



# **NEWLAND FURNACE, NEWLAND, Cumbria**

## **Archaeological Survey**



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## SUMMARY

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The iron-working complex at Newland, Cumbria (NGR SD 2998 7970), was one of eight blast furnaces that were built in the region during the first half of the eighteenth century and, in many respects, is one of the most important. Established in 1747, the Newland Furnace remained in blast until 1891, and was the last but one charcoal-fired blast furnaces in Britain to close. Since its closure, the site has survived largely intact, and Newland today provides a rare example of a charcoal-based iron production centre and associated industrial hamlet, which includes charcoal barns and workers' housing. Its historical and archaeological significance is reflected in the recent designation of elements of the site as a Scheduled Monument (SM 34986).

The site is maintained by the Newland Furnace Trust, members of which have completed considerable repairs to the monument since 1989. Most recently, in 2006, the Newland Furnace Trust applied to English Heritage for funding to carry out some emergency repairs to the furnace stack. This work was necessary to prevent the further ingress of rainwater into the stack, which was having a negative impact on the surviving fabric of the monument. Initial clearance work at the upper level of the stack, carried out by members of the Newland Furnace Trust, revealed a section of a single-skin wall abutting the south wall of the furnace stack. As this wall was to be concealed by the repair works, English Heritage requested that an archaeological survey was carried out as part of the repair work. In addition, whilst clearing overburden from the upper level of the furnace stack in preparation for the emergency repair work, members of the Trust exposed other elements of historic fabric, notably a walkway around the outside of the stack, which similarly merited an archaeological survey. The survey was completed by OA North between April and September 2007.

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## ACKNOWLEDGEMENTS

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Oxford Archaeology North (OA North) would like to express its thanks to John Helme of the Newland Furnace Trust for commissioning and supporting the project. Thanks are also expressed to Andrew Davison of English Heritage for his support.

The building survey was carried out by Chris Wild, who also compiled the report. The report was edited by Ian Miller, who was also responsible for project management.

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## 1. INTRODUCTION

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### 1.1 CIRCUMSTANCES OF THE PROJECT

- 1.1.1 The Newland Furnace is a Scheduled Monument (SM 34986), and is entered on the English Heritage Buildings at Risk Register (priority three). In addition to the actual furnace, the site incorporates charcoal barns, an iron-ore store, a refining forge, a blacking mill, a smithy and several dwellings, cumulatively forming a rare example of a charcoal-based iron production centre and associated industrial hamlet. Of these structures, however, only the furnace, blowing chamber and charging house are leased by the Newland Furnace Trust.
- 1.1.2 The monument is currently managed by the Newland Furnace Trust, which has maintained a programme of consolidation and repair since 1989. In 2006, the Trust applied to English Heritage for funding to carry out some emergency repairs to the furnace stack. This work was necessary to prevent the further ingress of rainwater into the furnace stack, which was having a negative impact on the surviving fabric of the monument. Initial clearance work at the upper level of the stack, carried out by members of the Trust, revealed a section of wall between the stack and the external walls of the charging house. This wall was to be concealed by the repair works, and as it constituted an important element of the fabric of the monument, English Heritage requested that an archaeological survey was carried out as part of the repair work.
- 1.1.3 In April 2007, Oxford Archaeology North (OA North) was commissioned by the Newland Furnace Trust to carry out the required survey. It was carried out in two stages by Oxford Archaeology North: the initial stage was undertaken in April 2007, and the survey was completed in September 2007. The scheme of work comprised a measured survey and a brief written description of the exposed structural elements, accompanied with a photographic record in both digital and black and white 35mm format.

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## 2. METHODOLOGY

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### 2.1 METHODOLOGY

- 2.1.1 The newly exposed elements of the furnace structure were surveyed by means of a reflectorless electronic distance measurer (REDM). The REDM is capable of measuring distances to a point of detail by reflection from the wall surface, and does not need a prism to be placed. The digital survey data was captured within a portable computer running TheoLT software, which allows the survey to be directly inserted into an industry-standard CAD package (AutoCAD 2004) for the production of the final drawings. All work was consistent with the relevant standards and procedures provided by the Institute of Field Archaeologists.
- 2.1.2 The survey was coupled with the compilation of a photographic archive, which was produced utilising a 35mm camera to produce both black and white contact prints and selective colour slides. A full record of digital images was also captured as part of the archive using a camera with 6+ megapixel resolution.

