SCIENCE AND STONEHENGE

RECENT INVESTIGATIONS OF THE WORLD'S MOST FAMOUS STONE CIRCLE

VEERTIGSTE KROON-VOORDRACHT

GEHOUDEN VOOR DE
STICHTING NEDERLANDS MUSEUM
VOOR ANTHROPOLOGIE EN PRAEHISTORIE

TE AMSTERDAM OP 2 MAART 2018

DOOR

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INTRODUCTION

Stonehenge is synonymous with prehistoric mystery. This unique and iconic stone circle serves as a tangible reminder of an ancient world that many believe can never be understood, an empty symbol to be filled with whatever fantasies we dream up, resistant to science and redolent of mystery and enchantment. Over the last nine centuries – and especially within the last 50 years – historians, antiquarians, archaeologists and assorted enthusiasts have proposed a wide range of interpretations of this curious monument – a sun temple of the druids, an astronomical observatory, a calendar, a centre of healing, a cenotaph to commemorate a gruesome massacre, and even an alien spaceship docking station are just some of these explanations.

Yet we live in a remarkable age which has seen a revolution in the development of scientific methods in archaeology as well as a maturity, after four decades of debating archaeological theory, in inference and interpretation (e.g. Kristiansen 2014). We are, hopefully, now thoroughly equipped to choose effectively between different hypotheses by following new lines of evidence, comparing different explanations, and rejecting hypotheses when evidence is contradictory.

A good indication of how the field has advanced can be gained by comparing today's knowledge with research undertaken just two decades ago. In 1997, the results of a conference on science and Stonehenge highlighted radiocarbon-dating, Bayesian statistical modelling, astronomy, engineering, GIS, geophysics, geology and environmental analysis as key scientific methods (Cunliffe and Renfrew 1997). Since then, scientific applications for studying Stonehenge have mushroomed, to include brand-new methods (the analysis of ancient DNA, isotopes and laser-scan images, LIDAR, ground-penetrating radar, and electro-magnetic induction

survey) as well as pre-existing techniques that have been applied to the physical evidence provided by new excavations (soil chemistry, geomorphology, human osteology and palaeopathology, ceramic and lithic petrography, geochemistry, and lipid residue analysis).

Figure 1. Stonehenge viewed from the northeast. Photo by Adam Stanford, Aerial-Cam Ltd.

Yet scientific methods no more make archaeology a science than a wooden leg makes a person into a tree, to paraphrase the late David L. Clarke. At the core of recent scientific enquiry into Stonehenge is the application of a hypothesis-testing approach. My own research began with a theory developed with Malagasy archaeologist Ramilisonina that Stonehenge was built as a monument to the ancestors, its stones embodying the permanence of the afterlife in contrast to the perishable wooden posts of the timber circles at nearby Woodhenge and Durrington Walls (Parker Pearson and Ramilisonina 1998a and b). Drawing on an analogy with megalith-building in contemporary Madagascar, this simple hypothesis explored the notion that the materiality of Neolithic monuments was intimately linked with their meaning. It set up the prediction

that Stonehenge was one half of a larger complex beside the River Avon, a 'domain of the ancestors' in contrast to a 'domain of the living' 3km upstream at the henges of Woodhenge and Durrington Walls. With the river serving to link these two domains, we further predicted the existence of an avenue linking Durrington Walls to the River Avon in the same way that Stonehenge's Avenue leads to the River Avon at West Amesbury.

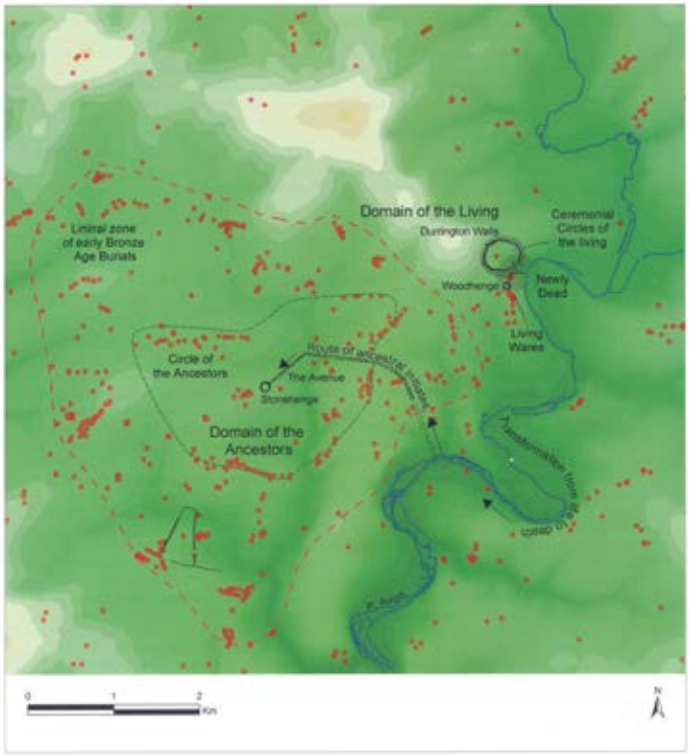

Figure 2. The Stonehenge landscape as interpreted by the 'Stonehenge for the ancestors' hypothesis. Source: Parker Pearson and Ramilisonina 1998a (fig. 7), re-drawn in Darvill 2005 (ill. 87) by Vanessa Constant.

RECENT RESEARCH AT STONEHENGE

In 2003 I began the Stonehenge Riverside Project, recruiting a team of co-directors – Colin Richards, Josh Pollard, Chris Tilley, Julian Thomas and Kate Welham – to run it. Over the next six years this collaboration involving many different universities conducted excavations and geophysical and topographic surveys within the Stonehenge World Heritage Site to test those predictions made in 1998 (Parker Pearson 2012). From 2005 I co-directed a second project, together with Andrew Chamberlain, Jane Evans and Mike Richards, that focused on the people of the time of Stonehenge. This was the Beaker People Project, an isotopic analysis of human teeth and skeletal remains from the Chalcolithic and Early Bronze Age as well as the Neolithic (Parker Pearson et al. 2016; Pellegrini et al. 2016).

The results of the Stonehenge Riverside Project (SRP) exceeded our expectations, especially in the quantity and quality of settlement evidence from Durrington Walls. This led to a third project, Feeding Stonehenge, which investigated the resources needed to build Stonehenge, particularly in terms of food procurement, feasting and cuisine, and applying isotopic analysis to the Stonehenge sites' faunal remains (Chan et al. 2016; Craig et al. 2015; Viner et al. 2010). In 2011, our team began a fourth project, the Stones of Stonehenge, investigating the sources of Stonehenge's megaliths, to find out why some of them – the smaller ones known as 'bluestones' – had been brought 240km from west Wales to Salisbury Plain (Parker Pearson et al. 2017). We are currently engaged in a fifth project, the Origins of Stonehenge, exploring what we believe to be the stone circle in Wales from which the stones of Stonehenge's first stage were taken.

The SRP was the first major project to take place in Stonehenge's environs in two decades, a period during which Stonehenge's early 20th-century excavations were collated and published (Cleal et al. 1995). The impetus of our SRP research led to subsequent projects by other researchers, notably Darvill and Wainwright's

SPACES project (Darvill and Wainwright 2009), English Heritage's Stonehenge Landscape Project (Bowden et al. 2015), the Stonehenge Hidden Landscape Project led by Gaffney and Neubauer (Gaffney et al. 2012), Darvill and Lüth's geophysical survey project (Darvill et al. 2013), Historic England's investigations in the southern half of the WHS (Pitts 2017), and the University of Buckingham's excavation of Blick Mead Mesolithic site (Jacques and Phillips 2014). In addition, commercial archaeological projects in advance of development have identified and excavated numerous sites, most notable of which is Wessex Archaeology's discovery of a second Neolithic causewayed enclosure within Stonehenge's environs (Thompson et al. 2017).

With publication of three books (Aronson with Parker Pearson 2010; Parker Pearson 2012; Parker Pearson et al. 2015) and over 80 academic papers (with five technical monographs in preparation), the SRP and the projects that it spawned have had a considerable academic impact. Public impact has been similarly far-reaching, with dozens of news items, television documentaries, numerous popular magazine and web news reports, and exhibition displays including the new Stonehenge visitor centre. Since the SRP began, visitor numbers to Stonehenge have steadily increased to well over a million each year. Stonehenge features increasingly frequently in popular culture from cult TV programmes such as 'Dr Who' to obscure literary references, and is used to advertise products ranging from biscuits to Boeing aircraft.

So what is it that we now know about Stonehenge as the result of all of this research? In terms of the who, when, how and why, we have a new understanding that is built on evidence recovered not just from Stonehenge itself but also from remains in its surrounding landscape and more widely across Britain. Stonehenge's five stages of construction straddle the period from the Late Neolithic to the Early Bronze Age, from c.3000 BC to c.1600 BC. Within this, we recognise a short Chalcolithic period (c.2450–2200 BC) when Bell Beaker-users arrived in Britain (Allen et al. 2012). Stonehenge's first two stages were built before this, the first stage

in the decades after 3000 BC and the second around 2500 BC. The third stage of construction, in 2480–2280 cal BC, coincided broadly with the initial period of Beaker arrivals whilst the fourth, in 2280–2020 cal BC, was carried out in the Early Bronze Age (Darvill et al. 2012). Both these latter stages consisted merely of re-positioning the small bluestones. The fifth and final stage, around 1600 BC, involved the digging of circles of pits for a construction project that may well have remained unfinished.

