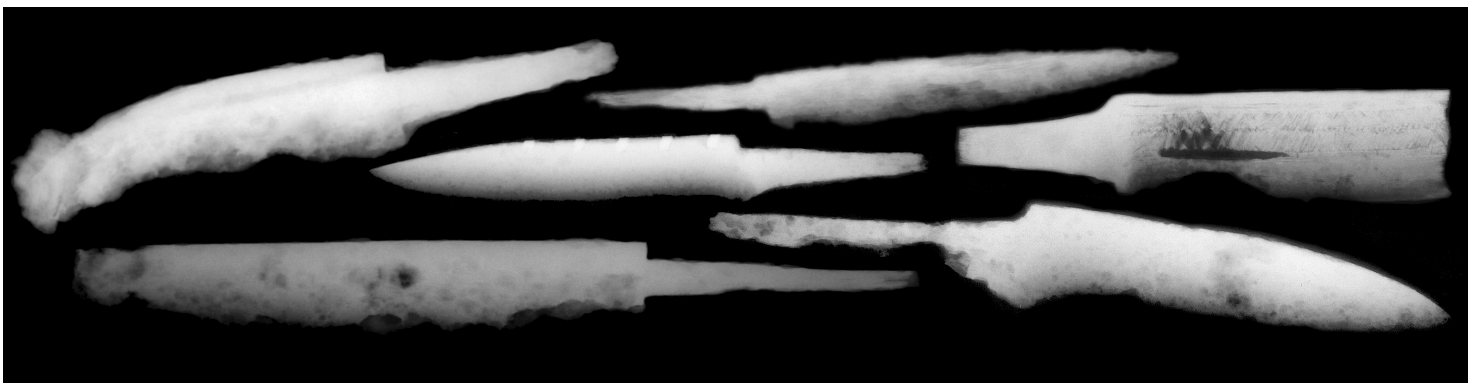


## Burdale

### X-Radiograph Report



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## Introduction

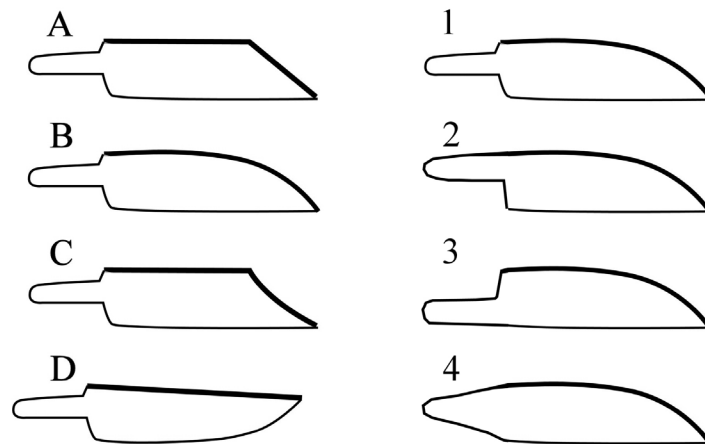
During the 1990s intensive prospection by metal detectorists led to the discovery of many new foci of Anglian and Anglo-Scandinavian settlements. Burdale is just such a site, identified on the Yorkshire Wolds valley-bottom where Anglian settlement features were identifiable from a rich palimpsest of crop marks. Excavations in Burdale during 2006-2007 revealed a multi-phase Anglian farmstead. Traces of sunken buildings and refuse pits were excavated and there was evidence for the development of a number of enclosures. Preliminary dating places the settlement in the 8th and 9th centuries (Richards 2007).

Archaeological investigations frequently yield numerous metal finds. X-radiographs of these finds can assist in the identification and interpretation of the finds, and thereby help understand the site (Fell *et al.* 2006). Whereas it is impossible to metallographically examine all iron knives at a site, x-radiographs taken can reveal the quality of preservation, the overall distributions of shapes, wear and manufacturing types, along with other features present, such as pattern welding and non-ferrous inlays (Blakelock & McDonnell 2007; Fell *et al.* 2006). In the past many knives have been examined to assess whether steel edges and/or weld lines could be identified, usually due to bad preservation of the artefacts (Blakelock & McDonnell 2007; Fell & Starley 1999; McDonnell 1992; McDonnell *et al.* 1991; Starley 1996).

