Stonehenge remodelled

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We are pleased to present the latest account of the sequence of burial and construction at the site of Stonehenge, deduced by its most recent excavators and anchored in time by the application of Bayesian radiocarbon modelling. Five prehistoric stages are proposed, of varied duration, and related by our authors to neighbouring monuments in the Stonehenge environs. While it may never be possible to produce a definitive chronology for this most complex of monuments, the comprehensive and integrated achievement owed to these researchers has brought us much closer to that goal. It is from this firm platform that Stonehenge can begin its new era of communication with the public at large.

Keywords: Britain, Neolithic, Beaker, Bronze Age, megalithic, Stonehenge, sarsen, bluestone, trilithon, radiocarbon, Bayesian modelling

Introduction

Since the early years of the twentieth century it has been recognised that Stonehenge on Salisbury Plain, Wiltshire, UK, was a long-lived monument with several stages of construction. The publication in 1995 of the twentieth-century excavations at the site (Cleal *et al.* 1995) broadly endorsed a three-phase sequence and, by means of a ground-breaking Bayesian modelling of the radiocarbon dates (Allen & Bayliss 1995; Bayliss *et al.* 1997; Bronk Ramsey & Bayliss 2000), was provided with a robust chronology. Subsequent minor revisions to the original Bayesian model (Bayliss *et al.* 2007; Parker Pearson *et al.* 2007, 2009) have followed. In this paper we remodel the Stonehenge sequence and present a revised phasing, based upon the results of the most recent investigations (Parker Pearson *et al.* 2007, 2009,

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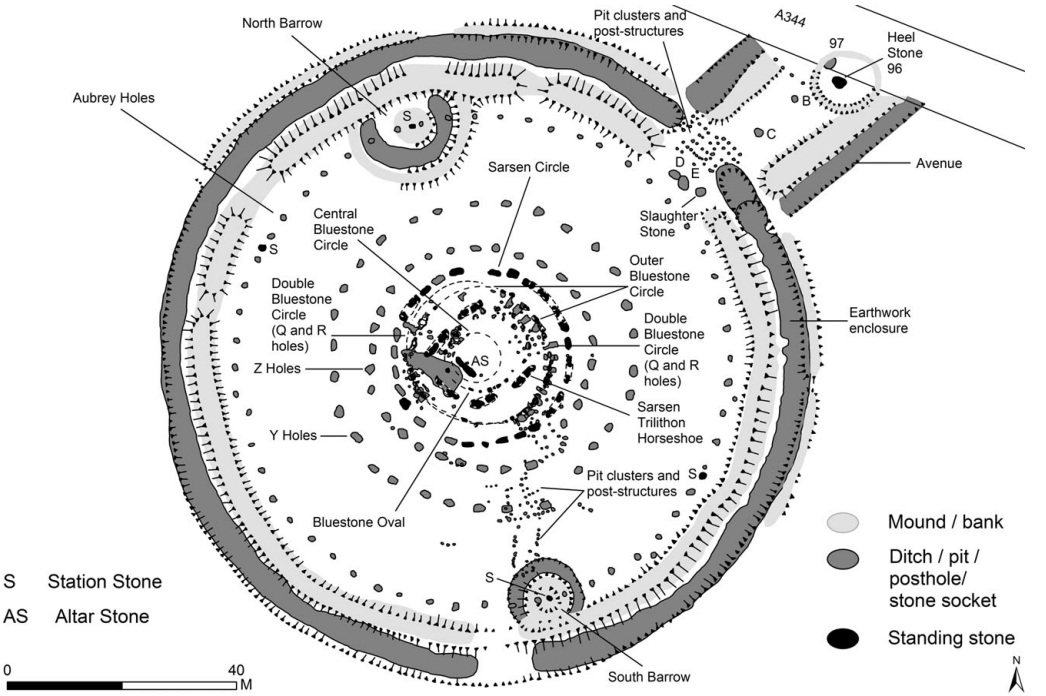

Figure 1. Plan of Stonehenge, showing the principal structural features (after Darvill 2006).

2010; Darvill & Wainwright 2009), reinterpretation of previously recorded stratigraphy, additional radiocarbon dates, and a series of new chronological models (Marshall *et al.* 2012). It is recognised that the scheme is provisional, and in places tentative, but we present it as a working hypothesis for future investigations to test.

The location and nomenclature of the principal structural features are given in Figure 1. The main components, from the exterior inwards, are: an *earthwork enclosure* with *north* and *south barrows*, a *southern entrance*, and a *north-eastern entrance* from the *Avenue* with a group of *standing stones* in and beyond the north-eastern entrance (including the 'Heel' and Slaughter' stones); within the enclosure, a circle of *Aubrey holes*, which may have held stones and/or posts; four *Station stones*; two roughly concentric rings of pits known as the *Y and Z holes* (barely visible on the surface); the *sarsen circle*; the *double bluestone circle* set in the *Q and R holes* (not visible on the surface); the *outer bluestone circle*; the *trilithon horseshoe*; the *bluestone oval* now visible as a *bluestone horseshoe*; a *central bluestone circle* (not visible on the surface); and, lying in the centre, the *'Altar' stone.* 'Bluestone' is an archaeological term popularised in the early twentieth century to refer to what had previously been called the 'foreign' stones (i.e. any stones that are not locally derived sarsens). The portmanteau term 'bluestone' thus embraces a range of dolerites (including the well-known spotted dolerites), tuffs, rhyolites and sandstones. Except for the sandstones (Ixer & Turner 2006), the other bluestones derive from the Preseli hills of north Pembrokeshire (Thomas 1923; Thorpe *et al.* 1991; Darvill *et al.* 2009; Ixer & Bevins 2010). A detailed plan of the excavations at Stonehenge is provided by Cleal *et al.* (1995: tabs 1 & 2); see also Richards (2007: 160) for a simplified plan.

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Table 1. Summary of the Stonehenge periodisation proposed by Richard Atkinson (1979).

Period	Main components	Suggested date
I	Construction of the bank, ditch, and Aubrey holes. Erection of the Heel stone, stones D and E, and the timber structure at A. Inception and use of the cremation cemetery. Station stones perhaps erected near the end of this period.	2800–2100 BC
II	Widening of the entrance causeway and transfer of stones D and E to holes B and C. Digging and filling of the Heel stone ditch. Construction of the first part of the Avenue. Erection of the double bluestone circle in the *Q* and *R* holes, unfinished.	2100–2000 BC
IIIa	Dismantling of the double bluestone circle. Erection of the trilithon horseshoe, sarsen circle, and the Slaughter stone and its companion. Carvings made after erection.	2000 BC
IIIb	Tooling and erection of stones of the dressed bluestone setting. At the end, digging and abandonment, unfinished, of the *Y* and *Z* holes.	2000–1550 BC
IIIc	Dismantling of the dressed bluestone structure. Re-erection of all the bluestones in the present bluestone circle and bluestone horseshoe.	1550–1100 BC
IV	Extension of the Avenue from Stonehenge Bottom to West Amesbury. Possibly some deliberate destruction of the stones.	1100 BC AD 50–400

Twentieth-century phasing models

Despite Herbert Stone's assertion that the "present structure of Stonehenge, as we see it, is all of one period" (1924: 2), early excavations (Gowland 1902; Hawley 1921, 1922, 1923, 1924, 1925, 1926, 1928) clearly showed that this was not the case. Writing in *Antiquity*, Robert Newall first articulated what later became known as the "Two Date Theory" of Stonehenge (Newall 1929: 84). This postulated an early phase comprising the earthwork enclosure, Aubrey Holes, and cremation burials, followed some time later by the central stone setting.

