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Radiocarbon Dating of Carbonised Plant Macrofossils

Woodcutts, Iwerne, Rotherley, Durrington Walls, Cuckoo Stone, Coneybury Henge, Lockington, Thanet Earth and Hunsbury Hillfort

Peter Marshall, Ruth Pelling, Christopher Bronk Ramsey, Elaine Dunbar, Irka Hajdas, Sanne Palstra and Paula Reimer

Investigative Science Team

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Summary

This document is a technical archive report on the radiocarbon dating of carbonised plant macrofossils in support of research undertaken by the Historic England Environmental Studies branch. It includes full details of 32 radiocarbon measurements obtained from Woodcutts, Iwerne, Rotherley, Durrington Walls, Cuckoo Stone, Coneybury Henge, Lockington, Thanet Earth and Hunsbury Hillfort.

Contributors

Peter Marshall, Ruth Pelling, Christopher Bronk Ramsey, Elaine Dunbar, Irka Hajdas, Sanne Palstra and Paula Reimer.

Acknowledgements

We would like to thank Wendy Carruthers, Angela Monkton and Ellen Simmons, for providing material for dating. The front cover photo shows a box of charred grain from Rotherley pit 43 without its lid from the Pitt Rivers collection held at Salisbury Museum and was taken at Fort Cumberland by Steven Baker (Historic England) on the 23 January 2017.

Archive location

Historic England, The Engine House, Fire Fly Avenue, Swindon, SN2 2EH.

Historic environment records

Wiltshire Archaeology Service, The Wiltshire and Swindon History Centre, Cocklebury Road, Chippenham, SN15 3QN.

Northamptonshire Record Office, Wootton Hall Park, Mereway, Northampton, Northamptonshire, NN4 8BQ.

Heritage Conservation, Kent County Council, Invicta House, County Hall, Maidstone, Kent, ME14 1XX.

Historic & Natural Environment Team, Leicestershire County Council, Room 200, County Hall, Glenfield, Leicestershire, LE3 8RA.

Date of research

2013–2023

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Introduction

This document is a technical archive report on the radiocarbon dating of 32 carbonised plant macrofossils from Woodcutts, Iwerne, Rotherley, and Hunsbury Hillfort (all from historic archives), Durrington Walls, Cuckoo Stone, Coneybury henge, Lockington, and Thanet Earth (Fig. 1), in support of research undertaken by the Historic England Environmental Studies team. It is beyond the scope of this document to detail the significance or otherwise of the results, however, elements of this report may be combined with further information in the future as part of comprehensive publications.

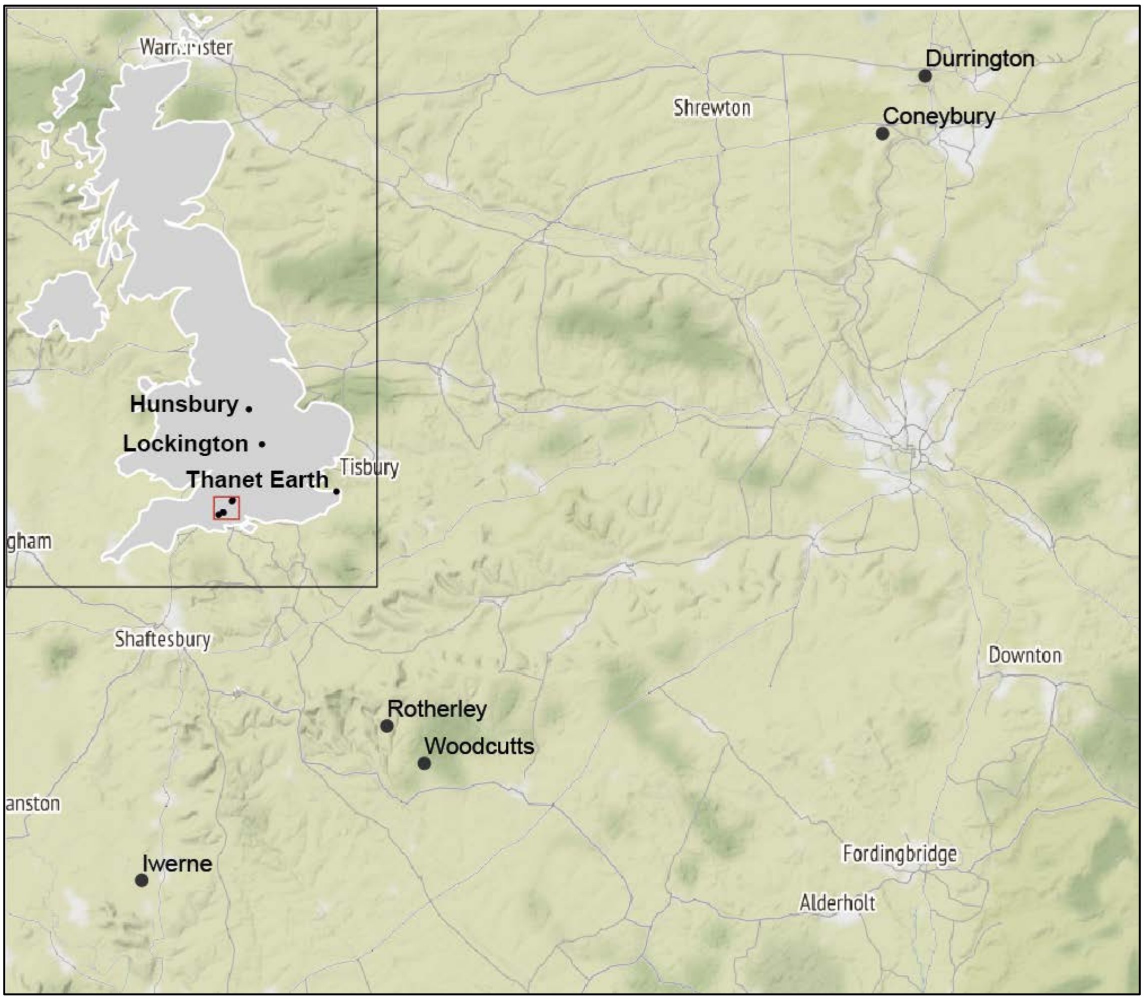

Figure 1: Sites with radiocarbon dated carbonised plant macrofossils

Radiocarbon dating

Laboratory methods

Radiocarbon measurements were made on a total of 32 plant macrofossils at the Oxford Radiocarbon Accelerator Unit (ORAU), Scottish Universities Environmental Research Centre (SUERC) ^{14}CHRON centre, The Queen's University Belfast, Centre for Isotope Research, University of Groningen (CIO) and Laboratory of Ion Beam Physics, ETH Zürich.