## Methodology

The corrosion layers present on the knives can often mask the form of the knife, therefore the x-radiographs were used to determine the knife shape. The classification of knife forms encounters the usual problem of objects that are individually hand made, which is that no two will be identical. Classification becomes a question of grouping together objects that are similar (Blakelock & McDonnell 2007). There are three very different typologies, Evison, Ottaway and McDonnell. In the Evison typology knives were split into six groups based on whether the back was straight, curved or angled and whether the cutting edge was straight or curved (Evison 1987, 113-117). Classification using the cutting-edge shape has been shown in previous studies to be unreliable because the shape will have been changed by wear and sharpening. For this reason Ottaway developed an alternative typology for his study of Anglo-Scandinavian ironwork from Coppergate, using the shape of the knife back as this is unlikely to alter through use (Ottaway 1992a). McDonnell (McDonnell *et al.* 1991) also created a typology, based upon an earlier version of Ottaway's criteria (Ottaway 1987, 86), that took into account the blade to tang interface. As all three typologies are different a new simpler typology has been created, one based solely on the shape of the knife back (Figure 1) (Blakelock & McDonnell 2007). A separate typology will be used to

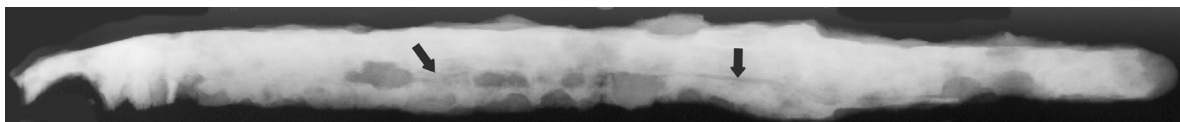
examine the tang to blade interface, identifying distinct interfaces on both sides, one side only or blades with no interface (Figure 1).



(Figure 1) Archaeological typology based on the knife back shape (left), and the blade to tang interface (right). A knife with an angle-back and a distinct blade to tang interface on both sides would therefore be A1.

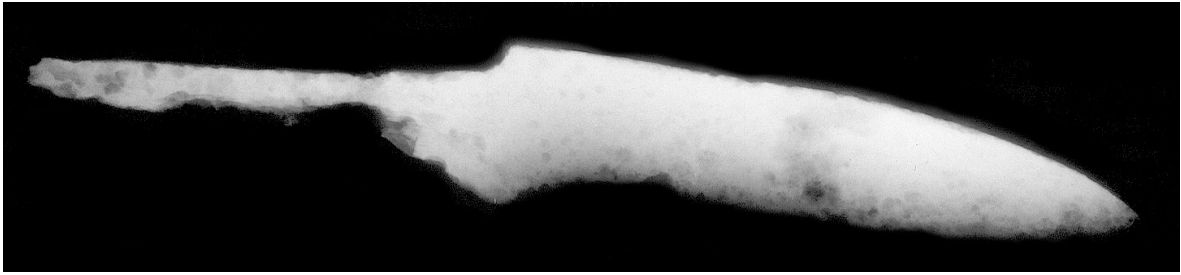
The state of preservation of the knife can be determined from the x-radiographs. This can also reveal areas of particularly bad corrosion or breakages or cracks in the knife. For this study knives were given a number from 1 to 5, with 1 being almost perfect preservation and 5 being non-existent. Particularly bad corrosion at the weld line was also noted.

X-radiographs of the knives were examined to assess whether steel edges and/or weld lines could be identified. Weld lines occur as distinct lines on x-radiographs. During the analysis of the Hamwic (McDonnell 1987a, 1987b) and Coppergate knives (McDonnell 1992) it became apparent that the high-quality steel edges had a characteristic x-radiographic image. This 'spotted' appearance was due to the presence of spheroidal slag inclusions, confirmed by metallography, which were enhanced by corrosion penetration; Figure 2 is a good example. This characteristic appearance has also been noted on x-radiographs by Fell and Starley (Fell & Starley 1999; Starley 1996). Therefore a Type 2 knife can be identified by the presence of a weld line, with (or without) the 'spotted' appearance. Type 1 and 5 knives are identified by the presence of steel with the absence of a weld line, although it is difficult to distinguish between them.