Although questioned by Cunnington (1935: 88) as being too simplistic, Stuart Piggott perpetuated the 'Two Date Theory' in a little-cited but important paper published in 1951 (Piggott 1951) at the start of new excavations by Atkinson, Piggott himself, and Stone. Five years later, it was Piggott's nomenclature and, to a lesser extent, his phasing that Richard Atkinson adopted (Atkinson 1956: 58–77). By the 1979 revision of Atkinson's *Stonehenge*, there were five radiocarbon dates for Stonehenge and four for its Avenue, and these appeared to confirm the overall sequence (Table 1; Atkinson 1979: appendix II).

The publication of twentieth-century excavations at and around Stonehenge provided an opportunity to review the structural sequence, obtain further radiocarbon determinations, and construct a Bayesian model that would provide a more robust chronological framework for the site (Table 2; Cleal *et al.* 1995). The revised structural sequence was a refinement of Atkinson's original scheme and was used, together with direct stratigraphic relationships where they existed, to build a Bayesian model for estimating the dates of recognised phases in the development of the monument. In all, 62 radiocarbon dates were available at the time of the analysis for the formulation of the new structural sequence at Stonehenge and its associated peripheral structural components; of these, only 52 were used in the

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Table 2. Summary of the Stonehenge phasing proposed by Ros Cleal and colleagues (1995).

Interior phase	Main interior components	Periphery phase	Main peripheral components	Suggested date ranges
1		1	Bank and ditch construction; Aubrey holes supporting timber settings; primary backfill in the ditch	2950–2900 cal BC
2	Timber settings in the interior, including the southern passage	2	Natural filling of the ditch; deposition of cremations in bank and ditch fill; timber settings in the Aubrey holes dismantled; cremations in the top of Aubrey holes	2900–2400 cal BC
	Arrival of the bluestones from south-west Wales			
3i	Double bluestone circle (*Q* and *R* holes)	3a	Stones: 97, Heel stone, and station stones; topmost fill of ditch forms; cremations continue	
	Arrival of sarsens from Wessex Downlands			
3ii	Sarsen circle and sarsen trilithon horseshoe	3b	Heel stone ditch dug; north and south barrow ditches dug; stones D, E, and Slaughter stone raised	2550–1600 cal BC
?3iii	?Bluestone settling with lintels			
3iv	Bluestone circle and bluestone oval	3c	Avenue constructed; stones B and C raised; Beaker burial in ditch	
3v	Bluestone horseshoe			
3vi	*Y* and *Z* holes			

new chronological model, the remaining 10 were rejected because of uncertain stratigraphic provenance, or technical problems with the laboratory processes (Cleal *et al.* 1995: 521). The continuing problem of identifying the relationships between stratigraphically disconnected components of the site was well recognised and taken into account by dividing the sequence into two separate parts, one covering the centre and the other the periphery of the site.

Stratigraphic readings

Critical to understanding the Stonehenge sequence is how the stratification recorded by earlier excavators may be read. Much has been made of single intersections, of which one of the most crucial is that between elements of the *double bluestone circle* (the *Q* and *R* holes) and the *sarsen circle*, in particular Atkinson's assertion (1979: 61) that the fill of *Q*

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hole 4 was cut by the socket for stone 3 in the sarsen circle. Atkinson's plan and photograph (Cleal *et al.* 1995: figs. 278 and 92 respectively) show that the cut for stone 3 is far wider than for almost all other sockets in the sarsen circle. Its dark, organic fill is also inconsistent with the clean chalk rubble normally used as packing in these stoneholes. One lesson learnt from the 2008 excavations is that later (sometimes much later) digging adjacent to extant stones has obscured the original stratigraphic relationships between features by effectively re-cutting their upper fills (Darvill & Wainwright 2009: 16). With this in mind, other possible relationships cited in support of the *double bluestone circle* pre-dating the *sarsen circle* and *trilithon horseshoe* can also be disputed. Stone 7 in the sarsen circle looks to have been recut on the inside to produce its apparent super-imposition in relationship to *Q* hole 9 (Cleal *et al.* 1995: fig. 97). The socket for stone 60 in the trilithon horseshoe (north-western trilithon) looks to have been re-cut on the outside, but the earlier feature it is assumed to cut (WA 3433) cannot be considered a *Q* or *R* hole on the basis of its position (Cleal *et al.* 1995: fig. 96, cf. plan 2).

In another case, the re-examination of records relating to the stratification of features around stone 56, the western upright of the *great trilithon*, reveals problems of interpretation (Parker Pearson *et al.* 2007: 619–26). What was once considered to be the construction ramp for stone 56 (WA 2448/3773 on Cleal *et al.* 1995: fig. 100) is actually a large pit dug against the north-west side of stone 56 some time between the construction of the trilithon horseshoe and the construction of the *bluestone oval*.

On the periphery of the monument, interpretations of seemingly established sequences have also been challenged. A re-examination of the recorded ditch fills reveals the presence of a stratigraphic disjunction that can be interpreted as a re-cut (Parker Pearson *et al.* 2009: 29–31). Attention has also been refocused on the interpretation of the *Aubrey holes*. When first excavated, Hawley (1921: 30–31) suggested they had once held bluestone pillars, a position disputed by later archaeologists (Newall 1929: 83; Piggott 1951: 280; Cleal *et al.* 1995: 102–107). Re-excavation of Aubrey hole 7 has revived the initial interpretation as a possibility (Pitts 2008a; Parker Pearson *et al.* 2010).

In developing a new sequence, we rejected the idea of neat architectural phases, in favour of five main periods or 'stages', each of which embraces a set of activities related to a more or less coherent pattern of archaeological evidence. Dating each stage, of varying duration, involves dating the events and activities assigned to it. This entails a consideration of vertical and horizontal stratigraphy, associated finds, and synchronisms established through the dating of particular items, deposits and horizons. The result is given in Table 3. Naturally, some components can be assigned more confidently to a particular stage than others, and we have tried to make this explicit. Here attention focuses only on the evidence relating to the third and early second millennia cal BC. We retain all existing naming, numbering, and lettering of stones and cut features such as stoneholes, so that the revised sequence is easily comparable to all previous (and subsequent) literature.

Towards a new dating model

Full details of the methodology, prior information and radiocarbon dates used in our preferred chronological models, based on a revised reading of some stratigraphic

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Table 3. Summary of the main stages in the use of Stonehenge during the third and second millennia cal BC proposed in this paper.

Stage	Main activities and resultant components	Suggested dates
I	Construction of a circular earthwork enclosure 110m in diameter bounded by a bank and ditch with main access on the NE and smaller entrance to the S (3000–2920 cal BC). Deposition of ancestral tokens in the base of the ditch. Digging of 56 Aubrey holes around the inner edge of bank, possibly to hold bluestones and/or posts. Cremation burials begin to be inserted into the ditch, bank, and Aubrey holes. Pits dug in the central area. Timber posts and stakes set up, in some cases forming simple rectangular structures. Possibly in this stage (or earlier) a post-built structure in the NE entrance; stones B, C and 97 outside the NE entrance.	3000–2620 cal BC
2	Trilithon horseshoe comprising five sarsen trilithons set up in the centre of the site with SW–NE solstitial axis (midwinter sunset/midsummer sunrise). Double bluestone circle of between 50 and 80 bluestones set up outside the trilithon horseshoe with a shared SW–NE axis. Sarsen circle comprising 30 shaped uprights linked by 30 lintels built outside the double bluestone circle. Altar stone perhaps placed within the trilithon horseshoe. Four Station stones. A D-shaped rammed chalk floor (?structure) around stone 92 at the SE entrance superceded by the south barrow. Stones B and C removed. Stone 95 (Slaughter stone) erected with stones D and E added inside the NE entrance. Possible modifications to the earthworks in the NE entrance. Cremations continue to be deposited through to *c.* 2400 cal BC. EITHER stone 96 (Heel stone) added to the existing stone 97 outside the NE entrance to form a pair fixing the solstice axis OR the stone formerly in stonehole 97 removed and re-erected as stone 96 (Heel stone). Ditch dug around the Heel stone (or early Stage 3).	2620–2480 cal BC
3	Bluestones (perhaps from Bluestonehenge) arranged as the central bluestone circle within the trilithon horseshoe. Main ditch recut. Stones D and E in the NE entrance removed. Avenue constructed to link Stonehenge to the henge built around the former Bluestonehenge beside the River Avon 2.8km away. Large pit dug against great trilithon. Beaker-style inhumation burial in ditch.	2480–2280 cal BC
4	Central bluestone circle and double bluestone circle dismantled and re-built as bluestone oval of *c.* 25 monoliths inside the trilithon horseshoe and the outer bluestone circle of between 40 and 60 monoliths in the space between the trilithon horseshoe and the sarsen circle.	2280–2020 cal BC
5	Extensive use of Stonehenge with working of some bluestones into artefacts. Working floor and occupation outside the earthwork on the NW side. Rock-art including Arreton-stage axes and daggers applied (*c.* 1650–1500 cal BC) to stones forming the sarsen circle and trilithon horseshoe. Construction of the *Y* and *Z* holes in the period 1630–1520 cal BC. Numerous round barrow cemeteries built in the surrounding landscape.	2020–1520 cal BC

