely from knapped flint analysis necessarily applicable to non-flint stone. This problem was also noted by Gillings et al. (2008, 319-322) in the analysis of remains of a sarsen standing stone in the Beckhampton Avenue, burnt and broken up in the eighteenth century. Very few of the sarsen pieces of the Vale of Pewsey project display clear signs of mechanical fracture unlike that Beckhampton assemblage. Describing items as ‘flakes’, for example, thus risks implying technical action which does not appear to have been used in the creation of the Vale of Pewsey project assemblage. Calculating a measure for form using Maximum Projection Sphericity and describing items with form factors (Blott and Pye, 2008) avoids a process-based classification of form based on assumptions about mechanical fracture, and deals with the continuum of shapes which are not easily divided into hard and fast classes. Form is discussed in more detail in the sections below.

In addition to the available site code, context number, sample number and small finds number (if allocated), a unique identifier was allocated to each piece of sarsen stone based on the context number followed by a running number (for example, 1006/001). These UIDs mentioned in this report can be related to the complete dataset for any given piece of stone in the accompanying datasheet (Excel workbook). The individual pieces of stone were not, however, marked with these references. Possible tools were set aside in newly-labelled finds bags. The total assemblage includes four unstratified pieces of sarsen stone, two items with small finds numbers for which the contexts need to be clarified (SF603 and SF604), and seven pieces from VOP15 Test Pit 1.

Most of the assemblage comprises saccharoid sarsen (n=884, 98%). The rest of the material is finer-grained more quarzitic sarsen. None is puddingstone, although a few pieces include occasional small to medium flint pebbles, including items 1026/003, 1038/025, 2218/007, unstrat/001, 93025/002 and 93044/003. Item 93016/001 has been classed as conglomerate, standing-out from the rest of the assemblage because it contains approximately 25% by area quartz/flint granules, moderately sorted in the matrix.

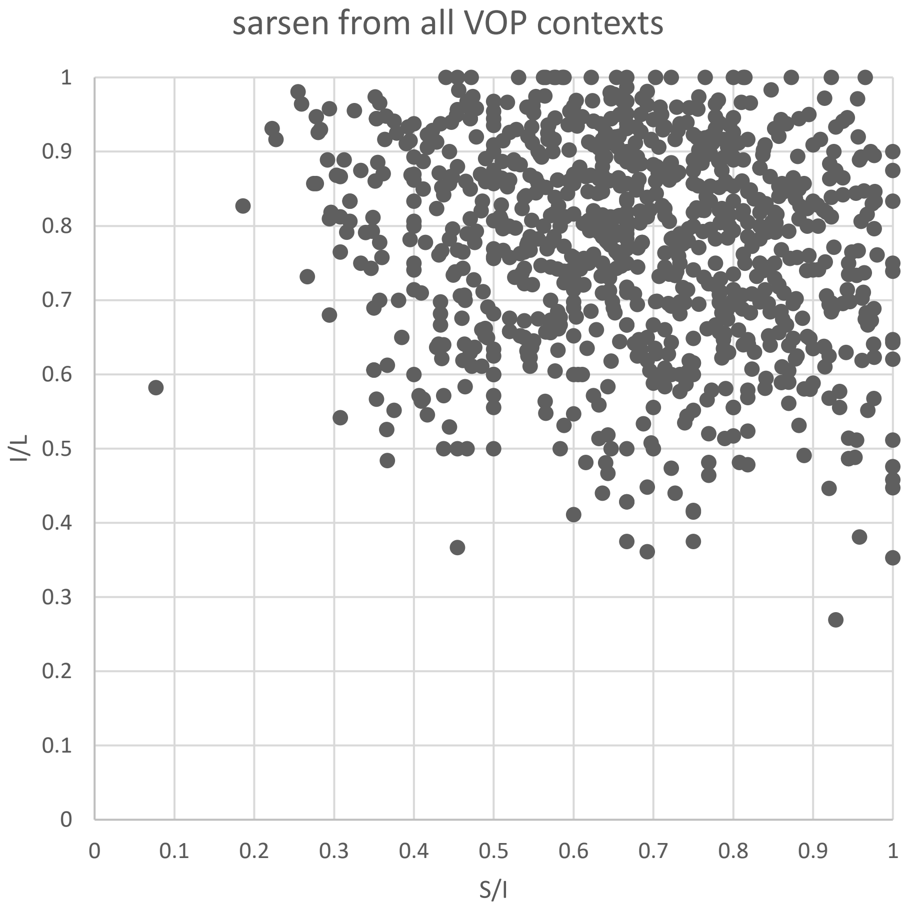


Figure 1 Form of sarsen pieces defined in terms of deviation from equancy using the longest (L), intermediate (I) and shortest (S) dimensions of each piece of stone. X axis is shortest/intermediate dimension, Y axis is intermediate/longest dimension. A fully equant item scores 1:1.

Overall, the sarsen pieces are small and angular. Very few are abraded. The mean weight is 139.5 and modal angularity is angular (n=414, 45.9%). The majority are sub-equant to equant in form (n=520, 57.9%), describing the largely chunky nature of the individual items (**Fig. 1**). The majority of pieces had been burnt (n=707, 78.4%). Burning was identified through a combination of attributes including pink to red colouration, cracking/crazing and sooting. Many of the apparently unburnt pieces which were part of assemblages dominated by stone that showed clear signs of being affected by heat were probably also burnt, given their angularity and small size. For example, context [1006], a burnt spread of dark charcoal-rich material, includes 166 pieces of sarsen which had been burnt but 52 which do not have the colouration or cracking to indicate burning or heat treatment. Those 52 pieces are, however, very angular to sub-angular and on average weigh only 15.3g. They probably derive from heated parent material but did not experience the same intensity or duration of heat as the discoloured and crazed pieces.

2 TOOLS

Type	Count	Datasheet UIDs
Dressed stone	2	2207/002, 2218/042
Hammerstone	2	6054/001, 7004/001
Hammerstone fragment	4	2109/003, 2224/076, 7004/001, 9082/001
Quern/polishing stone fragment	7	1006/010, 1006/028, 2218/024, 2218/052, 2226/001, 9001/002, 93003/011
Rubber fragment	6	1006/003, 1006/038, 2203/007, 2226/002, 7004/002, SF603
Total	**21**	

Sarsen stone tools and tool fragments

2.1 Dressed stone

Two pieces of dressed sarsen were identified from contexts excavated in 2016. One is clearly dressed and worked, the other is less certain.

2218/042, SF613 [2218]

SF613 comprises 145 pieces of sarsen excavated from a secondary fill [2218] of a small oval pit [2219]. Amongst assemblage SF613, a crescentic piece of saccharoid sarsen weighing 79g with some surviving cortex appears to have light pecking to its convex dorsal face. The surface has the dimpled, 'orange-peel' appearance coined by Atkinson (1956, 121) to describe dressed sarsen surfaces at Stonehenge. The effect is slight, however, and could perhaps have arisen from the loss of grains from the surface by weathering; the stone's pale red colour and cracking suggests that it was burnt, rendering it more susceptible to later weathering.

2207/002, SF606 [2207]

SF606 is a piece of dressed and worked light grey saccharoid sarsen weighing 1,706g. This sub-rectangular block of sarsen (164mm x 112mm x 73mm) includes a very flat dressed surface. It has concave flake scars to three sides and the fourth side is also straight and relatively flat, but its broken surface is unworked. It has a pecked convex face opposite the dressed surface.

The flat dressed surface has been pecked and ground. In some areas the pecking cuts through the smoothed ground surface, whilst others of the small sub-circular depressions left by pecking appear to be smaller in diameter with slightly over-work edges where they have been over-worn by grinding. Two areas are especially smooth to the touch and appear glossy under low-power magnification. This flat dressed surface is not at all dished. The working extends to the edges of the face and is interrupted by the broken sides. A crack extends from one corner into the body of the stone, possibly the result of an impact. The crack is over-worked.

Three flaked sides are scarred by concave removals. Slight sub-parallel cracks in the edges of the flat dressed surface indicate likely points of percussion, where crushing damage was caused and dissipated force affected the stone to the side of impact points. The flake scars extend fully to the opposite side of the stone. There is no obvious impact point to suggest how the straight unworked side was broken. This side is very close to a 90°angle to the flat dressed surface.

The face opposite the flat dressed surface is irregular and convex. Its central area is pecked but not ground. The pecking had the effect of slightly levelling-off the convex form, flattening it perhaps for stability or to reduce the stone to a more even thickness. Alternatively, the pecking may have been intended to make this item easier to hold. The pecking falls within, but close to, the limits of the distal ends of the side flake scars. In addition to the large crack extending from one corner, the face is interrupted by a smaller, finer crack in the middle of the straight unworked broken side. The pecking extends over these cracks.

The overall sequence resulting in its final form is not precisely clear. The stone appears to have been part of a larger item, one face of which had a repeatedly pecked and ground surface. That item was split at least in two, one piece of which was then flaked on three sides. The pecking on the face opposite to the flat dressed surface could have pre-dated the break, or been applied later to shape the smaller derived piece.

Examples of dressed sarsen include many of the shaped upright stones forming Stonehenge’s late Neolithic trilithons and lintelled circle (Abbott and Anderson-Whymark, 2012) and an orthostat with a partially-dressed face in an undated stone-hole [601] at Mile Oak Farm (Sussex) (Rudling, 2002, section 2/14-15). Those are, however, much more substantial pieces of stone. SF606 is similar in size and form to the sarsen grain rubber found amongst packing material [2416] from post-hole [2404] at Downsview Area I (Coldean Lane, Sussex), a D-sectioned piece of sarsen with one flat face, measuring approximately 13cm wide and 6cm thick and weighing 2,100g (Rudling, 2002, 187-8). Three other pieces of sarsen stone from Bronze Age contexts of the Downsview excavation also exhibit flat smoothed surfaces and were interpreted as grain rubber fragments.

SF606 was derived from a larger parent piece of stone, its dressed surface interrupted by the broken sides. It is impossible to judge the size of the original piece. Nevertheless, it is similar in thickness to complete sarsen saddle querns excavated from sites of various periods. In Wiltshire, examples include a 70mm-thick Iron Age saddle quern from All Cannings Cross Farm (Wiltshire Museum DZSWS:2006.1.2840), and an undated quern in two pieces, also 70mm thick, recovered from Westbury Iron Works (Wiltshire Museum DZSWS:715). Saddle quern 409 from the late Bronze Age enclosure site at Carshalton (Surrey) was approximately 7cm thick (Adkins and Needham, 1985, 38-9). Two sarsen saddle querns from Bronze Age contexts pre-dating 1350 BC at Flag Fen (Peterborough) were more substantial, each measuring 190mm and 100mm thick and both with roughly finished convex undersides (Pryor, 2001, 322-3).

Bearing these comparisons in mind, it is possible that SF606 represents a broken piece of sarsen saddle quern. The pecking to the face opposite to the flat ground surface may have contributed to shaping the quern, making it easier to use on the ground, or to shaping a secondary tool to be used in hand. It is possible that work to the underside of the quern, or re-dressing to the quern’s grinding surface, may have caused the damage that resulted in the straight broken side; sarsen can be broken cleanly in this way solely through percussive strokes in a line made with a hammer (Sam McArthur pers. comm.). It may be instructive to make comparisons with other similar objects, such as the 5.3cm-thick sarsen saddle quern fragment collected with other surface finds from an Iron Age enclosure on Pewsey Hill, interpreted as having been re-used to make a rubber (Thompson, 1971, 66, 69).

2.2 Hammerstones

2109/003, [2109]

A grey to light grey sarsen cobble with evidence of use as a hammerstone on one face. The cobble weighs 1,797g. It is a fine-grained sarsen, possibly more quarzitic than saccharoid. One broad flat face is a clean break oriented along the lines of further sub-parallel cracks that can be seen in the sides of the stone; it is likely that the cobble fractured during use along this plane. This has resulted in the hammerstone’s oblate spheroid form, from what was originally a thicker, heavier cobble. A further fracture occurred on one corner, removing a roughly triangular piece of stone. In an opposite corner, a crack running partially along a fault inside the cobble suggests that hammering forces during use encouraged natural internal weaknesses to fail. One curved side has been rounded and smoothed through use, whilst the other sides present unworked fractured surfaces. The curved face includes some crushing damage but this is well-smoothed. The smoothed surface is interrupted in two places by damage caused by light pecking.

2224/076, SF614 [2224]

SF614 comprises 144 pieces of sarsen excavated from the primary fill [2224] of a small oval pit [2219]. Amongst assemblage SF614 is a piece of light grey to grey saccharoid sarsen weighing 136g. The small (80mm x 65mm x 33mm) item has some cortex remaining on its rough convex outer face. Cracks in the stone indicate that it had been burnt. Sub-parallel cracks and battering damage to one edge suggest that this is a hammerstone fragment.

6054/001, SF307 [6054]

SF307 is a light grey fine-grained sarsen cobble weighing 516g. It is oblate spheroid in form, being considerably thinner than it is long and wide, with cortex to the unbroken surfaces. There may be light crushing damage to one corner but the slight sub-parallel cracks visible with a hand-lens are not definitive. The sides opposing this corner are each formed of scars, perhaps where flakes were struck from the parent cobble during use as a hammer. No clear impact points are visible, however. Identified as a possible hammerstone.

7004/001, [7004]

A very pale piece of fine-grained, quarzitic sarsen weighing 750g. The sub-rounded, sub-equant spheroid form arises from a combination of naturally rounded edges and fractured surfaces. There is a small area of cracking on a facet consistent with wear caused by battering. The other fractured surfaces do not have clear impact points and may not be the result of use as a tool. Identified as a possible hammerstone.

9008/001, [9008]

This very pale brown to white sub-equant spheroid piece of saccharoid sarsen stone weighs 270g. Sub-parallel cracks in its rounded edge could be from battering. It is possibly a hammerstone fragment, but it was recovered from subsoil and the damage may have arisen from tumbling during cultivation.

9082/001, SF504 [9082]

SF504 is a greyish-brown to light grey finer-grained sarsen cobble weighing 1,526g. It was recovered from the natural gravel deposit [9082] in the area of the main henge south-eastern entrance. Like SF 307 it is oblate spheroid in form, being considerably thinner than it is long and wide. The original surface of the stone survives on unbroken faces, but some of the cobble’s faces are the result of angular splits. There are battering damage and spall scars to opposite ends of the cobble. Damage to one of these points is more substantial, and is the source of a split which broke a part of the parent cobble away. Faults in the stone are visible on the surface, and it is likely that use as a hammerstone caused one or more to propagate cracks. There is no clear evidence that the angular ridges created by this damage were then used as hammer points. Identified as a partial hammerstone.

The sarsen assemblage includes only two hammerstones and four possible hammerstone fragments. This is a surprisingly low number given the utility of this locally-available hard stone for a range of percussive tasks in prehistoric contexts. It may be due in part to the condition of the sarsen stone overall. It is notable that none of the broken stone fragments in the sarsen assemblage are especially large, and many display signs of having been burnt. Clearly there had been extensive destruction, affecting the form, size and surfaces of what may have been tools but which cannot now be identified.

Despite this small number, it is possible to make a comparison with other sarsen hammerstones/partial hammerstones which have been recorded in similar detail, excavated from Trench 44 opened just outside of Stonehenge by the Stonehenge Riverside Project (Whitaker, 2020). There, a similar collecting strategy to that used during the Vale of Pewsey project resulted in both complete and fragmentary tools being collected.

The majority of the 88 Trench 44 hammerstones recorded in that analysis were quarzitic sarsen, whilst the Marden examples are equally divided between quarzitic sarsen and saccharoid sarsen. The majority of Trench 44 complete hammerstones were oblate spheroid in form (n=38, 43%), or sub-equant spheroids (n=28, 32%). The two complete hammerstones from Marden are also oblate spheroid and sub-equant spheroid in form and have similar battering and grinding damage to each piece, as the Trench 44 assemblage. The form of the majority of the broken hammerstone pieces from Trench 44 was also relatively equant, but with a greater variety amongst the remainder including 16 (24%) more platy and elongate examples, as is one of the hammerstone pieces from Marden (2224/076). Although it is difficult to draw firm conclusions from such a small assemblage, the Marden hammerstones are broadly similar to the Neolithic examples from Trench 44.

2.3 Querns/polishers

1006/010, [1006] <7>

A very small sub-equant block of light grey to grey saccharoid sarsen weighing 10g. Its angularity and cracks in the stone suggest that it has been burnt. One face is very smooth to the touch with a cortex-like appearance and under low magnification crescentic micro-cracks are visible in the surface (although their definition is not as clear as the micro-cracks in the surface of the rubber fragment from context [7004]). The piece is tentatively identified as a fragment of a quern or polishing stone.

1006/028, [1006] <27>

A very small, angular piece of grey saccharoid sarsen weighing 4g. This is a flake-like piece of stone, although it does not have a platform or crushing to indicate that it was purposefully removed. It does not have characteristic features of burning or heat treatment. Two of its faces are very smooth to the touch with a cortex-like appearance. Extending over adjacent faces, this surface would appear to be natural in origin. The larger area of this ‘cortex’ is, however, slightly convex in form and very glossy under low magnification. On this basis the piece is tentatively identified as a fragment of a quern or polishing stone.

2218/024, [2218] SF613

SF613 comprises 145 pieces of sarsen excavated from a secondary fill [2218] of a small oval pit [2219]. A small sub-equant block of pinkish grey to pale red saccharoid sarsen stone from the assemblage, weighing 42g, is very tentatively identified as part of a quern or polishing stone. One small face has a flat smooth surface. Under low magnification the sand grains appear cut and ground and there is possibly one crescentic micro-crack in the surface. The angularity and colouration suggest that the stone had been burnt.

2218/052, [2218] SF613

A small sub-equant spheroid of grey saccharoid sarsen stone weighing 72g. Fine cracks through the stone suggest that it has been burnt. One slightly dished face appears to be lightly pecked, but the indentations on the surface are very small. This surface does not give the impression of having been ground or polished, but the topography overall is even. Very tentatively identified as a possible quern fragment on the basis of the dishing of the face.

2226/001, [2226] SF615

SF615 comprises 41 pieces of sarsen excavated from fill [2226] of a shallow oval pit [2227]. Amongst assemblage SF615 is a small sub-equant block of pinkish grey to light pink saccharoid sarsen stone weighing 12g. The colouration and angularity of the piece suggest that it had been burnt. One level face is very smooth to the touch. Under low magnification the sand grains in this surface appear cut back and glossy (although no striations were visible under the available magnification). There are crescentic micro-cracks in the surface. Additionally, there is part of a possible impact point on this surface on one edge, where the face is damaged in a half-oval shape and the purple colour of sand grains below shows through. Possibly part of a quern or polishing stone.

9001/002, [9001*]

A small light brownish grey to light pink equant block of saccharoid sarsen stone weighing 12g. The angularity and colouration of this cracked and crazed piece suggests that it had been burnt. It has one smooth, dished face contrasting strongly with the other rough, irregular broken surfaces. Under low magnification the smooth surface is less regular than for example 2226/002 and there are voids where sand grains have been lost. Possibly a small piece of quern or polishing stone.
*this number is void according to the context register.

93003/011, [93003]

A small pinkish grey to weak red piece of saccharoid sarsen stone weighing 13g. The angularity and colouration of this small piece suggests that it had been burnt. It includes one very small flat face contrasting strongly with the other broken surfaces. Under magnification the topography of the flat face is irregular, where grains are missing. It is not highly smoothed. Its tentative identification as possibly a piece of quern or polishing stone is on the basis of how regular the flat surface is.

The seven possible quern or polishing stone fragments are all small pieces. Without examination under higher magnification this identification remains largely speculative on the basis of macroscopic properties. Thus far, direct comparison with other complete and fragmentary sarsen querns to resolve uncertainty has not been possible due to COVID-19 restrictions on museum visits. This also applies to the fragments of possible rubber or top stones.

2.4 Rubbers/top stones

1006/003, [1006] <7>

This very small sub-equant block of pinkish grey to reddish grey saccharoid sarsen stone weighs 4g. Its colouration suggests that it has been burnt. One slightly convex face is very smooth to the touch with a cortex-like appearance. Under low magnification the pink sand grains in that surface are visually distinct from the pale grey matrix as though worn or cut back as the result of grinding. Very tentatively identified as a possible rubber or top stone fragment.

1006/038, [1006] <27>

This very small sub-equant block of light grey to grey saccharoid sarsen stone weighs 14g. One slightly convex face is similar in smoothness and colour to 7004/002 and is very tentatively identified as a possible rubber or top stone fragment.

nnnn/nnn, [nnnn] SF603

SF603 is a very small piece of pale red to pinkish grey saccharoid sarsen. The colouration and angularity suggest that it has been burnt. Weighing only 2g, this angular elongate block includes one smooth, glossy face. That face is not perfectly flat, but under low magnification similar crescentic micro-cracks to those visible on 7004/002 are visible. Very tentatively identified as a possible rubber or top stone fragment.

2203/007, [2203] SF612

SF612 comprises 19 pieces of sarsen excavated from layer [2203] forming bank material of the main henge. Amongst assemblage SF612 is a small sub-equant block of pinkish grey to reddish grey saccharoid sarsen stone weighing 28g. Its colouration, cracks in the stone and angularity suggest that it has been burnt. One slightly convex face is very smooth to the touch with a cortex-like appearance. Under low magnification the sand grains in that surface are visually distinct from the pale grey matrix as though worn or cut back as the result of grinding. The surface topography is slightly irregular, which may be the result of old pecking damage which has been largely smoothed out; alternatively, this may be a natural rind or cortex. Very tentatively identified as a possible rubber or top stone fragment.

2226/002, [2226] SF615

SF615 comprises 41 pieces of sarsen excavated from the fill [2226] of a shallow oval pit [2227]. Amongst assemblage SF615 is a light grey sub-equant spheroid of saccharoid sarsen stone weighing 92g. The pink tinge to sand grains visible in the surfaces and cracking throughout the piece suggest that it had been burnt. One smooth face is slightly convex and includes crescentic micro-cracks in the surface (although far fewer than are visible in 2226/001). Overall this surface is not as smooth as that on 2226/001, but is similarly glossy. Possibly part of a rubbing stone.

7004/002, [7004]

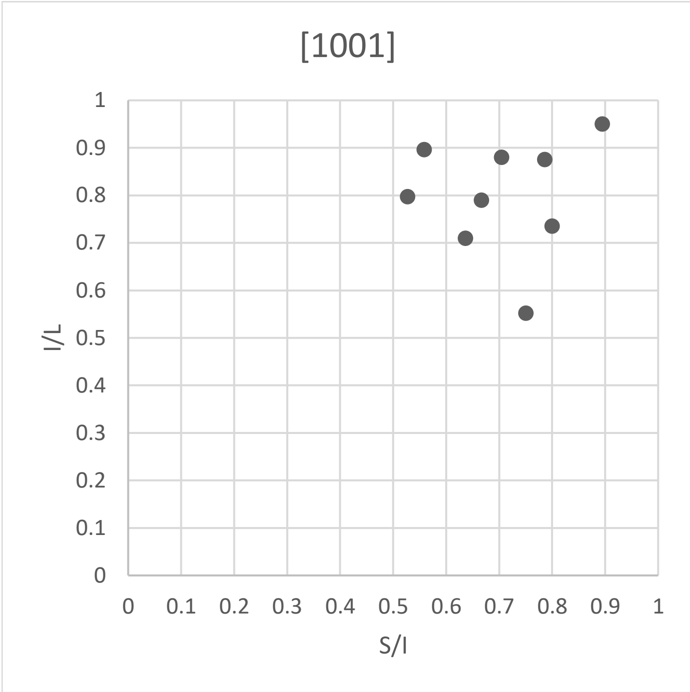
A fragment of a formerly oval tool, possibly a rubber or top stone. What remains is an equant block of pinkish grey to pale grey saccharoid sarsen stone weighing 154g. The colouration and cracks in the stone suggest that it has been burnt. The opposing convex ground surfaces are very smooth to the touch (although no directional striations were visible under the available magnification). A possible narrow root hole runs from one side to the other, visible in a broken face, indicating a point of weakness in the stone along which one of the breaks occurred. Slight damage to the last remaining area of the tool's circumference suggests that it had been lightly used for pecking or hammering.

A similar uncertainty around the identification of quern pieces applies to the fragments of possible rubber or top stones, which should be examined under higher magnification and compared with items from other collections. 7004/002 is the strongest candidate as a top stone used in association with a quern because of its formerly oval form and highly regular and smooth convex opposing faces. The slight pecking damage to the remaining area of its circumference may have come from using the stone to re-dress a grinding surface.

3 CONTEXT SUMMARIES

3.1 Trench A [1001], Modern phase

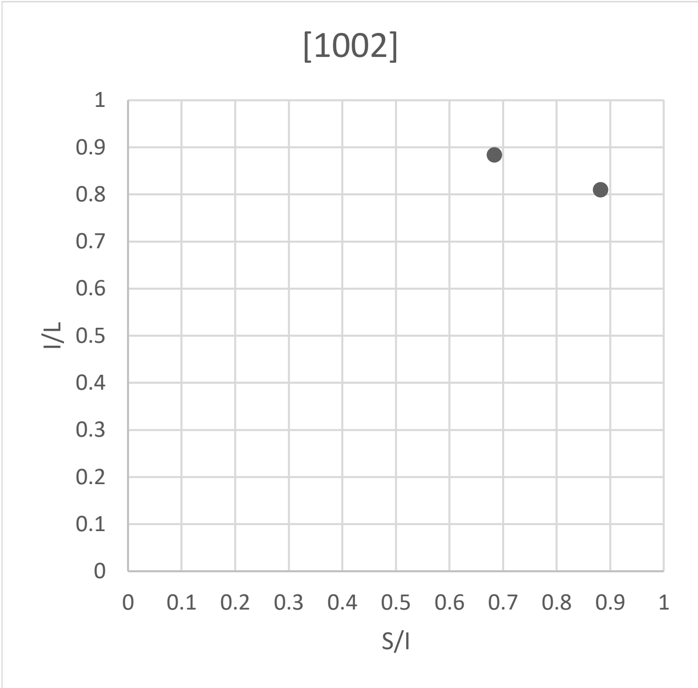
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
5	4	0
Completeness		
Fragment	**Complete**	
9	0	
Cortex		
Absent	**Present**	
3	6	
Burning		
Unburnt	**Burnt**	
1	8	
Weight (g)		
Total	**Mean**	**Range**
251	27.9	2 - 82



Nine pieces of sarsen stone were recovered from the topsoil and subsoil in Trench A. These very angular to sub-angular pieces are relatively equant in form. Four pieces re-fit to one another; their very clean, un-abraded breaks suggest that one burnt piece had been collected on site and its cracks failed later during transport or storage.

3.2 Trench A** [1002], Modern phase

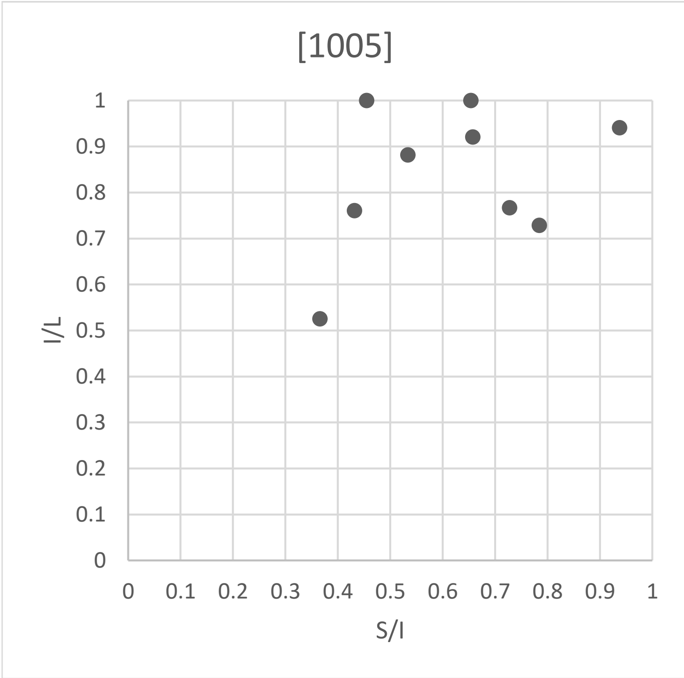
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
2	0	0
Completeness		
Fragment	**Complete**	
2	0	
Cortex		
Absent	**Present**	
2	0	
Burning		
Unburnt	**Burnt**	
0	2	
Weight (g)		
Total	**Mean**	**Range**
39	19.5	4 - 35



Two pieces of burnt sarsen stone were recovered from backfill to the 2010 season excavation trench. These angular pieces are relatively equant in form.

3.3 Trench A [1005], Phase 4 (Neolithic, main enclosure phase)

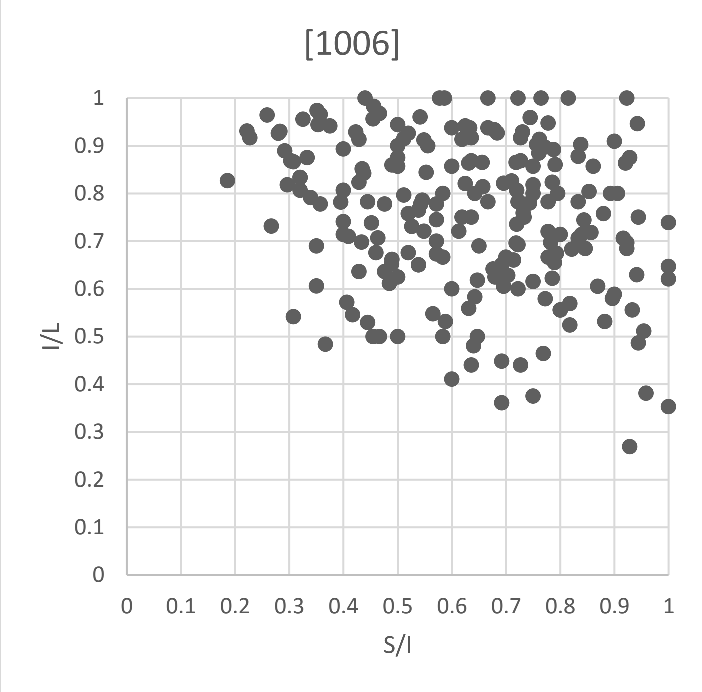
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
10	0	0
Completeness		
Fragment	**Complete**	
10	0	
Cortex		
Absent	**Present**	
6	0	
Burning		
Unburnt	**Burnt**	
1	9	
Weight (g)		
Total	**Mean**	**Range**
670	67.0	5 - 300



Ten small pieces of sarsen stone were recovered from the backfill to the sunken floor of the building over which the inner henge was built. These very angular to sub-angular pieces are relatively flat to equant in form, including one flake and one flake-like piece (one mis-measured piece is not shown on the scattergraph).

3.4 Trench A [1006], Phase 3b (Neolithic, burnt spread)

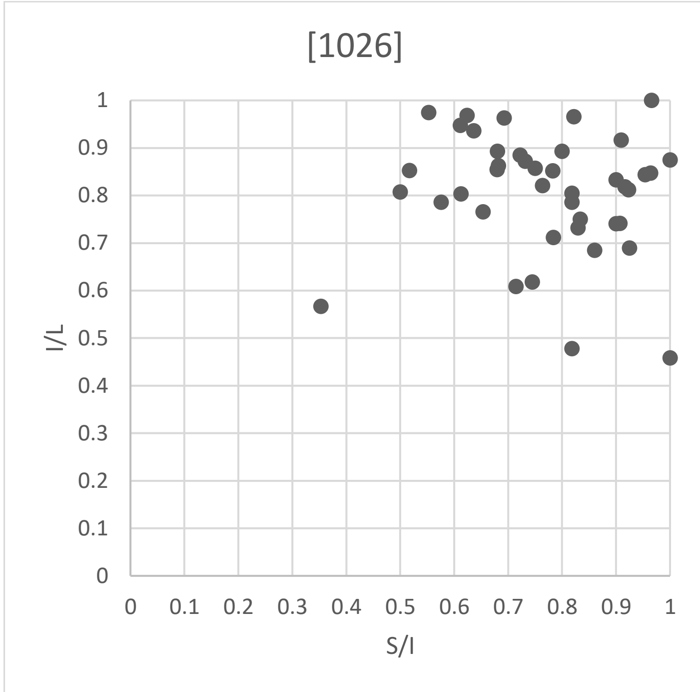
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
218*	0	0
Completeness		
Fragment	**Complete**	
218	0	
Cortex		
Absent	**Present**	
156	62	
Burning		
Unburnt	**Burnt**	
52	166	
Weight (g)		
Total	**Mean**	**Range**
3910	17.9	1 - 109



218 pieces of sarsen, including two pieces of possible quern/polisher and two pieces of possible rubber, were recovered from the burnt spread to the north-east side of the floor surface below the inner henge. 52 items did not exhibit the colouration or cracking to be expected from burning, but their high angularity and association with burnt pieces suggests that they too resulted from the same process. Although tending to be relatively equant in form, the assemblage includes numerous crescentic flake-like pieces which fall into more platy and elongate form classes. Only one, however, is a flake with a platform. The majority of the flake-like pieces are likely to have resulted from exfoliation due to temperature change. *and 51 small pieces <1g, unrecorded.

3.5 Trench A [1026], Phase 3b (Neolithic, midden deposit)

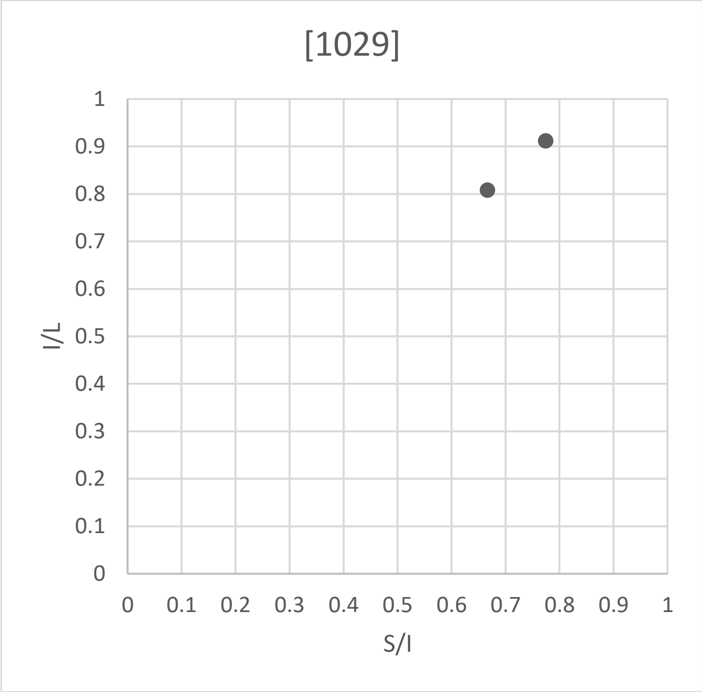
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
43*	0	0
Completeness		
Fragment	**Complete**	
43	0	
Cortex		
Absent	**Present**	
27	16	
Burning		
Unburnt	**Burnt**	
6	37	
Weight (g)		
Total	**Mean**	**Range**
3735	86.9	1 - 1277



Context [1026] includes 43 very angular to sub-rounded pieces of broken sarsen, the majority of which had been burnt. They are relatively equant in form except for a few more elongate pieces, although none of those are flakes caused by percussion and include only one flake-like piece (one mis-measured piece is not shown on the scattergraph). Item 1026/002 is the largest piece in the assemblage. Its mottled reddish grey to light grey colouration matches that of other pieces in the assemblage, suggesting that much of the material comes from one parent boulder. Eight pieces re-fit in three groups, and although they do not re-fit items 1026/026-028 are also very similar, suggesting that overall the 43 pieces are derived from a relatively small number of original cobbles. *and 4 small pieces <1g, unrecorded

3.6 Trench A [1029], Phase 3a (Neolithic settlement, building stakehole)

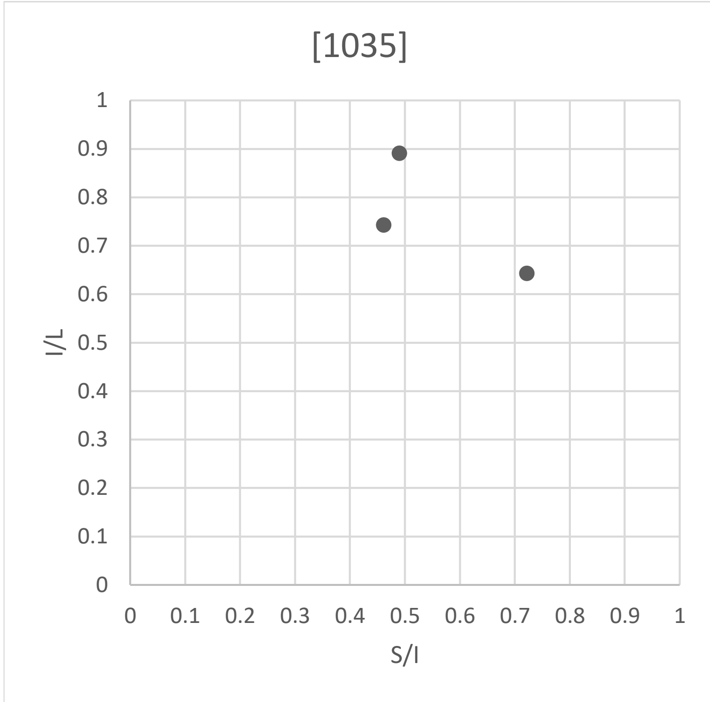
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
4	0	0
Completeness		
Fragment	**Complete**	
4	0	
Cortex		
Absent	**Present**	
4	0	
Burning		
Unburnt	**Burnt**	
4	0	
Weight (g)		
Total	**Mean**	**Range**
112	28	11 - 62



Four small pieces of broken saccharoid sarsen were found in the charcoal-rich fill [1029] of building stakehole [1033]. Two are relatively equant in form (two mis-measured pieces are not shown on the scattergraph). They had all been burnt. Items 1029/001-003 have similar colouration and although they do not re-fit they may have come from the same parent cobble. As it seems that the building walls had been demolished prior to the creation of the midden deposits [1026] and [1080], and [1026] includes considerable quantities of burnt broken sarsen, it is likely that the stone in [1029] was derived from the midden episode.

3.7 Trench A [1035], Phase 3b (Neolithic, burnt spread)

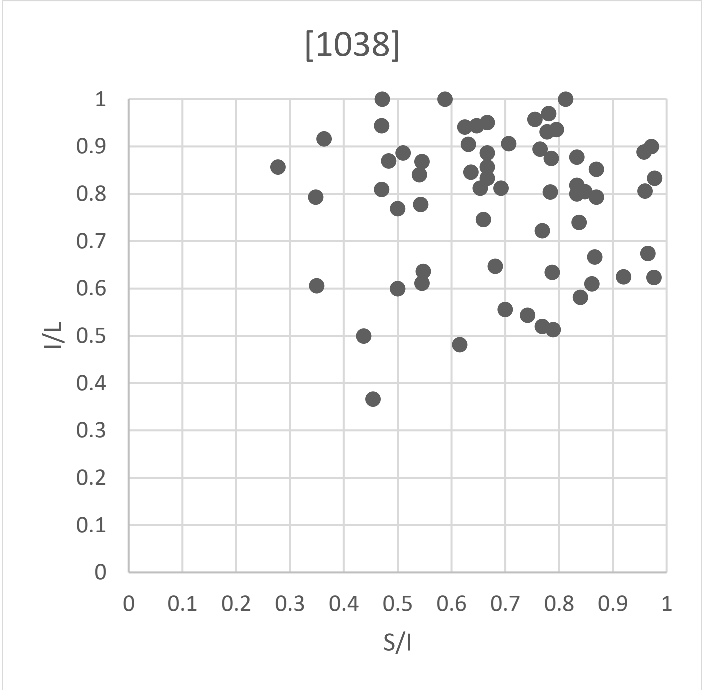
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
3	0	0
Completeness		
Fragment	**Complete**	
3	0	
Cortex		
Absent	**Present**	
3	0	
Burning		
Unburnt	**Burnt**	
0	3	
Weight (g)		
Total	**Mean**	**Range**
78	26	6 - 65



Context [1035] is a remnant of [1006], the burnt spread to the north-east side of the floor surface which was built over when the inner henge was constructed. The three sarsen pieces from [1035] fit the profile of the larger assemblage from [1006].

3.8 Trench A [1038], Phase 3b (Neolithic, burnt spread)

Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
65*	0	0
Completeness		
Fragment	**Complete**	
65	0	
Cortex		
Absent	**Present**	
54	11	
Burning		
Unburnt	**Burnt**	
11	54	
Weight (g)		
Total	**Mean**	**Range**
1952	30.0	1 - 158

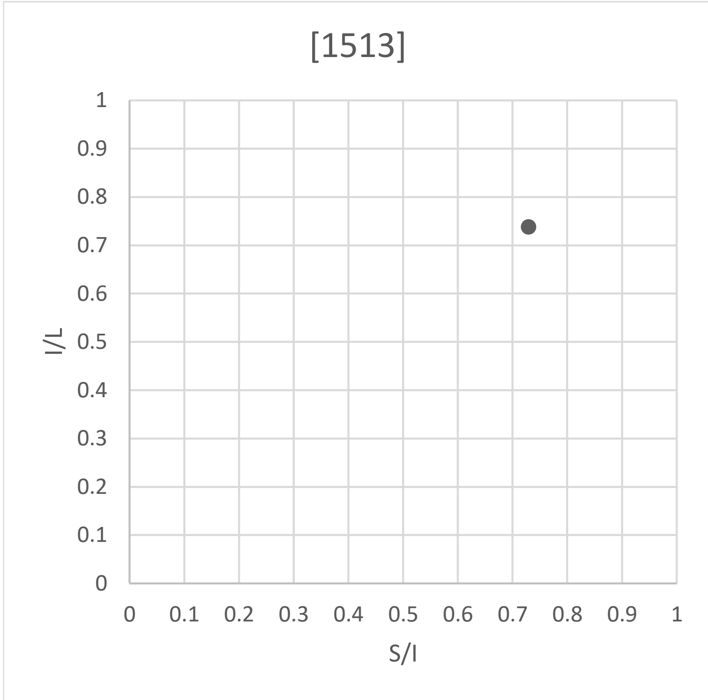


Context [1038] is a remnant of [1006], the burnt spread to the north-east side of the floor surface which was built over when the inner henge was constructed. The 65 very angular to sub-angular sarsen pieces from [1038] fit the profile of the larger assemblage from [1006]. Similarities in colouration between pieces from [1038] suggest that there may be re-fits in the assemblage, although none were observed in the time available to record the material. Four small flakes with platform-like proximal ends may have been removed by percussion, but other flake-like pieces did not have platforms or crushing to indicate that they had been struck. On the whole, it is likely that the small crescentic pieces from the context exfoliated from parent cobbles as a result of temperature change.

*and 10 small pieces <1g, unrecorded

3.9 Trench A** [1513], Phase 4 (Neolithic, main enclosure, inner henge construction)

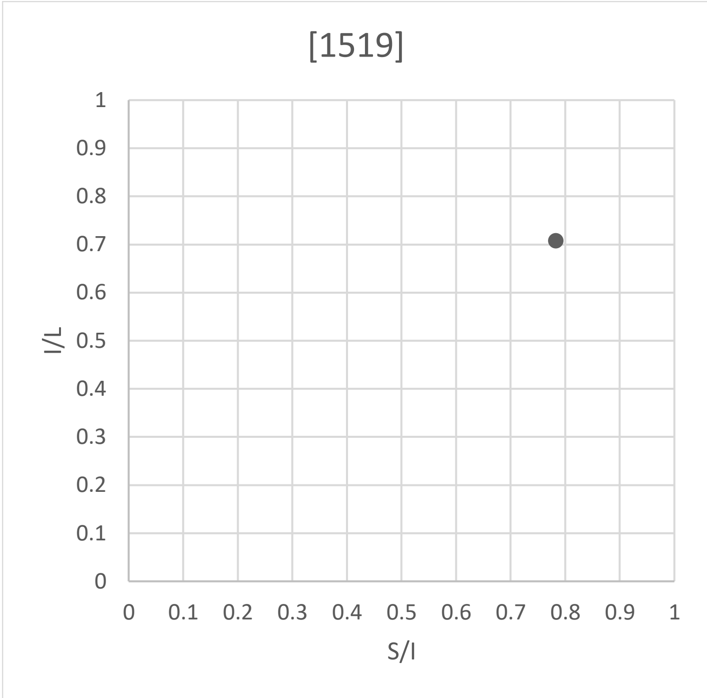
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
0	1	0
Completeness		
Fragment	**Complete**	
1	0	
Cortex		
Absent	**Present**	
0	1	
Burning		
Unburnt	**Burnt**	
1	0	
Weight (g)		
Total	**Mean**	**Range**
3587	-	-



Item 1513/001 from context [1513] is a large part of a sub-rounded, very pale quarzitic sarsen cobble. It is full of ‘root holes’ running through the stone, with openings visible in the convex outer surface of the cobble and broken open in the fractured surfaces of its edges. There are no signs of it having been worked or used as a tool. It was found in one of the layers of redeposited Greensand making up inner henge bank material.

