Wessex Archaeology

# Oldfurnace Cottage and Eastwall Farm Oakamoor, Staffordshire

Archaeological Evaluation and an Assessment of the Results

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# OLDFURNACE COTTAGE AND EASTWALL FARM, OAKAMOOR, STAFFORDSHIRE

## AN ARCHAEOLOGICAL EVALUATION AND AN ASSESSMENT OF THE RESULTS

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# OLDFURNACE COTTAGE AND EASTWALL FARM, OAKAMOOR, STAFFORDSHIRE

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*Cover: The River Churnet north of Eastwall Farm, looking west.*

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## AN ARCHAEOLOGICAL EVALUATION AND AN ASSESSMENT OF THE RESULTS


### Summary

Archaeological evaluation was undertaken by Channel 4's Time Team at two sites in the River Churnet valley, near Oakamoor, Staffordshire, (centred on SK 0415 4355 and SK 0350 4490), to investigate the development of medieval and post-medieval iron smelting in the area. The opportunity arose following an approach to Channel 4's 'Big Dig' programme from the owner of Oldfurnace Cottage, who wished to investigate the site of a former Elizabethan blast furnace, known to have been constructed on the site of the present cottage by Lawrence Loggin in 1592. The results of the 'Big Dig', undertaken in a 1 metre square test pit, indicated that earlier, previously undocumented, medieval bloomery smelting had also taken place on the site.

The evaluation undertook additional trenching at the cottage in an attempt to locate the blast furnace and at Eastwall Farm, 1.5 km to the north-west of Oldfurnace Cottage, where there were documentary records to show that medieval bloomery smelting had taken place.

The results of the work at Oldfurnace Cottage confirmed that iron smelting using the bloomery process, with associated pottery of 13$^{th}$-14$^{th}$ century date, was well-established on the site in the medieval period. However an unstratified sherd of Late Saxon pottery suggested that iron working on the site may have begun as early as the 10$^{th}$-11$^{th}$ century. The bloomery slag was overlain by large accumulations of post-medieval slag dating from the later blast furnace. The depth of deposits indicated that the valley sides had undergone considerable modification during the use of the site. No traces of any furnaces were found, which are likely to lie beneath the present cottage. A trench north-west of the cottage provided evidence of unsmelted ore in what may have been a storage area.

A geophysical survey at Eastwall Farm revealed an anomaly shown to be the well-preserved base of a bloomery furnace of probable 13$^{th}$-14$^{th}$ century date. The remains of the clay-built furnace included the tapping arch and channel, bellows location and bloomery slag from the final tapping. Other strong magnetic anomalies in the immediate area suggest that similar furnaces are present on the site.

The evaluation produced a small but important archaeological archive for future research in to iron smelting in the Churnet valley. It also provided a number of stratified samples of slag that will provide a valuable resource for the study of comparable smelting processes from medieval bloomery furnaces and later blast furnaces.

# OLDFURNACE COTTAGE AND EASTWALL FARM, OAKAMOOR, STAFFORDSHIRE

## AN ARCHAEOLOGICAL EVALUATION AND AN ASSESSMENT OF THE RESULTS


### Acknowledgements

The evaluation was commissioned and funded by Videotext Communications. The work would not have been possible without the support provided by Rob and Angela Chapman, owners of Oldfurnace Cottage, and the National Trust with Jeremy Milln (National Trust Regional Archaeologist) and their tenant Geoff Burton at Eastwall Farm. The support and collaboration of Bill Klemperer, formerly Principal Historic Environmental Officer, Staffordshire County Council, is also acknowledged.

The geophysical survey was undertaken by John Gater with staff from GSB Prospection, and survey by Henry Chapman, University of Hull. Excavation strategy was conducted by Mick Aston (Bristol University), site recording was coordinated by Phil Harding, assisted by Nick Best of Wessex Archaeology. The evaluation was undertaken by the Time Team's retained excavators with help from Katherine Bain, Debbie Forrester, Alison Nicholls and Suzi Blake. The archive was collated and all post-excavation analysis and assessment undertaken by Wessex Archaeology including management (Roland J C Smith), report (Phil Harding), finds (Lorraine Mepham, Angi Britten and Phil Andrews), charred plants remains (Sarah Wyles and Chris Stevens) and illustrations (Mark Roughley).

The progress and successful completion of the work also benefited from discussion on site with the following specialists: Debbie Ford (pottery), David Cranstone (industrial and historical metallurgist), Pete Brown, (industrial historian) and Gerry McDonnell (archaeological metallurgist).

# OLDFURNACE COTTAGE AND EASTWALL FARM, OAKAMOOR, STAFFORDSHIRE.

## AN ARCHAEOLOGICAL EVALUATION AND AN ASSESSMENT OF THE RESULTS

## 1 BACKGROUND

### 1.1 Description of the sites

1.1.1 In July 2003 Videotext Communications was commissioned by Channel 4 to carry out an archaeological evaluation as part of the Time Team television series at Oldfurnace Cottage (SK 0415 4355) and Eastwall Farm (SK 0350 4490), Oakamoor, Staffordshire. This report sets out the results of that evaluation, assesses the significance of the results and puts forward recommendations for further analysis and publication of the results.

1.1.2 Oldfurnace Cottage lies approximately 1.5 kilometre south-west of Oakamoor, Staffordshire (SK 0415 4355) in the heavily wooded narrow valley of Dimmings Dale (**Figure 1**). A stream flows through the dale from approximately 200 m OD at its source three km to its confluence with the River Churnet at approximately 100 m OD. The Churnet drains south to form a tributary of the River Trent. Oldfurnace Cottage stands on the north bank of the stream and comprises a small terraced garden that is laid to lawn with mixed herbaceous beds and a gravelled area east of the house. The southern boundary of the property is formed by a stone wall that may have been part of the mill race.

1.1.3 A field of pasture belonging to Oldfurnace Farm occupies the steeply rising ground south of the stream. The lower slopes were included in the area of the site.

1.1.4 Place name evidence and landscape features suggested that Oldfurnace Cottage was the site of the first blast furnace in North Staffordshire, established by Lawrence Loggin in 1592, for which the account books still survive. Bloomery and blast furnace slag is plentiful in the garden soil.