relationships, re-interpretation of the context of samples and the inclusion of new dates, can be found in the English Heritage report (cited as Marshall *et al.* 2012).

Using the revised sequence outlined below, the estimates for the main constructional phases of the monument have been incorporated into a model (Figure 2) as standardised

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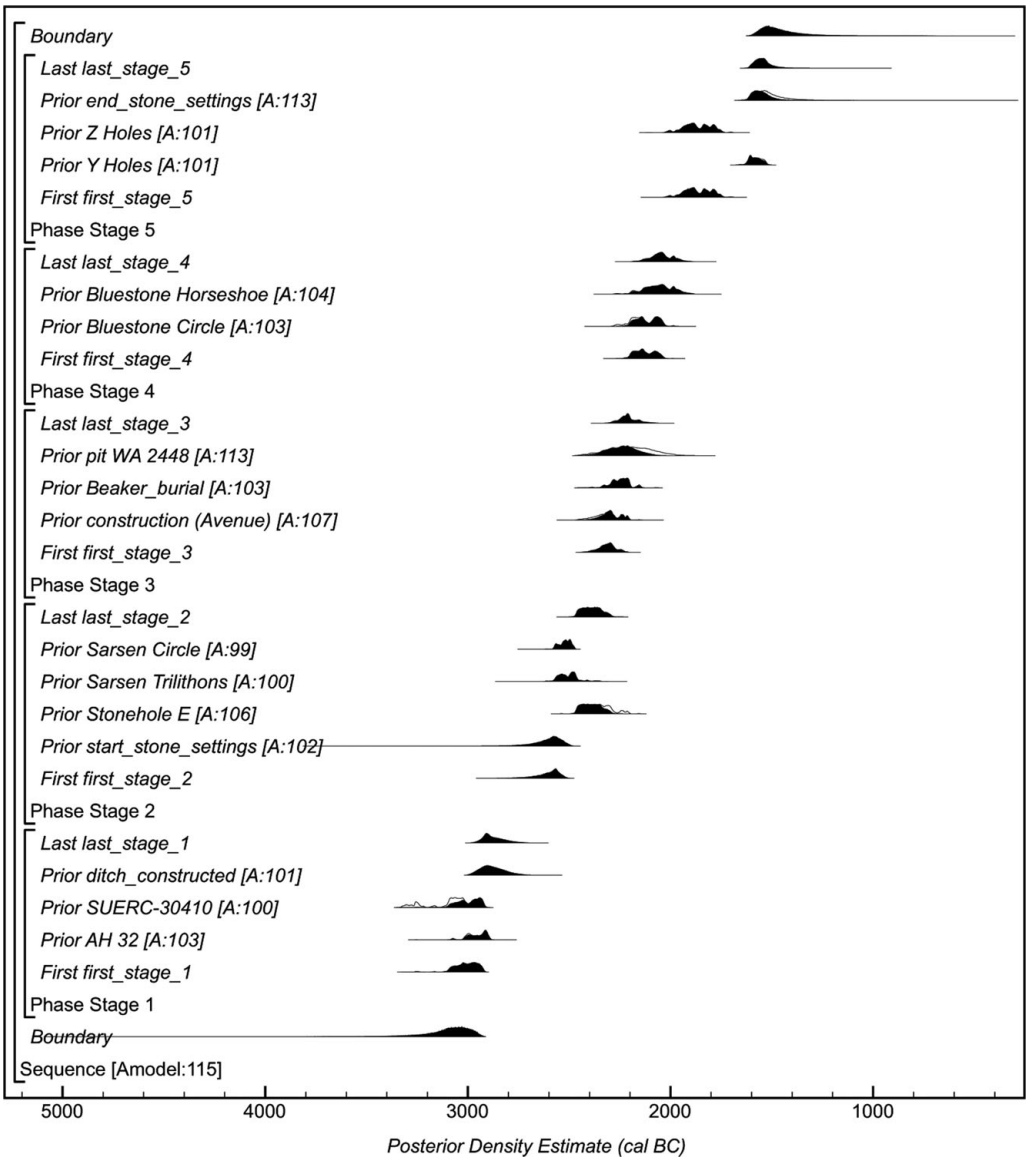

Figure 2. Chronological model for the five stages. Each distribution represents the relative probability than an event occurred at a particular time. The probability distributions for the major archaeological events at Stonehenge have been taken from the models described in Marshall et al. *2012 (figs 6–7, 13, 16, 22) and are shown in outline. Other distributions are based on the chronological model defined here, and shown in black. The large square brackets down the left-hand side along with the OxCal keywords define the model exactly.*

likelihoods to provide an indication of the chronology of Stonehenge through its five main stages. The model shows good overall agreement (Amodel = 115%). The estimates for the start and end date of each of the five stages are derived from the first and last dated events in a stage.

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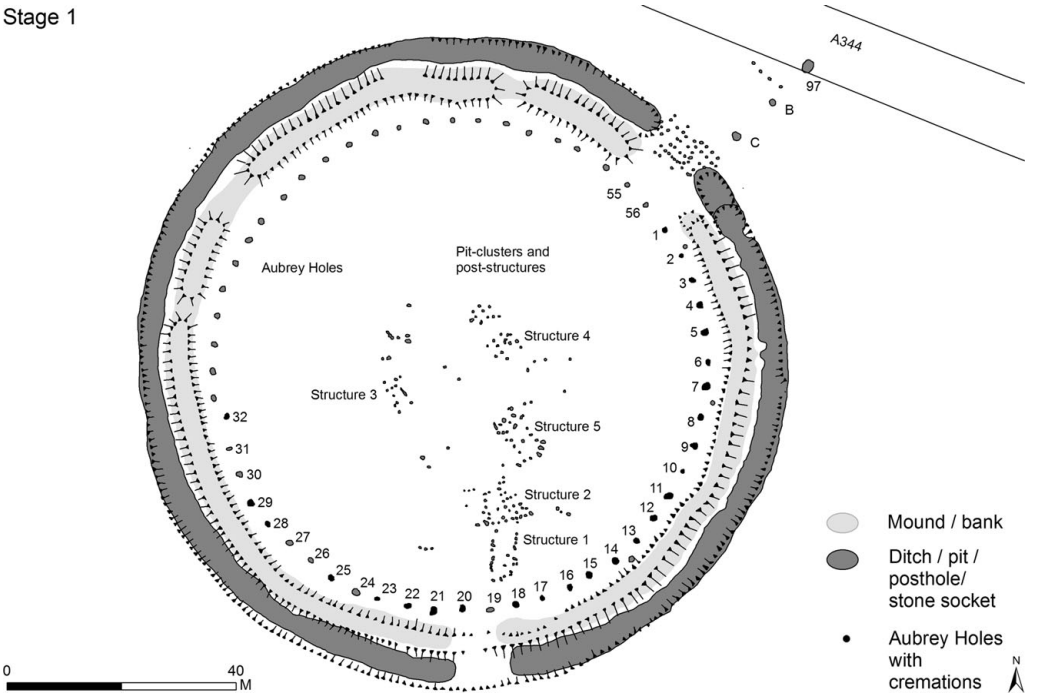

