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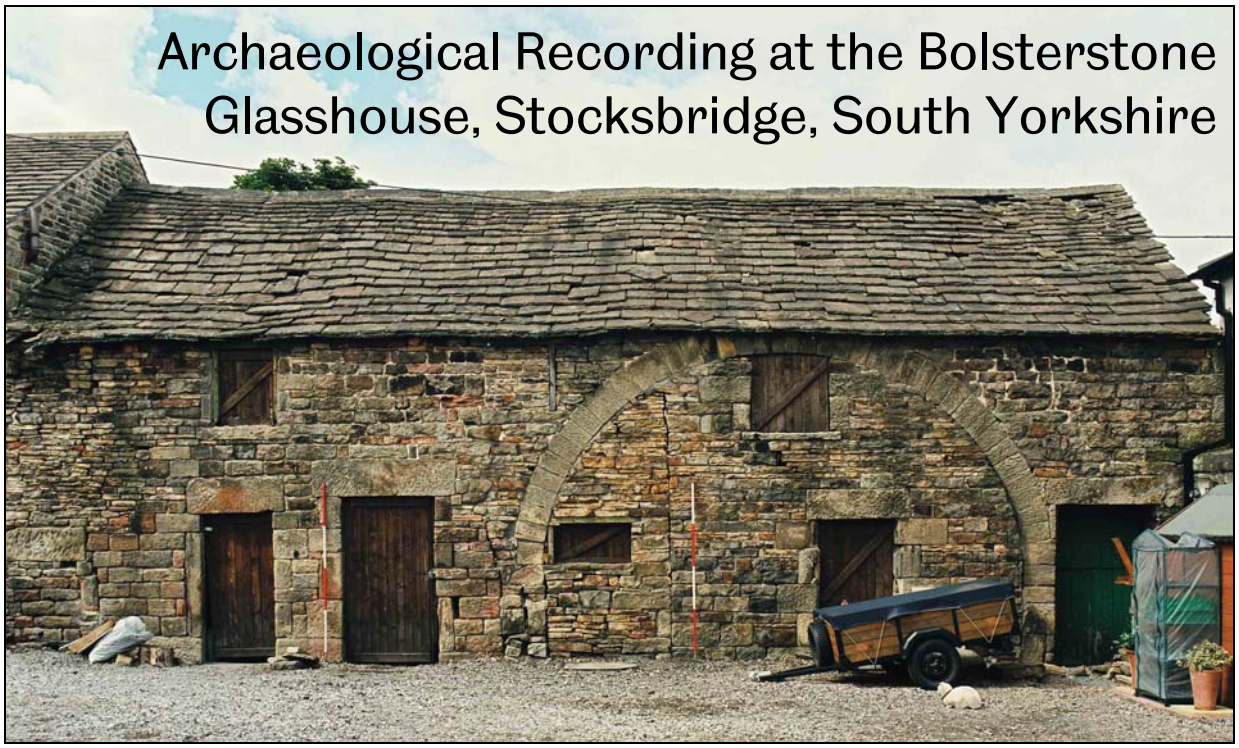
Project Report 863.1(2)

Archaeological Recording at the Bolsterstone Glasshouse, Stocksbridge, South Yorkshire



July 2008

By Oliver Jessop, Steve Baker and Katherine Baker
With contributions from Dr H. Wilmott, Dr C.G. Cumberpatch, Dr P. Buckland and Claire Coulter

Prepared for:
Mr Skene
Pot House Farm
Pot House Lane
Stocksbridge, Sheffield, S36 1ET

Bolsterstone Glasshouse, Whitwell Lane, Stocksbridge, South Yorkshire

National Grid Reference: SK 2670 9810 (centred)

Archaeological Assessment of Subsurface Deposits and Detailed Building Recording

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Fieldwork

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Illustrations

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Archive

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Checked by:	Passed for submission to client:
Date:	Date:
Oliver Jessop *Project Manager*	Anna Badcock *Assistant Director*

OASIS SUMMARY FORM

PROJECT DETAILS		
OASIS identifier	arcus2-46447	
Project title	Bolsterstone Glasshouse, Stocksbridge	
Short description of the project	A programme of archaeological characterisation and recording at the Bolsterstone Glasshouse was required to satisfy the conditions of scheduled monument consent for a programme of conservation and repair. The standing fabric was surveyed in detail including a survey and analysis of the roof structure, and dendrochronological and mortar assessments. Limited archaeological excavation was carried out on the western exterior area of the glasshouse, to determine the extent and depth of soil cover and archaeological features, and the degree of preservation. Archaeological features associated with the melting furnace within the northern room inside the glasshouse building were also uncovered, again to determine the extent and depth of the features.	
Project dates	01.04.05 to 01.11.07	
Previous/future work	Excavations in 1968-72; 1985-6	
Monument type and period	Post-medieval glass furnace (SAM SY1279)	
Significant finds (artefact type and period)	Mid 17th century glass furnace, adapted to a pottery in 18th century (glass and ceramic finds)	
PROJECT LOCATION		
County/Parish	South Yorkshire/Stocksbridge	
Site address	Whitwell Lane, Stocksbridge, South Yorkshire	
Site co-ordinates	SK 2670 9810	
Site area	0.375 ha	
Height OD	225m AOD	
PROJECT CREATORS		
Organisation	ARCUS	
Project brief originator	English Heritage	
Project design originator	ARCUS	
Project supervisor	Oliver Jessop and Steve Baker	
Project manager	Anna Badcock	
Sponsor or funding body	Mr Skene; English Heritage	
PROJECT ARCHIVES		
Archive Type	**Location/Accession no.**	**Content (e.g. pottery, metalwork, etc)**
Physical	Museum	Mortar samples, glass, ceramics
Paper	Museum/SMR/English Heritage	(museum only) context sheets, plans, sections; (all) report
Digital	SMR	pdf copy of report
BIBLIOGRAPHY		
Title	Archaeological Recording at the Bolsterstone Glasshouse, Stocksbridge, South Yorkshire	
Report no	ARCUS 863.1(2)	
Author	Oliver Jessop, Steve Baker and Katherine Baker	
Date	July 2008	

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NON-TECHNICAL SUMMARY

ARCUS were commissioned by Elden Minns architects on behalf of their client to undertake a programme of archaeological characterisation and recording at the Bolsterstone glasshouse, Stocksbridge, South Yorkshire (SK 2670 9810). The work was required to satisfy the conditions of scheduled monument consent for a programme of conservation and repair. A rectified photographic survey of the standing buildings was commissioned from the Downland Partnership, and this was used as the basis for further detailed building recording, which included a survey and analysis of the roof structure, as well as dendrochronological and mortar assessments. Limited archaeological excavation was carried out on the western exterior area of the glasshouse, to determine the extent and depth of soil cover and archaeological features, and the degree of preservation. Archaeological features associated with the melting furnace within the northern room inside the glasshouse building were also uncovered, again to determine the extent and depth of the features, and the degree of preservation.

The analysis of the standing fabric of the former glasshouse has established that remnants of the features from the initial phase of construction still survive. These are in the form of blocked openings, windows, doorways and former hearths, or lehrs. These correspond with the former survey of the building by Ashurst and excavations by Barrett in 1968-72 and 1985-6. However, evidence for another pair of hearths/lehrs previously unidentified within the east wall has been recorded. This feature has been converted into a doorway, although it is likely to have been identical in appearance to the existing remains on the west wall. The interior of the building has been subdivided on at least two occasions, creating smaller rooms and stalls for housing cattle, and latterly Shire horses.

Close to the western edge of the glasshouse, the backfill from previous excavations (Ashurst 1987) was encountered, and particularly towards the northern end of the paddock, this continued to some considerable depth and was observed to cut stratified in situ *deposits of furnace waste materials. The exterior wall of the western extension to the glasshouse was traced in this area, and the edges of the flue for the main furnace were located. In the western part of the paddock, stratified deposits of furnace waste materials survived* in situ*. Towards the southern end of the paddock, excavation backfill was much shallower. The southern end of the extension was identified, along with a later abutting structure associated with a cobbled floor. Within the inside of the glasshouse building, the surface of the main flue walls were uncovered as well as an area previously identified as a siege by Ashurst and Barrett.*

The discovery of a new pair of lehrs in the east wall, original openings (window and a door) in the north and south gables, along with a reinterpretation of the rectangular workshop outshut against the west wall has enabled a new reconstruction to be suggested for the earliest layout of the glass furnace. This, when considered with the subsurface evidence for the complex of flues and footings for the former glass furnace, provides new and unexpected evidence for an important industrial building which demonstrates a critical period in the development of the glass technology and manufacture in the mid-17th century.

1 INTRODUCTION

ARCUS were commissioned by Elden Mills Architects on behalf of their client Mr Skene to undertake a programme of archaeological characterisation and recording at the Bolsterstone Glasshouse, Stocksbridge, South Yorkshire (SK 2670 9810). Following the issue of a recording Brief and guidance notes supplied by English Heritage, a project design detailing the work was produced by ARCUS (2003) and approved by English Heritage prior to fieldwork commencing. The work was required to satisfy the conditions of scheduled monument consent for a programme of conservation and repair.

The Bolsterstone Glasshouse dates from the mid-17th century. The structure contains the remains of the furnace, ovens and working areas of the glassworks, and is the only known surviving structure of its type from the period; reflected by its scheduled status (SAM SY1279). The building has undergone several structural alterations since it ceased to be used as a glasshouse, including a pottery in the late 18th century, then a stable and granary.

This document presents the findings of the archaeological characterisation and recording that was carried out ahead of the programme of conservation and repair in 2005 and 2006. Detailed accounts of the fieldwork undertaken as part of this phased programme of analysis and assessment of the site are included as Appendices.

In addition, the results of previous archaeological investigations undertaken on the site between 1968-72 and 1985-6 are examined and a selection of site photographs previously unpublished, or used in earlier reporting, are included as **Plates 1-10**.

1.1 Site location and land use

Bolsterstone Glasshouse is situated close to the junction of Whitwell Lane and Pot House Lane, Stocksbridge, South Yorkshire (NGR SK 2670 9810) (**Illustration 1**). The site lies on a slight terrace at around 225m AOD on the steep north-facing slope of the Little Don Valley above Stocksbridge. The former glasshouse survives as a rectangular building, which adjoins a modern barn conversion to the south and an early 20th-century house to the north.

The glass furnace building is orientated northeast-southwest, although for the purpose of this report a site north has been used to ease referencing of the archaeological observations; thus the northeast wall is referred to as the north wall, the southeast wall as the east wall, the southwest wall as the south wall and the northwest wall as the west wall.

Prior to the archaeological investigations, the 'paddock' area west of the glasshouse was laid to rough grass with areas of scrub. A pronounced ridge was visible in the modern ground level running across the centre of the 'paddock' parallel to the glasshouse building. Adjacent to the modern gateway into the 'paddock' from Whitwell Lane, an area of ground had been artificially lowered to the exterior pavement level. To the east of the building a gravel yard provided internal access to the building and the neighbouring properties.

At the time of survey and archaeological excavation the interior of the former glasshouse was being used as a store and the original flagstone floor had been partially removed during previous excavations leaving only a thin earth floor remaining in places, although some areas were also covered with concrete.

2 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

An account of several different stages of excavations carried out in and around Bolsterstone Glasshouse during the 1960s, 1970s and 1980s was published by Ashurst (1987); this paper also includes a synthesis of historical references, and a summary of his findings is presented below. In addition, at least three unrecorded excavations by schoolchildren and college students took place in the 1950s, along with regular surface collection of artefacts, particularly from the 'paddock' area west of the glasshouse building.

2.1 Historical background

The glasshouse was owned throughout its existence by descendants of the Fox family, originally of Fulwood Hall in Sheffield, and is first attested in the mid 17th century. The glass furnace works appears to have closed with the death of Michael Fox in 1758. Following this the site operated as a pottery from 1778 to around 1796, although the exact location of the kiln is unknown. The glasshouse building was later adapted for agricultural use, and by the later 19th century had been converted to a stable. Material from the paddock area was removed in the early 20th century to provide foundation rubble for roads, and large quantities were dumped 200 metres north in Pothouse Lane to create a level foundation for cottages.

Most raw materials for glassmaking were available locally: coal, fireclay and ganister clay from the Pot Clay Coal and Coking Coal beds, both outcropping along the valley sides within 0.5 km; lead oxides for lead crystal glass from galena veins at Brightholmlee (3.5 km); lime from numerous kilns within South Yorkshire; and potash from bracken-burning on the moors above Bolsterstone. Finer sands and material for more specialised glasses (cobalt, copper and manganese salts) were not available locally, and would have been imported.

Timeline of known historical events

Mid 17th C	foundation of glasshouse and associated workshops and stores
1758	closed as a glass furnace
1778-1796	a pottery operated on the site, presumably reusing the glasshouse building
18th C	glasshouse building used for agricultural use (barn/granny)
Late 19th C	glasshouse converted to a stable for Shire horses
Mid 20th C	sporadic removal of glass furnace material from the paddock
1969-70s	archaeological excavations undertaken by Dennis Ashurst within and in the vicinity of the glasshouse building with Barnsley Archaeology Society in advance of road widening
1985/6	archaeological excavations undertaken by Dave Barrett and the South Yorkshire Archaeology Unit
1989	conversion of pot house barn adjacent to glass furnace building; recorded by Denis Ashurst
2005-7	archaeological recording and excavations undertaken by ARCUS and English Heritage Ancient Monuments Laboratory

2.2 Analysis of historic mapping

The glasshouse building falls within a complex today called Pothouse Farm, although historically has been referred to 'Bate Green' or 'Pot House' (Ashurt 1987:147). The available historical mapping for the site is relatively well documented from Jeffrey's Map of Yorkshire 1767, an estate plan of 1778 for the Marquis of Rockingham, through to the various editions of the Ordnance Survey. It is worth noting that the characteristic feature of the site boundary to the north is a Y shaped road intersection, which is maintained on the same alignment for all of the historic mapping.

The earliest available depiction of the site is Jeffrey's Map of Yorkshire dated 1767 (Ashurst 1987: 157, Fig.2, A). To the south of the road intersection are a pair of rectangular buildings, on an approximately north-south orientation. The eastern building is interpreted as the glass furnace building, although unfortunately the scale is not large enough to see any significant detail.

A more detailed map is an estate plan of the Marquis of Rockingham from 1778 (Ashurst 1987: 157, Fig.2, B). This survey illustrates three main structures with numerous additions, or rectangular outshuts. The western building is approximately a reverse S shape in plan, the central part representing the glass furnace. Located to the south is a large T shaped structure, again with the appearance of numerous additions. To the north is a square building with a projecting extension in the southeast corner. These buildings form two yards, with the northern boundary being open to Whitwell Lane. Two small square structures are also depicted in the northeast corner of the site, one on either side of the lane.

Further detail is evident upon the 1855 Ordnance Survey map (**Illustration 3**) which indicates that the large northern building has been demolished and the site has been subdivided into small property divisions. Interestingly, the furnace building has a small rectangular projection along the western edge, which would concur with the lean-too workshop building excavated in Area III (Ashurst 1987: 165, Fig.7). The 1893 Ordnance Survey map (**Illustration 3**) indicates that some of the inserted property divisions have been removed, but also splits the furnace building into two parts; the southern section representing the barn and the north the glass furnace. Between the publication of the 1906 (**Illustration 3**) and 1931 Ordnance Survey maps (**Illustration 3**) an approximately square building had been built attached to the northeast corner of the furnace building. This building still survives as a house.

The mapping has demonstrated that the existing layout of buildings forming Pot House Farm is comprised of structures spanning the whole history of the site, with the glass furnace building being the oldest.

2.3 Assessment of previous archaeological investigations

The article published by Dennis Ashurst in Post Medieval Archaeology (1987: 147-216) provides a comprehensive description of the history and archaeological development of the Bolsterstone glass furnace, however is misleading in that it makes no reference to all of the stages of archaeological excavation undertaken on the site apart from a comment stating that the investigations began in December 1968 as a 'rescue excavation' when a road widening scheme was planned (Ashurst 1987: 154).

In summary therefore, the actual work undertaken can be described thus. A series of narrow trenches along the edge of the road being widened (Nos. I, IA, II), with larger areas of excavation occurring in the immediate vicinity of, and within the glass

furnace building during 1985 and 1986 (Nos. III, IV, V). This later campaign of archaeological excavation and recording was undertaken under the direction of Dave Barrett with a team from the South Yorkshire Archaeology Unit. The results from this work are incorporated within the article by Ashurt, although not credited.

Building recording

The standing fabric of the glasshouse furnace building was identified by Ashurst as being historically significant and containing numerous phases of alteration. Ashurst produced stone-by-stone drawings of the sections of each wall elevation readily accessible. These drawings are very detailed, but lack structural phasing, although he does note alterations within the interior elevation of the west wall. Ashurst suggests (1987: 157) that the building was of 'dry stone walling', although this has subsequently been found to be incorrect (see section 5.3 and **Appendix 9**).

Internally, there was an inserted loft/ceiling which obscured the upper part of the walls and roof, none of which was drawn by Ashurst. In addition, the inner faces of both the east wall and the north wall were not recorded, neither was the external elevation of the north wall.

Archaeological excavations

Some twenty metres east of the glasshouse, a roadside trench (Area II) produced a stratified sequence of ash, glass and cinder layers relating to the dumping of waste from the production of fine glasswares (lead and decorative tablewares). Sherds of 'Midhope'-type slipware pottery were found only in layers above the furnace waste, establishing a clear stratigraphic break in continuity between glassware and pottery production. Two trenches further to the east produced no evidence of glass or pottery. Ashurst suggests (1987: 155) that decorative waste was dumped east of the building, and window and bottle glass cullet to the west.

Investigations to the west of the glasshouse (Area III) revealed the foundations of a rectangular structure bonded into the base of the main arch in the western wall at each end, to create an extension of the main working floor of the furnace. This structure had survived as a lean-to outbuilding within living memory. Another extension, built on a cobbled floor, was located in front of the smaller arches.

The south-western exterior area, now a garden, was associated with dumps of furnace waste material described by Ashurst as 'red ash and black cinder' (1987: 161), and with fragmentary areas of flagged and cobbled floors relating to ephemeral outbuildings or to exterior yard areas. Deposits of coal and furnace waste were also present west of the smaller arches, to a depth of 0.50m. The road widening established that these deposits also spread west of the paddock boundary wall. A concentration of crucible fragments was located in the northern corner of the paddock were possibly remnants of a midden deposit for the disposal of old and damaged crucibles.

Within the rectangular footprint of the glass furnace building (Area IV), three main trenches (T1-T3) were excavated across the width of the building, with a small sondage (**Plate 7**) against the south wall (see figure 7, Ashurst 1987:165). The upper levels of the floor comprised sandstone flagstones, which overlay a setted surface (**Plate 6**) that covered whole interior of the building. Excavations below the floor suggested that the original internal structures had been truncated to foundation level during conversion to a farm building.

At ground level the melting furnace, towards the northern end of the building, was

intact from siege level downwards. Each siege consisted of a single stone slab (**Plate 10**), below which the furnace sides sloped steeply outwards to form a triangular profiled channel (**Plates 8**, **9**). Glass deposits found on the sieges, and the range of crucible types and glass fragments recovered from the excavations, suggest that two open and two closed crucibles were in use simultaneously, the open crucibles being used for window and bottle glass and the closed crucibles for lead and coloured glasses. Immediately below each siege bed, holes in the furnace wall (**Plate 10**) are likely to have supported the iron bars which supported the grid of the fire bed. An arched channel feeding into the furnace below the sieges appears to have provided means of pre-heating the air in the flue intake, perhaps by extracting heat from the furnace dome and ducting it back into the air intake.

The main furnace flue was of sandstone dry-stone-walling construction, with a sandstone flagged floor, and ran both east and west from the base of the furnace. The flue profile was straight-sided, but narrowed within the furnace to an inverted V-profile, perhaps to compress the volume of air being drawn into the furnace. To the west, the flue ran beneath an extension (see below), where it was capped with stone flags, and was then traced under the paddock (**Plate 2**), where it had originally been open to the air, for at least three metres beyond the building extension. To the east (Area IV), the flue originally ended 4.50m outside the glasshouse wall; (**Plate 4**) this had later been extended to nine metres. Side flues on a smaller scale ran north and south from the furnace, also of dry-stone construction and capped with rough slabs of sandstone; these features may also have served a drainage function.

Two smaller brick arch structures in the western wall of the glasshouse building were interpreted by Ashurst as annealing furnaces or *lehrs*, probably with a fire set directly on a flagged floor and heating an upper level on which vessels were set for pre-heating or annealing. It is perhaps equally possible that these structures represent secondary furnaces relating to preparation of frit or firing of crucibles.

Artefacts

The range of glass fragments from the excavations suggests that the glasshouse was simultaneously producing both plain and coloured glass. All forms were typical of the late 17th to mid 18th centuries, and included:

- Window glass: typically plain, but including cobalt blue and purple lead;
- Large bottles: consistent with late 17th- and early 18th-century wine bottles, predominantly dark green but also in dark brown and clear glass;
- Small bottles and phials: clear and green glass;
- Plain glasses: a variety of forms (bottles, tumblers, bowls, beakers, vases, wine glasses, candlesticks, jugs) predominantly in clear lead glass, some in clear or green-tinged soda-lime glass;
- Coloured glasses: a variety of colours known from waste material (black, blue, white, amber, pink, green and purple); some sherds of combined colours (black and white, clear and white, blue and white) in a number of forms (bottles, beakers, bowls, jugs, wine glass stems).

