# THE MAKING OF IRON-AGE HORSE HARNESS MOUNTS: A CATALOGUE OF THE FIRED CLAY MOULD FRAGMENTS FOUND AT WALDRINGFIELD, SUFFOLK

*by* VAL RIGBY

THE DIGGING OF a grave in Waldringfield churchyard in 1984 resulted in the discovery of a number of fragments from fired clay moulds used to cast items of Iron-Age horse harness (Fig. 14). These were reported to Ipswich Museum and in October 1985 two trenches were dug near the find spot by Edward Martin of Suffolk County Council's Archaeological Service

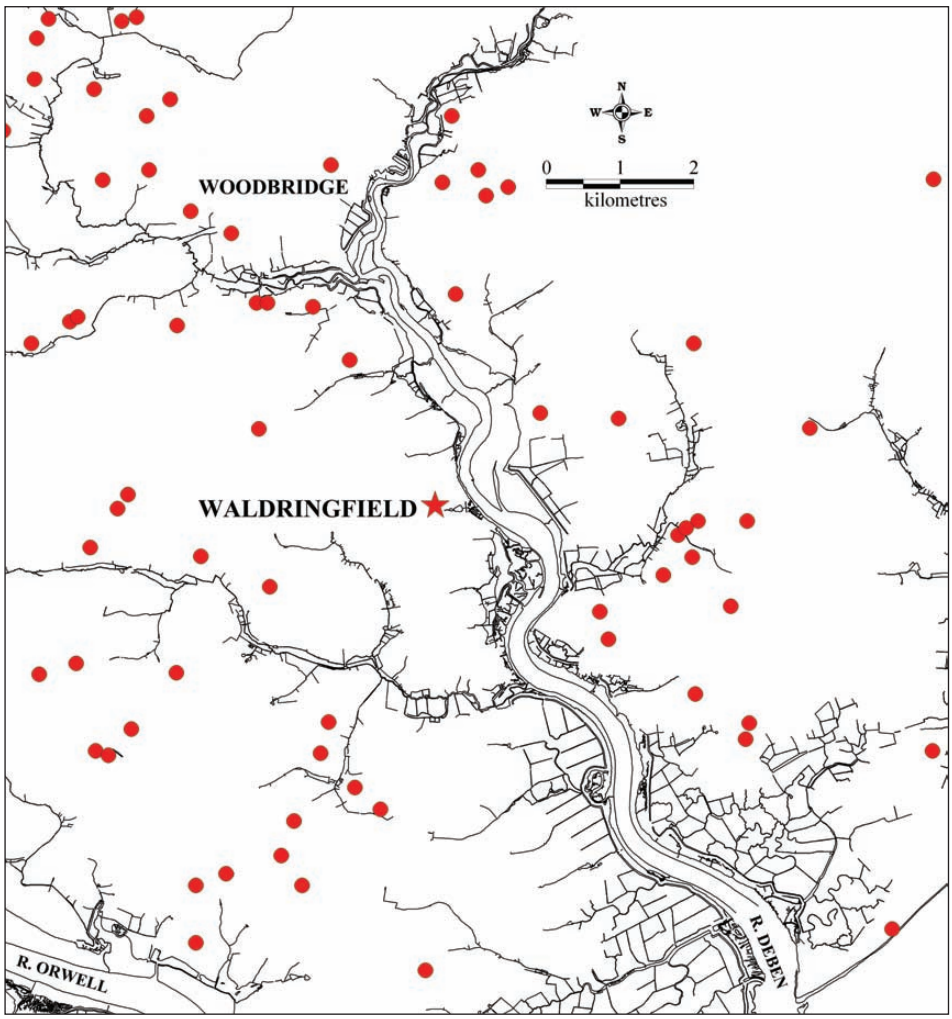



FIG. 14 – Waldringfield church: red star = site location;
red dots = Iron Age sites and finds recorded in the Suffolk HER.

and the late Hilary Feldman of Ipswich Museum, as described below. The fragments were subsequently submitted to the British Museum for recording and study and in 2007 the authors began to reassess the find using facilities provided by Suffolk County Council's Archaeological Service and the British Museum, Departments of Prehistory and Europe, and Scientific Research.