### 2.2 ARCHIVE

- 2.2.1 A full archive of the work has been prepared to a professional standard in accordance with current English Heritage guidelines (1991) and the *Guidelines for the Preparation of Excavation Archives for Long Term Storage* (UKIC 1990). A copy of the report will be forwarded to the County Sites and Monuments Record (SMR), and a summary sent to the National Monuments Record (NMR).

### 3. BACKGROUND

#### 3.1 LOCATION

- 3.1.1 Newland is situated 1.5km north-east of Ulverston, on the eastern edge of the Furness Peninsula, Cumbria (NGR SD 29987970). It lies at the mouth of a steep valley, which cuts through the edge of the fells. The eastern boundary of Newland Parish is marked by the rivers Leven and Crake, and the western is formed in part by Newland Beck.
- 3.1.2 The settlement is focused on the former iron-working complex, which is dominated by the blast furnace and its associated charcoal barns. The furnace stands at the foot of the valley slope into which the charcoal barns and charging house are terraced at a slightly higher level.

#### 3.2 HISTORICAL DEVELOPMENT

- 3.2.1 The iron-working complex at Newland was one of eight blast furnace sites that were established in the region during the first half of the eighteenth century and, in many respects, is one of the most significant. Established in 1747, the Newland Furnace remained in blast until 1891, and was amongst the last charcoal-fired blast furnaces in Britain to close. Since 1891, the site has survived largely intact, and Newland today provides a rare example of a charcoal-based iron production centre and associated industrial hamlet. Its historical and archaeological significance is reflected in the recent designation of elements of the site as a Scheduled Monument (SM 34986).



*Early twentieth-century view of Newland*

- 3.2.2 The archaeological and historical background to the Newland Furnace has been thoroughly researched previously and presented, for instance, by Marshall *et al* (1996), and English Heritage (RCHME 1997); it is not the intention here to reiterate the same detail *per se*, but rather to summarise the historical development of the site.
- 3.2.3 A deed of partnership between Richard Ford, his son William Ford, Michael Knott, and James Backhouse was executed in 1747, which specified that the trade of casting, smelting or making pig iron, or any other sort of iron or cast metal, was to be carried on at Newland, or any other place which the partners



might afterwards agree upon. This company became known as the Newland Company, and was to enjoy 'considerable prosperity' (Fell 1908, 218). The sole management of the business was to be in the hands of Richard Ford during the continuance of the partnership, and after his death or retirement, of his son William Ford (*op cit*, 270-2).

- 3.2.4 In addition to the Newland Furnace, the Company also operated the slightly earlier furnace at Nibthwaite, situated some six miles to the north. In 1752-3, the Newland Company established a blast furnace at Bonawe in Argyllshire, Scotland (Stell and Hay 1995), seemingly in order to secure a supply of charcoal. The four founding partners concluded two agreements for a 110-year lease of wood rights and the site of the ironworks with Sir Duncan Campbell of Lochnell on 30 September 1752, and a further contract for the supply of wood was agreed with the Earl of Breadalbane on 4 October 1752 (RCHME 1997, 3). Production at Bonawe started in 1753, and once this site was established the Company ceased iron smelting at Nibthwaite in c1755 (Bowden 2000, 48), and concentrated its production of cast iron in Furness at Newland. Nibthwaite continued to be used for the conversion of cast iron to wrought iron until 1840 (Riden 1993, 119), using a refining forge added in 1751.
- 3.2.5 The forge at Nibthwaite was not the only one operated by the Newland Company; between 1750-66, they occupied Hacket Forge, north of Coniston, and, in 1798, the Company also purchased Spark Forge, which they operated until 1848 (Bowden 2000, 67). In 1783, the Company built a forge at Newland, which incorporated a finery and a chafery (Riden 1993, 119). The exact site of the forge is uncertain, although it has been suggested that it occupied a site next to the weir across Newland Beck (Fell 1908, 218), from where the head race to the furnace and corn mill is taken off. The forge is thought to have ceased to work in 1807, although the Swedish metallurgist Gustaf Ekman is recorded to have visited Newland in 1828, where he observed an enclosed finery and chafery which provided a model for use in the Swedish industry (Trinder 1992, 393).
- 3.2.6 Richard Ford died in 1757, and the Company was run subsequently by his son, William Ford. Thomas Chadwick of Burgh and Nathaniel Tatlor of Ulverston also held shares in the Company, although these were sold to William Ford and George Knott. James Backhouse also sold his share in the Company to William Ford for £2000 in 1761 (Kelly 1998, 133). Following William Ford's death in 1769, the Company was run by George Knott, and became known as George Knott and Co. In 1784, however, the Company became known as Knott, Ainslie and Co, reflecting the involvement of Henry Ainslie in the concern. Following the death of George Knott, the Company was run by Matthew Harrison who, in 1812, bought the Knott share thus forming Harrison, Ainslie and Company. In 1818, Harrison, Ainslie and Company bought the Backbarrow Company, and completed their monopoly of Furness iron in 1828 by buying the furnace at Duddon Bridge (Morton 1962).
- 3.2.7 Detailed information about the production cycles for the latter years of the Newland Furnace is provided by the accounts of the Charcoal Iron Company Limited (CRO(B) BDB/2/7/1 and 2), which indicate that it was not in