The products of the Bolsterstone pottery were represented by large quantities of pottery waste found over the whole glasshouse site, comprising blackware, brown-glazed coarseware, and slipware.

2.4 Location and nature of existing archaeological archives

It is not the intention of this report to re-examine all aspects of previous archaeological work undertaken on the site, however it has proved necessary to consult aspects of previous work and as such a summary list of deposited archives and artefactual material is included as **Appendix 12**.

Principal Archaeological Archives:

- Weston Park Museum, Sheffield (relating to previous excavations)
- South Yorkshire SMR (paper reports and records associated with the site)
- English Heritage, York (inspectorate correspondence and copies of paper records and reports)
- ARCUS (excavation records and copies of ARCUS fieldwork data and reports to be deposited in Weston Park Museum)
- Dennis Ashurt Estate (additional details of research and material associated with the glasshouse in private family papers)

3 RESEARCH AIMS

3.1 Project rationale

The aims of the characterisation and recording programme were:

- to enhance and synthesise the current body of knowledge;
- to mitigate against any loss of information during the repair/conservation programme;
- to provide a record which can be used to guide and monitor any future work at the site;
- to address critical gaps in the understanding of the development and use of the standing structure;
- to assess the extent and preservation of the buried deposits, particularly on the exterior of the building.

3.2 Archaeological excavations

The archaeological excavations were intended to provide an assessment of the extent, depth and state of preservation of the archaeological features present within the western exterior 'paddock' of the glasshouse building and within the interior of the building. This assessment was required to inform the subsequent consolidation of the subsurface archaeological features as part of the programme of conservation and repair to the building and landscaping of the 'paddock'.

The specific aims of the archaeological excavations can be summarised as follows:

- to assess the extent and depth of soil cover and archaeological features, and the degree of preservation of the buried remains, particularly concentrating on the western exterior 'paddock' of the building;
- to carry out this assessment in as non-intrusive manner as possible to ensure the minimal disturbance of the buried remains;

- to gather evidence relating to the location and nature of the buried remains in order to build upon information gathered during previous excavations enabling comparisons to be made to assess the findings of this previous work;
- to assess the extent to which previous excavations have disturbed the buried remains in order to ascertain whether buried deposits still exist *in situ*.

3.3 Archaeological building recording

The archaeological building survey was intended to provide a permanent record of the present form and historic usage of the glass furnace building. The aims of the recording were to provide a written, drawn and photographic record of the standing fabric, including the roof structure.

The specific aims can be summarised as follows:

- to synthesise the available documentary, cartographic information and to provide a written description of the buildings;
- to document the buildings in the form of a drawn and photographic record;
- to produce a written report detailing the work carried out.

4 SURVEY METHODOLOGY

The archaeological characterisation and recording was carried out in accordance with the methodologies outlined in the Project Design (ARCUS 2003), with guidelines issued by the Institute of Field Archaeologists (IFA 1999) and with current industry best practice.

4.1 Archaeological excavations

Three stages of archaeological subsurface investigation were undertaken that were designed to be as non-intrusive as possible.

- **Archaeological evaluation of 'paddock':** A programme of minimally intrusive archaeological fieldwork was undertaken on the western exterior 'paddock' of the glasshouse building. This comprised seven small evaluation trenches, excavated to the surface of the archaeological deposits. Deeper excavation was carried out in areas where archaeological backfill was present, and in one sondage to enable assessment of the stratigraphy and depth within furnace waste deposits.

  A full written, drawn and photographic record of all material revealed was made during the course of the excavation. An EDM Total Station survey was taken during the course of the excavation to fix the excavated trenches in relation to nearby permanent structures, and to the National Grid and OS datum. All de-turfing and excavation was carried out by hand; archaeological structures exposed during excavation were protected by landscape matting before hand backfilling.
- **Archaeological cleaning inside glasshouse building:** Limited excavation was also undertaken within the interior of the glasshouse building. The surface of archaeological features relating to the previously excavated melting furnace was uncovered within the northern room. Full recording of these structures was not required as only the upper surfaces of the buried remains

were exposed, the majority of which had been previously excavated and recorded (Ashurst 1987).

A modern concrete surface was also removed within the middle room to assess the extent, depth and preservation of any hitherto undiscovered archaeological features that might have existed below. All excavation was carried out by hand.

- **Further exterior works:** As part of the programme of consolidation and repair, it was decided that the wall of the furnace floor extension structure, which was present below the ground within the 'paddock', should have a new 'dwarf' wall built above the ground to indicate its original extent. The position, size and extent of this wall was marked out in relation to evidence discovered during the recent excavation of the 'paddock' evaluation trenches and with reference to the findings relating to earlier phases of excavation.

  The large stone pile present within the 'paddock', which was a collection of the stones that had been previously lying across the extent of the paddock, was sorted through to identify suitable stones that could be used during the construction of the new wall.

  The 'paddock' was also levelled by hand to remove the pronounced ridge of ground that ran across the centre of the 'paddock' parallel to the glasshouse building and the resulting spoil was deposited to build up the area of lower ground adjacent to the modern gateway into the 'paddock'.

'Paddock' trench location and rationale

Seven evaluation trenches (**Illustration 4**) were excavated to characterise the extent and preservation of deposits in the 'paddock' to the west of the standing building:

- **Trench 1** (1.8 x 1.4 metres) was positioned to locate the southwest corner of the furnace extension structure identified by Ashurst;
- **Trench 2** (3.8 x 1.0 metres) was excavated lengthways across the furnace extension structure, to assess the depth and level of preservation of the main furnace flue structure, and the nature of the 'disturbed area' marked by Ashurst;
- **Trench 3** (1.6 x 1.5 metres) was positioned to locate the northwest corner of the furnace extension structure;
- **Trench 4** (5.8 x 0.4 metres) was an east-west slot designed to sample the deposits across the centre of the site towards the northern end, from the western wall of the furnace extension to the western edge of the 'paddock';
- **Trench 5** (2.1 x 1.3 metres) investigated the area to the west of the smaller arches and the remains of the later buttress described by Ashurst;
- **Trench 6** (7.8 x 0.5 metres) was an east-west slot designed to sample the deposits across the centre of the site towards the southern end, including the recently excavated area close to the modern paddock gate;
- **Trench 7** (4.0 x 0.5 metres) was an east-west slot designed to sample deposits in the central part of the site. The trench was extended in a 1.00m x 1.10m square to allow downward sampling and characterisation of the accumulated deposits.

4.2 Archaeological building recording

The recording of the standing fabric of the former glass furnace building involved a number of stages involving both targeted measured survey and monitoring in the form of a structural watching brief. Structural features were recorded with a numerical context system to aid with the process of analysing the individual aspects of the historic fabric (**Appendix 8**). A glossary of technical terms is included as **Appendix 11** at the rear of this report.

- **Stage 1 (metric survey):** A rectified photographic survey of the glasshouse structure was undertaken, using a large format camera on both exterior and interior elevations;
- **Stage 2 (structural analysis):** Enhancement and correction of the rectified photography with archaeological information and evidence for structural phasing;
- **Stage 3 (additional survey):** Ground floor and first floor levels were surveyed with a LEICA TCR1200 reflectorless instrument and enhanced with archaeological information;
- **Stage 4 (structural watching brief):** Following the removal of the stone roof tiles a structural watching brief was undertaken, which recorded the roof structure and noted
- **Stage 5 (specialist analysis):** Specialist surveys were undertaken including – a dendrochronological assessment and programme of mortar sampling

4.3 Fieldwork programme

The project was managed for ARCUS by Anna Badcock (ARCUS Assistant Director), excavations supervised by Steve Baker (ARCUS Project Officer) and building recording supervised by Oliver Jessop (ARCUS Project Manager).

Excavation site assistants (April 2005): Steve Baker, Helen Holderness, Lucy Loughman, Katherine (Martin) Baker and Miguel Satre.

Rectified photography (July 2005): the Downland Partnership

Building recording (August-September 2005): Oliver Jessop, Sanne Roberts, Simon Jessop.

Metric survey (August 2005): Chris Breeden.

Structural watching brief (January-February 2006): Oliver Jessop and Mark Douglas.

Dendrochronological assessment (January 2006): Ian Tyers.

Mortar sampling (February 2006): Tegwen Roberts, Alex Rose-Deacon.

Excavations of siege (March 2006): Anna Badcock.

Monitoring of stone pile and internal cleaning (July 2006): Steve Baker, Jonas Enns.

Levelling of Paddock (November 2006): Steve Baker, Katherine Baker, Lauren McIntyre and Elliot Barry.

5 SUMMARY OF RESULTS

Detailed descriptions of the results of the archaeological characterisation and recording are included as Appendices at the rear of this report. However, the principal findings of the work are described below.

5.1 Archaeological excavations

Seven evaluation trenches (**Illustration 4**) were excavated to characterise the extent and preservation of deposits in the 'paddock' west of the standing building. During excavation of these evaluation trenches numerical sequences of context numbers were ascribed to any structures, deposits, and cut features that were uncovered. A summary of these archaeological contexts (**Table 2**) relating to the subsurface archaeology is included as **Appendix 2**. The photographic registers detailing the photographs taken as a record of the excavation of these evaluation trenches are included as **Appendix 10**. Limited excavation was also undertaken within the interior of the glasshouse building to assess the extent and preservation of structures relating to the melting furnace within the northern room and to assess whether any structures existed below the concrete within the middle room. Further exterior works were carried out within the 'paddock' to lay out the original extent of the furnace floor extension structure, sort the stone pile and level the ground surface. Further *in situ* raking out layers of furnace waste deposits containing glassmaking waste were also observed in section on a neighbouring plot of land to the east of the site.

Archaeological evaluation of 'paddock'

Excavation in the western paddock encountered structural remains and deposits relating to Bolsterstone Glasshouse, and to later activity on the site. In general, structures corresponded to the locations suggested on Ashurst's excavation plan (**Illustration 5**). Based on evidence from the evaluation trenches, a projected deposit model can be suggested that shows the proximity of archaeological levels to the modern ground surface and a projection of this data across the entire paddock (**Illustration 6**). For the purposes of this projected deposit model Ashurst's plan has been used to extrapolate the likely position of further structural evidence.

Summary of extent and depth of preservation of archaeological features

The limit of Ashurst's excavation trench was identified within Trench 6, running parallel to the western wall of the glasshouse about four metres from the standing fabric, with two extensions identified within Trenches 4 and 7, running west into the paddock area. Masonry structures within the excavation trench had been left intact, with the surrounding deposits excavated to a varying depth. The depth of the northern part of the trench was considerable, with rubble backfill extending more than 0.70m below the modern ground surface. Towards the southern end of the trench the excavations had been shallower, with intact subsoil deposits encountered below about 0.30m of backfill.

Within Ashurst's trench area, a sequence of wall footings was encountered. These structures related to a western projection of the original glasshouse building, and a subsequent extension to the south. At the southern end of Ashurst's trench, footings were encountered in Trench 6 within 0.10m of the modern ground surface. To the north, these structures had been subject to progressively greater truncation, with stonework encountered at 0.17m below ground level in Trench 1, 0.30m below in Trench 4, and 0.48m below in Trench 3.

Other structures were encountered within the former trench area. The edges of the furnace flue were located in Trench 2, running northwest from the standing building, surviving 0.54m below ground level (southern edge) and 0.39m below ground level (northern edge). A cobbled surface, post-dating the original glasshouse structure, was located in Trench 5, 0.29m below ground level.

A small remnant of stratified furnace waste material survived in the north-eastern corner of Trench 2, with its upper surface 0.11m below ground level.

To the west of Ashurst's trench, identified within Trenches 3, 4, 6 and 7, stratified deposits of furnace waste survived intact to the western edge of the paddock, where they were interrupted by the construction trench for the modern boundary wall. The surface of these deposits was observed to slope down northwards, away from the modern ground level. This appears to follow the slope of the underlying topography. Consequently, in the south-western part of the paddock, archaeological deposits were encountered less than 0.10m below ground level. The depth of modern overburden gradually increased to the north, with 0.27m recorded in Trench 4 and 0.42m in Trench 3.

Where investigated in the sondage within Trench 7, the sequence of furnace waste deposits was 0.60m thick in total, with a fine layer of silt below probably representing the remnant of a pre-furnace soil. The sequence comprised a number of fine layers of material 0.05 – 0.22m thick, many containing clinker, coke, nodules of slag and fragments of burnt sandstone. The upper sequences in Trenches 4, 6 and 7 were similar, and suggest episodes of uniform deposition across the site, with a fine layer of pinkish-red clinker and slag overlying a thicker layer of silty soil.

The pottery within these stratified layers was consistent with an 18th century date. The presence of lump glass, vessel fragments and fine glassworking waste within these stratified layers demonstrates that they derive from the use of the furnace. The finely stratified sequences with evidence for uniform layers across the whole paddock suggests that these deposits represent *in situ* spreads of waste material deposited during use of the glasshouse, rather than later re-use of furnace material as made ground.

Summary of trench description

Within Trench 1 (**Illustration 7**), topsoil and backfill from previous excavations were removed to reveal the southern wall of the western extension to the glasshouse furnace floor (**Plate 11**) and, abutting this, the western wall of the later extension structure (**Plate 12**). Within Trench 2 (**Illustration 8**), topsoil and backfill from previous excavations were removed to reveal the northern and southern walls of the furnace flue (**Plate 13**) and a small pocket of undisturbed floor and sub-floor material (**Plate 14**) containing furnace waste relating to the levelling-up of the floor within the furnace extension building. Within Trench 3 (**Illustration 9**), topsoil and backfill from previous excavations were removed to reveal the northwest corner (**Plate 15**) of the furnace extension building and *in situ* deposits of furnace waste. Within Trench 4 (**Illustration 10**), topsoil, modern rubble and backfill from previous excavations were removed to reveal the western wall of the furnace extension building (**Plate 16**) and *in situ* deposits of furnace waste. Within Trench 5 (**Illustration 11**), backfill from previous excavations was removed to reveal the cobbled floor (**Plate 17**) of the later extension structure and the remains of the more recent buttress structure (**Plate 18**) against the glasshouse building. Within Trench 6 (**Illustration 12**), topsoil, modern rubble and backfill from previous excavations were removed to reveal *in situ* deposits

of furnace waste (**Plate 19**) and the western wall (**Plate 20**) of the later extension structure. Within Trench 7 (**Illustration 13**), topsoil and modern rubble was removed to reveal *in situ* deposits of furnace waste (**Plate 21**), which were investigated in the sondage (**Plate 22**).

Archaeological cleaning inside glasshouse building

Excavation within the glasshouse building took place in four separate phases. Two small sondages were excavated in the northern room. The first of these was excavated across the furnace flue to enable sampling for dating to take place and also revealed part of the siege. The second sondage was excavated at the eastern end of the building across the furnace flue and adjacent structures either side to assess the depth and preservation of these structures. Subsequently, these two sondages were extended to uncover the entire extent of the furnace structures within the southern part of the room. Finally, the concrete slabs were lifted within the middle room to assess whether any archaeological features were present below them.

Sondage across furnace flue and siege

A small sondage (1.80m x 0.80m) was excavated within the northern room to reveal the walls of the furnace flue identified by Ashurst, to enable English Heritage to undertake sampling of the furnace for directional archaeomagnetic dating (see section 5.2). The structure identified by Ashurst as a furnace siege was revealed at the northern end of the sondage (**Plate 23**). This furnace siege was observed to sit above the reddened burnt sandstone northern wall of the furnace flue. The siege was constructed from a large, square, flat slab of very pale coloured stone, which was highly vitrified and had fragmented, with many cracks running both horizontally and vertically through the stone. A sample of this stone was retained for further analysis, which has confirmed the rock is ganister, a stone type commonly used within furnaces due to its ability to withstand intense heat. Lying above this ganister stone was a thick layer of black coloured glass, which when originally in its molten form had melted down through the vertical cracks in the rock and spread along the horizontal cracks to create a layered effect when viewed in section. The siege was identified by Ashurst as the location where the crucibles filled with glass sat within the melting furnace, therefore, this glass was presumably derived from melted glass that had bubbled over the tops of the crucibles during melting within the furnace.

Sondage across furnace flue at eastern end

A further slightly longer sondage (2.50m x 0.50m) was excavated to the west of the first sondage to reveal the walls of the furnace flue to assess their depth and preservation. Stone flue walls were encountered in all parts of the sondage, below clean sand and hardcore of recent origin. Therefore, it appeared that this part of the flue was exposed during previous excavations, as indicated on Ashurt's plan, and subsequently filled in, as no *in situ* furnace floor or sub-floor deposits were encountered. The typical modern floor surface in this area of the room was 227.18m AOD and in places, particularly the middle of the sondage, the flue structures were within 0.05m of the modern floor surface, although particularly towards the northern end the levels were lower, up to 0.32m below floor level.

Archaeological cleaning of furnace structures within southern part of northern room

The depth of the archaeological features exposed within the second sondage was higher than anticipated. Therefore, the modern sand and hardcore levels were removed over the entire southern end of the northern room to reveal the surface of

the furnace structures, which had been uncovered during previous excavations, to discover if the structures were consistently at a high level in order to inform the nature of consolidation required. During this archaeological cleaning, the entire extent of the siege was revealed (**Plate 24**), which had previously only been uncovered in section within the first sondage. The nature of the entire extent of the siege was observed to be similar as had been previously only observed in section, with the vitrified stone having melted glass within the cracks creating a layered appearance.

Removal of concrete within middle room

The concrete that was present as the modern floor surface at the southern end of the middle room had not been removed during previous excavations and it was uncertain whether any further archaeological remains survived underneath. The concrete was found to have an intrusive modern rubble foundation, which was roughly 0.20m deep. No archaeological remains were observed below this level, which was of sufficient depth that restoration works would not disturb any archaeological remains that might be present below this level.

Further exterior works

Further work within the 'paddock' took place in three separate phases.

Furnace extension structure

The original extent of the western extension to the furnace building was marked above ground within the 'paddock' by the building of a new 'dwarf' wall to the west of the standing building. The dimensions of the original below ground remains of this wall were laid out in relation to evidence discovered during the excavation of the 'paddock' evaluation trenches and with reference to the findings of earlier excavations. The finished exterior ground level had been agreed at 227.52m AOD and an assessment of the current ground levels along the length of the wall revealed they were in general some way below the proposed new ground level, between 0.25m and 0.42m below the finished level. Therefore, the foundations for the new wall would be of a sufficient height not affect the preservation of the original archaeological remains below.

Sorting of stone pile

The large stone pile present within the 'paddock' was a collection of the stones which had been lying on the surface of the 'paddock'. This stone pile was presumed to mainly derive from the relatively modern buttress that had been against the southern end of the western elevation of the glasshouse building. Photographs from previous excavations (www.idigsheffield.org.uk) show this buttress surviving to the current height of the surviving remnant at the southern corner of the glasshouse, but extending across the entire front of the two smaller southern arches associated with the possible lehrs in the western elevation. Therefore, this buttress had all but completely collapsed. The stone pile was mainly composed of irregular relatively small blocks of stone unsuitable for re-use. However, there was a quantity of large, regular blocks of stone, which were suitable for re-use, some of these blocks were dressed showing tooling marks and a few were more elaborately carved to shape. There was also a small quantity of reddened burnt blacks of sandstone that had clearly originally been part of the furnace structure. One of these vitrified stones had melted glass on its surface and was retained.

Levelling of 'paddock' ground surface

The overall level of the 'paddock' was rather uneven, with a pronounced ridge visible in the modern ground level running across the centre of the paddock parallel with the glasshouse building, and an area of lower ground adjacent to the modern gateway in the western boundary wall. Hand excavation was carried out to remove this ridge of higher ground and dump it in the area of lower ground to level out the overall profile of the site. The entire ridge of ground was found to consist of the modern rubble deposit discovered within evaluation Trenches 4, 6 and 7

Observation of section through furnace waste deposits

To the east of the glasshouse building, on the other side of the modern yard area, a new garage has been built in recent years adjoining the house of a neighbouring property. This garage was erected without planning consent and consequently excavation work was carried out without archaeological supervision. During time on the glasshouse site, a section was observed below the wall that formed the property boundary to the south of this garage. This section had been cut during construction of the garage and within a two metre length of this section, south of the point where the garage joined the house, *in situ* deposits of furnace waste were observed containing glassmaking waste, which were presumably dumped raking out layers from the glass furnace. The location of this section is marked on **Illustration 2**.

5.2 Artefacts

Assemblages of pottery and glass were discovered during excavation of the evaluation trenches within the 'paddock'. The majority of the pottery assemblage was discovered within topsoil, backfill from previous archaeological excavations and the recent rubble deposit that created the ridge across the centre of the site. However, a small quantity of the pottery assemblage was discovered within *in situ* deposits of furnace waste. The assessment of the pottery assemblage is included as **Appendix 3**. The vast majority of the glass assemblage was discovered within *in situ* deposits of furnace waste, either from within sub-floor layers or from within raking out layers, which related directly to the glassmaking that had taken place on site. The assessment of the evidence for glassmaking is included as **Appendix 4**. A vitrified stone with melted glass on its surface was retained during the sorting of the stone pile and the siege exposed within the interior of the building was sampled in order for analysis to expand knowledge of its construction. The assessment of the vitrified stone is included as **Appendix 5**. The results of the assessments are summarised below.