## THE 1985 EXCAVATION (Fig. 15)[1]

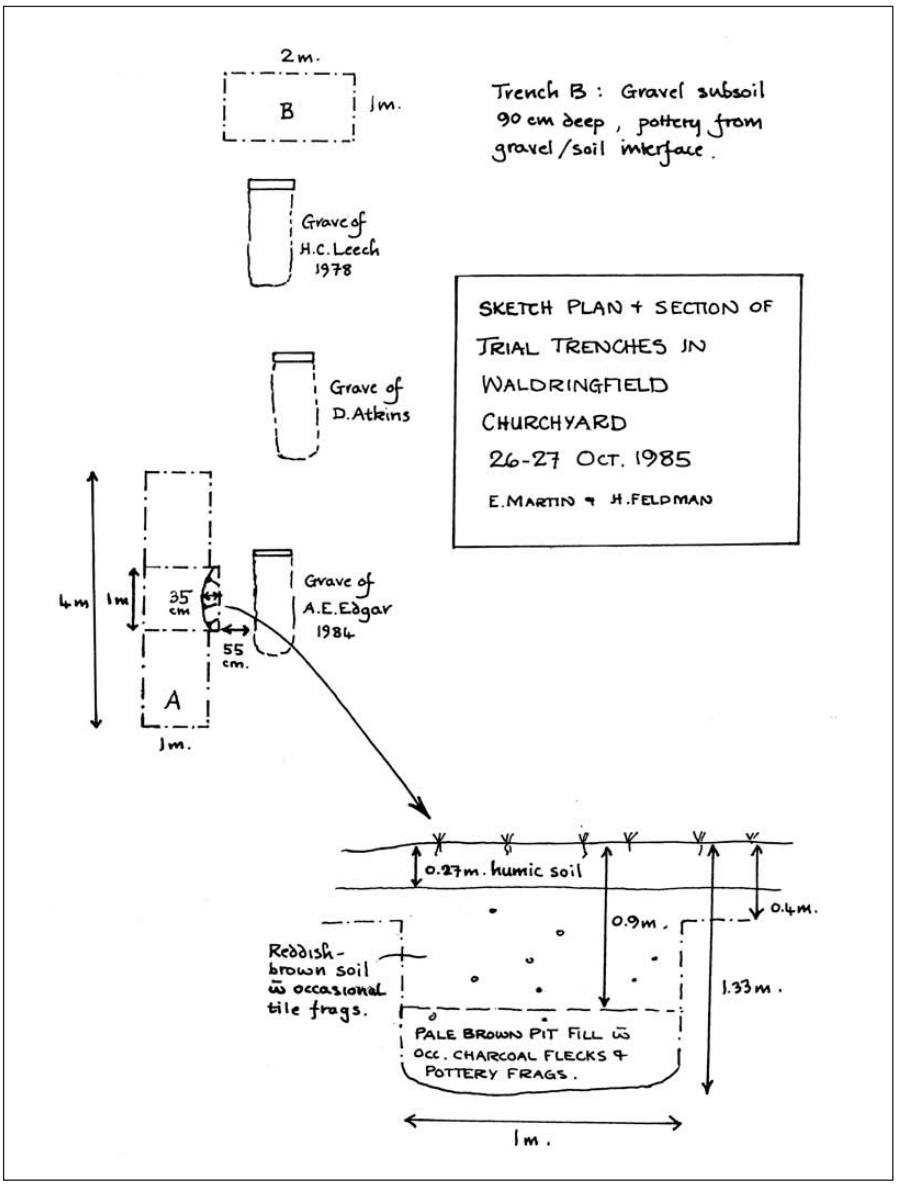



FIG. 15 – 1985 sketch plan of the trenches in Waldringfield churchyard (*Suffolk HER*).

Due to the location of the find, the excavators were limited to two trial trenches, labelled A and B. Trench A was dug 55cm from the edge of the grave where the fragments were found, but the only archaeological feature discovered was the edge of a pit that continued in the direction of the grave. The section showed that there had been a 0.9m thick build-up of soil over first-century levels, probably in the medieval period. A few small pieces of fired clay and sherds of flint-gritted pottery of Iron Age type were found, suggesting that mould fragments may have been disturbed from the pit. No evidence of structures or other metal working activity at the location was found, so that it is possible that the mould fragments were introduced by the later activity that had led to the build-up of the topsoil.

## THE MOULD FRAGMENTS

At least 19 individual investment moulds are represented, specifically 10 terrets (rein guides), 4 strap-union plates with 5 attachment loops, plus 5 miscellaneous crumbs. In total there are just 2 definite, and 2 probable, joining pieces. Typologically they can be classified as being for matched harness sets comprising 5 crescentic terrets, 4 with straight attachment bars and a pair of quadrilobe strap-unions with back loops functionally related to a set in the Westhall hoard.[2] Such sets would be decorated with a curvilinear design in reserved metal, set off by opaque red glass inlaid into excised background cells.

The 10 identifiable terret fragments are from different moulds and have unique designs. Nine are similar left or right side sections of the decorative crescent, with one a more-or-less central piece. Since both outer and inner edges are present, the orientation and size of each can be reconstructed. Each is represented by between one-tenth and one-third of the decorative crescentic zone of a single face, which means that between three-quarters and nine-tenths of the complete mould is missing (Figs 16–17).

The strap-union fragments are similarly small, but they can be identified as parts of quadrilobe strap-unions. They have no recognisable edges, so that their shape and size cannot be estimated, although designs can be orientated. Separation of the strap-union moulds would be particularly difficult because the faces were joined by fired clay 'bridges' for pierced motifs, as well as two strap loops on the reverse (Fig. 17).

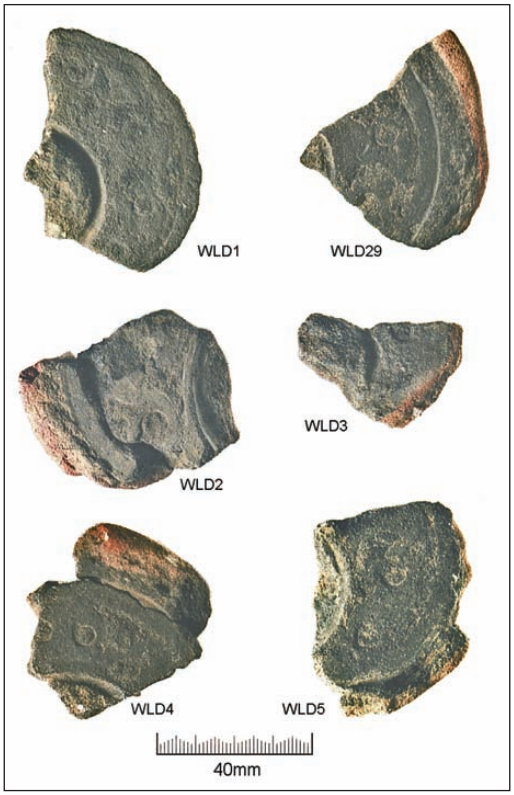
Generally, the surfaces and fracture edges are abraded but not heavily weathered, suggesting that after their initial discard the fragments were left lying loose. Allowing for their degree of fragmentation and weathering, all had been subject to several episodes of disturbance and movement between their initial fracture to remove the casting and their final resting-place in the churchyard.