The eight samples submitted to the ORAU were pre-treated following methods outlined in Brock et al. (2010), graphitised (Dee and Bronk Ramsey 2000) and dated by Accelerator Mass Spectrometry (AMS) (Bronk Ramsey et al. 2004).

The 10 samples dated at The Queen's University Belfast were processed using an acid wash (Reimer et al. 2015). The pre-treated and dried samples were placed in quartz tubes with a strip of silver ribbon to remove nitrates, chlorides, and CuO. The samples were then sealed under vacuum and combusted to CO_2 overnight at 850°C. The CO_2 was converted to graphite on an iron catalyst using the zinc reduction method (Vogel et al. 1984). The graphite samples were analysed with a 0.5MeV NEC pelletron compact accelerator, with the $^{14}C/^{12}C$ ratios corrected for fractionation using the on-line measured $^{13}C/^{12}C$ ratio and in accordance with Stuiver and Polach (1977).

The seven samples dated at SUERC were pre-treated and dated by AMS as described by Dunbar et al. (2016).

Three samples were dated at CIO. They were pre-treated using an acid-base-acid protocol (4% HCl, 1% NaOH, <1% HCl) and combusted in an elemental analyser (IsotopeCube NCS), coupled to an Isotope Ratio Mass Spectrometer (Isoprime 100) (Dee et al. 2019). The resultant CO_2 was graphitised by hydrogen reduction in the presence of an iron catalyst. The graphite was then pressed into aluminium cathodes and dated by AMS (Synal et al. 2007; Salehpour et al. 2016).

Four samples were dated at ETH Zürich. They were pre-treated using the acid-base-acid protocol described by Hajdas (2008), combusted and graphitised as outlined in Wacker et al. (2010a), and dated by AMS (Synal et al. 2007; Wacker et al. 2010b).

Data reduction at the CIO and ETH Zürich was undertaken as described by Wacker et al. (2010c).

All five facilities maintain continual programmes of quality assurance procedures, in addition to participation in international inter-comparison exercises (Scott et al. 2017). Details of quality assurance data and error calculation at Groningen are provided by Aerts-Bijma et al. (2021), and similar details for ETH are provided in Sookdeo et al. (2020).

Calibration

Radiocarbon dating is based on the radioactive decay of ^{14}C, which trees absorb from the atmosphere during photosynthesis and store in their growth-rings. The radiocarbon from each year is stored in a separate annual ring. Once a ring has formed, no more ^{14}C is added to it, and so the proportion of ^{14}C versus other carbon isotopes reduces in the ring through time as the radiocarbon decays. Radiocarbon ages, like those in Tables 1–7, measure the proportion of ^{14}C in a sample and are expressed in radiocarbon years BP (before present, ‘present’ being a constant, conventional date of AD 1950).

Radiocarbon ages are not the same as calendar dates because the concentration of ^{14}C in the atmosphere has fluctuated over time. A radiocarbon measurement has thus to be calibrated against an independent scale to arrive at the corresponding calendar date. That independent scale is the IntCal20 calibration curve (Reimer et al. 2020). For the period covered by the samples dated in this report, this is constructed from radiocarbon measurements on tree-ring samples dated absolutely by dendrochronology. The probability distributions of the calibrated radiocarbon dates derived from the probability method (Stuiver and Reimer 1993) using the program OxCal v4.4 (http://c14.arch.ox.ac.uk/oxcal.html; Bronk Ramsey 1995; 2001; 2009). are shown in Figures 2–8. The date ranges given in Tables 1–7 have been calculated using the probability method (Stuiver and Reimer 1993), and are quoted in the form recommended by Mook (1986); rounded outwards to 10 years if the error is >25 years and five years if the error is <25 years.

Results

Pitt Rivers archive

Known as the 'father of modern scientific archaeology', General Pitt Rivers spent the last twenty years of his life (from 1880–1900) excavating sites on his estate on Cranborne Chase. The collection of artefacts found during this period was given to the Salisbury and Wiltshire Museum in 1975 by HM Treasury in lieu of death duty (https://collections.salisburymuseum.org.uk/ Pitt Rivers Collection). Among the collection was a series of small boxes containing charred cereal remains, still retaining their original labels, as well as a selection of charcoal, some of which have been on display in Salisbury Museum for some years, although none of the material had previously been examined using modern criteria. The charcoal from two sites has been re-examined by Hazell and Campbell (2019a, 2019b).

Charred grain from three of the site archives held by the museum were examined by Pelling (in prep), and radiocarbon dated in 2017.

Woodcutts

The Iron Age and Romano-British settlement on Woodcutts Common, associated with tracks and 'Celtic' fields, covers about four acres, and was probably a single farmstead. It was excavated by General Pitt Rivers in 1884–5 (Pitt Rivers 1887). Two boxes of charred cereal grain were labelled “grains of corn”, both from pit 43. A total of 536 grain were counted from the two samples. The assemblage was remarkably well preserved and consisted predominantly of *Triticum spelta* (spelt wheat), with a few grains of *Hordeum vulgare* (barley).

Two charred *Triticum spelta* grains were radiocarbon dated from a sample labelled “pit 43, depth 2 feet” (Table 1; Fig. 2). The two radiocarbon determinations are statistically consistent at the 5% significance level (T’=2.8; v=1; T’(5%)=3.8; Ward and Wilson 1978) and could therefore be of the same age.

