Technology, ritual and Anglo-Saxon agrarian production: the biography of a seventh-century century plough coulter from Lyminge, Kent

Technology, Ritual and Anglo-Saxon agrarian production: The biography of a seventh-century century Plough Coulter from Lyminge, Kent

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Introduction

The transition from the scratch-ard to the heavy plough dominates nearly all narratives of post-Roman agricultural intensification in medieval Europe. According to the maximalist view, the assimilation of this new technology not only increased food production, a necessary prerequisite for population expansion, but also established the framework of the medieval countryside by triggering the wholesale reconfiguration of settlements and surrounding landscapes (Duby 1954; Bloch 1931).

While there is general agreement that the adoption of the heavy plough represents a crucial ingredient in the development of the medieval rural economy, the timing of its introduction to different parts of early medieval Europe has been a subject of intense debate (Fowler 2002: 308-310). On account of their durability, shares and coulters ('plough irons') have been central to this discourse because in most regions they constitute the only surviving vestiges of early medieval tillage implements themselves. For all their durability, however, there are major complexities in using these fragmentary survivals as a basis for interpretation, not least because their preservation is dependent upon culturally-distinct modes of deposition (e.g. hoards, burials) resulting in a highly uneven geographical and temporal distribution (Klápště and Jaubert 207: 97-100). Moreover, as the literature readily exemplifies, any one particular form of share or coulter can be interpreted in multiple ways often revealing clear divergences of view on how tillage implements were actually used and the technological stages by which the prehistoric ard evolved into the heavy plough (White 1964: 41-43; Klápště 1998; Fowler 2002: 182-186;).

Given these intrinsic problems with the data, it is perhaps unsurprising that archaeologists have failed to exploit the full interpretative potential of these artefacts. While theories on developments in early medieval plough technology have become more sophisticated, allowing for greater complexity and regional diversity in this technological transition (Fowler 2002, 183-202; Klápště and Jaubert 2007, 97-98), the underlying approach to the data remains essentially the same: descriptive typology supporting diffusionist statements on cultural origins and influence. With one or two notable exceptions (Lerche 1994), much less investment has been made in pursuing questions concerning the use-life and social biography of these objects through detailed analyses and a thorough consideration of depositional context (Joy 2009, 545; Jones 2002).

Representing the only example of its type from a well-dated Anglo-Saxon settlement context, this paper evaluates the significance of a vital new find of an early medieval plough coulter from Lyminge, Kent, in order to harness these neglected perspectives. We reconsider the development of Anglo-Saxon plough technology in light of this discovery, but take interpretation to a deeper level by adopting a biographical approach. The results of investigative conservation, high-resolution recording and metallographic analysis are integrated to shed light on the coulter's manufacture and use, while consideration of its find context is used as a platform for reinterpreting the meaning behind the deposition of plough irons in early medieval northern Europe.

Archaeological Background

The coulter was discovered in 2010 as part of an ongoing archaeological project examining the early medieval origins of the modern-day village of Lyminge, a documented Anglo-Saxon monastery established on the site of an earlier royal centre. The excavation of open spaces surrounding the churchyard has produced the first high-resolution settlement sequence for a royal centre in early medieval Kent, represented by a continuum of high-status occupation spanning the later fifth-later ninth century AD, characterised by monumental timber architecture and exceptionally rich cultural and bioarchaeological assemblages. This detailed site narrative has secured a new platform for investigating how the earliest generation of sites of royal residence in Anglo-Saxon England evolved in relation to wider socio-political change with a particular emphasis on the impacts of the conversion to Christianity (Thomas and Knox 2012; Thomas 2013).

Overall, the Anglo-Saxon settlement sequence at Lyminge breaks down into two chronologically successive sites. The plough coulter belongs to the earlier of these sites, located in the lower-lying reaches of the village beside the source of the River Nailbourne (Fig.1). Established by the end of the fifth century, this primary habitation passed through several phases of development before coming to abrupt end at some during the early eighth century by which time the settlement had refocused around the spiritual core of the newly established monastic community. The most dramatic episode in this early part of the occupation sequence was the construction of a suite of monumental timber halls sharing close architectural affinities with other excavated Anglo-Saxon royal residences including the Northumbrian site of Yeavering (Hope-Taylor 1977).

Deposition and date

The specific context of discovery was SFB 1, one of seven sunken-featured buildings (Grubenhäuser) widely dispersed across the spatial extent of the Early Anglo-Saxon settlement. The excavated footprint of the building comprised a sub-rectangular cut, measuring 4.70m in length, 3.60m in width and 0.5m in depth, with a pair of internal post-holes marking the position of axially-aligned roof supports (Hamerow 2013: 53-66). Micromorphology and geochemical analysis has established that the pit was rapidly infilled with dumps of domestic refuse soon after the structure had been abandoned in a manner common to this class of structure (Tipper 2004).

The coulter was found resting on the base of the pit adjacent to its south-east corner sealed below the earliest episode of dumping (Figs. 2 and 3). Its deposition can be confidently attributed to the first half of the seventh century cal AD on the basis of the chronological modelling of a pair of radiocarbon dates associated with stratigraphically consecutive events: a *terminus ante quem* from the earliest of the overlying dumps and a *terminus post quem* from a context associated with the abandonment of a post-hole building truncated by SFB 1 (Fig. 4; Table 1).

