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The radiocarbon dates from Pepper Hill, Southfleet, Kent

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1 INTRODUCTION

The primary aim of the radiocarbon programme was to date a series of aspects of the cemetery and varying burial practices, i.e. cremation vs bustum vs inhumation. In addition, the combination of some stratigraphic relationships and the potential to combine this with high precision dates made for an unparalleled opportunity of examining these aspects of Romano-British burial custom.

Some of the main and key questions articulated included:
What is the date of the earliest activity?

- How long was the gap (if any) between the disuse of the Iron Age features and the cemetery?

When was the cemetery established?
Are the different burial practices in the cemetery chronologically related?

- The *bustum* are a rare occurrence in Britain. When was the practice introduced to the cemetery? How long did it last?
- Are the prone and crouched burials related to older (?indigenous) or incoming traditions?
- Although largely contemporaneous, inhumations seem to outlast cremations. Can we establish the chronology of the two forms of burial?

How did the cemetery develop spatially?

- Was the location of the earliest burials influenced by the road (hollow way)? Are the earliest interments and the road contemporaneous (within 25 years)?
- Preliminary phasing suggests that the area defined by the boundary ditches was available for burial throughout the life of the cemetery.

When did use of the cemetery cease?

In order to even attempt to answer these questions it was imperative that the material selected for dating was both directly related to the burial event, and if was not the body itself, was comprised of short-lived material which had a very limited offset between its date and the action of burial (cf. Allen and Bayliss 1995; Allen *et al.* 2004). Where skeletal material was not available then non-curated and short-lived items were selected; where the remains of pyres or bustum were investigated both charcoal and charred plant remains were carefully scrutinised for twiggy elements and sap wood elements likely to be tinder. Although, in theory this was clear, the charcoal from the pyre-related debris associated with the cremation burials was not always charcoal rich, well defined and from clear deposits. Poor bone preservation meant that even poor and fragmentary skeletal elements were carefully examined to ensure the likelihood that the bone submitted was really a part of the individual and not some other residual or later bone. The soft sandy substrate into which the graves were cut also provided the field archaeologists with difficulties in recognising some cuts and recuts.

Initially it was intended date a series of busta by high precision dating at Belfast to provide a precise and close dating sequence for this activity. However, although the very nature of the Bustum produced a great deal of charcoal, there was no where near sufficient quantities (40g) of clearly roundwood or sapwood charcoal. Very little of the charcoal was roundwood, most being from large oak timbers, from which the separation of sapwood was exceptionally difficult and the quantity was not sufficient for high precision dating. Samples of suitable material were submitted for AMS dating. Initial reports indicated that a number of graves survived with skeletons enabling high precision dating. Bone preservation, however, was poor and when it did survive, often there was not enough collagen even for AMS measurement (see Table 1).

Although the possibility of achieving tight chronological relationships through high precision dates from busta was not possible, the dates of some burial events could be constrained by Bayesian analyses. Some graves clearly had had stratigraphic relationships with others and thus, in theory, it was possible to constrain burial event dates with this data. In practice, however, the numbers of stratigraphic relationships that were useful, or that contained suitable datable material in all relevant graves was few. In addition, the stratigraphy was not always clear during excavation and subtle relationships, cuts, and re-cuts were difficult to recognise in the loose sandy matrix through which the graves and other features were cut.

A series of 25 submissions were made which yielded 21 radiocarbon results which are presented in Table 1 and Figures 1-3; all have been calibrated with the atmospheric data presented by Stuiver *et al.* (1998) and performed on OxCal ver 3.9 (Bronk Ramsey 1995; 2001) and are expressed at the 95% confidence level with the end points rounded outwards to 10 years following the form recommended by Mook (1986).

1.1 Reliability of the radiocarbon results and rejected results

Due to the poor preservation of the bone and the low collagen content one third of the bone submissions failed (Table 1). Failure of bone samples in this case was indicated by complete demineralisation with no insoluble residue from which collagen could be extracted and thus insufficient carbon for AMS dating. For those bones which survived demineralisation and provided collagen from which to extract purified bone protein, elemental analysis and atomic

C:N ratios were calculated on two samples (see below) from of the eight for which AMS dates could be obtained (Table 1). These results indicated C:N ratios within the range of well preserved archaeological bone of 3.1 and 3.5 (van Klinken 1999, 691), and radiocarbon determinations on bone within these parameters were considered reliable.