*Figure 3. Summary plan showing the main components of Stonehenge attributed to Stage 1 (*3100–2920 cal BC *to* 2965–2755 cal BC*).*

The radiocarbon dates in plain text quoted below are simple calibrated results quoted at 95% confidence using the calibration dataset of Reimer *et al.* (2009) and OxCal 4.1 (Bronk Ramsey 1995, 1998, 2001, 2009). Those in italics are *posterior density estimates* derived from mathematical modelling and are quoted at *95% probability (*see Marshall *et al.* 2012: 11–12).

A revised structural sequence

Stage 1 (*3100–2920 cal BC* to *2965–2755 cal BC*; Middle–Late Neolithic)

Stonehenge first consisted of a circular bank and external ditch with an overall diameter of about 110m (Figure 3). This earthwork was entered by a main access from the north-east and a smaller entrance to the south. It is not technically a henge, because henges have a bank outside the ditch, but it conforms to the emergent class of 'formative henges' constructed in the late fourth and early third millennia cal BC (Darvill 2006: 97). The initial construction of the Stonehenge ditch is estimated to have been completed in *2990–2755 cal BC* (*Ditch constructed*: Marshall *et al.* 2012: fig. 6) and probably *2955–2830 cal BC* (*68% probability*). The latest dated cattle and red deer bones were *5–435* years (Marshall *et al.* 2012: fig. 9) and probably *110–360* years old (*68% probability*) before being placed on the bottom of the ditch near the entrances shortly after it was cut.

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Within the enclosure is a circle of 56 Aubrey holes, associated with cremation burials, likely to have originally numbered in excess of 150 (Parker Pearson *et al.* 2009). The cremation from the chalk packing within Aubrey hole 32 is probably earlier than the digging of the ditch (86% probability: Marshall *et al.* 2012: 16) indicating that the 56 recorded and projected Aubrey holes around the inner toe of the bank were broadly contemporary with the digging of the ditch (Parker Pearson *et al.* 2009). The stratigraphic positions of the other 64 deposits of cremated human bones, many of them at different layers in the ditch, are likely to place them within Stages 1 to 3, from initial construction to eventual filling of the re-cut ditch, though further radiocarbon dating is awaited to confirm this. The cremation burial of a middle-aged woman placed next to Aubrey hole 7 (*SUERC-30410*: Marshall *et al.* 2012: fig. 6) has a 98% probability of being earlier than the ditch. There is therefore a possibility that the Aubrey holes were dug before Stonehenge's ditch and bank.

Stones were probably present at the site from its inception. Re-excavation in 2008 of Aubrey hole 7 suggested that this hole may have held a standing stone (Pitts 2008a), supporting Hawley's original proposal (1921: 30–31). The stone that stood in stonehole 97 outside the north-east entrance, together with the stones that occupied stoneholes B and C, all presumably sarsens, may also tentatively be assigned to Stage 1. The stone in stonehole 97 sat within a filled linear depression which might have been a solution hollow formed beneath a recumbent sarsen (Pitts 1982, 2008b: 15).

Some of the pits, postholes and stakeholes within the earthwork enclosure no doubt also belong to Stage 1, and many stratigraphically pre-date stone settings. The only independent scientific dating evidence for this activity is a *terminus post quem, 2580*–2450 *cal BC* (*93% probability*; *OxA-V-2232-51*: Marshall *et al.* 2012: fig. 22) for the infilling of posthole 1884. Tentatively assigned to this stage are five groups of postholes, although others undoubtedly existed in areas as yet unexcavated, or were destroyed without record by antiquarian digging. The southernmost group forms a passageway leading from the south entrance through the earthwork enclosure through a façade of posts towards the centre of the site (*Structure 1* on Figure 3). The spatial patterning of postholes in the centre is suggestive not of a circular structure, as might be expected, but a series of separate structures of which three appear to be rectangular in shape. *Structure 2*, north-east of the passageway, has a stonehole near the centre. There are other single stoneholes to the west and north-west. A sixth structure in the north-eastern entrance comprises a rectangular arrangement of more than 50 posts, the ends of which have been truncated to the east by later modifications to the main earthwork ditch (Cleal *et al.* 1995: fig. 68) in Stage 2 (see below). Parallel to the axis of this structure, some 20m further out to the north-east, is a line of four postholes at intervals of 2m. The stones that once occupied stoneholes 97, B, and C, already mentioned, may also be part of this structure. Recent intensive survey of the site has revealed two features that could belong to this stage or even earlier but are too uncertain to be included. These are a *low mound*, measuring about 16 × 14m and *c.* 0.4m high (although this may be a spoil heap), and the so-called *north barrow* (Field *et al.* 2010: 34–35).

Over the four centuries included in Stage 1, a great deal happened and arrangements were episodically changed. Not all the structural elements should be seen as having existed contemporaneously. Indeed, all of the postulated timber structures would have had but fleeting existences in the unfolding sequence of activities. Some of the Aubrey holes had

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cremations inserted into their upper fills perhaps after the removal of stones or posts. Culturally, these activities are associated with the users of Grooved Ware pottery. The ring of about 25 monoliths popularly known as 'Bluestonehenge' beside the River Avon at West Amesbury was probably constructed during this stage although a robust date for its construction has not yet been obtained (Parker Pearson *et al.* 2010).

Stage 2 (*2760–2510 cal BC* to *2470–2300 cal BC*; Late Neolithic)

This relatively short stage was probably the most significant in the overall history of Stonehenge, as the site was transformed from something fairly commonplace to a structure quite unique in the ancient world. Something of the complexity of the changes made can be seen from the fact that the available evidence allows at least two equally likely scenarios to the way events unfolded (Figures 4 and 5).

The earliest stone structure in the centre of the site comprised the five sarsen trilithons (each a pair of uprights joined at the top by a lintel), arranged in a horseshoe plan open to the north-east and usually referred to as the *trilithon horseshoe*. The axis of this setting has a solstitial alignment marked to the north-east by the rising midsummer sun and to the south-west by the setting midwinter sun. This became Stonehenge's principal axis. Although the summer solstice nowadays attracts most attention, the arrangement of the trilithon horseshoe strongly suggests that its principal focus was the midwinter solstice. The estimate for the construction of this structure is derived from a single antler pick (OxA-4840) in the socket for stones 53/54 of *2585–2400 cal BC* (*93% probability*: *Last sarsen trilithons*: Marshall *et al.* 2012: fig. 22); two other samples once believed to date the construction of the great trilithon (stones 55/56) cannot now be accepted (Parker Pearson *et al.* 2007: 626).

Outside the trilithon horseshoe, the *double bluestone circle* was created, marked by the *Q* and *R* holes. The axis of this arrangement is the same as the trilithon horseshoe, with an entrance passage on the north-east side (Cleal *et al.* 1995: figs. 81 and 82). Around the east side of the double bluestone circle, the bluestones were set within dumbbell-shaped sockets as radially set, paired stones. *Q* hole 13 was examined in 2008 (Darvill & Wainwright 2009: 12) but found to have been heavily disturbed by later cuts. On the south and west sides, only a single line of stoneholes was detected by Atkinson, leading him to suggest that the structure was perhaps never completed (1979: 204). It is possible that some of the *Q* and *R* holes on these sides were eroded away by later activities (Darvill's preference). Alternatively, there was never more than a single circuit in this area (Parker Pearson's preference).