3.10 Trench A** [1519], Phase 3a (Neolithic settlement phase)

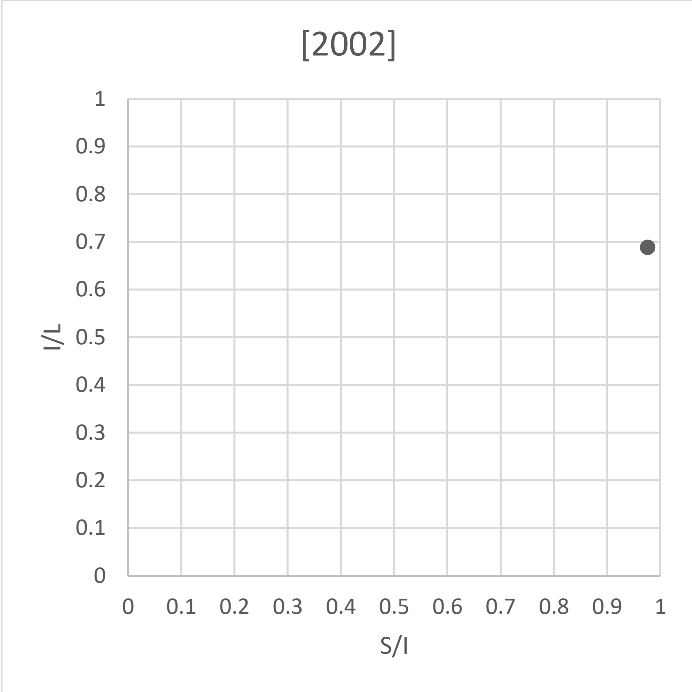
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
1	0	0
Completeness		
Fragment	**Complete**	
1	0	
Cortex		
Absent	**Present**	
0	1	
Burning		
Unburnt	**Burnt**	
0	1	
Weight (g)		
Total	**Mean**	**Range**
77	-	-



Item 1519/001 is SF274. It and various other finds were recovered from the Old Ground Surface. SF274 is a light grey to grey sub-equant block of saccharoid sarsen stone with a small area of cortex surviving to one face. It is sub-angular, with cracks running through the stone suggesting that it had been burnt although the colouration has not been altered.

3.11 Trench B [2002], Phase 3a (Neolithic settlement phase)

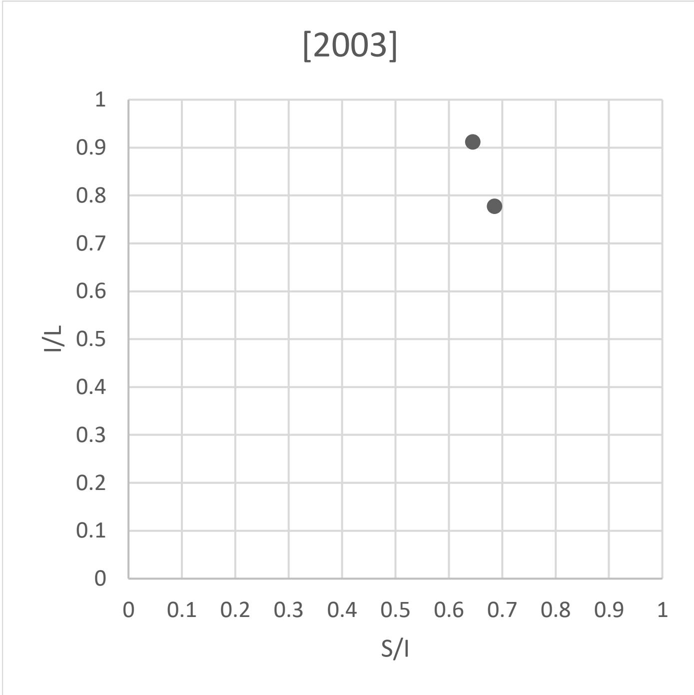
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
1	0	0
Completeness		
Fragment	**Complete**	
1	0	
Cortex		
Absent	**Present**	
1	0	
Burning		
Unburnt	**Burnt**	
0	1	
Weight (g)		
Total	**Mean**	**Range**
77	-	-



Item 2002/001 is a small sub-equant block of saccharoid sarsen. It is coloured weak red to reddish grey and is also cracked, which in association with its angularity indicate that it had been burnt. Context [2002] was a layer of gravel 0.12m thick, sealing postholes just outside the entrance in the south-eastern side of Marden henge. Possibly a natural deposit caused by erosion during the henge construction, or eroded from the henge bank, it included more recent intrusive material as well as animal bone, flint debitage and pottery. This small piece of sarsen is consistent with the other prehistoric finds from the context.

3.12 Trench B [2003], Phase 4 (Neolithic main enclosure)

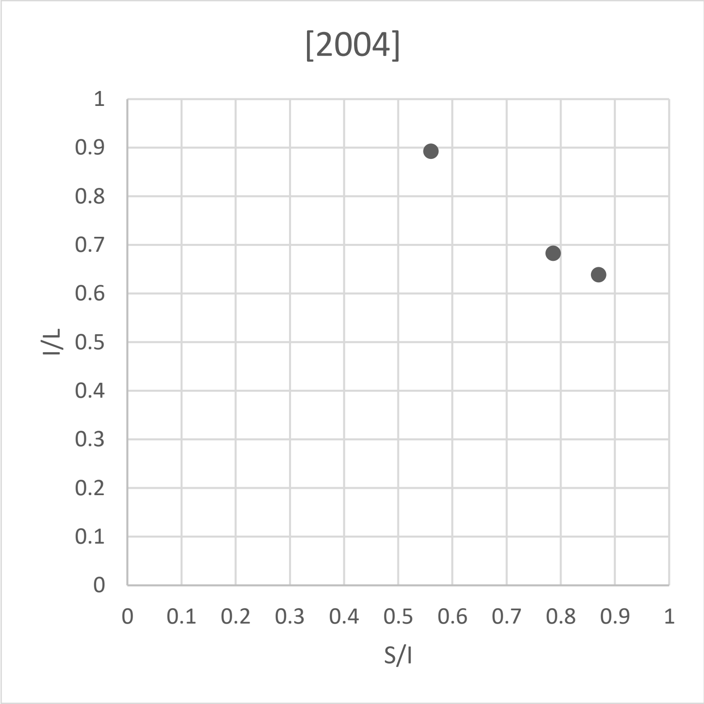
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
2	0	0
Completeness		
Fragment	**Complete**	
2	0	
Cortex		
Absent	**Present**	
1	1	
Burning		
Unburnt	**Burnt**	
0	2	
Weight (g)		
Total	**Mean**	**Range**
197	98.5	34 - 163



Context [2003] was the upper fill of pit [2007], a large feature cutting the natural in Trench B. The pit fills were finds-rich, including [2003] which had Grooved Ware and struck flint as well as these two pieces of burnt saccharoid sarsen stone which re-fit. They were formerly one piece of stone which retained an area of cortex to one face.

3.13 Trench B [2004], Phase 4 (Neolithic main enclosure)

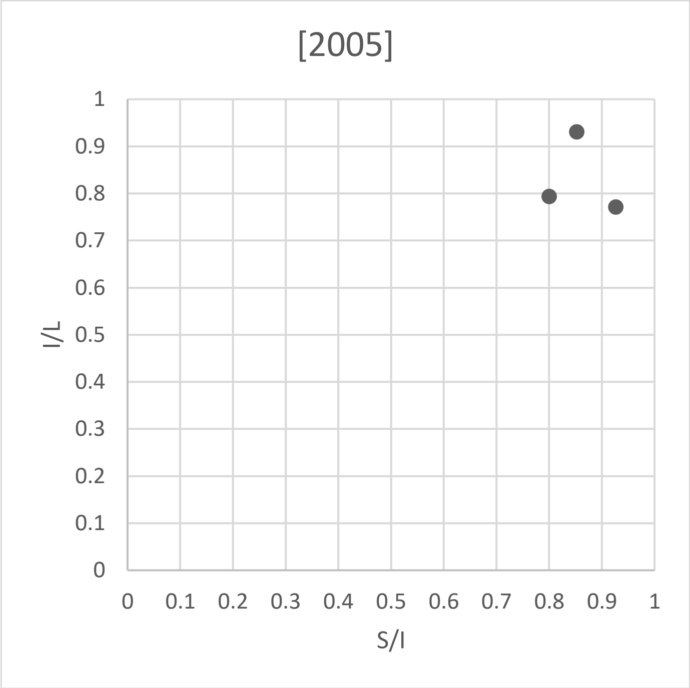
Stone type		
Saccharoid	Quarzitic	Conglomerate
3	0	0
Completeness		
Fragment		Complete
3		0
Cortex		
Absent		Present
2		1
Burning		
Unburnt		Burnt
0		3
Weight (g)		
Total	Mean	Range
50	16.7	7 - 27



Context [2004] was the secondary fill of pit [2007]. Like the primary and upper fills of this feature, the context was finds-rich including pottery and struck flint which appeared to have been deliberately placed into discrete areas within the pit. The fill included three small, angular to sub-angular pieces of saccharoid sarsen stone. Their angularity, colouration and cracks in the stone indicate that they had been burnt. They do not appear to have come from the same parent cobble and could also have been selected and placed along with the other artefacts in the context. They are very small, however, and may have entered the context unintentionally.

3.14 Trench B [2005], Phase 4 (Neolithic main enclosure)

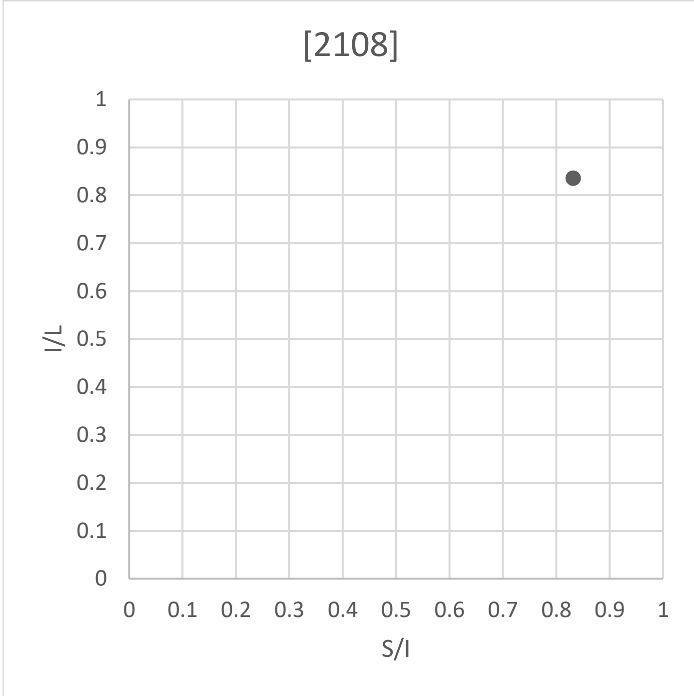
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
3	0	0
Completeness		
Fragment	**Complete**	
3	0	
Cortex		
Absent	**Present**	
2	1	
Burning		
Unburnt	**Burnt**	
0	3	
Weight (g)		
Total	**Mean**	**Range**
128	42.7	18 - 90



Context [2005] was the primary fill of pit [2007]. Like the secondary and upper fills of this feature, it was finds-rich including struck flints and Grooved Ware pottery. The pit was cut through gravels at the entranceway to south-eastern side of the main henge. The three small pieces of sarsen stone in context [2005] are very angular to sub-angular but relatively equant in form. Their colouration, cracks through the stone and angularity indicate that they had been burnt. Items 2005/002 and 2005/2003 re-fit. One adjoining face of each of these two pieces is very flat, although rough to the touch. It is possible that this was a worked surface, damaged by burning, but there are no specific use-wear characteristics other than the flatness of the faces.

3.15 Trench A* [2108], Phase 4 (Neolithic, inner henge construction)

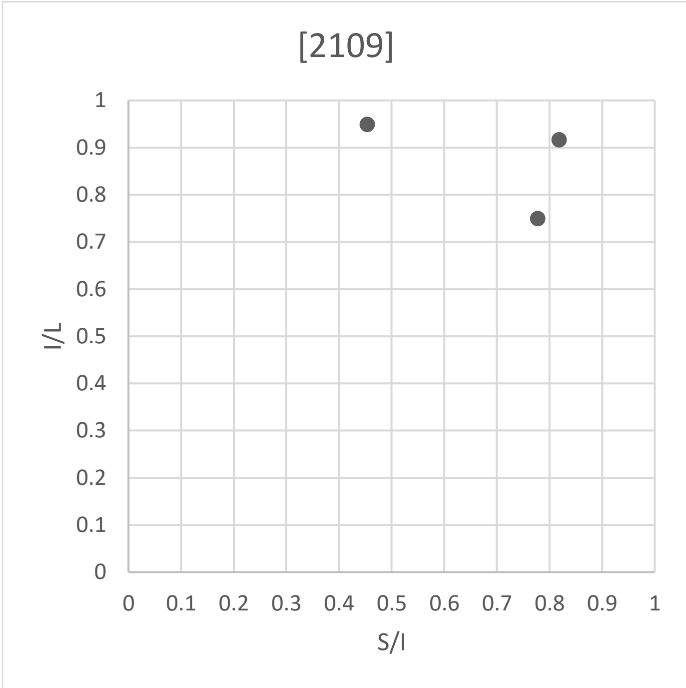
Stone type					
Saccharoid		Quarzitic		Conglomerate	
1		0		0	
Completeness					
Fragment			Complete		
0			1		
Cortex					
Absent			Present		
0			1		
Burning					
Unburnt			Burnt		
1			0		
Weight (g)					
Total		Mean		Range	
3471		-		-	



Item 2108/001 is a complete sarsen cobble, recovered from a construction layer of the inner henge bank. Context [2108] was a layer of gravel sealing, and sealed by, redeposited Greensand layers. The large, rounded, light brownish grey cobble shows no indications of having been worked or used as a tool.

3.16 Trench A* [2109], Phase 4 (Neolithic, inner henge construction)

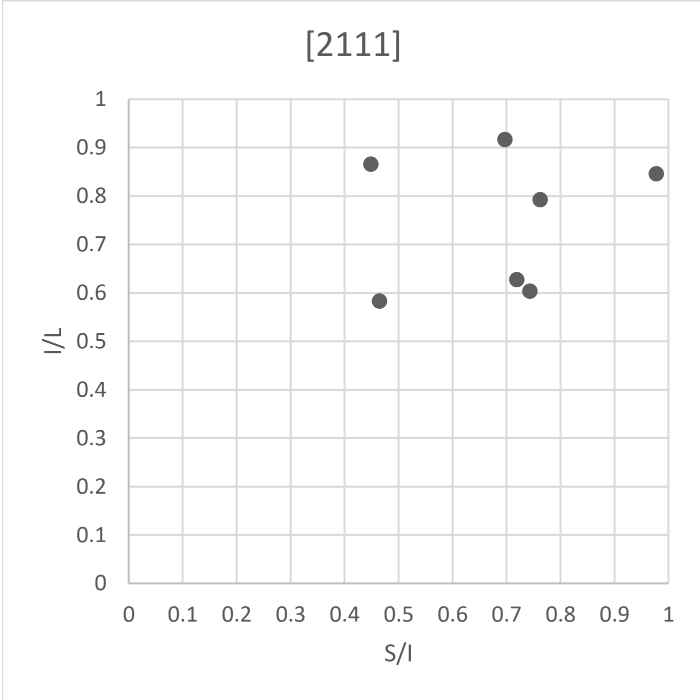
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
2	1	0
Completeness		
Fragment	**Complete**	
3	0	
Cortex		
Absent	**Present**	
2	1	
Burning		
Unburnt	**Burnt**	
1	2	
Weight (g)		
Total	**Mean**	**Range**
1813	604.3	8 – 1797



The three sarsen items from context [2109] comprise a broken hammerstone and two small re-fitting pieces of burnt stone. Context [2109] comprises redeposited Greensand forming the inner henge bank, over the revetting wall [2112]. The two light red to weak red sub-angular and relatively equant re-fitting pieces are also cracked. They may have been excavated as one piece of stone which later fell apart in transit or storage. The broken hammerstone is a sub-rounded grey to light grey piece of quarzitic sarsen. One side has completely broken away, resulting in the oblate spheroid form. The plane of this break conforms to sub-parallel cracks in one rounded face. These cracks and other crushing damage are well-smoothed, but pecking damage interrupts the surface on two corners.

3.17 Trench A* [2111], Phase 3b (Neolithic, burnt spread)

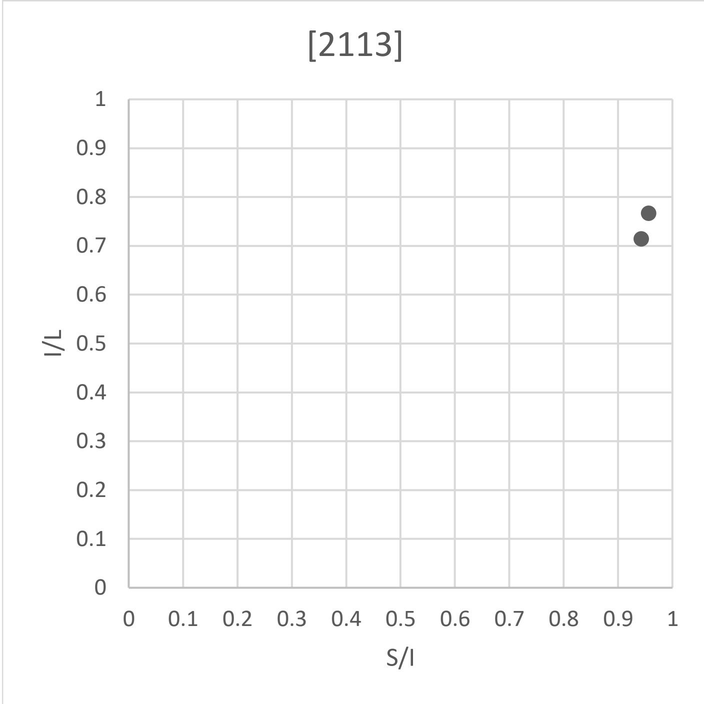
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
7	0	0
Completeness		
Fragment	**Complete**	
7	0	
Cortex		
Absent	**Present**	
4	3	
Burning		
Unburnt	**Burnt**	
0	7	
Weight (g)		
Total	**Mean**	**Range**
393	56.1	13 -108



Context [2111] comprises part of the burnt spread located to the north-east side of the floor surface in the environs of the inner henge. The seven pieces of saccharoid sarsen from this context are similar to the sarsen assemblages from contexts [1006], [1035] and [1038] which also form this burnt spread of material. They are angular to sub-angular pieces, relatively equant apart from two more platy pieces, both of which are a crescentic flake-like pieces, one from the outside of a cobble. All seven had been burnt, and are relatively small pieces falling within the overall weight range of the assemblages from the related contexts.

3.18 Trench A* [2113], Phase 3a (Neolithic settlement phase)

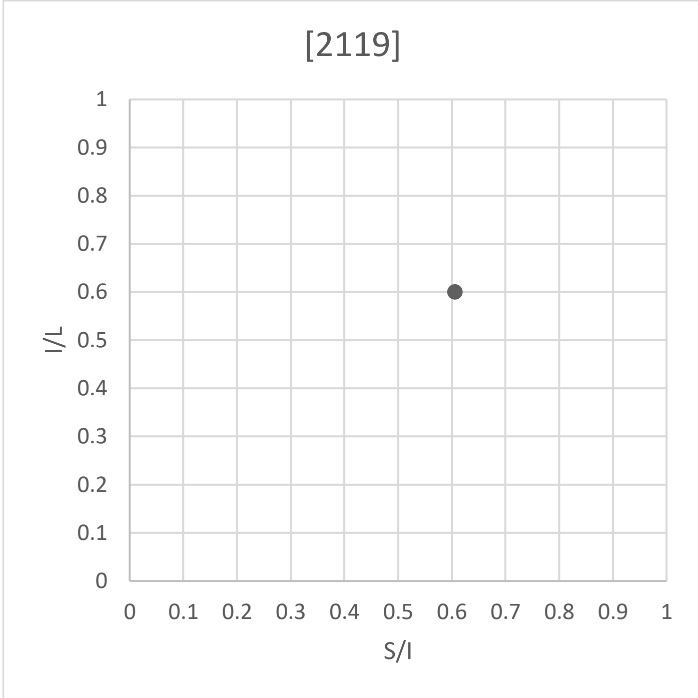
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
2	0	0
Completeness		
Fragment	**Complete**	
2	0	
Cortex		
Absent	**Present**	
2	0	
Burning		
Unburnt	**Burnt**	
0	2	
Weight (g)		
Total	**Mean**	**Range**
56	28	14 - 42



Context [2113] may be part of the Old Ground Surface. It included animal bone. Two small sub-equant blocks of light grey to light pink saccharoid sarsen stone which re-fit also came from this context. Their angularity and colouration, as well as the re-fitting crack, indicate that they had been burnt.

3.19 Trench A* [2119], Phase 4 (Neolithic, inner henge construction)

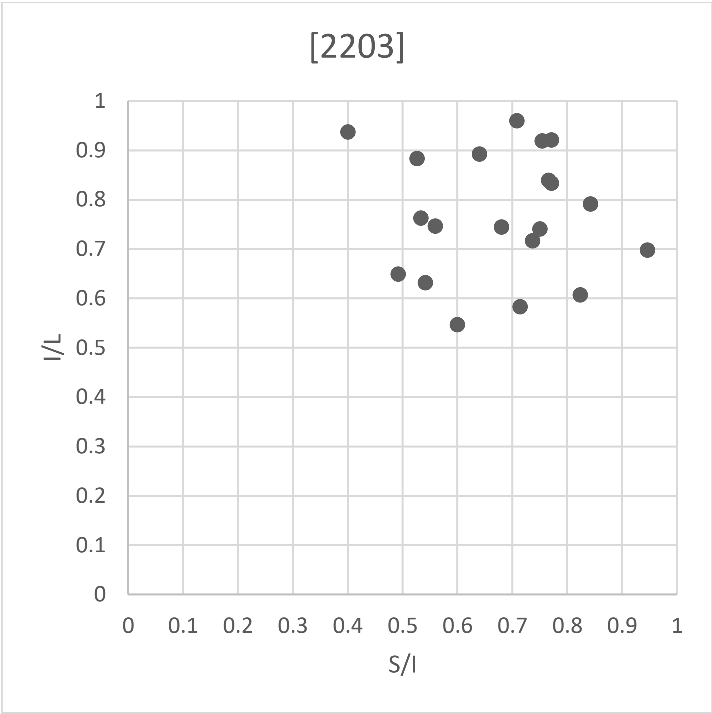
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
1	0	0
Completeness		
Fragment	**Complete**	
1	0	
Cortex		
Absent	**Present**	
0	1	
Burning		
Unburnt	**Burnt**	
1	0	
Weight (g)		
Total	**Mean**	**Range**
6740	-	-



Context [2119] was a 0.05m thick layer of gravel representing a phase making up the inner henge bank, sealed by further bank material (re-deposited Greensand). Item 2219/001 is a sub-equant block of broken cobble of light grey saccharoid sarsen stone. Its convex outer face incudes numerous sub-parallel cracks which give the impression of battering, but these lines continue across concave areas which cannot have been affected if this piece of stone had been used as a hammer. The opposite, flatter face revealing the interior of the cobble shows that some of these sub-parallel cracks run throughout the cobble, representing bedding within the matrix of the stone.

3.20 Trench J [2203], Phase 4 (Neolithic, main henge enclosure)

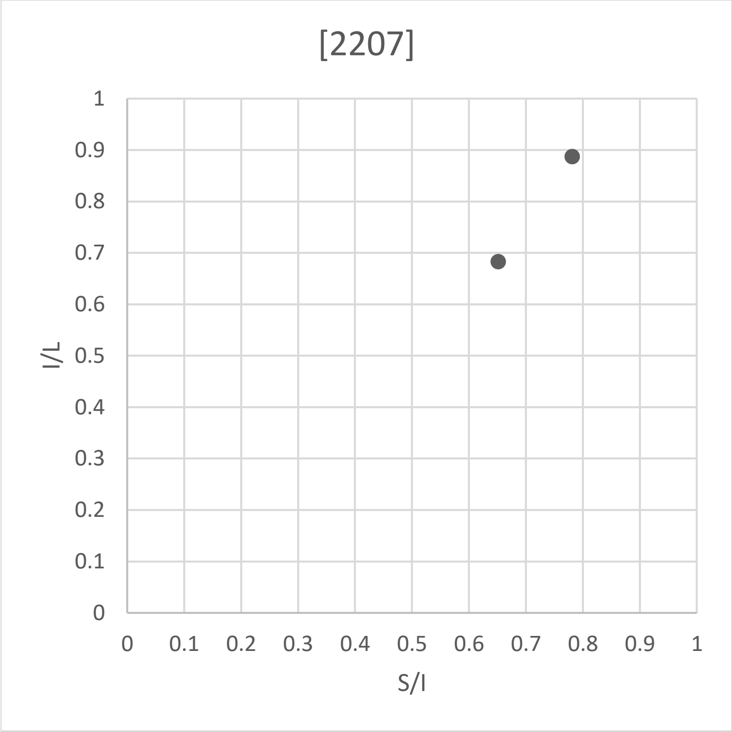
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
20	0	0
Completeness		
Fragment	**Complete**	
20	0	
Cortex		
Absent	**Present**	
14	6	
Burning		
Unburnt	**Burnt**	
2	18	
Weight (g)		
Total	**Mean**	**Range**
4962	248.1	1 - 3850



Twenty pieces of sarsen stone, 19 of which comprise SF612, were recovered from context [2203]. The context was a 0.21m thick layer of sand making up the main henge bank on the enclosure's eastern side. It included one broken light grey saccharoid sarsen cobble weighing 3,850g. SF612 is a group of much smaller broken pieces of angular to sub-angular stone including a fragment of possible rubber/polisher. All bar one of these pieces had been burnt and three re-fit. They are relatively equant, but six more platy items include small flake-like pieces and three pieces retaining cortex or rind from the outer surface of their parent cobble.

3.21 Trench J [2207], Phase 4 (Neolithic, main enclosure)

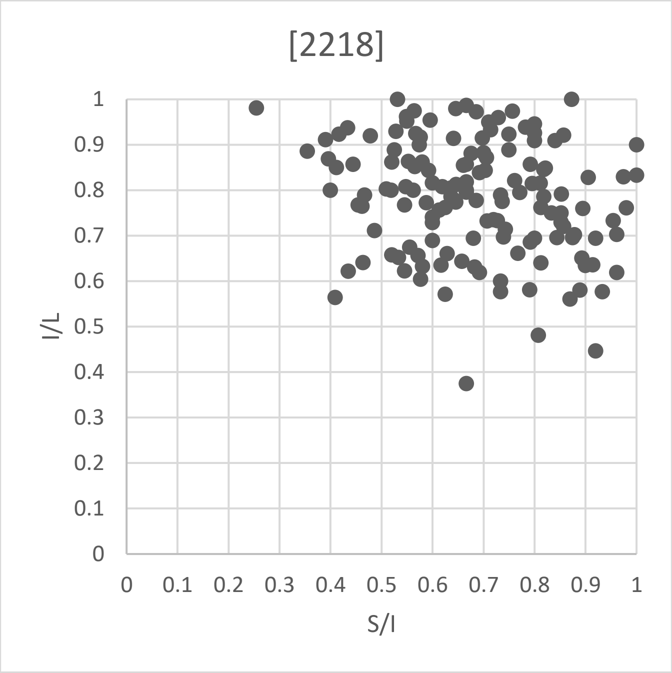
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
2	0	0
Completeness		
Fragment	**Complete**	
2	0	
Cortex		
Absent	**Present**	
2	0	
Burning		
Unburnt	**Burnt**	
1	1	
Weight (g)		
Total	**Mean**	**Range**
1844	922	138 - 1706



Context [2207] was the uppermost fill of pit [2208]. The pit cut a possible land surface [2225] which overlay a series of features and deposits over the henge bank on the eastern side of the main enclosure. The two pieces of sarsen recovered from [2207] were SF606, a piece of dressed sarsen described in Section 2.1, and a small sub-equant block of reddish grey saccharoid sarsen weighing 138g. The angularity, cracks and colouration of the small piece indicate that it had been burnt, unlike the larger piece of dressed stone. No sarsen was recorded from the primary fill [2222] or secondary fill [2213] of the pit. Context [2222] included three sherds of possible Beaker pottery whilst [2213] included pottery, flint and hammerstone SF611.

3.22 Trench J [2218], Phase 4 (Neolithic, main enclosure)

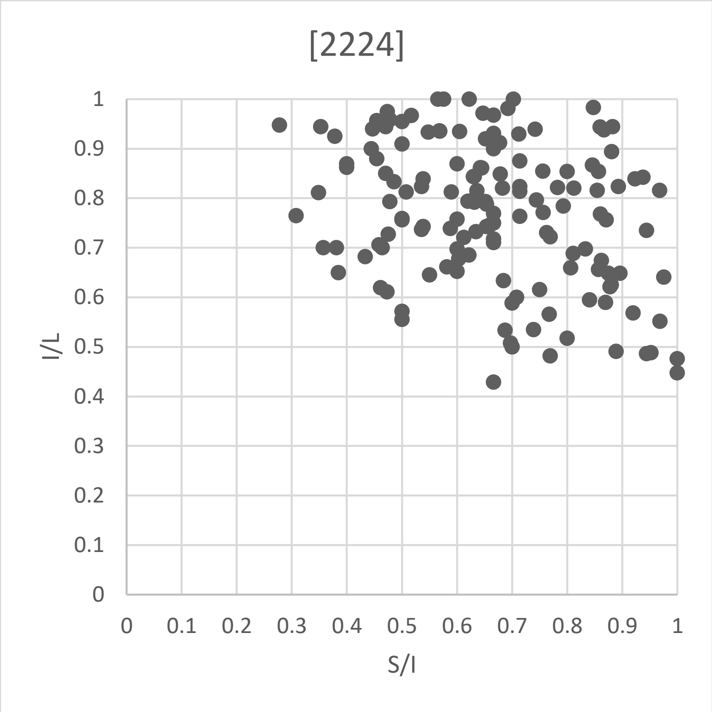
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
145*	0	0
Completeness		
Fragment	**Complete**	
145	0	
Cortex		
Absent	**Present**	
114	31	
Burning		
Unburnt	**Burnt**	
28	117	
Weight (g)		
Total	**Mean**	**Range**
7936	54.9	1 - 1072



Context [2218], a mid yellowish brown sand, was the secondary fill of pit [2219]. The small oval pit was one of a number of features cutting a colluvial deposit and the material of the main henge bank on its eastern arc. Fill [2218] included SF613, an assemblage of 145 very angular to rounded broken pieces of sarsen stone, the majority of which had been burnt. The items included one piece of possibly dressed sarsen and two possible quern fragments. Overall the pieces are relatively equant but include some more platy and elongate fragments. Crescentic flake-like pieces which do not have platforms or signs of crushing damage from percussion probably resulted from exfoliation due to temperature change. *and 3 small pieces <1g, unrecorded.

3.23 Trench J [2224], Phase 4 (Neolithic, main enclosure)

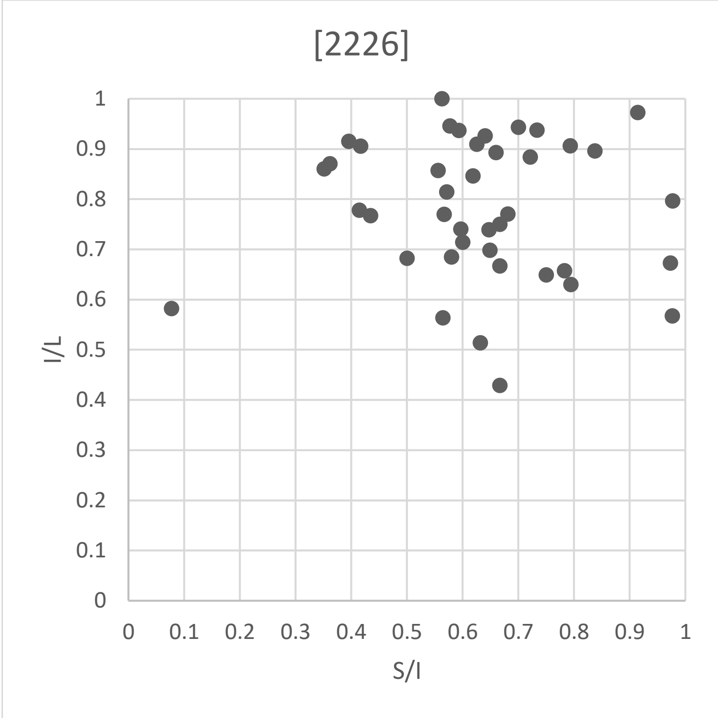
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
144	0	0
Completeness		
Fragment	**Complete**	
144	0	
Cortex		
Absent	**Present**	
112	32	
Burning		
Unburnt	**Burnt**	
24	120	
Weight (g)		
Total	**Mean**	**Range**
5847	40.6	1 - 247



Context [2224] was the primary fill of pit [2219], a very dark brownish grey sand containing SF614, 144 pieces of sarsen stone. These very angular to sub-rounded fragments, the majority of which had clear indications that they had been burnt, included one piece of possible hammerstone. Assemblages SF614 and SF613 (from the pit's secondary fill) both have similar profiles in terms of number of pieces, form, frequency of pieces retaining cortex and frequency of pieces with clear indications of having been burnt. Items in SF614, however, are overall smaller than those in SF613, with a smaller weight range and mean weight of 40.6g compared to 54.9g.

3.24 Trench J [2226], Phase 4 (Neolithic, main enclosure)

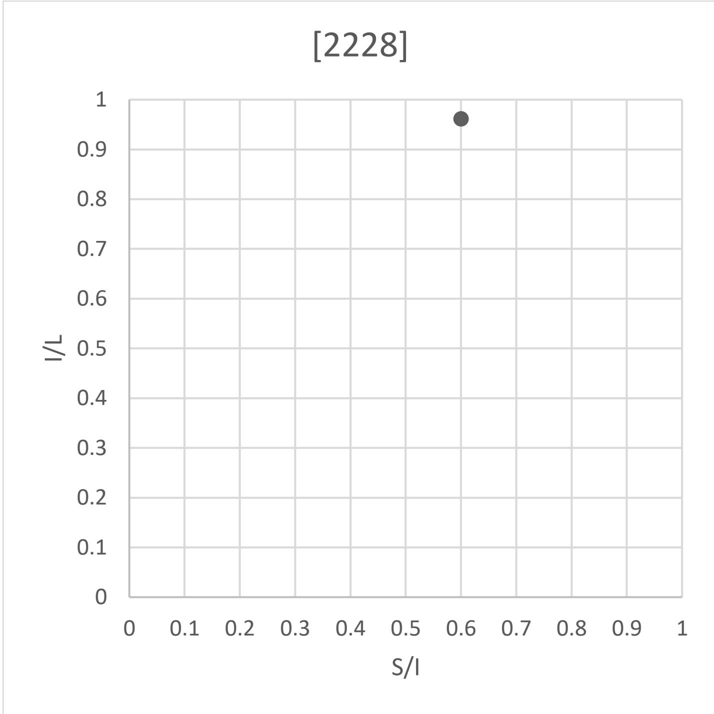
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
41	0	0
Completeness		
Fragment	**Complete**	
41	0	
Cortex		
Absent	**Present**	
33	8	
Burning		
Unburnt	**Burnt**	
2	39	
Weight (g)		
Total	**Mean**	**Range**
2249	54.9	1 - 192



Context [2226], the mid brownish grey sand fill of shallow oval pit [2227], included SF615; 41 pieces of broken sarsen stone. Like pit [2219], pit [2227] cut a colluvial deposit and the material of the main henge bank on its eastern side. The majority of the sub-angular to sub-rounded pieces had been burnt, including one fragment of possible quern or polisher and one fragment of possible rubber. Pieces 2226/005, 2225/006 and 2226/019 re-fit and although other refits were not observed, some fragments of stone have similar colouration and texture and may be parts of the same parent cobbles. Although on the whole relatively equant, half of the pieces making up SF615 are more elongate and platy fragments including numerous flake-like pieces, one of which had a possible platform.

3.25 Trench J [2228], Phase 4 (Neolithic, main enclosure)

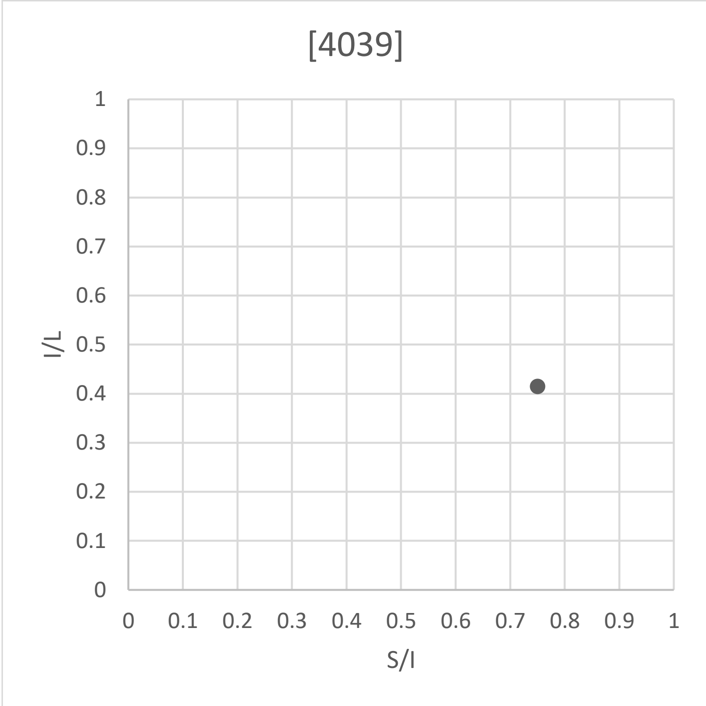
Stone type					
Saccharoid		Quarzitic		Conglomerate	
1		0		0	
Completeness					
Fragment			Complete		
1			0		
Cortex					
Absent			Present		
1			0		
Burning					
Unburnt			Burnt		
0			1		
Weight (g)					
Total		Mean		Range	
54		-		-	



Context [2228] was the mid brownish silty sand fill of a possible posthole [2229]. The fill included one small sub-equant block of possibly burnt sarsen stone weighing 54g. The slight pink to yellow tinge to the pale brown to light grey colouration of the sub-angular piece may indicate burning, but there is no crazing or cracking through the stone and could be due to weathering.

3.26 Trench D [4039], Phase 6 (Wilsford henge Late Bronze Age/Iron Age phase)

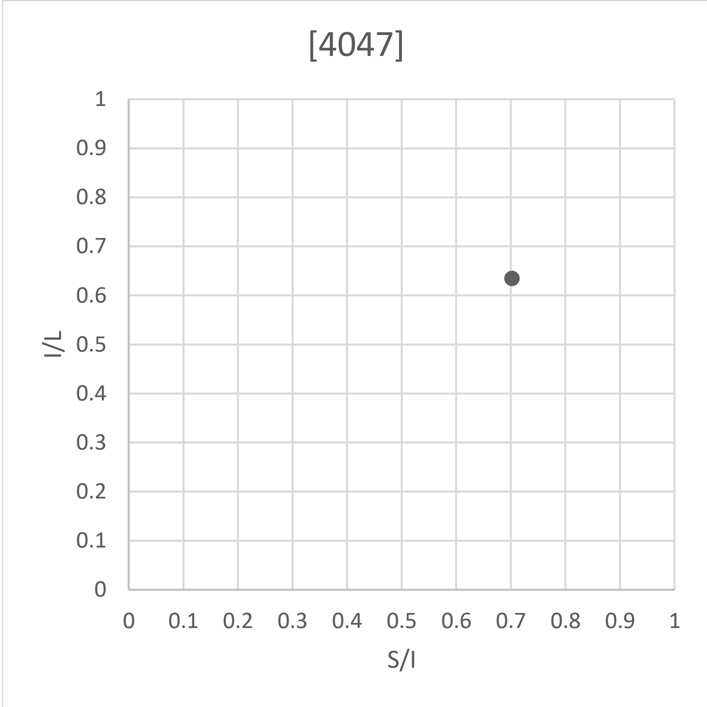
Stone type		
Saccharoid	Quarzitic	Conglomerate
1	0	0
Completeness		
Fragment	Complete	
1	0	
Cortex		
Absent	Present	
0	1	
Burning		
Unburnt	Burnt	
1	0	
Weight (g)		
Total	Mean	Range
2550	-	-



Item 4039/001 is SF69*, a large piece of saccharoid sarsen. It was found in context [4039], a dark grey-black/grey silty clay overlaying ditch fills of the Wilsford henge ditch above the Bronze Age burial excavated in 2015. The context included a substantial quantity of pottery and animal bone, a fragment of shale bracelet (SF70), a worn antler pick [SF104], a residual leaf-shaped arrow-head (SF69) and other flints (SF71, 80, 81, 181). The dark grey to grey sarsen piece is a long piece of broken cobble. From its broader end one face comprises what is in effect a step fracture, which has slight sub-parallel cracks to its platform-like surface. These small cracks are not very pronounced and it is not clear that the broken faces of the stone are anthropogenic.
*SF69 on the finds bag, SF67 noted in the VoP 2015 assessment report.

3.27 Trench D [4047], Phase 4 (Neolithic, Wilsford henge)

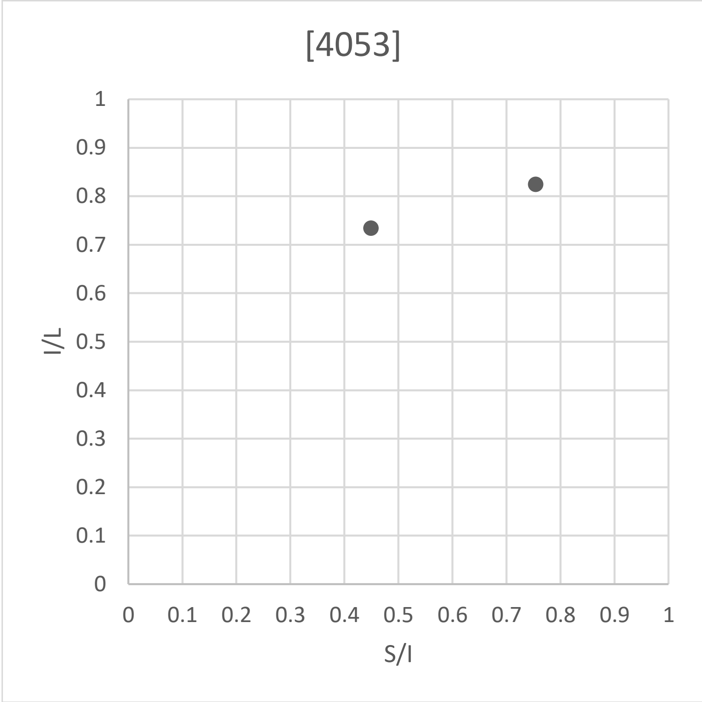
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
0	1	0
Completeness		
Fragment	**Complete**	
1	0	
Cortex		
Absent	**Present**	
0	1	
Burning		
Unburnt	**Burnt**	
1	0	
Weight (g)		
Total	**Mean**	**Range**
3788	-	-



Item 4047/001 is SF183. It is a grey to light grey piece of quarzitic sarsen, a sub-equant spheroid in form with black flecks across its pale surface. The stone was part of a group of natural features cutting the cobbled surface to the centre of Wilsford henge and other deposits.