Form and typology

Weighing 5.60kg and measuring 680mm in length, the Lyminge coulter is by a considerable margin the most substantial agricultural implement yet discovered from early Anglo-Saxon England. Morphologically, the coulter comprises two elements: a blade measuring 260mm long and 94mm at its widest point, featuring a curved back, and a straight cutting edge angled inwards at the back and terminating in rounded tip at the front; and a straight, rectangular-sectioned shaft measuring 420mm in length (Figs 5 and 6).

Two initial observations can be made in relation to the morphology of the coulter. First is its comparatively large size: it is over 100mm longer than the next largest coulter from Anglo-Saxon England and is only exceeded in size by the very largest examples known from the Romano-British and post-medieval periods (Leahy 2013: 224-225; Rees 1979, 60; Lerche 1994, 228, fig. 9.53).

A second feature of diagnostic relevance only came to light following X-radiography and investigative conservation: an 8mm circular perforation located adjacent to the cutting edge of the blade (Fig. 5). Although unparalleled on other early medieval coulters from the British Isles, this feature is attested on the continent during this period and is argued to have facilitated the connection of a chain between the plough-beam and the coulter (Henning 2009, 153-156).

Manufacture and use

Visible weld-lines, also delineated metallographically by lines of slag inclusions, indicate that at least three billets were used to forge the coulter (Fig. 7). A clear division in the metallography of the shaft raises the potential of a fourth billet rendered invisible by the attainment of a near perfect weld achieving crystal intergrowth between the two pieces of metal. If the latter is taken into account, then it can be determined that the coulter was originally forged from four equally-sized billets, each weighing around 1400g.

Each of the constituent billets was manufactured using different combinations of the three main alloy types present in early iron metallurgy: ferritic iron, phosphoric iron and steel. Metallographic analysis has shown that such piled or banded structures represent a standard feature of Anglo-Saxon ironwork across a wide range of products, but in most cases it is not possible to determine whether this was the result of deliberate manufacture or accidental generation during the smelting or primary smithing process (Tylecote and Gilmour 1986; McDonnell 1989). The same ambiguity holds for the Lyminge coulter, particularly in relation to the more structurally complex blade and shoulder sections where up to four bands are present (Table 2; Fig. 8A and B).

It should be emphasised that the manufacture of the coulter represented a considerable investment in terms of raw materials, manpower and resources. The four billets would have been individually forged from blooms, each derived from a separate smelting event. The final forming of the coulter most likely required three smiths and a bellows operator to execute: one smith to hold the separate bars, another to wield the heavy hammer, and both under the direction of a master smith who would determine where and when the hammer blows fell. This capacity falls well beyond what might be reasonably expected for a typical early medieval smithy under the operation of a single artisan (McDonnell et al. 2012).

Clear signs of wear are also evident on the coulter. The two overlapping surfaces of metal forming the scarf-weld in the central portion of the blade have sheered apart under stress, while further stress cracking is evident at the shoulder (Figs 9 and 10). Metallographic examination reveals that the latter occurred at natural point of weakness in the coulter, namely the interface between the brittle core of high carbon steel and the flanking bars of more malleable ferritic/phosphoric iron (Fig. 8D). A second indication of wear relates to the fact the perforation falls nearly on alignment with the cutting edge of the blade. The only way of explaining this precarious position is if the cutting edge of the blade had suffered considerable wear of the type documented by the experimental use of replica medieval ploughs (Lerche 1994: 187-189). The cumulative weight of evidence suggests that, when deposited, the coulter was no longer capable of fulfilling the use for which it was originally intended.

Discussion

Implications for Anglo-Saxon plough technology

The Lyminge coulter has attracted widespread comment in recent literature as a potentially paradigm-changing find which calls into question the conventional dating of the introduction of the heavy plough in Anglo-Saxon England (Hamerow 2013: 148; Higham and Ryan 2013: 325-6; Oosthuizen 2013: 65; Williamson 2013: 17-18; Banham and Faith 2014: 46). Prior to its discovery, plough irons were conspicuous by their absence from Anglo-Saxon contexts pre-dating the ninth century AD. (Astill 1997: 201-2). This negative evidence, combined with the later tenth-eleventh-century chronological horizon provided by depictions of heavy ploughs in Late Saxon illuminated manuscripts, has influenced most recent interpretations, the most authoritative examination of the subject to date concluding that: “until such is evidenced archaeologically before AD 900, the ard…and not the ‘heavy plough’…should be regarded as the principal cultivating implement of the Anglo-Saxons” (Fowler 2002: 203-4). To what extent does the Lyminge coulter challenge this view?

To examine this question critically it must be remembered that a coulter found on its own does not necessary constitute a plough. Some have hypothesised that ‘coultered’ tillage implements, distinct from a fully-developed heavy plough, may have been used at various times and places during the first millennium AD (e.g. Comet 1997: 22-3). In our view, the considerable size and weight of the Lyminge coulter – demonstrably on a par with some of the largest known archaeological survivals and examples attached to extant post-medieval ploughs − renders this interpretation unlikely. To develop this argument further it is necessary to consider the technological implications of the coulter’s distinctive perforated blade examined in its wider northwest European context.