continuous use. In August 1877, for instance, the furnace was 'blown in' and was 'blown out' on 14 March 1878, after being in blast for 31 weeks and producing a total of 529 tons 15 cwt of pig iron. The next blast commenced over a year later, on 3 May 1879, and lasted for 51 weeks with the production of 950 tons of pig iron. Some six months later, on 10 October 1880, the furnace was blown in. This 70 weeks blast ended on 18 February 1882, with a total production of 1392 tons 10 cwt of pig iron. The next campaign commenced on 30 September 1882 and lasted until 30 January 1885, an astonishing 122 weeks with a total production of 3323 tons 10 cwt of pig iron. The next blast commenced over a year later, on 1 March 1886 and lasted 99 weeks until 20 January 1888 with a total production of 2590 tons 10 cwt. The final blast began on 24 October 1889 and ceased on 18 January 1891 (65 weeks), with a total production of 1620 tons 5 cwt of pig iron.

- 3.2.8 There is evidence to show that the furnace underwent some modification and that different fuels were experimented with towards the end of the nineteenth century, suggesting that some problems were experienced in securing an adequate supply of charcoal. Modifications to the furnace included the installation of iron blowing cylinders, perhaps during the early nineteenth century (Marshall *et al* 1996, 199), an extension to the upper furnace stack, and the installation of a water-powered charging hoist. In 1873, the furnace was described as being in the process of 'converting into hot blast' (Griffiths 1873, 267), a system for the re-heating of furnace gases. The *Barrow Times* of 15 November 1879 noted that 'compressed turf, etc' had been tried by the Newland Company as a fuel, although it would seem that this experiment was unsuccessful as in 1875 it was observed that the Newland furnace 'has undergone considerable repairs, and coal and coke have been substituted for charcoal' (Mannex 1876, 163). In a slightly later trade directory, Mannex states that the 'considerable alterations' were begun in 1874 (1881, 249); the external appearance of the furnace subsequent to these modifications was captured on a photograph taken several years after the closure of the works, and published in the *North Lonsdale Magazine*, October 1897 (Section 4.2.3 below). This photograph shows the extension to the upper furnace stack.
- 3.2.9 The final blast at Newland ended on 18 January 1891 (Riden 1993, 119), and the site was closed due to a general depression in the iron trade, and by virtue of the growing stocks of unsold iron accumulated by the firm; by January 1891, 1071 tons of unsold iron were held at Newland (Marshall *et al* 1996, 198). These stocks continued to be sold, however, throughout 1891/2, and included the sale of 15 tons of small pigs to the Royal Arsenal in Woolwich (CRO(B) BDB/2/7/1). The last recorded delivery was to Hornby and Sons on 7 September 1892, and comprised five tons of small pigs (*ibid*). In 1903, Harrison, Ainslie and Co surrendered the lease of Newland to the Duke of Buccleuch, and the site was dismantled (Fell 1908, 218). Part of the site was occupied subsequently by James Athersmith, a local farmer. During the autumn of 1918, heavy rain and storms led to the collapse of the dam and serious flooding in the valley (Helme 2002, 68). In 1921, all the property at Newland owned by the Duke of Buccleuch was sold to Thomas Thompson, a joiner, for £1950.