3.28 Trench D [4053], Phase 6 (Wilsford henge Late Bronze Age/Iron Age phase)

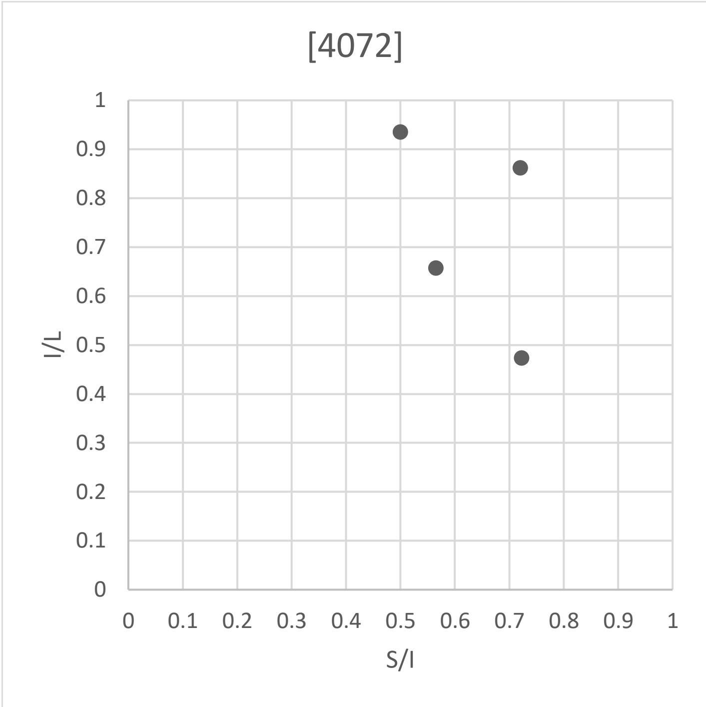
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
2	0	0
Completeness		
Fragment	**Complete**	
2	0	
Cortex		
Absent	**Present**	
0	2	
Burning		
Unburnt	**Burnt**	
0	2	
Weight (g)		
Total	**Mean**	**Range**
385	192.5	177 - 208



Context [4053] was ditch backfill overlying the burial in the Wilsford henge ditch. The dark black grey clay silt had frequent charcoal inclusions and an assemblage of pottery, animal bone and other material suggesting that it derived from a midden. Two small pieces of burnt sarsen stone, one very angular and the other sub-angular, were also in the deposit, consistent with this interpretation.

3.29 Trench D [4072], Phase 4 (Neolithic, Wilsford henge)

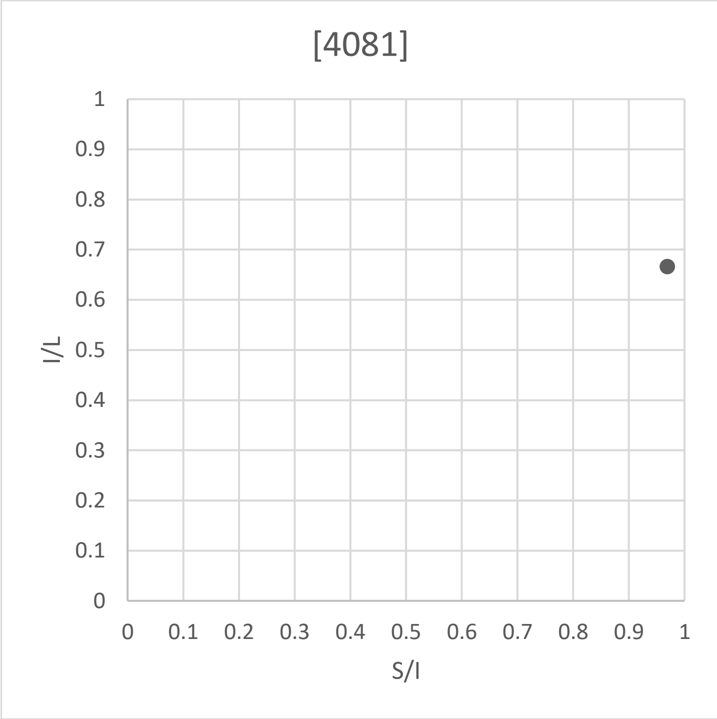
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
4	0	0
Completeness		
Fragment	**Complete**	
4	0	
Cortex		
Absent	**Present**	
1	3	
Burning		
Unburnt	**Burnt**	
0	4	
Weight (g)		
Total	**Mean**	**Range**
114	28.5	7 - 84



Four small pieces of angular to sub-angular burnt sarsen were recovered from context [4072], a deposit of dark grey brown clayey silt and redeposited Greensand in the Wilsford henge ditch overlying the earliest ditch fills. It included a flint arrowhead (SF192) and SF193 (flint) and SF195 (animal bone). Items 4072/002, 4072/003 and 4072/004 re-fit.

3.30 Trench D [4081], Phase 4 (Neolithic, Wilsford henge)

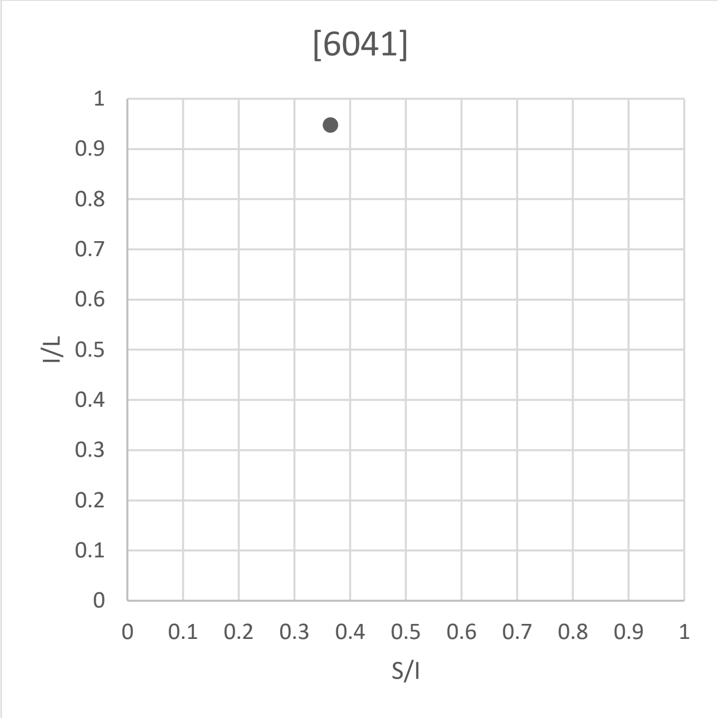
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
1	0	0
Completeness		
Fragment	**Complete**	
1	0	
Cortex		
Absent	**Present**	
1	0	
Burning		
Unburnt	**Burnt**	
0	1	
Weight (g)		
Total	**Mean**	**Range**
53	-	-



Context [4081] was mid-yellow brown clayey sand c0.35m thick, one of the earliest fills of the Wilsford henge ditch. It contained an assemblage of large animal bones, possibly aurochs. Item 4081/001 is a small sub-angular piece of light grey to pale red saccharoid sarsen stone. Its angularity and colouration suggest that it had been burnt. A dark grey oval patch is visible in one broken face, possibly the result of heat on iron oxide in the stone.

3.31 Trench F [6041], Phase 4 (Neolithic, main enclosure)

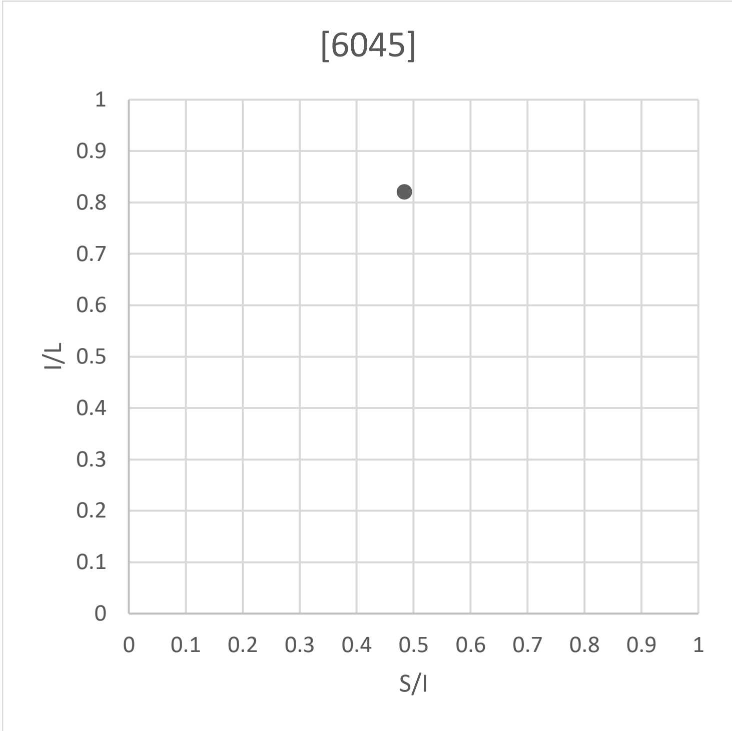
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
0	1	0
Completeness		
Fragment	**Complete**	
1	0	
Cortex		
Absent	**Present**	
0	1	
Burning		
Unburnt	**Burnt**	
1	0	
Weight (g)		
Total	**Mean**	**Range**
3408	-	-



Context [6041] was the fill of posthole [6048] within the central area of Marden inner henge. It included SF304, a very oblate spheroid piece of quarzitic sarsen stone. This is a very pale brown to light grey unworked broken cobble weighing 3,408g.

3.32 Trench F [6045], Phase 4 (Neolithic, main enclosure)

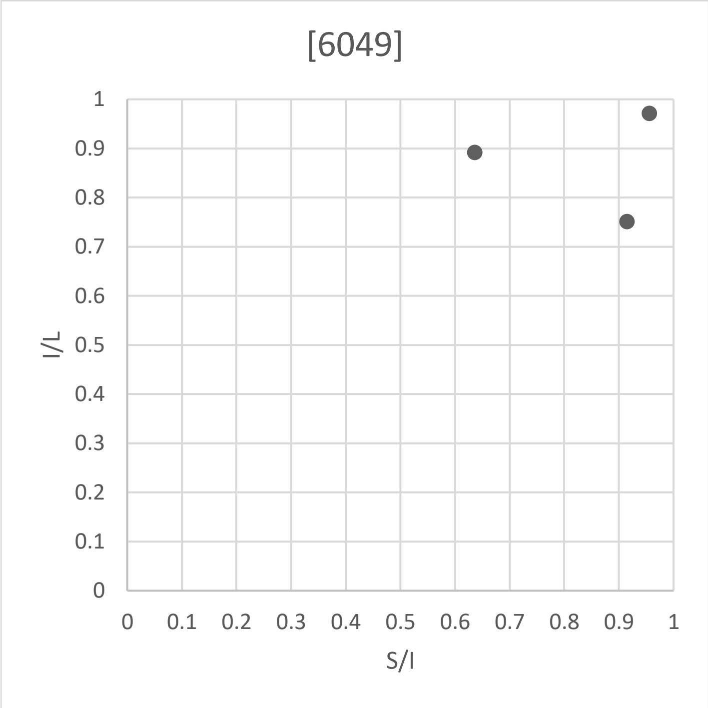
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
0	1	0
Completeness		
Fragment	**Complete**	
1	0	
Cortex		
Absent	**Present**	
0	1	
Burning		
Unburnt	**Burnt**	
1	0	
Weight (g)		
Total	**Mean**	**Range**
157	-	-



In the central area of Marden inner henge, cut [6069] was filled with context [6045], a light yellowish brown sandy silt. The fill included a small oblate spheroid piece of light grey quarzitic sarsen stone. Its surfaces are irregular but smooth to the touch and appear to be unworked; it is not clear if small flake scars to the thinnest end are the result of intentional or accidental/natural damage.

3.33 Trench F [6049], Phase 4 (Neolithic, main enclosure)

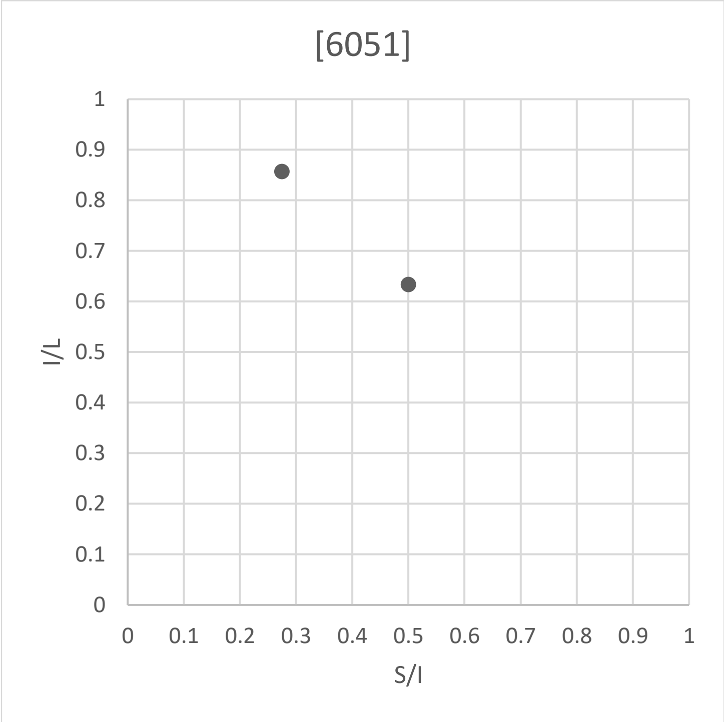
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
3	0	0
Completeness		
Fragment	**Complete**	
3	0	
Cortex		
Absent	**Present**	
2	1	
Burning		
Unburnt	**Burnt**	
0	3	
Weight (g)		
Total	**Mean**	**Range**
2031	677	20 - 1628



Three burnt pieces of sarsen were recovered from context [6049], the loose clay sand backfill to a possible post-pipe, associated with pit [6046] in the centre of Marden inner henge. The post-pipe earliest fill [6071] was a thin chalk layer, followed by possible packing stones [6068] and then fill [6049]. Item 6049/003 was SF308, a weak red to pale red angular sub-equant block weighing 1,628g. Its texture, colouration and cracking are similar to 6049/002 and although they do not re-fit they may be derived from the same parent cobble. After measurement, item 6049/001 broke into two pieces along the line of a crack caused by burning.

3.34 Trench F [6051], Phase 1 (natural)

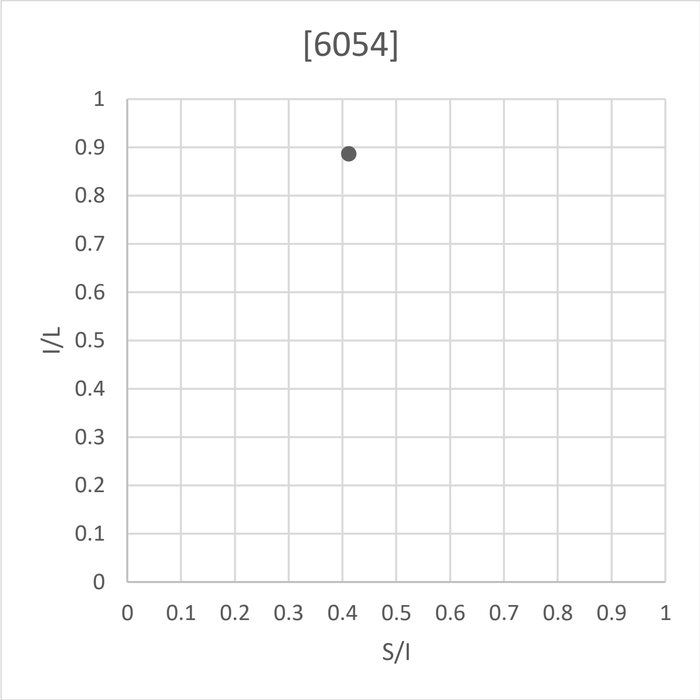
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
2	0	0
Completeness		
Fragment	**Complete**	
2	0	
Cortex		
Absent	**Present**	
0	2	
Burning		
Unburnt	**Burnt**	
2	0	
Weight (g)		
Total	**Mean**	**Range**
1560	780	269 - 1291



Natural Greensand deposits in Trench F were numbered context [6051]. Two pieces of light grey saccharoid sarsen, SF313 and SF316, were recovered from the context. They are both small pieces of unburnt broken cobble. The largely weathered scars to their fractured surfaces do not have impact points or other characteristics of anthropogenic causes.

3.35 Trench F [6054], Phase 4 (Neolithic, main enclosure)

Stone type		
Saccharoid	Quarzitic	Conglomerate
1	0	0
Completeness		
Fragment	Complete	
1	0	
Cortex		
Absent	Present	
0	1	
Burning		
Unburnt	Burnt	
1	0	
Weight (g)		
Total	Mean	Range
516	-	-



Context [6054] was the dark greenish brown soft clay fill of pit [6044]/[6082] in the centre of the inner henge. It included a sub-rounded oblate spheroid piece of saccharoid sarsen, SF307. This light grey piece of stone is possibly a hammerstone. There may be light crushing damage on one point but the slight parallel cracks visible with a hand lens are not definitive. Three opposite faces are each formed of flake scars although impact points are not clear.

3.36 [6063], void context number

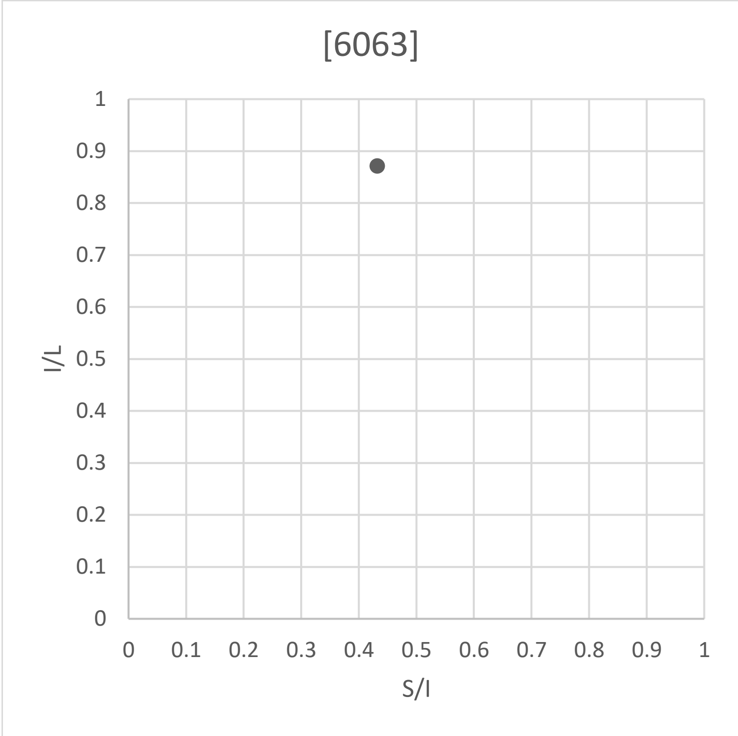
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
1	0	0

Completeness	
Fragment	**Complete**
0	1

Cortex	
Absent	**Present**
0	1

Burning	
Unburnt	**Burnt**
1	0

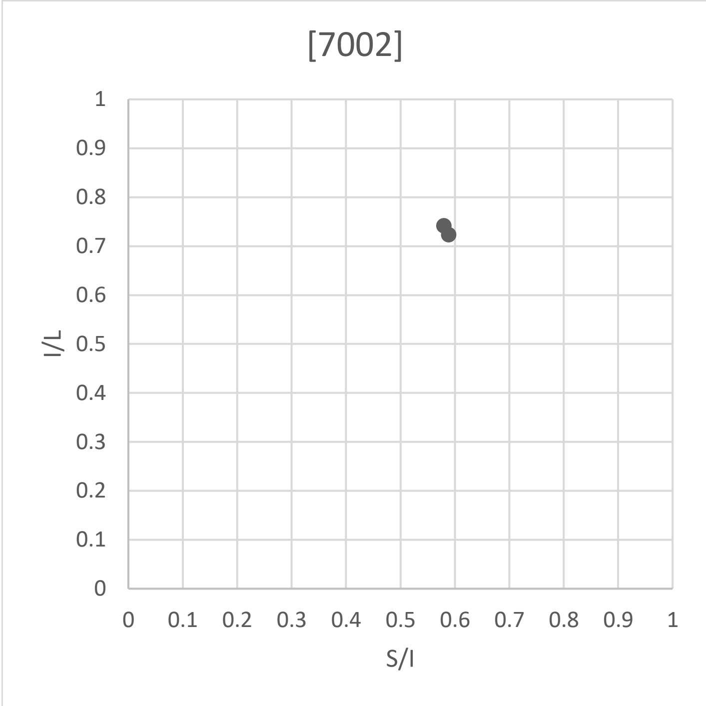
Weight (g)		
Total	**Mean**	**Range**
342	-	-



Item 6063/001, which is SF310, is a small unworked sarsen cobble.

3.37 Trench G [7002], Phase 10 (Modern)

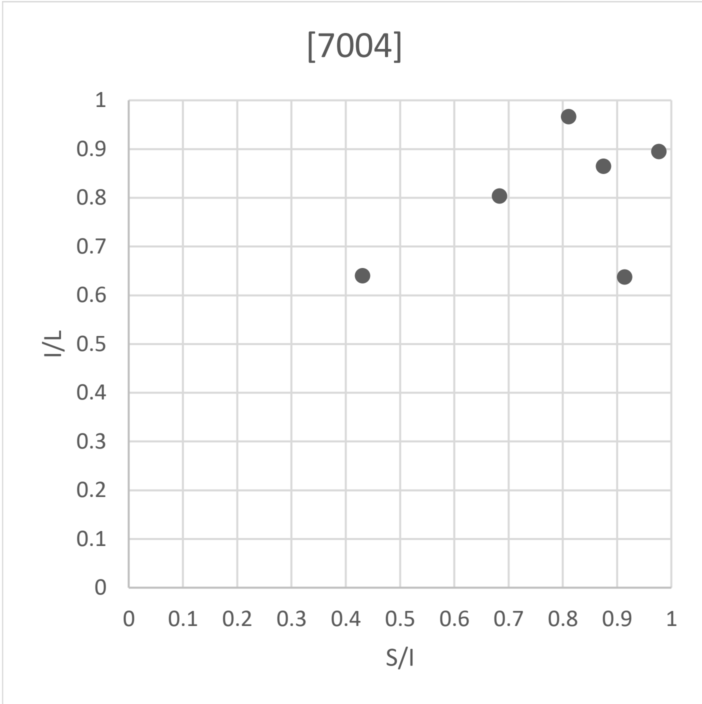
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
2	0	0
Completeness		
Fragment	**Complete**	
2	1	
Cortex		
Absent	**Present**	
0	2	
Burning		
Unburnt	**Burnt**	
2	0	
Weight (g)		
Total	**Mean**	**Range**
367	183.5	29 - 338



Two pieces of probably unburnt saccharoid sarsen were recovered from context [7002], the subsoil to Trench G. Item 7002/001 may have been pecked; under low magnification a few small depressions appear to interrupt the smooth surface. However, this could be where sand grains have been weathered out.

3.38 Trench G [7004], Phase 2 (Early activity, main henge enclosure)

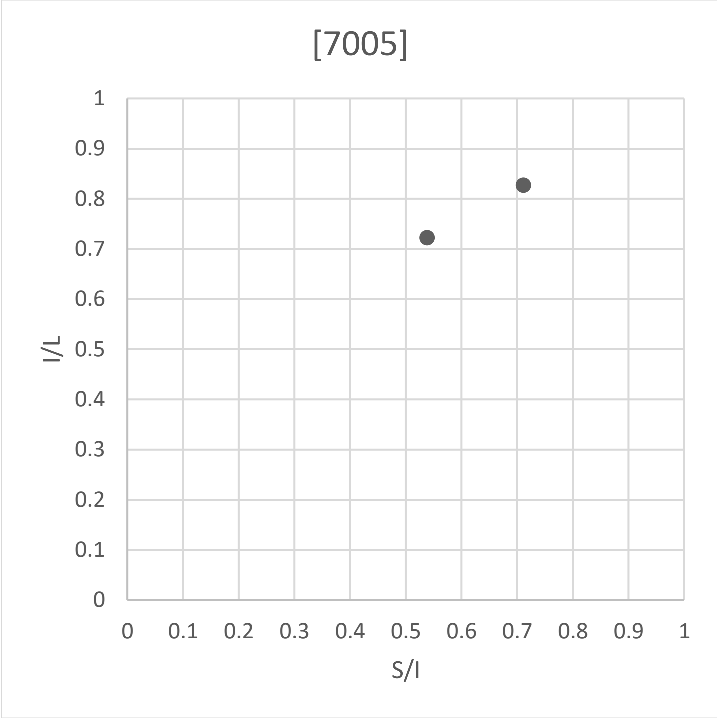
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
5	1	0
Completeness		
Fragment	**Complete**	
5	1	
Cortex		
Absent	**Present**	
4	2	
Burning		
Unburnt	**Burnt**	
3	3	
Weight (g)		
Total	**Mean**	**Range**
4383	730.5	32 - 2263



Context [7004] was a colluvial layer, sealing numerous other probably colluvial layers overlying the Greensand natural in Trench G. The layer was cut by features of Phase 4. The six pieces of sarsen recovered from [7004] include item 7004/001, a possible hammerstone (unburnt), and 7004/002, a fragment of a formerly oval tool, probably a rubber (burnt) (see Section 2). Item 7004/005 is SF415, a complete unused equant cobble weighing 2,263g, whilst 7004/006 is SF417, an almost complete oblate spheroid cobble weighing 1,118g. The other two pieces are small, broken and burnt.

3.39 Trench G [7005], Phase 2 (Early activity, main henge enclosure)

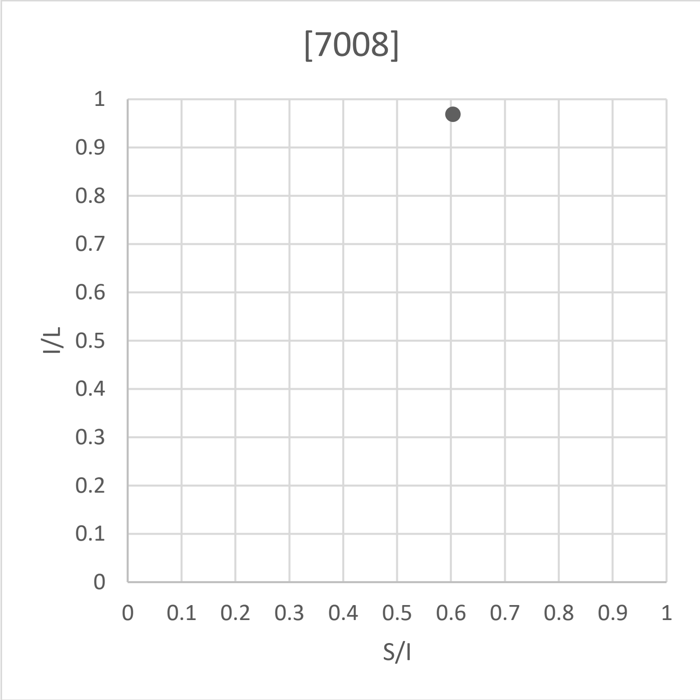
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
2	0	0
Completeness		
Fragment	**Complete**	
0	2	
Cortex		
Absent	**Present**	
1	1	
Burning		
Unburnt	**Burnt**	
2	0	
Weight (g)		
Total	**Mean**	**Range**
26910	13455	9910 - 17000



The thick accumulation of gravel [7005] overlying colluvial layers in Trench G included two small sarsen boulders. These unworked stones are the largest recovered during the Vale of Pewsey excavations.

3.40 Trench G [7008], Phase 4 (Neolithic, main enclosure)

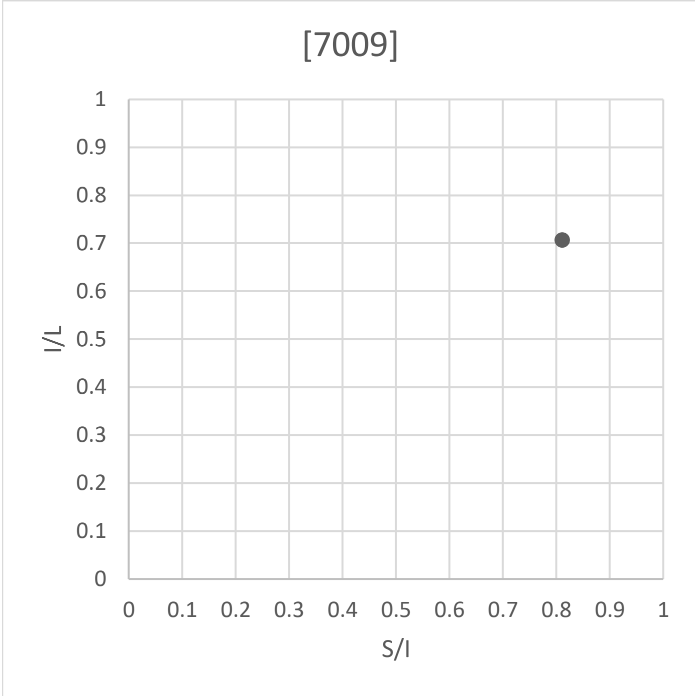
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
1	0	0
Completeness		
Fragment		**Complete**
1		0
Cortex		
Absent		**Present**
1		0
Burning		
Unburnt		**Burnt**
0		1
Weight (g)		
Total	**Mean**	**Range**
117	-	-



Item 7008/001 is a small sub-equant block of extremely pale sarsen stone. It is intensely cracked and its light, ‘dry’, texture indicate that it had been burnt. Context [7008] was mid-blackish brown loose sand filling pit [7013]. The pit cut colluvial deposits over the natural Greensand of Trench G. Its fill also included pottery and a small amount of calcified bone.

3.41 Trench G [7009], Phase 4 (Neolithic, main enclosure)

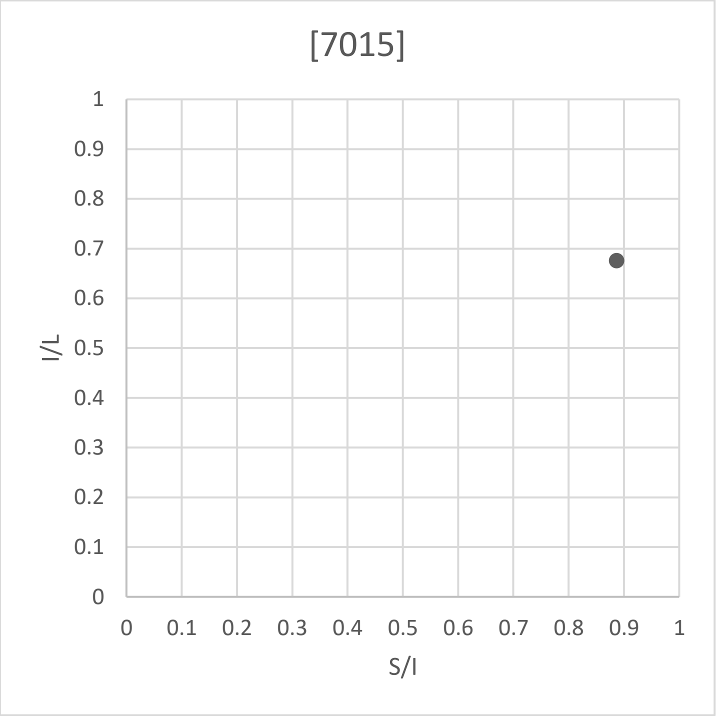
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
1	0	0
Completeness		
Fragment	**Complete**	
1	0	
Cortex		
Absent	**Present**	
0	1	
Burning		
Unburnt	**Burnt**	
0	1	
Weight (g)		
Total	**Mean**	**Range**
190	-	-



Item 7009/001 is a small sub-equant dark reddish grey to pinkish grey block of saccharoid sarsen stone. Its angularity, cracks and colouration indicate that it had been burnt. Context [7009] was the fill of pit [7014]. The pit cut colluvial layers over the natural Greensand of Trench G. The fill included frequent charcoal inclusions and evidence of burning.

3.42 Trench G [7015], Phase 2 (Early activity)

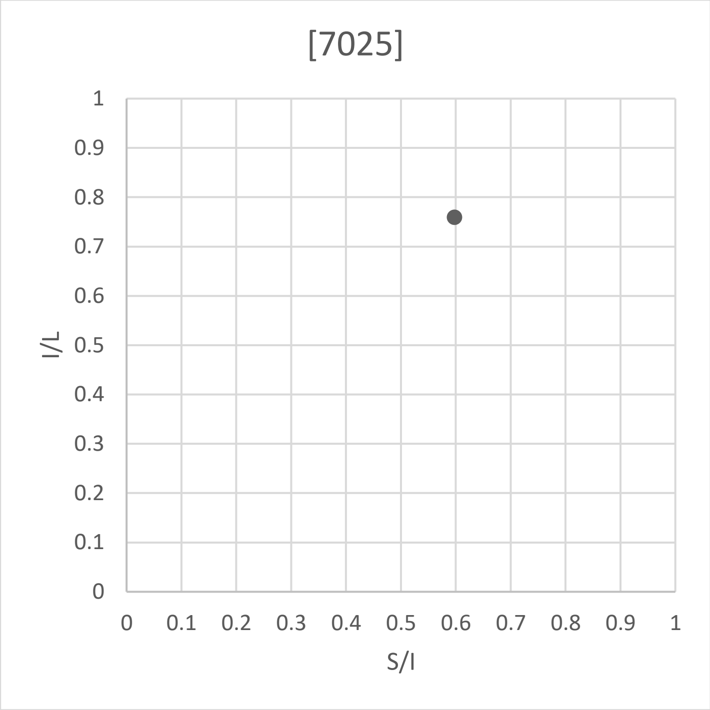
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
1	0	0
Completeness		
Fragment	**Complete**	
1	0	
Cortex		
Absent	**Present**	
1	0	
Burning		
Unburnt	**Burnt**	
1	0	
Weight (g)		
Total	**Mean**	**Range**
6190	-	-



Item 7015/001 is SF416. The light grey sub-equant spheroid of saccharoid sarsen is part of a small unworked boulder. The weathered surface feels rough to the touch, without a smooth rind or cortex. Context [7015] is one of the colluvial layers in Trench G inside the man henge enclosure.

3.43 Trench G [7025], Phase 2 (Early activity)

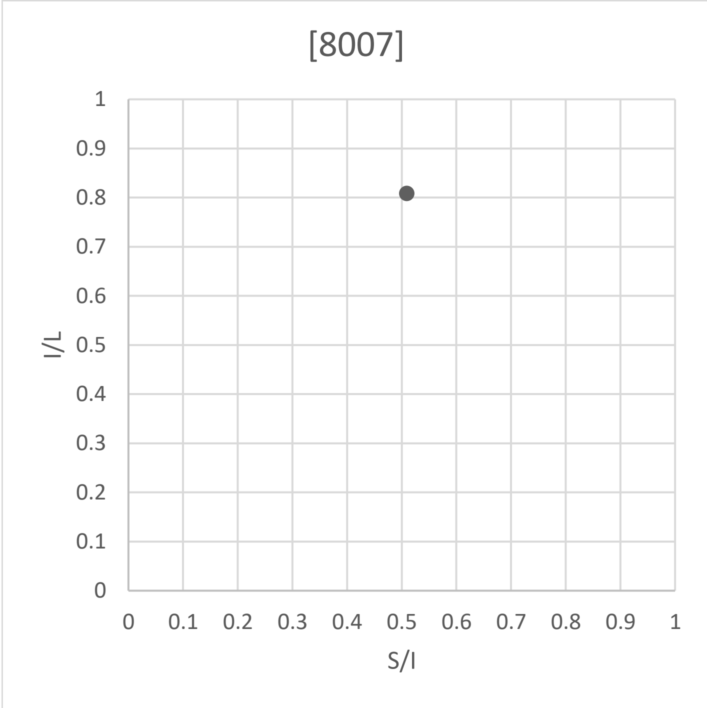
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
1	0	0
Completeness		
Fragment	**Complete**	
1	0	
Cortex		
Absent	**Present**	
1	0	
Burning		
Unburnt	**Burnt**	
1	0	
Weight (g)		
Total	**Mean**	**Range**
475	-	-



Item 7025/001 is a light grey oblate spheroid piece of saccharoid sarsen. Its edges are not sharply defined, giving the impression of weathering having smoothed off most of the high points; there are no use-wear signatures, this effect does not appear to be anthropogenic. Context [7025] was one of the colluvial layers in Trench G inside the man henge enclosure.

3.44 Trench Ia [8007], the riverine sequence

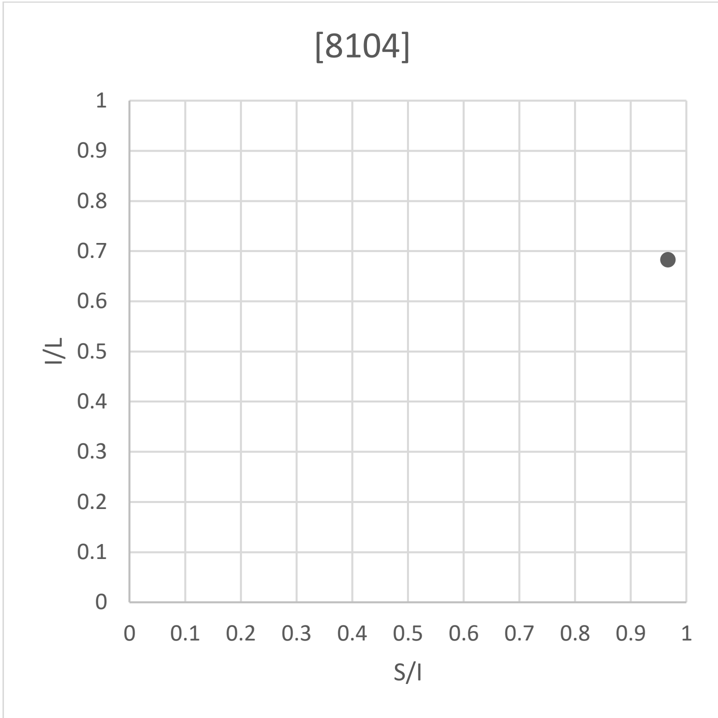
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
0	1	0
Completeness		
Fragment	**Complete**	
1	0	
Cortex		
Absent	**Present**	
0	1	
Burning		
Unburnt	**Burnt**	
0	1	
Weight (g)		
Total	**Mean**	**Range**
99	-	-



Context [8007] was a blue alluvial silt deposit, interleaved with context [8028] a sandier colluvial sediment possibly derived from the upslope ground on which the henge monuments were built. It overlay a sequence of layers including remnants of a poorly-developed soil in which was a flint blade and other flint fragments. It was below a possible buried land surface [8005]. From [8007], item 8007/001 is a remarkably coloured piece of quarzitic sarsen. The small fractured piece is a flat block in form, the reddish grey to dusky red giving an overall dense purple effect. One face retains an area of cortex. The colouration and angularity suggest that it had been burnt. This was the most extreme example of this depth of colour, however, and the stone was not cracked or friable, two characteristics that might be expected from intense or high-temperature burning.

3.45 [8104]

Stone type		
Saccharoid	Quarzitic	Conglomerate
1	0	0
Completeness		
Fragment	Complete	
0	2	
Cortex		
Absent	Present	
0	1	
Burning		
Unburnt	Burnt	
1	0	
Weight (g)		
Total	Mean	Range
8810	-	-



An unworked large light grey to very pale brown sarsen cobble. The rounded, sub-equant spheroid included two opposite ‘root’ or solution holes.

3.46 Trench H [9001], void context number

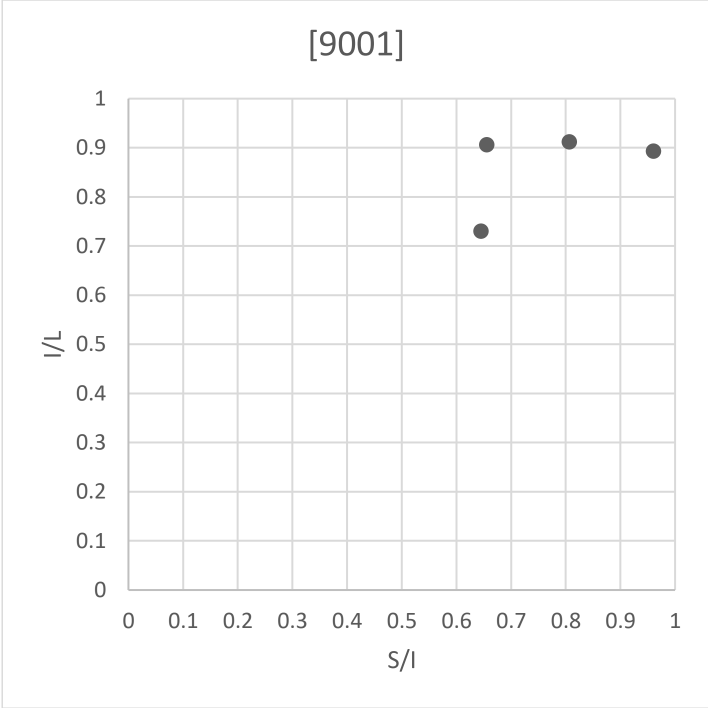
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
4	0	0

Completeness	
Fragment	**Complete**
3	1

Cortex	
Absent	**Present**
3	1

Burning	
Unburnt	**Burnt**
2	2

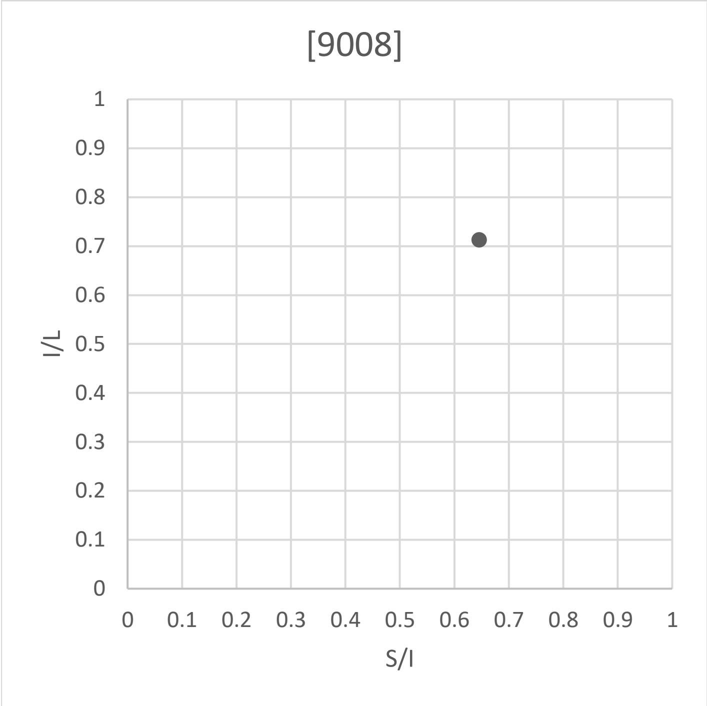
Weight (g)		
Total	**Mean**	**Range**
2567	641.8	12 - 2509



Four pieces of sarsen stone were recorded with context [9001], a void number. They include a large sub-equant spheroid light grey to very pale brown unworked cobble weighing 2,509g. The three other items were very small broken fragments. Item 9001/002, weighing 12g, was a very angular, highly equant, burnt and cracked piece possibly from a quern or polisher, with one very smooth, dished face. The two remaining fragments were both small quite equant pieces, neither of which appear to have been burnt.

3.47 Trench H [9008], Phase 10 (Modern)

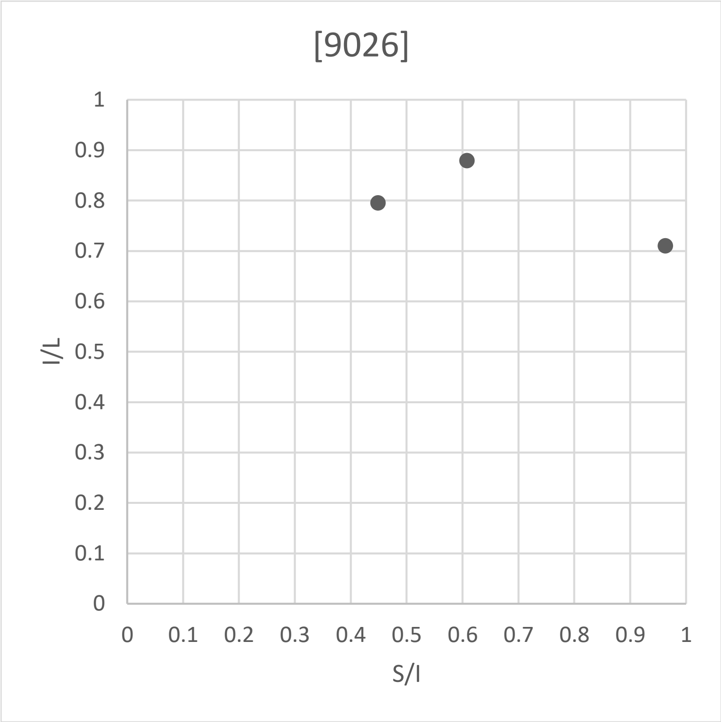
Stone type		
Saccharoid	Quarzitic	Conglomerate
1	0	0
Completeness		
Fragment	Complete	
1	0	
Cortex		
Absent	Present	
1	o	
Burning		
Unburnt	Burnt	
1	0	
Weight (g)		
Total	Mean	Range
270	-	-



Item 9008/001 is a sub-equant spheroid piece of saccharoid sarsen. The very pale brown to white stone is possibly a hammerstone fragment; sub-parallel cracks to one rounded edge may be the result of battering, but the piece is quite worn. Context [9008] was subsoil to Trench H, and the damage to this piece of stone may be the result of largely mechanical weathering from cultivation processes.