Pottery by Dr C.G. Cumberpatch

The pottery assemblage included a wide variety of pottery types of diverse date, including fragments of 17th- to 18th-century glass crucibles, late 19th-century to early 20th-century salt glazed sewer pipes, and 18th- to 20th-century tablewares and utilitarian wares. Pottery dating to the period of production on the site (*c*.1778 – *c*.1796) was rare, being positively identified only in contexts (705) and (706). Other pottery represents the range of wares which might be expected on a site occupied during the later 18th, 19th and 20th centuries. Taken alone, the assemblage is of no more than general interest, but given that the site is one which has seen a considerable amount of work over the years in relation to the glasshouse and the later pottery, it represents a minor but significant part of a much larger assemblage of pottery. Consequently, a full report should be seen as a contribution to any future

eventual full publication of the numerous small and medium scale archaeological interventions on the site.

Glass by Dr H. Willmott

The recent excavations at Bolsterstone Glasshouse have revealed interesting assemblages of crucibles, glass waste (**Plate 25**) and possible products (**Plate 26**). Whilst they have not vastly increased our understanding of glassworking on the site, after all a considerably smaller area was dug than in previous excavations, they have still proved most informative. They confirm many of the processes and possible products first suggested by Ashurst, indicating that his analysis is indeed reliable. Perhaps more importantly they also demonstrate that both primary and secondary deposits survive undisturbed in the area evaluated, and that either their preservation or total excavation be considered in any future planning applications.

Vitrified Stone by Dr P. Buckland, Dr. H Willmott and Claire Coulter

A fragment of vitrified stone was retained during the sorting of the stone pile within the paddock at Bolsterstone Glasshouse (**Plate 27**). It was originally part of the glass furnace structure and consequently became vitrified because of the high temperatures in the furnace. Several spots of melted glass are visible on its surface.

Seven fragments of vitrified stone were sampled from the location that Ashurst defined as a siege within the interior of the Glasshouse building (**Plate 28**). Glass has melted onto three fragments. The rock is a hard, granular, white (Munsell no. N9) quartzitic sandstone, with a subconchoidal fracture, commonly referred to as a ganister. Its origins lie in the Upper Carboniferous, where both ganisters and pot clays occur as the seat earths of coal seams. The process of podzolization in the contemporary soil profile has lead to the breakdown and removal of other minerals from the rock creating a virtually pure quartzite (Percival 1983), which was much prized for its refractory qualities. It was employed for furnace linings and other situations were the rock had to withstand intense heat.

Archaeomagnetic Dating by V.Karloukovski and M.W.Hounslow

(*extract from English Heritage research department report 83/2007*)

The glass furnace sieges and the structures associated with the lehrs within the west wall of the former glass furnace have been dated using archaeomagnetic techniques. The lintels above the lehrs were found to have not been heated sufficiently to enable dating, but nine samples were taken at the base of the main structure. These produced a direction (corrected to Meriden) of declination = 338.2˚, inclination 70.9˚ (a95= 1.8˚, K=326). This indicates that the best estimated date for the last heating of the structure is AD 1840 (95% confidence interval – AD 1800-1870).

Samples from the remains of the glass furnace sieges, and the possible glass moulding floor were collected. Three silica-rich samples and seven reddened sandstones together produced a mean direction (corrected to Meriden) of declination = 349.7˚, inclination = 73.5˚ (a95 = 1.5˚, K = 347). This suggests that the best estimated date for the last heating of the sieges and the use of the moulding floor is AD 1710 (95% confidence interval – AD 1680-1730).

5.3 Building recording

The detailed description of the historic fabric of the building is included as **Appendix 7**, and a brief summary of the main elements of the building are described below.

During the recording a numerical sequence of context numbers was ascribed to the different structural elements of the building, which are listed as table 5 in **Appendix 8**. Photographic recording of the standing fabric is listed as a series of registers included as **Appendix 10** and **Plates 29 - 80**.

Ground floor

The building was originally a freestanding rectangular structure that formed the core structure of a wider complex associated with the manufacture of glass artefacts. A later 18th-century barn and early 20th-century house were added to either end of the furnace building. There were opposing large archways through the northern half of the building, built from cut blocks of gritstone and mortared together. There are remains of a pair of external chimney stacks, for annealing ovens or lehrs on the west elevation and although totally rebuilt, the evidence indicates that there was a similar structure projecting from the east elevation as well.

Numerous phases of rebuilding of the upper sections of all the walls, blocking of openings and the insertion of windows and doors have resulted in a building which appears rather disjointed and of varying dates. The alteration from industrial to agricultural involved re-ordering the interior into three separate rooms which functioned as horse stables and possible pens for smaller livestock or fowl. In the latter part of the 20th century the building was being used as a general store and garage.

The first floor of the building appears to have been originally open to the underside of the roof, although following the closure of the glass furnace a hayloft was inserted with associated pitching windows and an access doorway in the south wall. This appears to have been used through the 19th, presumably until horses no longer were kept in the building and hay ceased to be cut and stored for fodder.

Roof

The roof was pitched and covered with stone tiles. It had clearly been replaced and was not contemporary with the primary phase of the glass furnace. Later repairs, possibly c.1840 (after Karloukovski and Hounslow 2007) involved relaying part of the west pitch which sealed up the chimney flue and lehrs in the west wall. The roof was never given an internal weatherproofing in the form of mortar torching on the underside of the slates and by 2005 was suffering from patches of fallen tiles and water ingress.

Denrochronological Assessment

A site visit was made by Ian Tyers (ARCUS dendrochronologist) during January 2006 following the removal of the roofing tiles. The exposed roof trusses, rafters and wallplates were all examined for the potential of dendrochronological analysis.

No timbers were found to be suitable for dating, they either contained too few growth rings, or were in an advanced state of decay.

Mortar analysis

As part of the archaeological investigation of the standing fabric a programme of mortar sampling was undertaken prior to the walls being re-pointed and subjected to conservation repairs.

Following the analysis of fabric a series of 29 locations throughout the building were identified for mortar sampling, each with the potential of helping understand the

structural development of the building. Due to a lack of available mortar, or due to inaccessibility, a total of 23 out of the possible 29 samples were finally taken from the building. Where possible, samples were obtained from within parts of historic fabric away from the surface, thus more likely to represent mortars used for the various phases of construction, rather than any intermittent periods of surface re-pointing.

Each sample was split into two and one bag has been dried, then visually examined, whilst the other has been retained for future analysis. The remaining residues from the mortar analysis have been incorporated within the fieldwork archive for deposition with Sheffield City Museum; thus they are still available for detailed chemical analysis at a future date, a course of investigation which may further refine our understanding of the phased development of the building.

The detailed results of the mortar analysis are included in a tabular form as **Appendix 9**. A summary of the individual types is listed below (**Table 1**).

Mortar type	Characteristics
A	Silt-sand mortar – sandy mortar of yellow/grey/brown colour, containing a considerable quantity of silt/clay but not containing much lime creating a friable mortar that easily disintegrates to a smooth sandy powder, sample observed to have equal proportions of sand and compact lumps of mortar.
B	Sandy lime mortar – sandy mortar of white/grey/brown colour, containing a considerable quantity of lime creating a compact mortar, sample observed to have a lesser proportion of sand to compact lumps of mortar.
C	Lime mortar – sandy mortar of brown/white/grey colour, containing a large amount of lime creating an extremely compact mortar, sample observed to have a considerably lesser proportion of sand to compact lumps of mortar.
D	Sandy mortar – sandy mortar of yellow/brown/grey colour, containing a small amount of lime creating a compact mortar that disintegrates under pressure to an extremely sandy powder, sample observed to have a considerably greater proportion of sand to compact lumps of mortar.
E	Ash mortar – sandy mortar of grey/black colour, containing a large amount of ash and a considerable quantity of lime creating a compact mortar, sample observed to have equal proportions of sand to compact lumps of mortar.
F	Pink sandy mortar – sandy mortar of a light pink colour, containing a large amount of brick dust and a considerable amount of lime creating a compact mortar that disintegrates under pressure to a fine sandy powder, sample observed to have equal proportions of sand to compact lumps of mortar.

Table 1: Summary of mortar types

The mortars have been subdivided into 6 distinct types, all of which appear to be essentially lime based and noticeably different to modern Portland based cements. They are not exclusively associated with each of the individual structural phases identified by the fabric analysis, however can be broadly summarised into the groupings listed below.

Types A and D were similar in character, both being sandy in texture and yellow/brown/grey in colour. They were used in a number of the phases of alteration along the east elevation, the rebuilding of the north gable and also for the central dividing wall [005].

Types B and C, both with a sandy and compact texture brown/white/grey colour used throughout the various phases of rebuilding in the southern half of the building at ground and first floor levels.

Type E was an ash/lime mortar noticeably different to the other samples not only in constituents but also colour. It was used for the later blocking of [028] and external re-pointing of [012].

Type F has a pink sandy composition and appears to be the most recent, being used for the blocking of the western lehr [043], presumably after their last use which has been dated by archaeomagnetic techniques to *c*.1840 (Karloukovski and M.W.Hounslow, 2007).

6 DISCUSSION

6.1 Phased development of Bolsterstone Glasshouse

It has been possible to subdivide the building into seven main phases of change, rebuilding and alteration. The earliest (phase 1) represents the original glass furnace structure built in the second quarter of the 17th century. Evidence for a minor alteration to one of the windows is attributed to phase 2, however following this and presumably after the closure of the glass furnace in 1758, the building appears to have suffered a period of decline.

A major programme of rebuilding and repairs subsequently took place (phase 3), involving subdividing the building into two separate areas, the southern further subdivided into animal pens, or stalls and northern left open sided perhaps for use as a hay barn or shelter shed. The roof was also replaced.

Later alterations in the 19th century (Phase 4) involved the conversion of the northern half of the building into stables for Shire horses and the insertion of a hayloft. This again involved the blocking up of openings and the partial re-ordering of internal spaces.

During the early 20th century brick and stone (phase 5) was used to make additional internal alterations, finally resulting in relatively recent episodes of minor repairs and partial rebuilding (Phases 6 and 7).

6.2 Reinterpretation of glass furnace building

The design of the earliest glass furnace at Bolsterstone has been extensively discussed by numerous authors including Ashurst (1987; 1990), Crossley (1990), Fenn (1980) and Willmott (2002) who agree that it is unique and represents a critical stage in the development of glass technology. In particular Ashurst (1990:27) discusses that the arrangement of the lehrs in the west wall should be considered significant in terms of the evolution of furnace design and as such the suggested twin lehr arrangement should be regarded as even more unusual. The complex design of two intersecting flues passing through each axis of the building adds to this baffling and perhaps even experimental layout.

The results of this programme of investigation now provide an even greater understanding of the earliest layout of the building, which can be described thus (see **Illustration 32**): the building was rectangular in plan and may have even been orientated to straddle a slight terrace part of the way up a hillside to maximise the effect of the prevailing wind in relation to the subterranean flues. The east elevation was dominated by a large open archway the full height of the building, whilst the opposite west elevation had a smaller arch which appears to have been associated with a rectangular extension attached to the main building. The remnants of low

projecting walls surrounding this extension may have even supported a timber framework, or open sided workshop with a mono pitch roof against the west wall.

Internally, it appears that there were a series of working areas, some of which may have required more light than other, therefore the provision of windows appears to be carefully chosen. There was a single doorway in the north wall, with additional access through each archway. The main furnace would have been positioned between the arches, straddling the principal west-east flue running beneath the building. The appearance of the furnace itself is conjecture as no remains survive above ground, however it has been suggested that the design of the furnace was different to those that followed, such as the cone at Catcliffe. Further research into the nature of glass furnaces is clearly required and it is suggested that there the structure may have even had distinct similarities to the slightly earlier furnace depicted upon the 15th-century Bohemia illustration from Sir John Manderville's Travels (BL Add. MS 214189) (Charleston 1991: 247, fig.109). Here there is a free standing dome with a fire trench below and a variety of glory holes from which to heat, observe and then gather the molten glass for blowing. The furnace is covered by a light timber shed, with ventilation all around to help dissipate the immense heat for the glass blowers and protect it from the elements. No chimney would therefore be required, this could have been the situation at Bolsterstone. The use of large arches therefore, both opened up the interior to a greater amount of natural light, but also would have greatly added ventilation.

The Bolsterstone furnace had two pairs of secondary hearths, or lehrs arranged on either side of the building and immediately adjacent to the arched openings and the central furnace. One of the main working areas may have therefore been located in the central part of the building, with equal distance to the furnace and lehrs on either side. The use of up to four lehrs indicates that there was the potential for multiple teams of glass blowers to operate at any one time, thus maximising output.

The lehrs were technologically advanced chimneys which were brick lined to retain heat and maintain a controlled environment for the annealing of glasswares. The quantity of reused stones within the building which are pink and indicative of exposure to excessive amounts of heat is interesting. Many of them are carefully tooled blocks and although it has not been possible to reconstruct any of the former furnace structure, or detail of the lehrs from this evidence, future research may offer a greater insight into these essential elements of the furnace building.

The original building appears to have been built as freestanding with windows in all walls expect to the east, however it is worth noting that it was only part of what was a much larger manufacturing operation. For example, in 1726 the site included various workshops in addition to the glass furnace building, including "*outhoufes Warehoufes Glashoufes Labaratories for the making and prepareing of Glafs wares or Comodities*…." (after Fenn 1985:6). Many of these buildings need not have had a complex structure like the furnace, but were still essential elements of the manufacturing process.

7 CONCLUSION

The archaeological analysis of the standing fabric and the re-excavation of the upper levels of the subsurface deposits prior to, and during the recent programme of repair and conversion of the former glass furnace at Bolsterstone, have provided new and unexpected evidence helping further our understanding of the historical use and

appearance of the building. The archaeological work has demonstrated that a re-consideration of previous campaigns of archaeological recording has proved essential, not only in explaining aspects of building, but raising further questions about its use.

Further analysis of the results may provide a greater understanding of the development of the glass industry during the later part of the 17th century, especially when the new evidence is compared the contemporary industrial structures. The metal working forge at Wortley only three miles away for example is housed within a building of similar date, which has side walls pierced by large semi-circular arches and may have architectural or technological links to the buildings at Bolsterstone.

New discoveries in the form of additional lehrs on the eastern side of the building and a greater understanding of internal working areas all provide a valuable insight into the former appearance and functionality of the glass furnace. It is recommended that the results of these investigations are worthy of publication and will add to the existing corpus of knowledge about the development of the English glass industry in the post-medieval period.

8 ARCHIVE

The site archive resulting from the excavations and investigations undertaken by ARCUS between 2005-2007 will be deposited with the Weston Park Museum in Sheffield under accession number **SHEFM:2008.61**.

In addition, the site archive relating to the 1985-6 excavations undertaken by Dave Barrett and the South Yorkshire Archaeology Unit will be appended to ARCUS archives and also deposited with Weston Park Museum under accession number **SHEFM:1996.146**.

A copy of this report will be deposited with Western Park Museum, retained within the ARCUS offices, issued to Mr Skene (the client), the South Yorkshire SMR, English Heritage (Tanner Row, York) and the National Monuments Record (Swindon).

9 COPYRIGHT

10 ACKNOWLEDGEMENTS

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Gill Woolrich of Sheffield Museums is thanked for help consultation of existing

archive and archaeological material held within their collections. A vast amount of historical and general reference material for the site, much of which relating to the earlier campaigns of investigation was provided by Louisa Matthews of the South Yorkshire SMR, who has been very generous with her time.

Finally, the authors would like to acknowledge Dave Barrett who has provided access to site records and photographic images produced during the 1985-86 seasons of fieldwork.

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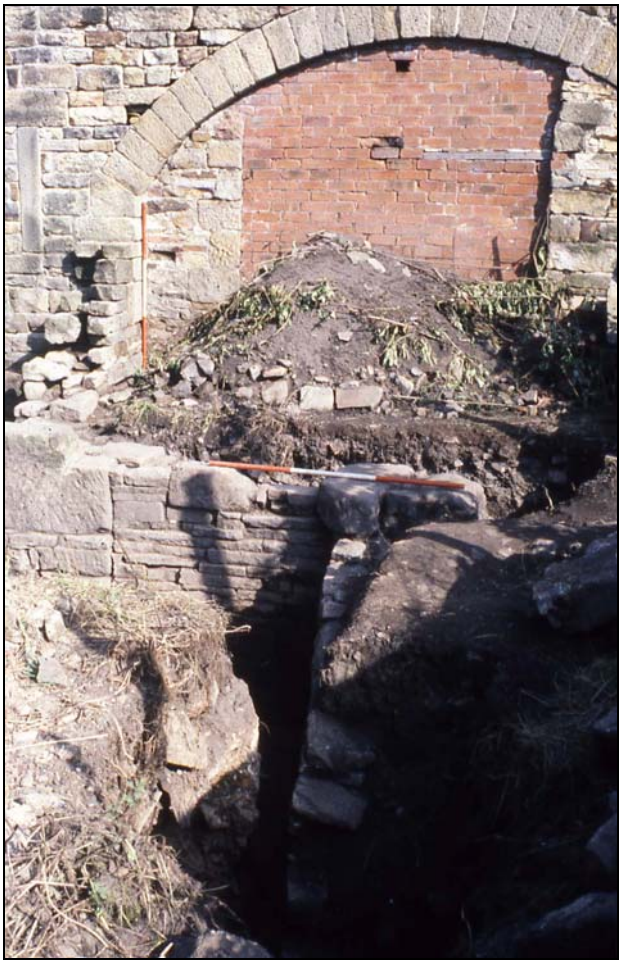

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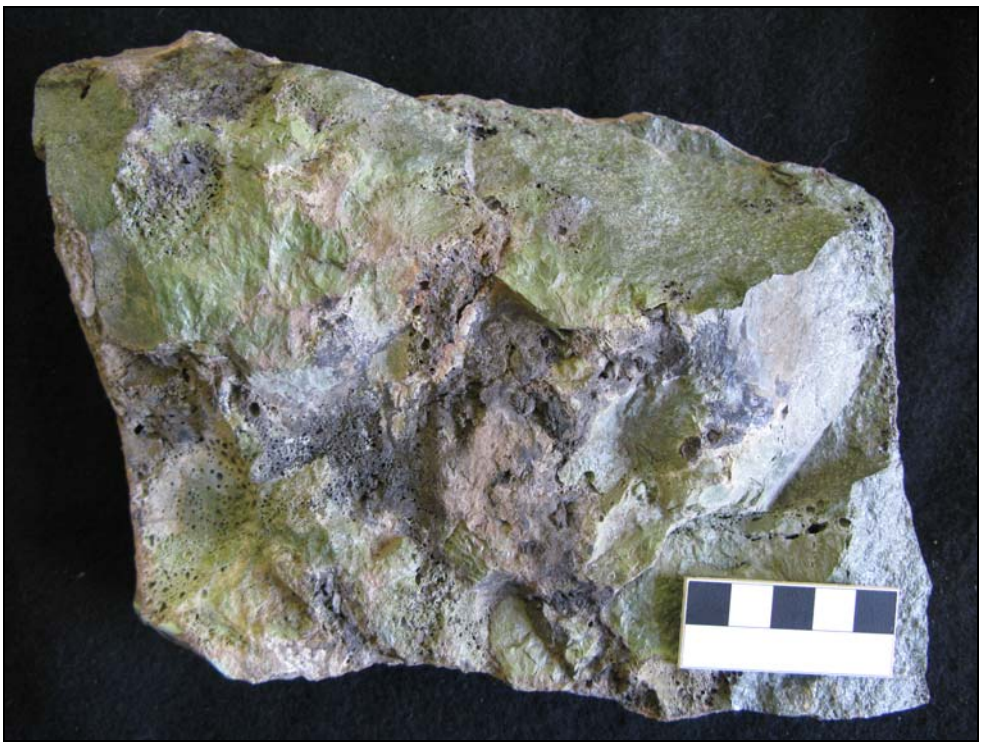

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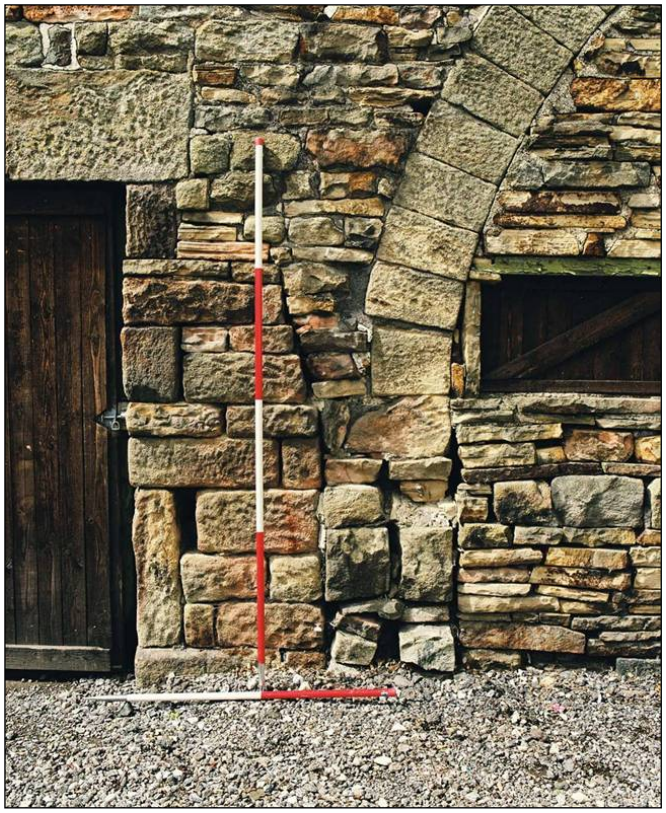