Iwerne

The Iron Age settlement and Roman villa near Park House Farm Buildings, were excavated in 1897 by General Pitt Rivers, but was not published before his death. Much of the archive was discarded or lost, and details are largely known from an examination of a limited surviving archive by Christopher Hawkes and Stuart Piggott (Hawkes et al. 1947). The Iron Age settlement is characterised by numerous pits and early during the Roman period the settlement was modified by the digging of ditches and sub-rectangular pits. A third century building was speculatively identified as a possible aisled barn. A fourth century building of flint rubble walls, with one room lined with painted wall plaster, was occupied from *c* AD 300–360. There is no mention of grain in the publication (ibid). One sample of charred grain in the Salisbury Museum collection had lost its original label but was at some point speculatively recorded as from Iwerne. The box contained 2,348 grain, most of which was *Triticum spelta* (spelt wheat) with occasional *Hordeum vulgare* (barley) and occasional possible *Triticum dicoccum* (emmer) and *Bromus* sp. (brome grass).

Three unprovenanced *Triticum spelta* grains were submitted for radiocarbon dating, one of which failed to produce enough carbon for analysis. The two measurements on the grains that were dated (Table 1; Fig. 2) are statistically inconsistent at the 5% significance level (T'=10.3; v=1; T'(5%)=3.8; Ward and Wilson 1978) and clearly of different ages. The grains are too early to originate from the Roman villa.

Rotherley

The settlement at Rotherley occupies the brow of a hill and prior to excavation was visible as an irregularly circular enclosure formed by a bank and ditch with an entrance opening into an oblong enclosure on the south-east and associated with further banks and ditches and a field system. Excavations by Pitt Rivers from 1885–6, revealed an Iron Age/Romano-British complex of storage pits with one- or two-house foundations, a corn-drying furnace, foundations of a small rectangular building, granaries and working hollows (Pitt Rivers 1888). Seven samples of charred grain were collected from five features or feature groups: pits 43, 55 and 56, a square hut foundation, and from a group of post holes interpreted as a small raised granary (this last sample is presumably composed of mixed material from more than one post hole). Over 3,500 grain were present in total, dominated by *Hordeum vulgare* (barley) with occasional grain of *Triticum spelta* (spelt wheat), possible *Triticum dicoccum* (emmer wheat), *Bromus* sp. (brome grass) and *Avena* (oats).

Four charred cereal grains were radiocarbon dated from Pit 43 (Table 1; Fig. 2), part of the main circle, and Pit 56, labelled "9 foot 7 inches deep". The two measurements on *Hordeum* grains from Pit 43 are statistically consistent at the 5% significance level (T'=1.6; v=1; T'(5%)=3.8; Ward and Wilson 1978) and could therefore be of the same age, while the two measurements on *Hordeum* grains from Pit 56 are statistically inconsistent at the 5% significance level (T'=92.9; v=1; T'(5%)=3.8; Ward and Wilson 1978) and clearly of different ages.

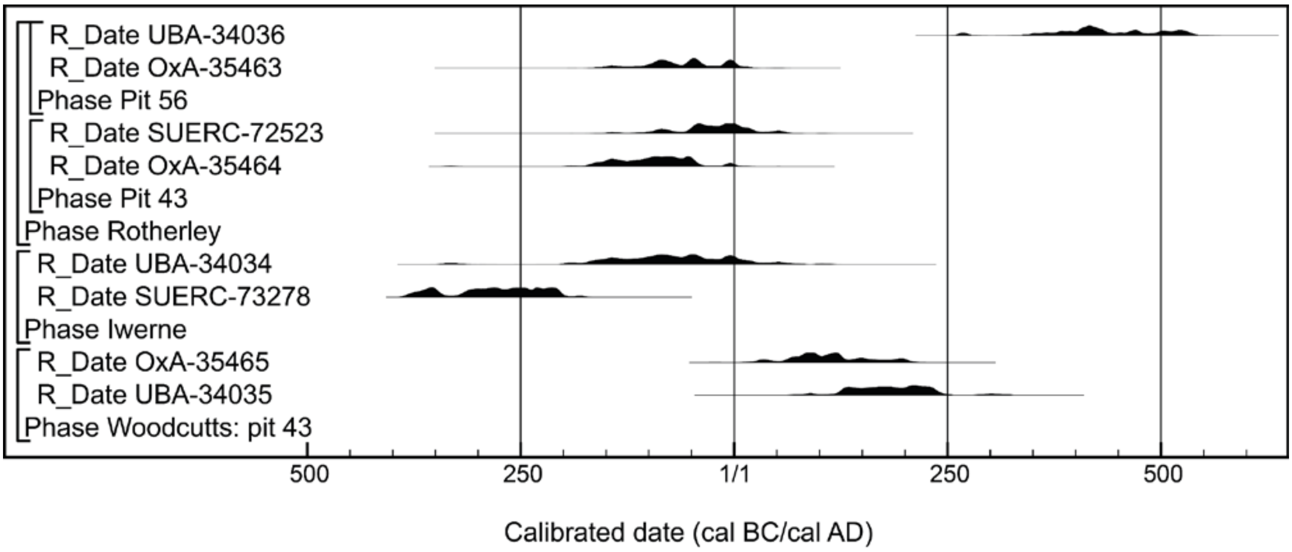

Figure 2: Probability distribution of the dates on carbonised cereal grains from the Pitt Rivers archive (Woodcutts, Iwerne and Rotherley). The distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993)

Table 1: Pitt Rivers archive: Woodcutts, Iwerne, and Rotherley – radiocarbon and stable isotope results