As in Anglo-Saxon England, the introduction of the heavy plough into the Frankish empire has been widely regarded as a relatively late development, associated with Carolingian land reforms of the later eighth and ninth centuries AD (e.g. Bloch 1931). This view has been predicated on the assumption that the collapse of the Western Roman Empire ushered in centuries of regression in the rural economy and a return to prehistoric modes of production exemplified by the widespread use of the primitive ard. Recent years have seen the credibility of this traditional historical account challenged from a range of archaeological perspectives stimulated by a proliferation of data derived from excavated rural settlements. Synthetic research demonstrates that far from being a period of regression, the seventh-ninth centuries AD witnessed dynamic and far-reaching innovations in systems of agricultural production across many parts of north-west Europe (Astill 1997; Castillo 2014).

One of the seminal contributions to this archaeological reassessment has been an expansive study of plough-irons from dated early medieval contexts represented across a broad swathe of the Frankish empire (Henning 2009: 153-58). According to this research, the archaeological evidence points towards the early medieval use of the so-called 'swivel plough', a distinct technological variant of the heavy plough previously regarded to represent a late, post-medieval, adaptation. This technology is distinguished by a moveable mouldboard and 'floating' coulter that, in contrast to the fixed components of an asymmetrical plough, could be switched to either side of the ploughshare when the end of the field was reached. Extant examples of such ploughs, in use in some regions until as recently as the nineteenth century, demonstrate that a chain was frequently used to attach the floating coulter to the plough-beam as an added means of security, explaining the appearance of perforations in archaeological discoveries of the early medieval period.

The Lyminge coulter's place of discovery is wholly consistent with this attribution. Strong political, dynastic and economic ties were established between the ruling elites of Kent and the Frankish kingdom during the second half of the sixth century and these connections only intensified with the conversion of the Kentish kingdom to Christianity (Wood 1983). It has been argued that the kingdom's political ascendency at this time was fuelled by imported luxuries supplied via these external links (Huggett 1988). The Lyminge coulter suggests that privileged access to foreign agricultural innovations may have played an equally important role in this process, a claim further supported by the recent discovery from the site of Northfleet, Kent, of the earliest watermill from Anglo-Saxon England (Hardy et al. 2011). What currently remains uncertain, bearing in mind the necessary distinction between the inception of an innovation and its widespread diffusion, is the extent to which early experimentation with such technologies in Kent stimulated their wider adoption within neighbouring client kingdoms (Astill 1997: 195; Van der Veen 2002: 2-6).

The deposition of plough-irons: object biography and ritual meanings

The early medieval era is characterised by the emergence of hybrid devotional practices generated by the interaction of pagan and Christian ideologies (Carver 2003; Pluskowski and Patrick 2003). One expression of this hybridity was the assimilation of pre-Christian modes of ritual deposition into the pararituals of Christian life (Crawford 2004; Gilchrist 2012, 227-236). Recent archaeological applications of an object biography approach encourage such acts of deposition to be viewed as ritual actions marking the final stage, or death, in the social life of the object (Gosden and Marshall 1999; Joy 2002; Gilchrist 2012: 11-13). Although unique in an Anglo-Saxon settlement context, the seemingly deliberate concealment of the Lyminge coulter in connection with the abandonment of a sunken featured building exemplifies a wider pattern of distinct and unusual depositional treatments characterising the social biography of early medieval plough-irons. In the final part of this discussion, we examine the background to these practices to understand the significance of the Lyminge coulter's seemingly deliberate deposition.

Consideration first needs be given to the iron hoards responsible for producing the overwhelming majority of plough irons from Anglo-Saxon England, including three of the four known plough coulters (Leahy 2013: Table 1). The most striking aspect of these collections is their functional diversity characterised by different combinations of agricultural implements, craftworking tools, door and/or chest furniture, weaponry and less commonly unworked billets. It is for this reason that such collections have frequently been interpreted in common-sense terms as caches of smith's tools and/or scrap metal concealed for safe-keeping (Leahy 2003: 169-171). More recently, interpretation of these hoards has taken a more nuanced turn taking into account the fact that many have been recovered watery environments characterising much earlier traditions of ritual deposition or in settlement contexts associated with the closure of significant buildings (Thomas 2008; Lund 2010; Leahy 2013). These contextual associations support the view that these collections were imbued with special meaning directly related to the widespread mythologisation of the smith in early medieval societies. Under this view, deposition can be understood as a ritual strategy for harnessing or controlling collections of tools rendered inalienable because they had come to personify the supernatural aura and transformative powers of their makers (Lund 2010: 58).