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## 4. BUILDING SURVEY RESULTS

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### 4.1 INTRODUCTION

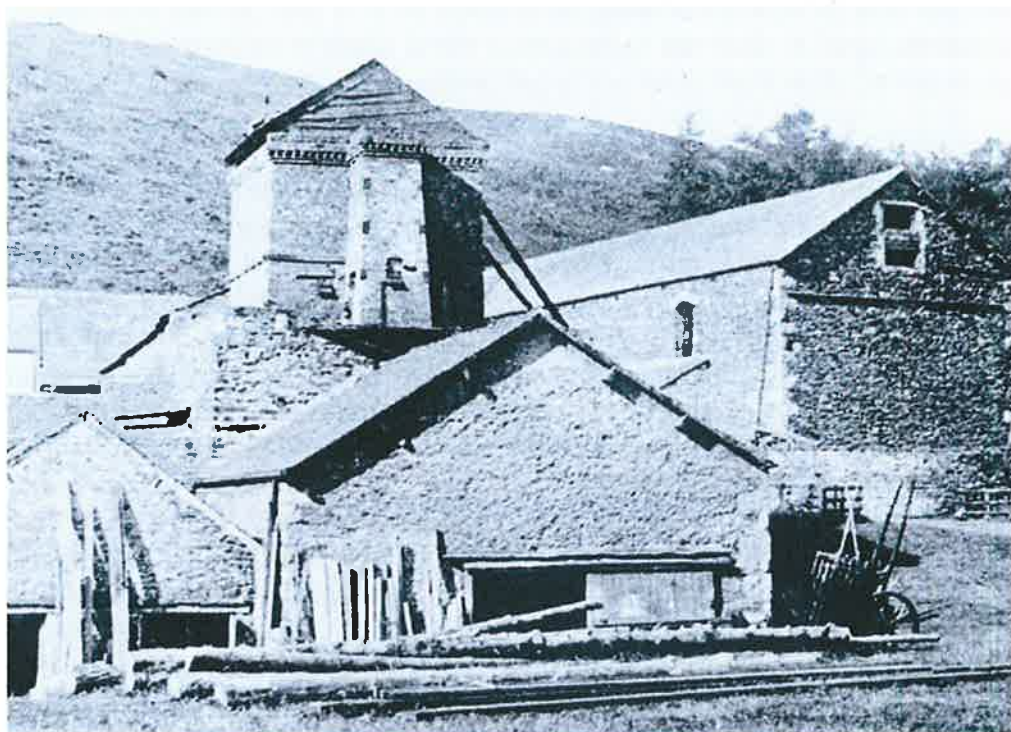
4.1.1 The archaeological survey was carried out in two stages. The initial element concerned the recording in elevation of the historic fabric forming the upper part of the furnace stack, and was completed in April 2007. The subsequent removal of loose debris and overburden in preparation for the emergency repair work revealed additional elements of historic fabric, which were subject to archaeological recording in September 2007.

### 4.2 THE FURNACE STACK

4.2.1 The walls of the furnace stack are of local roughly coursed stone construction, with face-work only surviving to depth of 0.6m, which coincided with the limit of excavation for the emergency repair work within most of the interior of the stack. Removal of the loose material and debris overlying the top of the furnace stack walling (Plate 1) revealed it to be of double-faced construction, 2' (0.61m) thick, with a rubble core bonded in pale lime mortar. Large quoin stones, both approximately 2 x 1' (0.61 x 0.30m), projected 1' (0.30m) above the wall top in the outer north-east and north-west corners of the stack (Fig 1), implying it to have been quoined returned, a detail unclear on the only known contemporary photograph of the extant stack (*North Lonsdale Magazine*, October 1897). Large stone slabs were revealed at a depth of c 0.8m below the top of the stack walls, projecting from the wall face by up to 0.4m, bridging each corner of the stack (Plates 2 and 3). These were presumably intended for the structural strengthening of the walls. Further stone slabs were exposed at a similar level along part of the western elevation of the furnace stack, which probably represented the floor of the furnace bridge, providing access between the charging house and the furnace throat. This was also marked by squared jambs on either side, providing an entrance to the furnace stack that was 1.72m wide (Plates 4 and 5). The area between the stack wall and the parapet was, however, infilled with flooring on all but the western side, creating a walkway around the top of the furnace stack (Plate 6 and 7).