Some or all of the *Q* and *R* holes might once have held the bluestone pillars formerly standing in the Aubrey holes and moved into the centre of the monument in Stage 2. It is further assumed that the bluestones used for the double bluestone circle were later reused in Stage 4 to form the structures known as the *bluestone oval* and the *outer bluestone circle*. This could explain why at least three of the bluestones at Stonehenge are topped with tenon projections, why two have pairs of mortise holes (and were therefore formerly lintels), and why two have tongue-and-groove joining. From the positions of the two bluestone lintels in later arrangements, they may have been used to frame entrances into the double bluestone circle on the north-east and south sides, echoing the two entrances through the enclosure ditch. How many of the other bluestones in the double bluestone circle were dressed is not

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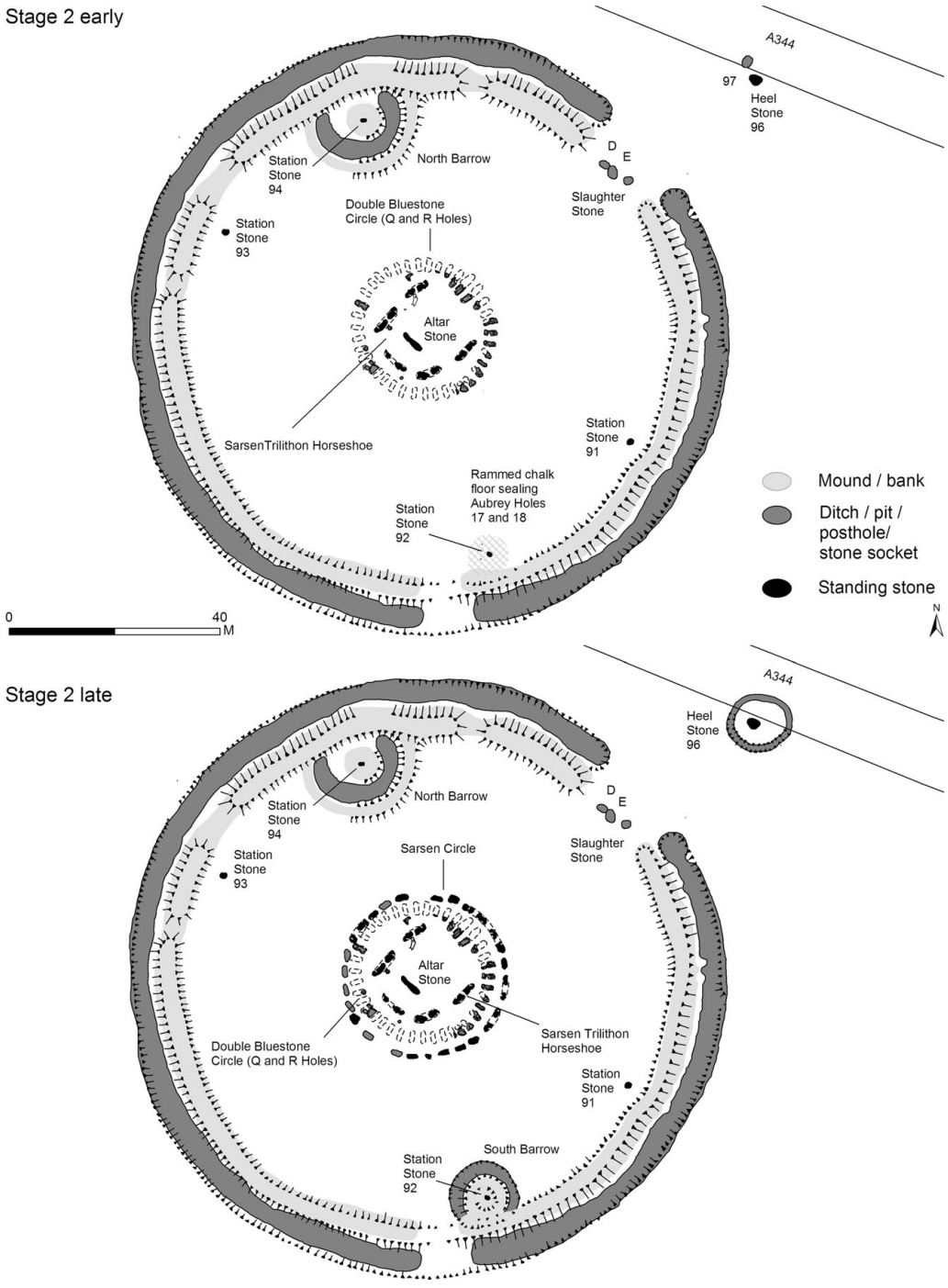

*Figure 4. Summary plan showing the main components of Stonehenge attributed to Stage 2 (*2760–2510 cal BC *to* 2470–2300 cal BC*) arranged as early and late sub-stages in Scenario 1.*

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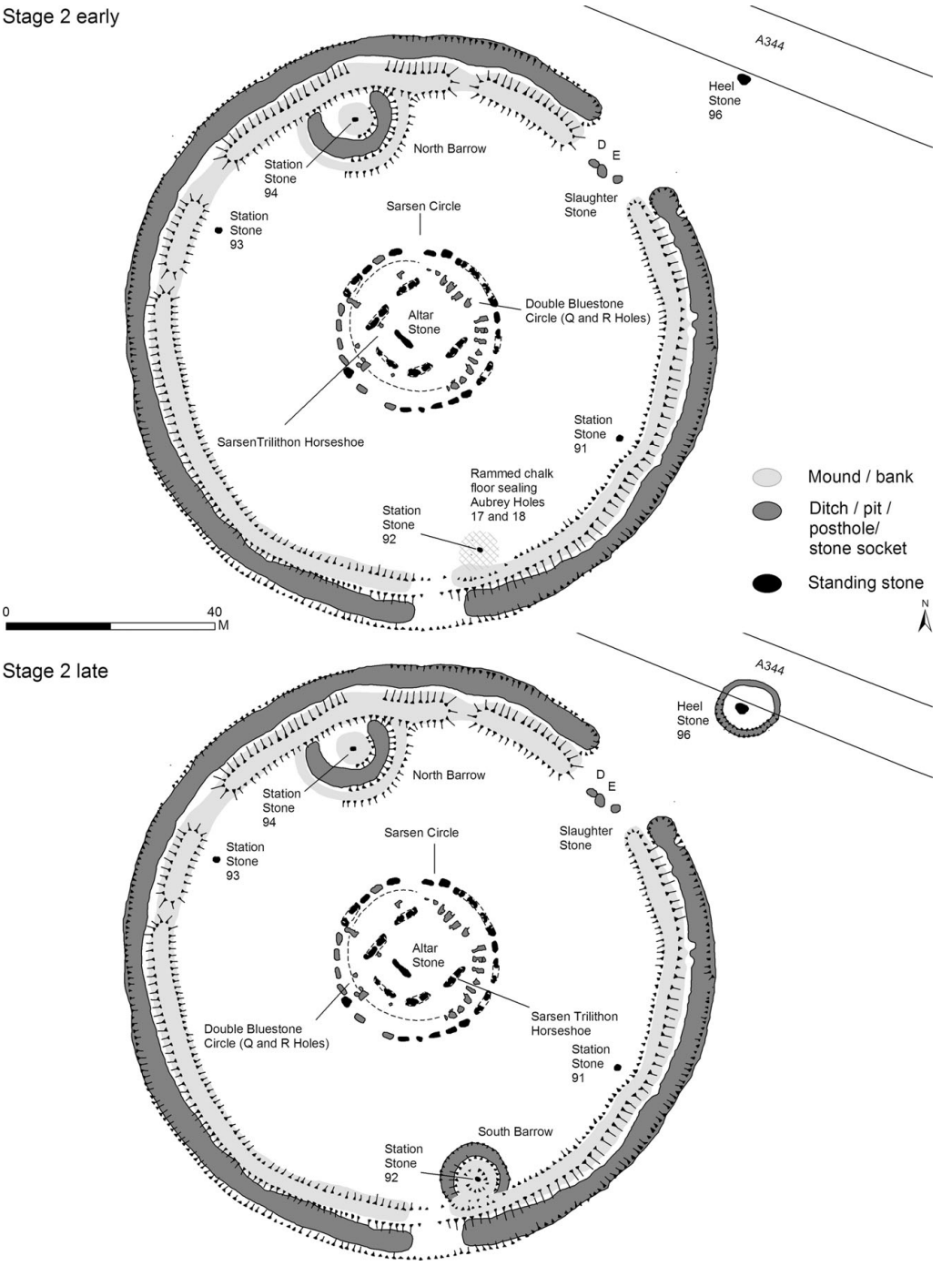