Plough-irons found in isolation in connection with early medieval settlements and furnished graves provide a rather different perspective on this theme. For in contrast to collections of iron tools curated by, and thus biographically entwined with, smiths, the majority of these single finds can be assumed to have entered a wider sphere of social relationships through daily use. It is important to note here that 'use' in an early medieval context included a ritualised setting divorced from the everyday activities of agricultural production: the early medieval judicial practice of 'ordeal by fire' whereby accused felons were required to hold or walk over glowing hot irons to establish their innocence. A documented connection between the fire ordeal and plough-irons, including coulters, is attested from c. AD 800 (Bartlett 1986: 4-12). But the deposition of shares and coulters in Merovingian graves of the sixth-seventh centuries AD, in some cases in aberrant ways characteristic of 'deviant burial', may well suggest that the association dates back to the earliest codifications of Frankish law (Henning 2007).

Although they represent more of a rarity, an argument can also be made that many of the plough-irons recovered from early medieval settlement contexts represent traces of ritual actions. Perhaps most striking are two instances of plough shares buried in association with ninth-century mortuary chapels, both plausibly as foundation deposits, one at the French site of Mountours in eastern Brittany and the other at the Anglo-Saxon settlement of Flixborough, Lincolnshire (Le Gall and Menez 2008: 18-21; Ottaway 2009: 245; Loveluck 2013: 44-45). It has been suggested that these cases might represent the aftermath of the ritual consecration of sacred Christian sites by ploughing, immediately recalling similar traditions of ritual tillage attested in connection with Bronze Age mortuary contexts (Bradley 2005: 23-28). While there is no direct documentation to support this theory, it gains some substantiation from synergies between the earliest-recorded Christian consecration rites and contemporary vernacular fertility rituals incorporating archaic votive practices (Gittos 2013: 19-49).

A growing number of plough-irons can also be confidently attributed to domestic contexts on early medieval rural settlements, the character of many bearing close comparison with structured foundation/closure deposits recognised on later prehistoric and Roman habitations in northern Europe (Brück 1999; Fulford 2001; Bradley 2005). The practice is attested earliest on Roman Iron Age (third-fifth century AD) settlements on the Germanic continent, mostly in connection with sunken featured buildings (Henning 2014, 341-46), but also recurs in the final century and immediate aftermath of the first millennium AD in the North Sea Zone and Ireland (Loveuck 2013: 45; O'Sullivan 2008;). Although the Lyminge coulter is the first example of its type to have been discovered in an Anglo-Saxon settlement context, the circumstances of deposition accords very closely with a wider repertoire of 'special deposits' recognised on English settlements of the fifth-seventh centuries AD, the majority of which relate to the closure of sunken featured buildings (Hamerow 2006).

Early medieval examples of plough-irons buried in house floors and other settlement contexts have to be understood as part of the long durée of the ritualization of domestic life: a process whereby everyday activities such as ploughing, grinding, cooking, spinning and weaving were emphasised in performative rituals employed to protect households and to meld people and their dwellings in a unified cosmological lifecycle (Bradley 2005). The efficacy of these rites resulted from these metaphorical entwinement of domestic tasks with concepts of fertility and reproduction that served to harmonise human experience with the seasonal rhythms of the annual cycle. Vernacular field blessings captured in Late Anglo-Saxon texts help to chart the incorporation of these long-standing beliefs, including rituals directly associated with ploughing, into an early Christian framework (Banham 2010). Although this continuity of ritual practice can only be glimpsed in the historical record, there is no reason to doubt that plough symbolism enjoyed any less prominence in the Anglo-Saxon period than it did in the middle ages by which time 'Plough Monday' is documented as one of the major seasonal rituals of the Christian calendar (Hutton 1996: 124-9; Gilchrist 2012: 106-7).

Conclusion

The Lyminge coulter redefines an understanding of the process by which the heavy plough came to be adopted in Anglo-Saxon England. Its size and distinctive form suggests that a continentally-inspired version of the 'swivel plough' was in use in Kent centuries before heavy plough technology is first depicted in Late Saxon manuscript illustrations. Its discovery in what was at the time of its deposition the most powerful and outward-looking of the Anglo-Saxon kingdoms serves as an important reminder that the adoption of agricultural technology in the past was always a contingent process governed by the receptivity of regions and communities.

This Lyminge find deserves to be understood as more than simply a missing link in the story of agricultural intensification in Anglo-Saxon England. The adoption of biographical approach has focused attention on the considerable investment that went into making the Lyminge coulter and the fact that it had sustained major damage and wear during the phase of its life attached to a plough. The circumstances of its deposition can be seen to fit into a consistent pattern of ritual treatments reflected in the find contexts of plough-irons from early medieval northern Europe. These archaeologically-attested practices shed important light on the ritual actions of plough symbolism in an age of religious hybridity and transformation.

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Figure captions

1. Location of excavations 2008-14 shown in relation to approximate extent of the two chronologically consecutive Anglo-Saxon settlement foci.

2. Plan and section of SFB1 showing locations of plough coulter, radiocarbon samples and underlying post-built timber structure.

3. The coulter during the final stages of excavation prior to lifting and recovery.

4. Probability distributions of dates from Lyminge based upon simulation using OxCal (v4.1) (Bronk Ramsey 2009).

5. Coulter after investigative conservation and refilling of metallographic sections.

6. Isometric profile through coulter generated by laser scanning using a Romer Absolute 7320 SI Arm Scanner and Geomagic Studio 2013 software.