1.2 Elemental analysis of bone gelatin

by Nancy Beavan Athfield

Samples for C and N are analysed on a Europa Geo 20/20, interfaced to an ANCA-SL elemental analyser in continuous flow mode. Carbon and nitrogen isotopes are analysed simultaneously from an average 1.0mg of bone protein. The nitrogen combustion process uses the Dumas method. The carbon dioxide and nitrogen gases are resolved using chromatographic separation on a GC column at 85° C, and analysed for percentage abundance and delta element value. C:N is calculated from atom percentage abundance. Analysis of each sample was done in duplicate; reported values are drift-corrected and an average of the duplicate. Machine error values are normally: ±0.1 per mill for carbon, ±0.3 per mill or better for nitrogen. The results given below are averages for two sets of data for each sample. Standards are: Leucine (13C -22.7; 15N 1.8) and Cystine (13C -17.1; 15N 8.1) which are run after every six samples of bone gelatin.

Grave	*skeleton*	*material*	*lab no*	*result no*	*%N*	*$\delta^{15}N$*	*%C*	*$\delta^{13}C$*	*C:N*
10961	11036	L femur frags	R-28645/1	NZA-20649	14.7	9.2	41.1	-19.6	3.3
11591	11626	Bone frags	R-28645/2	NZA-20650	14.4	10.1	40.8	-19.2	3.3

1.3 Rejected determinations

by Michael J. Allen and Nancy Beavan Athfield

Given the failure rate of bone from this site, a closer examination of the carbon and nitrogen results were made to determine whether those samples that did provide AMS results were reliable.

In addition to C:N ratios, which indicate protein preservation in bone, we reviewed the $\delta^{13}C$ and $\delta^{15}N$ results. All the determinations on bone, except one, gave $\delta^{13}C$ yields of between –18.22 and –21.16‰ that fall comfortably within the expected range for bone from terrestrial-sourced diets; $\delta^{15}N$ ranges also indicated a terrestrial trophic level for a consumer of a relatively protein rich diet. The anomalous determination, KIA-23948, from grave 11731 produced a $\delta^{13}C$ of –8.96‰, well outside the norm for our sample set. The enriched $\delta^{13}C$ did not necessarily infer a dietary-induced anomaly; the laboratory (Liebniz-Labor, Kiel) reported (P. M. Grootes) that there was 'not enough carbon to produce sufficient ion beam during AMS measurement, and that this result should be used with caution' and 'both samples tested gave small and sub-standard ion currents (70-75% of a normal sample)', suggesting that poor protein preservation or an unidentified contamination which created a poor graphite target for AMS analysis. This sample returned a medieval result of 899± BP which calibrates to AD 1020-1250; the result falls well beyond our expected Roman date range of AD 40-100, is at odds with the artefactual evidence, and falls in a period when there are no other dated events in the cemetery. Due to the obvious inconsistencies of the sample indicated by $\delta^{13}C$ and poor ion beam production during AMS analysis, we have rejected this result

Two results (KIA-23928, 10302±46 BP, and KIA 23923, 12111±56 BP) are acceptable radiocarbon measurements, after review of their stable isotope analysis and AMS analysis reports generated by the laboratory, but as they fall several millennia before our expected dates we can only assume that the material dated is residual charred or organic material within the cremation pyres (see below). This indicates that our rigorous selection procedure failed and that our assumption that these charred tuber and charred parachyma were clearly not short-lived material related to the cremation pyre.

One other results also confirms that our archaeological assumptions were poor. A result from a barley grain (KIA 23926, 140±27 BP) from cremation 11053, gave a modern result and must clearly be considered an small intrusive charred element that has worked its way through the sandy soil matrix. These last three results highlight that despite our very strict in our selection criteria and that, even with a rigorous policy, the presence of residual and intrusive charcoal remains more likely than we had assumed, and that dates produced from fragmentary human bone have also to be considered with care.