Laboratory number	Sample reference, material, and context	$\delta^{13}C_{IRMS}$ (‰)	Radiocarbon Age (BP)	Calibrated Date (95% probability)
Woodcutts				
UBA-34035	S.WCT.10.1: sample 1 Carbonised grain, *Triticum spelta*, from Pit 43, depth 2 feet	−23.6±0.22	1855±33	cal AD 90–300
OxA-35465	S.WCT.10.1: sample 2 Carbonised grain, *Triticum spelta,* from Pit 43, depth 2 feet	−24.6±0.2	1923±24	cal AD 30–205
Iwerne				
GU43393	S.WCT.10.1: sample 3 Carbonised grain, *Triticum spelta*, unprovenanced	Failed: insufficient carbon		
SUERC-73278	S.WCT.10.1: sample 3b Carbonised grain, *Triticum spelta*, unprovenanced	−23.2±0.2	2225±25	380–200 cal BC
UBA-34034	S.WCT.10.1: sample 4 Carbonised grain, *Triticum spelta*, unprovenanced	−22.3±0.22	2062±44	200 cal BC–cal AD 60

Laboratory number	Sample reference, material, and context	$\delta^{13}C_{IRMS}$ (‰)	Radiocarbon Age (BP)	Calibrated Date (95% probability)
Rotherley				
OxA-35464	S.WCT.10.1: sample 5 Carbonised grain, *Hordeum*, from the bottom of Pit 43, main circle	−24.1±0.2	2082±24	170–5 cal BC
SUERC-72523	S.WCT.10.1: sample 6 Carbonised grain, *Hordeum*, from the bottom of Pit 43, main circle	−24.6±0.2	2034±29	135 cal BC–cal AD 60
UBA-34036	S.WCT.10.1: sample 7 Carbonised grain, *Hordeum*, from Pit 56, 9 foot 7 inches deep	−22.9±0.22	1644±35	cal AD 270–540
OxA-35463	S.WCT.10.1: sample 8 Carbonised grain, *Hordeum*, from Pit 56, 9 foot 7 inches deep	−23.0±0.2	2057±34	150 cal BC–cal AD 15

Neolithic and Bronze Age cereals in the Stonehenge landscape

During the review of published archaeobotanical remains from central and southern England (Carruthers and Hunter Dowse 2019; Pelling and Campbell 2013), it became apparent that contamination (intrusion and residuality) was a notable, recurring theme in many assemblages (Pelling et al. 2015). This problem appears to be most prevalent in periods in which plant assemblages are generally less abundant, particularly the Neolithic and early medieval periods. In addition, it was suspected that some assemblages which had not been directly dated, had been attributed to the wrong phase. The importance of directly dating cereal remains from Late Neolithic and Beaker contexts was highlighted in a review of Neolithic and Bronze Age radiocarbon dates by Stevens and Fuller (2012). In order to investigate the degree of intrusion in Neolithic contexts in southern England, and to address insecure phasing of grain assemblages from the Stonehenge landscape, a series of charred grains were dated from three sites in Wiltshire: Durrington Walls, the Cuckoo Stone, and Coneybury Henge.

Durrington Walls

Durrington Walls is Britain’s largest henge enclosure (17ha), lying 3km northeast of Stonehenge in a dry valley perched above the west bank of the River Avon. Previous excavations (Farrer 1918; Stone et al. 1954; Wainwright and Longworth 1971) demonstrated the considerable quantities of animal bones, Grooved Ware pottery and other occupation debris at this large site, within half an hour's walk of Stonehenge. Excavations in 2004–2007 at the site Walls by the Stonehenge Riverside Project revealed the remains of a large late Neolithic settlement, much of it protected beneath the banks of the henge enclosure (Parker Pearson et al. forth; Parker Pearson 2007; Parker Pearson et al. 2007). An intensive flotation sampling programme produced a modest assemblage of charred plant remains including both wild food plants (*Corylus avellana* (hazel) nutshell, *Malus sylvestris* (crab apple)) and cereal remains (*Triticum dicoccum* grain and glume bases, *Hordeum vulgare* grain) (Simmons forth).

Nine charred cereal grains were dated from three contexts excavated as part of the Stonehenge Riverside Project (Table 2; Fig. 3). All three contexts contain grains of different ages and all are clearly intrusive given the main floruit of activity at the site took place in the middle of the third millennium cal BC (Pelling et al. 2015).

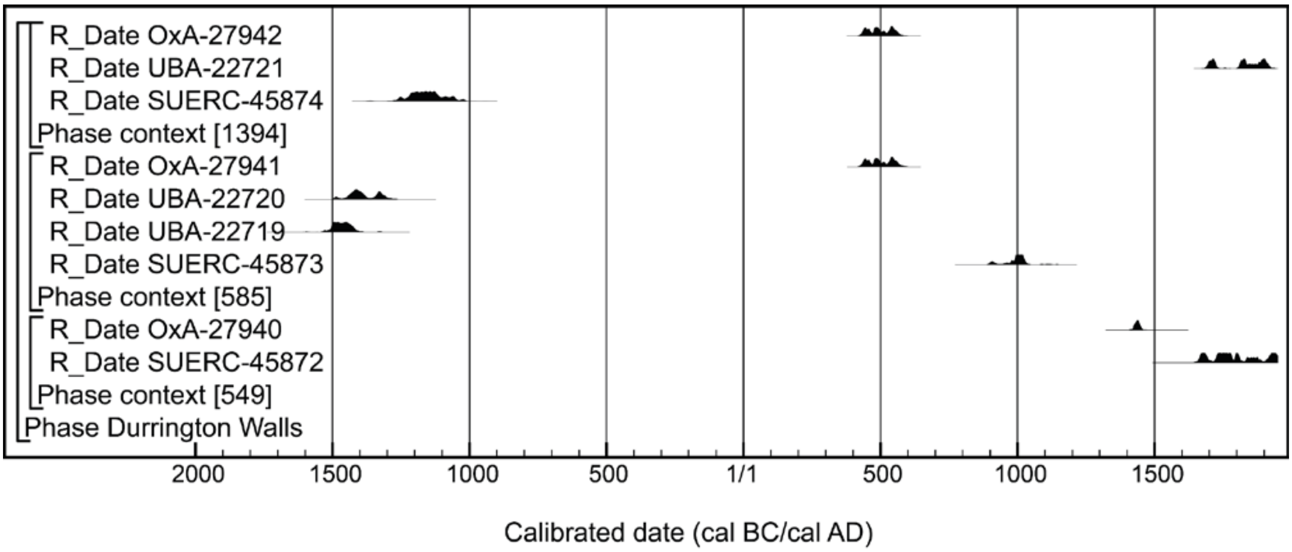

Figure 3: Probability distribution of the dates on carbonised cereal grains from Durrington Walls. The distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993)