1.1.5 Geologically the site lay on the cusp of the Hawksmoor Foundation of the Triassic Sherwood Sandstone Group and a narrow outlier of the later Denstone Formation of the Mercia Mudstone Group (BGS Sheet 124 – Ashbourne).

1.1.6 The site at Eastwall Farm occupied the orchard and adjacent field immediately north-east of the farm (SK 0350 4490), approximately 1.5 km west of Oakamoor. It lay on a flat terrace, at *c.* 151 m OD, immediately south of the River Churnet, a relatively mature river that meanders across a flood plain within a steep-sided wooded valley.

1.1.7 Part of the site has been destroyed by the installation of a septic tank and much of the rest is threatened by erosion of the riverbank. However, an extensive slag spread, approximately 1 m thick, was exposed in the section of the river cliff, which suggested that there may have been a large bloomery smelting operation in the vicinity.

1.1.8 Geologically Eastwall Farm lies on the Hawksmoor Foundation of the Triassic Sherwood Sandstone Group with a local cover of Quaternary Alluvium (BGS Sheet 124 – Ashbourne).

## 1.2 Previous archaeological work

1.2.1 The Sites and Monuments Record (SMR) of Staffordshire for Oldfurnace Cottage (PRN 251) contains anecdotal and place-name material with records of stray finds of slag and graphite 'casing pots' (believed to be a misprint of casting pots, a synonym for crucibles).

1.2.2 A test pit (1 m by 1 m and 0.6 m deep) was excavated on 23rd June 2003 in the lawn as part of Channel 4's 'The Big Dig'. It revealed a mixed deposit that contained a substantial amount of blast furnace slag and sherds of 13th/14th century pottery.

1.2.3 This early dating evidence, combined with the close proximity of the slag deposit to the water supply, led to speculation that a very early waterwheel-powered bellows system may have been present on the site.

1.2.4 A number of surface finds were also discovered in the flowerbeds of the garden during the test pit evaluation including post-medieval pottery and a graphite crucible bearing copper deposits.

1.2.5 No records of any previous archaeological discoveries are known on the SMR for Eastwall Farm (PRN 4292), however the 'Secunda Carta of Chedle' of *c*. 1240 mentions 'veteres forgias' (old forges) around Esteswalle (CRO D593/A/2/23/24) with subsequent mentions up to 1590 in the Shrewsbury accounts. The 14th century Chronicles of Croxden Abbey refer to the sale of timber from two woods - Gibbe Ruydinges and Le Neweheye, which still exist as Gibridding and Newhay on either side of Eastwall Farm. Other undocumented bloomery sites, which are listed in the SMR, have been identified from deposits of slag at Frame Wood, Star Wood, Cherry Eye Bridge (East and South), Consall Wood, Wallgrange and Jackson Wood, the latter about 800 m to the north of Eastwall Farm across the River Churnet.

# 2 METHODS

## 2.1 Introduction

2.1.1 Project designs for the work were compiled and provided by Videotext Communications (Videotext Communications 2003a and b). Full details of the

circumstances and methods are contained in this document and are summarised here.

## 2.2 Aims and objectives

2.2.1 The project provided an opportunity to examine the development of iron smelting in the Churnet Valley from the medieval bloomery furnaces to the development of blast furnaces. The two sites provided contrasting opportunities that would compliment one another in the final analysis. The site at Oldfurnace Cottage provided a small but well-documented site associated with a blast furnace built by Lawrence Loggin in 1592, whereas Eastwall Farm provided a larger area, which was thought from documents to contain remains of earlier bloomery furnaces. This site offered the chance to establish the wider distribution of bloomery furnaces whereas Oldfurnace Cottage offered the chance to examine the remains of a more permanent blast furnace with intensive large-scale production.

2.2.2 Specifically the evaluation sought to establish the presence of furnaces or bloomeries and associated outbuildings, including dwellings, charcoal pits, charcoal stores, ore stores, power sources (bellows) and any related/associated iron working features and processes.

2.2.3 The evaluation also aimed to use metallurgical analysis of slag to provide information on the techniques and efficiency of iron production.

2.2.4 Five over-arching aims of the work were proposed:

- to characterize the archaeological resource at each site
- to provide a condition survey of each site
- to investigate the position of the sites in their specific location within their respective valleys and in the wider landscape, especially with regard to transport connections nearby, such as the River Churnet.
- to establish the extent to which the Churnet was used for transport and the role of Eastwall in the trading links along the river.
- to interpret the nature of the structure and development of the bloomery at Eastwall.

2.2.5 Although small in scale, a well-resourced three-day evaluation using a combination of geophysics, excavation and metallurgical analysis was considered sufficient to address these aims and objectives.

## 2.3 Fieldwork methods

2.3.1 The fieldwork strategy was undertaken using a combination of an extensive gradiometer survey across the site and a series of evaluation trenches that were excavated (**Figure 1**) after consultation with the on-site director, Mick Aston and associated specialists. All excavation in the garden at Oldfurnace Cottage (Site Code OF 03) was undertaken by hand in accordance with the wishes of the land owner. Turf was lifted and was stored with spoil on plastic sheeting for reinstatement. Excavation in the adjacent pasture was undertaken using a

tracked mini-digger. Trenches at Eastwall Farm (Site Code EW 03) were opened with the agreement of Jeremy Milln, Regional Archaeologist for the National Trust, using a wheeled JCB excavator fitted with a back hoe and 1.8 m wide toothless grading bucket.

2.3.2 All machine work was undertaken with constant archaeological supervision and ceased at the identification of significant archaeological deposits, or where natural deposits were encountered first. When machine excavation had ceased all trenches were cleaned by hand and archaeological deposits were excavated.

2.3.3 A sufficient sample of all deposits was examined to allow the resolution of the principal questions outlined in the aims and objectives above. Other deposits were recorded and preserved *in situ* but not excavated.

2.3.4 All archaeological deposits were recorded using Wessex Archaeology's *pro forma* record sheets with a unique numbering system for individual contexts. Trenches were located to the Ordnance Grid using a Trimble Real Time Differential GPS survey system. A detailed contour and topographical survey, which was commissioned by the National Trust, of the site at Eastwall Farm including the orchard bloomery site, was made available to the project together with a RCHME-type earthwork survey at 1:200 scale. All archaeological features and deposits were planned at 1:10 or 1:20 and sections drawn at 1:10 or 1:20, whichever was appropriate for the circumstances. All principal strata and features were related to Ordnance Survey datum and a photographic record of the investigations and individual features was maintained.