7. Locations of metallographic sections and the iron billets used in the construction of the coulter. Billets 1-2, marked in solid boxes, are based upon visible weld-lines, whereas billets 3-4 (open boxes) are inferred from metallographic analysis.

8. The microstructure of billets 1 and 2 present in metallographic sections 2 and 3, prepared with 3% Nital (Nitric Acid in ethanol) with images taken with a reflected light microscope. (A) shows a central white phosphoric band, flanked by ferritic iron with black non-metallic slag inclusions orientated through section 2 and (B) (the right-hand portion of Section 3) shows phosphoric and ferritic banding with black slag inclusions, both at (WoF = 1mm). (C) is an image from the same section (WoF = 0.5mm) showing the edge of high carbon pool (0.8%C, top) degrading to lower carbon zone (bottom). The full microstructure of section 3 is sown in (D). A description of the microstructures can be found in Table 2.

9. X-radiograph showing stress damage to the shoulder and blade of the coulter. Point 1 shows sheering of the weld between billets 1 and 2 and point two stress cracking surrounding the weld joining billets 2 and 3. Taken by the Royal Armouries, AM2165 at 250kV, 5 mA, 30 seconds.

10. Laser-scanned image showing stress-distortion to the blade and shoulder section of the coulter.

Table captions

Table 1. Radiocarbon samples SUERC-35927/35929. The radiocarbon determinations have been calibrated with data from Reimer *et al* 2009 using OxCal (v4.1) (Bronk Ramsey 2009) with date ranges calculated according to the maximum intercept method (Stuiver and Reimer 1986).

Table 2. Summary of microstructure of the coulter revealed by each of the metallographic sections.

Table 1

Lab no.	Material	Radiocarbon Age (BP)	$\delta^{13}C$ (‰)	Calibrated date range (95% confidence)	*Posterior density estimate (95% probability)*
SUERC-35927	Animal bone, juvenile pig tibia (left) from an articulated animal disposal	1444±25	-21.4	cal AD 565-655	*cal AD 595-635*
SUERC-35929	Animal bone, cow (young adult) mandible including mandibular M3 from an articulated animal	1448±24	-21.8	cal AD 565-655	*cal AD 570-645*

Table 2

Billet/ Section No.	Component 1	Component 2	Component 3	Structure
1: Sections 1 and 2	ferrite	phosphoric	ferrite plus carbide	Banded structure with components present in four alternating bands at cutting edge and back of blade.
Billet 2: Section 3	ferrite	ferrite/phosphoric bands	high carbon steel	Central band of high carbon steel flanked on one side by a ferritic band and on the other by a strip which contains numerous thinner bands of ferritic and phosphoric iron
3: Section 4	ferrite	ferrite and phosphoric		ferritic and phosphoric iron with a carbon zone at the top of the section resulting from carbon diffusion.
4: Section 4	ferrite			ferrite and low carbon microstructure