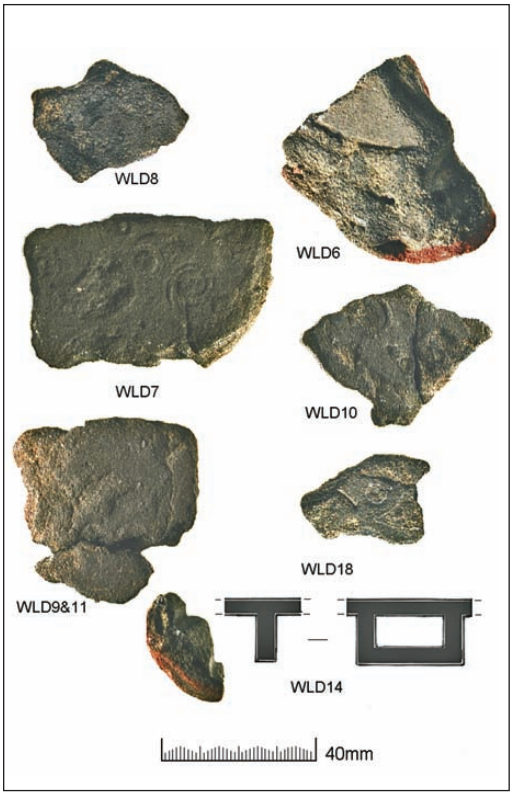
TOP LEFT *(page 27)*
FIG. 16 – Fragments from the fired clay moulds for crescentic terrets WLD1–WLD 5 and WLD29.

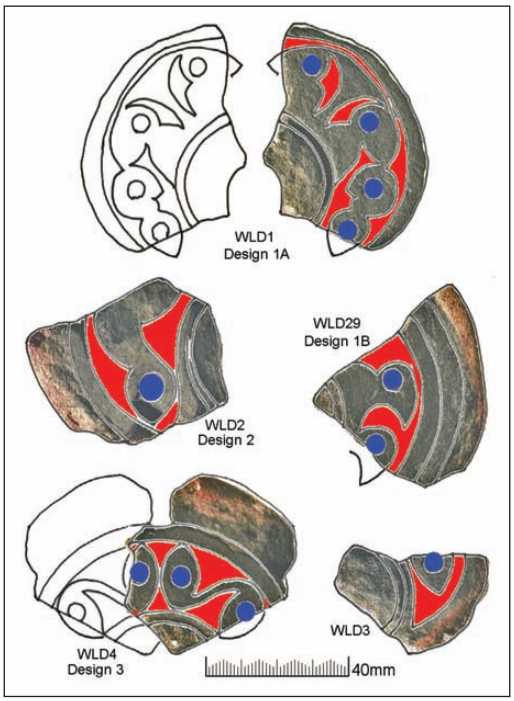
TOP RIGHT
FIG. 17 – Fragments from the fired clay moulds for crescentic terrets WLD6 and WLD8; quadrilobe strap-union places WLD7, WLD9&11; WLD10, WLD18, and one back loop with a diagrammatic X-section, WLD14.

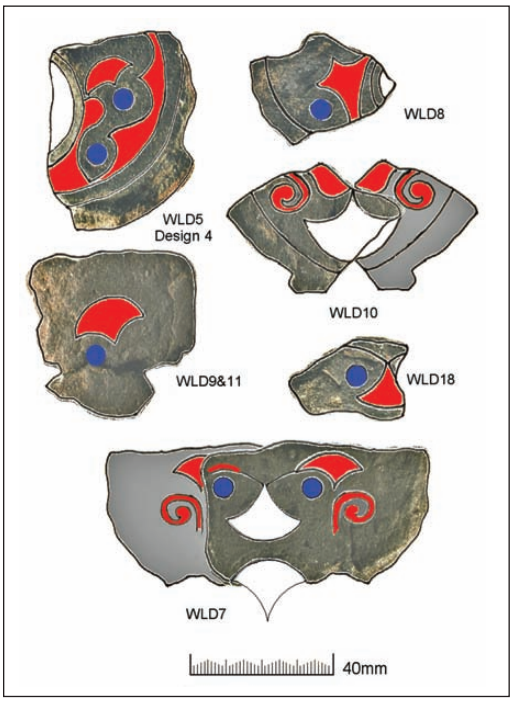
BOTTOM LEFT
FIG. 18 – Reconstruction of the designs and glass inlay used in the excised cells of the crescentic terrets WLD1–WLD4 and WLD29.

BOTTOM RIGHT
FIG. 19 – Reconstruction of the designs and glass inlay used in the excised cells of the crescentic terrets WLD5 and WLD8, and the quadrilobe strap-unions WLD7, WLD9&11, WLD10 and WLD18.


WLD1
WLD29
WLD3
WLD2
WLD4
WLD5
40mm


WLD8
WLD6
WLD7
WLD10
WLD18
WLD9&11
WLD14
40mm


WLD1
Design 1A
WLD29
Design 1B
WLD2
Design 2
WLD4
Design 3
WLD3
40mm


WLD8
WLD5
Design 4
WLD10
WLD9&11
WLD18
WLD7
40mm

## THE CATALOGUE

All are in the same iron rich coarse-grained sandy clay with occasional flint inclusions up to 2mm in diameter. The open and gritty texture of the clay matrix allowed for a contrasting finish to the surfaces of the inner faces – smooth areas for the reserved metal motifs and rough sandy background areas to be excised. It also aided the evaporation of the natural water of crystallisation and any added moisture without damage to the detail of the decorative faces. The exterior surfaces had been trimmed to shape and lightly smoothed to a finish which would not interfere with moisture loss during stages of natural drying and firing. The inner faces vary in colour from light grey to grey-black due to the reducing conditions within the moulds during firing and casting, while the exterior surfaces are variegated buff to orange-red due to exposure to oxygen in the atmosphere.