1.4 Ambiguous results

Despite this, we are still left with two 'ambiguous' results for which no radiocarbon, archaeological or stratigraphic evidence is immediately obvious. These are outlined here, but considered in more detailed below.

Cremation burial 11272. Two results were obtained from this burial, one of which (KIA 23928, see above) was on charred tuber material that was of late glacial date and was rejected as residual. The second was on short-lived Maloideae charcoal and gave a result of 2119±29 BP (KIA 23927) which calibrates to 350-40 BC. This grave contained Roman-period pottery placed as grave goods with an estimated date range of cal AD 70-130, and so on first inspection this seems difficult to reconcile. On re-examination of the records the charcoal has been assigned to the backfill and not the burial and in retrospect should never have been selected as it clearly could not date the burial event.

Cremation burial 10314 and inhumation 10404. These two burial events are recorded as having a clear stratigraphic relationship; cremation burial 10314 is clearly at, or near the top of a sequence of graves that begin with prone inhumation 10404. As the upper burial (cremation 10314) gave a date of 920-880 cal BC (2712±28 BP) on charred remains, and the lower burial gave a date of 350-40 cal BC on bone these clearly contradict the stratigraphy. Further, neither result falls within the expected or anticipated date ranges

2 IRON AGE CEMETERY

The Iron Age activity cannot be confirmed (due to lack of suitable samples) although the possibility that crouched burial 11386 (sk11388) was Iron Age was examined. Despite low initial collagen yields and two submission (KIA 23942 and KIA 24643) it gave a result of 1974±28 BP, KIA 24643, (δC^{13} -18.95) from bone which calibrates to 50 BC – AD120 indicating a very Late Iron Age - early Romano-British date for this burial custom. This was not, however, the earliest inhumation in the cemetery.

3 BUTSUM BURIALS

Two busta were radiocarbon dated using sapwood and grain (Table 1). The calibrated results all fell within the date range of cal AD 20 to 390, but with the phase being more likely to be within the period cal AD 50 to 300 cal BC; i.e. 250 years.

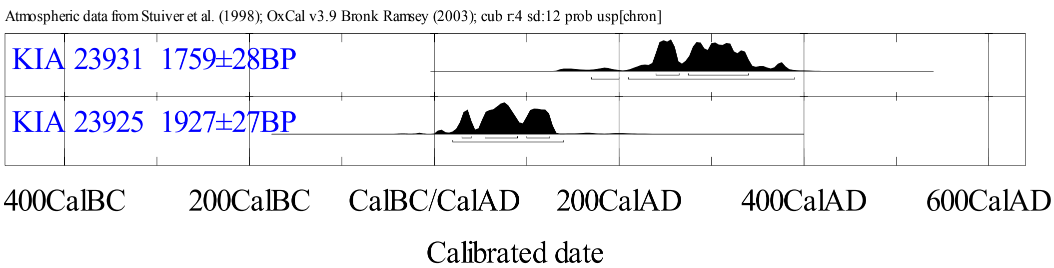


Figure 1. Radiocarbon distributions from busta

4 CREMATION BURIALS AND PYRE SITES

Seven cremations and four pyre sites were dated using charred remains assumed to be tinder from the cremation pyre. Two results were inconceivably early; that from charred parachyma from cremation burial 11092 gave a result of 12111±56 BP (13,400-11,700 cal BC), and that of a charred tuber from cremation burial 11272 was 10302±46 BP (10,750-9800 cal BC). Both must be residues of charred or organic items that became charred by firing and were incorporated into the backfill. The early date of both suggest activity in the Allerod phase which is well reported in Kent (Preece 1994), and the late glacial/early post glacial period.

One other cremation burial (11053) was dated by charred *Hordeum* (barley) grain/and rhizome. The result from this of 140±27 BP (KIA 23926) clearly indicates that this is intrusive small material (cal AD 1670-1960), and indicates the problematic nature of AMS samples in this sandy matrix.