4.2.2 Evidence for modifications to the furnace was provided by several episodes of localised remodelling of the original fabric, including an aperture that had been inserted in the base of the exposed northern elevation of the stack wall (Plate 6). It measured 4' (1.21m) wide, and was exposed only to a depth of 0.1m below a cast-iron lintel, which comprised a 5' (1.52m) length of solid rectangular-section, 4" (0.1m) deep. The aperture below was largely inaccessible, but was revealed to be of at least 0.45m depth. The section of the stack wall above the lintel was rebuilt, and contained refractory brick within its fabric. Another area of rebuilt fabric, which also incorporated refractory bricks, was observed in the eastern elevation (Plate 2). It is tempting to associate these rebuilt sections of wall with the documented modifications to the furnace carried out during the 1870s, and particularly the installation of 'hot blast' technology (*Section 3.2.8 above*). The precise nature of the 'hot blast' system employed at Newland is by no means clear although it probably

relied on a heat exchange mechanism, recycling exhaust gases to pre-heat air entering the furnace.



*Photograph of the Newland Furnace published in the North Lonsdale Magazine, 1897*

- 4.2.3 Elements of what was probably the heat exchanger mechanism are shown clearly on the late nineteenth-century photograph of the furnace, abutting the eastern side of the stack. Physical evidence identified during the survey included butt joints in both the stack wall and the parapet wall (Plate 8). The basal course of its southern elevation was also exposed, cutting through the parapet wall, demonstrating that it was a later addition.
- 4.2.4 The parapet wall itself was of similar roughly coursed local stone construction, built using a minimal amount of lime mortar, recessed deeply from the wall faces. It survives to approximately 4' (1.22m) in height, although it would probably have extended originally to the same height as the walls of the charging house to the immediate east. The north and south walls had 8" (0.20m) wide 6" (0.15m) drains through the wall, level with either end of the stack, although there was no evidence of a spout or even a projecting stone externally. The angle between the floor and both the parapet and extended stack walls had hard cement flashing to a height of these drains, to avoid penetration of rainwater. Also in the north and south walls, were higher level blocked apertures, each extending approximately 3' (0.91m) below the current wall head. They are positioned towards the end of each wall, and are c18" (0.45m) wide. All are blocked with either stone rubble or coursed refractory brick. Their function is unclear, but the fact that they are aligned in opposing pairs suggests that they may have housed cross members, possibly structural ties (presumably large scantling timber), with those on the western side of the stack possibly related to charging apparatus.

- 4.2.5 An additional wall was revealed to have been built on the southern side of the stack (Fig 1). This was of a single stone thickness, 18" (0.46m) wide, bonded in pale lime mortar, and with an upstanding quoin at its western end that was of similar proportions to those in the north wall of the stack. A large sandstone quoin was also exposed at the eastern end of the wall, flush with the surviving wall head.
- 4.2.6 The floor level of the parapet walkway was at that of the surviving wall top (Plate 9), typically around 6" (0.15m) below that within the charging house. The northern part of the floor sloped markedly to the north, providing run-off to the drains in the north parapet wall. It was constructed of three rows of refractory voussoir bricks, similar to those used within the furnace stack, the large gaps between the individual bricks infilled with hard, cement-based mortar (Plate 10). The southern part of the floor had clearly been rebuilt, and comprised an additional course of horizontally-laid bricks, both red and refractory, all hand-made. The size of individual bricks was typically 9 x 4½ x 2½" (229 x 114 x 64mm), conforming to standard late nineteenth-century dimensions. This course appeared to overly the larger refractory bricks at its northern boundary, implying that they were of a later construction. Nevertheless, the surface almost certainly represents the original floor level of this part of the walkway, as it is flush with drain apertures through the parapet wall in its southern elevation (Fig 1). The southern section of the walkway was significantly narrower than those bordering the eastern and northern sides of the stack, due to the existence of the 18" (0.46m) wide additional wall in this position. The purpose of this wall remains unclear.

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## 5. CONCLUSION

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- 5.1 The archaeological survey carried out in conjunction with the emergency repair works on top of the stack at Newland Furnace has allowed a detailed archaeological record to be made of elements of historic fabric that had not been recognised previously. In particular, the parapet walkway, or gallery, around the top of the stack was recorded, and evidence for modifications to the furnace was identified. A narrow wall was also revealed, abutting the southern wall of the stack, although the precise function of this wall remains unclear.
- 5.2 The paucity of structural remains on the western side of the stack is unfortunate, although their likely form can be inferred from those that do survive. It is probable that a ramp, either of timber or brick, spanned the width of the doorway in the gable wall of the charging house, providing access to the furnace throat through the stack wall.
- 5.3 It is unclear what the original wall height of the stack would have been, although it appears in the only surviving contemporary photograph to have been significantly above that of the charging house to the immediate west. It is probable that the parapet walls will also have been somewhat higher originally, and presumably supported a single-pitch roof that sloped up to the sides of the stack and covered the gallery. The resultant layout and proportions of the furnace stack are likely to have been typical of the other charcoal-fired blast furnaces in the region, with that at Duddon providing the best surviving comparator (Bowden 2000).