BEFORE STONEHENGE

Stonehenge's origins lie in the centuries and even millennia before its first stage of construction. Whilst the monument itself has its origins in the Middle Neolithic (as will be outlined later), the significance of place goes back into the Early Neolithic and indeed the Mesolithic. During the early eighth millennium BC, four pits were dug on the chalk plateau of Salisbury Plain within 250m of where Stonehenge would be built 5000 years later (Allen 1995). Some of these pits contained charcoal from pine posts or tree-trunks that had stood within them, although their radiocarbon dates suggest that none of these posts were standing at the same time. Monuments of any kind are rare for the European Early Mesolithic, so these 'totem pole'-like posts are remarkable. Another indication of Early Mesolithic activity in this part of Salisbury Plain is a single radiocarbon date of 7330–7070 cal BC on a fragment of charcoal from within the centre of Stonehenge (but otherwise without archaeological context; Darvill and Wainwright 2009: 12).

The chalkland of Salisbury Plain was never as densely wooded as other regions within Britain's early Holocene; it was an area of lightly wooded grassland (French et al. 2012) that would have attracted game animals, especially aurochsen, deer and wild pigs. Surface water was scarce, confined to the rivers running beside Salisbury Plain, notably the River Avon, the banks of which attracted Mesolithic hunters and their encampments. The largest such encampment so far identified is at Blick Mead, where a large

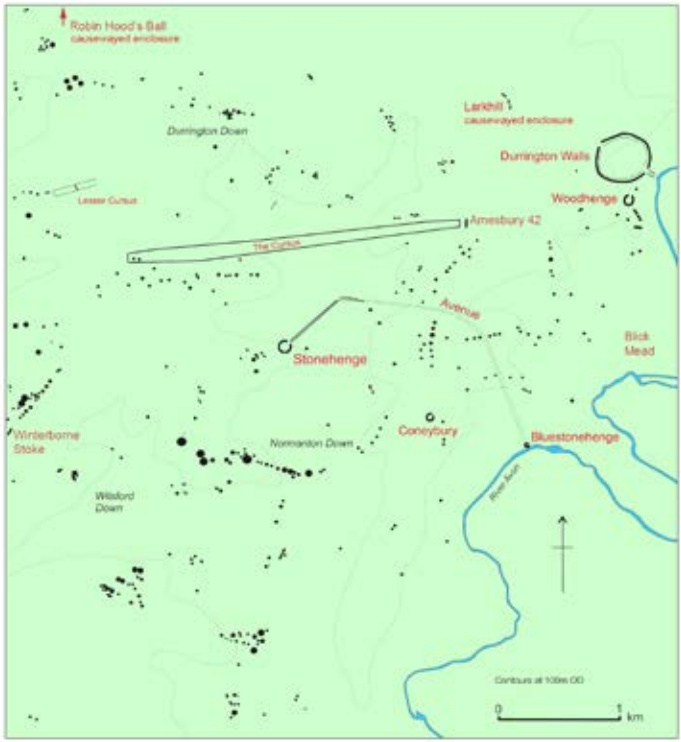

Figure 3. The landscape of Neolithic and Early Bronze Age monuments around Stonehenge. Source: Josh Pollard.

lithic assemblage is associated with a wide range of faunal remains that have provided a near-continuous suite of radiocarbon dates from the early eighth millennium BC to the very end of the fifth millennium BC (Jacques and Phillips 2014). Such a wide chronological spread is unmatched at any other Mesolithic 'persistent place' within Britain. The presence of a slate projectile point among Blick Mead's flint artefacts also indicates long-distance contacts, probably with Wales. This long-visited site raises the possibility that the Stonehenge area was established at this early date as a gathering-place at the centre of a network of paths and routeways across southern Britain.

New results from ancient DNA have opened up our understanding of the Mesolithic-Neolithic transition in Britain: the ancient DNA analyses indicate large-scale replacement of the indigenous Mesolithic population by continental European farmers around 4000 BC (Brace et al. forthcoming). No Early Neolithic activity within the Stonehenge landscape can so far be dated before 3750 BC (i.e. there is nothing from the earliest Neolithic), so there remains a 200–300-year hiatus in any use of Salisbury Plain's chalklands across the transition (Parker Pearson in press).

Yet the Early Neolithic evidence from after 3750 BC continues the theme of large numbers of people gathering on this waterless plateau. On a ridge overlooking the River Avon to its west and over the future site of Stonehenge to its east, early farmers buried the remnants of a large feast in a pit at Coneybury during the second half of the 38th century BC (Richards 1990; Barclay 2014). Given the freshly butchered remains of 10 cattle, nine deer and two pigs (Maltby in Richards 1990: 60–1), the meat yield from these carcasses could have fed a substantial gathering of perhaps as many as 1,000 people.

Monuments of the Early Neolithic (3750–3400 BC) are unusually prolific within the Stonehenge environs. Twenty-five long barrows have been discovered in this area, on both sides of the River Avon. Nine of them lie within an area just 2km across in the dry valley directly west of Stonehenge, just a kilometre away from the site of the monument. With two of these long barrows found only recently by magnetometer survey in advance of a proposed road tunnel, they form the densest concentration of such Early Neolithic barrows in Britain, at odds with the more usual pattern of widely spaced territorial demarcation (Renfrew 1976). High ground to the north of Stonehenge provides the location for two Early Neolithic causewayed enclosures, Robin Hood's Ball (Whittle et al. 2011: 194–9) and the newly discovered site at Larkhill (Thompson et al. 2017). These were succeeded by two linear monuments on lower ground to the south of them, the Greater

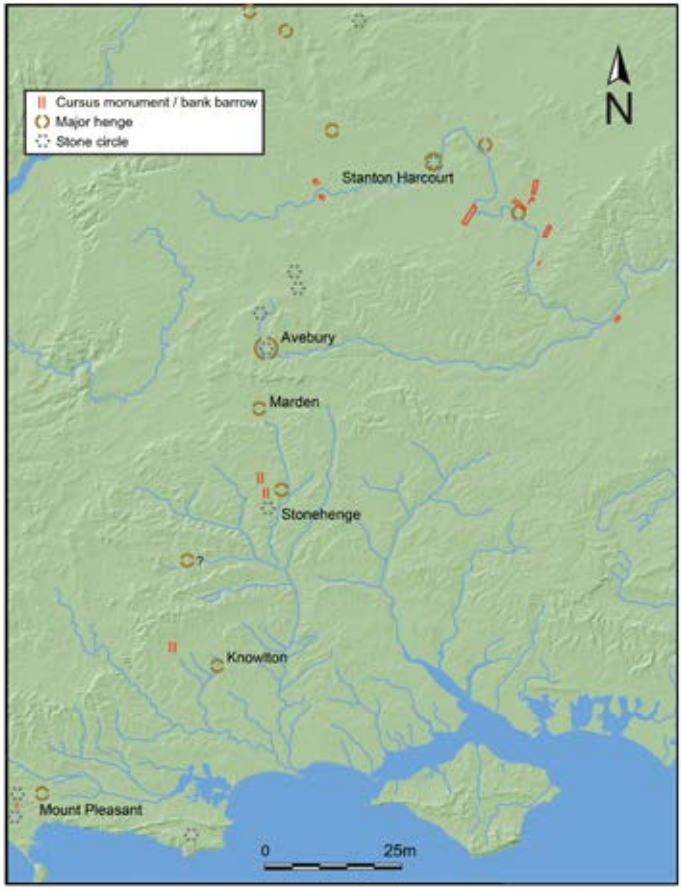

Figure 4. Middle and Late Neolithic monuments in central southern England, including Stonehenge. They have a north-south distribution that runs along the high chalk between Dorchester and Avebury and then continues northwards into the Thames valley. Drawn by Irene de Luis.

and Lesser Cursuses, dating to c.3600-3300 BC (Richards 1990; Thomas et al. 2009), across the Early–Middle Neolithic transition.

Evidence of Neolithic settlement on Salisbury Plain in the period before the construction of Stonehenge is restricted to artefact scatters in plough-soil and occasional finds of pits (Richards 1990; Pitts 2017). Early Neolithic flintwork is largely found only in the area east of the dry valley of Stonehenge Bottom, directly east of Stonehenge (Chan 2011). Thus the zone of the nine long barrows lies to the west of the majority of Early Neolithic settlement, which was concentrated along the Avon valley. Middle Neolithic settlement was more widely dispersed, particularly along the north and south sides and east end of the Greater Cursus, and includes a newly discovered site at West Amesbury Farm, close to Coneybury (Pitts 2017).

The Stonehenge area before Stonehenge was evidently a significant ceremonial locale, slightly more prominent than other emergent monument complexes on the high chalklands at Avebury, Cranbourne Chase and Dorchester. Together, these lay on the east–west boundary of two ceramic style zones (Pioffet 2017) and formed the southern arm of a 50km-wide corridor of causewayed enclosures and cursuses that runs from the Wash in eastern England to the south coast around Dorchester (Parker Pearson et al. 2015: figs 1.7 and 1.11). Rather than viewing such monument complexes as central places, they may be better understood as 'peripheral places' on the high ground between lowland-based territories. The Stonehenge area in the Neolithic can be considered as a neutral zone on a boundary between the inhabited areas of the river valleys to the east and west of the chalk plateau of Salisbury Plain.