This leaves us with four acceptable dated cremation burials and four pyre sites which indicate that cremation practice occurred from at least the Late Bronze Age (920-800 cal BC) as shown by cremation burial 10314 (KIA 23032) to the Late Romano-British period (cal AD 130-320), cremation burial 142 (KIA 23933)(see Figure 2). The other dated examples include one Middle to Late Iron Age example (350-40 cal BC), cremation burial 11272 (KIA 23927), and three Romano-British cremation burials and four pyre sites spanning the entire Romano-British period. Apart from the single dated Late Bronze Age cremation, all other dated cremation events fall within a much tighter time span of *c.* 200 cal BC to cal AD 250; ie nearly 500 years. The two dated busta fall with and at the end of this range.

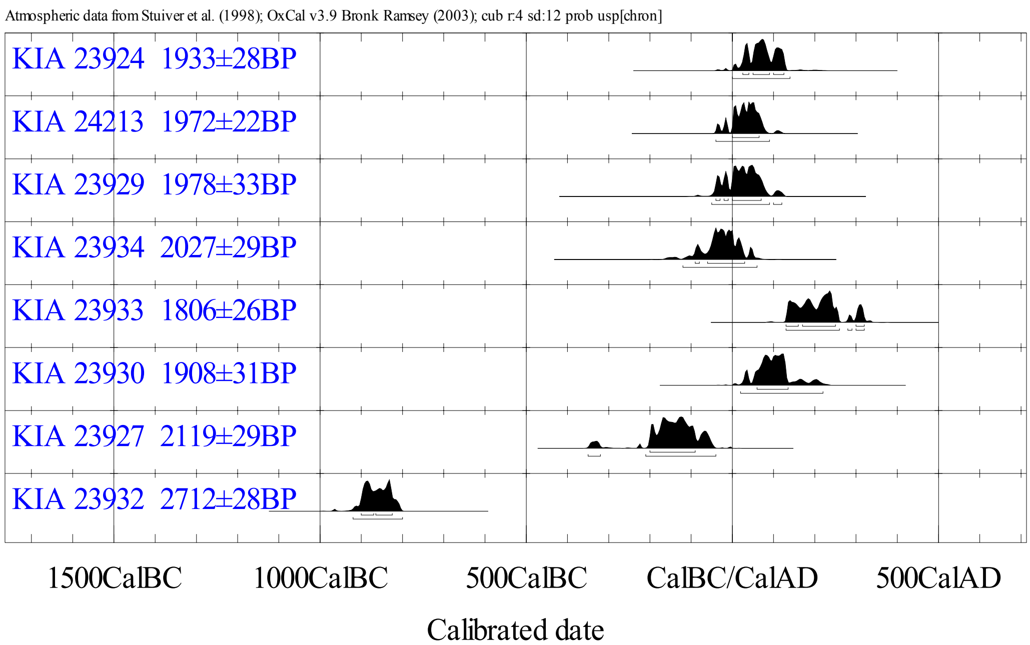


Figure 2. Accepted radiocarbon distributions from cremation burials

5 INHUMATION BURIAL

Obtaining radiocarbon determinations on the inhumation cemetery was very difficult. many of the skeletons did not survive, and those that did had poor collagen survival. A nearly 40% failure rate was recorded as thirteen submission produced only eight results (Table 1)

All accepted determinations were Middle Iron Age to Late Romano-British. The crouched burial (11386, KIA 24643) falls within a group of five inhumations that are statistically indistinguishable at the 95% confidence limit (Ward and Wilson 1978), suggesting the majority of the dated burials fall into a phase of 50 cal BC to cal AD 100 (i.e. Early Romano-British) during which time both cremation and Bustum practices were performed.