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## ILLUSTRATIONS

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### FIGURES

Figure 1: Plan of the exposed walls

Figure 2: Elevations of the exposed stack walls

### PLATES

Plate 1: North elevation of the furnace stack, showing the overburden atop the wall

Plate 2: Remodelled section of wall in central part of eastern elevation

Plate 3: South elevation of the stack, with projecting stone slabs at western end

Plate 4: Doorway in western elevation, providing access to charging house

Plate 5: Detail of projecting stones in the west elevation

Plate 6: View across the top of the furnace in April 2007, showing iron lintel in the north elevation of the stack wall

Plate 7: View looking north across the top of the furnace in September 2007, following the removal of overburden from the walkway

Plate 8: Evidence of heat-exchange structure, east parapet wall

Plate 9: North-western corner of the walkway, showing the projecting quoin and drain hole in the parapet wall

Plate 10: Southern side of the stack, showing walkway and additional single-skin wall



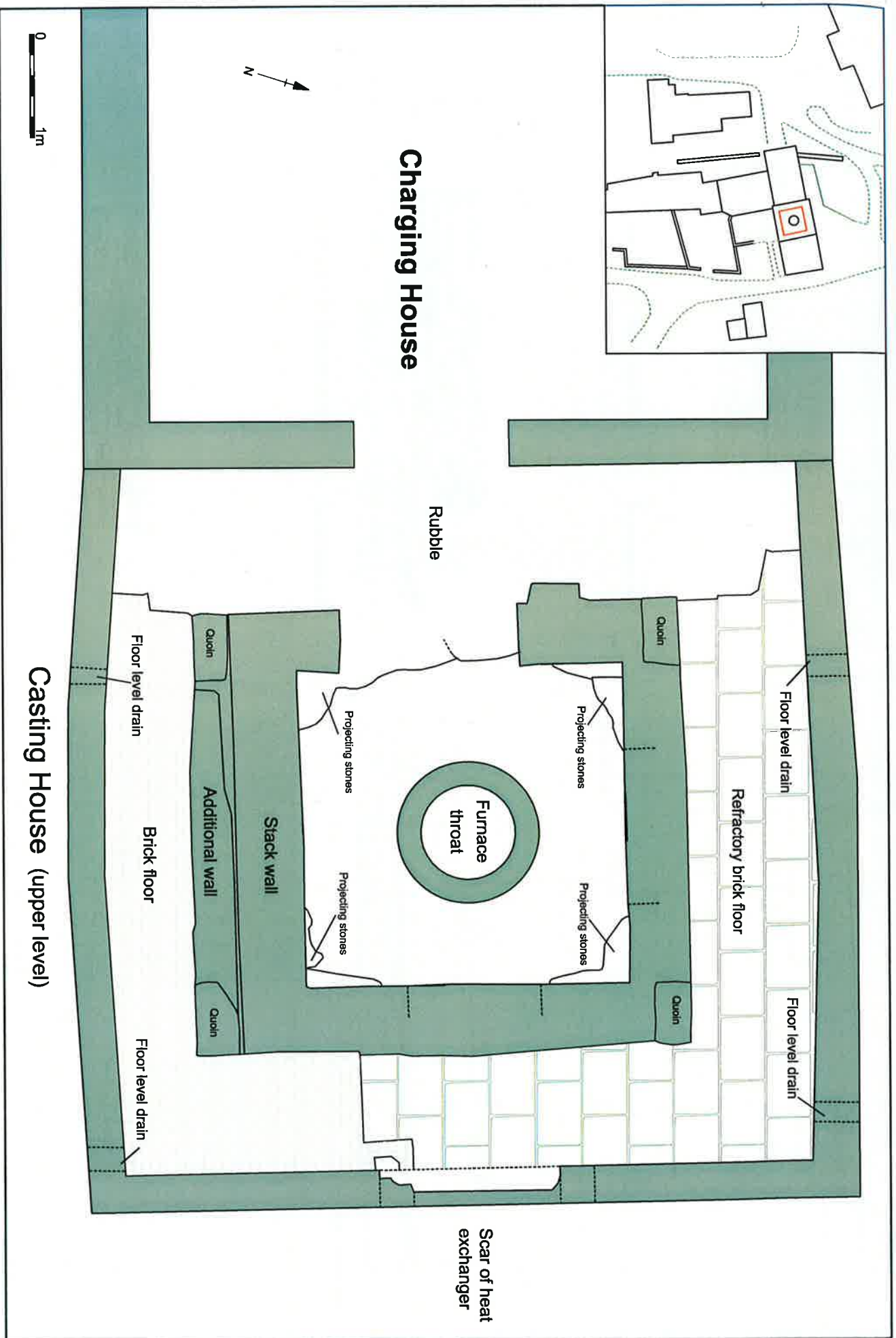
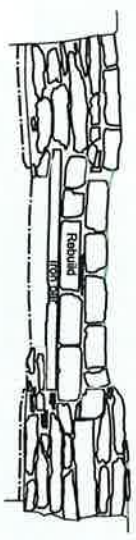
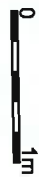