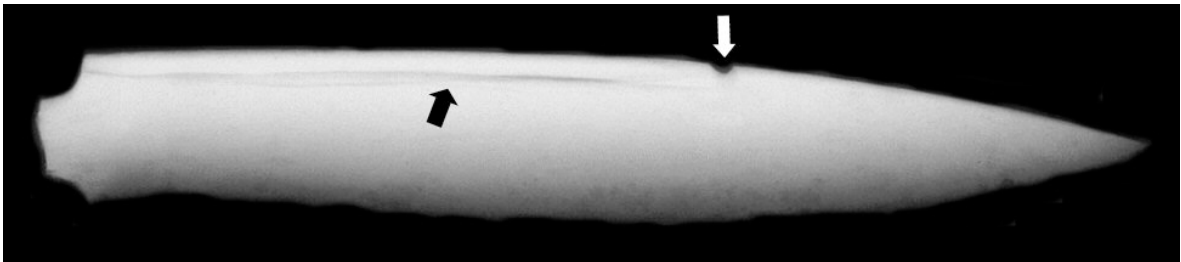
(Figure 2) X-radiograph of knife 75 (A1 type) from Burdale. Note the 'spotted' texture indicative of steel in the cutting edge (bottom strip) and a distinct weld line running along the blade (indicated by arrows).

The x-radiographs were also used to assess the amount of wear present in the knives, therefore suggesting use. Ottaway (1992a, 572-574) has suggested that the wear of knives depends on their method of construction. At Coppergate for example the type 1 'sandwich' knives frequently had an elongated S-shape (Figure 3) indicating they were heavily worn (Ottaway 1992a, 572-574).

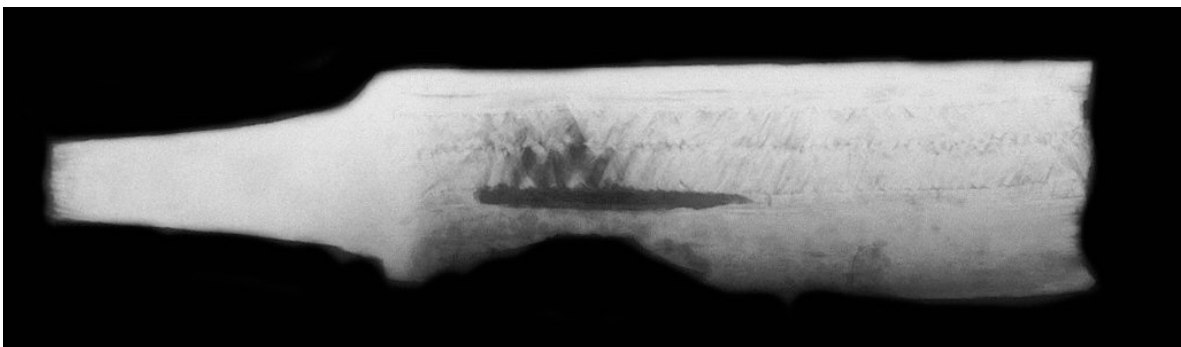


(Figure 3) X-radiograph of knife 7695 (B1 type) from Fishamble Street, Dublin showing the distinctive S-shape curved cutting edge indicating wear.