3.48 Trench H [9026], Phase 8 (Medieval)

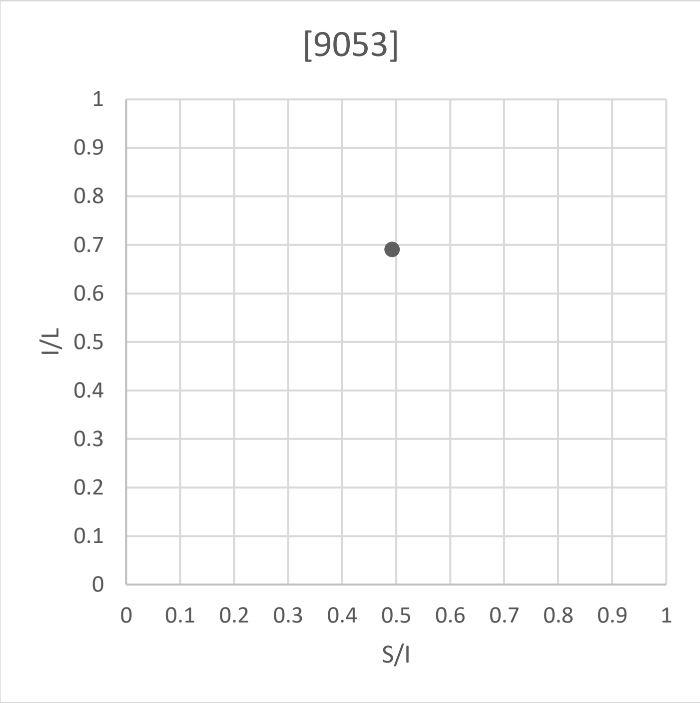
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
3	0	0
Completeness		
Fragment	**Complete**	
3	0	
Cortex		
Absent	**Present**	
1	2	
Burning		
Unburnt	**Burnt**	
1	2	
Weight (g)		
Total	**Mean**	**Range**
398	132.7	22 - 285



Four pieces of sarsen recovered from sandy deposits that had accumulated over the sequence of postholes in Trench H. The deposits are thought to be wind-blown, accumulating in the centuries following the prehistoric use and maintenance of the henge monument. Item 9026/001 is a fairly well-abraded oblate spheroid piece of sarsen weighing 285g. The other two pieces are smaller, more angular equant blocks. Their slightly pink cortex and patches in the interior may indicate that they had been burnt but there are no other signs of anthropogenic alteration.

3.49 Trench H [9053], Phase 2 (Early activity)

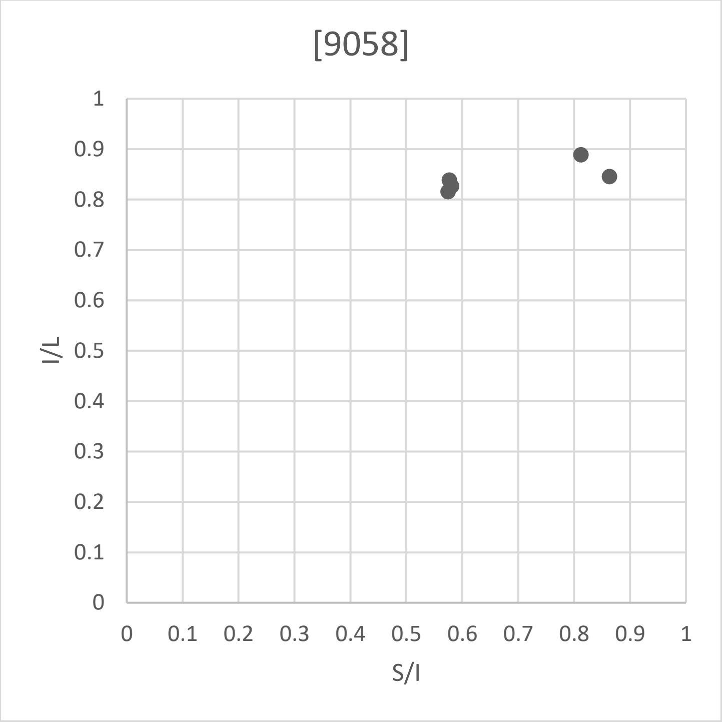
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
1	0	0
Completeness		
Fragment	**Complete**	
1	0	
Cortex		
Absent	**Present**	
0	1	
Burning		
Unburnt	**Burnt**	
1	0	
Weight (g)		
Total	**Mean**	**Range**
237	-	-



Item 9053/001 was recovered from the fill of a possible tree throw in Trench H. The stone is a sub-rounded oblate spheroid, pale brown to light grey, split from a larger, flattish, cobble. One end is formed by a cleanly snapped break, although there is no obvious point of percussion.

3.50 Trench H [9058], Phase 8 (Medieval)

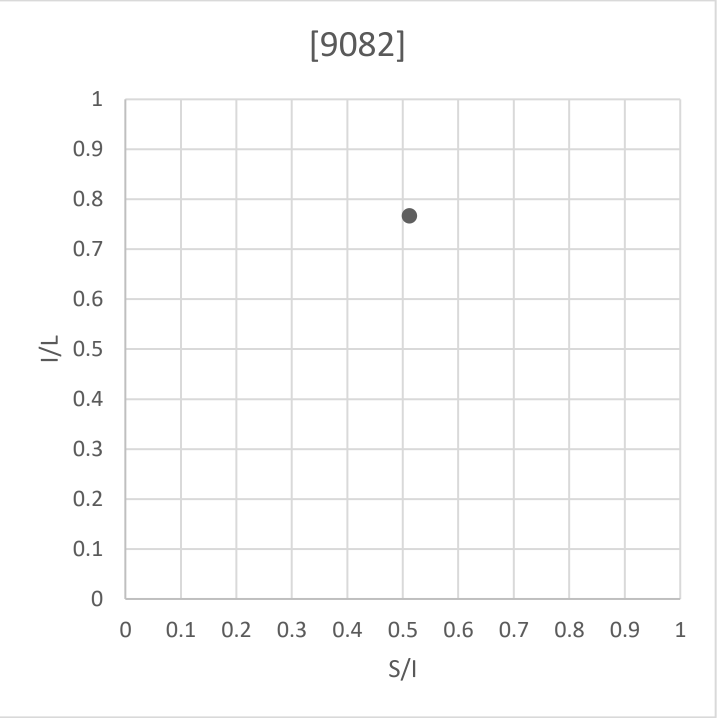
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
3	2	0
Completeness		
Fragment	**Complete**	
5	0	
Cortex		
Absent	**Present**	
3	2	
Burning		
Unburnt	**Burnt**	
0	5	
Weight (g)		
Total	**Mean**	**Range**
193	38.6	5 - 84



Five pieces of sarsen recovered from sandy deposits that had accumulated over the sequence of postholes in Trench H. These items are smaller and more angular than the four pieces from context [9026]. Items 9058/004 and 9058/005 re-fit, and both are similar in colouration to item 8007/001.

3.51 Trench H [9082], Phase 1 (Natural)

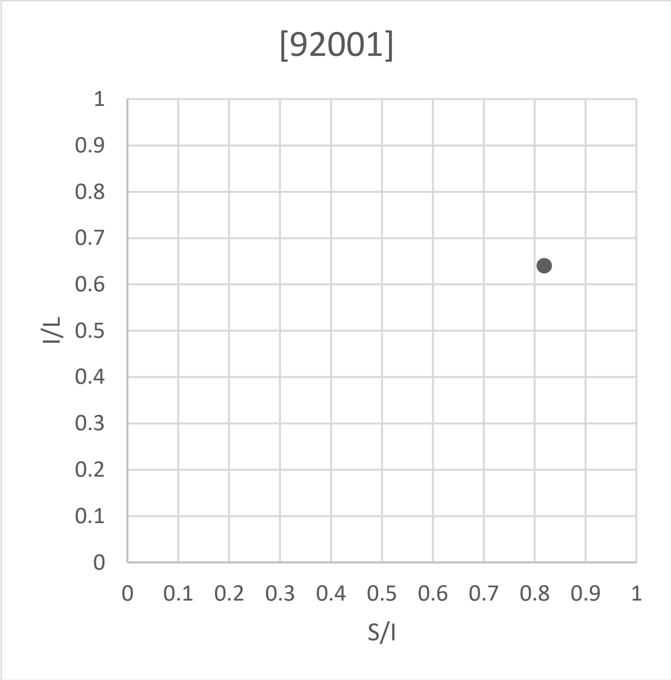
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
0	1	0
Completeness		
Fragment	**Complete**	
1	0	
Cortex		
Absent	**Present**	
0	1	
Burning		
Unburnt	**Burnt**	
1	0	
Weight (g)		
Total	**Mean**	**Range**
1526	-	-



Item 9082/001 is SF504. It is part of a hammerstone. The greyish brown to light grey rounded oblate spheroid weighs 1,526g. It has battering damage, including the loss of spalls leaving small flake scars, to both ends. The crushing damage is more substantial at one end, where the cobble split. The crushing at the opposite end is less significant but is above one large flake scar. It was recovered from context [9082], a widespread greyish brown gravel overlying periglacial stripes in Trench H at the eastern entrance to the main henge.

3.52 Trench B [92001], Phase 7 (Post-medieval)

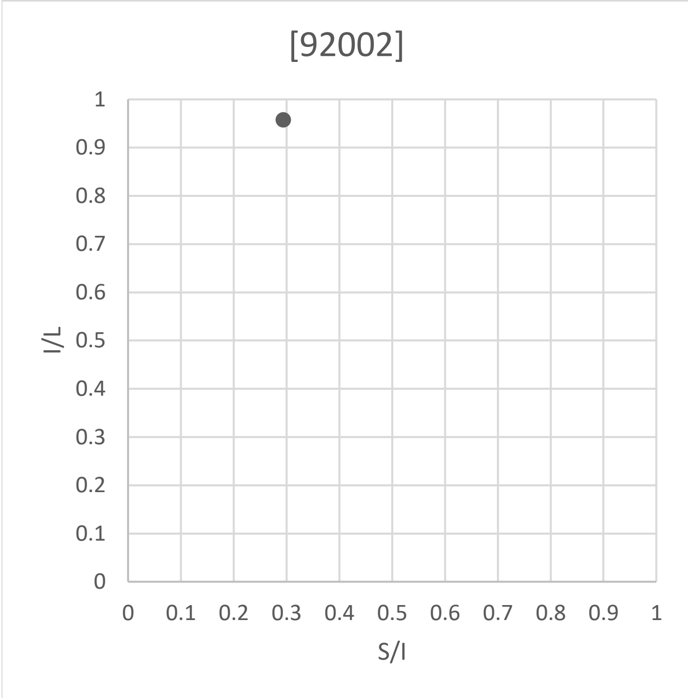
Stone type		
Saccharoid	Quarzitic	Conglomerate
1	0	0
Completeness		
Fragment	Complete	
1	0	
Cortex		
Absent	Present	
0	1	
Burning		
Unburnt	Burnt	
1	0	
Weight (g)		
Total	Mean	Range
-	-	-



Item 92001/001 is a large sub-rectangular block (too large for the available scales, weight TBC). It was recovered from a late fill of the main henge ditch. Areas of pale grey more highly silicified rind on the surface are in places impinged by small flake scars, possibly resulting from damage by freeze/thaw. The rounded sides and corners are weathered. One long and one short side are possibly intentionally split faces, but no crushing or impact points are visible. The regularity of form makes this ‘shaping’ look all the more deliberate, but there are cracks in the stone, some partial ‘root casts’ in the surface and variable silicification, indicating that natural weaknesses in the boulder could have failed, from which the shape arises.

3.53 Trench B [92002], Phase 6 (Post-enclosure phase)

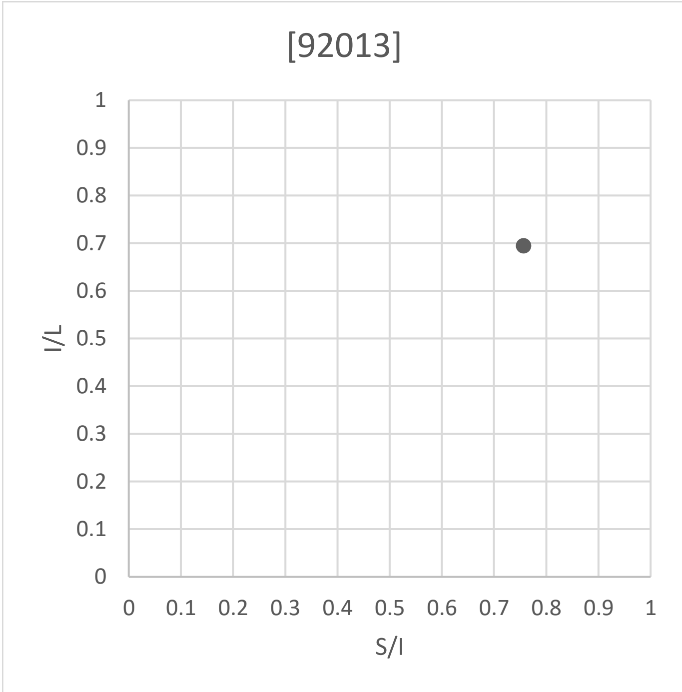
Stone type		
Saccharoid	Quarzitic	Conglomerate
1	0	0
Completeness		
Fragment	Complete	
1	0	
Cortex		
Absent	Present	
1	0	
Burning		
Unburnt	Burnt	
1	0	
Weight (g)		
Total	Mean	Range
93	-	-



Item 92002/001 is SF3059. In the 2010 excavation report it is described as a burnt flake broken at the distal end (2013, 159). There are no indications of burning, however. The 93g flake-like piece has a possible diffuse percussion platform and bulb of percussion, and flake scars to the dorsal face. There are no parallel cracks in the possible platform, nor an erailure scar or flake removal on the bulb in the direction of force, which struck sarsen tends to display. Small partially-detached flakes on the ventral surface are in multiple directions. It was recovered from a late fill of the main henge ditch.

3.54 Trench B [92013], Phase 5 (Neolithic, main henge enclosure)

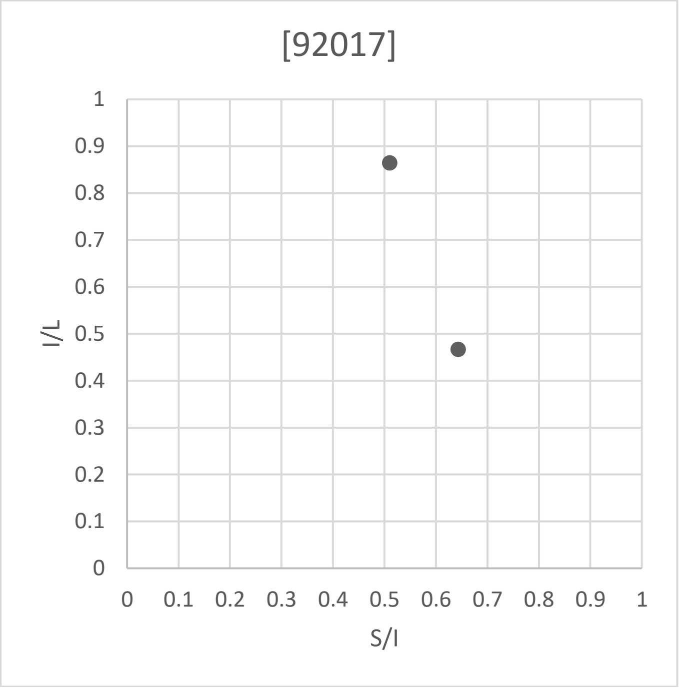
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
1	0	0
Completeness		
Fragment		**Complete**
1		0
Cortex		
Absent		**Present**
1		0
Burning		
Unburnt		**Burnt**
0		1
Weight (g)		
Total	**Mean**	**Range**
1069	-	-



Item 92013/001 is a large sub-equant block of saccharoid sarsen found in a fill of the main henge enclosure ditch. Its angularity, pinkish grey colour and cracks throughout indicate that it has been burnt. The more rounded faces on one side of the piece are perhaps the original outer surface of the parent boulder, whilst the opposing sharp, cleanly broken, faces show where cracks failed and the block came away from its parent boulder.

3.55 Trench B [92017], Phase 3 (Neolithic, main henge enclosure)

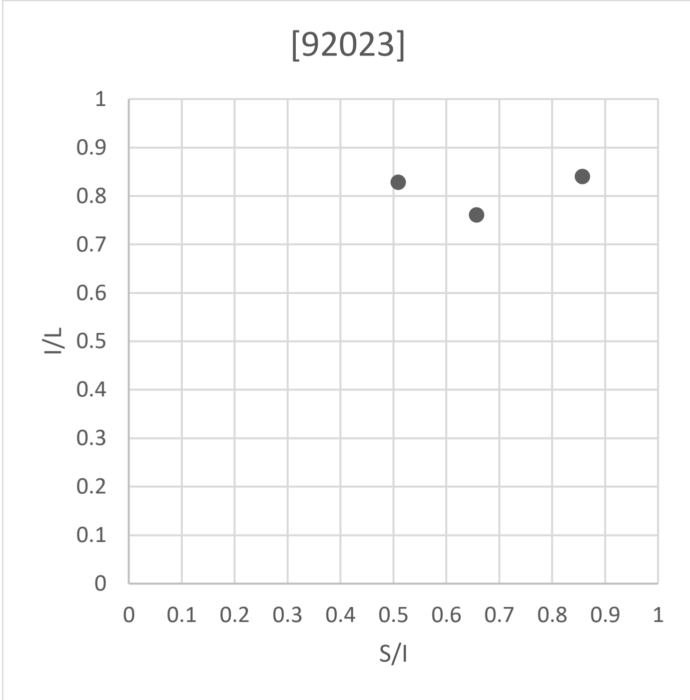
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
2	0	0
Completeness		
Fragment	**Complete**	
2	0	
Cortex		
Absent	**Present**	
2	0	
Burning		
Unburnt	**Burnt**	
0	2	
Weight (g)		
Total	**Mean**	**Range**
101	50.5	27 - 74



Two small pieces of pale grey saccharoid sarsen were recovered from this fill of the main henge enclosure ditch, a dark loamy sand 0.38m thick which also contained Grooved Ware sherds, an assemblage of struck flint and SF33688, the broken stem of a ripple-flaked oblique arrowhead. The angularity and cracks in the sarsen suggest that it had been burnt.

3.56 Trench B [92023], Phase 3 (Neolithic, main henge enclosure)

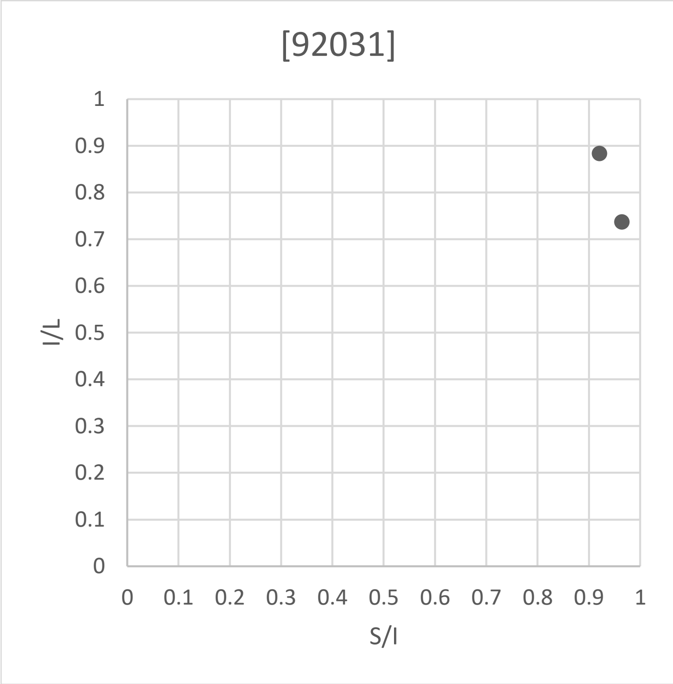
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
3	0	0
Completeness		
Fragment	**Complete**	
3	0	
Cortex		
Absent	**Present**	
2	1	
Burning		
Unburnt	**Burnt**	
1	2	
Weight (g)		
Total	**Mean**	**Range**
138	46	8 - 95



Three small pieces of saccharoid sarsen were recovered from this fill of the main henge enclosure ditch, along with fragments of Greensand, Grooved Ware sherds, and struck flint assemblage, animal bone and charcoal fragments. Three of the Grooved Ware sherds joined. The sarsen includes two highly abraded pieces, both of which are cracked and have the dry, light feel of burnt sarsen. The third piece is a flake-like piece weighing 95g. That has a possible point of percussion above one face including a sub-parallel crack, and a possible diffuse erailure scar to the ventral face.

3.57 Trench B [92031], Phase 3 (Neolithic, main henge enclosure)

Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
2	0	0
Completeness		
Fragment	**Complete**	
2	0	
Cortex		
Absent	**Present**	
2	0	
Burning		
Unburnt	**Burnt**	
0	2	
Weight (g)		
Total	**Mean**	**Range**
94	47	30 - 64



These two pieces of light grey, cracked, burnt sarsen re-fit. They have Greensand concretions adhering to one face and were recovered from a loose, dark, bluish-grey loamy sand which included two small heavily burnt flint flakes as well as animal bone fragments and a very small sherd of Grooved Ware. The deposit is a lower fill of the main henge enclosure ditch.

3.58 Trench C [93002], Phase 5 (Neolithic, main henge enclosure)

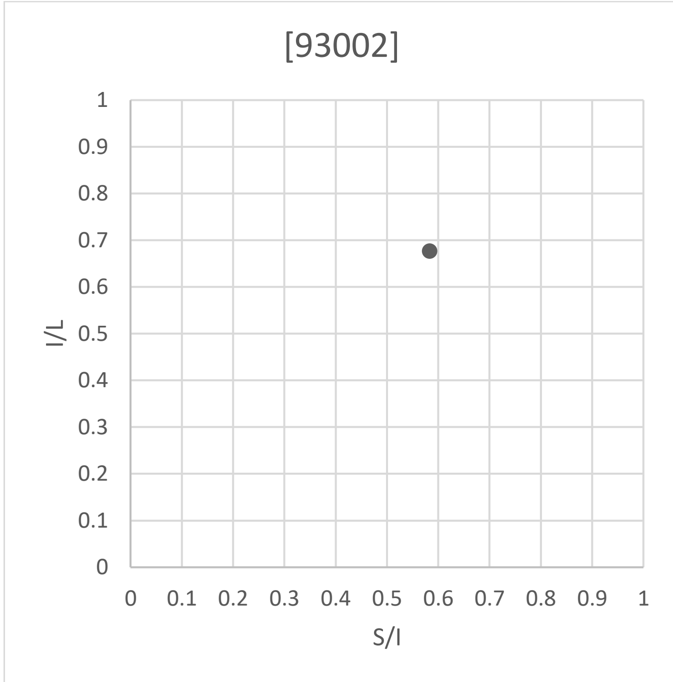
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
0	1	0

Completeness	
Fragment	**Complete**
1	0

Cortex	
Absent	**Present**
0	1

Burning	
Unburnt	**Burnt**
1	0

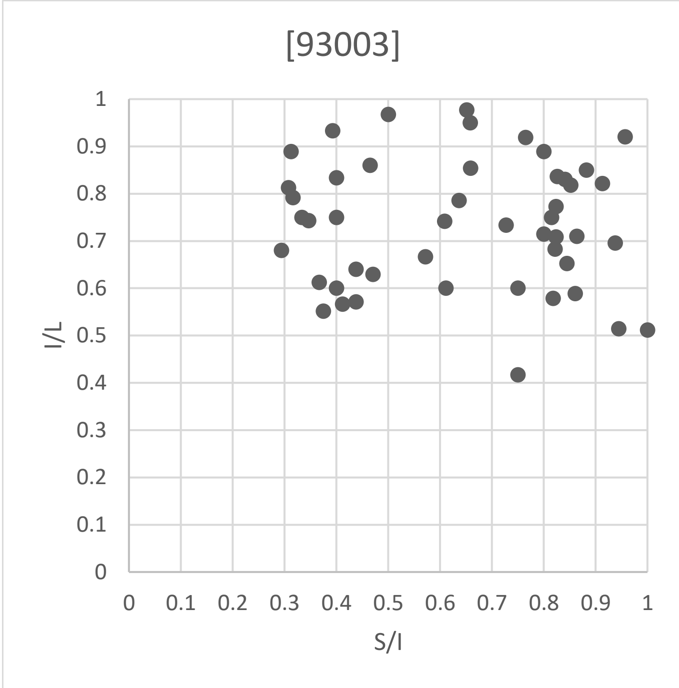
Weight (g)		
Total	**Mean**	**Range**
2301	-	-



This light grey to very pale brown weathered sarsen cobble was found in bank material of the inner henge bank. The deposit represented later remodelling of the inner henge bank and overlay the bank’s two revetting rubble walls. The context included seven Grooved Ware sherds. The cobble is unmodified.

3.59 Trench C [93003], Phase 4 (Neolithic, main henge enclosure)

Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
48*	0	0
Completeness		
Fragment		**Complete**
48		0
Cortex		
Absent		**Present**
39		9
Burning		
Unburnt		**Burnt**
17		31
Weight (g)		
Total	**Mean**	**Range**
978	20.4	1 - 114

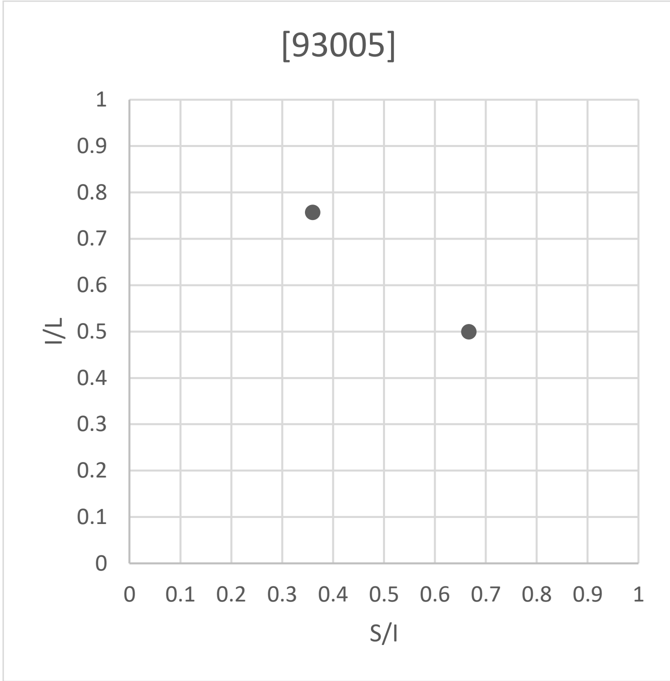


Context [93003] excavated during the 2010 season is the burnt spread surrounding the external hearth or site of *in situ* burning outside the Neolithic building in the south-west of the main henge enclosure. In later excavation seasons more of the deposit was excavated as [1006] and ancillary contexts (see above); they include large quantities of burnt sarsen. The assemblage from [93003] is similar to that recovered in 2015 and 2016, including the colour range of pieces, high angularity and largely sharp, clean broken surfaces. Item 93003/011 is possibly a sarsen quern fragment, which can be associated with two pieces of possible quern or polisher and two possible rubber fragments in context [1006].

*and 63 pieces <1g, unrecorded.

3.60 Trench C [93005], Phase 5 (Neolithic, main henge enclosure)

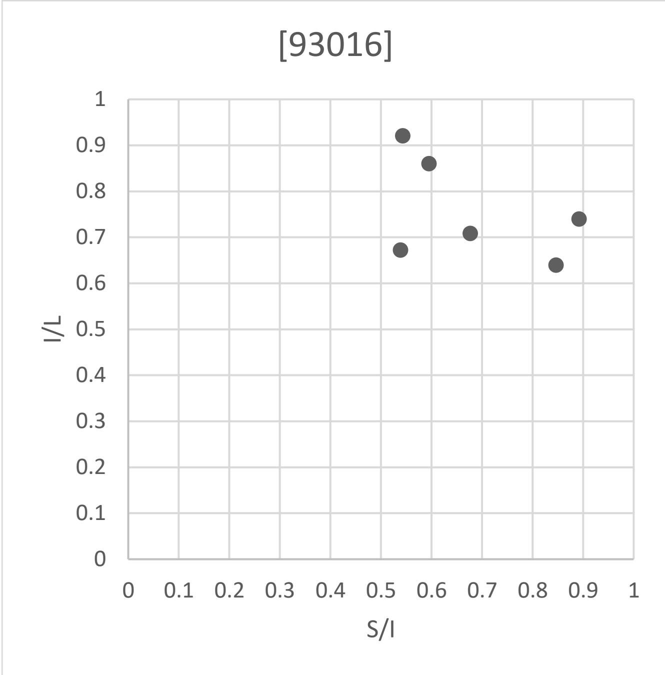
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
2	0	0
Completeness		
Fragment	**Complete**	
2	0	
Cortex		
Absent	**Present**	
0	2	
Burning		
Unburnt	**Burnt**	
0	2	
Weight (g)		
Total	**Mean**	**Range**
10	5	3 - 7



These two saccharoid sarsen fragments were originally one piece, SF33769, which has broken in storage. Pale grey cortex to the dorsal face contrasts with the pale red interior colour. Originally it was a flake-like piece with clean breaks to either end. Context [93005] is a deposit of the inner henge bank remodelling, sealing the midden and burnt spread and remains of the Neolithic building's chalk surface.

3.61 Trench C [93016], Phase 5 (Neolithic, main henge enclosure)

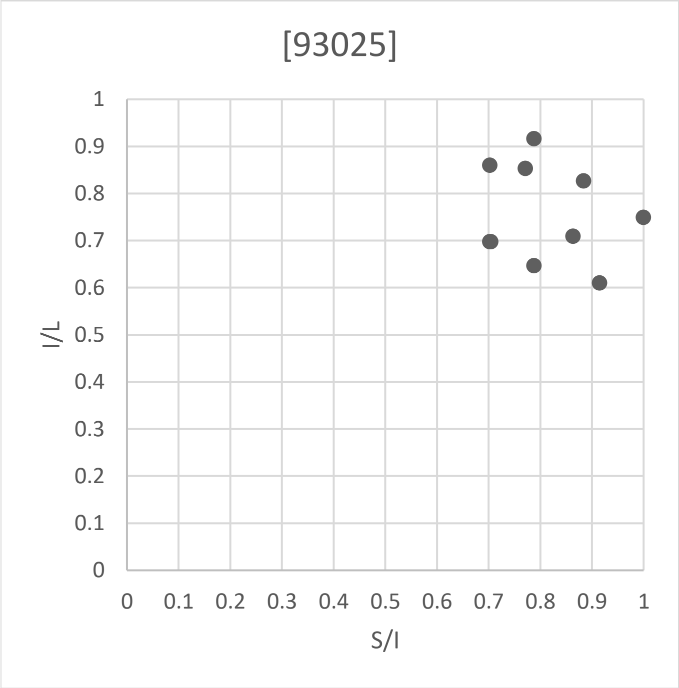
Stone type		
Saccharoid	Quarzitic	Conglomerate
5	0	1
Completeness		
Fragment	Complete	
6	0	
Cortex		
Absent	Present	
3	3	
Burning		
Unburnt	Burnt	
0	6	
Weight (g)		
Total	Mean	Range
283	47.2	20 - 84



Context [93016], a clean sand layer including animal bone fragments, was part of the inner henge bank remodelling. It included five pieces of relatively equant saccharoid sarsen with colours ranging from light grey to weak red. Their angularity, colour, one cracked piece and the commonly dry, light, feel indicated that they had been burnt. Items 93016/003 and 93016/004 may re-fit. The deposit has the only example of a more conglomeratic silcrete: item 93016/001 comprises approximately 25% by area quartz/flint granules up to 1.5mm wide, moderately sorted, in the matrix. This is the only example of this silcrete type observed in the total sarsen assemblage.

3.62 Trench C [93025], Phase 4 (Neolithic, main henge enclosure)

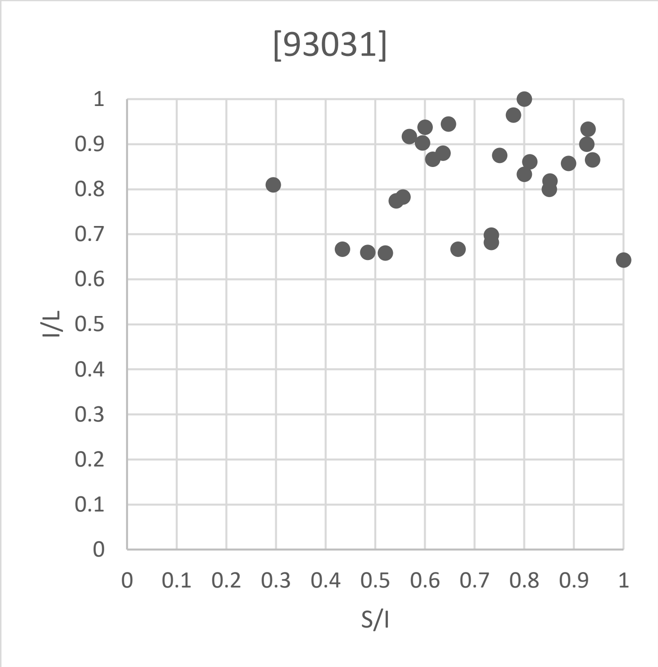
Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
10	0	0
Completeness		
Fragment	**Complete**	
10	0	
Cortex		
Absent	**Present**	
8	2	
Burning		
Unburnt	**Burnt**	
2	8	
Weight (g)		
Total	**Mean**	**Range**
591	59.1	8 - 148



Context [93025], a fill of posthole [93024], was derived from the burnt spread (see also [93003], [1006], [1035], [1038], [2111]) outside the chalk surface. It contained charcoal and two pieces of animal bone. The small sarsen pieces are all relatively equant, angular to sub-angular, ranging from grey to weak red in colour. Only one piece is abraded, the rest have sharp edges. Two pieces had remaining cortex. These ten pieces of sarsen are similar to the rest of the assemblage from the burnt spread, except that they are on the whole larger (mean weight 59.1g, compared to 17.9g from [1006], 26g from [1035], 30g from [1038] but 56.1g from [2111]).

3.63 Trench C [93031], Phase 4 (Neolithic, main henge enclosure)

Stone type		
Saccharoid	**Quarzitic**	**Conglomerate**
27	0	0
Completeness		
Fragment	**Complete**	
27*	0	
Cortex		
Absent	**Present**	
26	1	
Burning		
Unburnt	**Burnt**	
6	21	
Weight (g)		
Total	**Mean**	**Range**
468	17.3	1 - 98



Context [93031], along with [93043], was a finds-rich midden deposit outside the chalk floor (recorded as [1026] and [1080], Phase 3b, Neolithic, midden activity in the 2015 season). The small sarsen pieces in [93031] are similar to those from [1026]: the majority (24, 89%) are sub-angular to very angular, most are burnt or heat-affected and relatively equant in form except for a few flatter pieces, although none of those are flakes caused by percussion and include only one flake-like piece (but which has no indications of percussion). On the whole the items have sharp, cleanly broken faces but five are abraded. Some pieces have a similar mottled colouration to items in [1026], suggesting that the material is derived from a relatively small number of original cobbles.

*and 18 small pieces <1g, unrecorded

4 PHASED ASSEMBLAGE

(Phase numbers are taken from the separate interim reports on each excavation season, and may be subject to change)

4.1 Marden henge

The bulk of the excavated sarsen stone came from the Marden henge trenches.

Phase 1, Natural

Three sarsen stone items were recovered from natural [6051] at the main henge enclosure. These include SF313 and SF316, two small pieces of weathered unburnt broken cobble, which are to be expected given the presence of sarsen stone in association with Greensand (Geddes, 2000, 60, Jones, 1949, Osborne White, 1925). The third item, from a gravel [9082] overlying periglacial stripes in the environs of the main henge's south-eastern entrance, is part of a hammerstone (SF504). In the absence of a categorisation scheme of characteristics distinguishing sarsen stone hammerstones of different periods, which may not be possible given their informal nature, this tool can only be assigned to a general period leading up to the construction of the main henge. The possible influence of the periglacial stripes in the construction of the henge bank suggests that the stripes were visible in some form in the Neolithic (Leary, 2017, 27).

Phase 2, early activity

A small piece of broken sarsen cobble was found in context [9053], a fill of a possible tree-throw [9052]. This feature was amongst a group of possible tree-throws at the south-eastern entrance of the main henge, perhaps representing an episode of tree clearance (Leary, 2017, 9). Ten pieces of sarsen stone were found in contexts [7004], [7005], [7015] and [7025] amongst the sequence of colluvial layers overlying the natural excavated in Trench G (placed to explore a possible spring-head within the main enclosure). Whilst six were unworked complete or broken natural cobbles, two pieces were burnt fragments and two were tools, 7004/001 (a possible hammerstone) and 7004/002, a burnt part of a rubber with well-developed smooth surfaces to its opposing convex faces. Context [7004] containing these tools and the other burnt fragments was colluvium from 0.15m to 0.2m thick sealing the accumulations below and cut by Neolithic features. The two sarsens from [7005] are the largest recovered from the site, weighing 9,910g and 17,000g each.

Phase 3a, Neolithic settlement

Numerous small finds were found in context [1519], the Old Ground Surface found in the south-western area of the main henge enclosure where a Neolithic building had been built. They included SF274, a light grey to grey sub-equant block of saccharoid sarsen stone with a small area of cortex surviving to one face. Weighing 77g, it is sub-angular with cracks running through the stone suggesting that it had been burnt, although the colouration was unaltered. A possible soil horizon [2113] which may have been part of the Old Ground Surface, and which included animal bone, included two small sub-equant blocks of light grey to light pink saccharoid sarsen stone. These items re-fit. Their angularity and colouration, as well as the re-fitting crack, indicate that they had been burnt.

The charcoal-rich fill [1029] of stakehole [1033] of the building whose sunken floor cut the Old Ground Surface included four small pieces of broken saccharoid sarsen They had all been burnt. Items 1029/001-003 have similar colouration and although they do not re-fit they may have come from the same parent cobble. It is likely that the stone in [1029] is derived from the considerable quantities of burnt sarsen found in the overlying midden deposits [1026] and [1080] and burnt spread [1006] (Leary, 2018, 15).

Phase 3b, Neolithic midden activity and burnt spread

In total, 411 pieces of sarsen stone came from the midden contexts [1026] and [93031] (70 pieces) and the burnt spread contexts [1006], [1035], [1038], [2111] and [93003] (341 pieces). A further 124 fragments weighing less than 1g from the burnt spread and 18 from the midden contexts were counted but not recorded. These deposits were beside and in part covering the chalk surface of the building explored in Trench A/A*/A** (Vale of Pewsey Project) and in Trench C of the earlier 2010 season.

The pieces from midden contexts [1026] and [93031] are very angular to sub-rounded pieces of broken sarsen, the majority of which had been burnt. They are relatively equant in form except for a few flatter, more elongate, pieces, although none of those are flakes caused by percussion and include only two flake-like pieces. Item 1026/002 is the largest piece in the assemblage. Its mottled reddish grey to light grey colouration matches that of other pieces in the assemblage, suggesting that much of the material comes from one parent cobble. Some pieces from [93031] have a similar mottled colouration. Eight pieces from [1026] re-fit in three groups, and although items 1026/026-028 do not re-fit they are also very similar, suggesting that overall the material is derived from a relatively small number of original cobbles. This is consistent with the interpretation of this deposit as the result of a single episode of food preparation (Leary, 2018, 34).

The pieces of sarsen from contexts comprising the burnt spread associated with an external hearth include 261 burnt pieces. The remaining 80 items did not exhibit the colouration or cracking to be expected from burning, but their high angularity and association with the burnt pieces suggests that they too resulted from the same process. Although tending to be relatively equant in form, the assemblage in context [1006] includes numerous crescentic flake-like pieces which fall into more platy and elongate form classes. Only one, however, is a flake with a platform. From [1038], four small flakes with platform-like proximal ends may have been removed by percussion, but other flake-like pieces did not have platforms or crushing to indicate that they had been struck. The majority of the crescentic flake-like pieces are likely to have resulted from exfoliation due to temperature change. The ten pieces of sarsen from [1035] and [2111] fit the profile of the larger assemblage from [1006], as do the 48 recorded pieces from [93003] including some with similar crescentic flake-like forms but only one with a possible point of percussion.

None of these items are very large; the mean weight is 28.0g. This is consistent with the possible use of sarsen stone for cooking, perhaps using the external hearth. Experience from unpublished experimental work demonstrates how small to medium-sized sarsen cobbles used as hearth stones, pot-boilers and as hot cooking stones become cracked, fall apart and exfoliate into chunks and crescentic flake-like pieces during and after the heating period.

The sarsen assemblage from context [1006] includes two possible quern or polisher fragments and two possible rubber fragments. One further possible quern or polisher fragment has been tentatively identified from context [93003]. These tools could have been caught up in the burning process accidentally, disposed of amongst the spread of burnt material around the external hearth. The intentional destruction of artefacts including querns has, however, been commented on in varied contexts (Chapman, 2000) including Neolithic ones, such as at the LBK site of Geleen-Janskamperveld where the very high degree of fragmentation in quern pieces suggests the ritual ‘killing’ of these tools (Verbaas and Van Gijn, 2007). The broken tools at Marden may be seen in this light, given that the cooking and middening subsequent to the building demolition may have been part of a closing ceremony (Leary, 2018, 35).

Phase 3, Neolithic main henge enclosure

Context [92031], an early fill of the main henge enclosure ditch, included two re-fitting pieces of light grey, cracked, sarsen with Greensand concretions adhering to one face, as well as two small, heavily burnt, flint flakes. Although few, these items suggest that activities in the henge enclosure included burning, perhaps in a hearth. Animal bone fragments and a very small Grooved Ware sherd were also recovered from this context.

Phase 4, Neolithic, building backfill and inner henge construction

Ten small pieces of sarsen stone were recovered from the backfill [1005] to the sunken floor of the building over which the inner henge was built. These very angular to sub-angular pieces are relatively flat to equant in form, including one flake and one flake-like piece. All bar one had been burnt. They could be derived from the adjacent spreads of midden and burnt material, distributed during the levelling which was carried out prior to the construction of the inner henge. Similarly, the sarsen in context [93025], a fill of posthole [93024] just to the north-east of the building, is thought to derive from the burnt spread (Leary 2018, 16). Its ten pieces of sarsen are similar to the rest of the assemblage from the burnt spread contexts, except that they are on the whole larger (mean weight 59.1g, compared to 17.9g from [1006], 26g from [1035], 30g from [1038] but 56.1g from [2111]).

Four of the contexts comprising inner henge bank material included sarsen stone. Bank deposit [1513] of re-deposited Greensand included a large sub-rounded unworked cobble weighing 3,587g. Contexts [2108] and [2119] were layers of gravel including a 3,471g rounded cobble and a 6,740g angular small boulder respectively. Whilst these simply may be examples of opportune useful building material, single cobbles like these do not obviously lend structural integrity to the Greensand and gravel layers making up the henge banks.

Sarsen stone was used throughout the Neolithic to construct significant and ritually-important monuments. It was used in visible ways such as façade and chamber stones of early Neolithic funerary monuments including the West Kennet long barrow and Wayland’s Smithy, and in hidden ways; for example, the unworked sarsens incorporated into layers within Silbury Hill’s earlier organic mound. At Silbury Hill, the significance of the material properties of the dense, heavy stone and its role in the creation process as one of many types of matter present in the landscape brought for incorporation into the monument are stressed by Leary et al. (2013). The difference in date and monument type notwithstanding, something similar may be seen in this use of cobbles in the Marden inner henge bank as symbolically-resonant matter or specially-selected objects rather than convenient building stones.