Figure 1: Plan of the exposed walls

Line of rebuilding



Elevation 1: North elevation



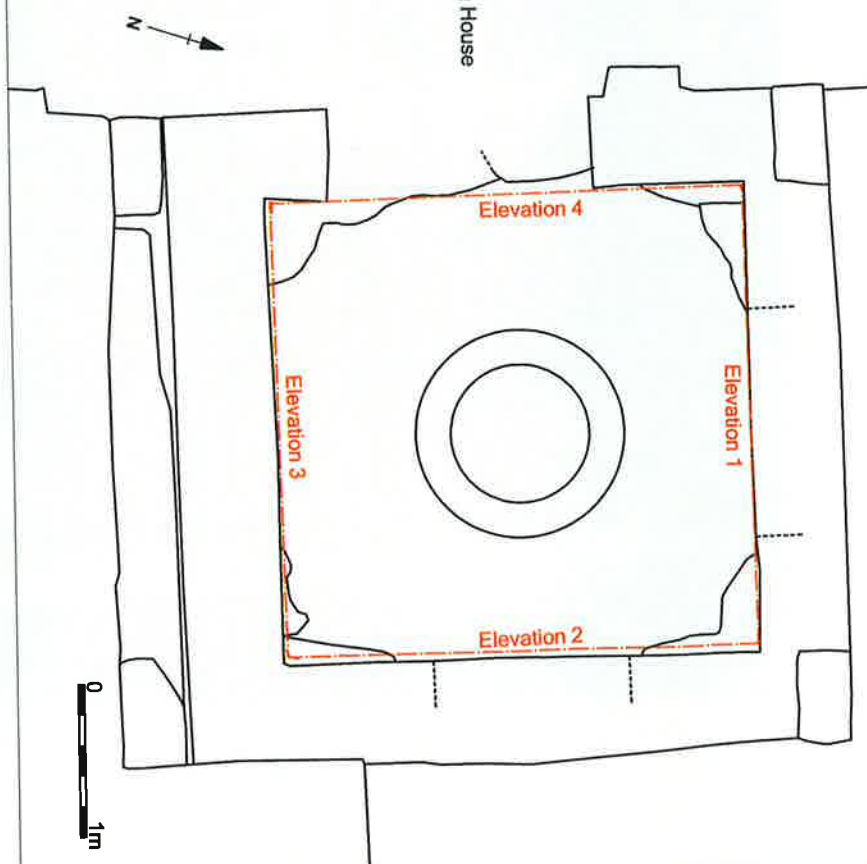
Elevation 2: East elevation



Elevation 3: South elevation



Charging House



Elevation 4: West elevation



Figure 2: Elevations of the exposed stack walls



PLATES



Plate 1: North elevation of the furnace stack, showing the overburden atop the wall



Plate 2: Remodelled section of wall in central part of eastern elevation, also showing the top of the stone slab bridging the corner of the stack





Plate 3: South elevation of the stack, with projecting stone slabs at western end