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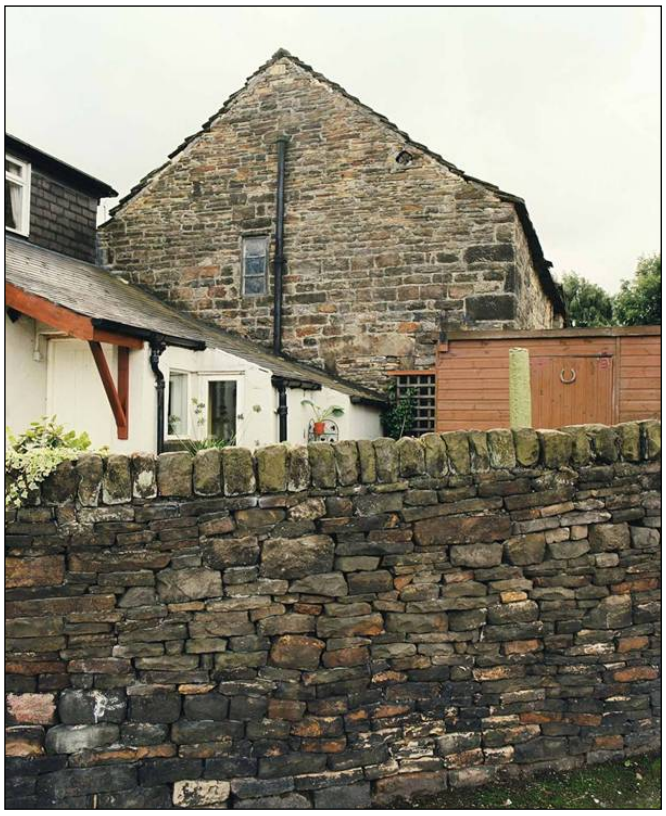

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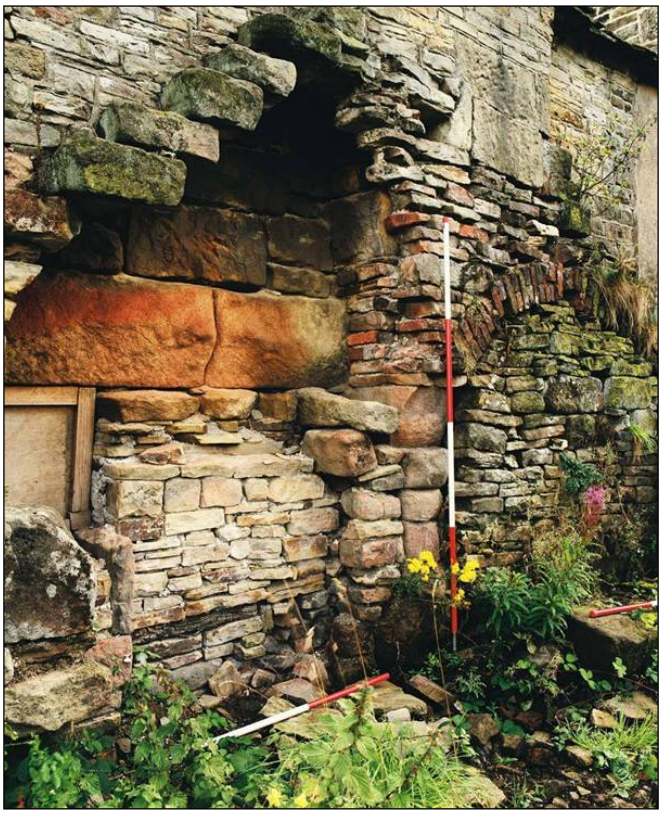

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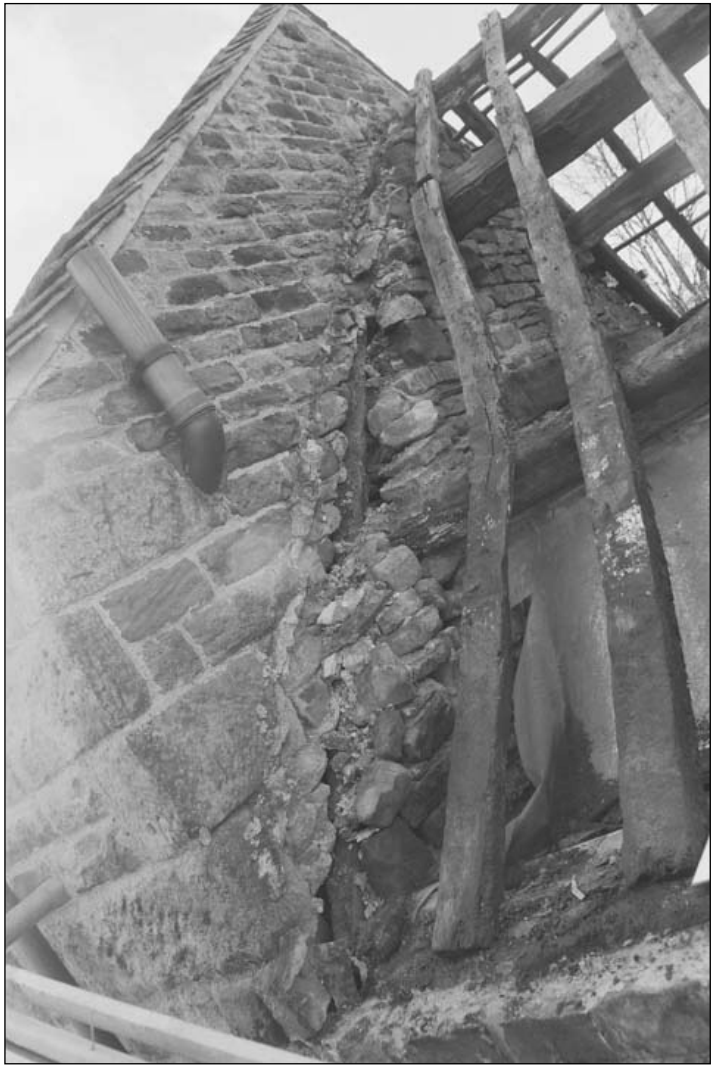

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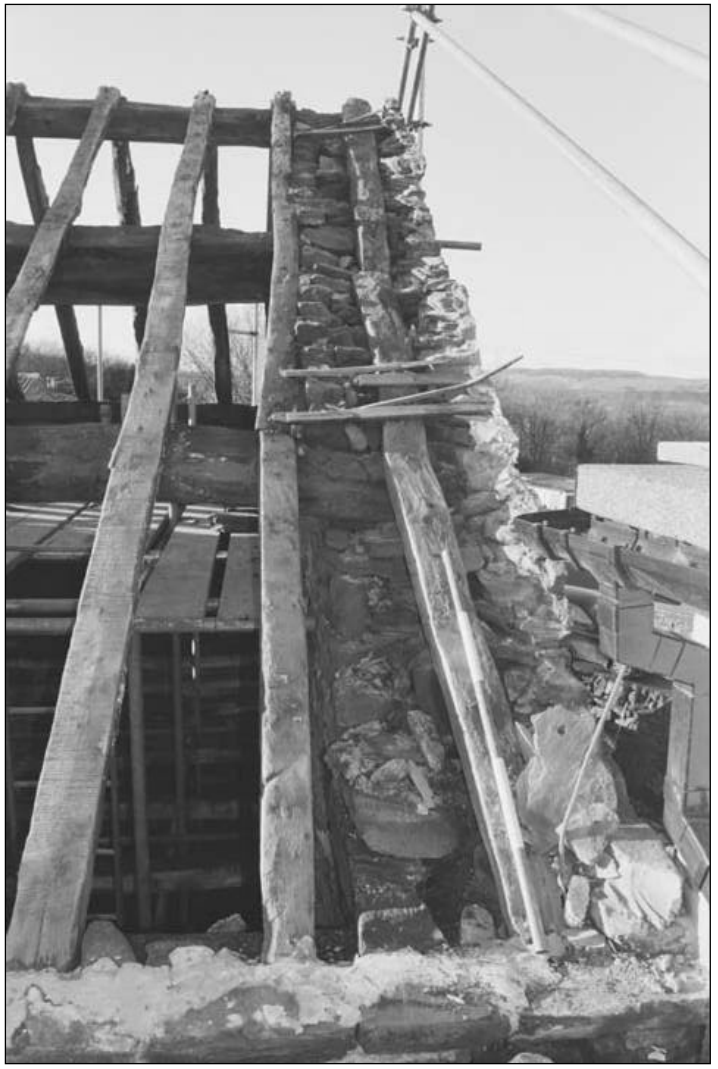

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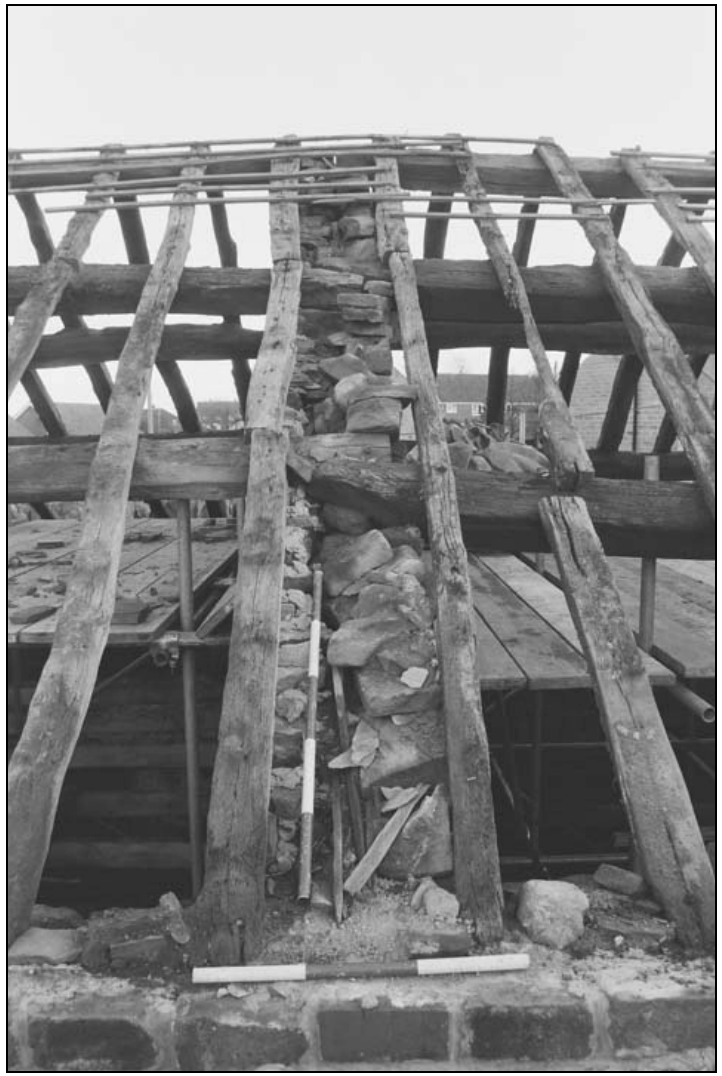

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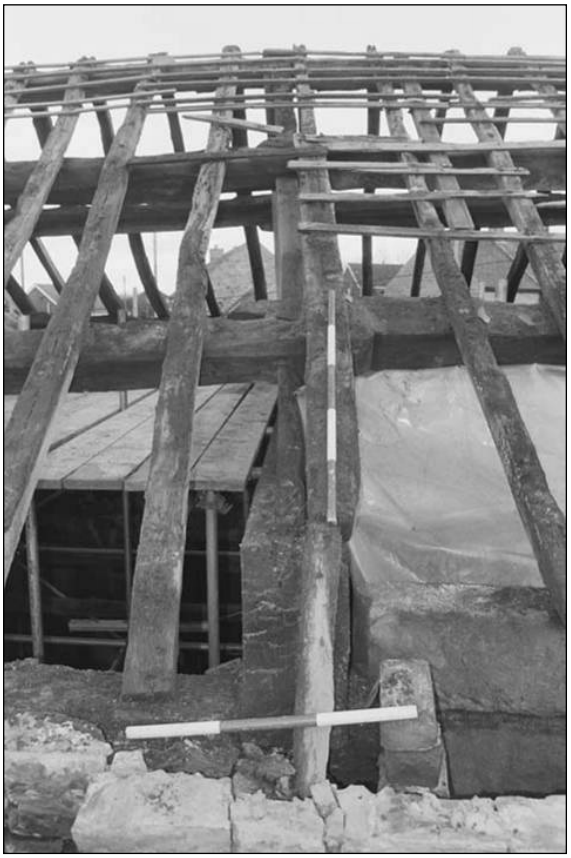

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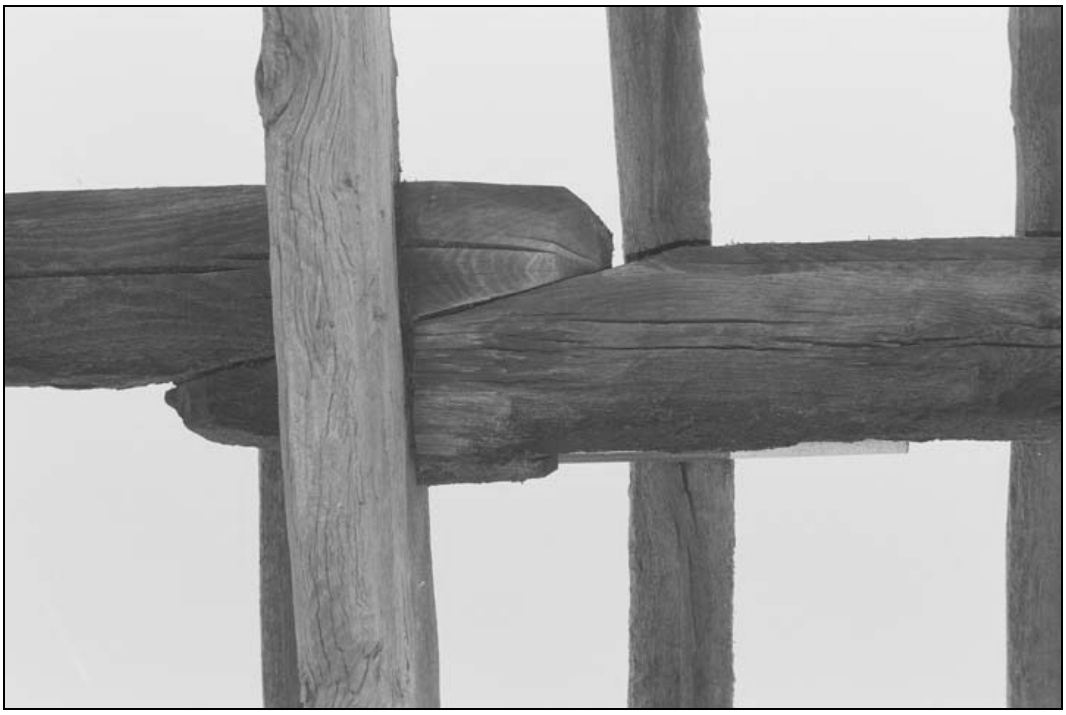

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APPENDIX 1: TRENCH DESCRIPTION

Trench 1

Below a loose silt topsoil (100), which contained fragments of pottery dating from the 19th to early 20th century as well as fragments of ceramic drain pipe dating from the mid-19th to 20th century, stonework was encountered within 0.17 metres of the modern ground surface, along with a loose rubble deposit (101) deriving from a backfill episode probably relating to Ashurst's excavations, which also contained fragments of pottery dating from the 19th to the early 20th century. This backfill rubble extended to a maximum depth of 226.91m AOD, 0.39m below the modern ground surface. When (101) was removed, a sequence of structures was revealed relating to the furnace floor extension shown by Ashurst, and to a later abutting structure to the west (**Illustration 7**).

South-west corner [103] and [104] of furnace floor extension structure

East-west wall [103], a well-built sandstone slab wall of dry-stone construction 0.65m wide and roughly faced to north and south, appeared to run out from the southern end of the main furnace arch in the west wall of the standing building, ending 0.70m inside Trench 1 (**Plate 11**). The topmost surviving course of [103] was present only just below the topsoil surface, at 227.27m AOD. [103] was interpreted as the south wall of the furnace floor extension. A poorly preserved sandstone slab wall or footing [104] ran north at right angles to the end of [103]; the alignment of this structure suggested that it represented the remains of the western wall of the furnace extension. The foundations of neither [103] nor [104] were exposed; these features probably continue to some depth (see below). No construction cut for either feature was identified; it appeared that a silt-clay buried soil (106) had accumulated against the outside face of the structure.

Western wall [102] of building abutting the furnace floor extension structure

A north-south wall [102], of dry sandstone block construction, faced on the west side and 0.46m thick, abutted the western end of [103] and ran south to the edge of the trench. The eastern side of this wall had been subject to some later disturbance. Although this structure was encountered, like [103], just below topsoil at 227.24m AOD, only two courses remained above a rough sandstone slab foundation [105], which lay at 226.93m AOD (**Plate 12**). The foundations of this structure were therefore much shallower than the furnace extension, and [102] was interpreted as the western wall of the later extension structure shown by Ashurst (ibid.). In the angle between [102] and [103], and abutting both walls, a layer of orange sandy material (107) was encountered 0.27m below the modern ground surface, and probably relates to the use of the later extension building.

Trench 2

Trench 2, across the interior of the furnace floor extension, encountered backfill rubble (201) from Ashurst's excavations, which contained fragments of pottery dating from the 19th to early 20th century, along with fragments of ceramic drain pipe dating from the mid-19th to 20th century, as well as fragments of glass crucible dating from the 17th to 18th centuries and lump glass/vessel fragments. This backfill was encountered immediately below the modern topsoil (200), which contained fragments of pottery and ceramic drain pipe dating from the mid-19th to 20th century.

The excavations had extended much deeper than in Trench 1 further south, and (201) continued beyond the limit of excavation at 226.56m AOD, 0.70m below the modern ground level. (201) was removed until the edge structures [202] and [209] of the main furnace flue were encountered, along with sandstone natural at the south end of the trench (**Illustration 8**). A small pocket of undisturbed floor and sub-floor material survived in the north-east corner, and a recent water pipe noted by Ashurst (ibid. 164) was also encountered at 226.52m AOD.

Furnace flue walls [202] and [209]

[202], the southern flue wall, ran east-west across the width of the trench, with the upper surface of its topmost surviving course at 226.63m AOD, 0.54m below the modern ground surface (**Plate 13**). This wall was of drystone construction, comprising a single skin of reddened burnt sandstone blocks roughly faced to the north inside the flue. 0.18m of the wall lay above the limit of excavation. [209], the northern flue wall, was represented by a single reddened sandstone block, upper surface at 226.78m AOD, and a collapsed structure of reddened sandstone slabs, upper surface at 226.82m AOD. This structure was contained entirely within archaeological backfill (201), and appears therefore to have collapsed during Ashurst's excavation or the subsequent backfilling of the trench.

Floor fragment [203] and glassmaking waste (204) to (207)

In the north-east corner of the trench, a pocket of ground 0.55m square had not been disturbed by Ashurst's excavation trench. [203], a single damaged sandstone slab, upper surface at 227.06m AOD, probably relates to part of a floor within the furnace extension building at some stage during its use (**Plate 14**). An undisturbed sequence of sub-floor deposits 0.36m thick lay below [203], as follows with upper deposits first:

- (204): 0.05m thick; black-red gritty silt with red brick fragments;
- (205): 0.20m thick; degraded light grey mortar and red brick fragments;
- (206): 0.08m thick; yellow-brown and gray-black sandy clay;
- (207): 0.05m thick; loose black clinker and coke;
- (208): extending beyond limit of excavation at 226.54m AOD; pink-red crumbs of degraded sandstone.

This sequence appears to relate to the levelling-up of the floor within the furnace extension building. Lump glass/vessel fragments were present in all of (204) to (207), with very fine glassworking waste present in (205) to (207). It is unclear whether this sequence was deposited during the active life of the glasshouse, or whether it represents the secondary deposition of glassworking waste in the context of later use. The presence of degraded reddened sandstone at the base of the sequence (208) may suggest that demolition or at least remodelling of furnace or flue structures had occurred before deposition of the upper sequence.

Sandstone natural (210) was encountered at 226.61m AOD in the southern end of the trench.

Trench 3

Topsoil (308), around 0.15m thick, merged into loose dark brown silt, with rubble including modern brick, tile, sandstone and glass. This material derived from two separate episodes of backfilling, the first probably associated with Ashurst's excavations (300), the second apparently relating to very recent disturbance (305).

Structures associated with the north-west corner of the furnace floor extension were located in the southeast corner of the trench; undisturbed deposits of material deriving from furnace waste or furnace demolition survived in the south-west corner (**Illustration 9**). In the remainder of the trench the rubble deposits (301) and (305) continued below the limit of excavation at 226.53m AOD, 0.62m below the modern ground level.