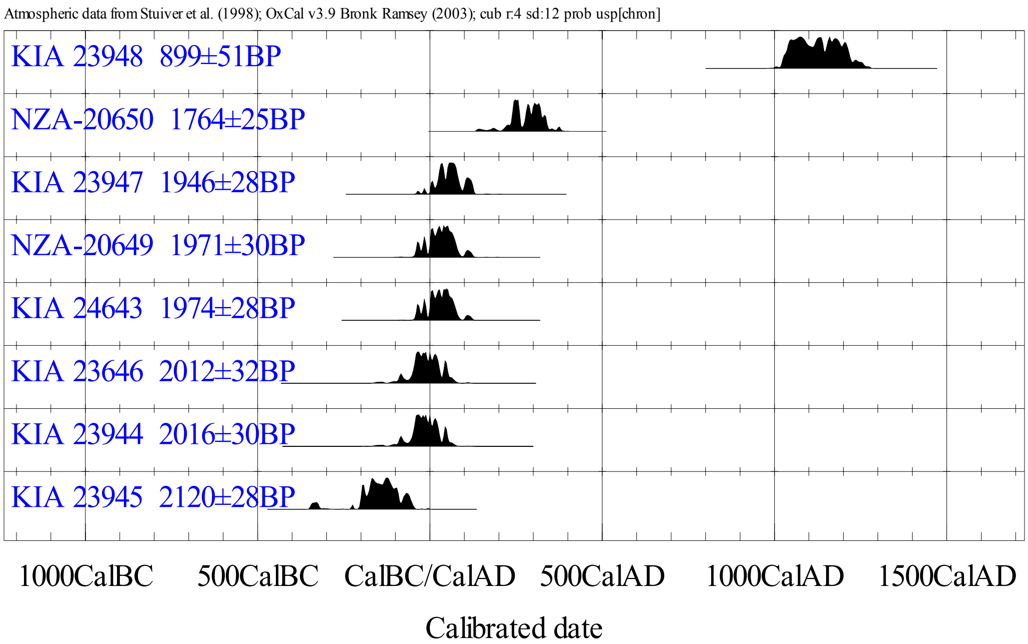


Figure 3. Radiocarbon distributions of the inhumation burials

6 STRATIGRAPHIC RELATIONSHIPS AND SPECIFIC DATED EVENTS

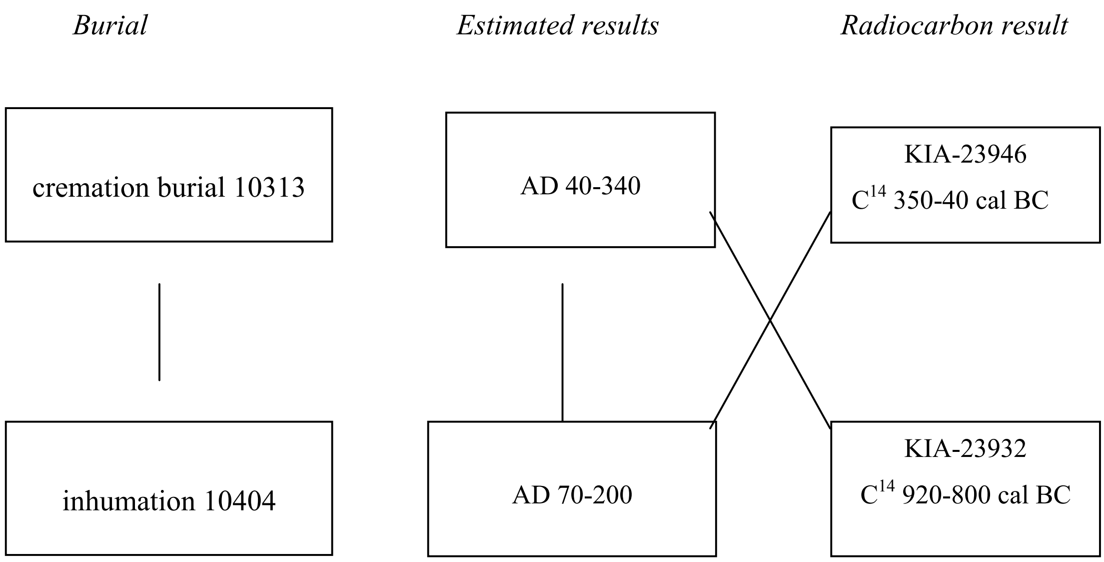
In order to attempt to provide tighter chronological control to enhance the chronological framework provided by both radiometric and artefactual means, a few short stratigraphic sequences were examined. In addition a number of sequences were modelled (see below).