Table 2: Durrington Walls radiocarbon and stable isotope results

Laboratory number	**Sample, material, and context**	**$\delta^{13}C_{IRMS}$ (‰)**	**Radiocarbon Age (BP)**	**Calibrated Date (95% probability**
OxA-27940	[549] <10079> sample A Carbonised grain, *Triticum* sp. (free threshing) from [549] the	–21.7±0.2	466±23	cal AD 1419–1456

Laboratory number	Sample, material, and context	$\delta^{13}C_{IRMS}$ (‰)	Radiocarbon Age (BP)	Calibrated Date (95% probability
	fill of a very shallow pit [538] part of the eastern pit complex.			
SUERC-45872	[549] <10079> sample B Carbonised grain, *Triticum* sp. (free threshing) from [549] the fill of a very shallow pit [538] part of the eastern pit complex.	–22.1±0.2	169±34	cal AD 1650–1950
OxA-27941	[585] <10731> sample A Carbonised grain, *Hordeum* indet. (hulled) from [585] a buried soil that formed over the Avenue.	–23.9±0.2	1558±24	cal AD 430–575
SUERC-45873	[585] <10731> sample B Carbonised grain, *Hordeum* indet. (hulled) from [585] a buried soil that formed over the Avenue.	–26.1±0.2	1045±34	cal AD 900–1110
UBA-22719	[585] <10730> sample C Carbonised grain, *Hordeum* indet. from [585] a buried soil that formed over the Avenue.	–24.6±0.22	3197±36	1530–1400 cal BC
UBA-22720	[585] <10730> sample D Carbonised grain, *Triticum dicoccum* from [585] a buried soil that formed over the Avenue.	–23.8±0.22	3126±33	1490–1290 cal BC
OxA-27942	[1394] <12067> sample A Carbonised grain, *Hordeum* sp. (hulled) from midden deposit [1394] which accumulated over the abandoned House 902 and was sealed beneath the henge bank	–22.6±0.2	1560±24	cal AD 430–575
SUERC-45874	[1394] <12067> sample B Carbonised grain, *Hordeum* sp. (hulled) from midden deposit [1394] which accumulated over the abandoned House 902 and was sealed beneath the henge bank	–23.4±0.2	2949±34	1270–1030 cal BC
UBA-22721	[1394] <12073> sample C Carbonised grain, *Triticum* sp.	–23.6±0.22	78±33	cal AD 1680–1930

Laboratory number	Sample, material, and context	$\delta^{13}C_{IRMS}$ (‰)	Radiocarbon Age (BP)	Calibrated Date (95% probability
	(free threshing) from midden deposit [1394] which accumulated over the abandoned House 902 and was sealed beneath the henge bank			

Cuckoo Stone

The recumbent sarsen stone known as the Cuckoo Stone lies 2.6km northeast of Stonehenge. Two pits, Pit 135 and Pit 180, were excavated as part of the Stonehenge Riverside Project (Parker Pearson et al. 2020). Radiocarbon dates on a cattle scapula shovel (OxA-18940; 4253±28 BP; Parker Pearson et al. 2020, table 7.2) from Pit 135 and articulating red deer bones (SUERC-46473; 4231±27 BP; Parker Pearson et al. 2020, table 7.2) from Pit 180 clearly demonstrate they were dug and infilled in the first quarter of the third millennium and are thus Late Neolithic.

Eleven cereal grains and one glume wheat glume base were recovered from fill (181) of Pit 180 and 11 cereal grains and one probable free-threshing, wheat rachis node from fill (136) of Pit 135 (Simmons 2020). In order to determine whether the cereals were Late Neolithic in date, or intrusive, two grains (*Hordeum* sp. and free-threshing *Triticum* sp.) were dated from each pit (Table 3; Fig. 4). The results clearly indicate that the grains are intrusive and represent material that has 'contaminated' the pit at different times (Simmons 2020, 390).

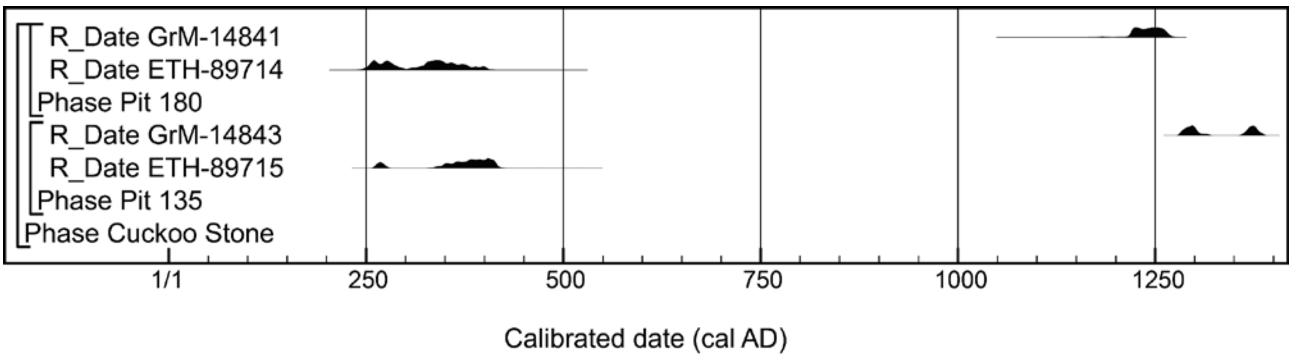

Figure 4: Probability distribution of the dates on carbonised cereal grains from the Cuckoo Stone. The distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993)