Context [2109], further re-deposited Greensand forming the inner henge bank, included a broken sarsen hammerstone and two re-fitting pieces of burnt sarsen, which are also cracked; they may have been excavated as one piece of stone which later fell apart in transit or storage. The broken hammerstone is a sub-rounded grey to light grey piece of quarzitic sarsen. Although it is possible that these items were accidentally caught up from the earlier contexts and deposited in the bank layer of loose Greensand during what Leary (2018, 36) envisages as the relatively rapid construction of the inner henge, their possible intentional placement along the lines of the unworked cobbles mentioned above should not be discounted.

Phase 4, main henge enclosure south-east entrance and eastern bank

The sarsen stone found in fills of pit [2007] in Trench B, in the environs of the henge south-eastern entrance, may also be seen in that light. The primary fill [2005] included three small pieces of burnt sarsen, two of which re-fit. One adjoining face of each of these two pieces is very flat, although rough to the touch. It is possible that this was a worked surface, damaged by burning, but there are no specific use-wear characteristics other than the flatness of the faces. Secondary fill [2004] included three very small pieces of sarsen. Although they are small enough to have been included unintentionally in the fill, it included pottery and struck flint which appeared to have been deliberately placed into discrete areas within the pit (Leary, 2018, 25, 35). The upper fill [2003] contained two re-fitting pieces of burnt sarsen as well as Grooved ware and struck flints.

To the north-east of Trench B, Trench J was laid out to investigate a heavily truncated section of the main henge bank on the eastern arc of the monument. Whilst 42.3% of the overall sarsen assemblage came from the midden and burnt spread deposits of Phase 3b inside the main henge enclosure, 41.5% came from the fills of two pits in the sequence of Phase 4 bank deposits investigated in Trench J.

The primary fill [2224] and secondary fill [2218] of pit [2219] contained 289 pieces of sarsen stone. In fill [2224], the assemblage is SF614. These very angular to sub-rounded fragments, the majority of which had clear indications that they had been burnt, included one piece of possible hammerstone. The assemblage from fill [2218] is SF613, 145 very angular to rounded broken pieces of sarsen stone, the majority of which had been burnt. Those items included one small piece of possibly dressed sarsen and two possible quern fragments. The pieces in SF613 are relatively equant but include some more platy and elongate fragments. Crescentic flake-like pieces which do not have platforms or signs of crushing damage from percussion probably resulted from exfoliation due to temperature change. Both assemblages SF614 and SF613 have similar profiles in terms of number of pieces, form, frequency of pieces retaining cortex and frequency of pieces with clear indications of having been burnt. Items in SF614, however, are on average smaller than those in SF613, with a smaller weight range and mean weight of 40.6g compared to 54.9g.

From pit [2227], SF615 in pit fill [2226] comprises a smaller sarsen assemblage of 41 items. The majority of the sub-angular to sub-rounded pieces had been burnt, including one fragment of possible quern or polisher and one fragment of possible rubber. Three pieces re-fit and although other refits were not observed, some fragments of stone have similar colouration and texture and may be parts of the same parent cobbles. Although on the whole relatively equant, half of the pieces making up SF615 are more elongate and platy fragments including numerous flake-like pieces, one of which had a possible platform. In other respects, including the number of corticated pieces, burnt pieces and mean weight, SF 615 is similar to SF613 and SF614.

Taken together, these features and their contents show a pattern of deposition during the creation of the main henge enclosure involving substantial quantities of shattered, angular, largely burnt sarsen stone pieces, some of which were derived from tools. There is no indication where the sarsen in these pit fills came from. The small number of pieces in the fills of pit [2007] and the large quantities in the fills of pits [2219] and [2227] could have been collected from a context such as a domestic hearth but the possible structured deposition in pit [2007] and the sheer quantity of material in SF613 and SF614 may indicate specially-prepared assemblages or burnt stone gathered from another important activity. On average the sarsen pieces from the midden and burnt spread deposits, where material of all sizes might be expected to have been left amongst the rubbish, are smaller than the sarsen in the fills of pits [2219] and [2227], where an element of selection may have been in play:

Features	Total count	Total weight (g)	Mean weight (g)	Weight range (g)
Burnt spread and midden contexts [1006] [1035] [1038] [2111] [93003] [93031]	411	11,514	28.0	1 – 1277
Fills of pits in the henge bank [2218] [2224] [2226]	330	16,052	48.6	1 - 1072

Comparison of sarsen pieces from Neolithic midden and burnt spread deposits with sarsen pieces from main henge bank pit fills.

Phase 4, inner henge central area

Very little sarsen stone came from the central area inside the inner henge. Context [6041], the fill of posthole [6048], included an unworked quarzitic sarsen cobble weighing 3,408g. A small piece of broken quarzitic sarsen was in context [6045], the fill of cut [6069]. It is not clear if small flake scars to the thinnest end are the result of intentional or natural damage.

Three burnt pieces of sarsen were recovered from context [6049], the loose clay sand backfill to a possible post-pipe, associated with pit [6046] also in the centre of the inner henge. Item 6049/003 was SF308, a weak red to pale red angular sub-equant block weighing 1,628g. Its texture, colouration and cracking are similar to 6049/002 and although they do not re-fit they may be derived from the same parent cobble. After measurement, item 6049/001 broke into two pieces along the line of a crack caused by burning.

Finally, a possible sarsen hammerstone SF307 was found in context [6054], the fill of pit [6044]/[6082]. This light grey, sub-rounded, oblate spheroid piece of saccharoid sarsen seems to have light crushing damage on one point but the slight parallel cracks visible with a hand lens are not definitive. Three opposite faces are each formed of flake scars although impact points are not clear.

Phase 4, inside the main henge enclosure

In Trench G, placed to explore a possible spring-head within the main enclosure, three pits were found cutting colluvial layers. Fill [7008] of pit [7013] included one small piece of burnt sarsen stone, and another came from fill [7009] of pit [7014]. Fill [7008] included pottery and a small quantity of calcined bone, and fill [7009] had frequent charcoal inclusions and signs of burning (Leary, 2017, 13-14).

Phase 5, Neolithic, late enclosure phase

A sequence of deposits formed as the main henge enclosure ditch continued to infill. One piece of burnt sarsen in ditch fill [92013] came from one end of a larger boulder, broken where interior cracks failed perhaps associated with thermal shock.

Two pieces of sarsen stone were found in the inner henge bank remodelling deposits, one cobble recovered from [93002] that overlay the bank’s revetting stone walls and a very small broken piece SF33769 from [93003]. That latter context sealed the earlier midden, burnt spread and chalk surface deposits as did [93016], another of the remodelling contexts. Five small pieces of burnt sarsen and one small piece of burnt conglomeratic silcrete were found in [93016]. Given the amount of broken sarsen in the midden and burnt spread deposits, it is surprising that there are not more sarsen pieces in these remodelling deposits, especially if that construction work happened relatively soon after the earlier building was demolished (Leary 2013, 33-4).

Phase 6, medieval

A few pieces of sarsen stone came from the sandy deposits, possibly wind-blown (Leary, 2017, 14), that had accumulated over the sequence of postholes in Trench H in the environs of the main henge enclosure south-eastern entrance. They include a fairly well-abraded oblate spheroid piece of sarsen weighing 285g and two pieces are smaller, more angular equant blocks, possibly burnt, from context [9026]. There were also five pieces from [9058]. They are smaller and more angular than the four pieces from context [9026] and two re-fit. The sarsen perhaps derives from prehistoric contexts that had begun to erode as the land was brought into cultivation. One piece of sarsen stone came from a later fill [92002] of the main henge enclosure ditch. Perhaps deliberate infilling relating to Roman or medieval ploughing, this item may also have come from an earlier context. The break to the distal end of this flake-like piece of sarsen could have occurred during cultivation.

Phase 7, post-medieval

The large sarsen block from [92001] appears to look shaped, but this may have resulted from freeze-thaw action on internal weaknesses in the stone. There are no clear indications of percussion or intentional shaping. The block came from a late fill of the main henge enclosure ditch which included a brown post-medieval bottle neck as well as residual earlier material. The piece of sarsen is large and heavy enough to have been intentionally moved to its location, either for clearance or to be a marker of some sort.

Phase 10, modern

Eleven pieces of sarsen stone came from topsoil and subsoil [1001] and [7002] and two pieces from the backfill [1002] to the 2010 excavation season trench. A possible hammerstone fragment came from [9008], the subsoil to Trench H. The sub-parallel cracks to one rounded edge may be the result of battering, but the piece is quite worn; the damage to this piece of stone may be the result of largely mechanical weathering during cultivation activity.

4.2 Wilsford henge

A small amount of sarsen stone was excavated from Wilsford henge contexts.

Phase 4, Neolithic

Cut [4047] included SF183, a grey to light grey piece of quarzitic sarsen weighing 3,788g. The sub-equant spheroid with black flecks across some of its pale surfaces was part of a group of natural features cutting the cobbled surface to the centre of Wilsford henge. The cobble had not been burnt; the black flecks are not charcoal or sooting.

Context [4081] was mid-yellow brown clayey sand c0.35m thick, one of the earliest fills of the Wilsford henge ditch. It contained an assemblage of large animal bones and one small sub-angular piece of light grey to pale red saccharoid sarsen stone. Its angularity and colouration suggest that it had been burnt. Four small pieces of angular to sub-angular burnt sarsen were recovered from context [4072]. Three of the pieces re-fit. The dark grey brown clayey silt and redeposited Greensand fill in the Wilsford henge ditch, overlying the earliest ditch fills, included a flint arrowhead (SF192) and SF 193 (flint) and SF195 (animal bone).

Phase 6, Late Bronze Age/Early Iron Age

Context [4053] was ditch backfill above the Bronze Age burial in the Wilsford henge ditch. The dark black grey clay silt had frequent charcoal inclusions and an assemblage of pottery, animal bone and other material suggesting that it derived from a midden (Leary, 2018, 31). Two small pieces of burnt sarsen stone, one very angular and the other sub-angular, were also in the deposit, consistent with this interpretation. The finds-rich dark grey-black/grey silty clay layer [4039] above ditch fill [4053] included a large piece of saccharoid sarsen, SF69 [SF69 on the finds bag, SF67 noted in the VoP 2015 assessment report]. The dark grey to grey sarsen piece is a long piece of broken cobble. From its broader end one face comprises what is in effect a step fracture, which has slight sub-parallel cracks to its platform-like surface. These small cracks are not very pronounced and it is not clear that the broken faces of the stone are anthropogenic.

5 REFERENCES

ABBOTT, M. & ANDERSON-WHYMARK, H. 2012. Stonehenge Laser Scan: Archaeological Analysis Report. Swindon: English Heritage.

ADKINS, L. & NEEDHAM, S. 1985. New research on a Late Bronze Age enclosure at Queen Mary Hospital, Carshalton. *Surrey Archaeological Collections,* 76**,** 11-50.

ATKINSON, R. J. C. 1956. *Stonehenge,* London, Hamish Hamilton.

BLOTT, S. J. & PYE, K. 2008. Particle shape: a review and new methods of characterization and classification. *Sedimentology,* 55**,** 31-63.

CHAPMAN, J. 2000. *Fragmentation in Archaeology. People, Places and Broken Objects in the Prehistory of South Eastern Europe,* London, New York, Routledge.

GEDDES, I. 2000. *Hidden Depths. Wiltshire's Geology and Landscapes,* Trowbridge, Ex Libris Press.

GILLINGS, M., POLLARD, J., WHEATLEY, D. & PETERSON, R. 2008. *Landscape of the Megaliths. Excavation and fieldwork on the Avebury monuments, 1997-2003.,* Oxford, Oxbow Books.

JONES, J. B. 1949. Wiltshire's Oldest Sarsens. *Wiltshire Archaeological and Natural History Magazine,* 53**,** 131-3.

LEARY, J. 2013. Marden Henge Excavations, Wiltshire, 2010. Stage 2, Project Number 5219. Archaeological Assessment Report. English Heritage.

LEARY, J. 2017. Vale of Pewsey Project, Season 2, 2016. Marden Henge and Wilsford Henge. Archaeological Assessment Report, Stratigraphy. University of Reading.

LEARY, J. 2018. The Vale of Pewsey Project, Season 1, 2015. Marden Henge and Wilsford Henge. Archaeological Assessment Report (Stratigraphy). University of Reading.

LEARY, J., CAMPBELL, G. & FIELD, D. (eds.) 2013. *Silbury Hill: the largest prehistoric mound in Europe,* Swindon: English Heritage.

OSBORNE WHITE, H. J. 1925. The Geology of the Country Around Marlborough: explanation of Sheet 266. London: HMSO.

PRYOR, F. 2001. *The Flag Fen Basin. Archaeology and Environment of a Fenland Labdscape,,* Swindon, English Heritage.

RUDLING, D. (ed.) 2002. *Downland Settlement and Land-use. The Archaeology of the Brighton Bypass,* London: Archetype Publications Ltd.

THOMPSON, N. P. 1971. Archaeological Research in the Pewsey Vale. *Wiltshire Archaeological and Natural History Magazine,* 66**,** 41-92.

VERBAAS, A. & VAN GIJN, A. L. 2007. Querns and other hard stone tools from Geleen-Janskamperveld. *In:* VAN DE VELDE, P. (ed.) *Excavations at Galeen-Janskamperveld 1990/1991.* Leiden: University of Leiden, Sidestone Press.

WHITAKER, K. A. 2020. Sarsen Working at Stonehenge. *In:* PARKER PEARSON, M., POLLARD, J., RICHARDS, C., THOMAS, J., TILLEY, C. & WELHAM, K. (eds.) *Stonehenge for the Ancestors. Part 1: Landscape and Monuments.* Leiden: Sidestone Press.

West Kennet Avenue occupation site excavations, 'Between the Monuments' project (2013, 2014, 2015)

Sarsen stone report

Katy Whitaker

This document was authored during a *South, West, and Wales Doctoral Training Partnership* studentship held at the University of Reading, and is supported by the Arts and Humanities Research Council grant number AH:L503939:1.

Sarsen stone from 'Between the Monuments' project excavations WKA13, WKA14 and WKA15

1 Introduction and Methodology

In total, 771 pieces of sarsen stone weighing 1g or greater were retained from three seasons of excavations at the West Kennet Avenue, Avebury (WKA13, 204, 26.5%; WKA14, 310, 40.2%; WKA15, 257, 33.3%). A slight majority (401, 52.0%) show signs of having been burnt, through their combination of colouration, cracking and high angularity (although see discussion below). Thirty-two items are tentatively identified as fragments of worked artefacts. Pieces of other sarsen tools may be present, but rendered unrecognisable by the loss of their shaped and worked surfaces. In addition to the majority of broken pieces of stone there are a few complete, unworked, cobbles and small boulders from various contexts including two used as packing stones (Table 1).

	count
Total sarsen pieces*	771
Burnt pieces	401
Total weight	97,177g
Weight range	1g – 4,414g
Complete cobbles	9
Possible tool fragments	32

*items <1g were counted separately by context (see Section 5) but not recorded in more detail and are not included in this table.

Table 1 Summary of the WKA sarsen assemblage.

Items were measured using a pebble box to capture their longest, intermediate and shortest dimensions oriented perpendicularly. The following attributes were also recorded:

- weight (g);
- roundedness (assessed visually using a standard geological roundedness index, Powers 1953);
- colour (noted twice from opposing faces in reference to a Munsell colour chart, the first recording a corticated face if present);

- stone type;
- presence/absence of cortex;
- cementation (a simple measure of friable/not friable);
- whether a broken fragment or complete cobble;
- type, location and degree of use-wear (if present);
- tool-type (if relevant);
- characteristics of burning (if present);
- evidence for percussion (if present).

Some pieces were photographed for reference purposes using a DSLR mounted on a camera stand and free-text notes were made if necessary. If required, significant surfaces of certain pieces were examined using a Leica S6E stereomicroscope.

In addition to the existing site code, trench number, square number, context number, feature number (if allocated) and phase, a unique identifier was allocated to each piece of sarsen based on the context number followed by a running number (for example, 603/001, 603/0002…). Those UIDs mentioned in this report can be cross-referenced to the complete dataset to find any given piece of stone in the accompanying datasheet (Excel workbook). The individual pieces of stone were not, however, marked with the UIDs. Possible tools were set aside in newly-labelled finds bags.

In this analysis, form is defined in terms of deviation from equancy using a method developed by Whitaker (2020), providing both a quantitative measure of relative equancy and a descriptive term for form. Sarsen stone can break sub-conchoidally, but on the whole pieces are chunky and irregular making them difficult to describe and categorise consistently. Neither is terminology derived largely from knapped flint analysis necessarily applicable to non-flint stone. That problem was also noted by Gillings *et al*. (2008, 319-322) in the analysis of remains of a sarsen standing stone in the Beckhampton Avenue, burnt and broken up in the eighteenth century. Very few of the sarsen pieces of the WKA assemblage display clear signs of mechanical or other fracture unlike that Beckhampton assemblage. Describing items as ‘flakes’, for example, thus risks implying technical action which may not be relevant.

Calculating a measure for form defined in terms of deviation from equancy using Maximum Projection Sphericity (MPS) and describing items with form factors (Blott and Pye 2008) avoids a process-based classification of form based on assumptions about mechanical fracture, and deals with the continuum of shapes which are not easily divided into hard and fast classes. The descriptive names and their boundaries are arbitrary and more normally applied to the analysis of sedimentary particles whose form is the result of natural process rather than highly varied human actions, but the method provides a useful indicative framework calculated from perpendicularly-measured longest (L), intermediate (I) and shortest (S) dimensions of each piece of stone.

Under evidence for percussion, items could be classed as flakes if they had identifiable flake attributes including for example being thin and feathered, with ridges to the dorsal face, a butt or possible platform, a bulb of percussion (if present, the bulb is usually diffuse). Sarsen flakes removed by percussion can also have crushing damage to the butt or sub-parallel cracks in line with the platform, and cracks in the ventral face extending from the point of percussion. It is also possible for sarsen removed by percussion to have no flake-like characteristics (Chan 2020, 312). Sarsen flakes can be produced by other processes, including thermally. Although some items were classed as flakes, free-text notes were used to summarise the evidence, if any, for percussion.

2 Summary

The bulk of the assemblage (717, 93%) comes from the soils and deposits excavated in 1m x 1m or 2m x 2m square units across the trenches. The remainder is from feature fills of varying date. Overall, most sarsen is from the Neolithic deposits – largely the two horizons of the worm-sorted soil interpreted as having formed by the fourth millennium BC (Table 2, Table 3).

Phase (code)	Phase description	Count
0	Tree throws and hollows of likely early Holocene date	6
1A	Early Neolithic	4
1B	Middle Neolithic and possible Late Neolithic	31
1	Neolithic	647
2	Post-medieval and modern including Keiller and animal burrows	83
3	Un-phased	0

Table 2 Summary of the WKA sarsen assemblage by phase.

Contexts excluding feature fills	sarsen count	% of total WKA assemblage	total weight (g)
Topsoil (067) (400) (600)	14	1.8	1,559
Colluvium/ploughsoil (069) (070) (078) (401) (601) (colluvium)	45	5.8	4,658
Soil over periglacial features (084) (419)	5	0.6	2,447
Upper stone-free soil (001) (004) (073) (079) (402) (602)	485	62.9	54,008
Lower stony horizon (002) (007) (014) (074) (080) (405) (603)	157	20.4	22,830
Backfill to Keiller trenches (005) (403) (backfill)	11	1.4	1,044

Table 3 Summary of sarsen from WKA contexts other than feature fills.

The total assemblage includes 11 pieces without context numbers (two from colluvium and nine from Keiller backfill) and 89 without excavation grid square numbers (17 from Keiller backfill; two from colluvium and 14 from topsoil; three from the silty deposit filling periglacial stripes; three from the upper stone free soil in (001) and (004); and 50 from contexts in numbered features).

Most of the assemblage comprises saccharoid sarsen (739, 95.8%). The rest of the material is finer-grained more quartzitic sarsen (30, 3.9%).[1] There are two pieces of conglomerate. Item 074/0001, a reddish-grey to pinkish-grey piece weighing 321g, contains 2%-5% very poorly sorted small to medium pebbles and one very large flint pebble. Item 402/0109 is a 62g puddingstone fragment. A small area of reddish-brown cortex survives to one face and the grey sandy matrix surrounds broken large pebbles. Two concave scars in the matrix show where other pebbles have been lost.

Although not unknown from the area, puddingstone is rare. A few sarsens amongst the surface spread in nearby Piggledene (*c*. 3.5km to the east) appear to be conglomeratic and there are some puddingstone pieces amongst the rubblestone walling of St Peter's Church, Broad Hinton, *c*. 7km to the north. These examples indicate that a lens of more pebbly Tertiary deposit in the region was silicified as well as the sands in which sarsens formed. Although some puddingstone pieces may be present amongst the superficial deposits in the environs of Waden Hill, it is conceivable that these two fragments were brought in to the West Kennet Avenue environs from slightly further afield.

[1] It should be noted that this classification is based on hand sample identification using a hand lens but not from fresh fractures. The silcrete known as 'sarsen' ranges from hard, fine-grained to coarser material (Nash and Ullyott 2007) so this identification is heuristic rather than geological: cobbles and small boulders of the tough, light grey to pale brown 'quartzitic' sarsen were sought out in the past for specific uses, especially as hammerstones in prehistory and for domestic construction (such as wall coping) more recently; whereas large sarsen boulders are saccharoid. Conglomerate is found both as cobbles and boulders.

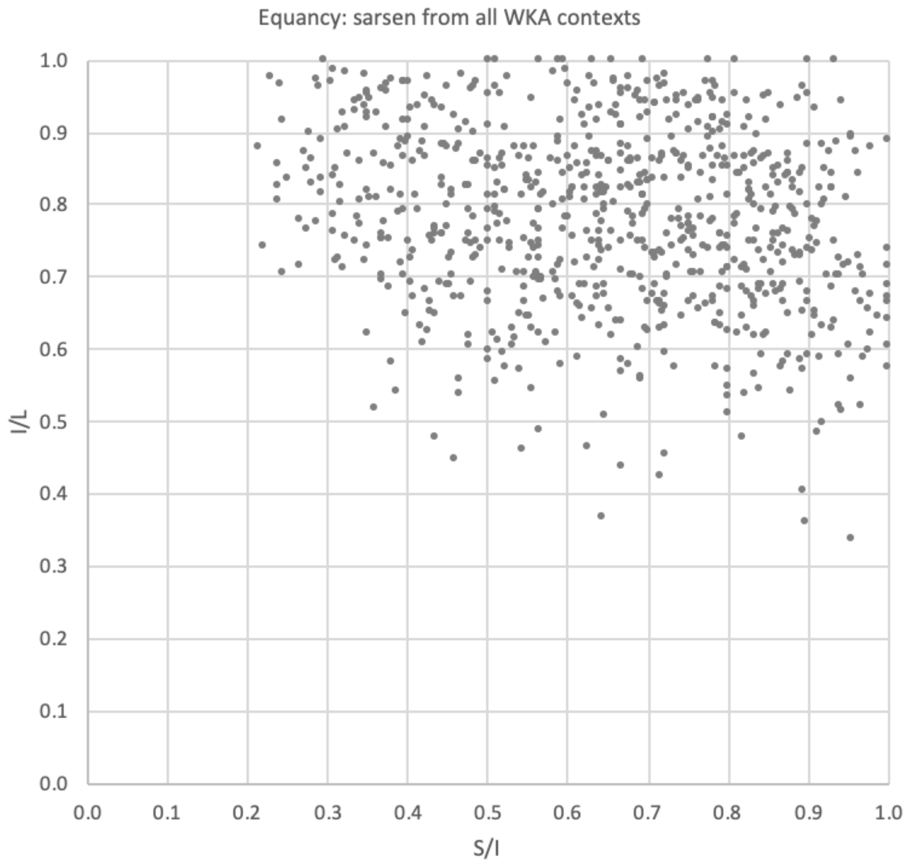


Figure 1 Zingg plot of the distribution of S/I and I/L ratios of all 771 WKA sarsen discussed in this report.

The overall distribution of the assemblage towards the top-right area of Figure 1 confirms its generally blocky, chunky nature. Just over half the pieces (434, 56.3%) are equant or sub-equant (S/I : I/L >= 0.6). A large proportion are in general thinner, shorter pieces (flat block/oblate spheroid and slab/very oblate spheroid, 276, 35.8%). Only 42 pieces (5.5%) have similar thinness but with the greater length of the elongate block/prolate spheroid class. Two items are thin and long enough to be classed as rods (0.3%) and only 17 (2.2%) fall into this scheme's blade class (S/I : I/L <0.6) (Figure 2). More pieces might have been described as 'blades' if the conventional flint definition had been adopted (a flake whose length is more than twice its width, Butler 2011, 35) despite being thick, blocky and unlike blades of truly knappable material. Of the 89 flake-like pieces in the assemblage, 38 exhibit no diagnostic characteristics of intentional flaking. Only 13 of the flake-like pieces are crescentic in form: ten of those are burnt, suggesting that they resulted from exfoliation caused by temperature change.

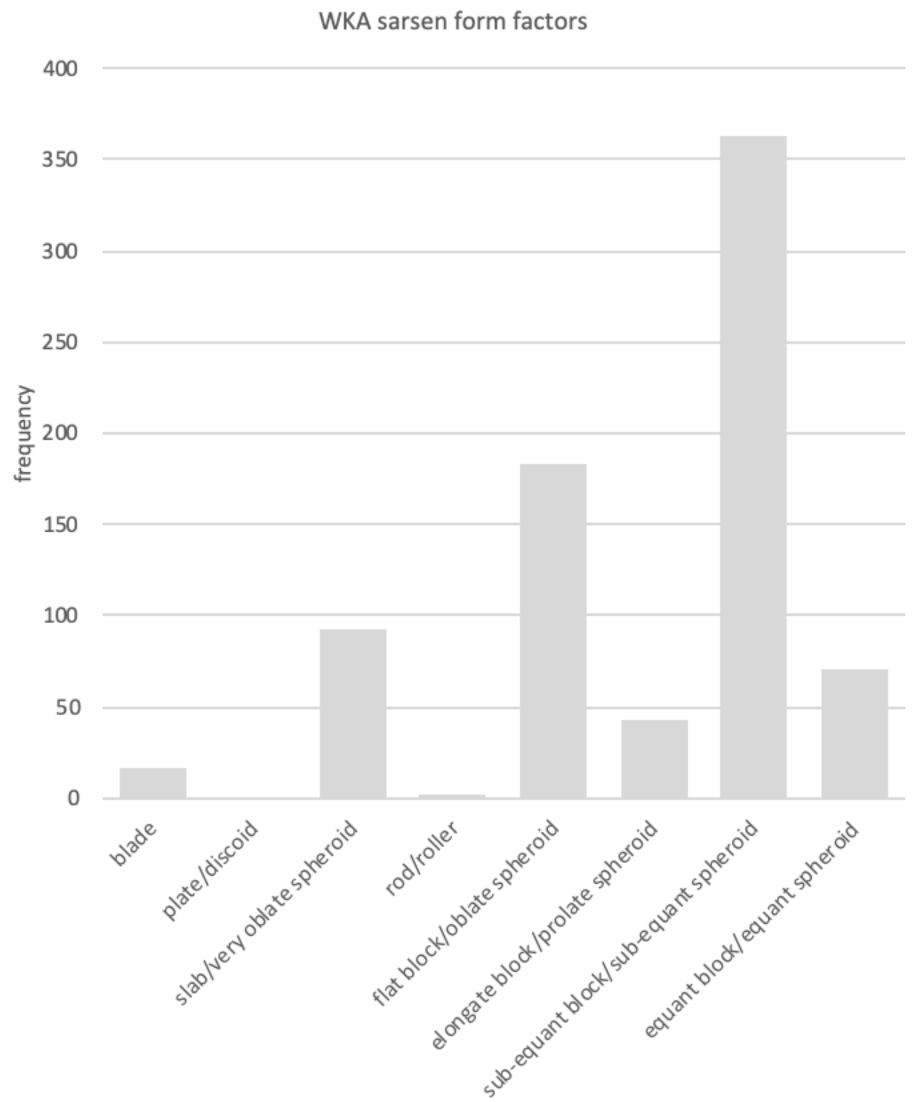


Figure 2 Shape of WKA sarsen fragments described using Blott and Pye (2008) form factors.

Overall, the sarsen pieces are small and angular and rarely abraded. The mean weight is 126.0g and modal angularity is angular (369, 47.9%). Had all of the excavated sarsen been retained these figures would have been slightly different. Whilst the weight range is 1g to 4,414g, only one piece of sarsen was retained from the sarsen and flint 'collar' (072) to F.35 and only one out of 19 of the packing stones (604) to F.58. The discarded items in (604) ranged from 0.3m to 0.7m in length. Other large sarsen cobbles/small boulders were not retained, including two, one weighing 19kg, from the top of F.42; the large sub-rectangular block in the top of F.55; and two large pieces from F.14. Material of that size would therefore have made a difference to the overall weight profile of the assemblage. Nevertheless, the modal weight range would remain 1g-150g (604, 78.3%), emphasising the small size of these broken pieces of stone which have largely been unaffected by the limited historical cultivation activities in the field.

When used of sarsen, the term ‘cortex’ refers to the usually undulating smooth natural surface of cobbles and boulders that contrasts with the sugary appearance of clasts and matrix in the interior. Cortex is highly varied, ranging in colour and thickness but usually more like a thin rind. Its smoothness, even on topographically irregular faces, can result in misleading interpretations that surfaces have been worked. Slightly more sarsen in the assemblage is un-corticated (425, 55.1%) than corticated (346, 44.9%), but the corticated material weighs in total much more than the un-corticated (64,635g compared with 32,542g respectively). The corticated pieces are therefore on the whole much larger than the un-corticated. It is difficult to infer anything from this given how few pieces overall show any signs of why and how they broke. It is likely a reflection of the weight of the small number of partial and complete cobbles in the assemblage. More important, however, is the caution required to assess small pieces of corticated sarsen, because of the possibility of mis-identifying them as fragments of tools or worked stone.

The slight majority (401, 52.0%) of burnt pieces were identified through a combination of attributes including colouration, cracking/crazing and angularity. No sooting or charcoal was noticed, although dark material adhering to 605/0002 may be derived from the charcoal flecking in (605), a fill of the post-pipe to F.58. Burnt sarsen can also become friable and abraded and develop a dry feeling to the touch, beyond the dryness of cleaned stone, that perhaps comes from the sensation of its weakened sandy texture. Harder to classify, that characteristic was recorded in the free-text when it was particularly noticeable.

A degree of caution should be applied to the identification of burnt sarsen from WKA contexts, given that the pink to red colours suggestive of burning could be the result of longer-term geochemical processes. Some sarsen in and around Avebury is noted for its bright to dark reddish surface colouration, including cobbles in the environs and small boulders used in stone settings within the henge monument, in particular the orthostats of the Z-feature in the henge's south-east quadrant. Although this local phenomenon has not been investigated petrographically or geochemically, it is possible that particular formation processes operating in a relatively discrete area resulted in this characteristic colouration. Possibilities include the introduction of iron oxides or hydroxides whilst sarsens were buried (David Nash pers. comm.); case-hardening; and the development of rock varnish or other type of geochemical film (see Dorn 2007, 247 for types of rock coating). When material identified as burnt only by colour (269, 34.9%) is removed from the tally, only 132 pieces (17.1%) with the characteristic cracking/crazing, or combined cracking and colouration, of burning remain.

3 Re-fits

A number of re-fits were noticed during the recording. More may be possible, if the whole assemblage could be laid out: similarities in fabric and colouration suggest that some material comes from the same parent stone, such as items 004/0157 and 084/0002, 004/0160 and 004/0161-0162, 014/0021 and 014/0022-0023, 402/0059 and 402/0061. Most re-fits are between two pieces from the same grid square and context, some clearly being recent breaks including examples of burnt material where cracks have failed since excavation. All of the noticed re-fits are tabulated below and the two most significant groups are described in greater detail (Table 4).

3.1 Group 18

Group 18 from Trench 4 comprises four pieces from context (402) and one from (405) in square 433. The distribution of surviving cortex shows that these derive from a flattish large cobble of more quartzitic sarsen. The angular, reddish-brown pieces all appear to have been burnt but there are no signs of percussion, suggesting that the cobble fell into pieces along cracks developed as a result of temperature change. The smallest piece in group 18 (405/0012, 24g) had moved further down the soil profile below the larger items (ranging from 85g to 450g). The close association of these pieces indicates relatively limited horizontal movement in this area. Group 19 and other, non-fitting, pieces of similar fabric in both (402) and (405) in square 433 may derive from the same parent material.

3.2 Groups 15 and 16

Groups 15 (four flakes) and 16 (four flakes) are of precisely the same distinctive fabric, a grey, glossy saccharoid sarsen. The two groups do not join one-another. Two other non-joining pieces, 402/0081 (square 422) and 405/0030 (square 451), are of the same fabric. Small areas of very smooth convex surface survive to 403/0001, 405/0025 and 405/0037 from group 15 and to 417/0003 from group 16, possibly indicating that they are derived from a rubber, intentionally or accidentally broken into flakes (see Section 4 for discussion of these flakes as possible tool fragments). The ten flakes were recovered from five different contexts, including two fills of F.55, spread across Trench 4.

Flake 421/0001 was in the primary fill (421) of large cut feature [425]. Two flakes 417/0003 and 417/0004 came from (417), the primary fill of re-cut [418] (F.55), a sub-oval pit over-lying and cutting fill(s) of the large cut feature [425]. Apart from 403/0001 recovered from Keiller's backfill, three of the flakes of this distinctive fabric were from (405), the worm-sorted soil's lower stony horizon, and three from (402), the upper stone-free soil; deposits that had already formed by the time the re-cut [418] was dug through them. The excavators suggest that [425] is possibly a Mesolithic feature, sealed by the worm-sorted soil that had developed by the fourth millennium BC, later interrupted in the Middle Neolithic by [418]. If so, these flakes were present from an early time such that one was incorporated into the primary fill (421) of [425] whilst the rest became part of the developing soil until two were caught up in primary fill (417) of the Middle Neolithic feature.

In contrast to the other re-fitting groups, which are discrete to individual squares or features, flakes from groups 15 and 16 in (402) and (405) and the two other non-joining pieces of this fabric are spread across Trench 4. Their distribution extends from square 424 at the south-west end of the trench to squares 451, 464, 455, 431 and 422 at the north-east, close to the position of Keiller's earlier cutting. The distribution is commensurate with the interpretation of an early presence of these flakes in the locality.

Group number	UIDs of group	Trench	Square/ feature	Context(s)	Notes
1	004/0057 004/0058	2	204	004	
2	004/0146 004/0147	2	210	004	A recent break
3	007/0049 007/0050	2	217	007	A recent break
4	004/0125 004/0126	2	218	004	
5	014/0022 014/0023	2	234	014	A recent break
6	004/0051 004/0052	2	264	004	
7	004/0161 004/0162	2	268	004	
8	004/0194 004/0195	2	272	004	
9	004/0230 004/0231 004/0232	2	286	004	
10	004/0138 004/0139 004/0140	2	322	004	
11	004/0236 004/0237	2	2305	004	A recent break
12	004/0029 004/0030	2	2306	004	
13	002/0010 002/0011	3	395	002	Two pieces from a possible hammerstone.

14	414/0004 414/0005	4	F.55	414	
15	403/0001 405/0025 405/0037 417/0004	4	backfill 455 464 F.55	403 405 417	Same fabric as group 16
16	402/0058 402/0072 417/0003 421/0001	4	432 424 F.55	402 417 421	Same fabric as group 15
17	402/0009 402/0010	4	430	402	A recent break
18	402/0025 402/0026 402/0027 402/0028 405/0012	4	433	402 405	
19	405/0016 405/0017	4	433	405	
20	402/0041 402/0042	4	474	402	
21	603/0006 603/0007 603/0008	6	620	603	
22	602/0025 602/0026	6	634	602	A recent break

Table 4 Groups of re-fitting sarsen.

4 Tools

There are no complete tools in this assemblage: sarsen artefacts identified during fieldwork were given Small Finds numbers and processed separately. Nevertheless, there are pieces of sarsen that can more or less confidently be identified as broken parts of tools.

4.1 Rubbers/top-stones and polishers

001/0018 [WKA13, Trench 3/6, Square 21, (001)]
A small area of very glossy, rounded sand grains to one convex face of the stone is visible under magnification, with void areas of lost grains. The pale brown to grey, sub-angular, equant block of saccharoid sarsen weighs 59g. The fragment is tentatively identified as used for polishing or burnishing.

001/0044 [WKA13, Trench 3/6, Square 18, (001)]
One smooth, convex face has rounded, glossy sand grains and void areas of lost grains. The very small (5g), slab-shaped light grey to brown piece of saccharoid sarsen is tentatively identified as a fragment of rubber or polisher.

014/0014 [WKA13, Trench 2, Square 251, (014)]
A very small (5g) angular, equant block of reddish-brown to light reddish brown saccharoid sarsen, probably burnt, with one smooth, convex face. That face has striations that can be seen with the naked eye, implying that they were made with some force. Some glossier patches are visible under magnification, also suggesting that this is part of a rubber or top-stone, but the identification is tentative given the very small size of the piece of stone.

069/0017 [WKA14, Trench 1, Square 26, (069)]
The outer convex surface of this small piece of saccharoid sarsen is smooth to the touch, with noticeably flattened sand grains of regular height visible under magnification. The pale red to light brown piece is also cracked, suggesting burning. It may be from a rubber or top-stone.

405/0034 [WKA15, Trench 4, Square 428, (405)]

This very small, angular, flat block of light grey saccharoid sarsen has one smooth convex face in which the sand grains appear flattened under magnification. Weighing only 7g, its identification as a rubber fragment is very tentative given how small the piece is.

4.1.1 Ten fragments of a possible rubber

Ten fragments of precisely the same fabric are tentatively identified as parts of a broken rubber. Each piece is summarised below, followed by a short discussion (see also discussion of refitting groups 15 and 16 in Section 3.2).

402/0081 [WKA15, Trench 4, Square 422, (402)]

This small (6g), very angular piece of light brownish grey to grey saccharoid sarsen includes a smooth convex face of flattened sand grains, their edges slightly rounded. Crescentic micro-cracks are visible in that surface under magnification. The face is interrupted by a possible impact point, including crushed sand grains, to one edge. This fragment does not fit to any of the others in the fabric group.

405/0030 [WKA15, Trench 4, Square 451, (405)]

One smooth, convex, face of this small (5g), light brownish grey to grey very angular fragment appear to have been ground. The face's glossy sand grains appear flattened with rounded edges and linear micro-fractures in the surface are visible under magnification.

402/0058 [WKA14, Trench 4, Square 432, (402)]

This tiny (2g), very angular grey flake is part of refitting group 16. It has no indications of being part of a tool, having come from the interior of the broken object. Neither does it show any diagnostic percussion features.

402/0072 [WKA14, Trench 4, Square 424, (402)]

This tiny (2g), very angular blade is part of refitting group 16. It has no indications of being part of a tool, having come from the interior of the broken object. Neither does it show any diagnostic percussion features. However, it has clearly snapped from item 417/0003 (found in a fill of F.55).

417/0003 [WKA15, Trench 4, F.55, (417)]
A small (11g), very angular grey piece of saccharoid sarsen with one smooth convex face that appears to have been ground. It is part of refitting group 16. The possibly ground face’s sand grains are flattened with rounded edges and the surface has crescentic micro-fractures in the surface similar to those on a sarsen rubber excavated from Marden henge (VOP16 sarsen item 7004/002). At one edge of the possibly ground area, where it gives way to a broken face, there is a slight possible impact point. This feature is very small, possibly derived from damage in transit after excavation.

421/0001 [WKA15, Trench 4, F.55, (421)]
This very small (2g), very angular flake of grey saccharoid sarsen, is part of refitting group 16. It has no indications of being part of a tool, having come from the interior of the broken object. It does, however, have a striking platform and bulb of percussion, suggesting that the parent object of which it is a part was struck to break it apart.

403/0001 [WKA15, Trench 4, (403)]
An angular, blade-like piece of light brownish grey to grey saccharoid sarsen weighing 2g, with one smooth possibly ground surface. That face has flattened sand grains with rounded edges, with linear and crescentic micro-fractures in the surface similar to those on a sarsen rubber excavated from Marden henge (VOP16 sarsen item 7004/002). At one edge of the possibly ground surface there are slightly damaged areas, possibly an impact point which may indicate that the piece was intentionally broken. It is part of refitting group 15.

405/0025 [WKA15, Trench 4, Square 455, (405)]
This small (4g), angular piece of grey saccharoid sarsen is part of refitting group 15. It has one smooth, glossy convex face that appears to have been ground. Its sand grains are flattened with rounded edges and the face has crescentic micro-fractures

in the surface similar to those on a sarsen rubber excavated from Marden henge (VOP16 sarsen item 7004/002).

405/0037 [WKA15, Trench 4, Square 464, (405)]

A very angular, blade-like piece of light brownish grey to grey saccharoid sarsen weighing 5g, part of refitting group 15. Like 405/0025 and 403/0001, it has one smooth, glossy convex face that appears to have been ground. Its sand grains are flattened with rounded edges and the face has crescentic micro-fractures in the surface similar to those on a sarsen rubber excavated from Marden henge (VOP16 sarsen item 7004/002).

417/0004 [WKA15, Trench 4, F.55, (417)]

This tiny (1g), very angular flake of grey saccharoid sarsen, is part of refitting group 15. It has no indications of being part of a tool, having come from the interior of the broken object. It does, however, have a striking platform and a diffuse bulb of percussion, suggesting that the parent object of which it is a part was struck to break it apart.

Discussion

The precisely similar fabric of these ten fragments is visually very characteristic. The glossy grey material is unlike the rest of the sarsen in the WKA assemblage, making it possible to single out each piece and identify that eight form two refitting groups of flakes.

Both groups 15 and 16 include features suggestive of intentional flaking. In group 15, item 417/0004 has a platform and diffuse bulb of percussion; the other three pieces in the group join in sequence below the bulb. In group 16, item 421/0001 has similar diagnostic features and the slight damage to 417/0003 (which joins 421/0001's dorsal face) may be part of the same impact.

If the parent stone was a rubber, as suggested by the possibly ground surfaces surviving to six of the ten pieces discussed here, then it was broken by at least two impacts. They may have resulted from use as a rubber, perhaps accidentally dropped or having been worked on a hard surface; or part of an intentionally destructive act. A note of caution is, however, warranted. The unusual fabric appears to be saccharoid sarsen and the glossy appearance of its interior may simply be the result of a high level of silica in the matrix; but it could alternatively be from a quartzite pebble, its very smooth convex faces and micro-fractures perhaps the water-worn result of tumbling in a stream. In that case, and given the likely early date of the presence of this material on the site (see Section 3), such a pebble may have been used as a hammerstone that broke, some of its flakes distributed about the locality. A closer examination of both the fabric and the possibly ground surfaces of the flakes are recommended.

4.2 Querns and polissoirs[2]

004/0173 [WKA14, Trench 2, Square 261, (004)]

This angular equant block of light grey saccharoid sarsen has one very smooth flat face, which under magnification has evenly flattened sand grains interrupted by possible peck marks perhaps cause by dressing. Its identification as a piece of quern or polissoir is tentative given its small size, at only 45g.

037/0009 [WKA13, Trench 2, F.14, (037)]

A small, sub-angular, sub-equant block of reddish-brown to pale brown saccharoid sarsen weighing 41g. One smooth, slightly concave face is highly glossy under magnification with sand grains in the surface that appear ‘cut’ or ground down. There are two possible impact points on the edges of the face. This may be a piece of intentionally-broken quern.

073/0005 [WKA14, Trench 1, Square 182, (073)]

A large (527g) angular sub-equant block of light grey saccharoid sarsen. The upper surface includes two smooth concave areas whose sand grains appear rounded or

[2] The name ‘polissoir’ applied to sarsen artefacts usually implies a bench for grinding and polishing stone axe-heads, such as the large example on Fyfield Down (Wiltshire) and on boulders in the West Kennet Avenue (Wiltshire) and Coldrum (Kent) barrows. In this report, no assumption is made about the materials that might have been shaped on pieces of sarsen stone (which could include bone, for example) or about the likely size of the parent artefact, which could be hand-held rather than megalithic. A key characteristic of items recorded in section 4.2 is at least one smooth flat or concave surface with visual indications that the shape and surface texture of that face’s sand grains is different to the rest of the piece of stone.

flattened under magnification. Between these two dished areas is a small flake scar (approximately 7mm x 8mm) from which some of the cracks radiate, suggesting that the stone has been struck. The block has cortex surviving to two side faces. The cortex is interrupted by a natural fault but there is a small discoloured area suggesting burning/exposure to heat. Furthermore, the stone is thoroughly cracked and has the ‘dry’ feeling suggesting that it has been burnt. Possibly an intentionally broken piece of quern or polissoir.