X-radiographs can also reveal other details about knives, which are often masked by the corrosion products. Transverse notches (Figure 4) have been identified on a number of knives most often at the shoulder. They have been identified at other sites like Coppergate, Thetford, Portchester and Lincoln (Ottaway 1992a, 579-582). It is unknown whether they serve some function. One form of decoration found in some knives includes indenting a line in the back of each side of the knife (Figure 4). These grooves are most often found on angle-backed knives and are relatively common from the 5<sup>th</sup>-6<sup>th</sup> century onwards (Ottaway 1992a, 579-582). Another form of decoration is the inlay and use of non-ferrous metal; this can often be seen as distinct brighter areas on x-radiographs. The final form of decoration, also rather distinct is pattern welding (Figure 5), the pinnacle of the smith's art. The effect is created by forging, twisting and welding together strips of different metals including, low carbon ferrite, phosphoric iron and high carbon steels (Anstee & Biek 1961; Piaskowski 1964), these strips would then appear as light and dark bands which could be emphasised by etching or rust (Ottaway 1992b, 481; Piaskowski 1964; Wilson 1981, 265-266). Pivoting or folding knives can also be identified using x-radiographs, using both the shape and the presence of a rivet as an indication.



(Figure 4) X-radiograph of knife 14725 (A1 type) from Christ Church Place, Dublin. This is an example of a knife with both a notch (white arrow) and an indent (black arrow) in the back.



(Figure 5) X-radiograph of knife 2475 (X1 type) from Fishamble Street, Dublin showing an excellent example of pattern welding.

## Results

All 23 knives from Burdale were examined (Table 1). Over 70% of the knives were in a good state of preservation.

The survey of the knives from Burdale has shown that the most common knives deposited were curved-backed knives; this was closely followed by the angle-back knife (Table 1). Unfortunately many of the knives were found broken therefore many were un-diagnostic. The survey also revealed that the type of tang to blade interface was varied although the majority had a distinct tang to blade interface on one side only.

Site	Number of Knives Examined	Good state of Preservation	Back Shape					Tang Interface				
			A	B	C	D	x	1	2	3	4	x
Burdale	23	17	7	9	-	1	6	6	1	9	4	3

(Table 1) A table showing the the general state of preservation and the archaeological typologies of the knives from Burdale. Note: x indicates were a knife was un-diagnostic or un-classifiable.

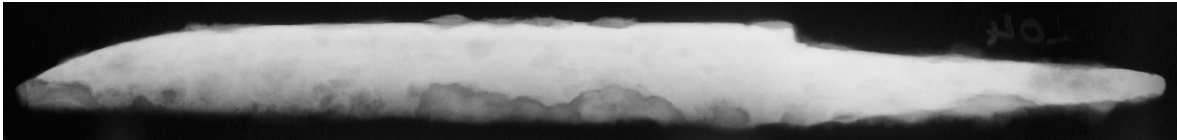
The analysis of the features (Table 2) recorded suggests that there are as many as 17 butt-welded knives. In total there were 18 knives identified as having steel cutting edges. Out of these knives only 13 were identified as type 2 butt-welded knives with steel. This leaves as many as 5 knives that could be type 1 'sandwich type' knives or homogenous steel knives.

Sites	Weld line	Steel	Weld and steel	Wear Pattern			
				None	Slight	Moderate	Heavy
Burdale	17	18	13	3	8	12	0

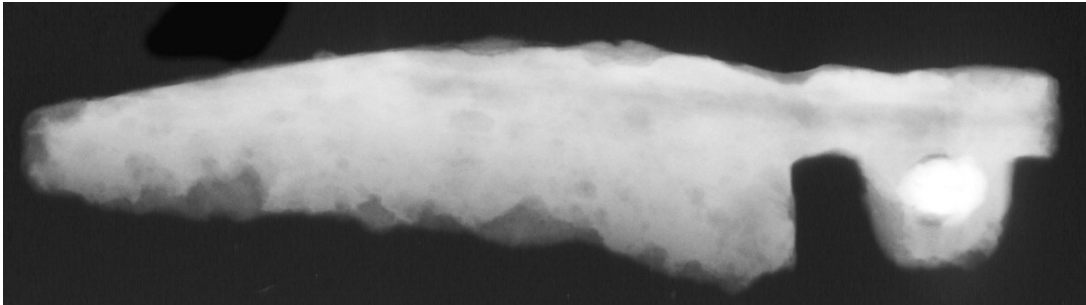
(Table 2) A table showing the features present and the amount of wear in the knives from each site.