THE FIRST STAGE OF STONEHENGE C.3000 BC: A DOMAIN OF THE DEAD

The first stage of Stonehenge, at the beginning of the Late Neolithic, consisted of a circular earthen bank and ditch (a 'henge') enclosing a circle of 56 pits (the Aubrey Holes, now considered to be holes for former standing stones). The main entrance into the enclosure was in the northeast, with a smaller

one in the south. The construction of the circular ditch is dated to 3000–2920 cal BC, and a cremation burial in a primary fill of an Aubrey Hole dates to 3030–2880 cal BC (Darvill et al. 2012; Parker Pearson et al. 2009; Willis et al. 2016).

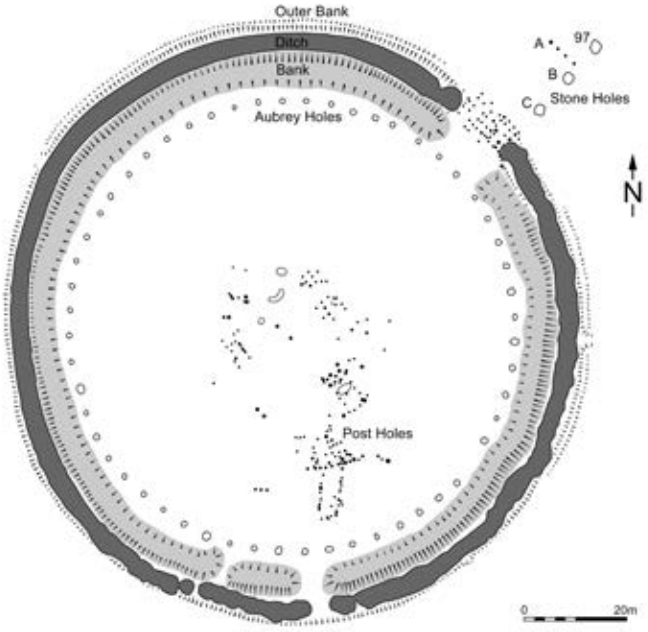

Figure 5. A plan of Stonehenge Stage 1 (3000–2920 cal BC). Source: Darvill et al. 2012 (fig. 3), drawn by Vanessa Constant.

The principal archaeological constituents of Stonehenge's first stage are some 63 cremation burials whose dates range from the time of its construction until about 600 years later (Willis et al. 2016). Most of these cremation deposits were originally excavated in 1919–1926 and were re-excavated in 2008 from Aubrey Hole 7 where they had been buried in 1935. Excavation records of the time indicate that cremation burials were found placed within the packing of former standing stones, against former standing

Figure 6. Excavation in 2008 of Aubrey Hole 7 at Stonehenge, to retrieve the cremated human bones buried here in 1935. Photo by Adam Stanford, Aerial-Cam Ltd.

stones, in the ditch, under the bank and in various locations within the circle. Of the MNI of 25 individuals identifiable from the mass of bone fragments in Aubrey Hole 7 (sadly mixed together by early 20th-century archaeologists), the majority are adults and more are female than male. Grave goods or pyre goods are few and consist only of bone/antler skewer pins, a stone macehead and a ceramic artefact that is possibly an incense burner (Cleal et al. 1995: 360–1, 394, 409–10). None can be associated with any identified individual.

The low number of sub-adults in the assemblage suggests that burial within Late Neolithic Stonehenge was restricted by age. The greater proportion of women represented is unusual compared with Early Neolithic collective burials and with subsequent Beaker-period burials. If this small sample of Stonehenge's burials (of which another 100 or more are likely to remain unexcavated at Stonehenge) is representative of the total, then it reveals an intriguing gender structure in Late Neolithic society as enacted at its most remarkable monument.

Stonehenge's location halfway down the slope of Stonehenge Bottom dry valley is perplexing: if the builders had wanted the monument to stand out as a prominent landmark, they could have chosen the high ground immediately to the south (Tilley et al. 2007). The reason for this topographically odd choice of location appears to be the presence of an unusual natural landform, the southwest end of which is occupied by Stonehenge's northeast entrance. This geomorphological landform was identified in 2008 as a southwest–northeast oriented pair of parallel ridges on either side of a series of unusually wide and deep periglacial fissures (Allen et al. 2016). These are flutes and fissures formed through freeze-thaw processes in the tundra environment of a previous Ice Age when the glaciers came within 100km or so to the north of Salisbury Plain. This periglacial natural feature feature can be traced for 150m and was clearly visible in prehistory since the two parallel ditches of the Stonehenge Avenue (built in Stonehenge's Stage 3) follow its outer edges. What makes this natural landform

Figure 7. An excavation across the Stonehenge Avenue, viewed from the northeast. The natural ridges and wide, deep periglacial fissures are visible within the trench. Photo by Adam Stanford, Aerial-Cam Ltd.

particularly unusual is that it is fortuitously oriented on a solstice axis, aligned with midsummer solstice sunrise to the northeast and midwinter solstice sunset to the southwest.

We may infer that the builders of Stonehenge Stage 1 were aware of this landform's coincidence with the extremes of the sun's movement, imputing a sense of cosmic unity to this axis mundi (axis of the world). Its recognition as a special feature, unique to this place, may be the reason why Neolithic people constructed eight separate monuments with solstice orientations within the Stonehenge environs, namely Stonehenge and its Avenue, Coneybury henge (next to the Coneybury pit), the Durrington Walls avenue, Woodhenge, the Southern and Northern Circles within Durrington Walls, and a post-setting (Structure 68) south of Woodhenge (Ruggles 2014). The Stonehenge landscape complex is indisputably interlinked with the solstice. By comparison, the neighbouring henge and stone circle complex of Avebury does not have a single orientation with demonstrable solstitial or astronomical significance (Ruggles 2012).

For most of the 20th century, the circle of Aubrey Holes inside Stonehenge's bank was thought to be no more than a ring of pits (e.g. Atkinson 1956). Reassessment of their dimensions, and of excavation records from 1919–1926, coupled with re-excavation in 2008 of Aubrey Hole 7, led to the realisation that they are not pits but empty stone sockets. The Aubrey Holes once held monoliths in the form of 'small upright stones' (Hawley 1921: 30–1 cited in Parker Pearson et al. 2009). Comparison of Aubrey Hole dimensions reveals that they are too shallow to have held wooden posts and are too narrow for sarsen stones; they are the same widths and depths as those pits that today hold the Welsh bluestones at Stonehenge (Parker Pearson et al. 2009: fig. 8).

As a result of this work on the Aubrey Holes, we may now understand the first stage of Stonehenge as a c.90m-diameter stone circle formed largely or entirely of bluestone pillars, surrounded by a bank and ditch. A line of three pits running through Stonehenge's northeast entrance may similarly be empty stone sockets but these are sarsen-sized, as are two or more within the centre of Stonehenge.

Figure 8. A bluestone monolith (Stone 69) at Stonehenge, viewed from the northeast. The bluestones are smaller than the sarsen uprights and were originally positioned in the Aubrey Holes. Photo by Adam Stanford, Aerial-Cam Ltd.

Just 2km southeast of Stonehenge, on the north bank of the River Avon, our project located a dismantled stone circle (Bluestonehenge), a 10m-diameter ring of as many as 25 emptied stone sockets at the end of Stonehenge's Avenue. Although no bluestone chips were found in the sockets, the distinctive shapes of the bluestone-sized pillars that once stood here were preserved in the soft chalk at the bottom of each socket (Allen et al. 2016). The only dating evidence from the stone circle's construction was provided by chisel arrowheads, dated typologically to the Middle Neolithic and the early part of the Late Neolithic (c.3400–2800 BC). For the dismantling of the stone circle, radiocarbon dates on antler picks in the emptied sockets reveal that the bluestones were taken away in 2470–2200 cal BC, possibly to be re-erected as a similar-sized circle within the centre of Stonehenge's Stage 3.

Figure 9.
The intersecting pits of Bluestonehenge at West Amesbury, viewed from the north. These pits proved to be sockets for bluestones, later removed in 2470-2200 cal BC when a henge bank and ditch were constructed around the former stone circle. Photo by Adam Stanford, Aerial-Cam Ltd.

THE BLUESTONES: RECYCLED FROM AN EARLIER STONE CIRCLE?

We can estimate that there were around 80 bluestones brought from Wales and erected within the 56 Aubrey Holes and 25 or so Bluestonehenge stone sockets. They then underwent various rearrangements, the 56 at Stonehenge being set within an arc (the Q & R Holes) outside the horseshoe of trilithons in Stonehenge Stage 2. In Stage 3, it appears that the Bluestonehenge stones were repositioned at Stonehenge, within the trilithon horseshoe. The bluestones' final position, which those that remain today still occupy, was in an inner bluestone oval/horseshoe and an outer bluestone circle. This perpetual re-positioning of bluestones may not have been confined to their time on Salisbury Plain, since there is evidence that they may have formed a stone circle in the Preseli hills of west Wales.