Northwest corner [304] of furnace floor extension structure and possible later re-use [307]

Wall corner [304] was encountered at 226.67m AOD, 0.48m below the modern ground level. This was interpreted as the northwest corner of the furnace extension building. [304] was of dry sandstone slab construction, with typical slab dimensions 0.44m x 0.32m x 0.07m, and was roughly faced to the outside, the inside being obscured by the overlying slab [307] (**Plate 15**). Two courses were present above the limit of excavation.

Resting on top of [304] with no bond, and on a slightly different alignment, was a large, well-faced block of fine yellowish sandstone [307], overlapping the inside wall corner of [304]. [307] was 0.22m thick, with an area 1.00m by 0.50m visible within the trench. The upper surface was at 226.93m AOD, 0.22m below the modern ground level. Observations during excavation suggested that, due to the alignment and sheer size of [307], it was not part of the original wall build [304] and may, therefore, derive from a later use of the furnace extension area. However, examination of photographs taken during the earlier 1986 excavation show an extremely large sandstone block present at the north-west corner of the furnace extension building. Even though this block formed the topmost course of this wall during the 1986 excavations, it was not discovered during recent excavations. Therefore, it appears possible that this large sandstone block might have collapsed towards the east either during the 1986 excavations or during backfilling and was found lying across the inside corner of wall [304] during recent excavations and interpreted as [307], whereas the upper surface of a lower course of [304] was exposed during recent excavations instead.

The cut [301] of Ashurst's excavation trench ran roughly parallel to the western face of [304], about 0.30m to the west, with the rubble backfill (300) against the face of the wall. A later excavation cut [306] disturbed this sequence in the northern part of the trench; the date from a drinks can found within the backfill (305) indicated that this had taken place since 2000.

Furnace waste material (302) and (303)

In the southwest corner of the trench, a small pocket of material survived undisturbed by recent excavations; the upper surface of this material was encountered at 226.73m AOD, 0.42m below the modern ground level. (302) white-yellow clay-silt mixed with patches of loose dark brown silt-sand and coke fragments, was 0.17m thick and overlay (303) mid red-brown sandy silt with crushed brick and fragments of burnt sandstone. (303) was at least 0.08m thick, extending downward below the limit of excavation. The presence of lump glass/vessel fragments, fine glassworking waste, and cobalt-blue glassmaking slag within (303) confirms that this deposit and presumably (302) also derive from furnace waste material.

Trench 4

Trench 4, a narrow slot, extended east-west across the northern part of the paddock. Part of the rationale for this trench was to investigate the nature of the rise in ground

level across the centre of the paddock. Before excavation, ground level at the eastern edge of the trench was 227.18m AOD, rising to 227.52m AOD in the centre of the trench and dropping again to 227.29m AOD towards the western edge of the paddock.

Topsoil (400), a dark brown silt-loam, which contained fragments of pottery dating from the 19th to early 20th century as well as fragments of ceramic drain pipe dating to the mid-19th to 20th century and fragments of glass crucible dating from the 17th to 18th century, was consistently around 0.15m thick along the trench. The uneven ground surface was due to the underlying deposit (401), dark brown sandy silt with sandstone rubble and mixed finds including modern drainpipe and plastic, but also fragments of pottery dating from the 18th to 19th century. (401) increased in thickness from 0.05m at the eastern end of the trench to 0.30m in the centre, creating the observed rise in ground level. This material appears to derive from fairly recent activity, possibly as a backfill episode relating to Ashurst's excavations, or from more recent landscaping.

Below (401), the western wall [406] of the furnace extension building was encountered (**Illustration 10**), with rubble-rich backfill deposits to the west (405), which contained fragments of pottery dating from the 18th to early 20th century, and to the east (407), both presumably derived from Ashurst's excavations. This backfill extended to some considerable depth, beyond the limit of excavation at 226.50m AOD, 0.98m below ground level in the centre of the trench.

Western wall [406] of furnace extension structure

The topmost surviving course of [406] was encountered towards the eastern end of Trench 4, at 226.89m AOD, 0.30m below the modern ground level. Running north-south across the trench, [406] was a sandstone slab wall of drystone construction, 0.44m wide and roughly faced to the western exterior side (**Plate 16**). Slabs were typically 0.08m thick, and five courses were visible on the western side. The wall had clearly been exposed during Ashurst's excavation, and was backfilled on both sides with rubble (405) and (407).

Furnace waste sequence (402), (403), (404)

The western edge of Ashurst's excavation [408] was encountered 2.50m west of the extension wall [406]. The excavation had cut at an angle through a stratified sequence of deposits that extended west from the lower excavated edge of the cut to the end of the trench; the upper surface of this sequence was at 227.02m AOD, 0.27m below ground level at the western end of the trench. (402), 0.05m thick, was a very loose pink-red to black deposit of coke, slag nodules, burnt sandstone and crushed brick fragments, lying above (403), yellow-brown sandy silt with charcoal flecks, 0.13m thick. Below (403), an orange-pink deposit (404) was composed of degraded crumbs of burnt and weathered sandstone, with large blocks of extremely reddened sandstone visible in the section. (404) extended below the limit of excavation at 226.50m AOD. Two fragments of 18th-century colour-glazed ware were associated with the upper surface of (402). Lump glass/vessel fragments were found within both (403) and (404).

(402) was therefore interpreted as a fine spread of furnace waste material; (404) appeared to include large sandstone elements relating to the furnace structure, and could represent a destruction or collapse layer associated with the flue running west across the paddock, or with decommissioning or refurbishment of the furnace itself. The intervening layer (403) was fairly clean silt, and may represent a period of stable

soil formation, or alternatively a spread of made ground across the paddock area.

Trench 5

Trench 5 was excavated in front of the smaller arches associated with the possible lehrs towards the southern end of the glasshouse. A rubble backfill layer (500), which contained modern plastic and drainpipe as well as fragments of pottery dating from the 18th to early 20thcentury, extended 0.25m below the modern ground surface, and probably represents archaeological backfill. A sandstone cobbled floor was encountered at this level, intact except on the northern side where it appeared to have been cut by deeper archaeological excavations (**Illustration 11**). A stratified sequence below the remains of a buttress structure was present in the eastern section, where it had apparently been cut by the earlier excavation(s). The northern end of the trench was extended to the east right up to the foundations of the infilled northern arch associated with the possible lehr. The sequence here remained unclear due to the safety considerations implied by the proximity of an unstable standing building, and might repay further investigation should circumstances allow.

'Edge' structure [512] and sandstone slab [513]

Immediately to the west of the northern arch associated with the possible lehr, the curving edge of structure [512] was encountered, at 226.94m AOD, 0.55m below the modern ground level. This edge was of brown-yellow clay, with irregular sandstone slabs set into it; the extrapolated curve of this structure would create a rough semi-circle extending 0.96m from the standing structure and intersecting each end of the northern arch associated with the possible lehr. The inner edge of [512] sloped steeply down towards the standing structure below the limit of excavation at 226.83m AOD. The space between [512] and the standing structure was filled with clast-supported rubble (511), apparently packed against the foundations of the standing building. This material was of fairly recent origin and contained fragments of pottery dating from the mid-19th to early 20th century, but also included some handmade 2 inch bricks and burnt sandstone slabs presumably deriving from the original furnace superstructure. (511) appears therefore to derive from a 20th-century infilling episode, perhaps in the context of a previous archaeological excavation, or alternatively as reinforcement material deposited against the foundation of the standing wall. Because of the proximity of the standing building it was not considered advisable to remove all of (511); this area might repay further investigation if reinforcement of the foundations is necessary. Therefore, it was not possible to fully evaluate the nature of the edge formed by [512]; it may simply represent the extent of a previous archaeological excavation dug against the northern arch through underlying sandstone material, and subsequently backfilled with rubble; alternatively, but probably less likely, [512] may represent a sub-floor archaeological structure associated with the original northern arch of the possible lehr. A sandstone slab [513] was set into the upper surface of the southern edge of [512], and may relate to part of a floor level. Ashurst certainly describes a sandstone slab floor in this location (ibid. 164) and it is possible that the floor was removed and underlying deposits investigated during these excavations, however, Ashurst does not specify this.

Cobble and slab floors [507], [508], [509]

A floor of sandstone cobbles [507] filled the northern part of Trench 5, with its surface around 227.11m AOD, 0.29m below the modern ground level (**Plate 17**). [507] ended above the possible edging structure [512], and appeared to be built onto its upper surface. The cobbles were sandstone slabs, typical dimensions 0.17m x 0.17m x

0.06m, set at 60-80° into a bedding material of red-brown silt-sand, and aligned roughly north-south. Against the northern edge of the trench, [507] had been cut away by the edge of a probable archaeological excavation [506], with the backfill rubble (500) extending below the limit of excavation at 227.09m AOD. [507] ended against a row of sandstone slabs [509] running east-west across the trench towards the standing building and possibly continued by [512] at the same level. These were of irregular shape, typical dimensions 0.43m by 0.25m, and set into a bedding material of mid brown sandy silt with patches of lime. [509] was set slightly lower than [507], typically at 227.09m AOD, and was associated with a change of level between the northern and southern cobbled floors. To the south, [508] was a similar area of sandstone cobbling, typically at 227.07m AOD with cobbles generally slightly closer-packed than [507], and aligned roughly NNE-SSW.

The location of the floor sequence [507], [508], [509] suggests that it may relate, at least in part, to the interior of the later extension structure represented by wall [102] and abutting the furnace floor extension building to the south. Therefore, it is possible that the row of slabs [509] may have formed the southern threshold of this building (Ashurst (ibid. 164) suggests that this building was open to the south), with the interior floor level [507] raised slightly above the external surface [508]. This phase is clearly later than the glasshouse furnace extension; whether this relates to later remodelling of the glass furnace structures or to a post-furnace phase is as yet unclear.

Later buttress and footings [501] to (505)

The eastern section of Trench 5 appeared to correspond to the extent of the earlier archaeological trench, and a stratified sequence was visible rather than rubble backfill (**Plate 18**). Above the cobbled floor [508] was a fine skim of lime-based cement or mortar (505), 0.04m thick, extending up to 0.48m west over [508]. Above (505) was a layer of sandstone rubble (504), 0.22m thick; no clear boundary was visible between (504) and the rubble (511) filling the area close to the northern arch; these deposits may therefore represent a single episode. Above (504), a single course of irregular sandstone blocks [503], typical dimensions 0.30m x 0.28m x 0.10m, ran along the southern part of the eastern section, with a layer of loam material (502) above, 0.12m thick and including sandstone slab rubble. (502) formed the footing for the later buttress structure [501], now surviving only one course high in the area of Trench 5, but running 2.38m to the southern corner of the glasshouse where five courses are visible. [503] may represent part of an earlier buttress or simply part of the footings for [501]. [501], of drystone construction, was composed of large and probably re-used sandstone blocks, dressed on all sides with some toolmarks visible, and typically measuring 0.35m x 0.33m x 0.19m. The buttress is clearly late in the structural sequence, with the base of its lowest course resting on the modern ground surface at 227.49m AOD, some 0.42m above the cobbled floor [508]. This later buttress was possibly continued by the sandstone blocks [510] present at the northern edge of the trench.

Trench 6

Trench 6 was excavated east to west across the southern end of the paddock area. The ground level was again higher in the central paddock area (although it was less marked than in Trench 4), rising from 227.39m AOD at the eastern end, to 227.57m AOD in the centre. The western end was complicated by the recent machine excavation to level the ground in the area of the entrance gate from Whitwell Lane. This excavation caused a sharp drop of approximately 0.30m to a ground level of

227.07m close to the gate.

A very fine layer of topsoil (600) was removed to expose the masonry of a north-south wall [610] towards the eastern end of the trench, with rubble (602) and (603) on each side interpreted as backfill from the Ashurst excavation (**Illustration 12**). The edge of the excavation trench [604] was encountered 1.00m west of the wall [610] (**Plate 19**). Westward from this point across the centre of the paddock, a layer of brown-black sandy loam (601) was removed, 0.18m thick, containing modern drainpipe, sandstone rubble, fragments of pottery dating from the 18th to early 20th century, and fragments of ceramic drain pipe dating from the mid-19th to 20th century. *In situ* glassmaking waste deposits lay below (601). The recent machine excavation [605] at the western end had removed (601) and the underlying layer of furnace waste (606), to expose further deposits of glassmaking waste material (608) and (609).

Western wall [610] of building abutting the furnace floor extension

The topmost surviving course of north-south wall [610] was encountered at 227.38m AOD, only 0.01m below the modern ground surface. [610] was a double-skinned drystone wall of sandstone slabs, 0.60m thick and roughly faced to both east and west (**Plate 20**). Only one course survived, 0.30m deep, apparently with rough sandstone slab foundations beneath. In build, dimensions and alignment [610] appears to represent a continuation of [102], the western wall of a later building abutting the southern end of the furnace floor extension, and may also therefore be associated with cobble floors [507] and [508], and possible threshold [509]. Backfill rubble from Ashurst's excavation was packed against [610] to east (602) and west (603), which contained fragments of pottery dating from the late 19th to early 20th century and fragments of ceramic sewer pipe dating from the mid-19th to 20th century, extending below the limit of excavation at 227.09m AOD, 0.30m below the modern ground level.

Glassmaking waste (606) and (607)

To the west of the cut [604] for Ashurst's trench, the surface of an *in situ* deposit of glassmaking waste (606) was encountered at 227.28m AOD, and followed west for 3.65m until it was cut away by the recent machine excavation [605]. (606) contained lump glass/vessel fragments and was a fine, 0.05m thick, loose layer of red and black burnt material, similar to (402), with the redder material towards the west end, and was composed of small fragments and nodules of coke, cinder, slag and burnt sandstone. Below (606), yellow-brown silt-sand (607) was visible in the side of Ashurst's excavation trench [604], at least 0.20m thick and extending below the limit of excavation.

Modern machine excavation [605] and glassmaking waste (608) and (609)

Towards the western end of the site, (606) and the overlying silt/rubble layer (601) had clearly been cut through by the recent machine excavation in the gate area. This process had exposed, beneath a thin layer of topsoil, further deposits likely to represent glassmaking waste material. Below (606), and extending 1.70m west from the edge of the machine cut [605], was an orange-brown silt sand (608) with sandstone rubble, surface at 227.09m AOD and notable for a concentration of small fragments of glassmaking crucible as well as containing lump glass/vessel fragments. At the extreme west end of the trench (608) had been truncated to expose (609), very firm yellow-brown sandy silt with sandstone slabs, and a smaller number of crucible fragments, surface at 227.02m AOD.

Trench 7

Trench 7 ran east-west from the highest part of the central paddock towards the western boundary wall. Ground level was 227.63m AOD at the eastern end, dropping away west to 227.20m AOD. A fairly consistent layer of topsoil 0.10-0.20m thick and a modern rubble spread (701)/(702)/(703) in the eastern part of the trench were removed, to reveal *in situ* glassmaking waste deposits along the entire trench. Subsequently the trench was extended towards the western end to create a sondage through the accumulated layers of glassmaking waste until the surface of the underlying natural was reached (**Illustration 13**). Ashurst's excavation trench was not located in the original Trench 7, but appeared to clip the southern edge of the sondage extension.

Glassmaking waste sequence (704) – (711)

The upper surface of deposit (704) was encountered fairly consistently around 227.15m AOD along the entire length of Trench 7, although it became patchy at the extreme western end where (705) was visible beneath (**Plate 21**). (704) was a fine, loose layer of gritty red and black materials, comprising small fragments and nodules of slag, cinder, coke and burnt sandstone, 0.06m thick and comparable to (402) and (606). A small quantity of glassmaking crucible and fine glassworking waste were present within (704).

Deposit (705) was visible beneath (704) at the western end of the trench, and in the sondage. It was a dark brown-grey silt-loam with sandstone slab fragments, 0.22m thick. A large quantity of glassmaking crucible, along with lump glass/vessel fragments and fine glassmaking waste, was present within (705). (705) also contained fragments of pottery dating from the 18th to 19th century.

The remaining layers were only encountered in the sondage, and are described from the top down (**Plate 22**):

- (706): 0.14m thick; a loose black gritty layer of ash, cinder, slag nodules, and fragments of coke and burnt sandstone. A large quantity of glassmaking crucible, along with lump glass/vessel fragments and fine glassworking waste, was present within (706). (706) also contained fragments of pottery dating from the 18th to 19th century.
- (707): 0.11m thick; yellow and grey gritty silt with burnt brick, sandstone and slag. A small quantity of glassmaking crucible fragments and lump glass/vessel fragments were present within (707). (707) also contained fragments of pottery dating from the late 17th to early 19th century.
- (708): 0.17m thick; black-grey gritty cinder with slag, burnt brick and sandstone.
- (711): 0.06m thick; compact black gritty deposit with slag, lump glass/vessel fragments, burnt brick and sandstone.
- (709): 0.11m thick; fine light green-grey silt, possibly a remnant of a pre-furnace soil.
- (710): sandstone natural: firm grey-yellow silt, sterile with sandstone blocks and slabs.

(710), sandstone natural, was encountered at 226.64-226.79m AOD, around 0.65m below the modern ground surface, with a slight slope downward towards the north (following the prevailing contour).

APPENDIX 2: ARCHAEOLOGICAL CONTEXTS (SUBSURFACE)

Context Number	Sub-Division	Context Type	Description
100	Trench 1	Deposit	Topsoil
101	Trench 1	Deposit	Rubble backfill of previous excavations
102	Trench 1	Structure	North-south stone wall footing of later extension structure
103	Trench 1	Structure	East-west stone wall footing of furnace floor extension
104	Trench 1	Structure	North-south stone wall footing of furnace floor extension
105	Trench 1	Structure	Rubble base for wall footing [102]
106	Trench 1	Deposit	Fine black silt layer covering [105]
107	Trench 1	Deposit	Orange sandy layer, possible sub-floor layer
200	Trench 2	Deposit	Topsoil
201	Trench 2	Deposit	Rubble backfill of previous excavations
202	Trench 2	Structure	Southern stone furnace flue wall
203	Trench 2	Structure	Stone slab floor
204	Trench 2	Deposit	Sub-floor layer with furnace waste below [203]
205	Trench 2	Deposit	Sub-floor layer with furnace waste below (204)
206	Trench 2	Deposit	Sub-floor layer with furnace waste below (205)
207	Trench 2	Deposit	Sub-floor layer with furnace waste below (206)
208	Trench 2	Deposit	Sub-floor layer with furnace waste below (207)
209	Trench 2	Structure	Northern stone furnace flue wall
210	Trench 2	Deposit	Natural silt-clay
211	Trench 2	Deposit	Silt backfill of previous excavations
300	Trench 3	Deposit	Rubble backfill of previous excavations
301	Trench 3	Cut	Cut of previous excavation trench
302	Trench 3	Deposit	*In situ* raking out layer from furnace
303	Trench 3	Deposit	*In situ* raking out layer from furnace below (302)
304	Trench 3	Structure	North-west corner of stone wall footing of furnace floor extension
305	Trench 3	Deposit	Modern rubble backfill
306	Trench 3	Cut	Modern cut
307	Trench 3	Structure	Later sandstone floor block
308	Trench 3	Deposit	Topsoil
400	Trench 4	Deposit	Topsoil
401	Trench 4	Deposit	Modern silt/rubble deposit
402	Trench 4	Deposit	*In situ* raking out layer from furnace
403	Trench 4	Deposit	Silt material below (402)
404	Trench 4	Deposit	Possible collapsed layer of northern furnace flue wall
405	Trench 4	Deposit	Rubble backfill of previous excavations
406	Trench 4	Structure	North-south stone wall footing of furnace floor extension
407	Trench 4	Deposit	Rubble backfill of previous excavations
408	Trench 4	Cut	Cut of previous excavation trench

Context Number	Sub-Division	Context Type	Description
500	Trench 5	Deposit	Rubble backfill of previous excavations
501	Trench 5	Structure	Recent stone buttress against standing structure
502	Trench 5	Deposit	Levelling below [501]
503	Trench 5	Structure	Single course of stone blocks below (502)
504	Trench 5	Deposit	Rubble below [503]
505	Trench 5	Deposit	Skim of lime mortar below (504)
506	Trench 5	Cut	Cut of previous excavation trench
507	Trench 5	Structure	Cobbled floor (north)
508	Trench 5	Structure	Cobbled floor (south)
509	Trench 5	Structure	Row of sandstone slabs
510	Trench 5	Structure	Possible continuation of later buttress [501]
511	Trench 5	Deposit	Rubble backfill of possible annealing furnace
512	Trench 5	Structure	Possible north-western edge of annealing furnace
513	Trench 5	Structure	Sandstone slab possible remnant from floor of annealing furnace
600	Trench 6	Deposit	Topsoil
601	Trench 6	Deposit	Modern rubble deposit
602	Trench 6	Deposit	Rubble backfill of previous excavations
603	Trench 6	Deposit	Rubble backfill of previous excavations
604	Trench 6	Cut	Cut of previous excavation trench
605	Trench 6	Cut	Modern excavation near gate
606	Trench 6	Deposit	*In situ* raking out layer from furnace
607	Trench 6	Deposit	*In situ* raking out layer from furnace below (606)
608	Trench 6	Deposit	*In situ* raking out layer from furnace below (606)
609	Trench 6	Deposit	*In situ* raking out layer from furnace below (608)
610	Trench 6	Structure	North-south stone wall footing of later extension structure
700	Trench 7	Deposit	Topsoil
701	Trench 7	Deposit	Fine silt layer
702	Trench 7	Deposit	Compacted modern rubble
703	Trench 7	Deposit	Recent silt layer
704	Trench 7	Deposit	*In situ* raking out layer from furnace
705	Trench 7	Deposit	Silt material below (704)
706	Trench 7	Deposit	*In situ* raking out layer from furnace below (705)
707	Trench 7	Deposit	*In situ* raking out layer from furnace below (706)
708	Trench 7	Deposit	*In situ* raking out layer from furnace below (707)
709	Trench 7	Deposit	Possible fragment of pre-furnace soil
710	Trench 7	Deposit	Natural sandstone
711	Trench 7	Deposit	*In situ* raking out layer from furnace below (708)

Table 2: Summary of subsurface contexts

APPENDIX 3: ASSESSMENT OF POTTERY

Assessment of the pottery from Bolsterstone

by Dr C.G. Cumberpatch

Introduction

Excavations at Bolsterstone Glasshouse produced an assemblage that consisted of 129 sherds of pottery of 18th-to 20th-century date. The results of the assessment of the assemblage, which provides a series of spot-dates for the contexts identified, are summarised below (**Table 3**).