Three short stratigraphic sequences were examined by radiometric and artefacts data in an attempt to provide smaller date ranges for specific events.

6.1 Sequence 1

Cremation burial 10314 and inhumation 10404.

These two dateable burial events are recorded as with a clear stratigraphic relationship; cremation burial 10314 is clearly at, or near the top of a sequence of graves that begin with prone inhumation 10404.



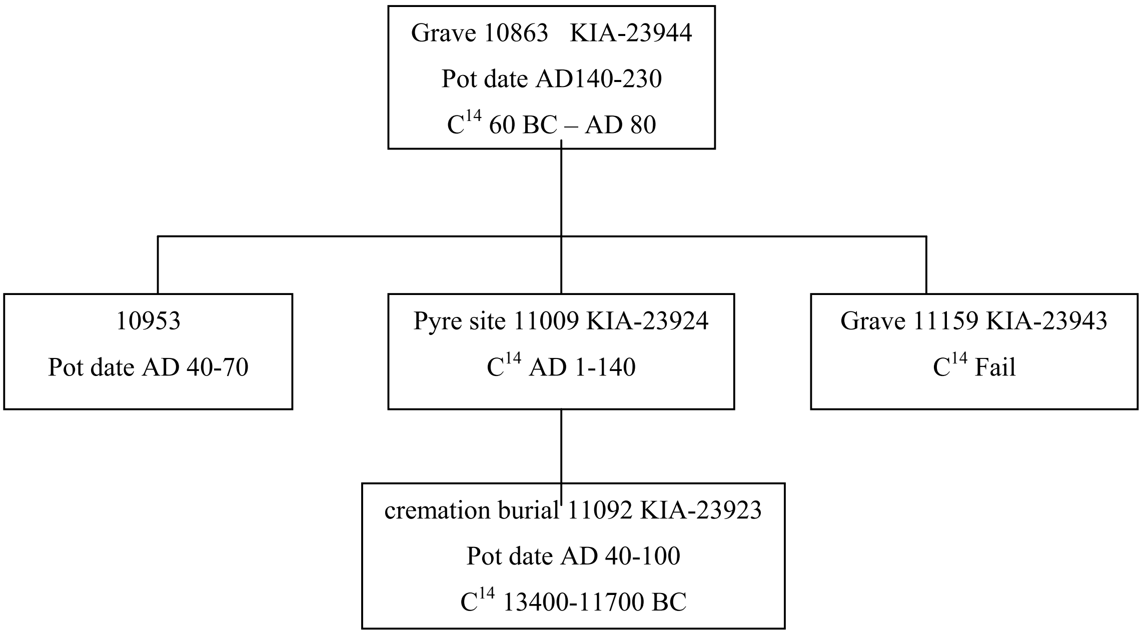
As the upper burial (cremation 10313) gave a date of 920-880 cal BC (2712±28 BP) on charred remains, and the lower burial gave a date of 350-40 cal BC on bone these clearly contradict the stratigraphy. Further, neither result falls within the expected or anticipated date ranges. The selected charred material from cremation burial 10313 was concentrated with 51g of cremated bone in one corner of the squared grave that contained three iron nails. We can be certain that the grave cut is not Bronze Age, but cannot resolve this incompatibility.

6.2 Sequence 2

A small stratigraphic sequence of five burials was identified from which date ranges on ceramics were available for three, and radiocarbon determinations attempted for three others. The sequence was bounded by cremation burial 11092 at the base with a ceramic date of AD 40-100, and at the top by grave 10863 with a ceramic date of AD 190-230.