*Figure 5. Summary plan showing the main components of Stonehenge attributed to Stage 2 (*2760–2510 cal BC *to* 2470–2300 cal BC*) arranged as early and late sub-stages in Scenario 2.*

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known. There are no dated samples associated with the construction of the double bluestone circle, although a sample from the backfill of an unidentified *Q* hole provides a *terminus post quem* for its slighting in Stage 3 of *2465–2220 cal BC* (*OxA-4901*: Marshall *et al.* 2012: fig. 22), suggesting that it was built in Stage 2.

Outside the double bluestone circle was the *sarsen circle*, also set up in Stage 2. It is likely that the sarsen circle originally comprised 30 dressed sarsen uprights linked at the top with 30 lintels with an overall external diameter of *c.* 29.6m. The construction of this component is complicated and has long been recognised as utilising techniques commonly seen in timber buildings (Atkinson 1979: 177). All the visible pillars and lintels in the sarsen circle were dressed, an activity that seems to have taken place outside the earthwork enclosure to the north. The gap between stones 1 and 30 (north-east) is slightly larger than elsewhere in the preserved sections of the sarsen circle, presumably to respect the principal axis and north-eastern entrance, while stone 11 (south) is narrower and shorter than the others perhaps to somehow mark the southern entrance (or it may even have been a later replacement). Five of the uprights on the south-west side (stones 13, 17, 18, 20 and 24) are missing, together with 24 of the lintels, which has led to suggestions that the sarsen circle was never completed (Ashbee 1998). More likely, however, is that stones were robbed in historical times since, in the case of stones 13 and 20, there is evidence of their original sockets (Cleal *et al.* 1995: plan 2). The best estimate for the date of construction of the sarsen circle, from an antler pick (UB-3821) in the socket around stone 1 is *2580–2475 cal BC* (*Last sarsen circle*: fig. 22: Marshall *et al.* 2012).

On purely practical grounds it seems likely that the sarsen circle was built after the construction of the trilithon horseshoe. How exactly the sequence of events within Stage 2 unfolded is more difficult and two possible scenarios are presented here. In the first (Figure 4), the trilithon horseshoe is initially surrounded by the double bluestone circle and then years, decades, or centuries, later the sarsen circle is added. Alternatively (Figure 5), the trilithon horseshoe, the double bluestone circle and the sarsen circle might have been erected in relatively rapid succession. The *Altar stone*, a former standing stone lying prone, is traditionally associated with the trilithon horseshoe because of its position and is therefore tentatively included in the Stage 2 structure though it could date to any point before the collapse of the great trilithon on top of it. The great trilithon collapsed after the building of the Stage 4 bluestone oval (*2205–1925 cal BC*: *Last bluestone horseshoe*: Marshall *et al.* 2012: fig. 22) but before the earliest plans were made of Stonehenge in the seventeenth century AD. Thus the Altar stone could have been laid in its current position at any point between the Neolithic and the early modern era.

Other components that can tentatively be attributed to Stage 2 include the four *Station stones*, of which only two now survive (stones 91 and 93), positioned just inside the enclosure bank to form a rectangle with astronomical sightlines (Ruggles 1997: 219–20). Their north-east/south-west solstitial axis is the same as that of the sarsen circle, double bluestone circle and trilithon horseshoe: towards the midsummer sunrise to the north-east and the midwinter sunset to the south-west. Their north-west/south-east axis is aligned approximately on the major southern moonrise (full in summer) and the major northern moonset (full in winter). Stone 94 forming the north-west corner of the rectangle was placed within the existing north barrow. Stone 92 diagonally opposite stood in the centre of the packed chalk floor sealing

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Aubrey holes 17 and 18, interpreted as the remains of a D-shaped non-domestic building (Parker Pearson *et al.* 2009: 33–34). Whether stone 92 was inserted into the floor, or the floor was built around a pre-existing stone is unclear from the excavated evidence (Parker Pearson *et al.* 2009: 33–34). By the later part of Stage 2, stone 92 lay within what is called the *south barrow*: a low mound surrounded by a shallow ditch tight against the inside edge of the enclosure earthwork.

The arrangement of stones around the north-east entrance changed during Stage 2. The stones in sockets B and C (see Stage 1) were removed and perhaps reused. Stone 96 (the *Heel stone*) was set up 2m south-east of stonehole 97. One interpretation (Darvill's preference) is that these two stones formed a pair of monoliths straddling the principal axis and physically marking the sightline from the centre of the monument to the position of the midsummer rising sun on the north-eastern horizon (Pitts 1982, 2000: 149–50). Within this interpretation, the Heel stone's encircling ditch was dug late in Stage 2 or perhaps early in Stage 3 when stone 97 was removed (Figure 4). An alternative interpretation (Parker Pearson's preference) is that the Heel stone is the monolith originally standing in stonehole 97, later being transferred to its present location (Pitts 2008b: 15) and surrounded by a ditch late in Stage 2 (Figure 5). Stones D, E and 95 (the *Slaughter stone*) were set up to provide a short façade in the north-eastern entrance through the earthwork enclosure which was itself perhaps modified slightly by removing some of the bank and levelling the ditch on the east side in order to provide a more symmetrical gap either side of the principal axis (Cleal *et al.* 1995: 139). Two antler picks dated from stonehole E (OxA-4837 and OxA-4877) provide an estimate for its erection of *2470–2275 cal BC* (*90% probability*: *Last stonehole E*: fig. 22: Marshall *et al.* 2012).

Culturally, Stage 2 is associated with the users of Grooved Ware and took place broadly contemporaneously with the construction and use of Woodhenge, three timber monuments south of Woodhenge, and the southern and northern timber circles and the houses and settlement at Durrington Walls (Parker Pearson *et al.* 2007).

Stage 3 (*2405–2225 cal BC* to *2300–2100 cal BC*; Chalcolithic)

During the two centuries or so represented by Stage 3, Stonehenge was in a period of transition (Figure 6). The stone circle at West Amesbury known as *Bluestonehenge* was dismantled and a classic henge with bank and internal ditch about 35m in diameter was constructed there around the area in which the circle had previously stood. It is possible, but unproven, that the 25 or so pillars (interpreted as bluestones on the basis of their imprints) were taken to Stonehenge for use in Stage 3. The positioning of an arc of five stoneholes (WA3285, 3286, 3700, 3702 and 3402) imply a *central bluestone circle* (Phase 3iii in Cleal *et al.* 1995: 206–209, fig. 109), which has the appropriate radius and spacing for a circle transplanted from Bluestonehenge beside the Avon (see above). This arc was cut by a very large pit of unknown purpose immediately west of stone 56 (pit WA2448; Parker Pearson *et al.* 2007: 618–26), which also partly cuts the line of the double bluestone circle. Pieces of antler from this pit's fill (OxA-4839: and BM-46) provide an estimate for the digging of the pit of *2410–2005 cal BC* (*Last pit WA 2448:* Marshall *et al.* 2012: fig. 22).