Fig. 1

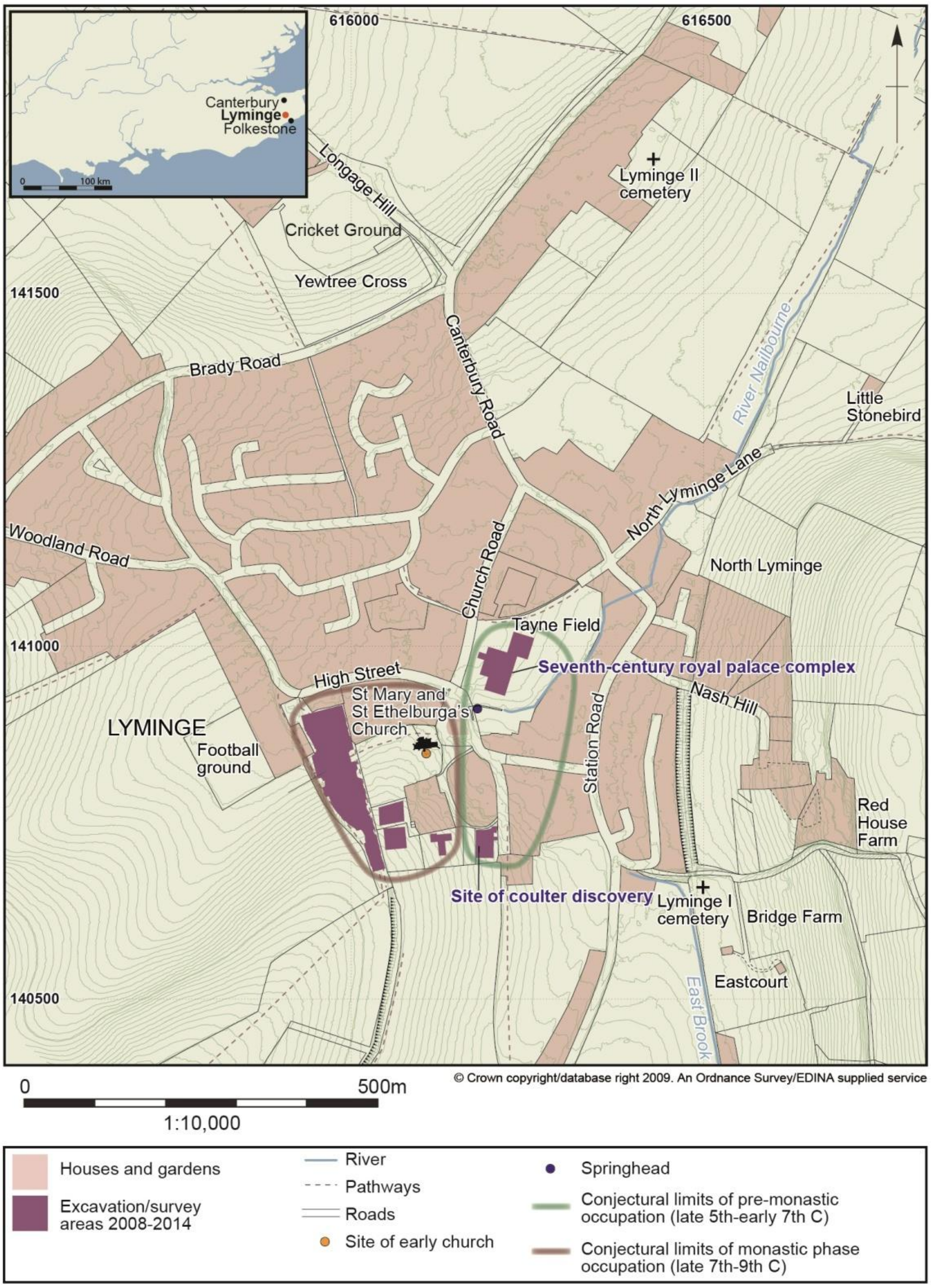

616000
616500
Canterbury
Lyminge
Folkestone
0
100 km
Longage Hill
Lyminge II cemetery
Cricket Ground
Yewtree Cross
141500
Canterbury Road
Brady Road
River Nailbourne
Little Stonebird
North Lyminge Lane
Woodland Road
Church Road
North Lyminge
Tayne Field
141000
Seventh-century royal palace complex
High Street
St Mary and St Ethelburga's Church
Nash Hill
LYMINGE
Football ground
Station Road
Red House Farm
Site of coulter discovery