Geochemical and petrographic analysis of Stonehenge's bluestones reveals that they consist of a variety of dolerite, rhyolite, volcanic and sandstone rocks that can be sourced to west Wales. Their provenance was broadly established in the early 20th century (Thomas 1923), yet only recently has analysis by geologists working with our project identified specific sources for some of these rocks (Bevins et al. 2014; Ixer and Bevins 2011; Ixer and Turner 2006; Ixer et al. 2017). Whilst the largest bluestone at Stonehenge, the 5m-long Altar Stone, can be sourced only broadly to the Devonian sandstones of western Britain (Ixer and Turner 2006), the spotted dolerites, plain dolerites, rhyolites, volcanics and other sandstones can all be sourced to a small region of west Wales in, and north of, the Preseli hills.

Study of bluestone debitage and of samples from some of the 43 surviving bluestones at Stonehenge has resulted in the identification of four groups to sources. Spotted dolerite, the most common type of bluestone at Stonehenge, is found only in the Preseli hills. More specifically, one of its two chemical groupings can be matched to a specific outcrop, that of Carn Goedog on

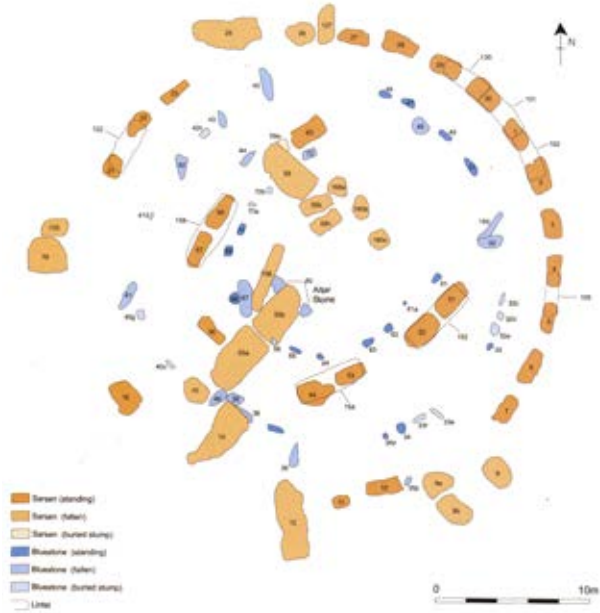

Figure 10. A plan of Stonehenge today, showing the positions of the bluestones (blue) and the sarsens (orange). Source: Parker Pearson 2012 (p. 29).

the north side of Preseli (Bevins et al. 2014). The second group may come from Carn Goedog or from a nearby outcrop, though it cannot have come from the outcrop of Carn Menyn which, until recently, was thought to be a source of Stonehenge's bluestones (contra Darvill and Wainwright 2009; 2014). Stonehenge's unspotted dolerite can be sourced to Carregmarchogion, on the spine of the Preseli hills (Bevins et al. 2014). One of the types of rhyolite has been sourced to the outcrop of Craig Rhos-y-felin, where the distinctive variations in micro-structure around the outcrop allow the precise position of the detached monolith to be identified, associated with a recess for a 2.5m-long bluestone pillar (Parker Pearson et al. 2015). Finally, Later Palaeozoic sandstone beds north of the Preseli hills provide a match for two of Stonehenge's sandstone bluestones (Ixer et al. 2017).

Our excavations of the spotted dolerite source of Carn Goedog and the rhyolite source of Craig Rhos-y-felin have revealed evidence of pillar-extraction in the Middle Neolithic, specifically in the last three centuries before 3000 BC (Parker Pearson et al. 2015; 2017). Quarrying installations include artificial platforms onto which pillars could be lowered from the outcrop and from which they could be dropped onto wooden sledges and dragged away. Tools include stone wedges used to open up the joints between each pillar.

Figure 11. The dominant source of Stonehenge's spotted dolerite bluestones at Carn Goedog, under excavation in 2016. Photo by Adam Stanford, Aerial-Cam Ltd.

Just why the bluestones were brought to Stonehenge from such a distance has to be at the heart of understanding Stonehenge. Explanations that rely on the perceived special qualities of the stones (such as for healing, musical properties etc.) falter when considered against the evidence: why choose such a wide range of rock types, why restrict the bluestones to Stonehenge and no other monument, and why leave no Late Neolithic evidence for activities relating to healing etc. at Stonehenge? Instead, it may be that what

Figure 12. Possible routes for the bluestones to have been brought from Preseli to Stonehenge. The position of the suspected former stone circle of Waun Mawn close to a south-facing pass across the Preseli hills would have made it possible to bring the bluestones southwards to Milford Haven and from there by sea, as originally proposed by Richard Atkinson. Drawn by Irene de Luis.

was being moved was not the stones per se but a monument that they formed part of. While exploring this hypothesis, the Origins of Stonehenge project has located what appear to be the remains of a dismantled stone circle at Waun Mawn, within 5km of the bluestones' sources. If it is indeed a full circle of emptied stone sockets, as it appears to be, then it would be Britain's second largest stone circle after the outer ring at Avebury.

STONEHENGE STAGE 2 C.2500 BC: THE MONUMENT IN ITS HEYDAY

Cremation burial rites at Stonehenge were in decline when its second and grandest stage was constructed. Dating to 2620–2480 cal BC, this stage involved the dismantling of the bluestone circle and re-erection of the bluestones in a double arc around the central feature of five trilithons. These massive trilithons were arranged in a horseshoe, with its open side towards midsummer solstice sunrise. In the opposite direction to the southwest, the sun could be seen setting at the midwinter solstice between the uprights of the great trilithon, which stood nearly 8m high. The bluestone array around the trilithons, known as the Q & R Holes, was itself surrounded by an outer ring of 30 sarsen uprights. Like the trilithons, these have shaped tenons on their tops to allow lintels with mortise holes to be laid on top. Although many lintels are now missing, presumably removed in the medieval period to construct local churches, the outer circle of sarsens may well have supported a continuous or near-continuous ring of inter-locking lintels.

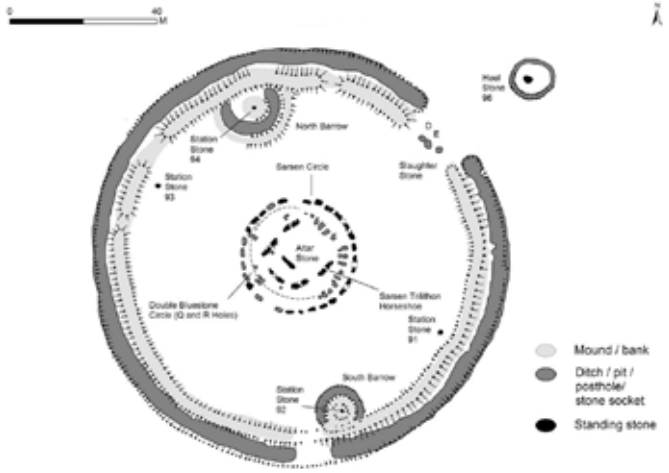

Figure 13. A plan of Stonehenge Stage 2 (2620–2480 cal BC). Source: Darvill et al. 2012 (fig. 5), drawn by Vanessa Constant.

We know much less about the sources of Stonehenge's sarsen stones than we do about the bluestones. Sarsen is a silcrete, formed of cemented sand grains, which is found across central-southern and southeast England. In the last four centuries the general view has been that the large blocks at Stonehenge could have come only from the Marlborough Downs in the Avebury area 30km to the north; antiquarians wrote of seeing extraction holes here, and roughly shaped monoliths lying ready for transport (Parker Pearson 2016). A new geochemical characterisation project is now underway to find out if Stonehenge's sarsens can be matched to source.

Figure 14. Stone 11 at Stonehenge, viewed here from the south, is unusually short and narrow for an upright in the sarsen circle. It could not have supported lintels to join it with the adjacent Stones 12 and 10, both of which have tenons. If Stone 11 is an original element of Stage 2, then the sarsen ring of lintels could never have been complete. It is also possible that Stone 11 is a later replacement for an original, larger upright in this position. Photo by Adam Stanford, Aerial-Cam Ltd.

Figure 15. Stonehenge's sarsens, viewed from the northeast, looking towards the direction of midwinter solstice sunset. Photo by Adam Stanford, Aerial-Cam Ltd.

Analysis of laser-scanned images of Stonehenge's stones has revealed distinctive patterns of stone-dressing on both the sarsens and the bluestones (Abbott and Anderson-Whymark 2012). Whilst fewer than half of the surviving bluestones were dressed, almost all of the sarsens (except for the Heel Stone within the Avenue) reveal evidence of systematic pounding with hammer stones. Our excavations have discovered that most of the dressing appears to have been carried out in an area 100m to the north of Stonehenge, extending in a wide arc in front of its north-east entrance. The density of discarded hammer stones in our excavated areas (2 per sq m) indicates that more than 10,000 hammer stones are likely to have been used.

Two methods of dressing were employed on the sarsens. Whilst transverse shaping accompanied longitudinal dressing on the trilithon uprights, the outer sarsen circle's uprights received only longitudinal dressing. Bluestones received the same forms of dressing as the trilithon uprights. This corroborates Hawley's (1921)

observation that the stones that once stood in the Aubrey Holes were undressed, only being dressed on their removal to their new settings alongside the dressed sarsens.