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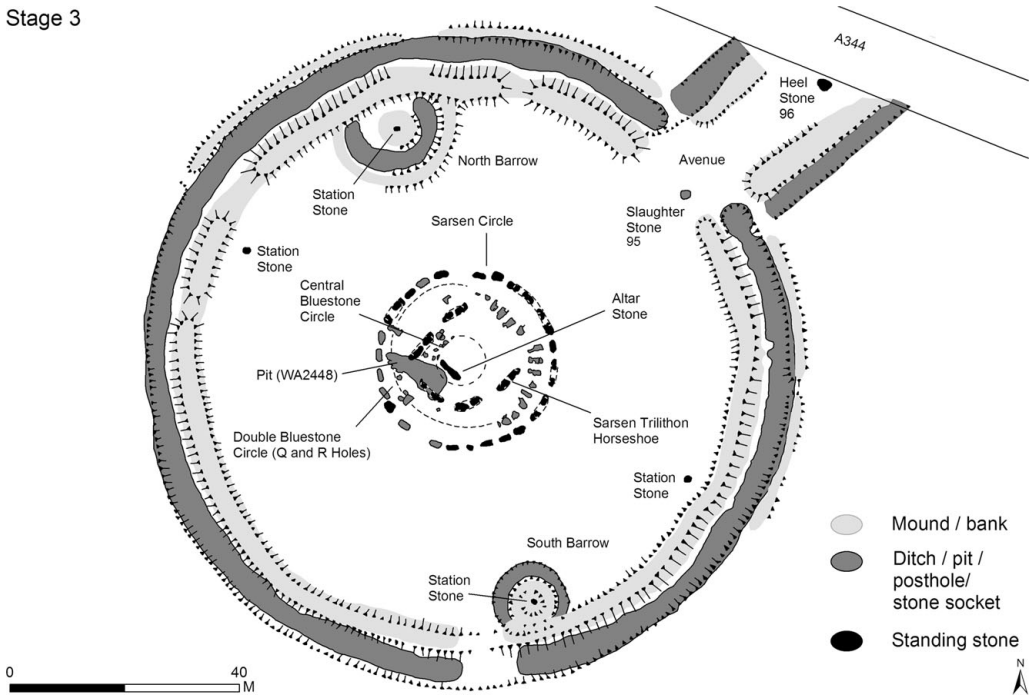

*Figure 6. Summary plan showing the main components of Stonehenge in Stage 3 (*2405–2225 cal BC *to* 2300–2100 cal BC*).*

In the north-east entrance, there were further changes to the arrangement of stones with the removal of the stones within sockets D and E to leave only stones 95 (Slaughter stone) and 96 (Heel stone) standing. The ditch of the earthwork enclosure was wholly or partly re-cut during Stage 3, perhaps providing the spoil for the counterscarp bank on the outside perimeter, as well as enhancing the main internal bank. Modelling of the ditch sequence provides a *terminus post quem* for the re-cut of *2450–2230 cal BC (Last re-cut*: Marshall *et al.* 2012: fig. 13).

Later in Stage 3, after the ditch around stone 96 had substantially silted up, the Stonehenge Avenue was built. This earthwork-defined ceremonial way led from immediately outside the north-eastern entrance to Stonehenge to the River Avon at West Amesbury *c*. 2.5km distant. The first 530m of the Avenue leading out of Stonehenge is straight and follows the line of the principal axis north-eastwards, but in Stonehenge Bottom it curves eastwards and then southwards to join the Avon where, by this time, the earthworks around Bluestonehenge would have provided a riverside focus. Dating the Avenue is difficult: there is evidence for re-cutting of its two parallel boundary ditches in later times, and it may possibly have been constructed in more than one episode. Modelling of the available dates suggests the Avenue ditch was initially constructed in *2430–2200 cal BC (Last construction*: Marshall *et al.* 2012: fig. 16).

Cremation burials probably ceased to be deposited at Stonehenge during Stage 3, but there is some evidence for inhumation. The burial of an adult male in a shallow grave cut

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into the upper fill of the enclosure ditch on the north-west side took place in *2340–2195 cal BC* (*Beaker burial*: Marshall *et al.* 2012: fig. 13). Three barbed-and-tanged arrowheads embedded in the body were undoubtedly the cause of death while a stone bracer on the wrist demonstrates that the man was himself an archer. A lost inhumation burial, straddling the principal axis in the central part of the site, may also date from this period (Cleal *et al.* 1995: 265) but could equally derive from later millennia (cf. Pitts *et al.* 2002).

Culturally, some at least of the changes during Stage 3 may be associated with people who used Beaker pottery. As well as the distinctive Beaker-style burial in the ditch already referred to, more than 200 sherds of Beaker pottery have been recorded at the site but only rarely in stratified contexts. Small sherds from the refills of *Q* holes 5 and 13 appear to be in context, but sherds loosely recorded from around stones 3 and 53 or 54 (Cleal *et al.* 1995: 354) may relate to re-cutting of earlier features. In the wider landscape there is also evidence for a strong Beaker presence, with the burial of the Amesbury Archer, the most richly furnished Beaker burial in north-west Europe (Fitzpatrick 2011), dated to *2380–2290 cal BC* (*95% probability: OxA-13541*: Barclay *et al.* 2011: fig. 58) and the Boscombe Bowmen dated to *2340–2200 cal BC* (*OxA-13624*: Barclay *et al.* 2011: fig. 58). Modelling provides an estimate for the first dated Beaker burial in Wessex of *2440–2380 cal BC* (Marshall in press). The henge ditches around Durrington Walls (*2480–2450 cal BC*: Marshall *et al.* in press) and Woodhenge (*2480–2030 cal BC*: BM-677: Marshall *et al.* in press) were dug in this period.

Stage 4 (*2210–2030 cal BC* to *2160–1925 cal BC*; Early Bronze Age)

The two centuries of Stage 4 witnessed the last major reorganisation of stones at Stonehenge as the bluestones were rearranged to form two new components (Figure 7). Inside the sarsen circle, the double bluestone circle was dismantled. A single dated sample from the fill of an unknown *Q* hole deposited after its stone had been removed provides a *terminus post quem* of *2465–2220 cal BC* (*OxA-4901*: fig. 22: Marshall *et al.* 2012)

Within the trilithon horseshoe, the central bluestone circle was dismantled and about 24 bluestones were arranged in an oval setting. Stones 67 and 68 of this *bluestone oval* were cut into the fill of the large pit WA 2448 adjacent to the great trilithon previously discussed and therefore date to the period after *2410–2005 cal BC* (*Last pit WA 2448:* Marshall *et al.* 2012: fig. 22; cf. Atkinson 1979: 56). This fits comfortably with the estimated date for the bluestone oval of *2205–1920 cal BC* (*Last bluestone horseshoe*: Marshall *et al.* 2012: fig. 22).

A second setting, the *outer bluestone circle*, comprising between 40 and 60 fairly close-set pillars was constructed in the gap between the trilithon horseshoe and the sarsen circle, effectively sub-dividing that space into two concentric corridors. Some of the stones of the bluestone circle cut into the refilled pits of the earlier double bluestone circle. Stone 41, most of which is now missing, probably cut the fill of pit WA 2448 and thus has the same stratigraphic relationship as the bluestone oval. Dates derived from antler (OxA-4900) and animal bone (OxA-4878) from the fill of the socket for stone 40c provide an estimate for its completion of *2275–2030 cal BC* (*Last bluestone circle*: Marshall *et al.* 2012: fig. 22).