Because the fragments are so varied I have found the reconstruction of each design very difficult. I concede that here and there details could be constructed differently. Overall I am confident in what was observed and is presented here.

*Crescentic terrets*

The outer edges of the moulds follow the crescentic shape of the terret. Five have a folded outer edge and the remainder are flat, which implies that a wax model was placed between two slabs of clay, one of which was folded over round the edges and then luted to the second. After casting it seems that a mould was split along the luted join at points around the outer edge, resulting in the two distinctive fragment shapes.

To provide estimated dimensions, the depth of the crescent and its decorative zone are measured at right-angles to the outer edge of its curvature as near to the vertical axis as possible, and then the maximum depth is projected.

*WLD1 – Terret Design 1A:* A flat fragment fired with dark grey inner face. The outer edge is neatly fractured following the line of the terret edge.

The decorative zone tapers in one direction from its maximum width, allowing it to be orientated. There are no drafting lines apart from the 'eyes' which were outlined with a blunt-ended circular stamp. The design is laid out with smooth burnishing for the reserved metal motifs, and slightly raised rough texturing for excised areas of background and the circles to be drilled for 'eyes'. Weathering has reduced the differences in the surface textures of some areas, making interpretation of the design difficult. It is the largest fragment in the assemblage, comprising about one-third of the crescent.

The motifs are:

a) Four 'bird-head' motifs in reserved metal.
b) Four outlined circular 'eyes' to be drilled as recesses for glass inlay – probably blue. The circle outlines are 5mm in diameter, slightly recessed, and rather larger than the textured spot they enclose.
c) Part of a pointed lobe terminal.

A mirrored repeat of a) to c) would complete most of the design, but there is no indication of how the missing central segment was developed. Although zoomorphic, the design conforms to the Waldringfield grouping by ending with pointed lobe terminals. No parallels for the motifs have been identified amongst any piece of harness equipment, the only related decoration being WLD29.

Dimensions:

Mould thickness – 8mm.
Depth of the crescent – 30mm, tapering to 25mm.
Depth of decorative zone – 20mm, tapering to 14mm.

Suggested overall dimensions of the finished terret:

Maximum width – 100mm.
Maximum depth – 80mm.

*WLD2 – Terret Design 2:* A fragment with a folded outer edge fired with a light grey inner face.

The decorative zone tapers in one direction towards a stop. The reserved metal motifs are smooth, and

the excised background and an 'eye' are slightly raised and rough in texture. Even allowing for differential weathering of the fragments, this mould stands out from the rest as being by a different hand since there are clear edges to the motifs. The surviving motifs comprise about one-quarter of the crescent. The motifs are:

a) One pointed lobe motif forming the terminal of an expanding scroll in reserved metal.
b) One circular 'eye' in the lobe to be drilled for glass inlay. The 'eye' is 9mm in diameter and has a recessed outline encircling a textured spot.

The shaping of the decorative zone, and the angle of the pointed lobe motif with its expanding development, resemble the equivalent section of a large terret with hollow stops found at Weybread, Suffolk, some twenty miles to the north.[3] If it is related to Weybread, then it is likely that the 'eye' was inlaid with the same red glass as the background cells.

Dimensions:

Mould thickness – 10mm.
Depth of the crescent – 40mm, tapering to 25mm.
Depth of decorative zone – 30mm deep, tapering to a point.

Suggested overall dimensions of the finished terret:

Maximum width – 120mm.
Maximum depth – 100m

*WLD3:* A flat fragment fired with a dark grey inner face. The outer edge is neatly fractured and follows the line of the terret crescent.

The crescent tapers in one direction and merges with part of a solid stop. The reserved metal motifs are smooth, and the excised background and an 'eye' are slightly raised and rough in texture. There is little difference in the surface texture and no drafting lines.

Only about one-tenth of the design survives and the motifs are:

a) One 'pointed lobe' motif in reserved metal forming a terminal of the design.
b) One circular 'eye' in the lobe to be drilled for glass inlay, probably blue. The circle is 7mm in diameter, its outline is sharp and the reserved centre recessed.

The suggested overall dimensions are similar to WLD1 and the motif may have formed the terminal of a similar design.

Dimensions:

Mould thickness – 9mm.
Decorative zone – tapers from 20mm to a point.

Suggested overall dimensions of the finished terret:

Terret crescent – tapers from 25mm to 10mm at the stop.
Maximum width – 100mm.
Maximum depth – 80mm.

*WLD4 – Terret Design 3:* A central fragment with folded outer edge and the inner face fired to dark grey-black. The folded edge is at least 2mm deep.

The crescent tapers slightly in one direction. The reserved metal motifs are smooth, and the excised background and three 'eyes' are slightly raised and rough in texture. The different textures are clear. About one quarter of the design survives.

The motifs are:

a) One almost complete S-motif with pointed lobe terminals adjoining part of an opposed partner in reserved metal.
b) Three outlined circular 'eyes' 5mm in diameter in the pointed lobes to be drilled for glass inlay, probably blue.

The position of the mould fragment near the vertical axis would allow sufficient space in the decorative zone for a total of four repeats of the S-motif arranged two by two symmetrically around the crescent with an out-turned pointed lobe forming the terminal. The design is unique.

Dimensions:

Mould thickness – 8mm.
Depth of the crescent – 30mm, tapering to 25mm.
Depth of decorative zone – 20mm, tapering to 15mm.

Suggested overall dimensions of the finished terret:
Maximum width – 100mm.
Maximum depth – 80mm.

*WLD5 – Terret Design 4:* A fragment with folded outer edge and the inner face fired grey-black.