The laser-scan analysis also reveals that certain surfaces were more carefully dressed than others, specifically those seen when looking southwest-wards towards the monument, and those seen when standing at the centre of Stonehenge. The former is interesting because it supports other evidence that midwinter (and not mid-summer) was of primary importance to the builders and users of Stonehenge. The most carefully dressed surfaces occur on that outer part of the sarsen circle that is seen when looking towards the midwinter sunset, and that midwinter solstice sunset is framed in the great trilithon.

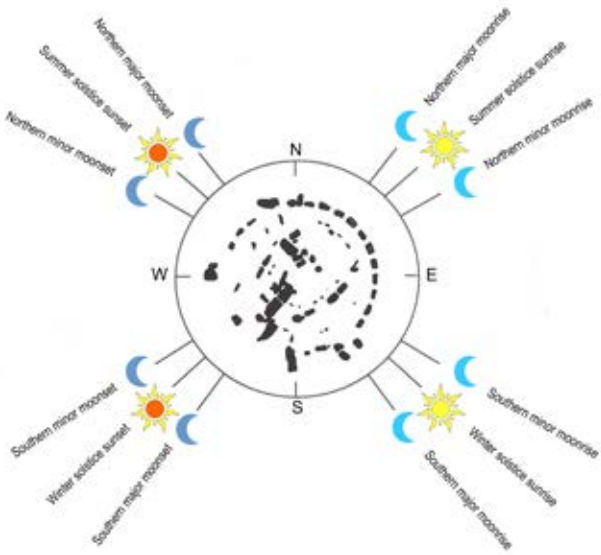

Figure 16. The directions of solstice sunrise and sunset and of major moonrise and major moonset at Stonehenge. Drawn by Irene de Luis after Ruggles 1997 (fig. 1).

Many extraordinary claims have been made about Stonehenge's astronomical properties (e.g. Hawkins 1965) but recent reappraisal of these various claims has restricted the reliable orientations to those of the solstices and, in the case of the four Station Stones (assigned to Stage 2), to the southern major moonrise and northern major moonset (Ruggles 1997). Similarly, the alignment of post-holes in the northeast entrance during Stage 1 is broadly towards northern major moonrise. Yet Ruggles notes that Stonehenge's various solar and lunar orientations are not particularly precise: he considers that the aim was to symbolise such movements of the sun and moon, and not to mark them with astronomical accuracy. We may better understand the solar and lunar alignments at Stonehenge as elements of a wider concern for symbolising the cosmic unity of sky, earth and people.

DURRINGTON WALLS: A SETTLEMENT OF THE LIVING

The modelled date for construction of Stonehenge's Stage 2 (2620–2480 cal BC) is based on only two radiocarbon determinations, one of which has a wide probability range (Cleal et al. 1995: 524). Nevertheless, this date is statistically identical to the more precise date of 2515–2470 BC for the occupation of a large village 3km away at Durrington Walls (Parker Pearson et al. 2013). Durrington Walls is a large henge, covering 17ha just north of a timber circle known as Woodhenge. The henge's bank and ditch were constructed in 2480–2450 cal BC on top of the remains of the village, of which nine houses have been excavated (Parker Pearson 2007; Thomas 2007). Given the density of houses and the extent of occupation layers preserved underneath all sides of the henge bank, we may estimate that there may have been as many as 1,000 houses within this village.

As set out earlier, we were exploring the hypothesis that Durrington Walls and Woodhenge represented a 'domain of the living' in contrast to a domain of the dead at Stonehenge.

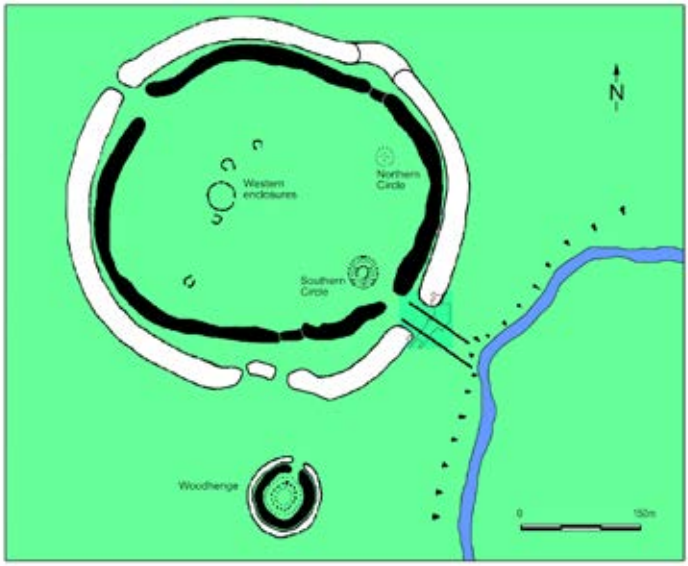

Figure 17. Durrington Walls henge and Woodhenge. The henge was built on top of an earlier village that included monumental structures consisting of the Southern and Northern Circles, and the five Western Enclosures. Drawn by Irene de Luis.

Previous excavations at Durrington Walls, working under rescue-excavation time constraints, had not been able to find the ephemeral remains of Neolithic houses, but discovered the large postholes of two monumental timber circles – the Southern and Northern Circles (Wainwright with Longworth 1971). They also located one end of a ceremonial avenue but did not realize that this was part of a linear feature running 180m towards the River Avon.

Two of the village's principal structural elements were this 30m-wide ceremonial avenue, aligned on the midsummer solstice sunset, leading from the River Avon to the Southern Circle, a concentric timber circle facing towards midwinter solstice sunrise. This avenue was constructed on top of a natural surface of weathered flint nodules within the bottom of the dry valley in

which Durrington Walls sits. Thus the orientation of the avenue on top of it, to within 1° of midsummer solstice sunset, indicates similar modification of a natural landscape feature – in this case, the valley bottom – similar to that found with Stonehenge's Avenue (Parker Pearson et al. 2007).

The Southern Circle has a horseshoe array of posts at its centre similar to the horseshoe of trilithons within Stonehenge except that at Durrington Walls its open side faces midwinter sunset. Outside the Southern Circle, the floor of a semi-circular building was excavated in 1967 (Wainwright with Longworth 1971); although interpreted at the time as a fenced midden, its chalk plaster floor indicates that this was actually a roofed building without a hearth and may be interpreted as a meeting house or ceremonial structure. A similar semi-circular building was excavated in 1921 at Stonehenge, just inside the south entrance of the banked and ditched circular enclosure (Hawley 1923). We might thus interpret the central structures at Stonehenge and the Southern Circle – the trilithons and the post array – as symbolic, monumentalised representations of meeting houses, one in wood for the living and one in stone for the ancestors. Woodhenge's concentric post settings, oval in plan, can also be understood as monumentalised versions of two semi-circular buildings placed with their open sides together.

The interior of the Durrington Walls village appears to have been largely open space, occupied by the Northern Circle (like the Southern Circle, facing midwinter solstice sunrise) and by an arc of five small henges (the Western Enclosures). Excavation of two of these revealed foundations of houses, suggesting that each of the Western Enclosures was a bank-and-ditch henge constructed around a house (Thomas 2007). The largest of these henges, at the centre of the arc, was 30m in diameter. The two excavated houses differed from others within the Durrington Walls settlement because each was surrounded by a circular timber palisade and both lacked domestic rubbish despite having fireplaces in the centre of their floors. It is possible that these refuse-free

Figure 18. A reconstruction of the Southern Circle. Photograph by Julian Thomas.

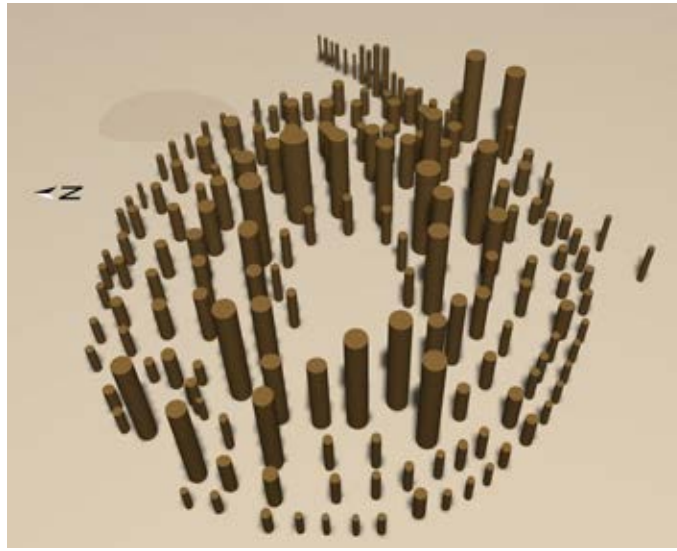

Figure 19. The Southern Circle in its final form (Phase 2) in 2485–2455 cal BC. Drawn by Irene de Luis.

houses, with their commanding views around the settlement and downslope to the Southern Circle and avenue, were not habitations but structures not for non-domestic use, such as cult houses.