2.3.5 The work at both sites was carried out over 18th – 20th July 2003.

2.3.6 At the completion of the work all trenches were reinstated using the excavated spoil from the trenches. All artefacts were transported to the offices of Wessex Archaeology where they were processed and assessed for this report.

# 3 RESULTS

## 3.1 Introduction

3.1.1 A full geophysical report (GSB 2003), details of individual excavated contexts and features, and results of artefact and environmental sample analysis are retained in archive.

## 3.2 Geophysical survey

3.2.1 Three areas (1 – 3) were surveyed at Eastwall Farm using gradiometry with an additional five areas (4 – 8) at Oldfurnace Cottage. The location of each area with interpretative results is shown in **Figure 1**.

3.2.2 The results from Area 1 revealed a number of strong anomalies, which were thought to be associated with medieval iron working. Excavation of one of

these in Trench 5 revealed the well-preserved remains of a bloomery furnace. The area of enhanced magnetic response was surrounded by a curving anomaly, which it was thought might relate to an enclosure ditch. Trench 6 failed to identify the feature.

3.2.3 Results in the west edge of Area 1 and in Area 2 were masked by modern ferrous objects, which included water pipes, agricultural machinery and fences. Area 3 was similarly disturbed magnetically due to remains of a recently demolished farm building.

3.2.4 Survey areas in the environs of Oldfurnace Cottage (Areas 4, 5, 7 and 8) produced results that indicated industrial type activity, none of which could be interpreted with certainty, however a number of distinct anomalies were detected in Area 4. One of these, sampled in Trench 7, produced evidence of a concentration of iron ore, which may indicate the use of this area for the storage of iron ore.

3.2.5 Area 6, within the garden of Oldfurnace Cottage, produced a strong response, which excavation showed to have been produced by slag dumps.

### 3.2 Trenches at Oldfurnace Cottage

3.2.1 Archaeological deposits in the garden at Oldfurnace Cottage, in the pasture field to the south (trench 2) and in the field to the north (trench 7) were overlain by dark brown silty topsoil up to 0.30 m thick (101, 201, 301, 401 and 701) (**Figures 1** and **2**). Modern pottery, glass and fragments of unstratified blast furnace slag were present throughout. No topsoil horizon was present in trench 5, which was located along a garden path. Trench 6 was assigned to work undertaken to define features of a stone wall on the south side of the stream, which it was thought might be part of a waterwheel structure.

3.2.2 Most deposits contained a large proportion of red sand matrix that was derived from the natural geology.

3.2.3 Trenches 1, 4 and 5 (with an additional test pit 3) were all located within the restricted area of the lawn of Oldfurnace Cottage to provide additional information to that already found in the 'Big Dig' test pit regarding iron smelting on the site. The results were all broadly similar and are described together.

3.2.4 Trench 1, which measured 3 m long and 0.7 m wide, was aligned east to west immediately north of the 'Big Dig' test pit. It was designed to provide more detailed information about the depth and character of the stratigraphic sequence in that part of the site. The trench was also positioned to examine an anomaly detected on the geophysical survey, which was thought might indicate a drain or culvert from the blast furnace to the stream.

3.2.5 Test pit 3 measured 0.7m by 0.7 m and was dug at the east end of the lawn to trace the extent of industrial activity in the vicinity of the present cottage,

which it was thought might have been constructed on the site of the 16th century blast furnace.

3.2.6 Trench 4 measured 1.2 m long and 0.8 m wide and was dug *c*. 1 m south of trench 1 to provide a more complete investigation of the anomaly detected by geophysics.

3.2.7 Trench 5 was located in the north-west corner of the garden and was placed as close as possible to the cottage and, therefore, to the likely site of the blast furnace. It measured 1.9 m long and 1 m wide and was aligned north to south.

3.2.8 The excavations indicated that two phases of iron working activity were represented in the sequence of deposits. The earlier phase was characterised by the presence of bloomery slag, which was overlain by blast furnace slag.

3.2.9 The natural geology on the site was exposed in trenches 4 and 5 at 149.52 m and 150.67 m OD respectively. That in trench 4 comprised a deposit of gravel, which may date to the Last (Devensian) Glaciation. The natural sand in trench 5 was revealed in a steep, almost vertical face of compact material at the north edge of the trench. The height/level of the natural deposits and gradient of the slope suggest that the valley side has been heavily modified by quarrying/terracing and overlain by successive deposits of industrial slag, which may periodically have been cleared away. All trenches were excavated to 1.20 m deep, shored or abandoned if considered to be unsafe.

3.2.10 Dark brown/black sandy deposits containing fragments of bloomery slag up to 0.20 m across and medieval pottery were identified in a sondage dug at the east end of trench 1 (105 and 106) and at the base of test pit 3 (306). There were also fragments of fired clay that may represent furnace lining.

3.2.11 A series of thin sandy lenses that were rich in charcoal (507) was identified at the base of trench 5 lying against the natural sand. However, it is possible that these charcoal-rich deposits were derived from medieval bloomery furnaces which produced the bloomery slag found in the adjacent trenches.

3.2.12 The natural bedrock and earliest archaeological deposit (507) had been heavily truncated in the west side of trench 5. This intrusive feature (509) was filled with redeposited sand (505, 506) and extensive dumps of blast furnace slag (503, 504). One sherd of Late Saxon pottery was recovered from (504) was is likely to be residual. It is uncertain whether the redeposited sand had eroded down-slope from the bedrock or was derived from the floor of an adjacent casting house.

3.2.13 The blast furnace slag in trench 1 was characterised by massive matrix-free fragments over 0.20 m across, which tipped away to the south and east (104). It was overlain on the east by a dump of finer debris (103) that could be traced to test pit 3, where the blast furnace slag was less concentrated (303, 304 and 305). The tip lines indicated that these deposits had been truncated by subsequent landscaping of the garden. The blast furnace slag in trench 4 (404), which lay immediately on the natural gravel, was 1 m thick and contained

possible roasted haematite ore fragments and burnt clay. The absence of a buried soil suggested that the area had been quarried away or periodically cleaned out. The distribution and orientation of this dump of slag also suggested that the blast furnace, which was most likely to be the source of this material, was probably located beneath the present Oldfurnace Cottage.