The crescent tapers in one direction. The projected position of the fragment suggests that it adjoined a stop. The design is partly obscured by weathering. The reserved metal motifs are smooth, and the excised background and two 'eyes' are slightly raised and rough in texture. One parachute-shaped triangular motif and the 'eyes' are still definitely outlined. About one-quarter of the design survives.
The motifs are:
a) A bird-shape with an open beak and a pointed-lobe tail which forms the terminal in reserved metal.
b) A parachute-shaped triangle forming the beak of the bird-shape to be excised and inlaid with red glass.
c) Two circular 'eyes' at the head and tail outlined with incised circles 6mm in diameter to be drilled for glass inlay, probably blue.

A mirrored repeat of a) to c) would complete the outer arcs of the design, but there is no indication of how the missing central segment was developed. The design bears some resemblance to WLD2, but on a smaller scale and with different texturing, so implying a different hand, in which case they are unlikely to have formed part of a set. The parachute-shaped triangle is paralleled on the strap union fragments.
Dimensions:
Mould thickness – 8mm.
Depth of the crescent – 30mm, tapering to 25mm.
Depth of decorative zone – 30mm, deep tapering to a point at 25mm.
Suggested overall dimensions of the finished terret:
Maximum width – 120mm.
Maximum depth – 100mm.

*WLD6:* A plain fragment with folded outer edge. Fired with a light grey inner face; the fired colours are similar to WLD2.

The surface is smooth and there is an impression of part of one stop set at an angle, so that the fragment formed part of the plain segment where the crescent joined the attachment bar.
Dimensions:
Surviving depth of stop – 6mm maximum.
Estimated diameter of stop – 12+mm.
Estimated diameter of inner crescent – 100mm.

*WLD8:* A small flat fragment fired with a dark grey inner face. It is severely abraded.

Only a small segment of the inner crescent moulding survives to allow it to be orientated. Due to weathering, little can be distinguished, but the rough and burnished shapes suggest that, like WLD2 and WLD6, the decorative zone terminated with an out-turned curving taper. The surviving depth of the crescent suggests it was a large terret.
The motifs are:
a) One pointed lobe motif in reserved metal forming a terminal of the design.
b) One 'eye' 5mm in diameter to be drilled for blue glass inlay.
Dimensions:
Mould thickness – 12mm.
Depth of the crescent – 35mm.
Depth of decorative zone – 25mm.

*WLD29 – Terret Design 1B:* A fragment with folded outer edge and the inner face fired grey.

The crescent tapers slightly in one direction, suggesting that the fragment is part of the upper segment of the crescent. The reserved metal motifs are smooth and the excised background and two 'eyes' are slightly raised and rough in texture. The outer edge of the crescent was outlined using a snub-nosed tool.
The motifs are:
a) One definite and one probable 'bird-head' motif facing the terminal.

b) Two 'eyes' in the 'bird-heads' outlined with incised circles 5mm in diameter to be drilled for blue glass inlay.

About one-fifth of the design survives and appears to be comprised solely of repeats of the same zoomorphic motif. A mirrored repeat of a) to b) would complete about half of the design, but there is no indication of how the missing central segment or terminals were developed. Like WLD1, there are no recorded parallels.

Dimensions:

Mould thickness – 10mm.
Depth of the crescent – 30mm.
Depth of decorative zone – 20mm.

Suggested overall dimensions of the finished terret:

Maximum width – 100mm.
Maximum depth – 80mm.

*Unidentified terret fragments*

*WLD19 and 22:* Too small to recognise any features.

*Quadrilobe strap-unions*

Investment moulds were necessary to produce the concealed loops on the back of the plate. There is no evidence for the finished shape or size of the plates. The designs on the decorated fragments were prepared using the same techniques as the terret moulds; due to weathering the low-relief finish makes it difficult to interpret the overall designs, and no reconstruction has been attempted. The position of pierced motifs can be identified because these areas have more obviously raised and broken surfaces, caused by remnants of the clay bridges which formed the reserves necessary for each cut-out, and which consequently joined the two faces of the mould together.

Parachute-shaped triangles of similar size are repeated on all four strap-union fragments either as excised cells or cut-outs. They are formed with three intersected arcs from a circle. Judging from existing examples, most cells were inlaid with red, the exceptions being blue or yellow 'eyes' and yellow 'curls'. The identification of blue and white marbled glass in the 'eyes' of the Westhall strap-unions suggests that slices from raw glass canes were used. The diameter of the canes may have predetermined that of the eyes, and hence the drill bit used to prepare the cells and the circular stamp used on the clay mould.

*WLD7:* The largest flat fragment with no definite outer edge or loop attachments on the reverse. The fracture edges are weathered. The inner face is grey.

Little of the design survives, but it can be orientated due to the position of two opposed parachute-shaped triangles, interpreted as pierced motifs because of their markedly raised and rough surfaces, caused when the clay bridges were broken open.

The motifs are:

a) Two opposed pierced parachute-shaped triangles composed of arcs from three overlapped circles about 35mm in diameter.
b) Two pointed lobes to form the concave sides of one of the parachute-shaped triangles.
c) Two outlined 'eyes', 6mm in diameter, symmetrically placed on either side of one triangle and to be drilled for glass inlay. Typically the glass would be red, blue or yellow.
d) One trumpet-shaped motif placed below, and partly enclosing, the 'eye' to be excised for red glass inlay.
e) One curl to be excised for glass inlay placed above the 'eye' on the most complete area of the mould. Usually the glass of curls is red, but on occasional pieces it is yellow.

The symmetrical arrangement of the surviving 'eyes' implies that this section can be completed with opposed copies of d) and e). If the overall design included an opposed repeat of the restored section, it would result in a large example of the type.

Dimensions:

Mould thickness – 10mm.

*WLD9 and 11:* Two joining flat fragments with no outer edges or loop attachments on the reverse. The fracture edges are weathered. The inner face is grey.

The design survives in such worn low relief that nothing of the design in reserved metal can be distinguished and the motifs appear rather randomly placed.