The seven houses excavated within Durrington Walls' east entrance were surrounded by large quantities of refuse (Parker Pearson 2007). Two of them were placed on either side of the avenue and were open to the elements on their southwest side, facing towards the river. The other five, with complete walls on all sides, were terraced into the hillside and were surrounded with middens. Excellent preservation of the house floors, protected beneath the bank of the henge, revealed that the houses were c.5.25m x 5.25m square, with rounded corners for their walls of wattle and daub. Each had a central circular hearth sunk into the floor. This floor was made of chalk plaster and extended to within a metre of the walls. In this space between the limits of the plaster floor and the wall, postholes and beam slots indicated the positions of former wooden furnishings, interpreted as box beds, a shelf unit (known as a 'dresser') and rectangular storage units. Geochemical analysis of floor layers reveals that hearths were raked out from one quadrant of the house, the same area where high phosphorous values indicate that cooking was carried out. Differential distributions of pottery sherds and species of wood charcoal reveal that some households may have relied on others to cook their food.

The Durrington Walls houses are almost identical, in size and layout, to the houses of Skara Brae, dating to the same period, in Orkney off the northern coast of Scotland. In the Late Neolithic Skara Brae houses, the furnishings were made of stone because of the absence of wood on these islands. Such houses in Orkney can be interpreted as the homes of family units consisting of women, men and children; if Durrington Walls was the village of Stonehenge's builders, as the radiocarbon dates suggest, then we can presume the same occupation of its houses by families. There is no indication that Durrington Walls was a settlement inhabited only by adult men. Megalith-building involved the whole community of men, women and children.

Soil micromorphological analysis of the houses' plaster floors reveals that re-plastering was carried out up to six times in a house's occupation. Each house was also associated with a group of intercutting pits from which chalk was extracted to make plaster and daub. The sequences of pit digging indicate that extraction took place up to 12 times. We may surmise that these refurbishments took place within a temporal cycle; if, for example, each house was refurbished once a year, then the houses would have thus been occupied for around a decade. This is rather shorter than the period of less than 45 years estimated for the settlement's occupation by modelling of radiocarbon dates which affords only a broad degree of precision. Extrapolating from the length of occupation of the Durrington Walls houses, it may be no great leap of inference to conclude that the second stage of Stonehenge was built in a decade or so.

Figure 21. The floor of House 851 at Durrington Walls was re-plastered six times. Mike Parker Pearson kneels in front of the hearth. The stake holes of the wattle and daub wall can be seen beyond the plaster floor, the edges of which are defined by beam slots that formerly held timbers for beds and furniture. The pit on the left was dug after the house was abandoned, probably as part of a closing ceremony. Photo by Adam Stanford, Aerial-Cam Ltd.

The huge quantities of refuse within the Durrington Walls settlement include animal bones predominantly of domestic pig (around 90%) with some domestic cattle (10%). Faunal analysis reveals a peak in pig slaughter during the animals' first autumn and winter, although culling continued at a low level throughout the year (Wright et al. 2014). The evidence that the winter solstice was the more important of the two annual solstices in the calendrical cycle is supported by the large-scale slaughter of animals at this point in time. The faunal evidence may indicate an increase in the number of inhabitants in the village, and it may also have been the season in which megalith-building was in full swing.

Patterns of bone discard reveal evidence for feasting; many bones were disposed of still in articulation and with only minimal extraction of marrow (Albarella and Serjeantson 2002). Burnt limb extremities demonstrate that some animals were barbecued, whilst lipid analysis of ceramics reveals evidence of meat being boiled (Craig et al. 2015). Larger, thicker-walled pots were used for cooking pork, with medium-sized pots for beef and the smallest sizes for milk, cheese or dairy products. Although the bones of pigs and cattle were uniformly distributed across contexts, lipid analysis of ceramics indicates that the deposition of cooking pots was structured by their ceremonial contexts. Whilst beef pots predominate on the middens, pork pots were the chief vessels placed in pits; most of these pits were special deposits, dug into the floors of recently abandoned houses. Milk pots were most common in the public ceremonial space in and around the Southern Circle.

Strontium isotope analysis of tooth enamel of cattle and pigs has produced unexpected results that show that Durrington Walls was provisioned by a supply network extending far beyond the local area. Whilst the majority of animals have strontium isotope ratios consistent with being reared on chalklands, and on Mesozoic strata that can be found as close as 50km away, a significant proportion of animals have ratios that are inconsistent with the geology of southern Britain. Instead, they can be matched in Britain only in

the Scottish Highlands, some 800km away (Viner et al. 2010). It is possible that such results may derive from animals being reared in Brittany, just 200km across the English Channel, but there is no evidence for cross-channel contact atthis time (Bradley et al. 2016: 117). The most likely possibility is that some animals raised in Scotland were deliberately brought to Stonehenge.

BEAKER PEOPLE AT STONEHENGE C.2400 BC: THE ARRIVAL OF METALLURGY

Britain's apparent cultural isolation from continental Europe at the time of Stonehenge Stage 2 and Durrington Walls may have extended back to the Middle Neolithic, when European-derived architectural styles such as causewayed enclosures, long barrows, dolmens and passage tombs were replaced by indigenous innovations such as cursuses, henges and stone circles. Evidence from the later phases of Durrington Walls' village hints at that isolation coming to an end. First, one of the sherds from a Durrington Walls house floor has a fabric consistent with it being part of aBell Beaker rather than a local Grooved Ware vessel. Second, there is evidence that copper tools were in use at the moment that the village was abandoned.

As the houses went out of use, a 440m-diameter circle of large wooden posts was erected around the perimeter of the village. Toolmarks in the side of one of the postholes have been produced by a thin, 0.2m-wide blade that would be consistent with a metal axe hafted as an adze (Parker Pearson et al. 2017). The loose packing of the postholes and post ramps of this timber enclosure suggests that the posts were intended as a temporary feature. Unlike the timber posts of Woodhenge and the Southern and Northern Circles – which remained in place until they decayed – these posts encircling Durrington Walls were taken down probably within a very short time of their being erected. They may have then been reused in the enlargement of the Southern Circle or in providing wooden ladders needed while digging

out the 5.5m-deep ditch of the henge. Each post was pulled out vertically, at the same moment as the henge bank was constructed (Parker Pearson and Gaffney 2016).

Magnetometry, GPR and archaeological excavation have confirmed that Durrington Walls' henge ditch and bank were constructed by digging out the ditch in inter-connecting 40m-long segments, resembling in plan a string of sausages. The overlap between segments reveals that each was dug at the same time as its neighbour, presumably by a different work gang. Differences between adjacent segments in the techniques used to extract chalk blocks with antler picks highlight different working practices between work gangs.

Excavation of one of these ditch segments in 1967 revealed a cache of 57 antler picks on the base of the ditch, potentially giving some insight into the size of the workforce within each segment. Removal of the harder chalk towards the bottom of the henge ditch would have required the labour of pairs of ditch-diggers, one to use the antler tip like a chisel and the other to hammer it, implying over 100 people in each work gang. In addition, basket-carriers had to scale the side of a near-vertical 5.5m-deep ditch and dump the extracted chalk onto a bank reaching about 3m in height. Full basket weights of around 40kg each can be calculated from identification of individual basket-loads within the henge bank. Some of the chalk blocks forming this henge bank have toolmarks consistent with the use of metal axes (Parker Pearson 2007).

Durrington Walls' henge bank was completed in 2480–2450 cal BC so the use of copper tools at this time is close to the date of Britain's earliest Bell Beaker burials (2475–2360 cal BC) which provide the earliest secure contexts for actual copper artefacts in Britain. The metal axe-marks from Durrington Walls could have been made up to a century before these earliest Beaker burials (Parker Pearson et al. 2017). The evidence from Durrington Walls suggests that aspects of the pan-European Bell Beaker phenomenon reached Britain in the first half of the 25th century BC, probably several decades before the beginning of the Beaker burial rite in Britain.

Recent analysis of ancient DNA of 37 Beaker burials in Britain reveals that most of these individuals are genetically distinct from British Neolithic farmers (Olalde et al. 2017). As is the case for Bell Beaker burials in continental Europe, they share a genetic ancestry that can be traced through the Corded Ware culture of central and northern Europe (c.2800 BC) to the Yamnaya culture of the Pontic steppe between the Black Sea and the Caspian Sea in the late fourth millennium BC (Haak et al. 2015; Allentoft et al. 2015; Olalde et al. 2017). European Bell Beaker individuals show a degree of genetic admixing between Corded Ware and European Neolithic ancestries but, in contrast, the British examples reveal little evidence, on reaching Britain, of any such mixing with British Neolithic ancestries. Within the next thousand years, it appears that the Beaker people effected a 90% replacement of the indigenous Neolithic population in Britain, establishing the genetic basis for the population of Britain over the next 4,000 years.

Isotopic analysis of Beaker burials in Britain reveals a high degree of mobility, with around 40% of individuals sampled providing evidence of having been buried in a region different to where they grew up. Only two out of a sample of 264 burials have extreme oxygen isotope values consistent with having grown up in continental Europe. One of these is the Amesbury Archer, buried 5km from Stonehenge around 2480–2290 cal BC, equipped with the largest assemblage of grave goods of any Beaker-period burial in Europe (Fitzpatrick 2011). The other is an otherwise undistinguished disarticulated skeleton from Bee Low, in the Peak District in northern central England, dating to 2200–2030 cal BC (Parker Pearson et al. 2016). Apart from these exceptional cases, the evidence for cross-Channel movement is slim but the true picture is obscured by similar geologies and similar oxygen isotope conditions on either side of the Channel. However, the different dates of the Amesbury Archer and the Bee Low man indicate that these migrants came to Britain over the course of many centuries and not in a single invasion.