Out of the 23 knives examined, 20 showed signs of some wear. The majority of which showed either an S-shaped curve (12) or slight (8) evidence of wear. None of the knives from Burdale had heavy wear. The frequency of wear suggests that the less hard type 0 and 3 knives or the type 1 'sandwich type' knife may be predominate.

Like at other Early Medieval sites (Ottaway 1992a, 579-582) there were a number of features present in the knives. One knife had a possible transversal notch but two, possibly three knives had indents in the back (Figure 6). In the majority of knives with notches and/or indents were angle-backed, this was also noted at Coppergate, York (Ottaway 1992a, 579-582) and Dublin (Blakelock 2007). There was also one pivoting or folding knife identified from Burdale (Figure 7). This knife had a non-ferrous pin and a form similar to pivoting knives found at Coppergate, York (Ottaway 1992a). This knife also had an indent in the back. None of the knives had any obvious form of decoration, eg pattern welding or non-ferrous inlays.



(Figure 6) X-radiograph of knife 204 (B3 type) from Burdale with faint traces of a line in the back indicating an indent is present.



(Figure 7) X-radiograph of knife 4 (AX type) from Burdale with a single non-ferrous pin and typical notch suggesting it is a pivoting or folding knife. Also note the presence of an indent in the back.

## Discussion

The survey of the knives from Burdale has shown that the most common knives deposited were curved-backed knives; this was closely followed by the angle-back knife, this pattern is very similar to that at Hamwic (McDonnell *et al.* 1991), Fishergate and Coppergate, York (Ottaway 1992a). Unexpectedly the assemblage at Burdale is different than nearby Wharram Percy which had slightly more angle backed knives than curved knives.

Site	Date	A	B	C	D	U/C	Total	Reference
<b>Settlements</b>								
West Stow, Suffolk	5 <sup>th</sup> -7 <sup>th</sup>	14	18	-	6	12	50	(West 1985)
Poundbury, Dorset	5 <sup>th</sup> -7 <sup>th</sup>	3	4	-	1	1	9	(Green <i>et al.</i> 1987, 101)
Wharram Percy	7 <sup>th</sup> -8 <sup>th</sup>	6	3	-	-	3	12	(Stamper & Croft 2000, 133-135)
Burdale	8 <sup>th</sup> -9 <sup>th</sup>	7	9	-	1	6	23	
Six Dials, Hamwic	8 <sup>th</sup> -9 <sup>th</sup>	42	66	-	-	24	132	(McDonnell <i>et al.</i> 1991)
Fishergate, York	8 <sup>th</sup> -9 <sup>th</sup>	1	15	-	-	13	29	(Rogers 1993, 1273-1276)
Coppergate, York	9 <sup>th</sup>	11	20	-	-	10	41	(Ottaway 1992a, 584)

The analysis of the features recorded suggests that there are as many as 17 butt-welded knives and possibly as many as 5 knives that could be type 1 'sandwich type' knives or homogenous steel knives. This is comparable to other analysis of Middle Saxon settlements which have shown that the type 2 knife predominated (Blakelock & McDonnell 2007).

Like at Coppergate, York (Ottaway 1992a, 579-582) there were a number of features present in the knives. The presence of not only knives with notches and indents, but also pivoting knives is unusual and may be indicative of craft activities. It is notable that at Wharram Percy no knives with transverse notches, indents or folding knives were identified (Blakelock 2006).

## Conclusion

Analysis of a number of knives from Burdale has revealed a trend in shape and manufacture similar to other Early Medieval settlements like Hamwic and York. Comparison with Wharram Percy on the other hand has revealed some interesting differences not only in the overall shape of the knives found but also the methods of manufacture. The other dramatic difference is the presence of surface features on the knives which may be an indicator of craft activity, since they mostly occur in the craft orientated urban settlements, e.g. Hamwic and York.