The identified motifs are:

a) One parachute-shaped triangular motif to be excised for red glass inlay.
b) One outlined 'eye', 7mm in diameter, to be drilled for glass inlay, placed within the concave arc of the triangle, with another similar eye close by.

As on WLD7 the plain areas would have been engraved.

Dimensions:

Mould thickness – 10mm.

*WLD 10:* A small flat fragment with no outer edges or loop attachments on the reverse. The fracture edges are weathered. The inner face is grey.

Little of the design survives, but it can be orientated due to the position of a parachute-shaped motif interpreted as pierced because of the markedly raised and rough surface caused when the clay reserve was fractured. The areas of reserved metal bear the impression of facets scraped with a flat-ended spatula.

The motifs are:

a) One parachute-shaped triangle, probably pierced.
b) Two opposed 'bird-heads', with upturned beaks in reserved metal arranged symmetrically to form the concave sides of the triangle.
c) One 'curl' arranged as an eye in the most complete 'bird-head' to be excised for red glass inlay.

The symmetrical arrangement of the surviving curls implies that this segment of the design can be completed with opposed copies of b) and c), and the overall design would include an opposed repeat of the restoration.

Dimensions:

Mould thickness – 8mm.

*WLD18:* A small flat fragment with no outer edges or loop attachments on the reverse. The fracture edges are weathered. The inner face is dark grey.

Little of the design survives, but if the interpretation is correct then it can be orientated.

The motifs are:

a) Part of parachute-shaped triangle to be excised for glass inlay.
b) A pair of opposed pointed lobe motifs in reserved metal forming the concave arcs of the triangle.
c) One outlined 'eye' in the most complete lobe to be drilled for blue glass inlay.

This section was completed by an opposed repeat of the surviving lobed motif and the overall design would include at least one opposed repeat of the restoration.

*Unidentified plate fragments*

*WLD16 and 26 and WLD20 and 28:* Too small for interpretation.

*Attachment loops*

There are three similar fragments, which had been broken from the outer edge of different moulds and can be vertically orientated to show the finished edge and minimum thickness of the decorated plate and the position of one loop. They provide some evidence for the length and clearance of the loop and the overall thickness of the complete mould. Given the size of the fragments, the dimensions are all estimated.

*WLD12:* Fired with grey inner surfaces.

Strap-union:

Minimum thickness of the plate – 3mm.

The loop:

Diameter – 5mm.
External length – 25mm.
Internal length – 18mm.
Vertical clearance – 9mm.

Thickness of the complete mould – 31+mm.

*WLD13:* Fired with grey inner surfaces.
Strap-union:
Minimum thickness of the plate – 3mm.
The loop:
Diameter – 5mm.
External length – 30mm.
Internal length – 21mm.
Vertical clearance – 10mm.
Thickness of the complete mould – 33+mm.

*WLD14:* Fired with grey inner surfaces.
Strap-union:
Minimum thickness of the plate – 4mm.
The loop:
Diameter – 5mm.
External length – 25mm.
Internal length – 18mm.
Vertical clearance – 8mm.
Thickness of the complete mould – 30+mm.

*WLD15 and WLD17:* Two fragments too small for measurement.

*Miscellaneous fragments*
*WLD21, 23-25 and 27:* Tiny crumbs too small for even a guess.

## ASSESSMENT OF THE POSSIBLE MANUFACTURING TECHNIQUES

While the Waldringfield mould fragments are easily equated to known terret and strap-union types, cast using a variation of the 'lost wax' method and then inlaid with coloured glass, it is difficult to envisage precisely how they were used. Since there is virtually no surface relief, they could not have been used in the standard technique of lost wax casting, where the cells were excised into a wax model of the artefact before being encased in wet clay. Such a technique posed particular problems for flat thin artefacts, decorated on both faces and functioning in matched sets like the crescentic terrets in the Westhall hoard, Suffolk.[4] The model could easily be pierced when cutting out the cells, or damaged when working on the reverse, and the result would be fragile. There was also the tricky question of how to draft matching designs onto both faces of the first terret of a set when only one face was visible to the decorator at any one time.

Given these problems, there are different interpretations of the function of the Waldringfield terret moulds. It is assumed that when cast both faces bore the same design, although they could have been different.[5] Both faces of the wax model may not have been similarly prepared: whilst one face was textured, the reverse could have been excised to reduce the amount of cold-working. Regardless of which type of wax model was made, the first terret may have been cast and then used as the pattern for impressing the remaining models, to complete the set or even several other sets.

Single-faced strap-unions presented different problems: how to cast motifs which pierced the plate, along with two three-dimensional attachment loops on the back (Fig. 17). A wax model was sculpted, with the decoration drafted on the front of the plate using the same textural technique as the terrets, with any pierced motifs cut out. Two matching wax loops were attached in parallel positions on the reverse. The finished model was carefully invested, so that the loops were completely encased and the pierced motifs filled with wet clay so joining the both faces of the mould where necessary.

Since the textural differences were slight, a design may have been redefined on the casting with fine engraved lines. Examination of objects where the glass is missing shows that circular 'eyes' have the typical 3D shape made by drill bits, whilst background cells have ribbed gouging on the base. The excising was presumably executed with the aid of shaped hard edges to ensure that the cell walls were smooth.[6] Once the surfaces had been polished, fine lines were engraved into the reserved metal to outline and link motifs into an integrated design. It is likely that the beaks on the 'bird-heads' of WLD1 and WLD29, and also the pointed lobe motifs, were engraved to emphasise their zoomorphic connections.