Context	Type	Number	Part	Spot date	Notes
100	Porcelain	1	Base	LC19th - EC20th	
100	Salt Glazed Sewer pipe	1	Rim	MC19th - C20th	
100	Unglazed Red Earthenware	2	Rim, BS	C19th	
100	Utilitarian stoneware	2	BS	LC19th - EC20th	
100	Whiteware	1	BS	C19th	
101	Brown Salt Glazed Stoneware	1	BS	C19th	
101	Utilitarian stoneware	1	Rim	C19th - EC20th	Flagon
200	Brown Salt Glazed Stoneware	1	Frag	MC19th - C20th	Lobed object
200	Salt Glazed Sewer pipe	3	BS	MC19th - C20th	
200	Utilitarian stoneware	1	BS	MC19th - C20th	Bottle
200	Whiteware	2	Rim	LC19th - EC20th	Decorated
201	Crucible	2	Frag	C17th - C18th	Contemporary with glasshouse
201	Salt Glazed Sewer pipe	9	Frag	MC19th - C20th	Various types
201	Salt Glazed Sewer pipe	7	Frag	MC19th - C20th	
201	Utilitarian stoneware	3	BS	LC19th - EC20th	
201	Utilitarian stoneware	2	Rim, BS	LC19th - EC20th	Jam jars
201	Utilitarian stoneware	2	Base, BS	LC19th - EC20th	Flagon
201	Whiteware	2	Base, BS	C19th - EC20th	
201	Whiteware	3	Rim, BS	C19th - EC20th	
400	Crucible	2	Frag	C17th - C18th	Contemporary with glasshouse
400	Salt Glazed Sewer pipe	7	Frag	MC19th - C20th	
400	Unglazed Red Earthenware	1	Frag	Undated	Tile
400	Utilitarian stoneware	1	Rim	C19th - EC20th	Jam jars
400	Whiteware	2	Base, BS	LC19th - EC20th	
401	Brown Salt Glazed Stoneware	1	BS	C19th	
401	Slipware	1	BS	C18th - EC19th	

Context	Type	Number	Part	Spot date	Notes
401	Slipware	1	BS	C18th	
401	Utilitarian stoneware	4	BS	C19th	
402	Colour Glazed ware	2	Rim, BS	C18th	
405	CBM	1	Frag	Undated	
405	Colour Glazed ware	1	BS	C18th	
405	Slipware	1	BS	C18th	
405	Whiteware	2	BS	C19th	One moulded
405	Whiteware type	2	BS	C19th - EC20th	Yellow finish
500	Colour Glazed ware	5	Base, BS	LC18th - C19th	
500	Creamware	4	Rim, BS	C18th - EC19th	Flatware
500	Porcelain	1	BS	C19th	
500	Slipware	2	BS	C18th	
500	TP Whiteware	2	Rim, BS	C19th	Asiatic Pheasants
500	Unglazed Red Earthenware	1	BS	C19th	
500	Utilitarian stoneware	2	Rim, BS	LC19th - EC20th	Jam jars
500	Utilitarian stoneware	4	Rim, BS	LC19th - EC20th	Jam jars
500	Utilitarian stoneware	1	BS	C19th	Flagon
500	Utilitarian stoneware	1	Rim	C19th	
500	Whiteware	5	Base, BS	C19th	
511	Colour Glazed ware	1	Rim	C19th	
511	Salt Glazed Sewer pipe	1	Frag	MC19th - C20th	
511	TP Whiteware	1	BS	LC19th - EC20th	Red decoration
601	Salt Glazed Sewer pipe	1	Frag	MC19th - C20th	
601	Utilitarian stoneware	1	Rim	C19th - EC20th	Jam jars
601	Yellow Glazed Coarseware	1	BS	C18th - C19th	Pancheon
603	Salt Glazed Sewer pipe	1	Frag	MC19th - C20th	
603	Whiteware	2	BS	LC19th - EC20th	
705	Brown Glazed Coarseware	1	BS	C18th - C19th	
705	Colour Glazed ware	1	BS	C18th - C19th	
705	Slipware	1	BS	C18th	
706	Brown Glazed Coarseware	1	BS	C18th - EC19th	
706	Late Blackware	1	Base	C18th	
707	Brown Glazed Coarseware	12	Base, BS	LC17th - EC19th	One jar
	Total	**129**			

Table 3: Summary of pottery

Discussion

The pottery assemblage included a wide variety of pottery types of diverse date. Amongst the industrial vessels were fragments from glass crucibles associated with the glasshouse on the site which was in operation between the mid-17th century and *c*.1758 (Ashurst 1987).

Fragments of salt glazed sewer pipes relate to the period after 1850 when the manufacture of such objects became a major industry associated with the reform of sanitation. The examples from Bolsterstone are probably of later 19th- or early 20th-century date.

Pottery dating to the period of production on the site (*c*.1778 – c.1796) was rare, being positively identified only in contexts (705) and (706). Other pottery represents the range of wares which might be expected on a site occupied during the later 18th, 19th and 20th centuries. Tablewares and utilitarian wares are both well represented, the latter including both earthenwares and stonewares.

Further work

Taken alone, the assemblage is of no more than general interest, but given that the site is one which has seen a considerable amount of work over the years in relation to the glasshouse and the later pottery, it represents a minor but significant part of a much larger assemblage of pottery. Consequently, a full report should be seen as a contribution to any future eventual full publication of the numerous small and medium scale archaeological interventions on the site.

APPENDIX 4: ASSESSMENT OF GLASSMAKING

Assessment of the evidence for glassmaking at Bolsterstone

by Dr H.Willmott

Introduction

The excavations at Bolsterstone Glasshouse produced significant evidence for glassmaking activities. This was recovered both by hand and through the subsequent wet-sieving of bulk soil samples taken from all relevant contexts through a 2mm mesh in the laboratory. Both these processes revealed fragments of both crucible and glass and these are summarised below (**Table 4**).

Context	Sample	Crucible	Lump/vessel	Working waste	Identifiable products?
201	-	-	46g	-	-
204	1	-	12g	-	-
205	2	-	22g	2g	tall phial base
206	3	-	31g	4g	Pb glass rim, phial waster
207	4	-	85g	3g	-
303	14	-	1,674g	4g	wine bottle rim, window
403	7	-	6g	-	window
404	8	-	8g	-	-
606	9	-	33g	-	-
608	11	1,312g	34g	-	window
609	12	29g	-	-	-
704	5	16g	-	2g	-
705	13	1,180g	190g	7g	wine glass stem waster?
706	15	4,339g	17g	6g	-
707	16	177g	92g	-	-
711	-	-	22g	-	wine bottle
	Total	***7,053g***	***2,272g***	***28g***	

Table 4: Summary of glass working waste

In the course of wet-sieving the samples a large quantity of clinker was also recovered. However, given the ubiquitous occurrence of this spent fuel on all industrial sites, no effort was made to quantify it. The remaining crucible and glass, both that found by hand and that recovered from sieving is discussed together contextually. However, no quantification of the unstratified crucible has been attempted, as due to the significant disturbance in recent years to the ground surface this would have been meaningless.

Crucibles

A total of just over seven kilograms of crucible fragments was recovered from stratified contexts. As a total this is not a great weight, indeed it represents a tiny fraction of a single crucible, although they certainly came from a number of different examples. All the fragments are typical of late 17th- or early 18th-century crucibles, being made from homogeneous grey stoneware fabric between three and five

centimetres in thickness. Ashurst in his earlier excavations (1987, 183-190) identified two types of crucible, open bucket-shaped ones and a very early variety of closed crucible. Insofar as it is possible to tell, all the examples from the recent excavations are bucket-shaped and in a few examples these can be seen to have flat vertical rims. All the crucibles have been used, probably until they suffered structural weaknesses and had to be replaced. Externally their surfaces have naturally vitrified through exposure to the constant heat of the furnace. In a few examples there are internal residues of glass still remaining, and these are all green in colour.

Crucibles are very common finds on all glassmaking sites, indeed Ashurst (ibid.) noted that at Bolsterstone they had been deliberately dug-up after the closure of the works for use as hardcore in road building. As such they are not very informative in identifying specific processes being undertaken on site, or suggesting what might have been produced. However, what is interesting is their distribution. Without exception, all those recovered from secure contexts came from Trenches 6 and 7, an area well way from the main building and area of glassworking. This pattern is logical: the glassmaker would not have wanted the bulky waste to clutter the working area, and it is usual to find broken crucibles either backfilled into old cut features, or in discrete surface dumps.

Glass waste

Glassmaking generates a considerable amount of waste, which is found on all production sites. Whilst some types will be found universally across the area, others are much more restricted in their distribution and the detailed analysis of their patterns of spread can indicate what processes were being undertaken in various parts of the site.

The majority of the waste takes the form of either lump glass or heat distorted vessel fragments, and in total over two kilograms were recovered from fourteen different contexts. Interestingly almost all the waste glass is green, with there being only a couple of tiny threads of colourless waste and two vessel fragments (discussed below). The majority of the waste consisted of large lumps of green 'pot metal'; glass that has gone through initial vitrification, but which still requires secondary melting to remove further impurities and gases. Some pot metal is of a good quality, whist other pieces are much more bubbly, the difference caused by the part of the crucible they were in. Quite a significant quantity of heat distorted vessel or window fragments were also included in this general waste. Almost all are undiagnostic, and it is not even certain all were made at the site, as deliberately collected glass, or cullet, was usually added to the crucible to help reduce the fusing temperature of the glass.

Perhaps more significant is the finding of very fine waste draws, trails and drops (**Plate 25**), all of which are indicative of actual glassworking and manipulation rather than just production.

During the course of blowing a vessel, the glassmaker would inadvertently create a considerable amount of waste, such as fine threads, as well as spilling very small quantities of molten glass. Such waste is at times almost microscopic, certainly too small for the glassmaker to have cleaned it all away, and this type of waste is usually only found in close proximity to where the glass was actually being worked. Therefore it is perhaps no surprise that fine working waste was only found in very specific contexts. In particular a quantity was recovered from Trench 2, which was located in the area identified by Ashurst (ibid. 164) as a possible working floor, and thus confirming this interpretation. Interestingly some fine working was also found in Trench 7. Its presence here is not immediately explainable. However, this trench also

contained significant quantities of crucibles, perhaps indicating that the glass waste here was deposited along with these, and originated in a different part of the site.

Identifiable products

Despite the presence of a reasonable amount of finished glass, which is often heat distorted, it is only possible to identify a few products from the waste recovered. Many of the fragments of waste glass clearly come from windows, and the presence of a few sections of cylinder edge confirms that this was almost certainly being produced on site.

However, there is more evidence for vessel manufacture (**Plate 26**), and as with the waste most of this appears to been made in a green glass. There are, for instance, two examples of green phials, although in differing states of completion. One from (706) is a very small example and was clearly discarded before completion, there being no attempt to fashion a rim. Furthermore, this phial was never annealed, so has slumped and become distorted. There is also the base of a second, probably finished, narrow phial from (205), and whilst it might have been brought onto site from elsewhere, the lack of wear on its underside strongly suggests that this was a product. The other green glass product is best represented by a fragment from (303), which is the rim from an onion or mallet wine bottle, and other fragments of thick vessel glass found mixed in with the waste probably came from similar products. Both phials and wine bottles were amongst the late 17th-century repertoire identified by Ashurst during his excavations (ibid. 192).

Whilst there is no evidence for crucibles holding a clear glass from the recent excavation and only a few fine threads of working waste have been found, there are two fragments of lead glass products. The first from (206) is a tiny chip of rim from a blown vessel, and originally it could have come from a wineglass, jelly or tumbler. The second, from (702), is a spherical object with a large internal air bubble. Although there are several possibilities as to its function, it is most likely that this was the first stage in the manufacture of a wineglass stem (encapsulating an internal teardrop). The glassmaker first blew a small sphere with an air bubble imbedded inside, and then with a pair of pincers would elongate this into the required stem, before adding a separate foot. Why this example was discarded half-finished is uncertain. Again Ashurst found fragments of similar lead glasses in his earlier excavations (ibid. 194).

Conclusion

The recent excavations at Bolsterstone have revealed interesting assemblages of crucibles, glass waste and possible products. Whilst they have not vastly increased our understanding of glassworking on the site, after all a considerably smaller area was dug than in previous excavations, they have still proved most informative. They confirm many of the processes and possible products first suggested by Ashurst, and show that his analysis is indeed reliable. Perhaps more importantly they also demonstrate that both primary and secondary deposits survive undisturbed in the area evaluated, and that either their preservation or total excavation be considered in any future planning considerations.

APPENDIX 5: ASSESSMENT OF VITRIFIED STONE

Assessment of vitrified stone from Bolsterstone

by Dr H. Willmott and Claire Coulter

A fragment of vitrified stone was retained during the sorting of the stone pile within the paddock at Bolsterstone Glasshouse (**Plate 27**). This fragment is 220 mm long, 160 mm wide and 60 mm deep and is unworked with a rough surface. It was originally part of the glass furnace structure and consequently became vitrified because of the high temperatures in the furnace. Several spots of melted glass are visible on its surface. It is recommended that the material be retained for the site archive.

Seven fragments of vitrified stone were sampled from the location that Ashurst defined as a siege within the interior of the Glasshouse building (**Plate 28**). Four of the seven fragments have flat surfaces on both sides. Glass has melted onto three fragments. It is recommended that the material be retained for the site archive

Further assessment of the vitrified stone sampled from the siege

by Dr P. Buckland

The rock is a hard, granular, white (Munsell no. N9) quartzitic sandstone, with a subconchoidal fracture, commonly referred to as a ganister. Its origins lie in the Upper Carboniferous, where both ganisters and pot clays occur as the seat earths of coal seams. The process of podzolization in the contemporary soil profile has lead to the breakdown and removal of other minerals from the rock creating a virtually pure quartzite (Percival 1983), which was much prized for its refractory qualities. It was employed for furnace linings and other situations were the rock had to withstand intense heat. The absence of other minerals which would have lowered the fluxing temperature of the rock also meant that in the nineteenth century ganister formed the basis of a local industry in which the rock was ground and combined with pot clay to manufacture fire brick for the steel industry (Battye 2004). In its weathered form at outcrop, the rock would also form an ideal starting point for glass manufacture providing sand free from iron and other impurities which would colour the glass.

The location of the Bolsterstone glassworks, close to the faulted contact between the highest grit in the Millstone Grit, the Rough Rock, and the Lower Coal Measure sandstone, the Crawshaw Sandstone, places it within a short distance of several potential sources of ganister (Mitchell *et al.* 1947), and there is widespread evidence of shallow workings and mines, where ganister and pot clay were often extracted together with the overlying thin coals (Battye 2004). Unfortunately the rocks are indistinguishable in hand specimen. Kenworthy (1918), however, notes the use of a 'siliceous sandstone' from beneath the Coking Coal from Townend Common at the glassworks and the eponymous Ganister Coal with its associated seat earth is within easy carting distance.

APPENDIX 6: LISTED BUILDING DESCRIPTION

SK29NE STOCKSBRIDGE POT HOUSE LANE

(south-west side)

Building name:	**Farm building at Pot House Farm; adjoining farmhouse to north**	LBS Number:	**335502**
		Grade:	**II**
Parish:	**Stocksbridge**	Date Listed:	**15 January 1985**
District:	**Sheffield**	Date of Last Amendment:	**15 January 1985**
County:	**South Yorkshire**	Date Delisted:	**N/a**
Postcode:	**S36 1ET**	National Grid Reference:	**SK 26606 98027**

Glass house now used as farm building, Late C17, altered. Hammer-dressed gritstone, stone slate roof. Single range, 2 storeys. Farmyard side: to right a large blocked round arch with voussoirs, springing from ground level rises to eaves level, Beneath the arch: a part-blocked door to right, window to left and boarded pitching hole above, To right of arch a board door, to left 2 other doors in quoined surrounds with square pitching hole above. Rear: to left a large segmental archway with springers set on quoined reveals, the archway falls short of the eaves. To its left a blocked window with heavy square-faced surround. To right, the ruinous remains of an external kiln structure. The site of Bolsterstone Glasshouse known to have operated from the mid C17 under several ownerships. Converted to pot manufactory in mid C18 when former employees established the Catcliffe Glass Works. Taller barn attached to left and house attached to front right corner not of special interest.

APPENDIX 7: DESCRIPTION OF HISTORIC FABRIC

Introduction

The furnace building is a rectangular structure with a pitched roof measuring externally 6.70m x 15.25m (22ft x 50ft), with walls approximately 0.50m (1ft7") thick. The external walls are c.4m (13ft) in height and the apex of the ridge is 6.50m (21ft3") above the surrounding ground level. The building is almost completely constructed from sandstone blocks of differing sizes, with larger sandstone, or coarse gritstone blocks forming the quoins, lintels and voussoirs of the arches. The roof is covered with stone tiles.

There is an early 20th-century house [023] built against the northeast corner of the building (**Plate 23**) and a two storey house [022] (formerly a barn) built against and over the top of the south gable (**Plates 35**, **38** and **40**).

Internally the building can be subdivided into three interconnecting rooms (**Illustration 14**). The largest (room 1) is at the north end of the building and measures 5.60m x 5.90m (18ft4" x 19ft4"). The remaining two rooms are approximately equal in size, with the central one (room 2) measuring 5.75m x 3.50m (18ft10" x 11ft5") and the one to the south (room 3) measuring 5.75m x 3.80m (18ft10" x 12ft5").

The following description of the historic fabric will examine each external elevation in turn, followed by a description of the roof structure. Each internal room will then be described in turn at ground and first floor levels.

External east elevation (**Plate 29**, **Illustration 15**)

This elevation faces the east yard and represents the principal facades of the building. The wall has been extensively altered, but the core fabric [001] comprises irregular coursed blocks of sandstone with a rubble core bonded with lime mortar. Long and short gritstone quoins survive at the corners, although the majority of the quoins from the southeast corner have been removed and replaced with a narrow coursed section of sandstone slabs [021].

At the north end of the elevation is an inserted doorway [003] with a single sandstone lintel and straight jambs. There is a recessed groove around the external edge of the jambs, presumably to house an earlier doorframe. The existing wooden door is set against the inner face of the opening and is a split stable door design.

The northern half of the elevation is dominated by a large semi-circular arch [002] (**Plate 31**), which was once open sided and measures 5.60m (18ft4") in width and 3.65m (11ft11") in height from the ground to the underside of the central voussoir. It is constructed from 40 carefully tooled gritstone blocks 0.35m x 0.20m (1ft1" x 7") in size, each of which is slightly tapered, forming voussoirs. No evidence for metal ties was observed on the upper face of the arch (**Plate 46**), although a thin spread of mortar was noted between each stone. Supporting the voussoirs and impost block of the north side of the arch is a pier constructed of single stone blocks, whilst the southern impost block is supported upon coursed and slightly projecting stones noticeably different in character [012] (**Plate 32**). These stones are approximately 1m in height and are interpreted as a truncated section of walling that would have projected away from the building, similar to the stub walls [033], [038] on the west elevation (**Plates 5** and **34**).

The arch [002] has been completely blocked with irregular coursed sandstone in two phases of activity. The earliest was when a short section of wall in the southern part of the arch was built [005] which continued through the building, effectively subdividing the interior into two approximately equal spaces. The northern section of the arch [002] remained open. Built within [005] was a low horizontal window [006] with a narrow sandstone lintel, which had subsequently been blocked with vertical wooden planking. The second phase of blocking [007], completely filled up the remaining opening within the arch [002]. Again coursed sandstones were used, although the stones were larger and more uniform than those used in [005] (**Plate 31**). Curiously, the upper section of [007] is built from narrower more slabby stones, similar in appearance to [020] at the southern end of the elevation. The change in stone type within [007] is however, interpreted as a break in construction, perhaps over winter, rather than two distinct phases of activity. There is a central ground floor within [007] which has a sandstone lintel and long and short jambs. It has a recessed outer edge, identical in style to the adjacent doorway [003], with which is likely to be contemporary. The lower part of [009] has been blocked with brick [010], creating a window, which has been externally blocked with vertical wooden planking. In the central upper section of [007] is a square pitching window [008]. This has a narrow sandstone cill, long and short sandstone jambs and the lintel is formed from the underside of the main arch [002]. The window [008] has been blocked with vertical planks.