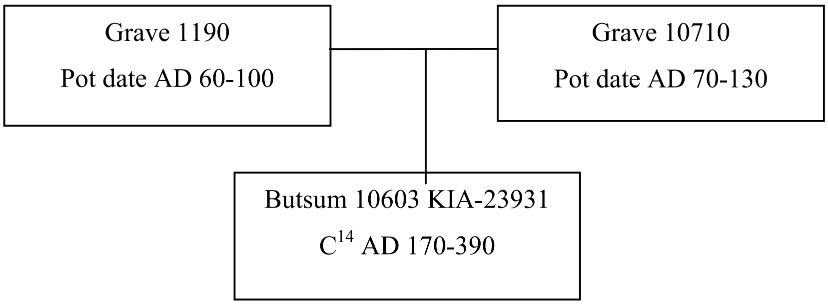
The vessel in grave 10863 potentially represents redeposited material as it was fragmentary and found 0.24 m above the base of the grave. It is, however, a folded beaker typically manufactured from *c.* AD 180-190, though it may have been made a little earlier, but certainly after AD 130/140. The radiocarbon result on teeth gave a result of 60 BC - AD 80 (2016±30 BP) and thus if correct it is unlikely that the radiocarbon result and the pottery are contemporary. The pottery cannot be redeposited or residual. It can only be intrusive.

Unfortunately the radiocarbon determination to constrain the earlier events dated late glacial charred remains rather than that which was thought to belong with the cremation pyre material.



6.3 Sequence 3

Bustum grave 10603 was cut by two graves containing 1st/ 2nd century grave goods which provide a constraint on the bustum event, and the bustum was above an Iron Age grave. Unfortunately, however the result from the bustum grave on charred spelt/emmer grain thought to be a part of the tinder was 1959±28 BP, which calibrates to AD 170-390 after the date of the burials that cut it. Once again the radiocarbon results and stratigraphy are irreconcilable. The charcoal was not allocated a distinct record (i.e. grave deposit) in the field but was ascribed to the backfill. However, from field records the charcoal appeared to be part of a coherent deposit with a clear association with cremated bone and *in situ* burnt soil. Thus is it seemed safe to assume that all these elements were a part of one and the same event. Although the total bone content was lower than expected (there was evidence of truncation), attempting to date this event was particularly important in order to determine the origin and chronology of the bustum rite. However, following receipt of the result we can only conclude that the selected charcoal was from the backfill, rather than among or below the cremated bone, and was therefore intrusive.



7 MODELLING PHASES AND SEQUENCES

by Peter Marshall and Edward Biddulph

Over 550 graves or other funerary-related features were uncovered during fieldwork. The cemetery, as dated by grave goods and stratigraphic relationships, belonged largely to the later 1st and 2nd centuries. Some 40% of graves or other funerary-related features dated to the early Roman period (AD 43-130). The rate of burial declined rapidly after that time. Almost 15% of graves dated between AD 130 and 260 (middle Roman), with most of these being confined within the 2nd century. Just five graves were dated to the late Roman period (AD 260-410).

It is worth noting that a large proportion of mainly inhumation graves - over 20% - yielded no grave goods and could not be closely dated. However, given the general trends of the cemetery, and the chronological focus of the inhumation graves with radiocarbon determinations, it is likely that these also belong to the 1st and 2nd centuries.

Inhumation grave 10404, assigned by its radiocarbon date to the middle Iron Age, was chronological isolated; the absence of certain late Iron Age graves suggests that burial activity did not continue between the *c* 50 BC and AD 43. However, some burials such as the crouched inhumation 11386 are likely to be very early in the sequence, and date soon after the Roman conquest, or a little way before it.

7.1 Parameters of the dated cemetery

In general terms we can see dated burial practice of one form or another commencing with cremation in the Late Bronze Age (920-800 cal BC, cremation 10314) and extending to at least the early medieval period in the form of inhumation (cal AD 1020-1250), burial 11371.

All three burial practices were concurrent, though the bustum is essentially exclusively a Romano-British phenomenon. The general phase of dated activity can be summarised as follows:

Inhumation	*c.* 300 cal BC to cal AD 350
Bustum	*c.* cal AD 50 to cal AD 300
pyre sites	*c.* 50 cal BC to cal AD 125
cremation	*c.* 900 cal BC to cal AD 325

These parameters, however, must be viewed with some caution given the chronological trends of the cemetery and technical and stratigraphic difficulties outlined above. In any case, the burial traditions in what was essentially a Roman-period cemetery did not continue unbroken from the Iron Age to medieval period.