073/0026 [WKA14, Trench 1, Square 191, (073)]

A light grey to grey angular saccharoid sarsen fragment weighing 567g with evidence to suggest it is a piece of broken quern or polissoir. The sub-equant block is cracked having been burnt. One face is very slightly concave, with approximately 80% of its surface ground/polished in large patches. Small declivities in that surface may be dressing impact points, whose edges are not rounded by reuse.

074/0003 [WKA14, Trench 1, Square 179, (074)]

Weighing 713g, this large, angular, greyish-brown sub-equant block of saccharoid sarsen may be part of an intentionally-broken quern. One slightly concave face has possibly ground patches surviving to its surface, interrupted by damaged areas (which could not be examined under magnification because the stone size exceeded the maximum extension of the microscope’s focussing column). There are flake scars to two sides with part of a possible impact point over one of those scars, interrupting the concave face, suggesting intentional flaking.

401/0012 [WKA15, Trench 4, Square 461, (401)]

This sub-angular grey to greyish brown slab of saccharoid sarsen weighs 91g. Whilst both of its opposing broad faces are quite flat, one is smoother than the other. That surface includes possibly ground patches of flattened, slightly glossy, sand grains. Those areas are interrupted by lost grains, although not clearly pecked dressing marks. The fragment is very tentatively identified as a piece of ground sarsen.

402/0063 [WKA15, Trench 4, Square 429, (403)]

A sub-rounded, sub-equant spheroid of reddish-brown saccharoid sarsen weighing 41g, with one smooth and glossy concave face. Sand grains in that surface appear flattened with rounded edges under magnification. There are voids where sand grains have been lost, some of which are large enough to be pecked dressing marks. Given its small size, this is tentatively identified as a quern fragment.

402/0083 [WKA15, Trench 1, Square 461, (402)]
This is a small, angular, equant block of grey saccharoid sarsen. It has one very flat, smooth, face with sand grains and surrounding matrix appearing very level. The fragment weighs only 10g, so this is tentatively identified as a quern or polissoir fragment.

405/0001 [WKA15, Trench 4, Square 452, (405)]
A small (64g) sub-angular flat block of pale red to light brownish-grey saccharoid sarsen, fire-cracked and darkened. One face is smooth to the touch. Although its topography overall is slightly uneven, including a paler raised area (possibly of higher silica content and thus more resistant to wear), under magnification the sand grains appear to be glossy and levelled with rounded edges. The piece is tentatively identified as a quern fragment.

405/0023 [WKA15, Trench 4, Square 471, (405)]
This small (44g) angular slab of light brownish grey to pale brown saccharoid sarsen is a broad flake-like piece with a diffuse bulb and scars to its dorsal surface. Part of its possible platform appears ground and polished. Under magnification the sand grains of this patch appear flattened and regular, interrupted by a small area of possible dressing. Over the diffuse bulb there is damage probably caused by percussion. The possibly ground area measures only 10.3mm x 4.8mm, so this flake is only tentatively identified as an intentionally-broken piece of quern or polissoir.

602/0025, 602/0026 [WKA15, Trench 6, Square 634 (602)] (Group 22)
Item 602/0025 (2g) is a tiny piece of saccharoid sarsen refitting to 602/0026 (86g). Both pieces retain a smooth, glossy surface of flattened sand grains. Overall the stone is degraded having been burnt and cracked, but the possible quern surface is nevertheless very noticeable.

4.3 Hammerstones

002/0010, 002/0011 [WKA13, Trench 3, Square 395, (002)] (Group 13)

Item 002/0010 (69g) is a corticated piece of saccharoid sarsen refitting to 002/0011 (219g), also corticated. They are part of a burnt broken small cobble. There is some possible damage to the surviving end of the cobble suggesting its use as a hammerstone, but that is very slight. The break is very clean and may have been caused solely by fire-cracking, but to one face there is part of a possible impact point split by the break. Accordingly, this group is very tentatively interpreted as a broken hammerstone, but it is perhaps the least likely candidate of all the possible hammerstones.

004/0145 [WKA14, Trench 2, Square 210, (004)]

This broken piece of yellowish-brown to pale brown saccharoid sarsen cobble weighs 324g. It is a sub-angular flat block with some surviving cortex. The cortex has been lost from the fragment's curved ridge, which also includes three small impact points. The damage is not fresh from post-excavation transit, neither are the other edges abraded, but the possible percussive damage is slight and does not include flake or spall scars. Tentatively identified as part of a hammerstone.

014/0025 [WKA13, Trench 2, Square 284, (014)]

A brown to very pale brown sub-angular flat block of saccharoid sarsen weighing 410g. The surviving rind to opposing faces indicates that this piece is part of a flattish small cobble broken through the middle. One broad face is interrupted by numerous flake scars, the majority of which were propagated from the lost part of the cobble so there is no evidence for the active edge and how the scars were formed. The opposing face has more rind remaining interrupted by five small flake scars. The broken face feels smooth and looks glossy, suggesting that it represents the line of a natural fault along a more silicified area of stone which could have failed as a result of impact. This is tentatively identified as a hammerstone.

077/0001 [WKA14, Trench 2, F.35, (077)]

With cortex surviving to one face and around its curved sides, this fragment of saccharoid sarsen is a broken piece from a small cobble. The reddish-brown to light grey piece weighing 165g has battering damage and spall scars to its circumference. The remaining flatter corticated face has a flake scar, over which is an impact point with crushing and sub-parallel fractures in-line with the circumference. It is likely that the parent cobble was used briefly as a hammerstone, causing the damage and flake removal and may have been the reason why the cobble broke apart.

402/0097 [WKA15, Trench 4, Square 435, (402)]

A large (379g) sub-angular, sub-equant block of weak red to light brownish-grey saccharoid sarsen with cortex surviving to two adjacent faces. There is damage and spall scars on, and either side of, the sharp ridge where a corticated and a broken face meet. Some of the scars interrupt the cortex, whilst the ridge is in part formed by sub-parallel fractures consistent with hammering damage.

405/0043 [WKA15, Trench 4, Square 430, (405)]

This sub-rounded, sub-equant spheroid of reddish-brown to pale brown saccharoid sarsen weighs 609g. It retains cortex to two faces but is from a larger broken piece of stone, and has been burnt. On an edge where a corticated face meets one of the broken faces there is a patch of battering damage alongside an area of spall scars. The spall scars interrupt both the cortex to one side and the broken face to the other, suggesting that it was used briefly as a hammer after it had broken from the parent stone.

603/0003 [WKA15, Trench 6, Square 640 (603)]

This 96g piece of sub-rounded reddish brown to light reddish grey saccharoid sarsen is broken from a small cobble that has been used as a hammerstone. It has an area of battering damage 42.2mm x 25.1mm on its circumference towards one end. Its two broken faces are cleanly split from the parent cobble. Both of the flatter convex sides of the partial cobble have small flake scars, one of which may be an impact point. The stone appears to have been burnt.

4.4 Worked stone

079/0002 [WKA14, Trench 5, Square 534, (079)]

A large piece of light brownish-grey saccharoid sarsen weighing 1,916g. A small area of cortex interrupted by ‘root holes’ survives to one face but the rest of the stone is covered in flake scars. One of the possible points of percussion has damage in the form of sub-parallel cracks in line with the striking platform that can indicate intentional flaking. On the other hand, two adjacent feathered flake scars have no characteristics of intentional removal. The stone may have been intentionally shaped.

4.5 Discussion

On the whole these pieces look like discarded broken tools amongst the deposits of the worm-sorted soil, mixed with the flint and other material culture of the Neolithic occupation site. Only three pieces were in feature fills. Of those, the flake from the fill of the possibly Mesolithic pit warrants closer examination to confirm whether or not it is a rubber fragment. The piece of quern from the fill of F.14 is likely redeposited during/following the relatively recent sarsen extraction event represented by that feature. The hammerstone fragment from the fill of F.35 could have been caught up accidentally in the possible hearth, expediently used as a convenient stone for some cooking activity, or intentionally broken in the fire.

Four pieces of possible quern have indications of percussion that suggest they were intentionally broken (037/0009, 073/0005, 074/0003 and 405/0023). Whilst they could equally have broken accidentally during use, such as when being re-dressed, the intentional destruction of artefacts including querns has been commented on in varied contexts (Chapman, 2000) including Neolithic ones, such as at the LBK site of Geleen-Janskamperveld where the very high degree of fragmentation in quern pieces suggests the ritual ‘killing’ of these tools (Verbaas and Van Gijn, 2007). Some broken tools from the occupation site may be seen in this light.

Unused sarsen cobbles from the Neolithic WKA contexts hint at resource procurement, although there are too few to suggest caching. Unfortunately, little is known in detail about the overall distribution and availability of smaller sarsen pieces, in particular the harder quartzitic cobbles and small boulders (Ixer and Bevins 2021). Unpublished distribution data collected during the Stonehenge Environs Project

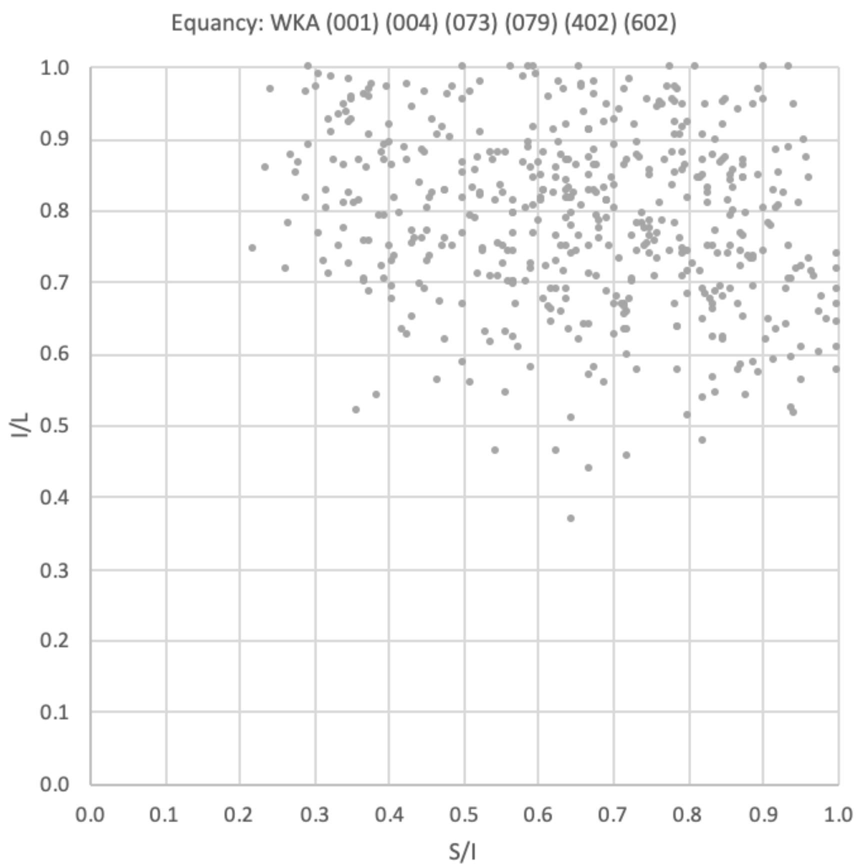
(Richards 1990) archived at the Salisbury Museum could offer some insight for the south of Wiltshire but there is no similar record for the Avebury environs, where anecdotal evidence points to their availability in stream courses, cleared to arable field edges and collected for rubblestone walling and coping.

5 Context summaries

5.1 (001) (004) (073) (079) (402) (602), upper stone-free soil

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	467	17	1
Completeness	**Fragment**	**Complete**	
	483	2	
Cortex	**Absent**	**Present**	
	277	208	
Burning	**Unburnt**	**Burnt**	
	222	263	
Weight (g)	**Total**	**Mean**	**Range**
	54,008	111.4	1 – 2,764

* and 6 pieces <1g.



In total 485 sarsen pieces came from the upper stone-free soil across the trenches, representing 62.9% of the overall assemblage from WKA seasons. They are predominantly saccharoid sarsen (467, 96.3%) which is to be expected given the dominance of this material in the landscape. The material from tougher, harder quartzitic cobbles perhaps reflects their attraction as tools, notably hammerstones, in prehistory but also indicates their availability in the area. Two unused complete cobbles were collected from the deposit: 001/0036, a slab-shaped very pale brown large cobble weighing 676g; and 079/0001, a larger very pale brown to grey flat block weighing 805g. Their colouration is in contrast to the high proportion of corticated pieces with light red to dusky red cortex (58, 27.9%).

The upper stone-free soil also included item 402/0109, a very angular piece of puddingstone (62g). It has a small area of reddish-brown cortex whilst the grey sandy matrix of the interior includes well-rounded oval flint pebbles: a broken black pebble (19.87mm x 16.61mm), a broken pale brown pebble (24.60mm x 13.11mm), part of a pale brown pebble (15.81mm x 10.64mm) and a small black pebble 5.81mm long. Two smooth concave scars in the matrix show where pebbles have been lost.

The sarsen from the upper stone-free soil is dominated by very angular to sub-angular pieces (416, 85.6%), largely equant to sub-equant with some slightly longer and thinner flat blocks and slabs. Just over half appear to have been burnt (263, 54.2%). Bearing in mind the local prevalence of naturally red-coloured sarsen, the tally of burnt pieces falls to 90 (18.6%) if only cracked, or cracked and coloured, pieces are included. The mean weight, 111.4g, indicates the small size of most of the sarsen. The largest pieces from the deposit (>1kg), all saccharoid sarsen, include 402/0110 (2,764g), 001/0051 (2,341g), 079/0002 (1,916g) and 004/0147 (1,069g). 402/0110 is part of a large weak red to light reddish-brown cobble with a large crescentic scar interrupting its cortex suggestive of exfoliation due to heat. 001/0051 is a broken, cracked brown to light brownish grey piece similar to 079/0002, although the latter piece has numerous scars interrupting its cortex. 004/0147 represents the bulk of a yellowish brown to white cobble, recently broken from 004/0146.

There are 52 flakes or flake-like pieces from the upper stone-free soil. Of these, 20 (38.5%) had no clear signs of having been formed intentionally by percussion. Even in the strongest candidates for mechanical flaking (Table 5), the description of facets as 'platforms' is tentative in the majority of instances, highlighting the difficulties in identifying sarsen flaked percussively.

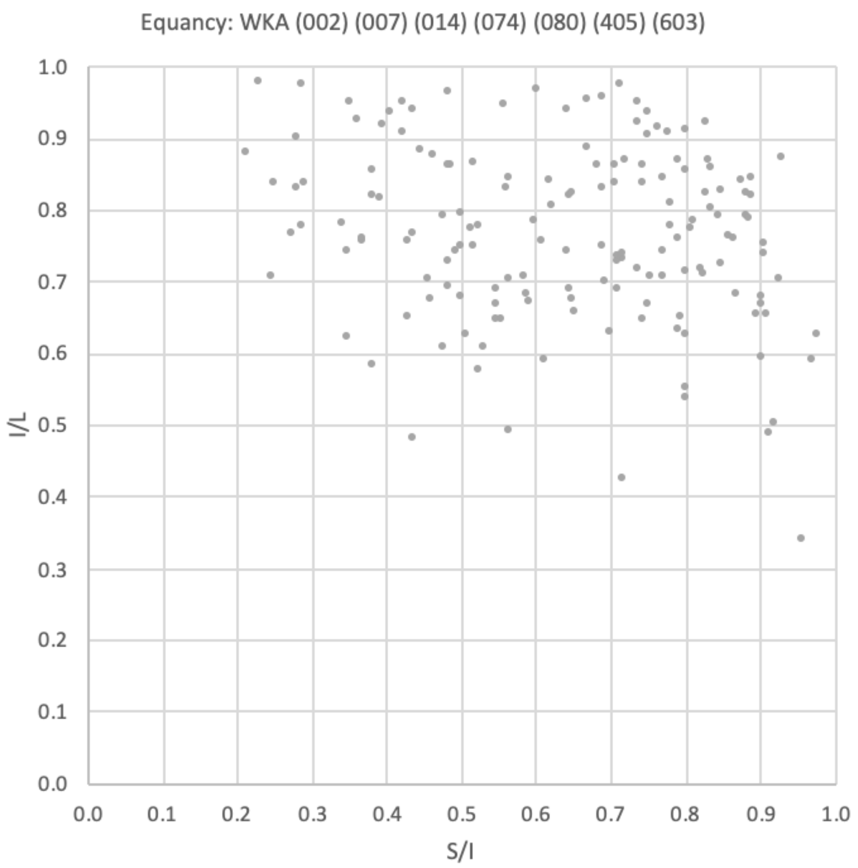
UID	Weight (g)	Notes
001/0003	82	Diffuse bulb, no damage to platform
001/0046	6	Crushing to platform and diffuse bulb
001/0060	48	Corticated platform has sub-parallel cracks, diffuse bulb, dorsal flake scars
004/0047	8	Diffuse bulb, no damage to platform, dorsal flake scars
004/0049	32	No damage to platform, dorsal flake scars
004/0061	31	Diffuse bulb, no damage to platform
004/0111	26	Diffuse bulb, no damage to platform
004/0158	30	No damage to platform, dorsal flake scars
004/0250	19	Diffuse bulb, no damage to platform
073/0004	39	Diffuse bulb, no damage to platform
073/0025	28	Diffuse bulb, no damage to platform, dorsal flake scars
402/0032	36	Diffuse bulb, no damage to platform
402/0038	29	Corticated platform, diffuse bulb, dorsal flake scars
402/0039	75	No damage to platform, dorsal flake scars
402/0052	52	Diffuse bulb, no damage to platform, dorsal flake scars
402/0068	19	No damage to platform, dorsal flake scars
402/0096	48	Diffuse bulb, no damage to platform
602/0021	116	Perpendicular platform slightly crushed, strong bulb, dorsal flake scars
602/0022	938	No damage to platform, dorsal flake scars

Table 5 Flake-like pieces of sarsen from the upper stone-free soil that may have been mechanically flaked.

Twelve pieces may be tool fragments, including two pieces possibly from hammerstones, two pieces with smooth convex faces that may have come from rubbers, seven that may be broken pieces of quern and one small piece with an area of glossy, rounded sand grains that may have been used for polishing (see Section 4).

5.2 (002) (007) (014) (074) (080) (405) (603), lower stony horizon

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	143	13	1
Completeness	**Fragment**	**Complete**	
	153	4	
Cortex	**Absent**	**Present**	
	74	83	
Burning	**Unburnt**	**Burnt**	
	74	83	
Weight (g)	**Total**	**Mean**	**Range**
	22,830	145.4	1 – 2,074



Contexts comprising the lower stony horizon included 157 pieces of sarsen. On average they are larger than the material in the upper stone-free soil above (mean weight 145.4g compared with 111.4g). A higher proportion are pieces of quartzitic sarsen (8.3%

compared with 3.5%) (Table 6), which may also explain why more have surviving cortex given that this finer material usually comes in the form of cobbles with a higher surface area to volume ratio than saccharoid boulders.

	Upper stone-free soil	Lower stony horizon
Mean weight	111.4g	145.4g
Saccharoid sarsen	96.3%	91.1%
Quartzitic sarsen	3.5%	8.3%
Conglomerate	0.2%	0.6%
Fragment	99.6%	97.5%
Complete cobble	0.4%	2.5%
Corticated	42.9%	52.9%
Burnt	54.2%	52.9%

Table 6 Comparison of general sarsen characteristics in the horizons of the worm-sorted soil.

Four unworked sub-rounded to rounded cobbles were collected from the deposit. All were recorded as saccharoid sarsen for want of a fresh break to examine the clasts and matrix. From Trench 2, the largest is 007/0001 weighing 2,074g, a yellowish brown to brown very oblate spheroid, whilst 007/0041 weighs only 160g, a brown to yellowish brown equant pebble. Item 014/0019 also from Trench 2 is a rounded, brown to yellowish-brown sub-equant spheroid weighing 312g. From Trench 4, item 405/0011 is a light grey to very pale brown oblate spheroid weighing 336g.

The lower stony horizon provided a further piece of puddingstone, item 074/0001 from square 192 in Trench 1. This sub-angular, sub-equant block weighs 321g. It has reddish grey cortex and a pinkish grey matrix. The clasts include 2% - 5% very poorly sorted granules and small to medium pebbles and one broken large flint pebble. Most of the granules and pebbles are pale pink and the piece appears to have been burnt. A broken root hole[3] is visible in one face.

[3] Sarsen often includes irregular tubular features which may be hollow or partially filled with petrified material. They range in size from thin, filament-like features, to wide voids a number of centimetres in diameter. When cortex is present it is often clear that these structures pierce a cobble or boulder perpendicularly from the outer surface, into or even completely through the stone. Many are likely to be root casts, while some are the result of dissolution and later weathering (Nash and Ullyott 2007).

Like the upper stone-free soil, the majority of the sarsen in the lower stony horizon is very angular to sub-angular (131, 84.4%) and largely equant to sub-equant in form. Just over half appears to have been burnt, but again the tally of burnt pieces falls substantially when cautiously limited to those that have a combination of fire-cracking and colouration (23, 14.6%) rather than including all the pink to red-coloured pieces.

The largest pieces in the deposit (>1kg) are also similar to those from the upper stone-free horizon. Item 007/0001 weighing 2,074g is an unused cobble (see above). Item 405/0046 is an angular broken quartzitic cobble weighing 1,786g. This corticated slab is yellowish brown to light yellowish brown in colour. Item 405/0007 is a broken sub-rounded, sub-equant piece of brown saccharoid sarsen weighing 1,653g. Numerous root holes are exposed in its broken face.

There are 18 flake-like pieces from the deposit, of which 11 (61.1%) have no clear signs of having been formed intentionally by percussion. The strongest candidates for mechanical flaking are listed below (Table 7).

UID	Weight (g)	Notes
002/0008	63	Corticated platform, diffuse bulb, dorsal flake scars
007/0017	3	Possible platform, step fracture to dorsal flake scar
007/0020	149	Possible point of percussion interrupting cortex
007/0021	16	No damage to platform, dorsal flake scars
007/0026	18	Diffuse bulb, no damage to platform
007/0032	57	No damage to platform, dorsal flake scars
063/0011	26	Diffuse bulb, no damage to platform

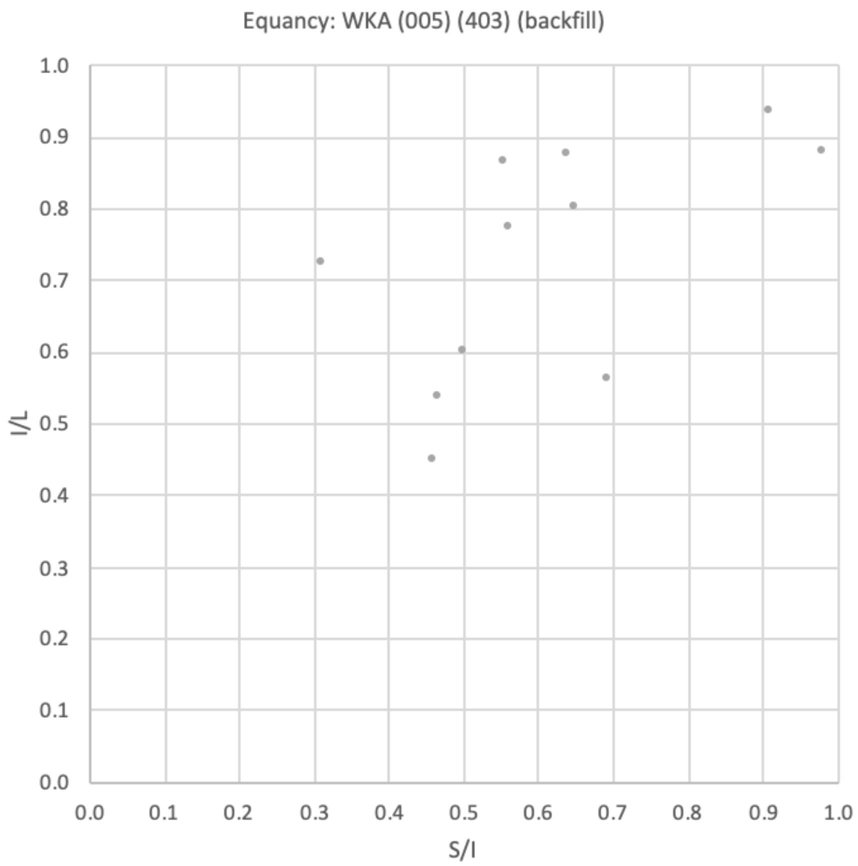
Table 7 Flake-like pieces of sarsen from the lower stony horizon that may have been mechanically flaked.

Five pieces with possible impact points include four tool fragments (see Section 4) and item 007/0008, a very angular sub-equant block of reddish grey to grey corticated saccharoid sarsen weighing 83g. It is fire-cracked. A small crescentic scar to the block’s flattest surface lies above a perpendicularly-broken face, possibly resulting from intentional percussion.

Twelve pieces may be tool fragments, including five fragments possibly from hammerstones, three pieces that may come from querns and five possibly from rubbers (see Section 4).

5.3 (005) (403) (backfill), Keiller backfill

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	11	0	0
Completeness	**Fragment**	**Complete**	
	11	0	
Cortex	**Absent**	**Present**	
	8	3	
Burning	**Unburnt**	**Burnt**	
	6	5	
Weight (g)	**Total**	**Mean**	**Range**
	1,044	94.9	22 - 311



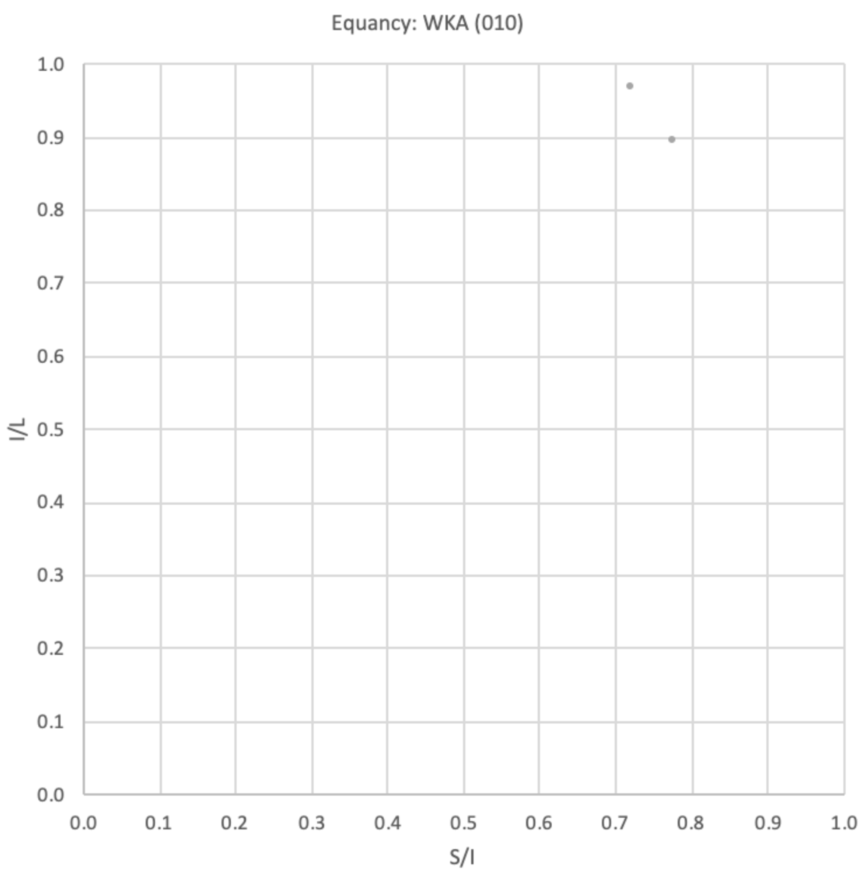
A small quantity of sarsen was recovered from backfill to Alexander Keiller's 1930s trenches. Two of the 11 pieces had been given context numbers, the rest simply have ‘backfill’ written on their bags (their UIDs follow the format ‘back/0001’). All bar one piece come from Trench 2.

The most significant piece is 403/0001, possibly from a rubber and part of re-fitting group 15 discussed in Section 3. The other 10 items, all broken pieces of saccharoid sarsen, are similar to the overall assemblage. They comprise a mix of burnt and unburnt material and three pieces have remaining cortex. Only two are noticeably abraded (005/0001 and back/0005), possibly as a result of their movement and re-deposition during Keiller’s excavations. Both appear to have been burnt, possibly weakening their fabric.

Three are flake-like pieces, two of which have attributes suggesting mechanical flaking. Item back/0003 is a slab weighing 33g with a diffuse bulb below an undamaged platform. Back/0006 is a blade weighing 101g. It has a diffuse bulb below an undamaged platform and dorsal flake scars. Neither had been burnt.

5.4 (010), fill of F.3 sarsen extraction pit

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	2	0	0
Completeness	**Fragment**	**Complete**	
	2	0	
Cortex	**Absent**	**Present**	
	1	1	
Burning	**Unburnt**	**Burnt**	
	0	2	
Weight (g)	**Total**	**Mean**	**Range**
	410	205	174 - 236



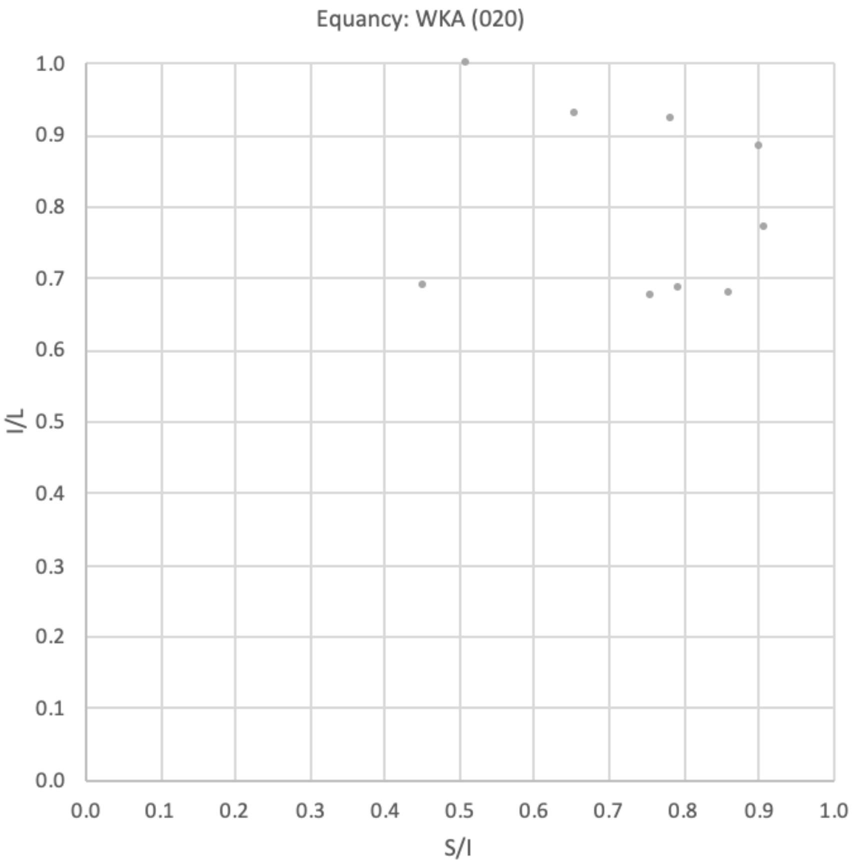
Two pieces of sarsen were found in (010), the fill of sarsen extraction pit F.3 in Trench 3. The brown clayey silt deposit included angular flint pieces, a discrete deposit of fresh worked flint and two Peterborough ware sherds, and a patinated piece of an Upper

Palaeolithic or early Mesolithic blade. The pit is published in Gillings and Pollard (2016), in which the discrete flint deposit is suggested to be late Neolithic/early Bronze Age and the pit possibly the source of a boulder for the West Kennet Avenue.

The smaller of the two sarsen pieces, 010/0002 (174g), is a sub-rounded, sub-equant block of saccharoid sarsen. Its cortex remaining on opposing faces shows that it is part of a small cobble. Its weak red colour suggests that it had been burnt. The larger item, 010/0001 (236g), had also been burnt. Cracked and sub-angular, the stone also has the ‘dry’ feeling mentioned above (Section 2) that is characteristic of much burnt sarsen.

5.5 (020), fill of F.6 Middle Neolithic pit

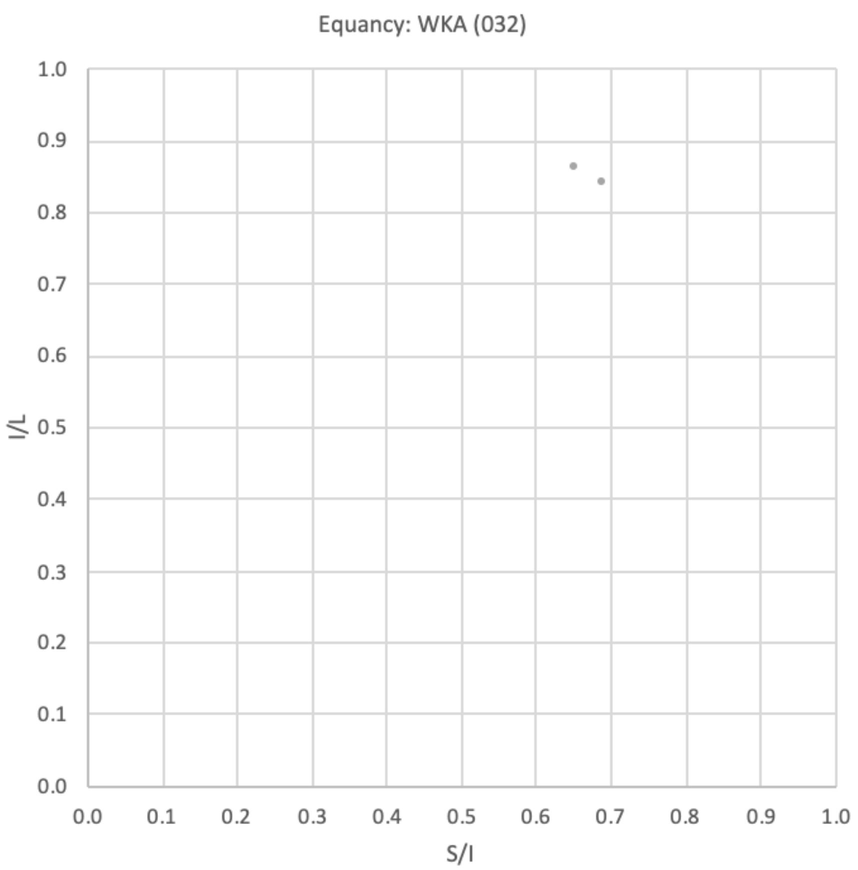
Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	9	0	0
Completeness	**Fragment**	**Complete**	
	9	0	
Cortex	**Absent**	**Present**	
	6	3	
Burning	**Unburnt**	**Burnt**	
	4	5	
Weight (g)	**Total**	**Mean**	**Range**
	917	101.9	11 - 619



Context (020) is the fill of a bowl-shaped pit in Trench 3/6. The dumped deposit included burnt antler fragments and a large quantity of worked flint, interpreted as hearth debris, soil and knapping waste. The nine saccharoid sarsen pieces from the fill include five clearly burnt pieces and three more small, friable, abraded pieces with the ‘dry’ feeling that suggests they were burnt, although they do not exhibit the pink to red colouration that might be expected. The majority (7, 77.8%) are very angular to sub-angular, equant to sub-equant blocks. None are flake-like and none exhibit any attributes of percussion.

5.6 (032), fill of F.12 sarsen extraction pit

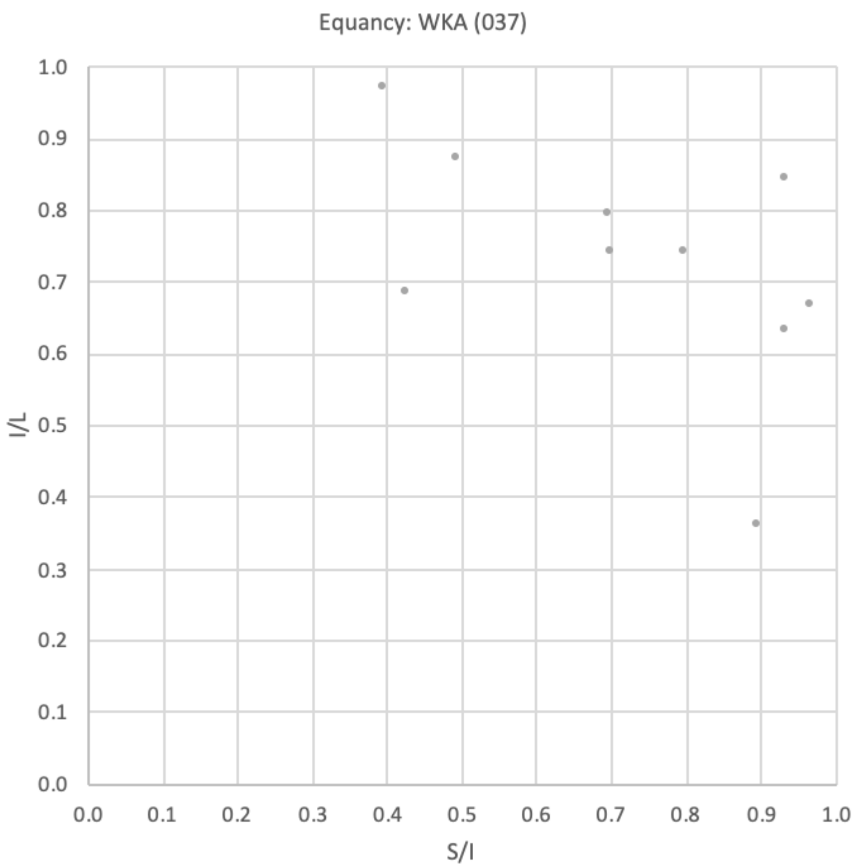
Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	2	0	0
Completeness	**Fragment**	**Complete**	
	2	0	
Cortex	**Absent**	**Present**	
	1	1	
Burning	**Unburnt**	**Burnt**	
	0	2	
Weight (g)	**Total**	**Mean**	**Range**
	217	108.5	70 - 147



Context (032) is the single fill of F.12, a second prehistoric sarsen extraction pit in trench 3. The fill included worked flint and like F.3, this hollow may have been the source of a boulder extracted and erected in the Avenue settings (Gillings and Pollard 2016, 11). Only two pieces of sarsen were recovered from the partially-excavated feature. Both are small pieces of burnt saccharoid sarsen. They are sub-angular, sub-equant blocks, one retaining some cortex.

5.7 (037), fill of F.14 sarsen extraction pit

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	10	0	0
Completeness	**Fragment**	**Complete**	
	10	0	
Cortex	**Absent**	**Present**	
	4	6	
Burning	**Unburnt**	**Burnt**	
	2	8	
Weight (g)	**Total**	**Mean**	**Range**
	1,128	112.8	13 - 301

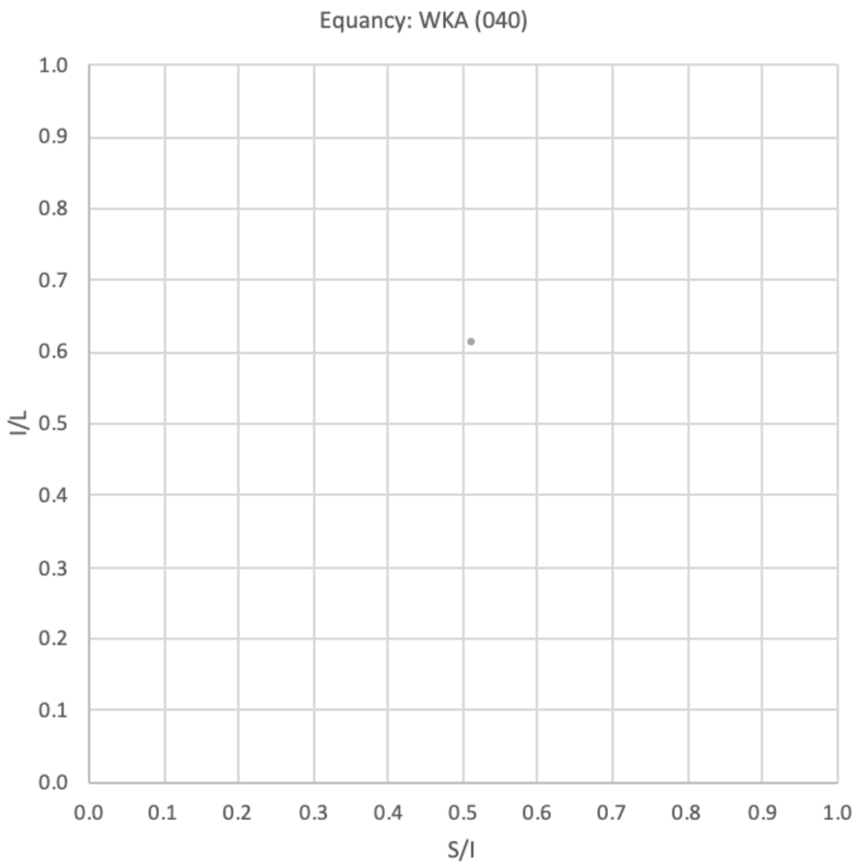


F.14 is a recent sarsen extraction pit in Trench 2 (Gillings and Pollard 2016, 8-9). Two small, apparently unworked, sarsen boulders were noted, one (up to 0.3m in length) on the western side of the pit and a second (up to 0.2m in length) in the fill towards the centre of the feature. The ten sarsen fragments recovered from the fill are all saccharoid, a slight majority including surviving cortex. The majority (8, 80%) are burnt, including a fire-cracked dusky red to brown piece (037/0002) and seven pieces distinguished by their colour and angularity.

It is unclear that any of these pieces are from the removed parent boulder. Item 037/0003 is a broken piece from a small cobble whilst 037/0009 may be a piece of quern (see Section 4). Item 037/0007 (unburnt) includes a medium flint pebble in its matrix and a broken root hole to one face. Items 037/0004, 037/0005 and 037/0006 are of a similar fabric, although they do not form a re-fitting group, and do not match any of the other pieces from the fill. Unfortunately, it is not possible to compare these three pieces with the two larger, discarded, pieces of stone from the pit fill.

5.8 (040), fill of F.16 stakehole

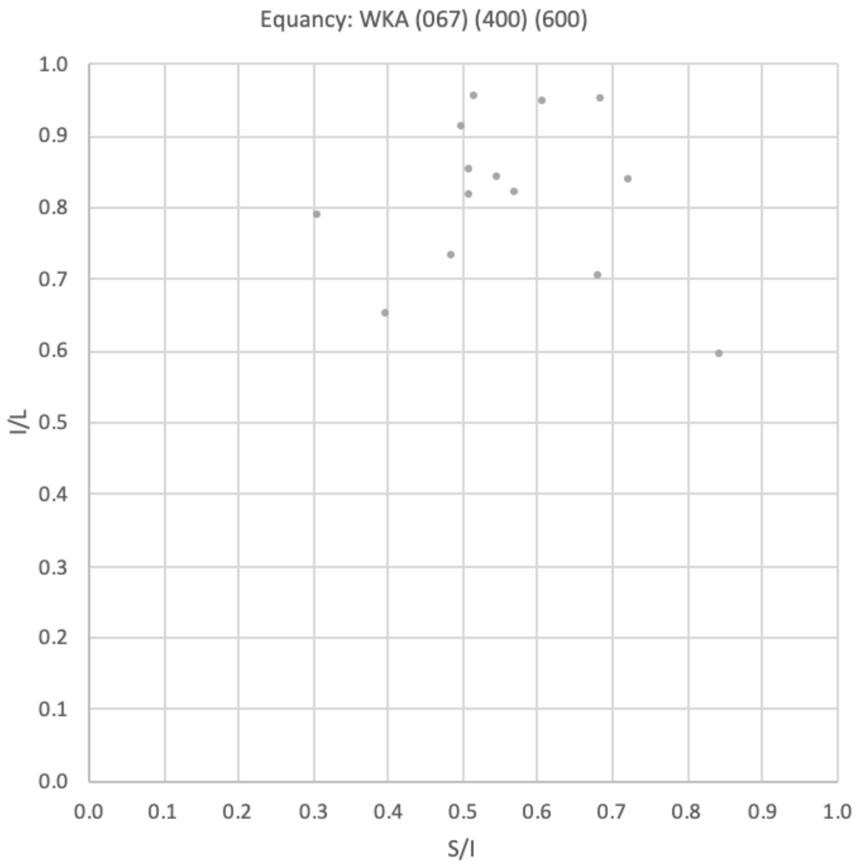
Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	1	0	0
Completeness	**Fragment**	**Complete**	
	1	0	
Cortex	**Absent**	**Present**	
	0	1	
Burning	**Unburnt**	**Burnt**	
	1	0	
Weight (g)	**Total**	**Mean**	**Range**
	48	-	-



One small piece of sarsen weighing 48g was recovered from (040), the fill to F.16. The feature is one of 29 stake-holes identified in trench 3/6. The light grey, angular flat block is flake-like but has no diagnostic percussion features. A quartz granule is visible in one face.