It is assumed that the 80 or so stones used to construct the bluestone oval and the bluestone circle represent the reuse of bluestones from earlier structures at or near Stonehenge.

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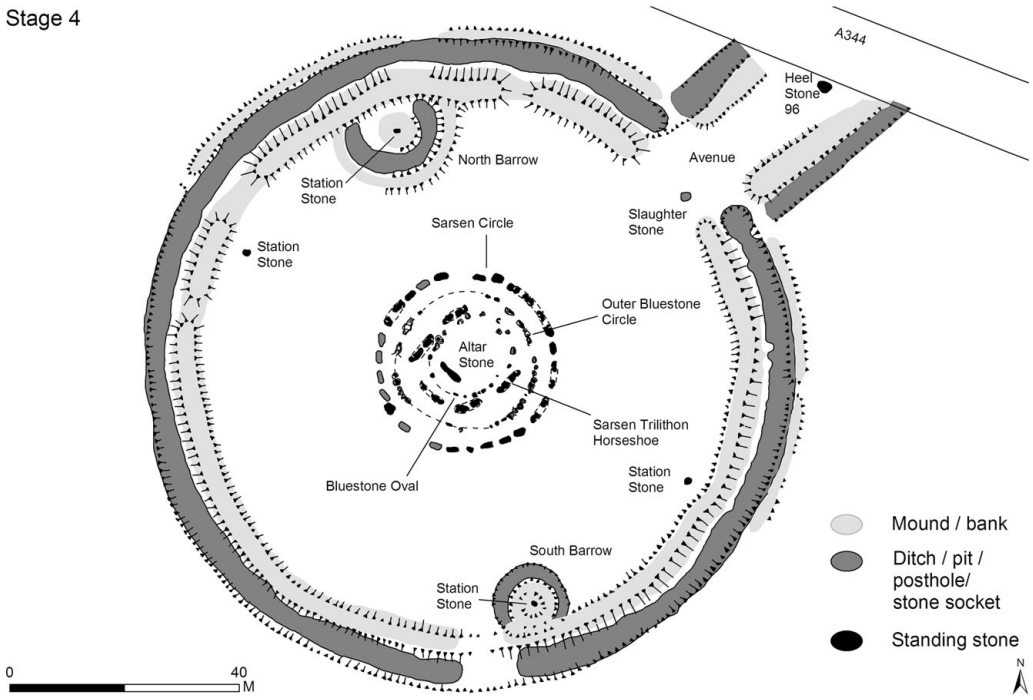

*Figure 7. Summary plan showing the main components of Stonehenge in Stage 4 (*2210–2030 cal BC *to* 2160–1925 cal BC*).*

Certainly, these two sources would provide about the right number of stones, although the possibility of further material derived directly from west Wales cannot be ruled out. Only 43 of them survive on the site as stones or stumps. Some pieces of bluestone were worked on site into tools of various kinds, as indicated by discarded rough-outs. Other bluestones were broken up much later, during Roman times and perhaps after (Darvill & Wainwright 2009). Indeed, it seems highly likely that removal of at least seven pillars at the northern end of the bluestone oval, to create a bluestone horseshoe (Atkinson 1979: 80–82; Cleal *et al.* 1995: 231), was actually carried out in the Roman period. Culturally, users of Beaker pottery were responsible for the activities represented in Stage 4.

Stage 5 (*2010–1745 cal BC* to *1620–1450 cal BC*; Early–Middle Bronze Age)

In the centuries following *2010–1745 cal BC (First first_stage_5*: Figure 2*)* Stonehenge continued to be used, new features added and details changed (Figure 8). More than 150 sherds of Late Beaker, Food Vessel and Collared Urn style pottery attest these activities (Cleal *et al.* 1995: 365–66). The carvings of Arreton-Down-tradition bronze axes and daggers on stones in the sarsen circle and the trilithon horseshoe can be attributed to Stage 5 on the basis of independent dating of these Wessex II metalworking traditions to the period 1750–1500 cal BC (Needham *et al.* 2010: tab. 1). Bluestones and, to a lesser extent, sarsens were being broken up during Stage 5 as clearly shown by the debris associated with a working floor and small structure just outside the earthwork enclosure west of the Heel stone.

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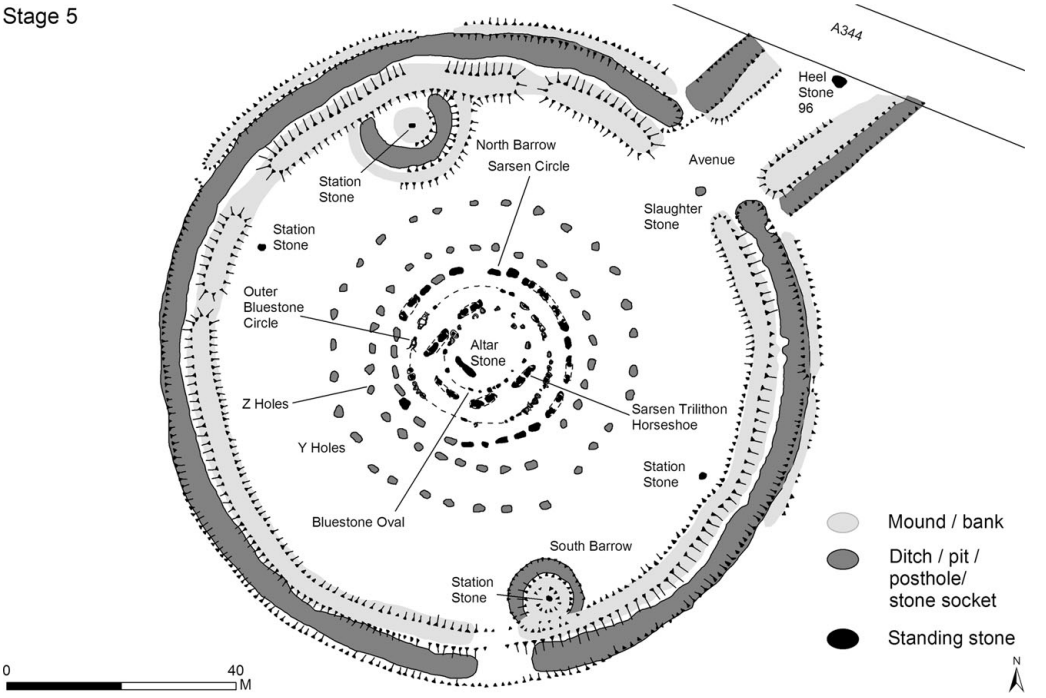

*Figure 8. Summary plan showing the main components of Stonehenge in Stage 5 (*2020–1745 cal BC *to* 1620–1450 cal BC*).*

The last main structural alteration at Stonehenge itself in prehistoric times occurred during the Middle Bronze Age when the two concentric circles of pits, known as the *Y and Z holes* were dug outside the sarsen circle. It seems they were left open and became filled with windblown sediments, most likely blown in from cultivated areas in the vicinity, although we cannot rule out the possibility that some or all of the *Y* and *Z* holes actually held small standing stones that, on their removal, left hollows to fill with windblown sediments. Low ridges recently identified outside each pit-ring may be either hedge lines or the remains of spoil heaps created when they were first dug (Field *et al.* 2010: 34).

In the environs beyond Stonehenge, the development and use of extensive round barrow cemeteries within the surrounding landscape dominated activity through the early part of this stage.

Conclusions

The remodelled chronology of the Stonehenge presented here provides a new interpretation of this iconic monument's complex constructional sequence. Over 15 centuries, the site went through many structural changes in what could be seen as a long-term process of alteration, punctuated by major episodes of construction. Stonehenge was a monument first created

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in the middle Neolithic period, whose power and influence was continually revived—most recently in modern times.

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