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Feature	***cut***	***context***	***sample***	***context details***	***material***	***result no.***	***δ C*** [13]	***result BP***	***cal***	***estimate***
Bustum 11700	11702	11703	402	pyre debris - base	A. elatius/oak sapwood	KIA 23925	-25.21	1927±27	AD 20-140	AD 40-130
Bustum 10605	10603	10604	320	pyre debris - base	grain T. spelta/dicoccum	KIA 23931	-23.36	1759±28	AD 170-390	AD 40-140
Pyre site 11008	11009	11010	220	pyre debris - base	oak sapwood	KIA 23924	-24.18	1933±28	AD 1-140	AD 40-70
Pyre site 11502	11504	11503	360	Bustum debris	Maloideae	KIA 24213	-23.42	1972±22	40BC - AD90	AD 40-70
Pyre site 11707	11708	11709	408	pyre debris – base	charcoal Maloideae roundwood	KIA 23929	-26.73	1978±33	50 BC-AD 120	AD 40-140
Pyre site 10856	10857	10686	154	pyre debris base	charcoal Fraxinus roundwood	KIA 23934	-24.75	2027±29	120BC-AD60	AD 70-100
cremation 107	142	158	34	pyre debris – top	charcoal Maloideae, Alnus/Corylus	KIA 23933	-22.35	1806±26	AD 130-320	AD 50-100
cremation 11007	10999	11042	212	pyre debris – top	charcoal Maloideae	KIA 23930	-24.57	1908±31	AD 20-220	AD 70-100
cremation 11271	11272	11274	288	pyre debris - top	charcoal Maloideae	KIA 23927	-27.18	2119±29	350-40 BC	AD 70-130
cremation 10313	10314	10315	31	pyre debris – top	Vicia/Lathyrus + charcoal Maloideae, Alnus/Corylus	KIA 23932	-23.28	2712±28	920-800 BC	AD 40-340
Grave 11591	11589	sk 11626		inhumation below 10963	Human bone frags	NZA-20650	-21.16	1764±25	AD 170-390	pre AD 40-70
Grave 836	837	sk 839		Inhumation - top	L femur frags	KIA 23947	-18.22	1946±28	AD 20-120	AD 70-100
Grave 10963	10961	sk 11036		inhumation - middle	L femur frags	NZA-20649	-19.84	1971±30	50BC-AD120	AD 40-70
Grave 10963	10961	sk 11036		inhumation - middle	R femur frags	KIA 23945	-20.57	2120±28	350-50 BC	AD 40-70
Grave 11388	11386	sk 11387		crouched burial = KIA 23942	L femur and skull frags	KIA 24643	-18.95	1974±28	50BC-AD120	650BC-AD70
Grave 11388	11386	sk 11387		crouched burial	R femur frags	KIA23942+ KIA 24643		FAIL FAIL		
Grave 10862	10863	sk 10866		inhumation - top	teeth	KIA 23944	-19.44	2016±30	60 BC-AD 80	AD 200-230
Grave 10403	10404	sk 10405		Prone burial - base	L femur frags	KIA 23946	-18.86	2012±32	350-40 BC	AD 70-200
Grave 10712	10710	sk 10874		Primary burial in grave, but in long strat sequence	R humerus	R-28529		FAIL		
Grave 11158	11159	sk 11252		inhumation - middle	L humerus frags	KIA 23943		FAIL		
REJECTED RESULTS										
Grave 11732	11731	sk 11730		inhumation - base	lower limb	KIA 23948	-8.96	899±51	AD 1020-1250	AD 40-100
cremation 11271	11272	11275	292	pyre debris - top	tuber	KIA 23928	-23.36	10302±46	10750-9800 BC	AD 70-130
cremation 11091	11092	11095	250	pyre debris - base	charred parachyma	KIA 23923	-22.52	12111±56	13400-11700 BC	AD 70-100
cremation 11052	11053	11054	215	pyre debris - base	Hordeum sp. + rhizome	KIA 23926	-26.71	140±27	AD 1670-1960	AD 70-100

Table 1. Radiocarbon results from Pepper Hill