5.9 (067) (400) (600), topsoil

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	14	0	0
Completeness	**Fragment**	**Complete**	
	14	0	
Cortex	**Absent**	**Present**	
	11	3	
Burning	**Unburnt**	**Burnt**	
	12	2	
Weight (g)	**Total**	**Mean**	**Range**
	1,559	111.4	6 - 272

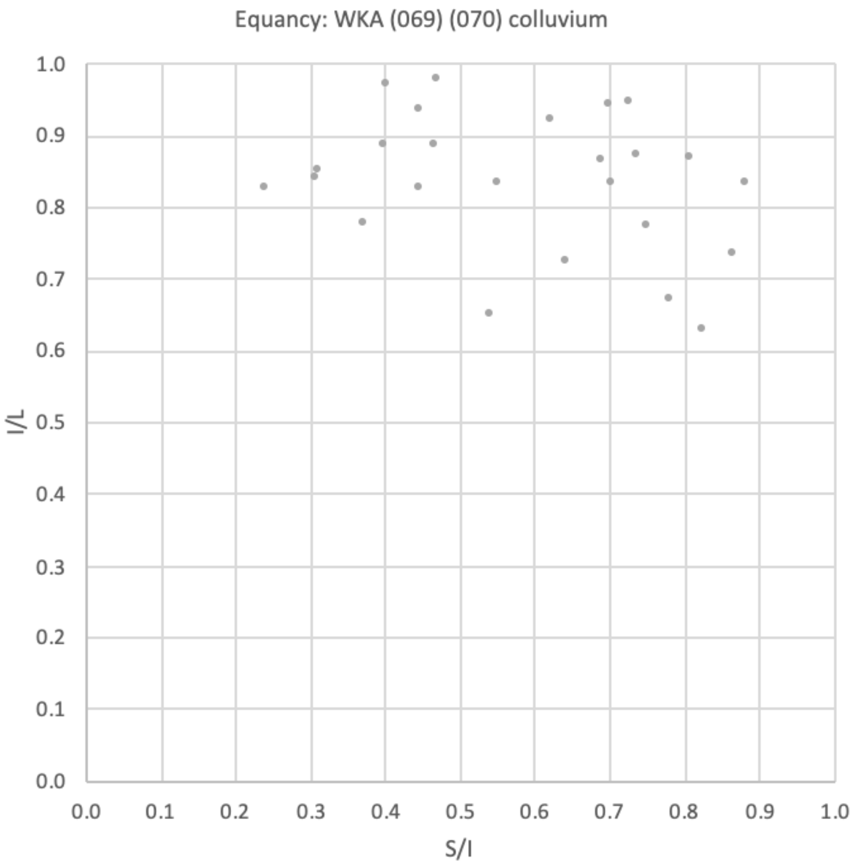


Fourteen pieces of sarsen were retained from the topsoil. They are a mix of very angular to sub-rounded pieces of saccharoid sarsen, three with some surviving cortex. Only two appear to have been burnt, suggested by their weak red and pinkish grey colouring. Three are flake-like pieces and one, 600/0003, is a flake with flake scars to its dorsal face and what could be described as an erailure scar. It, and item 400/0007, both have root holes visible in the broken faces.

Only four of the 14 pieces have an equancy greater than 0.6, which is unusual given the predominantly equant to sub-equant form of the whole assemblage. This group tends to have a higher ratio of intermediate/longest dimension with eight falling into the slab and flat block form classes. Only one piece, 600/0001, is at all abraded. Taken together, these characteristics suggest that there has been little recent movement or damage to the material in the topsoil.

5.10 (069) (070) (colluvium), colluvium

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	25	0	0
Completeness	**Fragment**	**Complete**	
	25	0	
Cortex	**Absent**	**Present**	
	12	13	
Burning	**Unburnt**	**Burnt**	
	15	10	
Weight (g)	**Total**	**Mean**	**Range**
	1,819	72.8	7 - 230



Contexts (069) and (070) are colluvial deposits in Trench 1, likely former plough-soils originating up-slope on Waden Hill to the west of the excavated area. Twenty-three pieces of sarsen were retained from those contexts, with a further two from colluvium in Trench 2.

All broken pieces of saccharoid sarsen, their form more broadly reflects the overall assemblage than the fewer pieces from the overlying topsoil. Just over half (13, 52%) are equant or sub-equant, the rest falling into the slab and flat block form classes. They range from very angular to sub-rounded but the modal angularity is angular (14, 56%). Just over half (13, 52%) include surviving cortex, another similarity, although 10 (40%) are burnt, slightly under average compared with the whole assemblage. On the whole they are small (mean weight 72.8g).

The 10 burnt pieces include six identified by colour alone, ranging from weak red to pinkish grey. Item 070/003, an angular piece weighing 44g, is however cracked and has the dry feeling indicative of burning whilst 069/0002, 069/0017 and 069/0020 are not only coloured but also cracked.

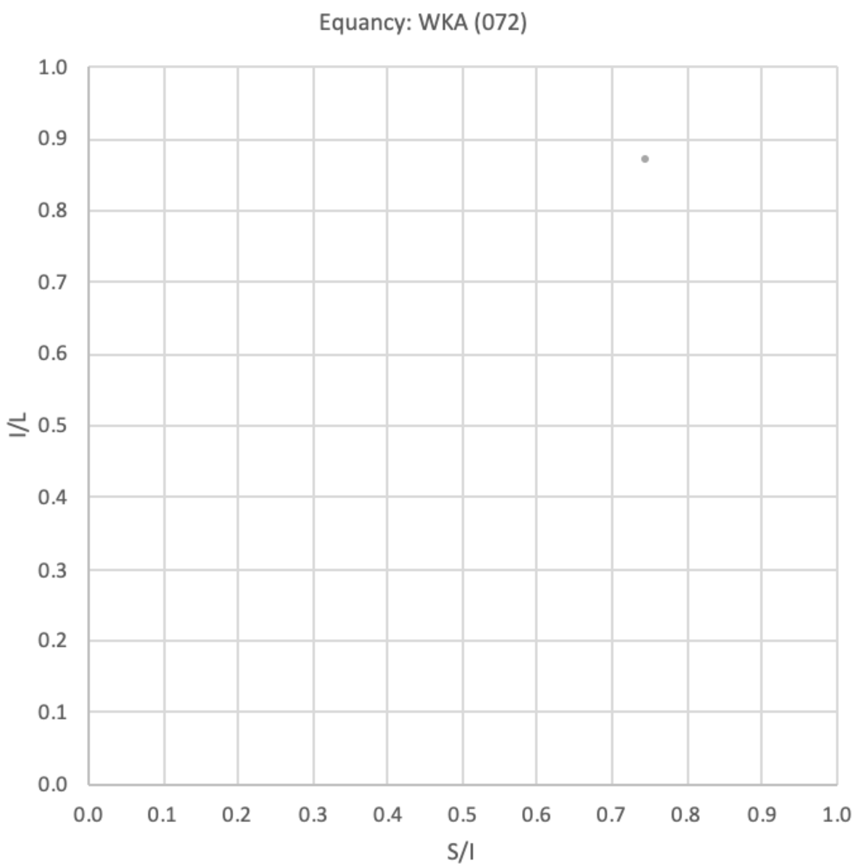
One piece may be a broken fragment from a rubber. Item 069/0017, weighing 66g, is a pale red to light brown angular sub-equant block. It has one convex surface, smooth to the touch, comprising sand grains which under magnification are noticeably flattened and regular in height. The colour and cracks suggest that it has been burnt.

Two flake-like pieces have no obvious percussion characteristics but four, 069/0006, 069/0011, 069/0015 and 070/0001 display more diagnostic features including diffuse bulbs of percussion and dorsal flake scars. Four small pieces (7g – 22g) retaining cortex are very angular to sub-angular fragments from sarsen pebbles.

It is possible that the sarsen from these contexts represents some naturally-occurring and broken pieces ultimately derived from the superficial deposits mantling Waden Hill, mixed with pieces that have been through anthropogenic processes and manured into cultivated soils prior to colluviation.

5.11 (072), sarsen/flint 'collar' to F.35

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	1	0	0
Completeness	**Fragment**	**Complete**	
	1	0	
Cortex	**Absent**	**Present**	
	0	1	
Burning	**Unburnt**	**Burnt**	
	0	1	
Weight (g)	**Total**	**Mean**	**Range**
	212	-	-



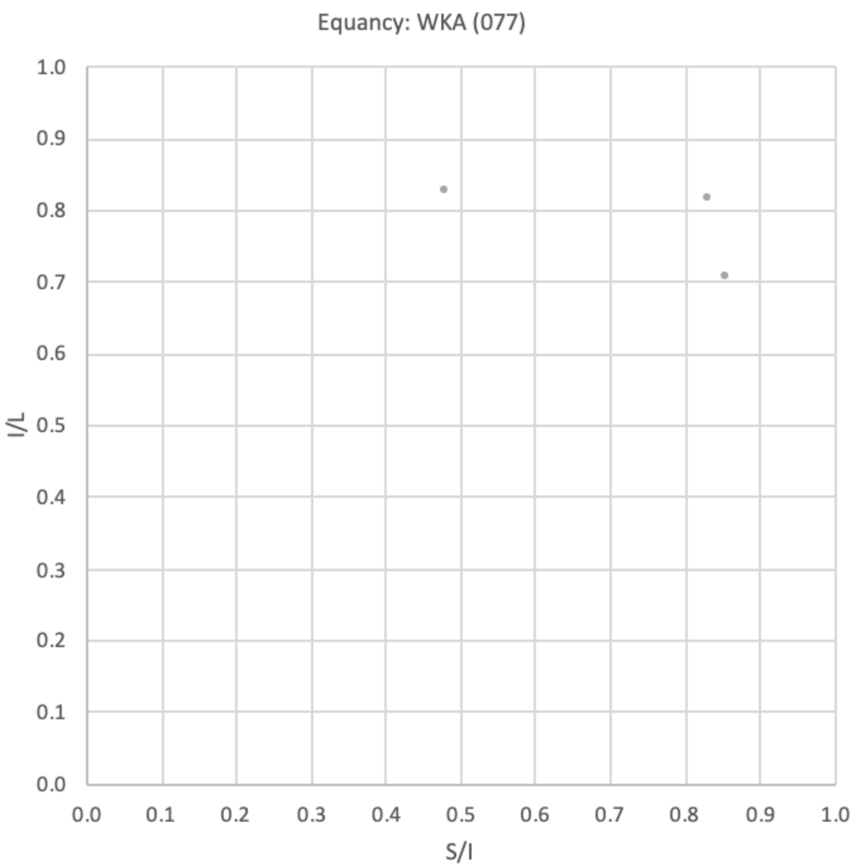
Item 072/0001 is the only piece of sarsen collected from the sarsen and flint 'collar' (072) that encircled the top of fill (077) to F.35.

Feature F.35 is a shallow oval scoop approximately 0.2m deep, excavated in Trench 2. The feature cut through deposit (007), the lower stony horizon of the worm-sorted soil. The excavators suggest that form of the cut feature and its arrangement of stone indicate that it represents the remains of a hearth.

Characteristics of 072/0001 may support that interpretation. The piece of corticated saccharoid sarsen is an angular sub-equant block weighing 212g. Its weak red colouration suggests burning, although caution is merited on account of the similarity of its cortex with naturally-red sarsens in the locality. The interior, revealed in the broken faces, is occasionally mottled. On the other hand, the faces are relatively flat and in at least two instances almost perpendicular to the corticated face, consistent with the crack patterns of other heat-fractured pieces of sarsen that have nevertheless not yet fallen apart. Sarsens this colour tend to be smaller items within the range of large cobbles/small boulders more suited to making a structure like a hearth.

5.12 (077), fill of F.35

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	3	0	0
Completeness	**Fragment**	**Complete**	
	3	0	
Cortex	**Absent**	**Present**	
	2	1	
Burning	**Unburnt**	**Burnt**	
	2	1	
Weight (g)	**Total**	**Mean**	**Range**
	345	115	44 - 165



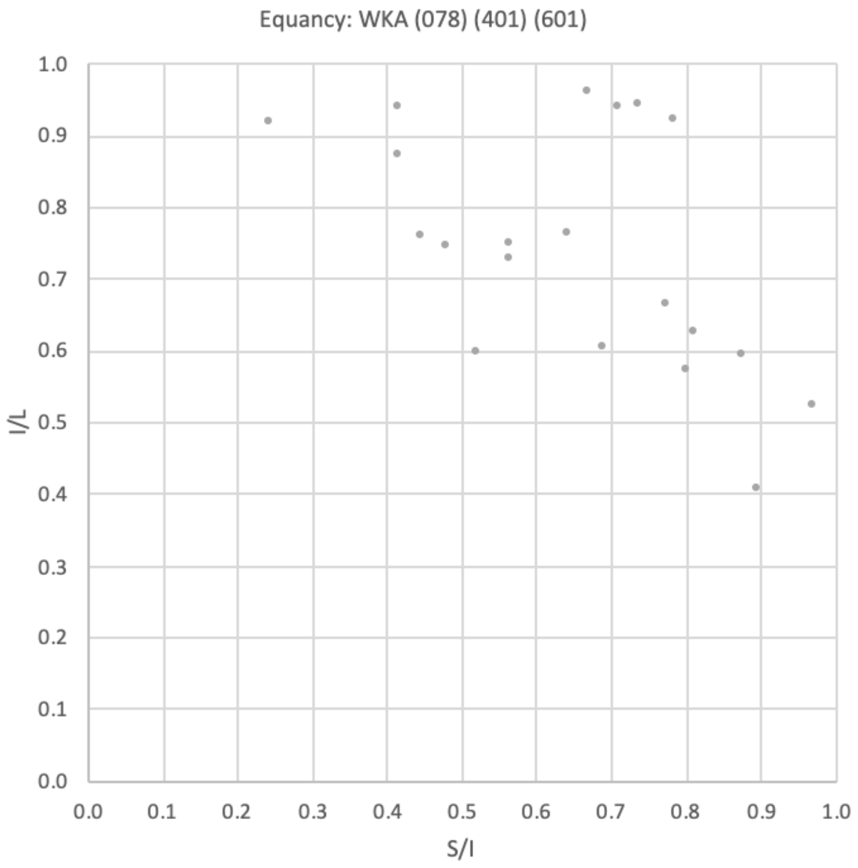
Context (077) is the fill of F.35, a shallow oval scoop in Trench 2 interpreted as the remains of a hearth. The top of the fill was ringed by the flint and sarsen collar (072). Three pieces of sarsen were recovered from (077).

Item 077/0001 is possibly a piece of broken hammerstone. The characteristics suggesting that it is a tool are discussed in Section 4. Its reddish-brown exterior may indicate that it is burnt, although the colouration does not extend more than *c*. 2mm into the interior which is light grey. That internal colour is revealed both in broken faces and by a flake scar interrupting the cortex. The flake scar is possibly a product of percussion (during use as a hammerstone). Had this item been burnt after its use and discard as a tool, the stone revealed by the flake scar and the other broken faces should also have changed colour, so the exterior colour is more likely the result of Fe movement/cortex development.

The two other pieces from this context, 077/0002 (44g) and 077/0003 (136g), are quite equant very pale brown to light grey saccharoid sarsen. They are similar enough to have come from the same parent material. The larger piece is cracked as though burnt.

5.13 (078) (401) (601), late C19 ploughsoil

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	20	0	0
Completeness	**Fragment**	**Complete**	
	20	0	
Cortex	**Absent**	**Present**	
	14	6	
Burning	**Unburnt**	**Burnt**	
	13	7	
Weight (g)	**Total**	**Mean**	**Range**
	2,839	142	10 - 565



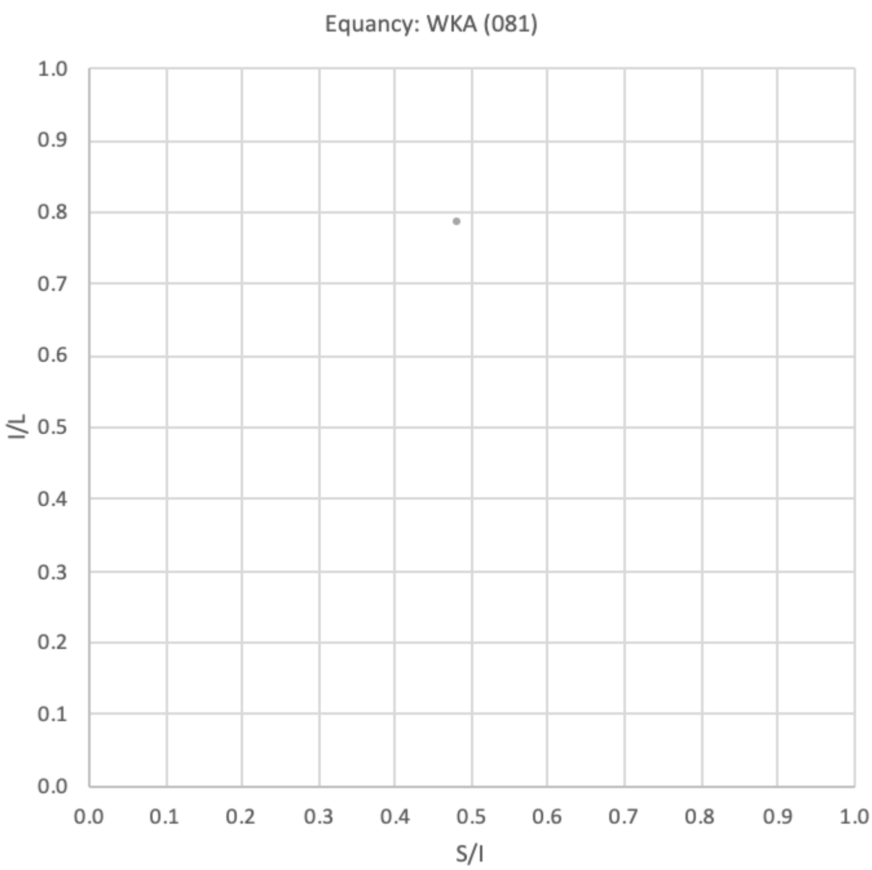
A late nineteenth-century period of ploughing was identified by the presence of contexts (003), (078), (401) and (601), a thin former ploughsoil across some of the trenches. Twenty saccharoid sarsen pieces were retained from the latter three deposits.

This assemblage is in a way quite heterogeneous. The modal group of 8 equant and sub-equant pieces is only 40% of the assemblage. The rest are largely flat blocks and oblate spheroids (6) or prolate spheroids and elongate blocks (4) (in total 50% of the assemblage). That indicates the flatter, more extended shapes of the pieces, becoming either more platy or more roller-like. The weight range of 555g is larger than the assemblages from the topsoil (n=14, 266g) or colluvium (n=25, 223g). This heterogeneity could be the result of the way that the short episode of cultivation disturbed and mixed the non-soil components which include flint, coke, small pieces of CBM etc, compared with the sorting effects of longer-term colluviation and the development of the topsoil once the ploughing finished.

One item, 410/0012, may be a piece of ground sarsen. This small (91g) grey to greyish-brown sub-angular slab has possibly ground patches to one face. The sand grains in the patches are flattened and slightly glossy, although not smooth. The patches are interrupted by numerous voids but these are not distinct enough to have been made clearly by dressing.

5.14 (081), fill of F.46

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	1	0	0
Completeness	**Fragment**	**Complete**	
	1	0	
Cortex	**Absent**	**Present**	
	0	1	
Burning	**Unburnt**	**Burnt**	
	1	0	
Weight (g)	**Total**	**Mean**	**Range**
	102	-	-

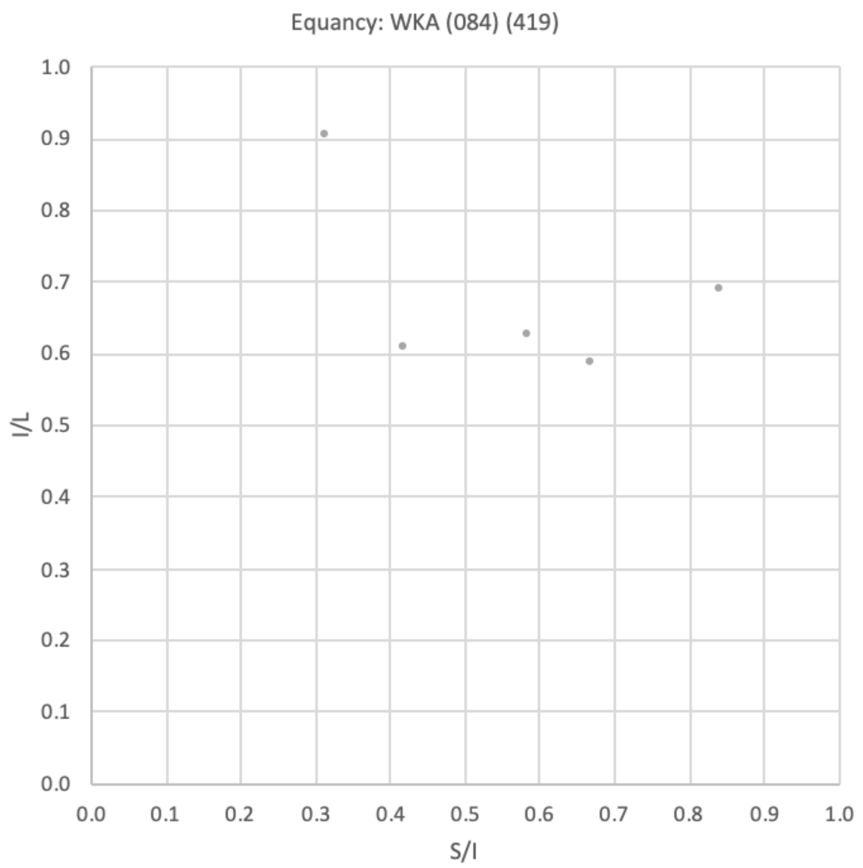


Context (081) is the fill to F.46, interpreted as a deflated pit feature excavated in Trench 1. The thin horizon included work flint and sherds from a Fengate Ware vessel associated with the Middle Neolithic occupation. The single piece of saccharoid sarsen, 081/0001, is a

102g pale brown to light brownish grey flat block. It is a flake-like piece with a corticated convex dorsal face, but no diagnostic characteristics of percussion.

5.15 (084) (419), fill of periglacial stripes

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	5	0	0
Completeness	**Fragment**	**Complete**	
	4	1	
Cortex	**Absent**	**Present**	
	0	5	
Burning	**Unburnt**	**Burnt**	
	5	0	
Weight (g)	**Total**	**Mean**	**Range**
	2,447	489.4	167 - 887

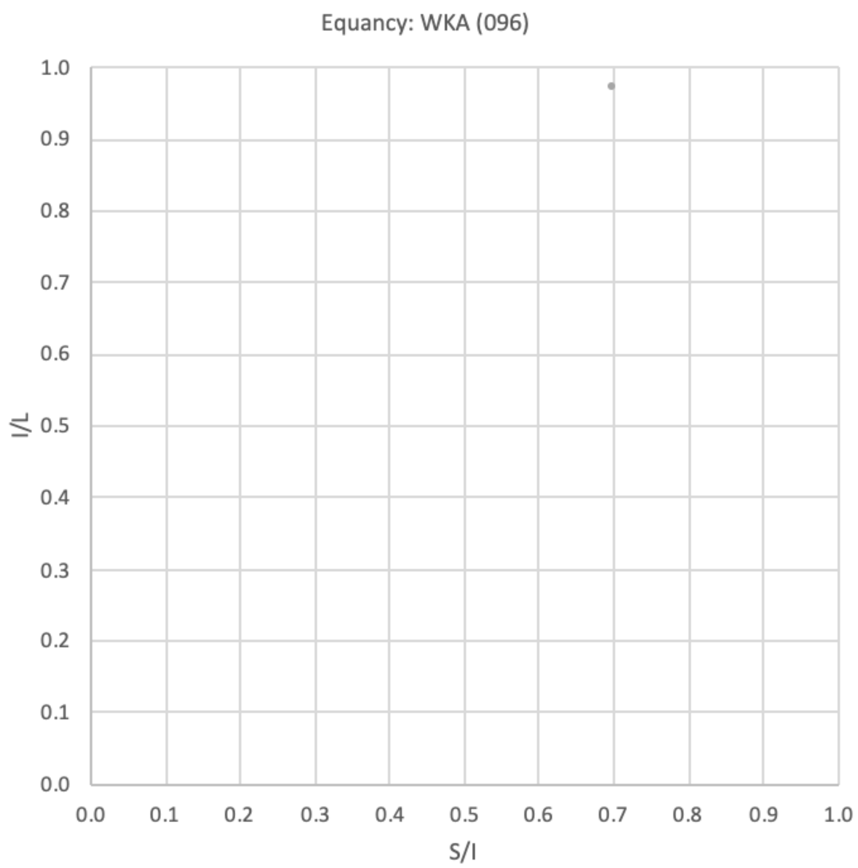


A stiff orange-brown silty-clay soil filling periglacial 'stripes' in the Coombe rock was numbered contexts (084), (092), (419) and (613). Five large pieces of sarsen were collected from two of the contexts, (084) and (419).

These are noticeably large items with a mean weight just under half a kilogram. Item 084/0001 is a complete small cobble, whilst the items from (419) are all parts of cobbles. The size in particular is likely to have made these pieces stand out and it is possible that there has been some differential collection in the field, given that more sarsen fragments might have been expected in the deposit that has developed in the frost-patterned ground.

5.16 (096), fill of F.42

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	1	0	0
Completeness	**Fragment**	**Complete**	
	0	1	
Cortex	**Absent**	**Present**	
	0	1	
Burning	**Unburnt**	**Burnt**	
	1	0	
Weight (g)	**Total**	**Mean**	**Range**
	1,733	-	-

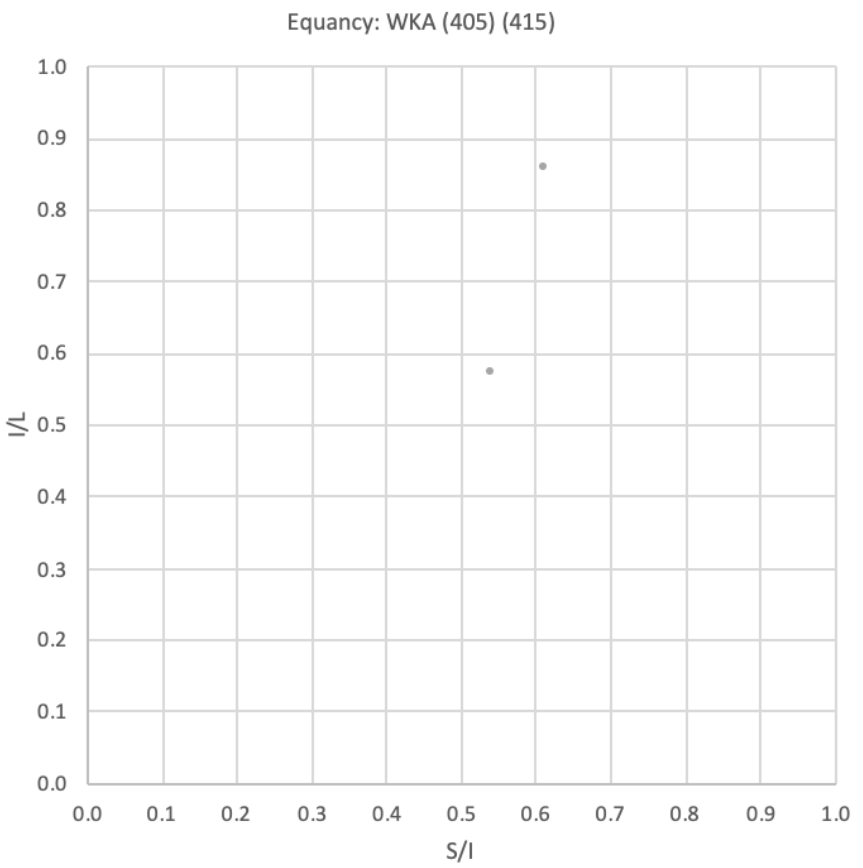


There were two large pieces of sarsen in the top of tree-throw F.42 in Trench 2, one of which was a small, dark coloured, boulder weighing 19kg. From one of its fills, item

096/0001 was an unworked large cobble weighing 1,733g. It is a yellowish brown to dark greyish brown rounded sub-equant spheroid.

5.17 (406) fill of F.53, (415) fill of F.57, modern drains

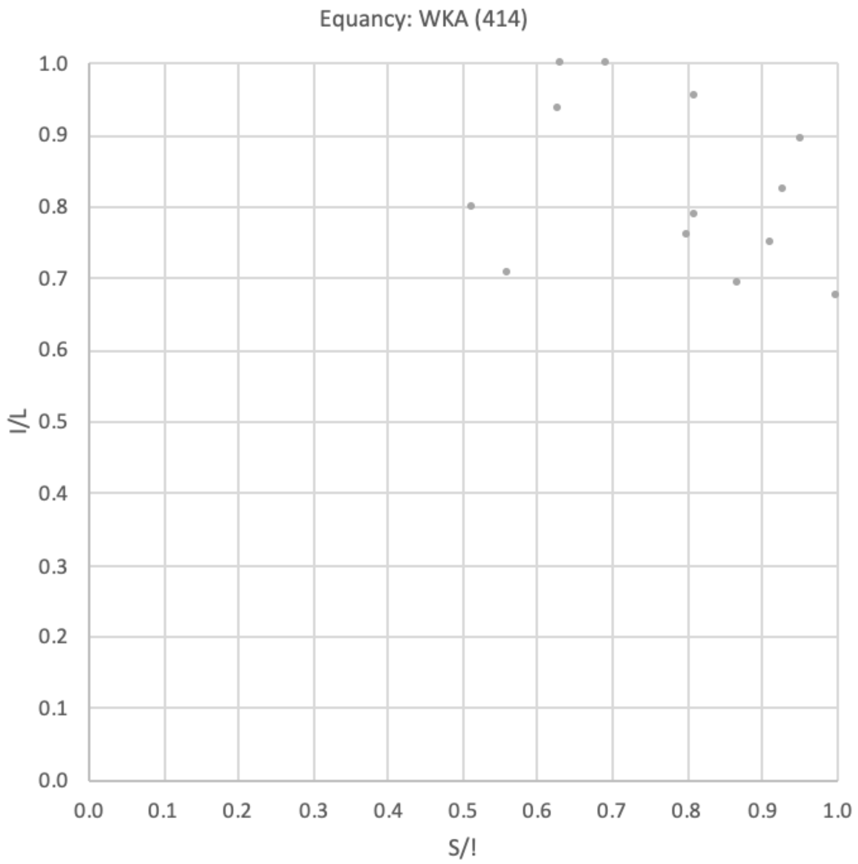
Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	2	0	0
Completeness	**Fragment**	**Complete**	
	2	0	
Cortex	**Absent**	**Present**	
	2	0	
Burning	**Unburnt**	**Burnt**	
	1	1	
Weight (g)	**Total**	**Mean**	**Range**
	64	32	4 - 60



Two pieces of sarsen were retained from fills to modern drainage features in Trench 4. The smallest, 415/0001 (4g) is a yellowish-brown to light red fragment with the 'dry' feeling of burnt sarsen, sub-rounded and abraded. The larger (60g), 406/0001, is blade-shaped.

5.18 (414), fill of F.55

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	13	0	0
Completeness	**Fragment**	**Complete**	
	13	0	
Cortex	**Absent**	**Present**	
	7	6	
Burning	**Unburnt**	**Burnt**	
	7	6	
Weight (g)	**Total**	**Mean**	**Range**
	634	48.8	1 - 217

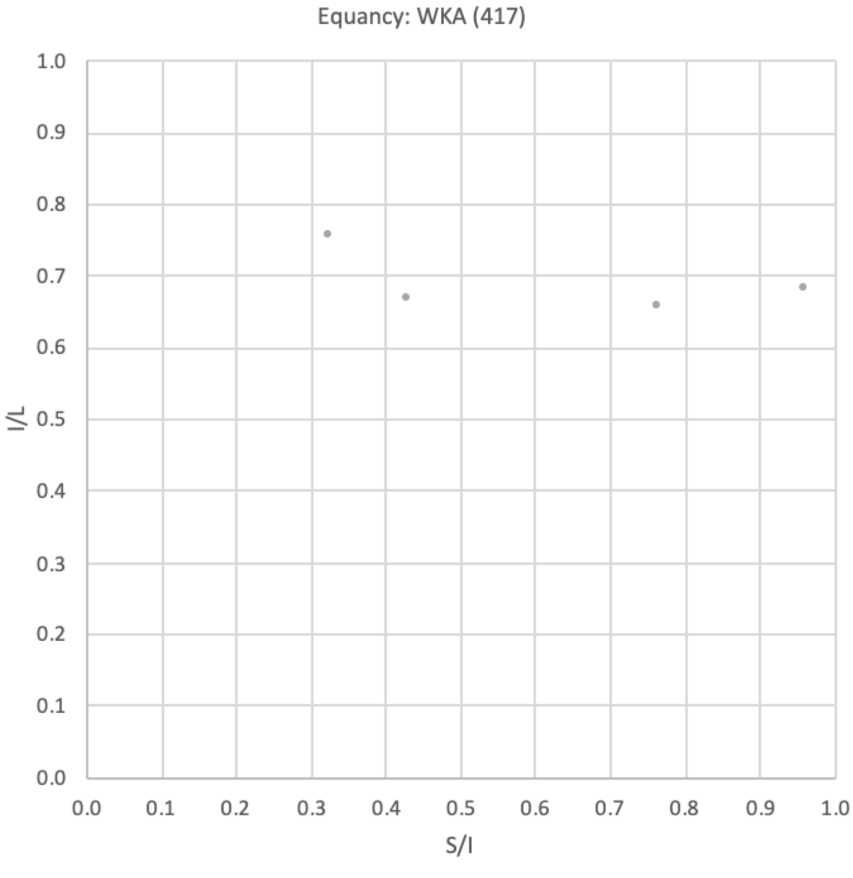


Context (414) is the upper fill of the re-cut part of F.55, a Middle Neolithic sub-oval pit. The deposit was a dark, olive-brown clay loam with abundant charcoal flecking containing a substantial flint assemblage. The thirteen pieces of broken saccharoid sarsen from (414) are small (mean weight 48.8g), mostly angular to sub-angular (9, 69.2%) and sub-equant or equant in form (11, 84.6%).

Just under half have the clearest signs of having been burnt. That is suggested by the colouration and angularity of four pieces and by the cracks and angularity of two. Items 414/0004 and 414/0005 re-fit (Group 14), apparently along an irregular crack propagated by burning. Although seven pieces are not classed as burnt, four of those have the ‘dry’ feeling described in Section 2. Two of those pieces are abraded and the other two are angular. Overall, the small sarsen assemblage from (414) has been burnt or affected by heat, consistent with the excavators’ suggestion that the deposit was in part drawn from a midden or hearth source.

5.19 (417), fill of F.55

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	4	0	0
Completeness	**Fragment**	**Complete**	
	4	0	
Cortex	**Absent**	**Present**	
	3	1	
Burning	**Unburnt**	**Burnt**	
	2	2	
Weight (g)	**Total**	**Mean**	**Range**
	157	39.3	1 - 138

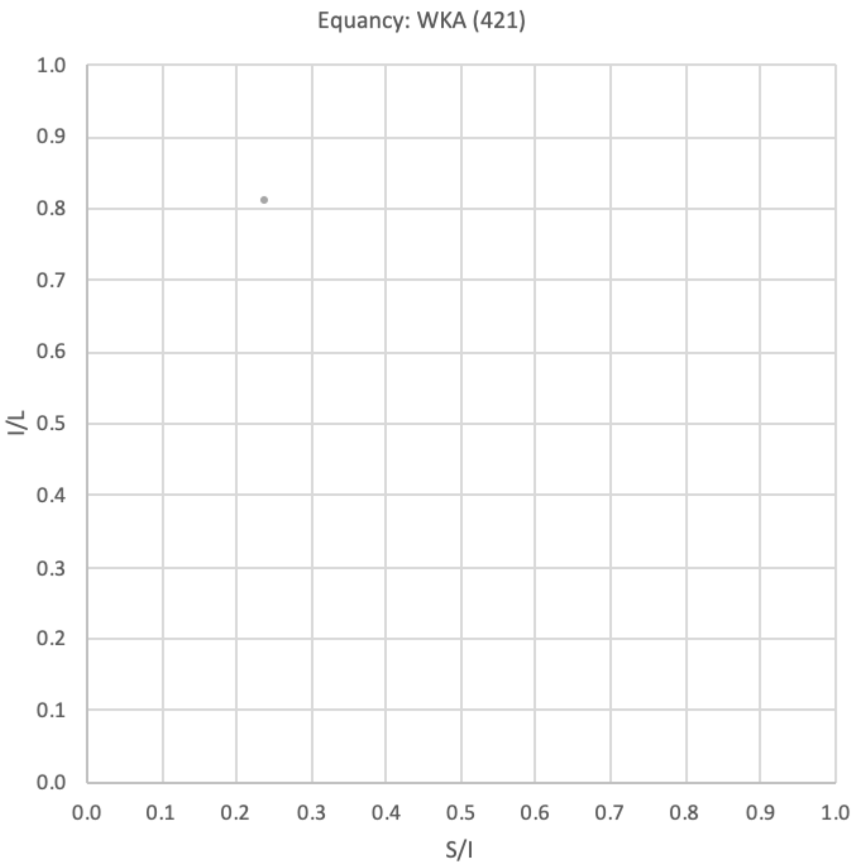


Context (417) is the lower fill of the re-cut part of F.55, a Middle Neolithic sub-oval pit. The dark brown clay-loam contained small flint fragments ‘alongside a concentration of sarsen fragments’. Four pieces of saccharoid sarsen were recovered. Their mean weight, 39.3g, and range of 1g to 138g, makes them slightly smaller on average than the pieces of sarsen from (414). They are very angular or sub-angular except one piece, 417/0001, which is rounded, and they are on the whole less equant than the pieces from (414): the two smallest fragments from (417) are flatter. Of these, 417/0003 is possibly a fragment from a rubber, whilst the smallest piece weighing only 1g, 417/0004, is flake-like with a diffuse bulb of percussion but no damage to its possible platform.

Items 417/0001 and 417/0002 are clearly burnt. 417/0001 is cracked and very friable, hence its abraded, rounded form. It has the characteristic ‘dry’ feeling of burnt sarsen. 417/0002 is the largest piece from this context, weighing 138g. The reddish-brown to light reddish-brown sub-angular piece is cracked and also ‘dry’ to the touch.

5.20 (421), fill of F.55

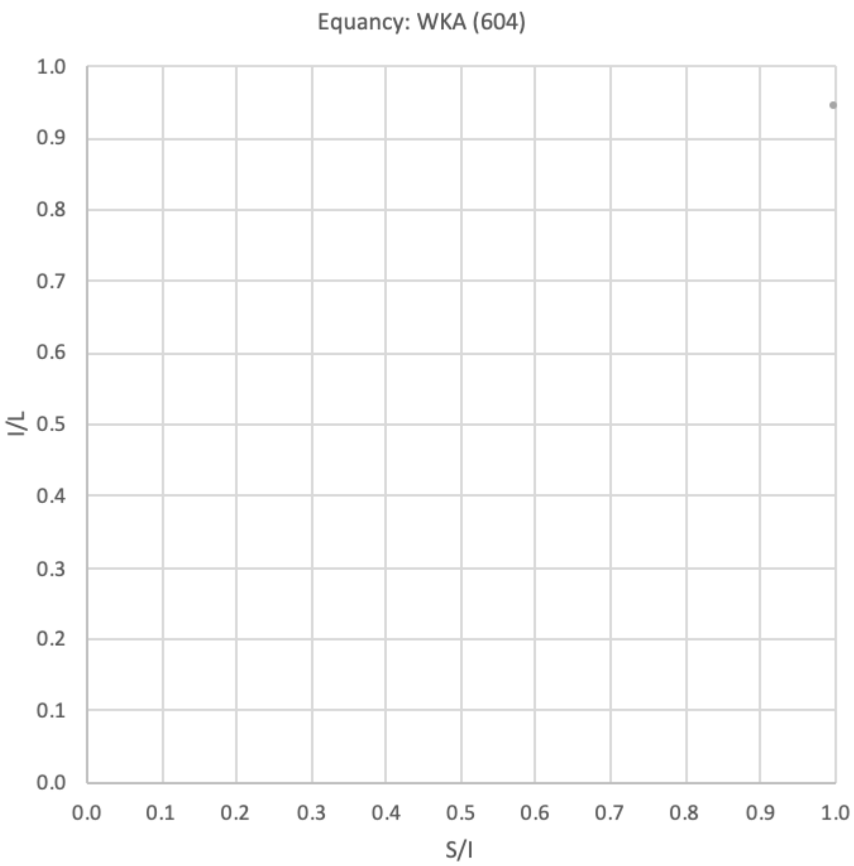
Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	1	0	0
Completeness	**Fragment**	**Complete**	
	1	0	
Cortex	**Absent**	**Present**	
	1	1	
Burning	**Unburnt**	**Burnt**	
	1	0	
Weight (g)	**Total**	**Mean**	**Range**
	2	-	-



Item 421/0001 is a small flake-like chip of saccharoid sarsen with a bulb of percussion. The very angular 2g piece of stone is part of re-fit group 16 (see Section 3) and is the only piece of sarsen from context (421). The stiff, orange-brown clay-loam deposit flecked by charcoal is the primary fill of a large feature [425], possibly Mesolithic in date.

5.21 (604), packing in (608), F.58

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	1	0	0
Completeness	**Fragment**	**Complete**	
	0	1	
Cortex	**Absent**	**Present**	
	0	1	
Burning	**Unburnt**	**Burnt**	
	1	0	
Weight (g)	**Total**	**Mean**	**Range**
	4,414	-	-

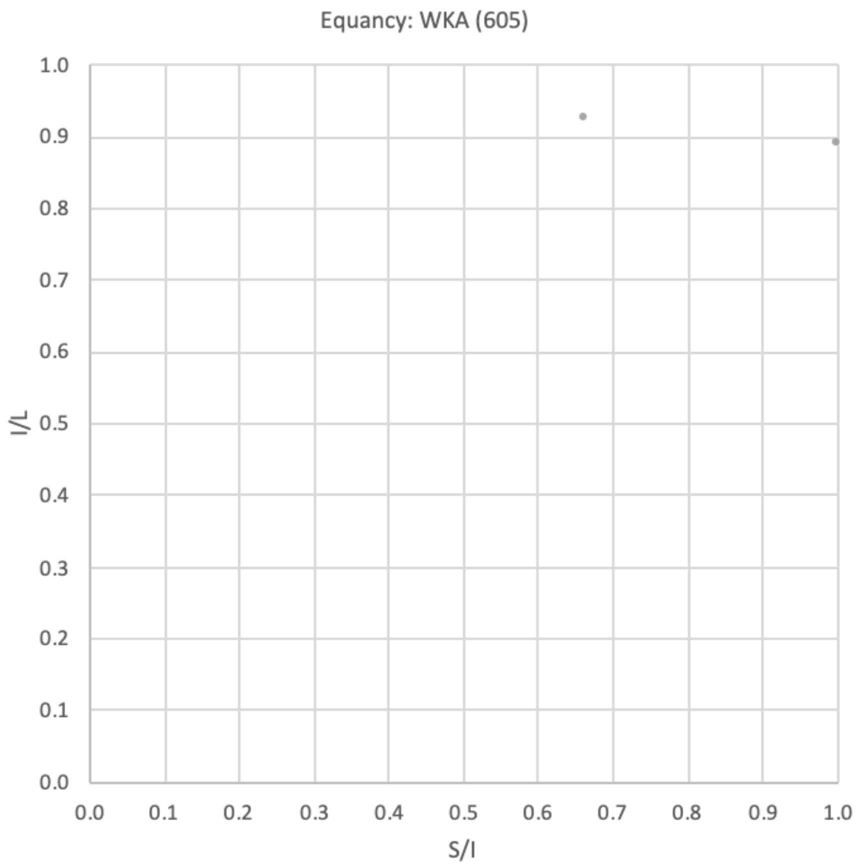


Item 604/0001 is the largest sarsen retained from the WKA excavations. It is a large pale brown to very pale brown rounded cobble weighing 4.4kg, recorded as saccharoid sarsen albeit without being able to examine the interior fabric. Highly equant, it is typical of similar sarsen cobbles visible in modern building fabric in the locality.