The material dimensions of this Beaker migration have been very evident for a long time. Beaker ceramics are very different to indigenous British Grooved Ware, Beaker inhumation rites are distinct from indigenous cremation rites of the kind found at Stonehenge, and Beaker houses with their curvilinear plans are different to British Neolithic architecture of the kind found at Durrington Walls. Yet subsistence practices show only gradual changes, such as the growing importance of sheep in contrast to pigs. Finally, many Late Neolithic monuments, Stonehenge included, reveal Beaker-period reuse.

Yet Stonehenge, Bluestonehenge and other re-used Neolithic monuments reveal no evidence of Beaker pottery being used alongside Grooved Ware. Apart from the single putative Beaker sherd on the floor of a Grooved Ware-using house at Durrington Walls, no sealed contexts containing Grooved Ware also contain Beaker pottery. This appears to be part of a wider pattern across Britain, in which Beaker pottery was deposited after Grooved Ware and not alongside it. Grooved Ware may have continued in use in some areas such as Orkney until the end of the third millennium BC (Bayliss et al. 2017) but in the Stonehenge area it was largely replaced by Beaker pottery in 2460–2320 cal BC (Barclay and Marshall in Fitzpatrick 2011: 180). With no evidence of stylistic overlap in ceramics, assumptions of cultural continuity between Grooved Ware- and Beaker-using communities may be unwarranted; a reassessment of this major cultural transformation is required in the light of the genetic and isotopic evidence.

The Beaker period marks a major change in monumentality and labour-mobilisation for monument-building in Britain. In the decades either side of 2400 BC, the enormous mound of Silbury Hill was constructed close to Avebury henge, 30km north of Stonehenge (Leary et al. 2014). Two other mounds, not quite as large, were also constructed in the area north of Stonehenge, one at Marlborough and the other within the large henge of Marden (Leary and Marshall 2012). These are among the last of Britain's great monument-building events. The radiocarbon-calibration

plateau for this period – effectively Britain's short-lived Chalcolithic period c.2450–2200 BC – makes it difficult to see whether this change in monument-building was abrupt or gradual. Either way, within a 250-year period, large-scale mobilisation was replaced by more decentralised systems of political and religious authority. Beaker-period monuments – whether stone circles, henges or round barrows – were generally small, requiring labour organised at the lineage level rather than involving thousands of people.

Stonehenge Stage 3 is the first of Stonehenge's constructional stages to have been built within the Beaker period. Dating to 2480–2280 cal BC, it consists of three main features. The first was the digging of a substantial pit to the bottom of the great trilithon's uprights (Parker Pearson et al. 2007). The second was the installation of a probable bluestone circle within the centre of Stonehenge, most likely the dismantled circle of Bluestonehenge, with which it appears to share its diameter and spacing. A third feature was the digging of the Stonehenge Avenue's ditch, which leads from Stonehenge to Bluestonehenge, where the emptied sockets of the dismantled bluestone circle were now encircled by the ditch and bank of a small henge.

The large pit at the base of the great trilithon was misinterpreted by archaeologists for many years as a loading ramp for the erection of the trilithon's tall sarsens; consequently the Beaker-period dates of antler picks from within this pit were thought erroneously to date the erection of the sarsens in Stonehenge's Stage 2. Now that we know that this pit belongs to Stage 3, in the early part of the Beaker period, and that in engineering terms the pit cannot have been a ramp, we have the problem of explaining its purpose. It could have been dug out as an iconoclastic event designed to slight the monument. Yet it would seem that the great trilithon did not collapse until after Stage 4, when the central bluestone circle was replaced by a bluestone oval, stones of which lie underneath the stones of the fallen trilithon.

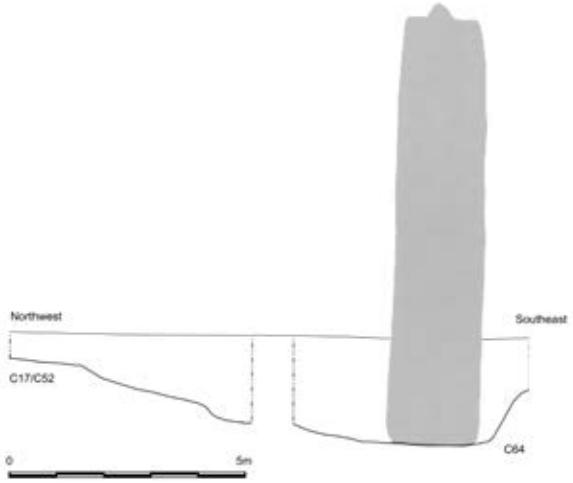

Figure 22. A reconstructed section through the pit dug in Stonehenge's Stage 3 around the uprights of the great trilithon. Drawn by Mike Parker Pearson.

STONEHENGE IN THE EARLY BRONZE AGE: A MONUMENT IN DECLINE

Stage 4 (2280–2020 cal BC) consisted of the inner bluestone oval and also an outer bluestone circle, inside the circle of outer sarsen uprights. This stage of Stonehenge falls within the period in which bronze metallurgy became predominant in Britain (Needham 1996). Beakers were still placed with inhumation burials, and Food Vessels and Food Vessel Urns appeared, used as accompaniments for cremation (although some Food Vessels were also placed in inhumation burials). The Late Neolithic tradition of cremation seems to have continued, albeit in declining numbers, alongside the introduction of Beaker inhumation rites (Anna Bloxam pers. comm.); cremation rites with Food Vessel ceramics mark the beginning of a resurgence of cremation from this period onwards.

Only in 2012 was the dating of the stages of Stonehenge finally resolved (Darvill et al. 2012). The desire to see the lavishly equipped Amesbury Archer as the 'King of Stonehenge' has to be dismissed – his dates are too late to make him a builder. Archaeologists of earlier generations – even less aware of Stonehenge's true antiquity – thought that the Early Bronze Age man buried under Bush Barrow, within sight of Stonehenge, was the architect of Stonehenge. Recent reassessments of this remarkable burial, excavated over 200 years ago, reveal its full splendour (Needham et al. 2010a; Corfield 2012). The man in Bush Barrow seems to have been buried in a crouched position, with an ornamented gold lozenge plaque cover on his chest and a smaller one by his mace, with a sheet-gold belt-buckle cover by his waist. His accompaniments included a bronze axe, two daggers (one of copper and one of bronze) and a probable bronze knife. The daggers are remarkable because their wooden handles were each ornamented with around 150,000 tiny gold studs, indicative of the highest levels of craftsmanship within Early Bronze Age society.

The Bush Barrow burial is the epitome of the high-status burials identified by Stuart Piggott (1938) as the Wessex Culture. With one such 'Wessex I' burial dated to 2020–1770 cal BC (Needham et al. 2010b), this group is considered to date to around 1900 BC and is connected to similar gold-provisioned burials in Brittany. Needham et al. (2010a) consider that the man in Bush Barrow was a member of a dynasty buried in the round barrows on Normanton Down, the high ground just 1km south of Stonehenge. They suggest that, whilst Stonehenge still retained its high spiritual and social standing, its main axis of approach had shifted away from Durrington Walls and the River Avon to routes leading from the south. Such routes would relate ultimately to the coast and thus to cross-Channel contacts, and to the coastal trade in tin, gold and copper.

In this period, the Stonehenge landscape – along with many other areas in southern Britain – became a focus for round barrows in their thousands. Durrington Walls appears to have been

at the centre of this Stonehenge-area distribution, with barrows spreading both east and west of the River Avon. Round barrow cemeteries developed on the skylines around Stonehenge, creating an 'envelope of visibility' around the monument, in close proximity to which there were only around 40 barrows within this 'envelope' (Woodward and Woodward 1996). Some of Britain's largest and most impressive round barrows were constructed on the edge of this 'envelope', notably the 'Monarch of the Plain' to the west of Stonehenge and the linear cemetery on King Barrow Ridge to the east. None of these unusually large round barrows have ever been excavated, and it is, of course, possible that their burials might exceed that of Bush Barrow in the lavishness of their provisioning.

The last constructional stage of Stonehenge, Stage 5, hardly compares with the previous stages, even the limited modifications of Stages 3 and 4. It consists of two concentric rings of sub-rectangular pits encircling the outer sarsen circle, known as the Y and Z Holes. These pits contained few finds other than red deer antlers and small chunks of rhyolite bluestone. Smaller than sarsen sockets yet larger than bluestone sockets, the purpose of these pits is a mystery although Atkinson (1956: 72) suggested that they were dug to hold 59 bluestones moved from the interior of the monument. Perhaps the least well understood of Stonehenge's features, they hint at an unfinished building project in which Stonehenge ended not with a bang but with a whimper. Radiocarbon dates on the antlers from the Y and Z Holes suggest that this stage dates to 1630–1520 cal BC.

This fifth and final stage of activity corresponds with the typological dating of axehead and dagger carvings on some of Stonehenge's sarsens. The axeheads depicted are in the Arreton style of long-flanged axes, dating to c.1750–1500 BC. Whilst some of these carvings were first recognised in the 1950s, most of the 122 axeheads and three daggers were not identified until the laser-scanning analysis of 2012 (Abbott and Anderson-Whymark 2012). Similar axe and dagger motifs are found on carved stones within burial cists at Badbury round barrow, Dorset, and Kilmartin

in western Scotland, suggesting that they may have held a funerary significance relating to some of the many burials in the surrounding round barrows on Salisbury Plain.