3.2.14 The final phase of activity in the garden was represented by a deposit of orange brown – red sandy soil (102, 302, 402 and 502), which ranged from 0.20 m to 0.70 m thick. It contained fragments of slag, brick and fired clay and appeared to represent material that was used to raise and landscape the present garden after the blast furnace dumps had been levelled.

3.2.15 Trench 6 was located in the north bank of the stream to expose a length of standing wall and associated masonry immediately below the garden of the present house. It was thought that the wall might represent the foundations for a waterwheel which powered the bellows of the blast furnace. The results were inconclusive, although a sherd of post-medieval pottery was found in a void in the wall. The work was abandoned when it became clear that the wall was potentially unsafe.

3.2.16 Trench 2, which measured approximately 2 m square, was dug in the pasture south of the stream in response to an anomaly shown on the geophysics survey. It revealed that the natural sand was overlain by a thin lens of undated charcoal (206), which was sealed by deposits of sand (205, 204) that may be colluvium. The remaining deposits in the trench comprised approximately 0.80 m of compact sandy material (203, 202, 201) containing slag and brick that probably represent layers of make-up.

3.2.17 Trench 7 measured 1 m square and was excavated to investigate a strong magnetic anomaly that was detected by geophysics in Area 4 to the north-east of Oldfurnace Cottage. The results revealed the edge of a large feature (703), possibly a pit, 0.5 m deep that occupied the west side of the trench. It was filled with homogeneous red-brown sandy silt (702) and contained large quantities of unprocessed iron ore. The feature was sealed by red-brown sandy colluvium (701) and topsoil.

### 3.3 Trenches at Eastwall Farm

3.3.1 Two trenches were excavated at Eastwall Farm. They were mistakenly labelled and recorded consecutively as trenches 5 and 6 from the series allocated at Oldfurnace Cottage. These trench numbers have been retained but are differentiated within the project archive by the site code (EW 03) to avoid the unnecessary task of re-labelling and cross-referencing the complete site archive. This section of the report has been compiled from the site records and from discussion on site with Gerry McDonnell.

3.3.2 Trench 5 measured 7 m east to west and 1.6 m north to south (**Figures 1** and **3**) and was excavated to investigate a large geophysical anomaly, which proved to be a well-preserved medieval bloomery furnace. The trench was

subsequently extended to the north by an area 3.25 m long and 2 m wide to reveal the full extent of the furnace chamber.

3.3.3 The oval furnace chamber (508), which survived to a height of 0.45 m, measured 0.50 m north to south and 0.40 m east to west (**Plates 1** and **2**). The clay furnace walls averaged 0.15 m thick and were heavily fired by the intense heat, which had also reddened the adjacent natural gravel (514) around the base of the furnace. The furnace walls showed no sign of having been repaired or relined, which suggests that the structure had been built in one operation. The furnace chamber was filled with a deposit (510) of mid-brown silt with small, rounded pebbles and fragments of slag, and a spread of charcoal (522) abutted the west edge of the chamber.

3.3.4 A hole (520) approximately 0.15 m wide was located in the south side of the furnace chamber to accommodate the tuyère for the bellows. This aperture lead to a narrow, shallow feature (521) which was cut into the natural gravel and was probably also related to the bellows.

3.3.5 The tapping arch (519) lay at the base of the furnace on the east side and measured 0.18 m high and approximately 0.33 m wide. It was partially filled with a flow of *in situ* bloomery slag (513, 515, 517), which could be traced along the tapping channel (516) and represented the final smelt of the furnace. The tapping channel was lined and roofed with large slabs of sandstone, 0.20 – 0.30 m across and 0.04 m thick, that were packed with clay (507). The roof had collapsed but could be traced 0.70 m east from the tapping arch.

3.3.6 The tapping channel led into the tapping pit (506), a large, shallow feature measuring approximately 2m by 2m and 0.30 m deep that was excavated into the natural gravel (509). The south side of the tapping pit contained large quantities of slag (503) derived from tapping / raking out the furnace and the floor was covered with a layer of burnt material (518), including charcoal and slag that is likely to have been residue from the final smelt.

3.3.7 It is probable that the furnace was designed to have included some form of surrounding wooden structure or earthen bank to allow the furnace to be charged with ore and fuel, although no evidence was found to indicate this.

3.3.8 The absence of evidence for any repair or re-lining of the chamber indicates that the furnace was not used over a long period of time. The presence of solidified bloomery slag in the tapping channel can be related directly to the final smelt, and after the furnace was abandoned the tapping pit was backfilled with smelting waste from other furnaces.

3.3.9 No artefacts were recovered to date the use of the furnace and there was insufficient material for archaeomagnetic dating, however there is a strong probability that this structure is of 13$^{th}$ or 14$^{th}$ century date.

3.3.10 At the conclusion of the excavation this well-preserved furnace base was sealed with a permeable membrane and a layer of sand before the topsoil was replaced. The land is in the ownership and care of the National Trust who

operate a long-term management plan which will ensure the permanent preservation of the structure.

3.3.11 Trench 6 at Eastwall Farm was 5 m long and 1.6 m wide and was machine excavated in response to an anomaly on the magnetic survey (**Figure 1**). It revealed that the grey brown sandy silt topsoil, 0.20 m deep, overlay the subsoil and natural gravel. The magnetic anomaly was confirmed as a water pipe.

# 4 FINDS

## 4.1 Introduction

4.1.1 Finds were recovered from all of the eight trenches excavated, as well as a few items found unstratified. All finds have been cleaned (with the exception of the metalwork) and have been quantified by material type within each context. Quantified data form the primary finds archive for the site and these data are summarised by trench in **Table 1**.

4.1.2 Subsequent to quantification, all finds have been very briefly scanned in order to gain an overall idea of the range of types present, their condition, and their potential date range. All finds data are currently held on an Access database.

4.1.3 This section presents a brief overview of the finds assemblage. The assemblage is largely of post-medieval date, with a smaller amount of medieval and prehistoric material, and is dominated by a large collection of post-medieval ironworking slag.