The cobble is one of 19 sarsen packing stones present in (608), the mixed chalk rubble and fine, cemented, beige chalk silt forming packing to post-hole F.58 above (615). Some of the packing matrix adheres to one side of 604/0001. The sarsens were seen to have been used carefully, with smaller stones lower down and larger ones towards the top of the context noted to have been up to 0.7m in length. Item 604/0001 is one of the smaller stones.

5.22 (605), fill of F.58

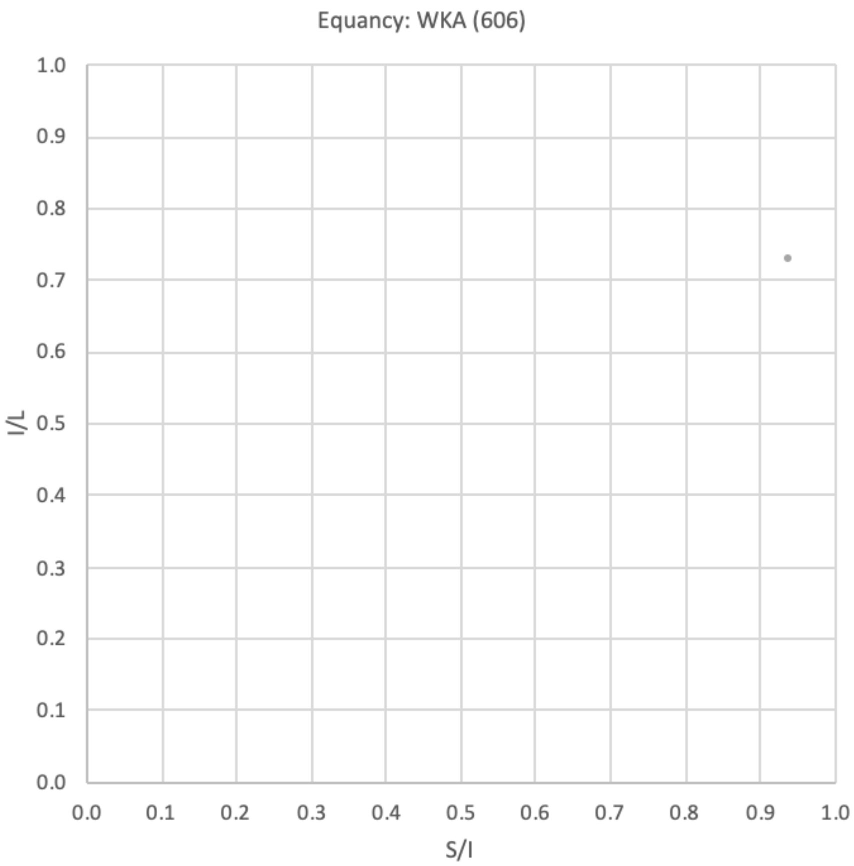
Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	2	0	0
Completeness	**Fragment**	**Complete**	
	2	0	
Cortex	**Absent**	**Present**	
	1	1	
Burning	**Unburnt**	**Burnt**	
	0	2	
Weight (g)	**Total**	**Mean**	**Range**
	208	104	42 - 166



Two pieces of sarsen were collected from context (605), a charcoal-flecked dark brown clay loam of the upper part of the post-pipe to post-hole F.58. These small saccharoid sarsen fragments had both been burnt. Item 605/0001, a small light grey to pale red sub-angular equant block weighing 42g, is cracked. It retains an area of cortex. The larger piece, 605/0002 (166g), is a reddish-brown to light grey sub-angular sub-equant block. Black material adhering to it in places may be derived from the charcoal in (605).

5.23 (606), fill of F.59

Stone type	**Saccharoid**	**Quartzitic**	**Conglomerate**
	1	0	0
Completeness	**Fragment**	**Complete**	
	1	0	
Cortex	**Absent**	**Present**	
	0	1	
Burning	**Unburnt**	**Burnt**	
	0	1	
Weight (g)	**Total**	**Mean**	**Range**
	40	-	-



Item 606/0001 is from context (606), one of two fills to F.59, a large tree-throw whose fills included lightly burnt flint, worked flint, 'a little sarsen' and a sherd of early Neolithic pottery. The small (40g) yellowish brown sub-angular sub-equant block of saccharoid sarsen retains some cortex and is fire-cracked.

6 Phased assemblage

6.1 Phase 0, tree throws and hollows of likely early Holocene date

A small amount of sarsen was retained from contexts in Phase 0, comprising five pieces from silty deposits (084) and (419) filling periglacial stripes, and one piece from (096), fill of tree-throw F.42. As a result of periglacial processes, these cobbles (including pieces likely broken by freeze/thaw action) would have been amongst the sarsen distributed across the landscape and within the developing Clay-with-Flints and Head on the higher ground and slopes.

6.2 Phase 1A, Early Neolithic

Four pieces of sarsen come from early Neolithic contexts. One small, heat-cracked piece from (606), a fill of tree-throw pit F.59, is associated with 'lightly burnt flint' in the feature's deposits. Other material culture amongst those fills suggests an early Neolithic date for the tree-throw. The burnt stone hints at settlement in the area including perhaps hearths. The remaining pieces are from the large posthole F.58, including post-packing (604) and two burnt pieces from post-pipe fill (605). Clearly, sarsen cobbles were collected as part of the construction process to erect this substantial timber post.

6.3 Phase 1.B, Middle and possible Late Neolithic

Fills of five Middle or Later Neolithic features include in total 31 pieces of sarsen.

The features include two sarsen extraction pits **F.3** and **F.12** which Gillings and Pollard (2016, 11) suggest could have been the source for two of the boulders standing in the West Kennet Avenue. The four sarsen fragments from their contexts (010) and (032) were burnt, suggesting that some at least of the material in the pit fills derived from hearth or midden sources. That supports the excavators' observations and discussion of likely deliberate deposition of contemporary feasting material, including animal bones and pottery, in the prehistoric sarsen extraction hollows (Gillings and Pollard 2016, 15).

Feature **F.6**, a Middle Neolithic bowl-shaped pit in Trench 3/6, contained deposit (020) interpreted as a mixture of hearth debris, soil and knapping waste. None of the mixed burnt and unburnt sarsen pieces from that context are worked or tool fragments. Also part of the Middle Neolithic occupation, the deposit (081) remaining of **F.46**, a shallow pit containing Fengate Ware sherds and worked flint, had one unburnt, flake-like piece of sarsen. Fills (414) and (417) to the Middle Neolithic re-cut of pit **F.55** in Trench 4 contained in total 17 sarsen fragments along with a considerable assemblage of knapped flint. Eight of the 17 sarsen pieces had been burnt and one of the unburnt pieces is possibly a fragment of rubber or top-stone. The burnt sarsen along with charcoal flecking in (414) suggest that the fills are derived from a midden or hearth.

Taken together, just over half of this small assemblage of sarsen pieces in Neolithic pit contexts appears to have come from sources involving heat or burning. Seventeen (54.8%) have diagnostic features of having been burnt. Overall, they are blocky pieces: 24 (77.4%) are equant or sub-equant. Their roundedness is very varied, from very angular to rounded, although the modal value is sub-angular (14, 45.2%). They are fairly small, weighing on average 78.6g (range 1g – 619g) which is well under the mean for the total assemblage from the excavations of 126.0g.

Unfortunately, there are few comparative sarsen assemblages from contexts of similar date recorded and published in detail. Substantial quantities of broken sarsen in Middle Neolithic pits excavated at the White Horse Stone site (Kent) went unrecorded or were only weighed in bulk (Hayden and Stafford 2006, 85). Sarsen from a midden deposit and from a large spread of burnt material recently excavated during the Vale of Pewsey (VOP) project at Marden henge (Wiltshire) is, however, characterised in similar detail (Whitaker 2021). The midden is possibly associated with a ‘closing ceremony’ for a Neolithic house whilst the burnt spread (associated with an external hearth), which included some fresh, fitting Grooved Ware sherds, was located over part of the building’s floor surface. Although not precisely comparable in date (a small henge monument was built over the house but absolute dating is not yet available), the assemblages from Marden nevertheless provide a useful contrast as perhaps representing the sort of material from which the West Kennet Avenue sarsen had been drawn for deposition in the pits.

In total, 535 sarsen fragments were recovered from those midden and burnt spread contexts at Marden henge, of which 411 weighing 1g or more were recorded in full. They include five pieces that are possibly fragments of tools (three perhaps from querns, two from rubbers or top-stones). The majority had been burnt (319, 77.6%). Overall the pieces are relatively equant but a small number from the midden deposits are flatter, more elongate (although none of the flake-like pieces appeared to have been produced by percussion) and from the burnt spread there are numerous crescentic flake-like pieces which may have been removed from their parent stone by exfoliation due to temperature change. Pieces range from very angular to sub-rounded: the modal class is angular (203, 49.4%). The mean weight of the 411 pieces is only 28.0g (range 1g – 1,277g) (Table 8).

	WKA **sarsen from Neolithic pits and sarsen hollows**	**VOP** **sarsen from Neolithic midden and burnt spread deposits**
Total pieces (>= 1g)	31	411
Burnt	54.8%	77.6%
Modal form	sub-equant	sub-equant
Modal angularity	sub-angular	angular
Mean weight	78.6g	28.0g

Table 8 Comparison of general characteristics of sarsen from WKA contexts (010), (032), (081), (414), (417) and VOP contexts (1026) (93031) (1006) (1035) (2111) (93003).

On the basis of this comparison, it is possible that the characteristics of the small group of 31 items from the West Kennet Avenue pits indicate a degree of selection. The profile of the sarsen assemblage from Marden suggests that, had the sarsen in the West Kennet Avenue Neolithic pits been collected randomly from hearth or midden sources, there would have been more burnt pieces, a little more variety in their form including more flake-like pieces and more often angular, and that they would have been smaller overall.

This conclusion should be treated with caution. There are only 31 pieces of sarsen from the West Kennet Avenue pits, which themselves are not necessarily precisely contemporaneous, probably made for different purposes and, concomitantly, with different practices applied to their infilling. The heating and burning processes at the two sites may have been quite different resulting in different fracture patterns in the sarsen available for deposit (hearth stones, pot-boilers, steaming, griddle stones, duration and intensity of burning etc affecting the fracture patterns). Furthermore, different methodologies were deployed at the excavations, resulting in much more sarsen being collected from Marden including smaller material retained by wet-sieving bulk samples through a 4mm mesh, compared with dry sieving fills using a 10mm mesh at West Kennet.

6.4 Phase 1, Neolithic

6.4.1 Features

One further feature containing sarsen, shallow oval scoop F.35 in Trench 2, is associated with the Neolithic. Cutting through the worm-sorted soil that is thought to have developed by the fourth millennium BC, this possible hearth had a ‘collar’ of sarsen and flint (072) encircling the top of its fill (077). One piece of sarsen was collected from (072). As discussed in Section 5.11, the burnt block is consistent with having been used as a hearth stone. Fill (077) included three pieces of saccharoid sarsen, of which 077/0001 had been burnt. That item is possibly a piece of hammerstone, burnt and then broken prior to deposit (see Sections 4.3 and 5.12). It is possible that after this small cobble was used as a hammer, it was burnt and intentionally broken before being placed in the feature.

Context (421), the primary fill of a large feature [425], contained one small piece of sarsen. Weighing only 2g, this very small chip is part of the fabric group discussed in Section 4.1.1. The context included a piece of *Pomoideae* wood charcoal giving a Middle Neolithic date of 4363±30 BP (SUERC-70788: 3086-2905 cal. BC at 95.4%). The excavators argue that the charcoal fragment had likely been moved downwards into the fill by biological action because, stratigraphically, the cut [425] and its fills must pre-date the worm-sorted soil and are perhaps Mesolithic.

6.4.2 The worm-sorted soil

By far the greatest proportion of sarsen was recovered from the worm-sorted soil containing the *in situ* Neolithic flint scatter: in total 642[4] pieces were collected, comprising 485 from the contexts comprising the 'upper stone-free soil' and 157 from the 'lower stony horizon'. It is notable that there is almost three times as much sarsen from the upper stone-free soil than the lower stony horizon. That so much flint but relatively little of the sarsen was sorted down into the lower horizon is curious.

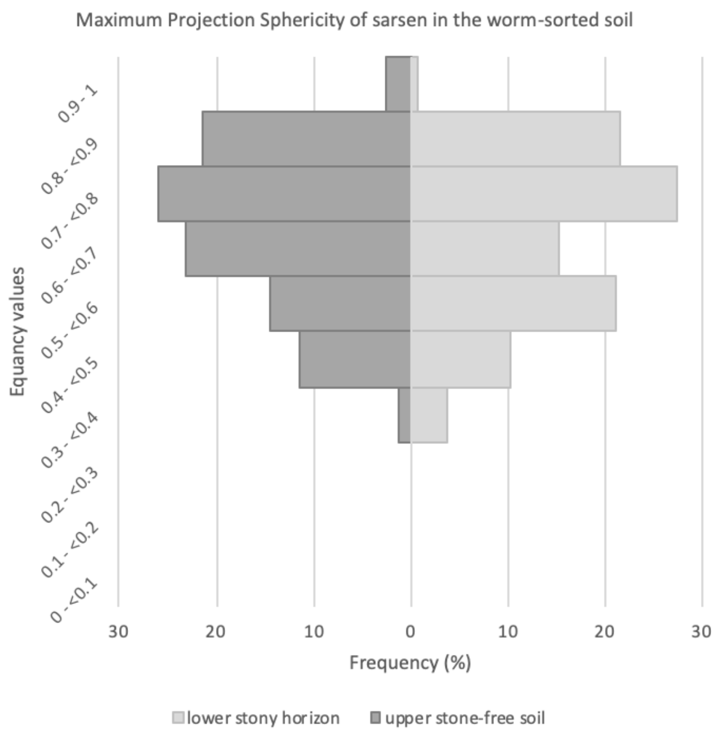


Figure 3 Comparison of the Maximum Projection Sphericity of sarsen from the upper stone-free soil and lower stony horizon contexts.

Sarsen in the upper stone-free soil is marginally more equant than the material remaining in the lower stony horizon. The lower stony horizon has a smaller

[4] This total includes 9 pieces from finds bags with relevant context numbers but no square number, of which 6 were additionally marked 'backfill'. I have used the context numbers from those bags in the recording and analysis but, without square numbers, those 9 sarsen pieces cannot be included in the distribution plots (below). Furthermore, 67 of the pieces were excavated in 2m squares and are thus also not included in the plots, which are organised by the 1m square trench grids.

proportion of sarsen pieces with Maximum Projection Sphericity greater than 0.6 (sub-equant to equant) and a larger proportion of more platy and elongate pieces under 0.6: but the differences are slight. Overall, the form profiles of the assemblages from each horizon of the worm-sorted soil are quite similar (Figure 3). The subtle difference is perhaps more obvious when comparing Sneed and Folk diagrams expressing the variation in form, with a greater proportion of items towards the upper (more equant) part of the plot for sarsen in the upper stone-free soil (Figure 4) compared with the lower stony horizon (Figure 5).

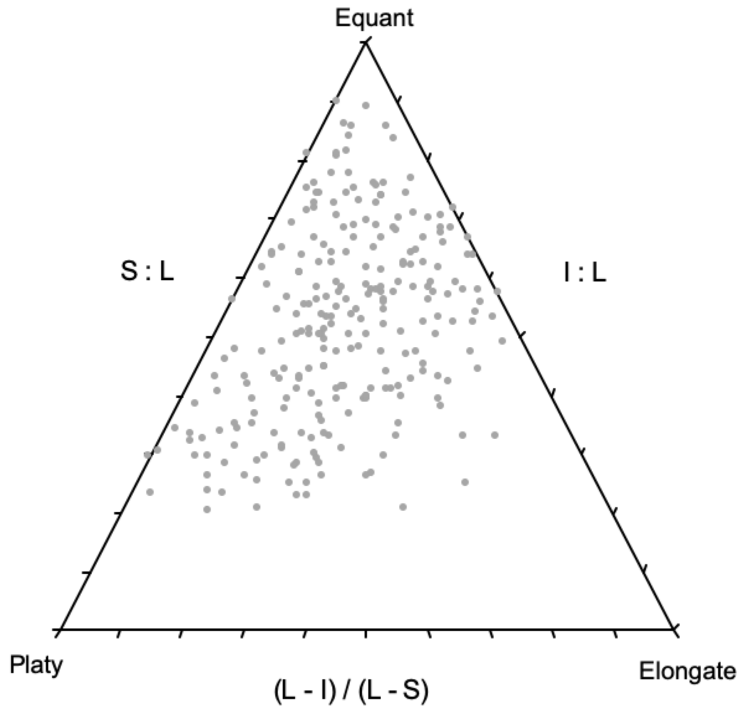


Figure 4 Sneed and Folk diagram (Graham and Midgley 2000) for form of sarsen in the upper stone-free soil.

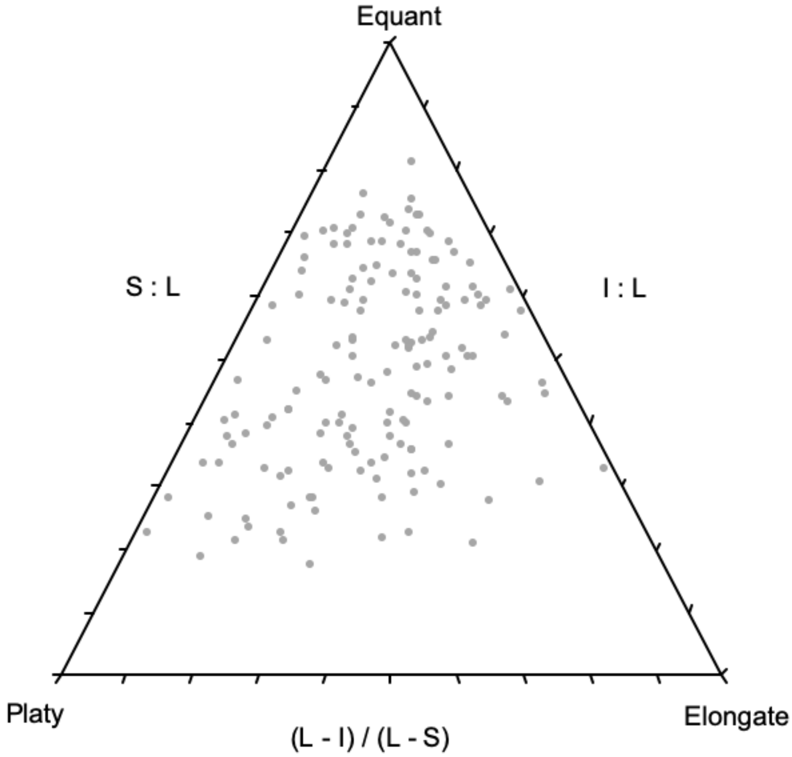


Figure 5 Sneed and Folk diagram (Graham and Midgley 2000) for form of sarsen in the lower stony horizon.

Neither do differences in weight satisfactorily explain why there is more sarsen from the upper than lower horizons of the worm-sorted soil. There are 97 large (>150g) pieces of sarsen in the upper stone-free soil compared with 38 from the lower stony horizon (20.0% and 24.2% respectively). There is marginally less small sarsen (<150g) from the lower stony horizon than the upper stone-free soil: 75.8% compared with 80.0% respectively. The mean weight of sarsen from the upper stone-free soil is 111.4g (range 1g – 2,764g) compared with 145.4g (range 1g – 2,074g) from the lower stony horizon: proportionately, the sarsen in the lower stony horizon is marginally larger than that from the upper stone-free soil, despite the largest pieces in the worm-sorted soil being recovered from higher up the soil profile. Nevertheless, the weight profiles are very similar (Figure 6).

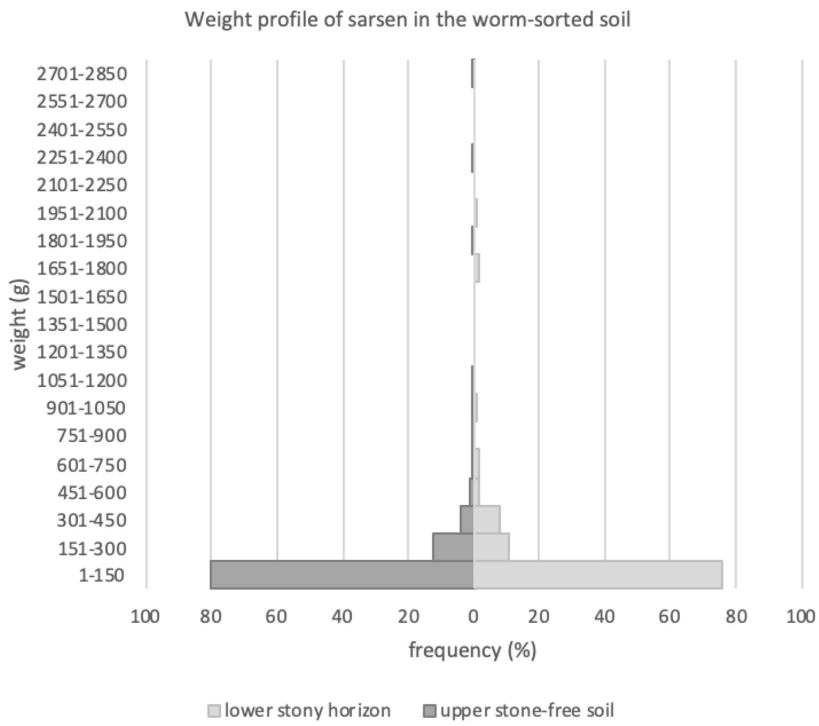


Figure 6 Comparison of the weight of sarsen from the upper stone-free soil and lower stony horizon contexts.

The disparity in the amount of sarsen between the horizons could be due to the volume of deposit. The upper stone-free soil is reported to have been thicker overall across the site (0.1m – 0.3m) than the stonier horizon below which was 0.04m – 0.2m but 'typically *c*. 0.05m' thick. Nevertheless, this fails to explain why so much flint and so little sarsen was sorted into the lower part of the soil profile.

The distribution in plan of sarsen in the worm-sorted soil largely mirrors that of the flint. There is a slight concentration of sarsen in the western part of Trench 2 and the northern part of Trench 4, contrasting with the relatively low incidence of sarsen in Trench 1. Albeit that many of the 1m squares in Trench 1 went unexcavated, it is surprising that more sarsen was not recovered there given the trench's position relative to the low resistance zone interpreted as corresponding to the area of prehistoric occupation. Trench 2 was located straddling the boundary of the low resistance zone and Trench 4 was outside it, yet they produced considerable quantities of sarsen (Figure 7).

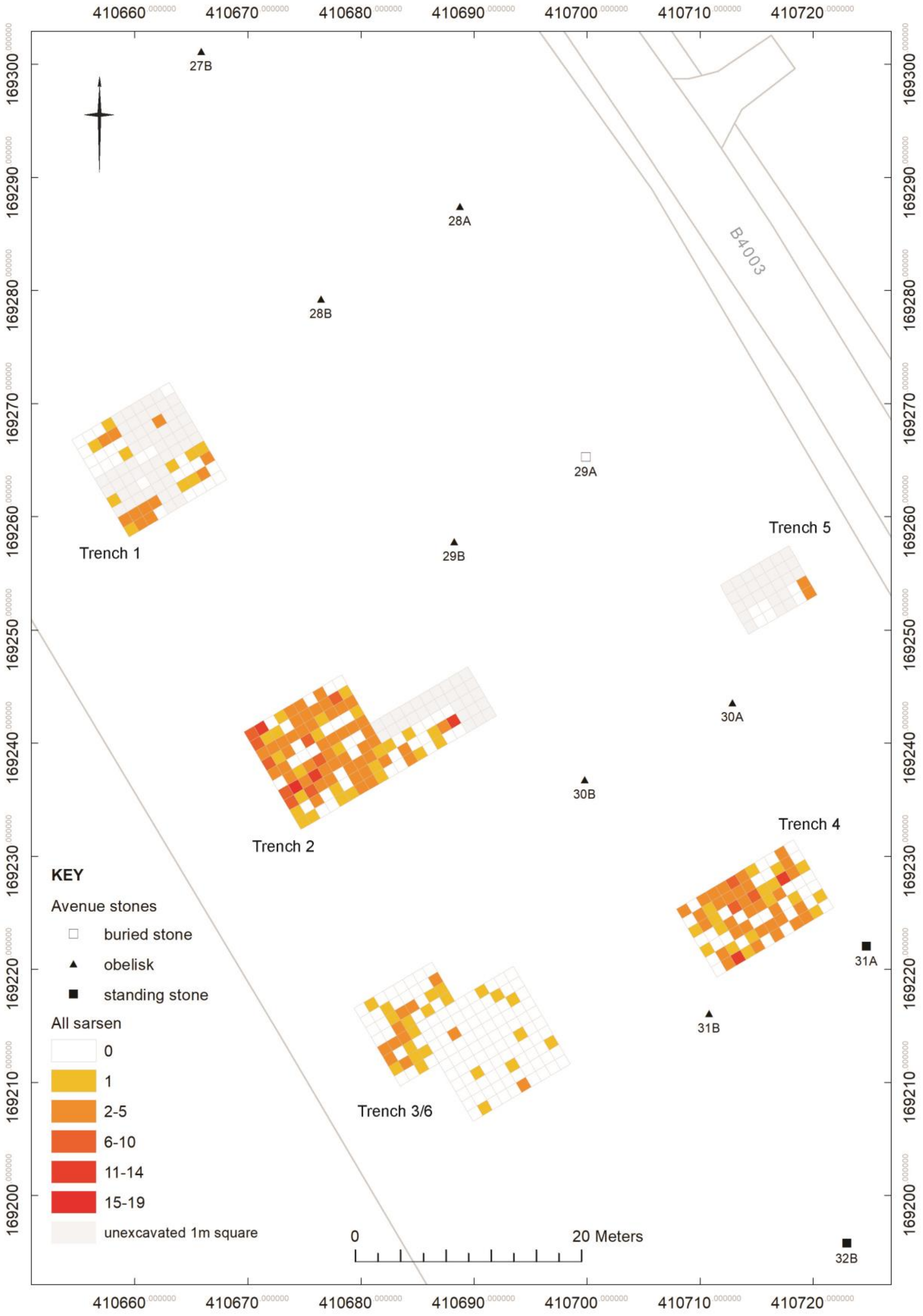


Figure 7 Distribution of sarsen from the worm-sorted soil by 1m excavation grid square.

As well as being relatively small and equant, the sarsen pieces in the worm-sorted soil are characteristically angular. Only 95 (14.8%) are sub-rounded to rounded compared with 547 (85.2%) that are very angular to sub-angular. There is little abrasion despite the majority being saccharoid sarsen rather than the even tougher, finer-grained quartzitic type, suggesting that the pieces have not experienced considerable movement and weathering (although it should be noted that all sarsen is notably hard, durable and resistant).

	Count	%	Total weight (g)	Mean weight (g)	Weight range (g)
Unburnt	296	46.1	38,163	128.9	1 – 2,074
Burnt	346	53.9	38, 675	111.8	1 – 2,764
Corticated	291	45.3	50,549	173.7	1 – 2,764
Un-corticated	352	54.7	26,289	74.9	1 - 938

Table 9 Burnt/un-burnt and corticated/un-corticated sarsen in the worm-sorted soil.

A slight majority (54.7%) of the pieces are un-corticated, compared with 45.3% with cortex. However, the corticated pieces weigh in total 50,549g compared with 26,289g un-corticated and are thus very much larger on the whole, reflected in their mean weight (173.7g) (Table 9). This is explained in part by corticated material in the worm-sorted soil including some large whole or near-whole cobbles, possibly indicating their collection and use on the prehistoric occupation site.

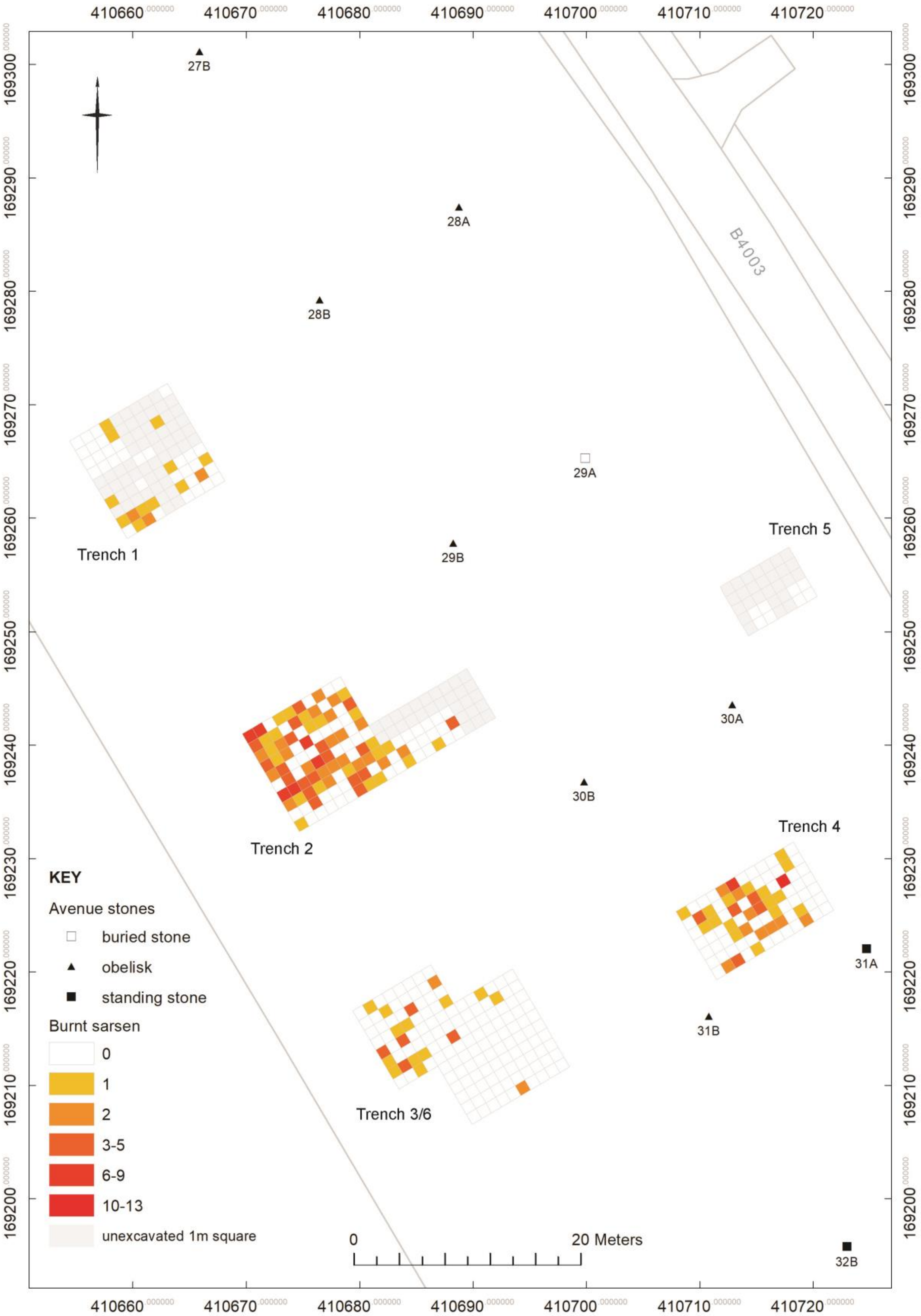


Figure 8 Distribution of burnt sarsen from the worm-sorted soil by 1m excavation grid square.

In contrast there is more of a balance between burnt and unburnt sarsen in the worm-sorted soil. There is slightly more burnt material (53.9%) and it has a similar size/weight profile to the unburnt sarsen (mean weight 111.8g and 128.9g respectively) (Table 9). The sarsen is more or less equally likely to have been burnt as not. The distribution of the burnt material echoes the overall sarsen distribution in the trenches and no particular clusters are indicated (Figure 8).

With so few diagnostic features such as flaking and percussion to suggest how sarsen from the occupation area was broken up, it is difficult to draw conclusions about its use. The material in the worm-sorted soil does, however, have a number of similarities with the sarsen from the Neolithic midden and burnt spread deposits at nearby Marden (mentioned in Section 6.3): it is worth extending the comparison between those Marden contexts and sarsen in the WKA Neolithic pit features to the worm-sorted soil containing the *in situ* Neolithic flint scatter.

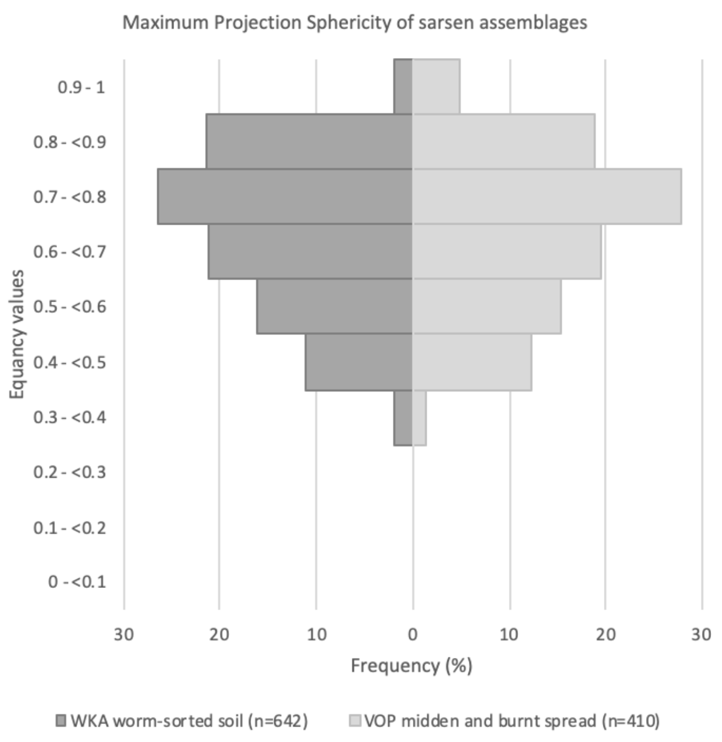


Figure 9 Comparison of the Maximum Projection Sphericity of sarsen from the WKA worm-sorted soil and Marden henge midden and burnt spread contexts.

The assemblages have a very similar form profile, comprising large numbers of angular sub-equant and equant pieces of stone (MPS >0.6) with an almost identical proportion of more platy, elongate items (Figure 9). The high equancy may be explained in part by burning. Having been burnt, sarsen becomes susceptible to fracture along cracks induced by temperature change. The cracks often form in sub-perpendicular patterns and many of the blocky pieces likely resulted from failure along those lines (as is further indicated by occasional fitting burnt pieces excavated from the same WKA context and square, see Section 3).

	WKA: sarsen from the worm-sorted soil	**VOP: sarsen from Neolithic midden and burnt spread deposits**
Total pieces (>= 1g)	642	411
Burnt	53.9%	77.6%
Modal form	sub-equant	sub-equant
Modal angularity	angular	angular
Mean weight	119.7g	28.0g
Tool fragments	27	6

Table 10 Comparison of general characteristics of sarsen from WKA worm-sorted soil and VOP contexts (1026) (93031) (1006) (1035) (2111) (93003).

There are three main differences between the two assemblages (Table 10). First, sarsen in the worm-sorted soil is generally larger (as indicated by mean weight) than that from the midden and burnt spread deposits at Marden. That may simply be a result of the different methodologies deployed at the excavations, resulting in many more much smaller pieces retained from Marden by wet-sieving bulk samples through a 4mm mesh, compared with dry sieving fills using a 10mm mesh at West Kennet.

Secondly, there is less burnt material from the worm-sorted soil. That perhaps reflects the more general character of the sarsen at West Kennet. It is likely to include a mix of anthropogenic material derived from various activities including cooking, tool manufacture, construction etc and pieces present in the locality by virtue of longer-term natural processes, compared with the entirely anthropogenic midden material and burnt matter at Marden. Furthermore, the Marden deposits were probably formed quite quickly, perhaps during one feasting event, whereas the

West Kennet assemblage is likely the accumulated material of a longer and more varied occupation. Supporting the more general character of the occupation spread in the worm-sorted soil are the 27 possible tool fragments.

Thirdly, flake-like pieces from the Marden contexts are more often crescentic in form than those in the worm-sorted soil. 'Crescentic' here refers to the convex dorsal face and concave ventral face of a piece of stone making it resemble a curving overshot flake.[5] Only 11 (1.7%) of the items in the worm-sorted soil are crescentic, compared with 35 (8.5%) from the Marden midden and burnt spread. Unpublished experimental data shows how similar flakes will exfoliate when a heated block of sarsen is suddenly cooled, for example when splashed with cold water to generate steam. This difference between the assemblages hints at the application of different technologies at the two sites, but without further experimental work and suitably adapted recording protocol it is difficult to draw firmer conclusions.

6.5 Phase 2, Post-medieval and modern

Later colluvial deposits and likely nineteenth century ploughsoil contained 44 pieces of sarsen, including a small piece possibly from a rubber (069/0017) and a possibly ground piece of sarsen (401/0012). Like the two pieces recovered from F.53 and F.57 (modern drainage features), this is redeposited material including a range of burnt (18, 39.1%) and unburnt (28, 60.9%) sarsen.

A more recent sarsen extraction hollow falls into this phase. Feature F.14 in Trench 2 cut the worm-sorted soil, thus post-dating the Neolithic occupation. Ten pieces of sarsen were collected from its fill (037) (two large un-worked pieces of sarsen were not kept). In total the retained material weighs 1,128g (mean weight 112.8g, range 13g – 301g). Eight of the pieces are burnt, one of which is a small piece of quern or polissoir. As discussed in Section 5.7, the ten fragments likely come from different parent material. Given the likelihood that a sarsen boulder was taken from here within the past few hundred years, those remaining small pieces are most probably

[5] A disadvantage of describing form in terms of MPS measured using a pebble-box is that the method reduces the visibility of this shape in the data. Noticeably crescentic pieces are therefore described in the notes field of the assemblage datasheet.

redeposited having been disturbed from the surrounding worm-sorted soil (although it should be noted that context (037) did not contain any Neolithic worked flint).

Had the boulder been removed by being broken up using fire, both the extraction hollow and the fill would in all likelihood have resembled one of the Beckhampton Avenue stone pits where that practice was used in eighteenth century dilapidations (Gillings *et al* 2008), with more remnant sarsen chips clearly from the same parent boulder left behind in a fire pit dug out around or beneath the recumbent boulder. However, F.14's sub-oval pit preserved its slightly dished base and solution pipes that had formed below the sarsen boulder, while the fill includes only those few small pieces of sarsen. The lost boulder could have been split up using traditional masonry tools and techniques (King 1968) sometime in the past 150 years. Although that might be expected to leave a tell-tale extraction gully and tool marks on remaining stone surfaces, those characteristics are not always present from such extraction episodes (Whitaker forthcoming) and the two large seemingly un-worked angular pieces of sarsen left in the fill would be commensurate with such activity. Alternatively, the boulder, which measured perhaps 2m x 1m in size given the maximum pit dimensions of 2.7m x 1.71m, may simply have been lifted and hauled away.

7 References

BLOTT, S.J. and PYE, K. (2008) 'Particle shape: a review and new methods of characterization and classification.' *Sedimentology* 55: 31-63

BUTLER, C. (2011) *Prehistoric Flintwork* Stroud: The History Press

CHAN, B. (2020) 'Sarsen from the sarsen-dressing area in Trench 44 and the Stonehenge Avenue in Trench 45' In Parker-Pearson, M. *et al, Stonehenge for the Ancestors* Part 1, 311-329, Leiden: Sidestone Press

DORN, R.I. (2007) 'Rock Varnish' In Nash, D.J. and McLaren, S.J., *Geochemical Sediments and Landscapes*, 246-297, Oxford: Blackwell Publishing

GILLINGS, M. *et al* (2008) *Landscape of the Megaliths* Oxford: Oxbow Books

GILLINGS, M and POLLARD, J. (2016) 'Making Megaliths: Shifting and Unstable Stones in the Neolithic of the Avebury Landscape.' *Cambridge Archaeological Journal* 26(4): 537-559

GRAHAM, D.J. and MIDGLEY, N.G. (2000) 'Graphical Representation of Particle Size Using Triangular Diagrams: an Excel Spreadsheet Method.' *Earth Surface Processes and Landforms* 25(13): 1473-1477

HAYDEN, C. and STAFFORD, E. (2006) *The Prehistoric Landscape at White Horse Stone, Aylesford, Kent. CTRL Integrated Site Report Series* Oxford Wessex Archaeology Joint Venture https://doi.org/10.5284/1044807

IXER, R.A. and BEVINS, R.E. (2021) 'Petrography of sarsen debitage from the Stonehenge Landscape – a broad and perhaps scattered church.' *The Wiltshire Archaeological and Natural History Magazine* 114: 18-41

KING, N.E. (1968) 'The Kennet Valley Sarsen Industry.' *The Wiltshire Archaeological and Natural History Magazine* 63: 83-93

NASH, D.J. and ULLYOTT, J.S. (2007) 'Silcrete.' *In* Nash, D.J. and McLaren, S.J., *Geochemical Sediments and Landscapes*, 95-143, Oxford: Blackwell Publishing

POWERS, M.C. (1953) 'A new roundedness scale for sedimentary particles.' *Journal of Sedimentary Petrology* 23 (2): 117-119

RICHARDS, J.C. (1990) *The Stonehenge Environs Project* London: Historic Buildings and Monuments Commission

WHITAKER, K.A. (2020) 'Sarsen-working at Stonehenge.' In Parker-Pearson, M. *et al, Stonehenge for the Ancestors* Part 1, 332-354, Leiden: Sidestone Press

WHITAKER, K.A. (2021) *Vale of Pewsey Sarsen Stone*. Unpublished report.

WHITAKER (forthcoming) 'Sarsen stone quarrying in Southern England.' *Post-Medieval Archaeology.*

Public engagement diary

1. Lectures

2022 ‘Sarsen extraction’
Wiltshire Industrial Archaeology Conference

‘Hard stone, hard labour? Post-medieval sarsen stone quarrying in southern England’
Basingstoke Archaeological and Historical Society

2021 ‘The source of Stonehenge’s sarsen stones’ (online)
Combined Hertfordshire Archaeology Societies

‘Building with sarsen stone’ (online)
Somerset Vernacular Buildings Research Group

2020 ‘New research into old rocks: fieldwork in the sarsen fields of north Wiltshire’ (online) Wiltshire Archaeology Conference

2019 ‘Sarsen stone geology and archaeology in the Vale of the White Horse’
Astons History Society

‘Sarsen stone geology, history and archaeology’
Royal Wootton Bassett History Society

‘Sarsen stone in buildings’
Wiltshire Buildings Record Study Day

2017 ‘An Introduction to Sarsen Stone’
Devizes U3A Geology Group

‘An Introduction to Sarsen Stone’
Kennet Valley National Trust Association AGM

‘Hampshire Rocks! The Sarsen Stones in Wessex project in Hampshire’
Hampshire Field Club Post-graduate Research Conference

2. Workshops and Demonstrations

2022 Past Participate (Dorset) lecture and volunteer training day.

2017 Open Farm Sunday, Marlborough Downs ‘Spaces for Nature’ collective

3. Archaeological walks leader

2022 West Woods, Wiltshire, for the Council for British Archaeology Wessex Group

West Woods, Wiltshire, for Forestry England (Festival of Archaeology)

2021 Devil's Den, Wiltshire, for the Council for British Archaeology Wessex Group

2019 Monkton Down, Wiltshire, for Wiltshire Archaeological and Natural History Society

Morgan's Hill and environs, Wiltshire, for the Council for British Archaeology Wessex Group

Marlborough Downs, Wiltshire, for the Reading Geology Society and Farnham Geology Group

2018 West Woods, Wiltshire, for the Council for British Archaeology Wessex Group

Ashdown, Berkshire/Oxfordshire with Dr Eloise Kane (University of Bristol) for the Council for British Archaeology Wessex Group

2016 West Woods, Wiltshire, for Wiltshire Archaeological and Natural History Society.

2015 Knap Hill and environs, Wiltshire, for the Council for British Archaeology Wessex Group

4. Exhibitions

2020 PLACEing Objects, SpudWorks Gallery, Sway, 27 February-4 March.