Table 3: Cuckoo Stone radiocarbon and stable isotope measurements

Laboratory number	Sample, material, and context	Radiocarbon age (BP)	$\delta^{13}C_{AMS}$ (‰)	$\delta^{13}C_{IRMS}$ (‰)	Calibrated Date (95% probability
ETH-89715	102. Hordeum Carbonised grain, *Hordeum* sp. indet. from the fill (136) of Pit 135	1681±23	−23.0		cal AD 260–420
GrM-14843	102. Triticum Carbonised grain, cf. *Triticum* sp. (free threshing wheat) from the fill (136) of Pit 135	670±20		−23.0±0.15	cal AD 1283–1386
ETH-89714	114. Hordeum Carbonised grain, *Hordeum* sp. indet. from the fill (180) of Pit 181	1732±22	−21.5		cal AD 250–400
GrM-14841	115. Triticum Carbonised grain, cf. *Triticum* sp. (free threshing wheat), from the fill (180) of Pit 181	810±20		−23.0±0.15	cal AD 1209–1269

Coneybury Henge

A henge, surviving as a cropmark and initially recorded as a ploughed-out disc barrow Coneybury Hill, Coneybury Henge was subject to surface collection, geophysical survey and excavation in 1980 as part of the Stonehenge Environs Project (Richards 1990). The whole site slopes gently to the south, and the interior of the enclosure appears to have been cut back into the hillside in order to create a level interior platform. Excavation confirmed that the enclosing ditch, with a single entrance to the north east, had been accompanied by an external bank. Various internal features were excavated, comprising a few pits and post holes, numerous stake holes, and an arc of post holes concentric to the inner edge of the enclosure ditch which may have represented a post-circle. Some of the internal features probably pre-dated enclosure construction, and pottery from the site suggests that activity spanned the Early Neolithic through to the Middle Bronze Age. At the entrance, the one ditch terminal to be excavated contained a large, apparently cumulative deposit, including a substantial quantity of cattle bones and lithic material indicative of carcass preparation and cooking associated with Beaker pottery.

Two sections were excavated across the ditch, one to the south and the other across the western terminal. Radiocarbon dating of the part skeleton of a male dog from the primary fill of the ditch (OxA-1408; 4200±110 BP) suggests it was dug in the first half of the second millennium cal BC.

The fill of the ditch contained a sample of just over 300 naked and hulled barley grains in the ratio of 3:2 (Carruthers 1990). While the specialist report suggested the grain deposit was recovered from a secondary, Early Bronze Age deposit (Carruthers 1990, 250), it is given as Late Neolithic in the table (Carruthers 1990, 251). A selection of three naked and three hulled barley grains were dated to confirm the age of the deposit. The six radiocarbon determinations on individual barley grains (Table 4) are statistically consistent at the 5% significance level (T'=6.3; v=5; T'(5%)=11.1; Ward and Wilson 1978) and could therefore be of the same actual age. The barley found in the ditch therefore dates to the centuries either side of 2000 cal BC and is hence much later than the primary infilling of the ditch (Fig. 5) and is not related to Late Neolithic activity at Coneybury Henge (Pelling and Campbell 2013).

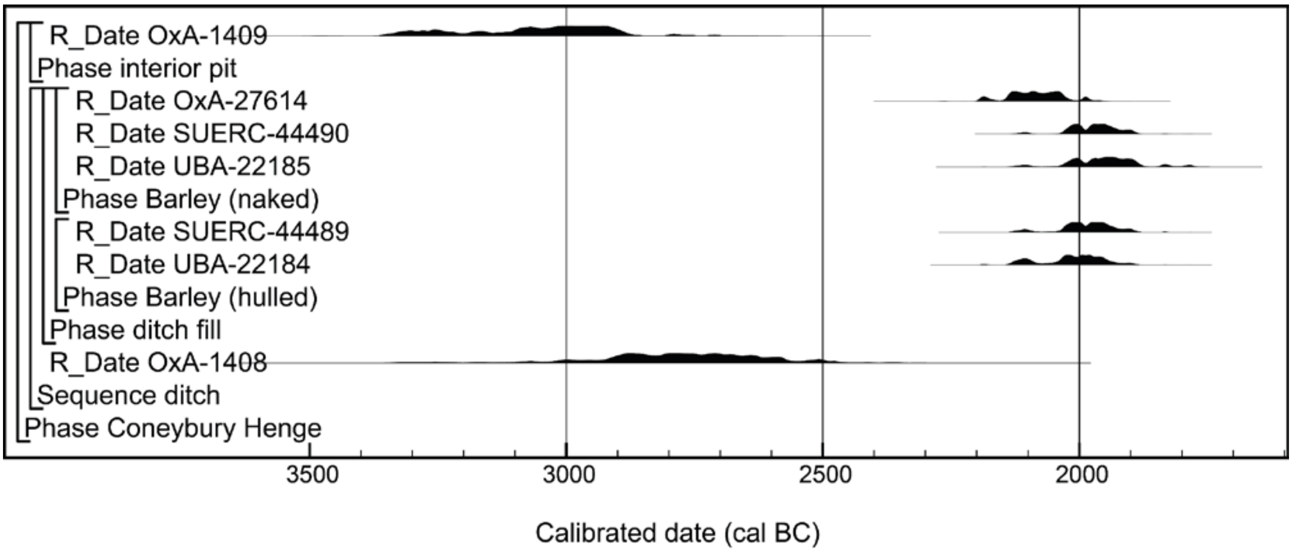

Figure 5: Probability distribution of the dates on carbonised cereal grains from Coneybury Henge. The distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993)

Table 4: Coneybury Henge radiocarbon and stable isotope measurements

Laboratory number	**Sample, material, and context**	**$\delta^{13}C_{IRMS}$ (‰)**	**Radiocarbon Age (BP)**	**Calibrated Date (95% probability**
UBA-22185	1444 (naked) sample A Carbonised grain; *Hordeum vulgare* var *nudeum* (naked six-row barley) from the fill of the henge ditch (W2)	−24.4±0.22	3594±37	2110–1800 cal BC