## References

- Anstee, J. W. & L. Biek 1961. A Study of Pattern-Welding. *Medieval Archaeology* 5:71-93.
- Blakelock, E. & G. McDonnell 2007. A Review of the Metallographic Analysis of Early Medieval Knives. *Historical Metallurgy* 41:40-56.
- Blakelock, E. S. 2006. *Analysis of knives from the Middle Saxon Rural Settlement of Wharram Percy, Yorkshire* Unpublished Undergraduate Dissertation: The University of Bradford.
- Blakelock, E. S. 2007. Viking Settlement of Dublin: X-Radiograph Report, University of Bradford: Unpublished Report.
- Evison, V. I. 1987. *Dover: the Buckland Anglo-Saxon cemetery*. Historic Buildings and Monuments Commission for England archaeological report ; no.3. London: Historic Buildings and Monuments Commission for England.
- Fell, V., Q. Mould & R. White 2006. *Guidelines on the X-radiography of archaeological metalwork*. Swindon: English Heritage.
- Fell, V. & D. Starley 1999. *A technological study of ferrous blades from the Anglo-Saxon cemeteries at Boss Hall and St Stephen's Lane – Buttermarket, Ipswich, Suffolk*. Ancient Monuments Laboratory report 18/99. Portsmouth: Ancient Monuments Laboratory report 18/99.
- Green, C. S., S. M. Davies & A. Ellison 1987. *Excavations at Poundbury, Dorchester, Dorset, 1966-1982 Vol.1. The settlements*. Dorset Natural History and Archaeological Society monograph series; no.7. Dorchester: Dorset Natural History and Archaeological Society.
- McDonnell, G. 1987a. *Analysis of Eight Iron Knives and Four Other Tools from Hamwih, Southampton*. Ancient Monuments Laboratory report 137/87. London: Ancient Monuments Laboratory report 137/87.
- McDonnell, G. 1987b. *Metallurgical Analysis of Six Iron Knives from Hamwih, Southampton*. Ancient Monuments Laboratory report 93/87. London: Ancient Monuments Laboratory report 93/87.
- McDonnell, G. 1992. Metallography of the Coppergate knives. In P. Ottaway (ed.) *Anglo-Scandinavian ironwork from 16-22 Coppergate*: 591-599. London: York Archaeological Trust.

- McDonnell, G., V. Fell & P. Andrews 1991. *The Typology of Saxon Knives from Hamwih*. London: Ancient Monuments Laboratory report 96/91.
- Ottaway, P. 1987. Anglo-Scandinavian knives from 16-22 Coppergate, York. In B. G. Scott, H. Cleere and R. F. Tylecote (eds) *The crafts of the blacksmith : essays presented to R.F. Tylecote at the 1984 symposium of the UISPP Comit e pour la Sid erurgie ancienne.*: 83-86. Belfast: UISPP Comit e pour la Sid erurgie ancienne, in conjunction with Ulster Museum.
- Ottaway, P. 1992a. *Anglo-Scandinavian ironwork from 16-22 Coppergate*. The archaeology of York; 17/6. London: York Archaeological Trust.
- Ottaway, P. 1992b. Invention and innovation: the blacksmith's craft in 8th-11th century England. In S. Jennings and A. Vince (eds) *Medieval Europe 1992: a conference on medieval archaeology in Europe, 21st-24th September 1992 at the University of York - Volume 3 Technology and Innovation*: 117-124. York: Medieval Europe 1992.
- Piaskowski, J. 1964. The manufacture of mediaeval damascened knives. *Journal of the Iron and Steel institute* 202:561-568.
- Richards, J. D. 2007. *University of York: Burdale Research Design*. York: University of York.
- Rogers, N. S. H. 1993. *Anglian and other finds from 46-54 Fishergate*. The archaeology of York; 17/9. London: York Archaeological Trust by the Council for British Archaeology.
- Stamper, P. & R. A. Croft 2000. *The South Manor area*. York University Archaeological Publications 10. York: University of York.
- Starley, D. 1996. *A technological study of knives and spearheads from the excavations at Mucking, Essex*. Ancient Monuments Laboratory report 37/96. Portsmouth: Ancient Monuments Laboratory report 37/96.
- West, S. 1985. *West Stow: the Anglo-Saxon village Vol.1, Text*. East Anglian Archaeology report 24. Ipswich: Suffolk County Council.
- Wilson, D. M. 1981. *The Archaeology of Anglo-Saxon England*. Cambridge: Cambridge University Press.