Inlaying double-faced terrets presented the major technical problem of how to deal with both faces in sequence without losing any inlay in the heating process. Opaque red glass is typically the main, or frequently the sole, colour used for the inlay. It is a soda-lime-silica glass that was coloured and opacified by adding varying amounts of copper and lead oxides. Scientific analysis shows that the brightest red was produced by a high copper and lead mix (5–12 per cent copper and 20–40 per cent lead).[7] It retains its colour when heated in air at a temperature sufficiently high to make it pliable, but below the actual melting point when it would oxidise to blue and flow. It is proposed that fragmented and softened red glass was worked into prepared background cells, one face at a time, using a limited heat source rather than powdered glass fritt.

## THE COMPOSITION OF THE HARNESS SETS

Only terrets and strap-union moulds have been identified in the assemblage, and judging from the evidence provided by excavated chariot burials they were used to cast copper alloy components for the yoke: a full set comprising five terrets spaced along the yoke and a strap-union at each end.[8] The fragments, however, belong to different designs and are items from ten different sets of terrets and four pairs of strap-unions, raising the question whether they are the products of the same melt – single items for ten sets cast together, or are they all that survives from a series of up to ten melts each producing a full matched set? In addition, a pair of linch-pins was needed to complete the functional equipment of the chariot, but they could be made of horn, iron, or iron with cast copper alloy terminals top and bottom, and so were not integral to all sets and may have been produced by specialist smiths.

Based on the portion of each surviving terret mould, the original number of fragments produced when the castings were removed can be estimated at twelve minimum, which means that only a small proportion of the original debris has been recovered. If all pieces from ten sets were discarded in the same dump at more or less the same time, why are there no definite, or even possible, design matches, attachment bars and other relevant debris? Similarly, the absence of pieces from sprue cups, crucibles, fired clay debris, and metallic waste suggests that the initial waste heaps at the furnace were disturbed by contemporary sorting and recycling. There is no way of assessing how representative of the total Waldringfield output the surviving group is, and it remains to be discovered if the Waldringfield smiths specialised in yoke equipment.

## CONCLUSION

To date, Waldringfield is the only site where the moulds for crescentic terrets and quadrilobe strap unions have been found. No evidence of structures for metal-working activity were found, and since only a small proportion of the original debris has been recovered, the surviving materials must have been widely dispersed by later land use. The sparse debris was further turned and redeposited by churchyard activity in modern times, so that it is possible that moulds were introduced by the later activity which led to the build-up of the topsoil, and the actual smithing area could be at some distance from the find-spot.

The only dating evidence is a small assemblage of pottery recovered during the excavation. The sherds are small and abraded with no joins, and none can be closely dated. There is one foot-ring jar base and a few miscellaneous body sherds of Romano-British grey coarse wares dating to the late first or second centuries which do not provide any secure dating evidence for the use or initial discarding of the moulds. Furthermore, none of the typological parallels for Waldringfield is from a secure excavated context. The discovery of a fragmentary crescentic terret of British type at the Claudio-Neronian fort of Hofheim, Taunus, can provide a *terminus ante quem* of *c.* AD 60 for its manufacture and that of the group.[9] A similar date is argued for the horse trappings found in the Folly Lane burial, St Albans, Hertfordshire, where the associated pottery belongs to the period between the Roman invasion and the Boudiccan rebellion.[10] The deceased was identified as an adult. A pre-Claudian date of manufacture can be calculated if the harness equipment was not made for the funerary ceremony but was gifted when the deceased assumed maturity, therefore, depending on age at death, the date of manufacture ranges between AD 15 and 30. Should the pieces have been a family inheritance, sacrificed because there were no obvious successors in a period of defeat and Roman occupation, then a date in the first century BC emerges. Due to intense heat and fragmentation before burial, it is not possible to see any degree of wear. The overall date range for crescentic terrets and quadrilobe strap-unions is usually estimated within the period between 50 BC and early Roman occupation.

Despite its small size, the Waldringfield assemblage adds considerably to the repertoire of designs on crescentic terrets, since four of the five most complete terrets are without parallels and only one, WLD2, may relate to a recorded find. The most unusual motifs are the so-called 'bird-heads' of WLD1 and WLD29, which are notably zoomorphic and for this reason are classified together as Terret Style 1. The decorative crescents on five terrets terminate in similar pointed lobes, with 'eyes', and this is a characteristic shared by a number of finds, all with different designs, most notably the matched set of five in the Westhall hoard, Suffolk, and small examples found at Richborough, Kent and Lakenheath, Suffolk, which integrate the Waldringfield workshop into a more general stylistic grouping.[11]

Like the terrets, the designs on the quadrilobe strap-unions are unique. Similar pointed lobes with 'eyes' are significant motifs in three of the four designs: WLD7, WLD9 and 11, and WLD18. The fourth, WLD10, is intriguing and different, since it appears to include opposed pairs of 'bird-heads', but with upturned beaks and curls for 'eyes', so outside the usual range of Waldringfield motifs. As they survive, the largest mould fragments have extensive areas of plain reserved metal so, judging from existing examples, the excised motifs were entwined with engraved lines and motifs into a complex overall design. Similarly, whilst the background cells would have been inlaid with red, the curls could be red or yellow and the 'eyes' are most likely to have been variations of blue, red or yellow.

During the first century BC there appears to have been an increasing demand for objects with clear bright colours, particularly red and typified by imported pottery and glass, as seen in the finds at Camulodunum, so the extensive use of red glass inlay can be seen as part of this trend. Where early red glass was made is not known, but current research suggests that the source for all pre-conquest pieces sampled was in the eastern Mediterranean, where its manufacture in the Roman period is known, and that it was imported as raw ingots. One such ingot was found in Fish Street, London.[12] It is roughly oval – 20mm by 50mm by 60mm, and weighs 0.16 kg, and chemical analysis has identified its composition as leaded soda-lime-silica glass, similar to those used in the Iron Age and Roman periods. There is no convincing evidence that the technology to make this type of glass was ever introduced to pre-conquest Britain, which may help to explain why its use in decoration is limited. At the very least its import would be haphazard and expensive.