Although Stonehenge continued to be visited for millennia afterwards, its significance waned after the Early Bronze Age. Recent excavation and survey has identified a ditch system, dug towards the end of the Early Bronze Age probably c.1600 BC, which formed a sub-rectangular 'precinct' 2.5km x 1.4km in size enclosing Stonehenge and the Normanton Down round barrow group (Pollard et al. 2017). Field systems were laid out beyond this enclosure, as the area outside the precinct was brought under cultivation and integrated into a wider system of mixed farming. This marks a period of agricultural intensification on Salisbury Plain and more widely across southern Britain (Field and McOmish 2017; Yates 2007). We may consider it the end of Stonehenge's central significance in prehistory.

EXPLAINING STONEHENGE

Looking at Stonehenge's context within British prehistory, a number of key questions emerge concerning the circumstances in which the sequence of Stonehenge construction projects took place. One is the question of why Stonehenge was built, especially in its first and second stages. Another is the question of the material conditions behind its construction, providing its social, economic and environmental context. A third is the question of why Stonehenge is such a singular monument, uniquely utilising stones that were brought unparalleled distances, dressed and raised as lintels on top of uprights.

Archaeologists and historians generally agree that the best circumstances for monument-building in pre-state societies include surplus production, large populations freed from subsistence activities, centralised structures of authority, long-distance exchange networks, and hospitable environmental conditions.

Yet there are indications that Stonehenge was constructed in times of economic crisis, social disaggregation and population decline.

In line with the transition to agriculture in other parts of the world, the Mesolithic–Neolithic transition in Britain and Europe is reckoned to have enabled the maintenance of higher population levels, linked to increased fertility, but subject to significant population fluctuations (Downey et al. 2014). Recent modelling of summed calibrated radiocarbon date probability distributions (SCDPDs) for the Neolithic period across Western Europe has revealed declining numbers of radiocarbon dates within half a millennium or so of the arrival of agriculture in each region (Shennan et al. 2013).

Working on the assumption that the numbers of available radiocarbon dates may be deemed to be proxies for the extent of human activity and thus the relative size of the population, Shennan et al. (2013) have interpreted the decline in radiocarbon dates after 3500 BC in Britain as indicative of a decline in population. Although their approach may be criticised for assuming that retrieval bias plays little part in skewing the observed chronological distributions of dates, this SCDPD decline does correlate with a period of increased landscape cover in deciduous woodland, as identified in a collective study of dated pollen sequences from across Britain (Woodbridge et al. 2014).

Taken together, the two strands of evidence suggest that Britain's Middle Neolithic population declined at the same time that cleared ground regenerated as woodland. Both graphs reveal a pattern of little change after 3500 BC until c.2400 BC, the beginning of the Beaker period when the dramatic rise in the SCDPD correlates with a resurgence of land clearance, as indicated by a decline in the overall percentage of deciduous arboreal pollen.

A similar SCDPD approach reveals a dramatic decline in radiocarbon-dated domesticated cereal grains commencing around 3600 BC, falling further around 3300 BC and even

further around 2900 BC (Stevens and Fuller 2012). The relative numbers of dated cereal grains only pick up with the beginning of the Beaker period. Stevens and Fuller argue that the number of dated cereal grains through time can be used as a measure of the reliance on cereal cultivation, and that the Middle–Late Neolithic decline represents a subsistence shift away from mixed agriculture towards pastoralism.

The cause of these inferred declines in population and cereal cultivation has been recently suggested to be a climatic downturn between c.3600 and c.3300 BC (Bevan et al. 2017). Since the climatic evidence suggests recovery by 3300 BC, the inference must be that agricultural systems in Neolithic Britain were sufficiently disrupted by that date that the population failed to recover until almost a thousand years later. Such a scenario is difficult to believe, and it may be that any such long-term decline in agriculture and population might have been more the result of long-term processes such as declining soil fertility (in the absence of manuring and fallow-regimes) or the arrival of diseases such as *Yersinia pestis*, the bubonic plague, which is known from Eurasia as early as the beginning of the third millennium BC, just half a millennium later than the start of Britain's Middle Neolithic (Rasmussen et al. 2015).

As hinted earlier, the problem with such SCDPD analyses of meta-data is that they are only as reliable as the data on which they are based. Even if representative, they mask regional and local variability that may be significant for understanding population dynamics as they relate to monument-building. When examining evidence at a local scale, it is evident that certain regions such as Salisbury Plain and Orkney became major centres of population, with large-scale deforestation during the Middle Neolithic (French et al. 2012; Bayliss et al. 2017). In contrast, a region such as the bluestone source of Preseli reveals little evidence, either palynological (Fyfe 2007) or archaeological (Darvill and Wainwright 2016) for Late Neolithic occupation in the period 3000–2400 BC. Even in the Middle Neolithic, the

relative scarcity of finds of pottery of this period throughout west Wales (Ard and Darvill 2015) is particularly striking.

The apparent absence of activity in the Preseli region could potentially represent a real absence of people, caused by emigration. In this respect, it is intriguing that strontium isotope analysis of human remains from Stonehenge and Salisbury Plain has revealed a potential migration stream during the Late Neolithic–Early Bronze Age from Silurian and Devonian geological regions, which include the Preseli region (Snoeck et al. forthcoming; Parker Pearson et al. 2016). The strontium isotope ratio for a cattle mandible placed on the bottom of the Stonehenge ditch, consistent with its having been reared on Silurian/Devonian geology, reveals that even animals (whether dead or alive) made the long-distance journey from the far west of Britain when Stonehenge Stage 1 was built.

Stonehenge's initial construction (Stage 1) took place alongside significant changes in material culture, both portable and monumental. Regional differences in Early Neolithic ceramic styles (Pioffet 2017) gave way to the shared Peterborough Ware style (c.3400–2800 BC) across southern Britain in the Middle Neolithic, and Grooved Ware across the whole of Britain after 3000 BC. Regional tomb styles such as long barrows (predominantly in eastern Britain) and dolmens (in western Britain and Ireland) gave way to less regionally confined monument types such as cursuses and henges. The social context in which Stonehenge's first two stages were built was one of increasing island-wide commonality in terms of shared cultural practices.

This growing cultural unity across southern Britain by the time of Stonehenge Stage 1, and extending across the whole of Britain by Stage 2, offers a convincing context for understanding Stonehenge as a monument not just to the ancestors but to a unification of ancestors. Since it seems unlikely that Salisbury Plain could have provided the stones for Stonehenge (the nearest likely source of sarsens being the Avebury area 30km away), one

of Stonehenge's defining features is that it was built of stones that had to be brought from far away. In the case of the bluestones, some or even all of them may have been brought from a stone circle in Preseli, a stone circle that could have been one of the two largest in Britain. Thus Stonehenge may well be a 'second-hand' monument, incorporating aspects of symbolism relating to one or more earlier stone circles. It is not impossible that many of Stonehenge's sarsens came from the largest of Britain's stone circles, Avebury; although considered to date to some point within the third millennium BC, all three of Avebury's stone circles remain undated (Gillings and Pollard 2004). Originally composed of around 500 standing stones, some of them weighing up to 100 tonnes, Avebury has lost most of its monoliths, many in historical times, but only future research can reveal whether any were removed in prehistory.

Another possibility is that the bluestones and the sarsens represented the ancestries of Neolithic farmers arriving in Britain, one group landing in west Wales and the other in southeast England where sarsens were the local stone used by the earliest farmers to build their tombs such as Coldrum in Kent, dating to the 39th century BC (Healy 2008). Among various models for the arrival of farming in Britain, Sheridan (2010) has proposed that colonising farmers brought the Breton style of the closed-chamber dolmen to west Wales and that a separate migration of farmers from northern France arrived in southeast England.

In the case of Stonehenge Stage 2, the impetus for a major rebuild 500 years after the first stage may have come from a need to reassert unity in the face of forces that threatened that unity. Although the Beaker phenomenon had not reached Britain by 2500 BC, its arrival was only decades away. New groups of steppe-descendants such as the Corded Ware-related Single Grave culture in the Netherlands were already established just 50km from the British coast by c.2800 BC, with Dutch Bell Beaker-users in existence by 2500 BC (Drenth and Hogestijn 2001). Stonehenge Stage 2 appeared in the very moment when Britain's long period of cultural isolation was about to end.

On the theme of unification, some final points can be made about the nature of Stonehenge's architecture. The sarsen circle – linked together by interconnected lintels – is suggestive of unity, just as the horseshoe of trilithons may represent an ancestral meeting house. The mortise-and-tenon jointing and the dovetail jointing of the lintels, techniques belonging to carpentry, could also symbolise the collective amalgamation of stone and timber circles from across different parts of Britain.

In conclusion, a great deal of what we know about Stonehenge has been discovered only in the last decade or so, and our knowledge is changing so fast that publications before 2012 are now largely out of date on key points. In this fast-moving field of research, further discoveries will no doubt continue to force us to reappraise existing evidence, modify our interpretations and direct new questions. It is an exciting time to be studying prehistory.

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Printed by

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ISBN/EAN 978-90-817066-9-8