Laboratory number	Sample, material, and context	$\delta^{13}C_{IRMS}$ (‰)	Radiocarbon Age (BP)	Calibrated Date (95% probability
SUERC-44490	1444 (naked) sample B Carbonised grain; *Hordeum vulgare* var *nudeum* (naked six-row barley) from the fill of the henge ditch (W2)	–24.7±0.2	3611±27	2110–1890 cal BC
OxA-27614	1444 (naked) sample V Carbonised grain; *Hordeum vulgare* var *nudeum* (naked six-row barley) from the fill of the henge ditch (W2)	–24.4±0.2	3695±30	2190–1980 cal BC
UBA-22184	1444 (hulled) sample A Carbonised grain; *Hordeum vulgare* L emend (hulled six-row barley) from the fill of the henge ditch (W2)	–26.3±0.22	3640±33	2130–1900 cal BC
SUERC-44489	1444 (hulled) sample B Carbonised grain; *Hordeum vulgare* L emend (hulled six-row barley) from the fill of the henge ditch (W2)	–24.3±0.2	3620±29	2120–1890 cal BC
OxA-27707	1444 (hulled) sample C Carbonised grain; *Hordeum vulgare* L emend (hulled six-row barley) from the fill of the henge ditch (W2)	–24.5±0.22	3639±29	2140–1920 cal BC

Contamination: archaeophytes

A review of archaeophytes (plant species introduced during the Holocene before AD 1500) indicated an increasing number of species arrived in the British Isles through time, with a number of classic cornfield weeds including *Anthemis cotula* (stinking mayweed) and *Agrostemma githago* (corncockle) arriving in the late Iron Age or Roman period (Preston et al. 2004). Given the inherent risk of contamination of deposits by more recent material, finds of a particular taxon significantly earlier than usual should be treated with caution. (Pelling et al. 2015).

Thanet Earth

Situated between Monkton and Birchington (near Margate) on the Isle of Thanet, Kent, the 'Thanet Earth' site covers 90 hectares (about 220 acres), of which about 47 hectares (nearly half a million square metres) have been examined archaeologically. Open area excavations in 2007–8 prior to the building of the UK's biggest glasshouse complex by the

Canterbury Archaeological Trust revealed nine barrows, 63 structures, 75 sunken featured structures, about 70 enclosures and 33 trackways (including drove ways and hollow ways), and a considerable number of burials (both inhumation and cremation burials, all of prehistoric or Roman provenance) (Rady 2010).

The fill of pit [10454] contained a surprisingly high concentration of grains of *Triticum aestivum/turgidum* (free-threshing wheat), one of which was directed dated to the Early Neolithic (UBA-22207; 5000±45 BP), as well as tetraploid wheat rachis identified as a variety of *Triticum turgidum* (rivet wheat type) (Carruthers 2019; Henshaw et al. 2019, table 6). Also present in the pit were *Corylus avellana* (hazel) nutshell fragments, seeds of *Anthemis cotula* (stinking chamomile), a possible capsule fragment from corncockle (*Agrostemma githago*) and a possible *Pisum sativum* (pea). *Anthemis cotula* and *Agrostemma githago* are considered archaeophytes, introduced to the British Isles in the Late Iron Age or Roman period (Preston et al. 2004, table 2), while pulses are not reliably recorded prior to the Middle Bronze Age (Treasure and Church 2016). The radiocarbon dating of *Anthemis cotula* seeds (Table 5) was undertaken to investigate the extent of contamination of the pits fill.

The fact that the *Anthemis cotula* seeds dated to the first two centuries of the second millennium cal AD (Fig. 5) confirms that they are intrusive despite the pit being apparently well sealed and containing Early Neolithic grain.

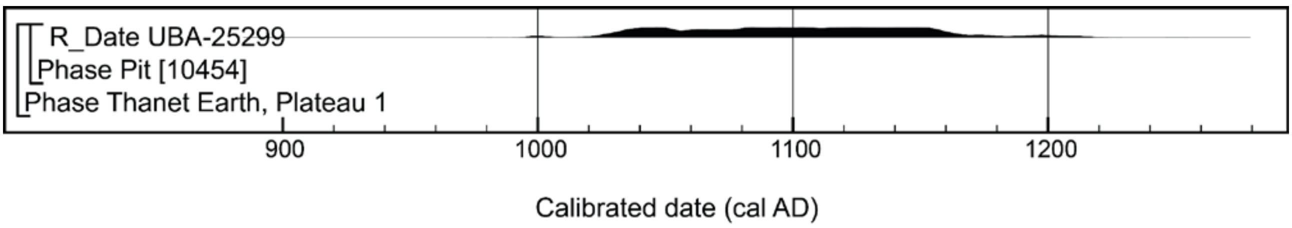

Figure 6: Probability distribution of the date on plant macrofossils from Thanet Earth. The distribution is the result of simple radiocarbon calibration (Stuiver and Reimer 1993)

Table 5: Thanet Earth radiocarbon and stable isotope measurements

Laboratory number	**Sample, material & context**	**$\delta^{13}C$ (‰)**	**Radiocarbon Age (BP)**	**Calibrated Date (95% probability**
UBA-25299	Context (10452) <1851> Carbonised plant macrofossil, *Anthemis cotula* x 9, from fill (10452) of pit [10454]	–	948±38	cal AD 1020–1200

Regional Reviews of charred plant remains

English Heritage (now Historic England) has commissioned three regional reviews of plant macrofossil data covering the northern, midland, and southern counties of England. The first of these, '*A Review of the Evidence for Macrofossil Plant Remains from Archaeological Deposits in Northern England*', was produced by Hall and Huntley (2007). In support of the midlands regional review (Carruthers and Hunter Dowse 2019) radiocarbon dating was undertaken on material from Lockington, Leicestershire.