The Waldringfield moulds, and other related harness mounts, are objects of conspicuous consumption and display, and as such provide an insight into the attitudes of both the smiths and the status-conscious British owners. They are significantly more colourful and flamboyant than their earlier equivalents, posed unique technical problems, took at least twice the time to finish as comparable single-faced items, and all required the import of rare coloured glass from the Mediterranean area. Even though only one face of the object would have been visible at a time, the owners would have had the satisfaction of knowing that any onlooker would realise that it was double sided and appreciate its magnificence. Although engaged to cast matched sets the makers apparently ignored a technique which would have assisted them to standardise and maximise their output, preferring methods which promoted variation whilst capitalising on their hand-eye expertise.[13]

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The assessment of the possible manufacturing techniques depends on the results of chemical analyses of ancient coloured glass by Professor Ian Freestone, with Colleen Stapleton, when in the Department of Scientific Research, British Museum. Two other colleagues, Catherine Johns and Susan Youngs, provided invaluable advice and information about Roman and medieval techniques. Over many years we discussed in detail how the composition and different melting points could fundamentally affect all so-called enamelling techniques.

## NOTES

1 Martin and Feldman 1986, 155–56. Also SCCAS archive plan WLD 001: 'Sketch plan and section of trial trenches in Waldringfield churchyard 26–27 Oct. 1986', E.A. Martin and H. Feldman.

2 BM Registration 1855, 5–19, 1–5, 9–10. The objects were part of what is described in the *Medieval and Later Register* as a hoard of metal objects discovered by chance in draining Millpost Field in the spring of 1855. There are no further details. Since the objects include a Roman coin, a lamp, a sherd of samian, other pottery and a flue tile, it is presumed that the site of a later Roman settlement had also been disturbed.

3 Martin 1978, 137–40. It is described as a chance find.

4 BM Registration 1855, 5–19, 1–5, 9–10.

5 See the find at Banham, Norfolk, which could be a terret or a metal pattern for impressing wax models for two different designs. Gurney (ed.) 1998, 184–85, Fig 2, A. Object not examined by VR.

6 See the second linch-pin head found at Colne Fen, Huntingdonshire: Tebbutt and Fox 1961, 235–38, pl. XLV, 2. When examined in detail, the cell edges of this linch-pin are scalloped and uneven and floor is grooved with gouge impressions. Although not visible in the publication, these details are recorded on photographs by Dave Webb of Cambridge Archaeological Unit.

7 Freestone *et al* 2003, 144, table 16.1, columns 1–2 and 5–6.

8 The idea that the Waldringfield workshops specialised in yoke furniture was proposed by Dr Mansel Spratling. See the layout of five terrets in Kirkburn, Burial K6, Stead 1991, 13–19, fig. 127.

9 Ritterling 1913, 37, pl. XIII. The original information was provided by Mansel Spratling.

10 Foster and Northover 1999, 133–43; Rigby 1999, 185.

11 Bushe-Foxe 1949, 106, pl. 1, 2; Foster 2002, fig. 37 and cover; Ashmolean Museum 1927.4615.

12 Freestone *et al.* 2003, 144, table 16.1; BM Registration 1932, 10–19, 8.

13 For the composition of ancient glass used to inlay other Iron Age artefacts and discussion of the techniques used, see Stapleton 2006, 129; and Rigby 2006, 115–21.

## BIBLIOGRAPHY

Bushe-Foxe, J.P., 1949. *Fourth Report on the excavations of the Roman Fort at Richborough, Kent*. Report no. XVI of the Research Committee of the Society of Antiquaries, London.

Foster, J., 2002. *Life and Death in the Iron Age*. Oxford.

Foster, J. and Northover, P., 1999. 'The Funerary Finds' in R. Niblett, *The excavation of a Ceremonial Site at Folly Lane, Verulamium,* 135–43. London.

Freestone, I., Stapleton, C. P., and Rigby, V, 2003. 'The production of glass and enamel in the late Iron Age, Roman and Byzantine Periods' in C. Entwistle, (ed.), *Through a Glass Brightly: Studies in Byzantine and Medieval Art and Archaeology Presented to David Buckton,* 141–54. Oxford.

Gurney, D. (ed.), 1998. 'Archaeological Finds in Norfolk 1997', *Norfolk Archaeol.,* **43**, 184–85.

Martin, E. A., 1978. 'A New Iron Age Terret from Weybread', *Proc. Suffolk Inst. Archaeol.,* XXX, 137–40.

Martin, E. A. and Feldman, H., 1986. 'Waldringfield', in 'Archaeology in Suffolk 1985', *Proc. Suffolk Inst. Archaeol,* XXXVI, 155–56.

Rigby, V., 1999. 'Gallo-Belgic Wares and Local Imitations' in R. Niblett, *The excavation of a Ceremonial Site at Folly Lane, Verulamium,* 182–92. London.

Rigby, V., 2006. 'Weapons and fittings with enamelled decoration' in Stead 2006, 115–21.

Ritterling, E., 1913. *Das Frührömische Lager bei Hofheim im Taunus,* Annalen des Vereins für Nassauische Altertumskunde und Geschichtsforschungen, XI.

Spratling, M. G., 1972. 'Southern British decorated bronzes of the late pre-Roman Iron Age.' Unpublished PhD thesis, University of London.

Stapleton, C.P., 2005. 'Analysis of the enamels' in Stead 2006, 129.

Stead, I.M., 1991. *Iron Age Cemeteries in East Yorkshire*. English Heritage Archaeological Report no. 22.

Stead, I.M., 2006. *British Iron Age Swords and Scabbards*. British Museum, London.

Tebbutt, C.F. and Fox, C., 1961. 'The Linch-pins found at Colne Fen, Huntingdonshire', *The Antiquaries Journal*, **41**, 235–38.