Plate 4: Doorway in western elevation, providing access to charging house



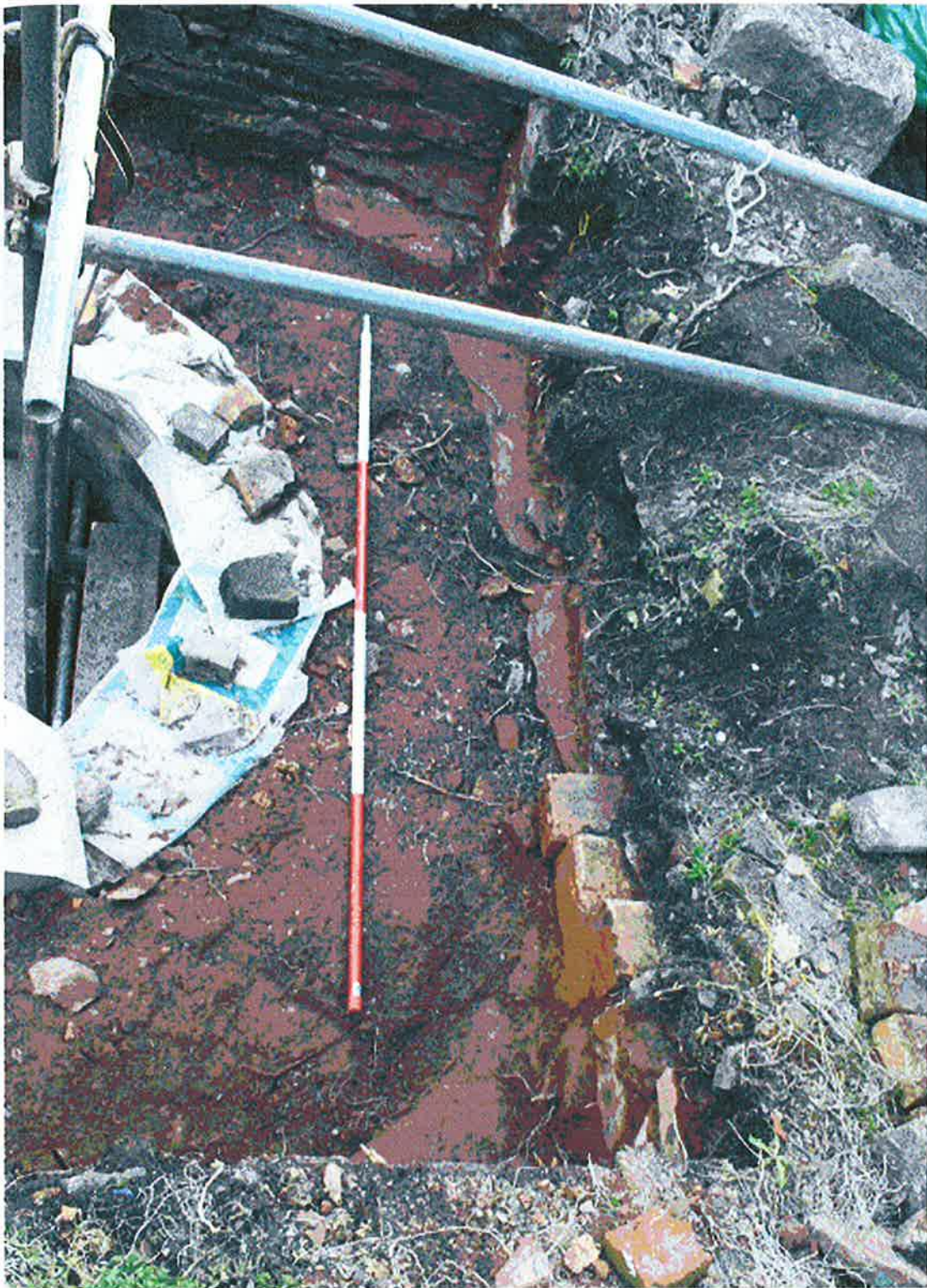


Plate 5: Detail of projecting stones in the west elevation





Plate 6: View across the top of the furnace in April 2007, showing iron lintel in the north elevation of the stack wall



Plate 7: View looking north across the top of the furnace in September 2007, following the removal of overburden from the walkway





Plate 8: Evidence of heat-exchange structure, east parapet wall



Plate 9: North-western corner of the walkway, showing the projecting quoin and drain hole in the parapet wall





Plate 10: Southern side of the stack, showing walkway and additional single-skin wall