Lockington

Excavations in 1994 in advance of the construction of the A564(T) Derby southern bypass near the village of Lockington in north-west Leicestershire exposed an early Bronze Age barrow cemetery. Prior to the fieldwork a cluster of cropmarked features at Site V suggested the presence of a pit circle (Hughes 2000). The fill (175) of F182 was the most productive, in terms of charred plant remains, of the features excavated from Site V. The presence of *T. dicoccum* (emmer) and *Triticum spelta* (spelt) were confirmed from diagnostic chaff (glume bases) forming 62% of the recovered charred material by count (Moffett and Monkton 2000). Radiocarbon dating of *Corylus avellana* and *Prunus spinosa* charcoal (hazel and blackthorn) from the pit (Beta-83721; 3039±80 BP) suggested it was infilled in the middle Bronze Age (1470–1040 cal BC; 95% probability).

In order to confirm the potential early occurrence of spelt wheat in the region four *Triticum spelta* glume bases from pit F182 were dated (Table 6). The glume bases are noticeably younger than the charcoal (Fig 7) and given the high proportion of chaff in the feature, suggesting that it is the by-product from the preparation of wheat grain (Hillman 1981), it is probable that the charcoal is residual. While the spelt wheat was the earliest occurrence of spelt wheat in Leicestershire at the time of dating, it is significantly later than the introduction of spelt to the southern counties where it is recorded from the late Early/Middle Bronze Age (Carruthers and Hunter Dowse, 2019, 199) and is unlikely to be the earliest example in the midlands.

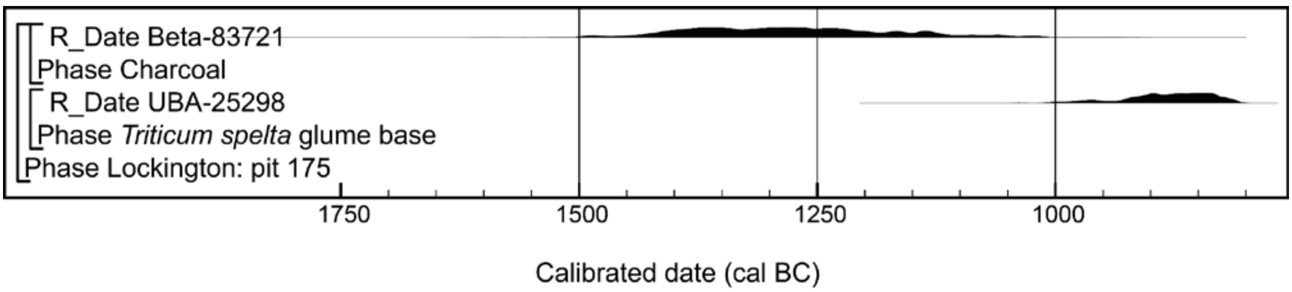

Figure 7: Probability distribution of the dates from Lockington F182. The distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993)

Table 6: Lockington radiocarbon and stable isotope measurements

Laboratory number	**Sample, material and context**	**δ^{13}C (‰)**	**Radiocarbon Age (BP)**	**Calibrated Date (95% probability**
UBA-25298	Context [175] <38> Carbonised plant macrofossil, *Triticum spelta* glume base x 4, from fill (175) of F182	–	2737±38	990–810 cal BC

Hunsbury

The monument at Hunsbury is situated on the summit of a prominent hill overlooking the Nene Valley, Northamptonshire, and includes the earthwork and buried remains of a multivallate Iron Age hillfort (Fell 1936). Finds recovered during excavations for iron stone at the end of the 19th century are held by the Northants and British museums. A box of charred cereal grain recovered from the site had been held by the Economic Botany collection at Kew since it was deposited by T J George of the Northampton Public Museum in 1902. The box label states that the grain was collected from a quern. The box of grain was forwarded to Historic England for scientific analysis (Bouchard-Perron forthcoming).

In order to confirm the assumed middle Iron Age date of the charred grain deposit from Hunsbury three grains of *Triticum spelta* were dated (Table 7). The radiocarbon determinations are statistically consistent at the 5% significance level (T'=1.3, T'(5%)=3.8, v=2; Ward and Wilson 1978) and could be of the same actual age. The results confirm the grains are middle Iron Age in date (Fig. 8).

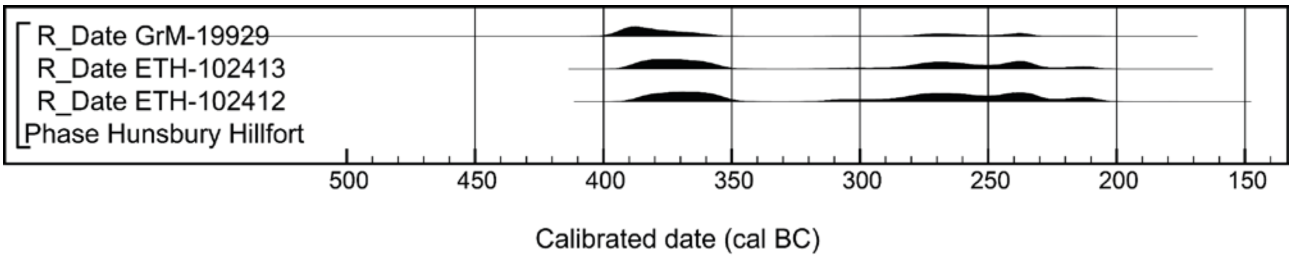

Figure 8: Probability distribution of the dates on carbonised cereal grains from Hunsbury hillfort. The distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993)

Table 7: Hunsbury radiocarbon and stable isotope measurements

Laboratory Code	**Sample, material & depth**	**δ^{13}C$_{IRMS}$ (‰)**	**δ^{13}C$_{AMS}$ (‰)**	**Radiocarbon Age (BP)**	**Calibrated Date (95% probability**

GrM-19929	26786.1 Carbonised grain, *Triticum spelta*, from Kew Economic Botany collection (Cat. N. 26786)	−23.5±0.15		2289±24	390–210 cal BC
ETH-102412	26786.2 Carbonised grain, *Triticum spelta*, from Kew Economic Botany collection (Cat. N. 26786)		−23.3±1.0	2252±22	390–210 cal BC
ETH-102413	26786.3 Carbonised grain, *Triticum spelta*, from Kew Economic Botany collection (Cat. N. 26786)	−25.3±1.0		2263±22	395–205 cal BC

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