An area of inserted wide coursed stone blocks [060] to the south of the blocked arch contains two doorways [015] and [018]. Both these openings are similar in style with large lintels and large stone jambs, although they differ in size and internal detailing; [015] has straight revels, whilst [018] has slightly angled splays. In addition, although externally modern planking has been added to the wooden doors, internally [015] has a split stable door and [018] a vertical baton design. A low rectangular opening [024] is positioned at the southern edge of [060]. This has a large sandstone lintel and slightly irregular jambs, the southern one being replaced by [021]. Prior to being blocked with medium sized blocks of coursed sandstone [025], this opening provided direct access to the interior. It is too low to be a window and it is therefore suggested that it may have been intended to have functioned as an entrance for livestock, such as fowl, or pigs.

The walling above [060] at first floor level has proved difficult to interpret (**Plate 30**). The central section [019] comprises medium sized blocks in regular courses, which differs in style to [060], although there is no distinct construction break and they may in fact be part of the same period of rebuilding/alteration. To the north of [019] is a small patch of irregular coursed sandstone that appears to be a remnant of the primary wall fabric [001]. There is a second section of rebuilding at the eaves level [011] immediately above the arch [002] and a sandstone blocked [014] square window [013], or pitching door to south with a worn sandstone cill and wooden lintel. A second pitching window [017] located above [018] appeared to be integral to the construction of [019] (Plate 30). It had a thick sandstone cill, long and short jambs and a wooden lintel comprising a reused section of turned wallplate with three exposed notches originally intended to secure rafters.

It has already been described that the quoins forming the southeast corner have been replaced with [021], however there is a section of sandstone walling at first floor level [020] which is very narrow coursed and irregular in thickness. This is likely to represent part of the period of rebuilding of the south gable and may be contemporary with [101].

The northern edge of [060] is demarked by a curved construction joint [027] which is c.1.8m in height (**Plate 32**). This scar, when examined in conjunction with the truncated stone wall [012] at the base of [002] is interpreted as the remains of a projecting feature located immediately south of the arched opening. The exact nature of this feature is unclear, although internal evidence in the form of a truncated lintel [059], behind [060] and cut by the insertion of [015] indicates that the former projecting structure may have been a third lehr. It is directly opposite [042] and would have been of similar dimensions. The external face of [060] incorporates stones which have a good surface finish and approximately 30% of them are pink, indicative of fire damage. In addition, the lintel of [018] has an central area of pink staining, with an inwardly curved profile almost identical to the inner face of the edge of the lintel above [042]. It can therefore be suggested that the negative evidence of [060] actually represents the former location of not one, but a pair of lehrs of identical dimensions to those still extant within the west elevation (**Plate 36**). The rebuilt upper section [019] would therefore demark the site of the former chimney stack, and may help explain the walling at first floor level which is of noticeably different character to [001], but has some resemblance to the coursing and stones [041] above lehr [042].

External north elevation (**Plate 33**, **Illustration 21**)

Only the upper part of this north facing gable is exposed today as a result of the construction of a house against the northeast corner of the glass furnace building in the early part of the 20th century. The corners of the building retain sandstone quoins from the earliest structure and the walling below the eaves level appears to be the original wall fabric [001], comprising of irregular coursed sandstone blocks. The upper half of the gable is constructed from narrow coursed sandstone slabs with a roof pitch of 40° and it is suggested that this differing walling style may either represent a constructional break, perhaps over winter, or more likely a period of rebuilding associated with the insertion of the extant roof structure. The lower purlin from the west elevation projects through the stone coursing of the gable, indicating that the upper section of walling and sections of the timber roof structure may indeed be contemporary.

The upper section of a square window [054] with a large sandstone lintel and jambs comprising single narrow stones is visible in the western part of the gable. This opening has been blocked with a narrow coursed slabby sandstone, similar in appearance to the coursing of the upper part of the gable. There is a narrow vertical window comprising three lights [056] with a wooden frame positioned slightly off centre, set just below the eaves level. This is an inserted secondary window that is noticeably different in style to all of the others within the building, presumably intended to light the hay loft above the internal 19th-century animal stalls.

There is a faint scar of a former pitched roof that cuts across the inserted window, that may represent one of the earlier buildings, or outshuts depicted on the 1855 Ordnance Survey map (**Illustration 3**).

External west elevation (**Plate 35-38**, **Illustration 18**)

This elevation faces the paddock and represents the main rear elevation of the former glass furnace. It has many similarities to the east elevation, although more historic features such as the fragmentary remains of a pair of lehrs [042] [043] are still extant. The core fabric [001] comprises broadly coursed blocks of sandstone, supported at either end with long and short gritstone quoins. A later drystone field wall [031] abuts the northeast corner and a barn [022] is built immediately to the

south (**Plate 38**). Within the primary wall fabric at the north end of the elevation is a square window with single large sandstones for the jambs and lintels (**Plate 34**). The opening has been blocked in two phases, the earliest to the north [029] using handmade brick, whilst the southern half has been filled with coursed sandstone blocks [030].

The northern half of the elevation is dominated by a large arch [032], similar in character to [002] on the east elevation, although it is narrower in width at 4.8m (15ft8") and 0.95m lower in height measuring only 2.7m (8ft10"). It is constructed from 29 tooled gritstone blocks of identical size to those in [002] each of which is slightly tapered, forming voussoirs. The base of the arch, comprised of two short projecting walls [033] and [038] which relate to a rectangular extension to the furnace observed in Trenches 1-3 (**Plates 1-3**) and reported upon by Ashurst in 1987 (**Illustration 5**).

The arch has been blocked in three phases (**Illustration 18**), with the earliest being when the central longitudinal wall [005] was inserted. The second phase involved a stone wall being built in the northern part of the arch [034] that coincided with the total blocking up of the eastern arch with [007], thus creating a double width doorway (**Plate 34**) that opened onto the paddock to the west. This double opening was subsequently blocked with machine pressed bricks [035] measuring 24 x 8 x 10cm and laid in stretcher coursed with a grey ash cement mortar. The brick blocking incorporated a single doorway [036] with a narrow wooden lintel, which has in turn been blocked with machine pressed bricks [037] of similar dimension and character to [035]. A later square opening [039] has been created in the lower part of [005], perhaps for livestock and coarsely blocked with un-mortared gritstone blocks [040].

To the south of the arched opening [032] are the fragmentary remains of rear wall of two lehrs, or hearths [042] and [064], that were originally open to the interior of the building. Both have been blocked in a series of phases with mortared and un-mortared sections of stone walling [045] [046] [047] [048] and [049] (**Plate 36**). Between the two openings is the remains of a stone pier [044] which has chamfered edges and pink discolouration from prolonged heating (**Plate 37**). The exposed upper section of [042] represents the internal core of the former chimney flue [051], again with pink discolouration from former internal firing. The outer (rear) wall of [042] is missing and its former profile is unclear, although a stub of sandstone walling [050] against the southern end of [064] may represent part of this former structure. The upper part and lower edge of [064] is a brick arch [043]. This is the only place within the building where brick has been used for a primary feature and may indicate that the rear section of the lehr/hearth was actually brick lined. If this were so, then it would help retain heat and correlate with the standard practice of using brick in domestic fireplaces, and bread ovens during the 17th century. An internal flue within [001] exited from the apex of each lehr and out through a chimney stack in the roof (**Plate 58**), although this was truncated when the western part of the roof was repaired in the second quarter of the 19th century (see roof section below).

Following the decommissioning of the chimney, the upper section of the wall [041] was rebuilt in irregular coursed blocks of sandstone, which appears to have been recently re-pointed. These repairs may be contemporary with a section of cement render [053] that has been applied over the southern end of the elevation (**Plate 35**), partially concealing a square window [052]. This window appears to have been of a similar design to [028] at the north end of the elevation, with long stones for the lintel, cill and jambs.

External south elevation (**Illustration 23**)

The south facing gable of the former glasshouse has since 1998 been totally encased within a modern barn conversion, that has involved building a new structural wall, immediately south of the gable within what was a former barn (**Illustration 23**). During the conversion Denis Ashurst undertook an archaeological watching brief (Ashurt 1998) to monitor ground works within the building and to record aspects of the earlier south gable of the glasshouse building to the north, the internal ground level of which was *c*.0.5m lower. Ashurst was able to produce a stone-by-stone drawing of this south gable and take a limited number of colour photographs. His drawing has been redrawn for the purpose of this report and enhanced with additional observations from his photographs. The following description is therefore relatively brief, being based upon observations made from these secondary sources.

The south gable is similar to the one to the north in that it is built from coursed sandstone, has undergone numerous phases of alteration and has had secondary structures built against it. The lower section contains coursed sandstone blocks [001] from the primary phase of the building with a central square opening with a large stone lintel and single stones for the jambs [084]. This central opening has been blocked with coursed sandstones [085]. To the east of [084] is a second opening [081] of similar dimensions. It has coursed stones for jambs, which may indicate that it is slightly later in date, or alternatively has been converted from a doorway. Unfortunately, the floor level within the barn is at the level of the stone forming the cill and it was not possible to establish whether there were vertical joints continuing below to test this possibility. The opening had been reduced in size with roughly coursed sandstones [082] to form a narrow window [083], which had in turn been in-filled with a single large stone [095]. A doorway [086] with poorly finished jambs had been inserted into the western side of the gable at ground level and blocked with irregular coursed brick [086].

The central section of the south gable had been rebuilt in roughly coursed sandstones [101] of varying sizes including a number of pink, fire damaged stones. The upper section of this rebuilt has a roofing scar at a pitch of 40˚ which corresponds with the north gable and the existing pitch of the glasshouse roof (**Plate 33**). Centrally located in the middle of the first floor is a doorway [092] with stone lintel and coursed stone jambs. This has been blocked with two fills of irregular coursed sandstone, the lower [093] representing the conversion of the opening to a window and the upper [094] when it was totally sealed. To the west of [092] is a second opening [090] which appears to be a second doorway of slightly smaller proportions, however has itself been converted from a window [089]. The window has a single narrow sandstones for the lintel and jambs, although the cill has been cut and lowered. It is worth noting that the dimensions of these stones are notably narrower than those used for the primary phase of windows within the building, such as [028] (**Plate 34**). The opening has subsequently been blocked with modern blockwork [091].

The top section of the gable [102] comprises smaller coursed sandstones and represents the upper gable of the barn, which was built over the top of the earlier and lower south gable (**Plate 40**) of the glasshouse.

The roof (**Plates 39-80**, **Illustration 29**)

The building has a pitched roof set at 40˚ (**Plates 29, 38**), with locally sourced sandstone roof and ridge tiles. The roof tiles [004] had been laid in diminishing courses that oversail the eaves as is common practice with agricultural buildings in

the region. No evidence for guttering was observed. The tiles were secured over riven oak laths (**Plates 50, 56**) with oak slating pegs. No internal evidence for mortar torching or plastering was noted on the underside of the tiles. Sections of brick [026] had been incorporated within the wallhead, presumably to make the building weather tight

Prior to the removal of the roof tiles for renovations, the structure was found to be relatively intact, but many of the uppermost tiles were loose, or had collapsed inwards, especially on the western pitch (**Plate 34**).

The timber roof structure can be subdivided into four structural bays (**Illustration 29**), with bay 1 at the southern end. There are stone gable walls at either end and a dividing wall [005] between bays 2 and 3 that acts as a intermediate internal gable and divides the roof into two separate spaces/cells. The roof structure is a simple design, with upper and lower through-purlins on each pitch supported by kingpost trusses (**Illustration 30**). Rafters are nailed above the pulins and housed in a timber wallplate with a simple notch.

It would appear that the oldest section of the roof is the northern half, although it is unlikely that the surviving structure would have been the roof covering during the time of operation of the glass furnace. The main reason for suggesting this is that there was no evidence for smoke blackening on any of the roof timbers, a detail that would be expected within the roof space of an industrial building when a process such as glass manufacture, which generated immense amounts of heat and waste gases, was in operation. No evidence for a chimney, ridge vent, or raised cupola was noted and it seems likely that the existing roof therefore dates to the early part of the 19th century after glass production had ceased and the building had been remodelled, possibly associated with its change in use to a pottery. Further confirmed by the end purlins which were actually built within the upper fabric of the two stone gables (**Plates 40, 48**), both of which have been rebuilt.

The kingpost truss (**Plate 63**) between bays 3 and 4 (**Illustration 30**) is a simple design with rough vernacular detailing. The principal rafters/blades are pegged and housed in tenons within the head of the kingpost and upper face of the tiebeam (**Plate 65**). The kingpost flares slightly to form an angled head and has a central notch to house the ridge piece, whilst the foot has a simple joggle (**Plate 64**) to supporting two raking struts. There are cut notches for pairs of through-purlins on the upper face of each principal rafter.

Two pairs of assembly marks were noted on the upper face of the purlins (**Illustration 29**), although they appear unrelated and offer no insight into the sequence of roof construction. One pair was on the upper purlins of the east pitch between bays 3 and 4, comprising four incised lines (IIII); whist the others (**Plate 55**) were located on the west pitch above the inserted wall [005] and were in the form of carved Roman numerals (VI) on the top face of the upper pulins.

The dividing wall [005] inserted between bays 2 and 3 appears to have replaced an earlier truss. No part of an earlier roof truss was noted, but the nature of walling is indicative of construction from below which has been made to fit around an existing structure (**Plate 53**). In addition, at the junction where the south end of the ridge piece of bay 3 meets the stone wall [005] the timber has been cut back (**Plate 73**), indicating that it once was housed within another timber, presumably the head of a kingpost from an earlier truss.

Whilst elements of the roof structure of the southern part of the building may be

contemporary with those to the north there is more evidence for secondary alteration, again probably contemporary with the insertion of the wall [005]. The rafters along the western pitch are nailed in position at the level of the lower purlin only, this is notably different to the remaining rafters in the building, the majority are nailed in position at two or three locations, usually the wallplate and ridge and in addition on either the lower, or upper purlin as well.

Further evidence for alteration along the western pitch of bays 1 and 2 is the kingpost truss (A) (**Plate 76**) which is notably different in design to truss (B) (**Plate 63**) in the northern section of the roof (**Illustration 30**). This truss is symmetrical in design, with good quality joinery and surface finish. The central post has a moulding beneath the head (**Plate 75**) and the foot has a joggle with a chamfered design. The principal rafters/blades are pegged into position, being securely housed in mortices within both the central post and tiebeam (**Plate 78**). The two raking struts have assembly marks in the form of incised lines (III and IIII) where they meet the principals. There are sawn notches on the upper face for the pulins, however they appear to be larger than is required for housing the purlins (**Plate 76**). The tie beam is also of interest as it has a prominent lower chamfer, with simple cut stops, a level of tooling uncommon in agricultural buildings. There are also pairs of vertically drilled holes on the underside of each end of the tiebeam, indicative of fabrication off site, with the potential use as mortices for curved downward braces, usually found in timber framed buildings.

The features detailed above that are either structurally redundant, or unnecessary for an agricultural building and the elaborate design details of Truss A indicates that it is highly likely that it was a standard design bought 'off the shelf' from a builders merchant and adapted to fit the building. The incorporation of the truss during roof repairs coincided with the sealing up of the chimney flue (**Plate 58**) from the lehrs in the west wall, presumably marking the date when the building became a purely agricultural building with no requirement for heating.

Room 1 (**Illustration 14**)

The north wall of room 1 (**Illustration 22**) mirrors the external features of the north gable (**Illustration 21**). It can be broadly subdivided into three parts. The lower section is *c*.2.6m in height and much of the stone walling is obscured by paint, but was built with irregular coursed sandstone blocks [001]. There are two openings, one a doorway [069] with splayed revels in the eastern half of the gable and the other a window [054] with single stone jambs to the west. Both these openings have substantial timber lintels and appear to be part of the original layout of the furnace building. The window [054] is blocked with narrow coursed slabby sandstone [055] that is flush with the inner wall face. In contrast the doorway [069] is blocked with irregular coursed sandstones only one skin thick; the lower part of which appears to have been initially converted into a window [070], before being totally blocked. To the west of [054] *c*.1.5m above ground level is a pair of angled timbers [100] that would have supported a manger along the west wall of the building.

Above the timber lintels is a row of six square sockets [098] that demark the position of a former ceiling/hay loft above the stalls for horses. These are a secondary insertion into the wall fabric and the walling is painted, or whitewashed below. At eaves level there is a continuous timber [099] built into the wall. This feature may have been intended to act as a wall tie, although interestingly it correlates with an external change in stone coursing (**Illustration 22**) and may be associated with the rebuilding of the upper part of the gable. There is a narrow window [056] below this

timber which has been inserted slightly off centre. The upper part of the gable is constructed from randomly coursed rounded blocks forming part of the period of construction of many of the upper sections of walling within the building.

The east wall contains the large east facing archway [002] that was originally open to the exterior. The arch extends as high as the eaves and has been infilled with narrow coursed sandstones [007]. There is a square pitching window in the apex of the arch with a stone cill. Centrally positioned within the blocking of the arch is a doorway [009], that has been partially blocked with brick [010] to form a large window. The window still retains its wooden frame, which is divided into two parts. The upper section contains two rows of 5 glazed lights, whilst the lower comprised vertical wooden slats forming a vented grill. To the south of [009] is a recessed cupboard [058] built within the fabric of [007], possibly for a lantern.

The northern part of the east wall contains a wide ground floor doorway [003] which contains a split wooden stable door. This has a wooden lintel and is interpreted as a secondary insertion into the primary wall fabric [001].

There is a wooden timber *c.*2.5m above the floor demarking the level of a former hayloft, which is immediately below the cill of [008]. Curiously *c.*0.25m above the level of this timber is a rectangular cut socket [057] in one of the internal voussoirs of [002]. This appears to correspond with a socket on the opposite wall [068] and is interpreted as the location of a former beam that would have spanned the width of the building. Its purpose is unclear, but is likely to have either been associated with part of the original glass furnace, or the secondary inserted hayloft.

The south wall [005] is a dividing wall added into the building to subdivide the interior onto two main sections. It is built from irregular coursed sandstone blocks and continues to the apex of the roof. Within the upper section of the wall and towards the base are intermittent blocks which are pink and fire damaged. There are the remnants of a hayloft, *c.*2.8m above the ground level, comprising sawn off joists [096] and traces of flooring boards. Beneath the level of this loft the wall has been painted, or limewashed. There is a single doorway [074] through [005] in the southeast corner of the room. It has a wooden lintel and is very vernacular in style and is therefore suggested to be a secondary insertion into this wall, being unlike the other doorways within the building. Slightly off centre at a height of 2m is a blocked square window [074] with reused gritstone blocks for jambs and lintel. It is blocked with random coursed sandstone blocks [073].

The west wall of room 1 has the largest section of primary walling fabric [001] in the building, incorporated within which is the large arch [032]. There is a square window [028] in the northwest corner with a large wooden lintel and has two phases of blocking. The first in brick [029] reduced the opening by more than half, which was later blocked with coursed sandstone [030]. As has been described above there is a rectangular socket [068] *c.*0.25m above the floor level, that appears to have housed a large beam spanning the width of the building. The arch [032] has been reduced in width by the additional of a short section of sandstone wall [034] and then totally in-filled with brick [035], whilst retaining a single doorway [036] with a timber lintel. This doorway has in turn been blocked with brick [037].

Room 2 (**Illustration 14**)

The north wall of room 2 [005] is the dividing wall added into the building to subdivide it into two main areas, and its composition and dimensions are identical to those described above for the north face. There is a much greater quantity of reused pink

fire damaged stones in the south elevation when compared to the north. There is a single (possibly inserted) doorway [074] in the northeast corner and, similarly to room 1, there is evidence for a former hayloft [104]. The lower part of the wall has been painted, or limewashed. Obscured behind a modern cupboard unit is the blocked window [072]. A row of three open sockets at eaves level in the centre of the elevation [075] may relate to an upper ceiling from another hayloft or storage space.

The east wall is dominated by the lower part of the arch [002] and the gritstone pier from which it springs. The arch is blocked with the dividing wall [005] and contains a narrow rectangular window [006]. The southern part of the wall contains a large inserted doorway [015] which retains a split stable door. The doorway has a wooden lintel and straight reveals. Immediately to the north of the doorway at a height of 1.3m above the floor level is a large rectangular gritstone block [059]. This stone has been shortened and appears identical in character to the stone lintels [042] [064] from the two lehrs directly opposite on the west elevation. It would appear therefore that this stone represents new evidence for a pair lehrs in this part of the building.

Beneath the stone the opening has been blocked with medium sized sandstone blocks [060], many of which are pink and fire damaged. The walling above [059] has been partially rebuilt as part of the removal of the lehrs against the external wall and the upper part contains reused pink stones. There is a square pitching window [013] blocked with coursed sandstones [014] above the arch [002], although no evidence for the former floor of the inserted hayloft was observed.

The south wall [061] is only single storey in height and forms a secondary internal subdivision within the southern half of the building. It is a roughly coursed sandstone wall with medium to large sized stones, a number of which are burnt. Much of the wall is obscured with plaster, paint, or limewash. There is a central doorway with a reused stone lintel [077], blocked in two phases initially with irregular coursed sandstones [078] to form a high window and then totally with random sandstone rubble [079]. At the west end of the wall a secondary doorway [080] had been created with a wooden lintel. This presumably occurred when [077] was converted into a window. The only other feature of note is a small narrow slit window [076] in the eastern part of the wall.