## 4.2 Pottery

4.2.1 The pottery assemblage is mainly of post-medieval date, with a small quantity of medieval sherds, most of which occurred in mixed groups with post-medieval material. The assemblage has been quantified by ware group (for the medieval wares) and ware type (for the post-medieval wares); quantities are given in **Table 2**.

4.2.2 A Late Saxon jar rim sherd from context (504), identified on site by Debbie Ford as a Stafford-type ware (orange gritty fabric) of $10^{th}/11^{th}$ century date, has not been located amongst the finds processed by Wessex Archaeology.

4.2.3 Medieval sherds were recovered from both Oldfurnace Cottage (27 sherds) and Eastwall Farm (4 sherds). Both coarsewares and finewares are present. These have not at this stage been related to known ware types and/or sources. The finewares are all pale-firing and completely or partially glazed. Coarsewares are all sandy, and include one jug handle and one jar rim; three sherds (including one bowl rim) are in a harder-fired, wheelthrown oxidised ware (late medieval orange ware: $15^{th}/16^{th}$ century). Apart from the latter sherds (all of which came from trench 7 at Oldfurnace Cottage), the medieval wares can be broadly dated as $13^{th}/14^{th}$ century.

**Table 1: Finds totals by material type (number/weight in grammes)**

| | OLDFURNACE COTTAGE | | | | | | | EASTWALL FARM | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| **MATERIAL TYPE** | **Tr. 1** | **Tr. 2** | **TP. 3** | **Tr. 4** | **Tr. 5** | **Tr. 7** | **unstrat** | **Tr. 5** | **Tr. 6** | |
| Pottery | 174/817 | 2/39 | 52/315 | 29/164 | 28/171 | 15/246 | - | 10/128 | 1/22 | **311/1902** |
| *Medieval* | *10/99* | - | *6/42* | *2/27* | *5/23* | *4/92* | - | *3/77* | *1/22* | ***31/382*** |
| *Post-medieval* | *7/718* | *2/39* | *46/273* | *27/137* | *23/148* | *11/154* | - | - | - | ***280/1520*** |
| Ceramic Building Material | 5/242 | 8/1796 | 9/188 | 16/265 | 2/364 | 2/43 | - | 3/43 | - | **45/2941** |
| Fired Clay | 10/295 | - | 3/9 | - | - | - | - | - | - | **13/304** |
| Clay Pipe | 7/14 | - | 1/4 | - | - | - | - | 1/6 | - | **9/24** |
| Stone | 1/173 | - | 2/27 | 10/140 | | 28/4650 | - | 9/3761 | - | **50/8751** |
| Worked Flint | - | - | - | - | - | - | 2/6 | - | - | **2/6** |
| Glass | 4/35 | - | 2/15 | - | 1/1 | 1/23 | - | 7/7 | - | **15/81** |
| Slag | 8/11,691 | 46/4822 | 7/22,189 | 6/24,379 | 15/1307 | 3/28 | 1/5650 | 121/7556 | 2/472 | **209/78,094** |
| Metalwork | 7 | 2 | 1 | 2 | - | 3 | - | - | 1 | **16** |
| *Iron* | *2* | *2* | - | *2* | - | *3* | - | - | *1* | ***10*** |
| *Copper Alloy* | *3* | - | *1* | - | - | - | - | - | - | ***4*** |
| *Lead* | *2* | - | - | - | - | - | - | - | - | ***2*** |
| Animal Bone | 4/37 | - | 1/9 | 1/33 | 4/44 | - | - | - | - | **10/115** |

4.2.4 Early post-medieval coarsewares (16th/17th century) are represented by Midlands Purple and Yellow wares, and some of the coarse redwares, including one sgraffito slipware (trench 7 at Oldfurnace Cottage). Alongside these are a few finewares – mottled ware and trailed and combed slipware. Other wares are 18th century or later, and this group is dominated by refined white earthenwares of 19th or 20th century date.

**Table 2: Pottery totals by ware group/type**

| WARE TYPE | OLDFURNACE COTTAGE | | EASTWALL FARM | | TOTAL | |
|---|---|---|---|---|---|---|
| | **No.** | **Wt.(g)** | **No.** | **Wt.(g)** | **No.** | **Wt.(g)** |
| MEDIEVAL | | | | | | |
| Misc. Coarsewares | 21 | 256 | 1 | 70 | **22** | **326** |
| Misc. Finewares | 3 | 17 | 3 | 29 | **6** | **46** |
| Late Med. Orange Ware | 3 | 11 | - | - | **3** | **11** |
| POST-MEDIEVAL | | | | | | |
| Coarse Redwares | 40 | 580 | - | - | **40** | **580** |
| Midlands Purple Ware | - | - | 1 | 20 | **1** | **20** |
| Midlands Yellow Ware | 6 | 86 | - | - | **6** | **86** |
| Mottled Ware | 1 | 7 | - | - | **1** | **7** |
| Slipwares | 1 | 49 | 1 | 6 | **2** | **55** |
| Stonewares | 7 | 89 | 1 | 19 | **8** | **108** |
| Refined Redware | 2 | 7 | - | - | **2** | **7** |
| Refined Whiteware | 216 | 651 | 4 | 6 | **220** | **657** |
| **TOTALS** | **300** | **1753** | **11** | **150** | **311** | **1903** |

## 4.3 Ceramic building material

4.3.1 This group, the majority of which is very abraded, is of post-medieval date. It includes one large, unfrogged brick fragment and two vitrified fragments (probably furnace lining) from Oldfurnace Cottage (trench 2), and an incomplete nibbed tile (trench 1). The rest consist of miscellaneous small brick and roof tile fragments.

## 4.4 Fired clay

4.4.1 These are featureless fragments but most show evidence of subjection to high temperatures, characteristic of hearth/furnace lining. One fragment from Oldfurnace Cottage (trench 1) has ironworking slag adhering.

## 4.5 Stone

4.5.1 The group of stone fragments from trench 7 at Oldfurnace Cottage is probably iron ore intended for smelting. There is also a small amount of roasted ore from trench 4 on the same site. Other stone comprises pieces of sandstone with no obvious signs of working but probably representing building material.

## 4.6 Metalwork

4.6.1 This includes objects of iron (all unidentified), copper alloy (two buttons, a ring and a halfpenny) and lead (waste). All objects are demonstrably or probably post-medieval in date.