Lyminge I cemetery
Bridge Farm
Eastcourt
140500
East Brook
© Crown copyright/database right 2009. An Ordnance Survey/EDINA supplied service
0
500m
1:10,000
Houses and gardens
Excavation/survey areas 2008-2014
River
Pathways
Roads
Site of early church
Springhead
Conjectural limits of pre-monastic occupation (late 5th-early 7th C)
Conjectural limits of monastic phase occupation (late 7th-9th C)

Fig. 2

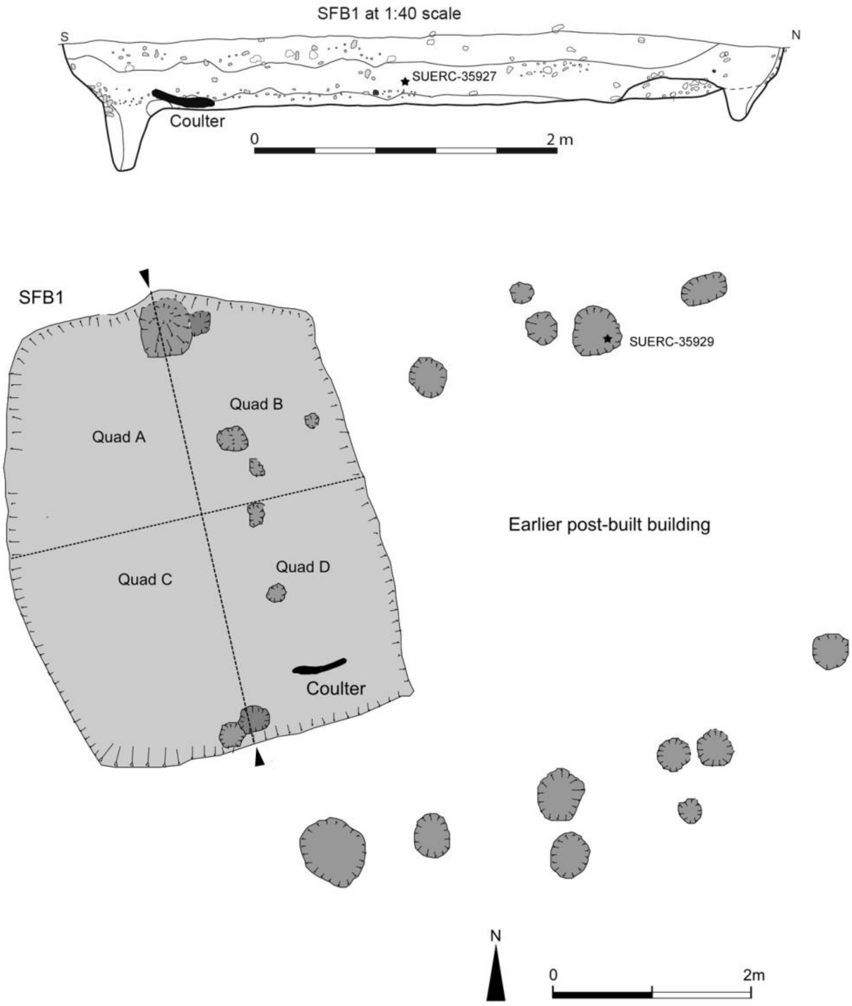
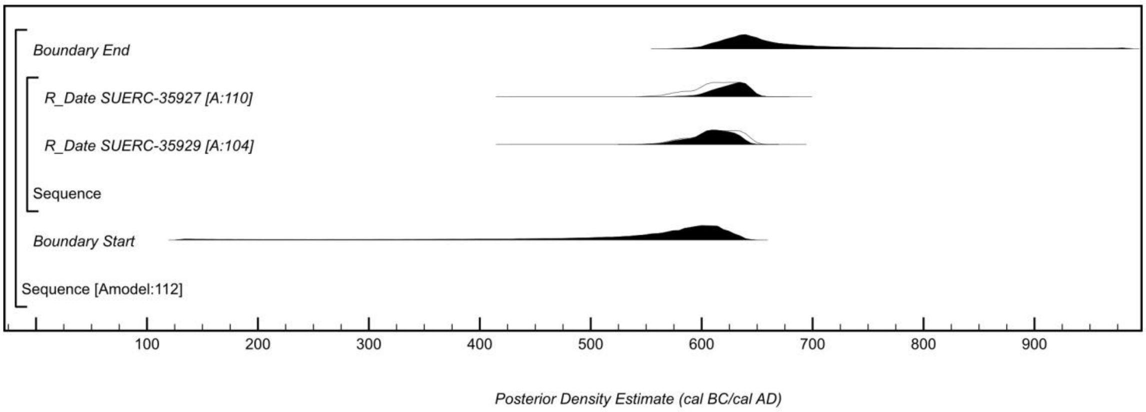