## 4.7 Other finds

4.7.1 These comprise clay pipe (plain stems), worked flint, and glass (vessel and window). Apart from the worked flint (found unstratified at Oldfurnace Cottage), which is of Mesolithic or early Neolithic date, all these are post-medieval.

## 4.8 Animal bone

4.8.1 Ten fragments of animal bone were recovered from four made-ground or topsoil contexts. Their condition ranged from very poor (trench 5) to fair, but none were in particularly good condition and some gnawing was visible. Sheep/goat, domestic fowl, and a large mammal, probably cattle, were identified in the assemblage, of which two could be aged and two measured. Butchery was noted on five pieces, all saw marks intended to portion the carcass, indicating a post-medieval date for this assemblage.

## 4.9 Slag

4.9.1 Approximately 70kg of slag was collected from the Oldfurnace Cottage site and a further 8kg from Eastwall Farm. This represents only a very small proportion of what was present, and slag was not retained from all contexts which contained iron-working debris. A range of slag samples has been retained by Gerry McDonnell for metallurgical analysis.

4.9.2 The Oldfurnace Cottage material comprises almost exclusively fragments and larger pieces of glassy / cindery blast furnace slag – as would be expected, though tap slag probably deriving from a bloomery furnace was present in context 305. This provides evidence for earlier, medieval iron-working on the site rather than, for example, material brought in as 'feedstock' for the blast furnace. It is probable, however, that some iron-rich bloomery slag was re-used for this purpose. The greatly increased temperature and reducing conditions of the blast furnaces, achieved by increasing the fuel to ore ratio, resulted in a much more efficient process. The earlier bloomery process by contrast had a relatively poor yield, rarely exceeding 55% of the iron in the ore and frequently only around 20%, with the remainder of the iron being lost in the slag (Tylecote 1962, 300). Indeed, 'the old bloomery slags were one of the prime feedstocks of the new blast furnace process in [late] medieval Europe' (Craddock 1995, 250).

4.9.3 The bloomery slag from Eastwall Farm, some showing a ropey appearance characteristic of tap slag, can be attributed to the excavated medieval furnace or others that lay in the vicinity which, it has been suggested, were early

examples of water-powered bloomery furnaces. Such furnaces represent an intermediate stage between the hand-powered examples of the earlier period and the post-medieval water-powered blast furnaces. Most of the material collected came from the chamber and the tapping pit of the furnace.

## 5 ENVIRONMENTAL SAMPLES

5.1 Nine bulk samples of between 6 and 20 litres were taken. Five samples were taken from Oldfurnace Cottage from what appeared to be dumps of industrial waste. A further four samples were taken from the furnace at Eastwall Farm.

5.2 The bulk samples were processed by standard flotation methods and the presence of charred remains quantified in **Table 3**. The flots had relatively little rooty material and most were of reasonable size, between 40 and 300 ml.

5.3 A single seed of cleavers (*Galium aparine*) was recovered from context 305 at Oldfurnace Cottage. A fragment of hazelnut shell (*Corylus avellana*) was recovered from Eastwall Farm trench 5 (511). Charred fungal spores (fungal sclerotia) were also common within the samples. These spores from both fungi and mould are present both within the soil and within plants.

**Table 3: Summary of charred plant remains assessment**

| | | | | Flot | | | | | | | Residue |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Trench | Context | Sample | Size litres | flot size ml | Grain | Chaff | Weed Seeds Uncharred | Weed Seeds Charred | Charcoal >5.6mm | Other | Charcoal >5.6mm |
| Eastwall Farm | | | | | | | | | | | |
| Furnace 508 | 510 | 501 | 8 | 140 [10] | - | - | - | - | A | - | - |
| | 511 | 502 | 17 | 60 [2] | - | - | - | C (h) | A | - | - |
| | 517 | 503 | 6 | 40 [10] | - | - | - | - | B | - | - |
| | 514 | 504 | 10 | 125 [10] | - | - | - | - | C | - | - |
| Oldfurnace Cottage | | | | | | | | | | | |
| Test pit 3 | | | | | | | | | | | |
| Layer | 302 | 1 | 10 | 100 [10] | - | - | - | - | B | - | - |
| Layer | 304 | 2 | 10 | 80 [5] | - | - | B | - | C | - | - |
| Layer | 305 | 3 | 10 | 40 [5] | - | - | - | C | B | - | - |
| Trench 4 | | | | | | | | | | | |
| Layer/dump | 404 | 4 | 20 | 140 [20] | - | - | B | - | B | - | - |
| Trench 5 | | | | | | | | | | | |
| Layer/dump | 507 | 5 | 7 | 300 [5] | - | - | - | - | A | - | - |

KEY: A = ≥10 items, B = 9 - 5 items, C = < 5 items, (h) = hazelnuts:
NOTE: [1]flot is total; flot in superscript = ml of rooty material. [2]Unburnt seed in lower case to distinguish from charred remains

5.4 Charcoal was noted from the flots of all the bulk samples, and fragments of oak charcoal and vitrified remains were present in several. None of the samples appeared to contain roundwood from twigs and smaller branches, but only that from trench 5 (507) at Oldfurnace Cottage contained any significant amount of larger fragments of wood charcoal.

## 6 DISCUSSION

6.1 The Churnet valley lies in the centre of an area which played a significant role in the history of iron smelting in North Staffordshire, containing vital resources of iron ore, woods for charcoal production and water power. Documentary evidence exists recording the location and development of iron smelting sites within the area, including forges (bloomery furnaces) around Eastwall Farm from *c*. 1240 with additional references up to 1590. The site at Oldfurnace Cottage was believed to be connected with the foundation of what may been the first blast furnace in North Staffordshire, constructed by Lawrence Loggin in 1592.

6.2 The project therefore provided an opportunity to undertake archaeological evaluations at these two well-documented sites and record remains that may reflect the development of iron smelting in the Churnet valley.

6.3 There is nothing to indicate conclusively when iron production began in the Churnet Valley. However, the earliest evidence of occupation, which may be linked to iron working, was found at Oldfurnace Cottage where a large, unfortunately unstratified, sherd of unabraded ?Late Saxon pot was found in trench 5.

6.4 The furnace, located by geophysics at Eastwall Farm, proved to be an exceptionally well-preserved structure which, although undated, was probably typical of many small-scale bloomery furnaces in existence in the area during the 13$^{th}$-14$^{th}$ century. These clay-built furnaces were relatively small, possibly with a surrounding timber or earth structure to allow the furnace to be charged, and would have required frequent repair or rebuilding to maintain them in operation.

6.5 Large quantities of slag in the riverbank indicated that the industry at the site was of a considerable scale, and a number of strong magnetic anomalies in the immediate area of the furnace suggested that other bloomery structures were also present on the site. A few large fragments of oak charcoal were also found; iron smelting consumed substantial amounts of charcoal which was probably produced by a complex of charcoal burners in the area.

6.6 Despite the uncertainty about whether iron working began at Oldfurnace Cottage in the Saxon period, the presence of bloomery slag stratified below blast furnace slag confirmed a long history of smelting on the site. The site embraced the conversion to the improved, larger and more permanent blast furnace process, utilising waterpower. Documentary sources indicate that this occurred in the late 16$^{th}$ century at a time when similar references cease at Eastwall. No traces of the blast furnace structure at Oldfurnace Cottage were found, although the stratigraphy of the waste heaps suggest that it lay under the present house. Ore deposits found nearby may reflect the location of a storage area associated with the operation of the blast furnace or the earlier bloomeries.

6.7 Samples of both bloomery and blast furnace slag were taken from both evaluation sites. Provisional results from initial metallurgical analysis of the slag (not included in the scope of this assessment) suggest that the bloomery smelting process at Eastwall was relatively efficient. This may indicate that the furnaces here were early examples of water-powered (rather than hand-powered) bloomery furnaces. The slag retained will provide comparative samples for future research which may provide further evidence for the nature and scale of production, as well as the technological processes involved, including levels of efficiency of production.

## 7 RECOMMENDATIONS FOR FURTHER WORK

7.1 Time Team's evaluation project has been successful in providing useful data on iron smelting in the Churnet valley. The evaluation has produced a small but important archaeological archive for future research. It also provided a number of stratified samples of slag that will provide a valuable resource for the future study of comparable smelting processes from medieval bloomery furnaces and later blast furnaces.

7.2 Further detailed analysis of all the results of this project, however, are not considered to be appropriate in view of the limited scale of the evaluation. Some limited further work is proposed, however, and is set out below.

7.3 Samples of slag were recovered by Gerry McDonnell on site and a report on his assessment of the material will be incorporated into the project archive in due course. There may be opportunities, as part of future research, for the analysis of further slag samples to examine evidence for the technological processes involved in iron production at this site.

7.4 Apart from the bloomery and blast furnace slag, the finds assemblage recovered from Oldfurnace Cottage and Eastwall Farm is quite limited. Pottery provides the primary dating evidence for the episodes of medieval and post-medieval iron smelting, but otherwise the finds have little potential to further inform an understanding of the site. No further work is therefore proposed although, if more precise dating of the medieval and early post-medieval sequence is required, the pottery should be submitted for specialist comment (Debbie Ford).

7.5 Further analysis of the charred plant remains will not provide any further information on the industrial processes, although the vitrified and mainly large-wood charcoal is typical of furnaces and kilns. The charcoal, particularly that recovered from furnace-related contexts, might reveal the selection of timber used as fuel and by inference the management of local woodland.

7.6 Copies of this report and the geophysical survey report will be deposited with the Staffordshire Sites and Monuments Record. A publication note will be distilled from this report and published in the Transactions of the Staffordshire Archaeological and Historical Society and in the newsletter of the Historical Metallurgy Society.

## 8 THE ARCHIVE

8.1 The archive, which includes all artefacts, written, drawn and photographic records relating directly to the investigations undertaken, is currently held at the offices of Wessex Archaeology under the site codes OF 03 and EW 03 and Wessex Archaeology project code 52568. It is intended that, in accordance with the wishes of the landowner, the excavated material and records will eventually be deposited and curated at the Potteries Museum in Stoke-on-Trent.

The paper archive is contained in a lever arch ring binder file. It includes:

Time Team Big Dig report *by Rob Chapman*
2 x Project Designs
Finalised Assessment Report
Geophysical survey report

The geophysics report includes a record of all data, plots of the results, interpretation with detailed comments and conclusions.

The excavation archive includes:

*OF 03*
1 x A4 Number record
2 x A4 Photographic records
1 x A4 Levels Register
1 x A4 Graphic Register
1 x A4 Environmental Sample Index
5 x A4 Context Index
1 x A4 Trial Trench Record
37 x A4 Context Record Sheets
3 x A3 drawing sheets
4 x A4 drawing sheets

*EW 03*
1 x A4 Number record
2 x A4 Photographic records
2 x A4 Levels Register
1 x A4 Graphic Register
1 x A4 Environmental Sample Index
2 x A4 Context Index
1 x A4 Trial Trench Record
25 x A4 Context Record Sheets
1 x A1 drawing sheet
2 x A4 drawing sheets

4 x A4 Sheets: GPS data showing trench location, geophysics grid and TBMs

The photographic archive includes:
50 x colour transparency slides
Monochrome photographs

## 9 REFERENCES

Craddock, P.T., 1995 *Early Metal Mining and Production*, Edinburgh University Press

GSB Prospection 2003 'Oakamoor, Staffordshire' unpublished geophysical survey report 2003/59

Tylecote, R.F., 1972 *Metallurgy in Archaeology*, London

Videotext Communications 2003a 'Proposed archaeological evaluation at Eastwall (NGR SK 035 449)', unpublished project design

Videotext Communications 2003b 'Proposed archaeological evaluation at Oldfurnace (NGR SK 042 436)', unpublished project design


Mapping supplied by Time Team.
Licence number AL 100018665.