SFB1 at 1:40 scale
S
N
SUERC-35927
Coulter
0
2 m
SFB1
SUERC-35929
Quad A
Quad B
Quad C
Quad D
Earlier post-built building
Coulter
N
0
2m

Fig.3

Fig. 4



Boundary End
R_Date SUERC-35927 [A:110]
R_Date SUERC-35929 [A:104]
Sequence
Boundary Start
Sequence [Amodel:112]
100
200
300
400
500
600
700
800
900
Posterior Density Estimate (cal BC/cal AD)

Fig. 5

Fig. 6

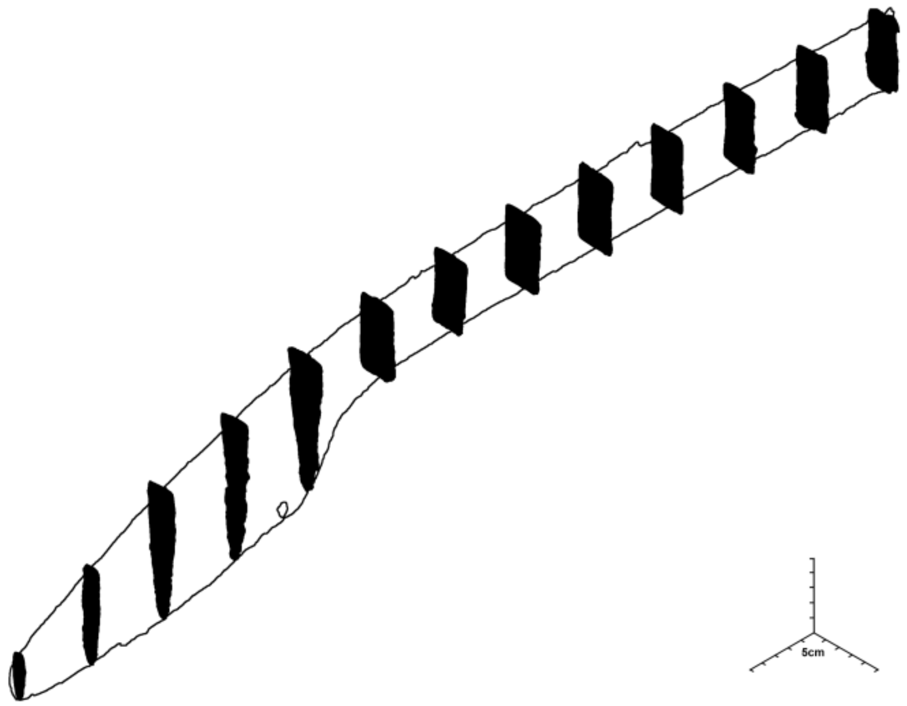


Fig. 7

Fig. 8

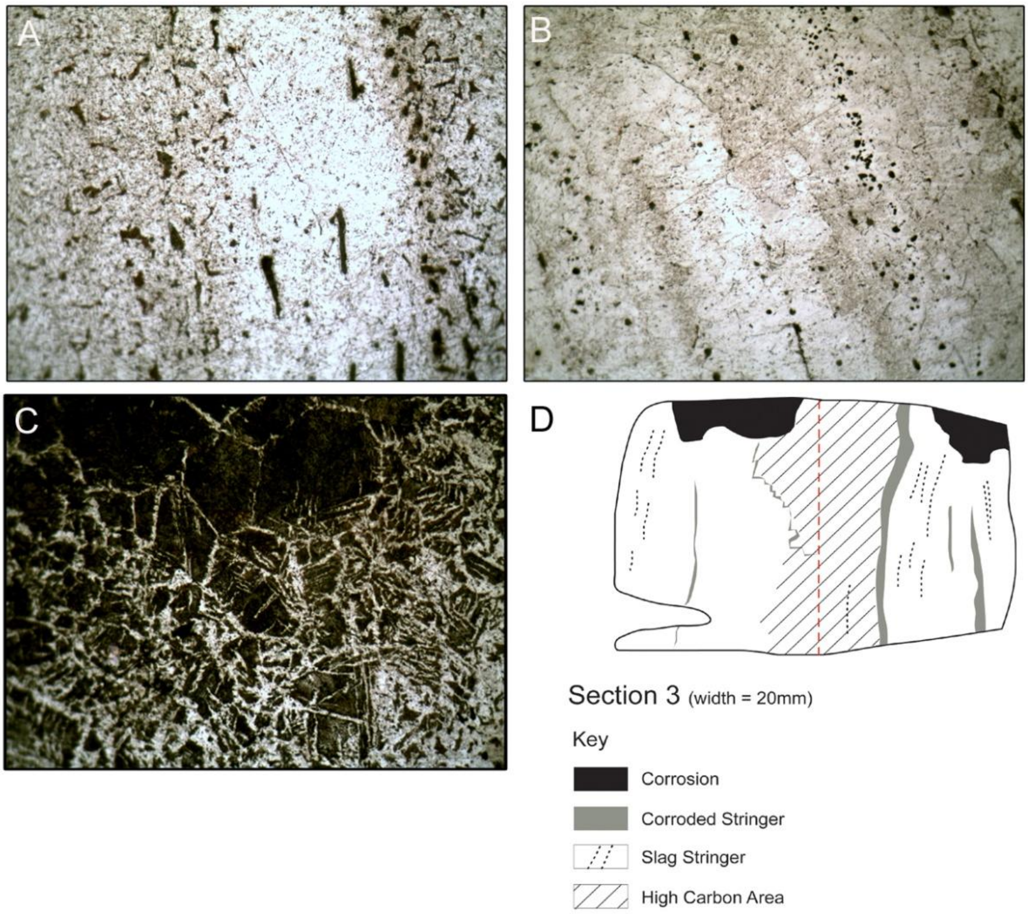

A
B
C
D
Section 3 (width = 20mm)
Key
Corrosion
Corroded Stringer
Slag Stringer
High Carbon Area

Fig. 9

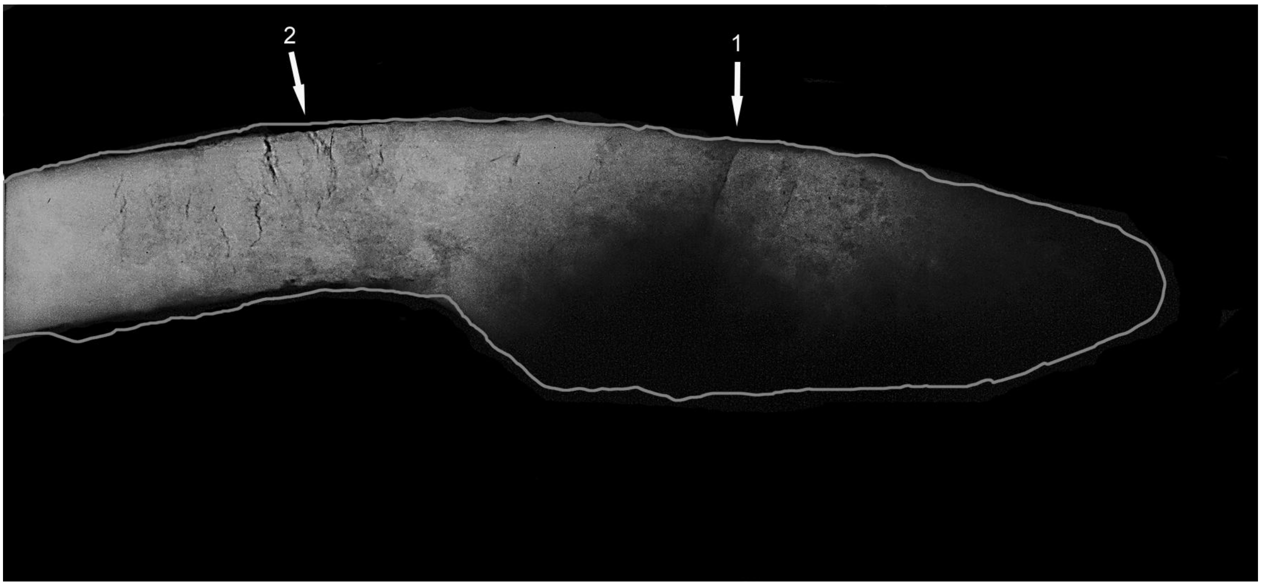


Fig. 10