Geophysical data courtesy of GSB Prospection Ltd

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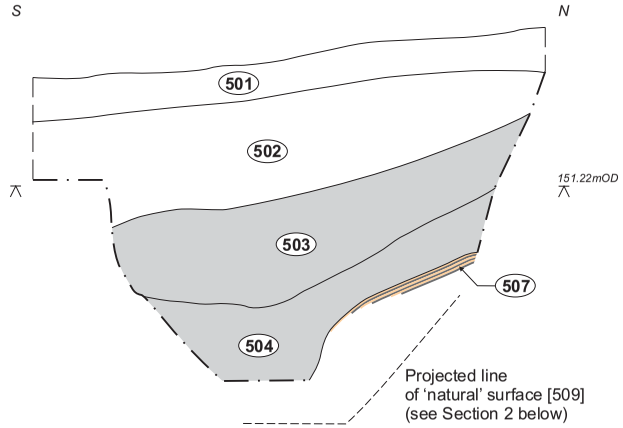
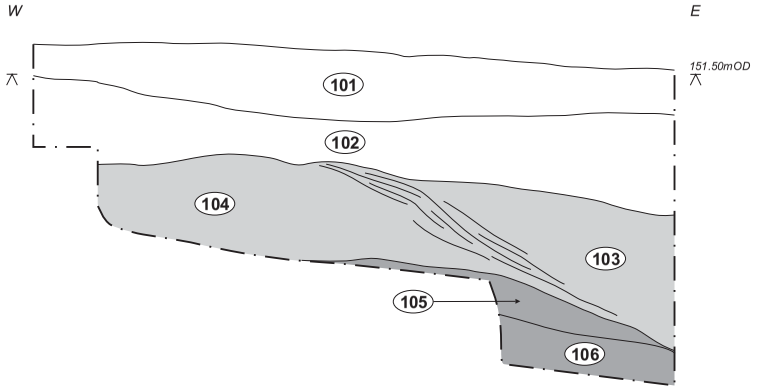
Site and trench location maps including geophysical survey results

Figure 1

### Trench 5 - Section 1




### Trench 1 - Section

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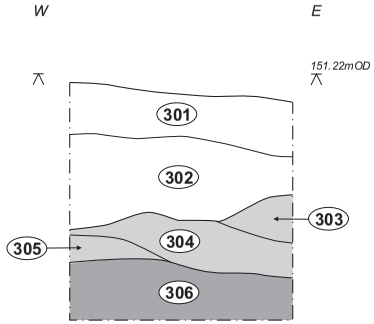
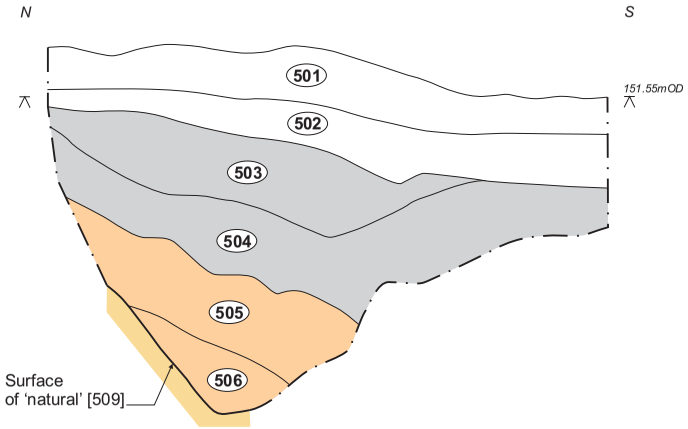
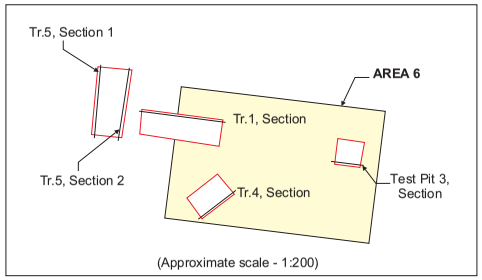
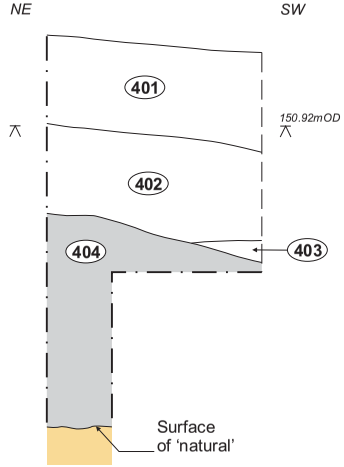



### Trench 5 - Section 2




### Trench 4 - Section




Blast Furnace | Bloomery | Charcoal | Sand | Natural

0 1m

Scale for sections - 1:25



Wessex Archaeology

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Oldfurnace, Sections from Trenches 1, 4 & 5; and Test Pit 3

Figure 2

## Trench 5 - Section

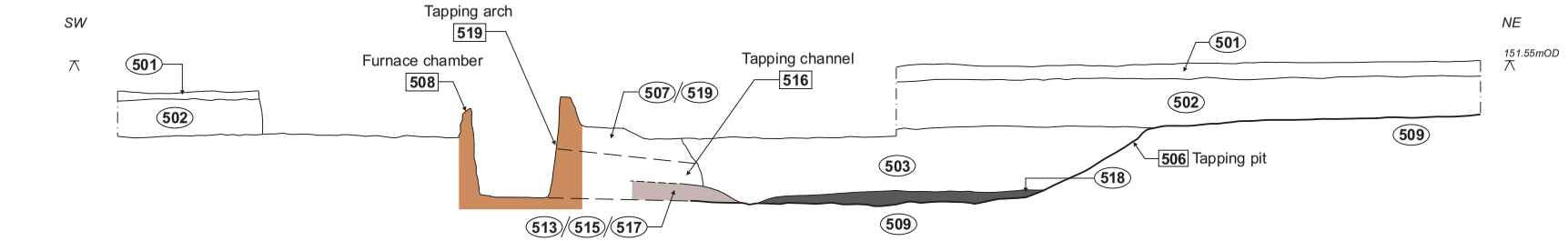


Plate 1: General view of Eastwall Trench 5 with furnace chamber (508) & tapping pit (506). Looking north-west. Scale 1m

Plate 2: Detail of furnace chamber (508) Looking east. Scale 0.5m




Furnace chamber

Slag

Charcoal

Stone

0 1m

Scale for sections - 1:25

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Eastwall, Trench 5 plan and section

Figure 3

Plate 1. General view of East wall trench 5 with furnace chamber (508). Looking north-west.

Plate 2 Detail of furnace chamber (508).

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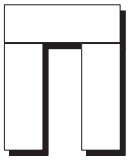

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