The features within the west wall of room 2 are a continuation of those within room 3. There is a large fireplace, or lehr [042] with a large gritstone lintel and sandstone pier [044] forming a central division to the second lehr [064] immediately to the south in room 3. The northern edge of [042] is built from cut gritstone blocks that form the base pier to the large arch [032]. The opening [042] has been blocked with numerous phases of sandstone walling, many of which are irregularly coursed. The opening has been reduced in width by [045] and [046] thus forming a narrow opening that would have been similar to one in [064]. Presumably both of these openings were created to allow livestock to access the paddock to the west and occurred as part of the decommissioning of the lehrs.

The arch [032] springs from below the lintel of [042] and continues into room 1. The walling is mainly from the primary phase of the building [001], although the section above [042] has evidence for partial rebuilding [041], containing a number of burnt pink stones in the upper courses.

Room 3 (**Illustration 14**)

The north wall [061] of room 3 is a single storey in height and forms a secondary internal subdivision within the southern half of the building. Its composition has

already been described in room 2 above, although the principal features are a central blocked doorway [077] and an extant doorway at the western end [080]. Many of the walling stones are pink and fire damaged and partially obscured paint or limewash. Remnants of a hayloft in the form of a wooden floor and joists [103] survive above.

The east wall of room 3 represents part of the internal elevation of the east side of the building (**Illustration 14**). The upper part of the wall [019] and sections at ground level are not the original fabric [001] and have been rebuilt following the removal of external features; some stones are pink and fire damaged. Within [019] is a doorway [018] with a wooden lintel and slightly splayed reveals. In the south corner is a low blocked opening [024], with a substantial sandstone lintel and large stone jambs. This feature appears to be secondary and may have been used as an opening for livestock between room 3 and the yard to the east. Above [018] is a square pitching window [017] and there is a horizontal timber at first floor level [103] denoting the position of a former hayloft.

The south wall of this room represents the inner face of the end gable of the building (**Illustration 24)**, and many of the features directly correlate with those described on the external elevation (**Illustration 23**). The ground floor section retains the original coursed sandstone walling [001] of the furnace building and has two original openings. There is a central 'T-shaped' opening [084], blocked with narrow coursed sandstone [085] and a square window to the east [081]. Both openings are supported by substantial wooden lintels and [084] has single stones acting as jambs. The function of the 'T-shape' profile for [084], which is not mirrored externally, is unclear, although it would appear to be directly related to one of the subterranean flues that formed part of the operation of the former glass furnace in the north part of the building. The window [081] has been reduced in width to form a recessed cupboard containing a single narrow light [083], which has subsequently been blocked with a single stone [095] prior to the conversion of the barn to the south. A doorway has been roughly inserted in the western side of the gable, with a small wooden lintel and poorly finished splays. The lower part is blocked with brick [087] and the upper with modern blockwork [088]. The ground floor section of this south wall has been painted white.

Remnants of an inserted floor/loft [103] survive in the form of occasional wooden poles and sawn off timbers at first floor level. This appears to be contemporary with the rebuilding of the upper part of the wall [101] to form a hayloft/store. This was undertaken using roughly coursed sandstone of varying sizes, which involved the reuse of pink fire damaged stones. A large timber lintel, positioned above eaves level, provides support for a central first floor doorway [092] and an adjacent window [089] to the west. Interestingly, both the door and window have been blocked in two phases, indicating a swap in function. The lower section of [092] was blocked with irregular coursed sandstone [093], thus turning it into a window, whilst the window [089] had the cill lowered to form a doorway [090]. The upper part of [092] was then totally blocked with narrow coursed sandstone and [090] has more recently been filled with blockwork [091]. The only additional feature of note is that the upper purlin on the western pitch is supported upon a projecting stone acting as a corbel (**Plate 80**), a detail not observed elsewhere in the building.

The west wall contains significant amounts of original fabric [001], although there a number of pink fire damaged stones in the upper section possibly indicating partial rebuilding, or patched repairs perhaps associated with the external work [041]. There is a square window in the southwest corner of the room [052] which has a stone lintel, beneath a wooden joist and single stones for the jambs. There are the remains of a row of sockets [062] *c.*2.4m above the floor level, which would have supported

the floor joists for the hayloft above and are contemporary with [103].

The main feature of this part of the room is the blocked remains of a large fireplace, or lehr [064] which forms part of a pair of annealing ovens from the original glass furnace. The opening has a large gritstone lintel and there is a sandstone pier [044] with a chamfered capital forming the central division between the second lehr [042] to the north in room 2. The opening [064] is blocked with two phases of irregular coursed sandstone blocks, the western part [065] contains a few pink fire damaged stones. It appears that the eastern part of the opening was left open, perhaps for livestock, although subsequently blocked with coursed rubble [066].

The final feature in room 3 is a projecting sandstone corbel [063] *c.*2.1m above the pier [044] in the west wall. This is a semi-decorative/functional feature and may relate to the function of the lehrs, but later alterations have removed any associated evidence.

APPENDIX 8: ARCHAEOLOGICAL CONTEXTS (BUILDING)

Context Number	Context Type	Description
001	Feature	Irregular coursed gritstone/sandstone wall with rubble core
002	Feature	Large semi-circular arch through east elevation of [001]
003	Feature	Rectangular doorway through east elevation of [001]
004	Feature	Sandstone roof tiles laid in diminishing courses
005	Blocking	Irregularly coursed 'u' shaped sandstone/gritstone dividing wall
006	Feature	Rectangular window within east return wall of (005)
007	Blocking	Irregularly coursed gritstone/sandstone infill of [002]
008	Feature	Square window in apex off (007)
009	Feature	Rectangular ground floor doorway in (007)
010	Blocking	Irregularly bonded machine brick infill of [009]
011	Blocking	Triangular sandstone infill of upper part of [001] below eaves
012	Feature	Lower element of external southern jamb of [002]
013	Feature	Square window below eaves in east elevation of [001]
014	Blocking	Irregularly coursed sandstone infill of [013]
015	Feature	Rectangular doorway in east elevation of [001]
016	Feature	Two small rectangular stones above [015]; possible blocked sockets
017	Feature	Square window in eastern elevation of [001]
018	Feature	Rectangular doorway within east elevation of [001]
019	Feature	External section of walling in east elevation of [001]
020	Feature	Area of rebuilt narrow coursed sandstone
021	Feature	Rebuilt southeast corner of east elevation of [001]
022	Feature	Adjacent barn built over southern gable of [001]
023	Feature	Store extension to rear of adjacent house
024	Feature	Low rectangular opening between [018] and southeast corner of [001]
025	Blocking	Coursed uneven blocking to [024]
026	Feature	Intermittent brick/sandstone levelling course at eaves level
027	Cut	Prominent joint between [012] & [015]
028	Feature	Square window in northwest corner of west elevation of [001]
029	Blocking	Handmade-brick blocking of northern half of [028]
030	Blocking	Sandstone/gritstone blocking of southern half of [028]
031	Blocking	Drystone sandstone blocking built against northwest corner of [001]
032	Feature	Large semicircular arch through west elevation of [001]
033	Feature	Projecting gritstone wall at base of [032]
034	Blocking	Gritstone blocking in north section of [032]
035	Blocking	Brick infill between [034] and [005], filling cart passage [032]
036	Feature	Doorway built within [035]
037	Blocking	Stretcher coursed machine pressed brick blocking of [036]
038	Feature	Projecting gritstone wall from southern jamb of [032]

Context Number	Context Type	Description
039	Feature	Rectangular opening in base of (005)
040	Blocking	Drystone gritstone blocking of [039]
041	Feature	Gritstone/sandstone rebuild of upper central section of west elevation [001]
042	Feature	Stone lintel/fireplace in west wall of [001]
043	Feature	Internal handmade brick skin at rear of [064]
044	Feature	Gritstone column dividing [042] & [064}
045	Blocking	Partial gritstone blocking of [042]
046	Blocking	Central sandstone blocking of [042]
047	Blocking	Lower northern sandstone blocking to [042]
048	Blocking	Upper northern gritstone blocking of [042]
049	Blocking	Irregularly coursed gritstone/sandstone blocking of rear of [064]
050	Feature	Large gritstone wall forming back to [042] & [064]
051	Feature	Chimney stack above [042] & [064]
052	Feature	Rectangular window in southwest of western elevation of [001]
053	Feature	Modern cement render on southwest corner of [001]
054	Feature	Square window in northern gable of [001]
055	Blocking	Irregularly coursed sandstone infill of [054]
056	Feature	Inserted narrow first floor window in [001]
057	Feature	Cut socket in internal elevation of [002]
058	Feature	Shall recess/cupboard built into (007)
059	Feature	Truncated massive sandstone lintel built against internal face of [002]
060	Blocking	Irregularly coursed gritstone blocking of [059]
061	Feature	Stone spine wall
062	Feature	Row of joist sockets above [064]
063	Feature	Double chamfered corbel above [064]
064	Feature	Fireplace adjacent to [042}
065	Blocking	Central sandstone/gritstone blocking of [064]
066	Blocking	Northern gritstone blocking of [064]
067	Feature	Square stone recess/cupboard in internal face of (005)
068	Feature	Large square socket above [032]
069	Feature	Former window in [001], extended down to form door [070]
070	Feature	Doorway created by cutting [001] away beneath [069]
071	Blocking	Irregularly coursed sandstone blocking of [069] & [070]
072	Feature	High level window in (005)
073	Blocking	Irregularly coursed sandstone/gritstone blocking to [072]
074	Feature	Internal doorway through (005)
075	Feature	Row of five sockets in internal southern gable wall of (005)
076	Feature	Narrow vertical slit in east end of [061]
077	Feature	Doorway centrally located in [061]
078	Blocking	Lower sandstone/gritstone fill to [077]; timber above forming an opening
079	Blocking	Upper sandstone blocking to [077]

Context Number	Context Type	Description
080	Feature	Doorway through [061]
081	Feature	Square window at ground floor level in south elevation of [001]
082	Blocking	Narrow coursed sandstone/gritstone blocking to [081]
083	Feature	Narrow slit window created in [082]
084	Feature	Large 'T' shaped opening, centrally within southern gable of [001]
085	Blocking	Narrow coursed sandstone/gritstone blocking to [084]
086	Feature	Inserted doorway through southern gable of [001]
087	Blocking	Lower brick blocking to doorway [086]
088	Blocking	Upper blockwork blocking to doorway [086]
089	Feature	Former square window at first floor level in southern gable of [001]
090	Feature	Removal of [001] below [089] in order to create doorway
091	Blocking	Blockwork fill of [089] & [090]
092	Feature	Central first floor doorway in southern gable of [001]
093	Blocking	Irregularly coursed sandstone/gritstone lower blocking of [092]
094	Blocking	Random coursed sandstone/gritstone/ brick upper blocking of [092]
095	Blocking	Brick fill to [083]
096	Feature	Inserted floor
097	Feature	Wooden stalls/partitions relating to conversion to stables
098	Feature	Row of 6 sockets in north gable wall, demarking former floor/ceiling
099	Feature	Timber beam in north gable wall at eaves level
100	Feature	Wooden batons demarking angled profile of former manger along west wall
101	Feature	Rebuilt upper section of south gable
102	Feature	Upper stone section of south gable above [101], representing north gable of barn
103	Feature	Remnants of wooden loft/floor above room 3
104	Feature	Remnants of wooden loft/floor above room 2

Table 5: Summary of building contexts

APPENDIX 9: RESULTS OF MORTAR ANALYSIS

Sample No.	Location	Colour	Composition	Particles	Particle size and shape	Type	Comments
1	Ground floor external face of NE elevation [7]	Mid grey-brown	Fine silt-sand	Lime Charcoal Organic matter	<2mm sub-rounded <5mm sub-angular Seed/husk	A	Silt-sand mortar
2	Ground floor internal face of NW elevation [1]	Mid yellow-brown	Fine sand	Lime Charcoal Glass	<1mm sub-rounded <1mm sub-angular <2mm angular	D	Sandy mortar
3	Ground floor external face of NE elevation [12]	Dark black-grey	Fine sand	Lime Charcoal	<1mm sub-rounded <2mm sub-angular	E	Ash mortar
4	Ground floor internal face of NW elevation [55]	Mid brown-grey	Medium sand	Lime Charcoal Organic matter	<3mm sub-rounded <2mm sub-angular Horse hair	D	Sandy mortar
5	Ground floor external face of NE elevation [60]	Mid brown-grey	Medium silt-sand	Lime Charcoal Organic matter	<5mm sub-rounded <5mm sub-angular Seed/husk	A	Silt-sand mortar
6	Ground floor internal face of NE elevation [25]	Light brown-grey	Medium sand	Lime Charcoal Slag Burnt sandstone	<4mm sub-rounded <2mm sub-angular <20mm angular <10mm angular	B	Sandy lime mortar
7	Ground floor SE elevation of north internal wall [5]	Light brown-yellow	Fine sand	Lime Charcoal Burnt sandstone	<2mm sub-rounded <4mm sub-angular <15mm angular	D	Sandy mortar
8	Ground floor NW face of south internal wall [61]	Light brown-grey	Medium sand	Lime Charcoal Organic matter	<2mm sub-rounded <10mm sub-angular Grass	C	Lime mortar
9	Ground floor NW face of south internal wall [61]	Mid grey-brown	Medium sand	Lime Charcoal	<10mm sub-rounded <1mm sub-angular	B	Sandy lime mortar

Sample No.	Location	Colour	Composition	Particles	Particle size and shape	Type	Comments
10	Ground floor internal face of SW elevation [65]	Mid grey-brown	Medium sand	Lime Charcoal	<6mm sub-rounded <2mm sub-angular	B	Sandy lime mortar
11	Ground floor internal face of SW elevation [50]	Light brown-grey	Fine sand	Lime Charcoal	<4mm sub-rounded <3mm sub-angular	D	Sandy mortar
12	Ground floor internal face of SE elevation [1]	Light grey-brown	Medium sand	Lime Charcoal Brick dust	<10mm sub-rounded <1mm sub-angular <0.5mm sub-rounded	B	Sandy lime mortar
13	N/A	N/A	N/A	N/A	N/A	N/A	Sample not taken
14	Ground floor external face of NE elevation [1]	Mid yellow-brown	Medium silt-sand	Lime Charcoal Organic matter	<2mm sub-rounded <10mm sub-angular Grass	A	Silt-sand mortar
15	Ground floor external face of SW elevation [29]	Mid grey	Fine sand	Lime Charcoal Brick dust Burnt sandstone	<3mm sub-rounded <1mm sub-angular <5mm angular <10mm angular	E	Ash mortar
16	Ground floor external face of SW elevation [38]	Mid brown-yellow	Fine silt-sand	Lime Charcoal Organic matter	<2mm sub-rounded <5mm sub-angular Root intrusion	A	Silt-sand mortar
17	Ground floor external face of SW elevation [49]	Light pink	Fine sand	Lime Charcoal Brick Dust Glass	<10mm sub-rounded <1mm sub-angular <1mm rounded <5mm angular	F	Pink sandy mortar
18	N/A	N/A	N/A	N/A	N/A	N/A	Sample not taken
19	Ground floor internal face of NE elevation [59]	Mid brown-grey	Medium sand	Lime Charcoal Organic matter		D	Sandy mortar

Sample No.	Location	Colour	Composition	Particles	Particle size and shape	Type	Comments
20	N/A	N/A	N/A	N/A	N/A	N/A	Sample not taken
21	First floor internal face of NW elevation [1]	Light brown-grey	Medium sand	Lime Charcoal Glass Organic matter	<2mm sub-rounded <1mm sub-angular <2mm angular Horse hair and straw	D	Sandy mortar
22	First floor internal face of NE elevation [19]	Light white-grey	Coarse sand	Lime Charcoal	<5mm sub-rounded <1mm sub-angular	C	Lime mortar
23	First floor internal face of SW elevation [1]	Mid yellow-brown	Medium silt-sand	Lime Charcoal Organic matter	<12mm sub-rounded <2mm sub-angular Grass	A	Silt-sand mortar
24	First floor internal face of SE elevation [1]	Mid grey-white	Coarse sand	Lime Charcoal Brick dust	<5mm sub-rounded <1mm sub-angular <2mm angular	C	Lime mortar
25	First floor internal face of SE elevation [1]	Light white-grey	Medium sand	Lime Charcoal	<4mm sub-rounded <1mm sub-angular	C	Lime mortar
26	N/A	N/A	N/A	N/A	N/A	N/A	Sample not taken
27	N/A	N/A	N/A	N/A	N/A	N/A	Sample not taken
28	N/A	N/A	N/A	N/A	N/A	N/A	Sample not taken
29	First floor external face of NE elevation [19]	Mid white-grey	Medium sand	Lime Charcoal Brick Dust	<4mm sub-rounded <1mm sub-angular <0.5mm sub-rounded	B	Sandy lime mortar

Table 6: Summary of mortar samples

APPENDIX 10: PHOTOGRAPHIC REGISTERS

Film 1 (Subsurface Excavations)					
Format	Black & white	**Type**	35mm	**Photographer**	S. Baker

Film & Frame	Report Plate	Description	Direction	Date
1:1	-	ID shot	-	19/04/05
1:2	-	Trench 1 general plan	E	19/04/05
1:3	-	Trench 1 general plan	E	19/04/05
1:4	-	Trench 1 north facing section	S	19/04/05
1:5	-	Trench 1 north facing section	S	19/04/05
1:6	-	Trench 1 detail shot	N	19/04/05
1:7	-	Trench 1 detail shot	N	19/04/05
1:8	-	Trench 4 west end, deposit 402	W	19/04/05
1:9	-	Trench 4 west end, deposit 402	W	19/04/05
1:10	-	Trench 4 west end, deposit 402	W	19/04/05
1:11	-	Trench 4 west end, deposit 402	W	19/04/05
1:12	-	Trench 4 section through 402, 403, 404	W	19/04/05
1:13	-	Trench 4 section through 402, 403, 404	W	19/04/05
1:14	-	Trench 4 general shot	W	19/04/05
1:15	-	Trench 4 general shot	W	19/04/05
1:16	-	Working shot	N	19/04/05
1:17	-	Working shot	N	19/04/05
1:18	-	Trench 4 east end including wall 406	E	19/04/05
1:19	-	Trench 4 east end including wall 406	E	19/04/05
1:20	-	Trench 3 section 300, 301, 302, 303	S	20/04/05
1:21	-	Trench 3 section 300, 301, 302, 303	S	20/04/05
1:22	-	Trench 2 flue 202 in plan	E	20/04/05
1:23	-	Trench 2 flue 202 in plan	E	20/04/05
1:24	-	Trench 2 section 203, 204, 205, 206, 207	E	20/04/05
1:25	-	Trench 2 section 203, 204, 205, 206, 207	E	20/04/05
1:26	-	Trench 2 deposit 207	E	20/04/05
1:27	-	Trench 2 deposit 207	E	20/04/05
1:28	-	Trench 2 general shot	S	20/04/05
1:29	-	Trench 2 general shot	S	20/04/05
1:30	-	Trench 2 Flue 202	SE	20/04/05
1:31	-	Trench 2 Flue 202	SE	20/04/05
1:32	-	Trench 1 detail of rubble 105 under 102	E	21/04/05
1:33	-	Trench 1 detail of rubble 105 under 102	E	21/04/05
1:34	-	Trench 5 section with later buttress	E	21/04/05
1:35	-	Trench 5 section with later buttress	E	21/04/05
1:36	-	Trench 5 section with later buttress	E	21/04/05
1:37	-	Trench 2 sandstone blocks under 206 and 207	E	21/04/05
1:38	-	Trench 2 sandstone blocks under 206 and 207	E	21/04/05

Film 2 (Subsurface Excavations)					
Format	Colour slide	**Type**	35mm	**Photographer**	S. Baker

Film & Frame	Report Plate	Description	Direction	Date
2:1	-	ID Shot	-	19/04/05
2:2	-	Trench 1 general plan	E	19/04/05
2:3	11	Trench 1 general plan	E	19/04/05
2:4	-	Trench 1 north facing section	S	19/04/05
2:5	-	Trench 1 north facing section	S	19/04/05
2:6	-	Trench 1 detail shot	N	19/04/05
2:7	-	Trench 1 detail shot	N	19/04/05
2:8	-	Trench 4 west end deposit 402	W	19/04/05
2:9	-	Trench 4 west end deposit 402	W	19/04/05
2:10	-	Trench 4 west end deposit 402	W	19/04/05
2:11	-	Trench 4 west end deposit 402	W	19/04/05
2:12	-	Trench 4 section through 402, 403, 404	W	19/04/05
2:13	-	Trench 4 section through 402, 403, 404	W	19/04/05
2:14	-	Trench 4 general shot	W	19/04/05
2:15	16	Trench 4 general shot	W	19/04/05
2:16	-	Working shot	N	19/04/05
2:17	-	Working shot	N	19/04/05
2:18	-	Trench 4 east end showing wall 406	E	19/04/05
2:19	-	Trench 4 east end showing wall 406	E	19/04/05
2:20	15	Trench 3 north facing section	S	19/04/05
2:21	-	Trench 3 north facing section	S	19/04/05
2:22	-	Trench 2 flue 202 in plan	E	20/04/05
2:23	-	Trench 2 flue 202 in plan	E	20/04/05
2:24	-	Trench 2 section showing 203, 204, 205, 206, 207	E	20/04/05
2:25	14	Trench 2 section showing 302, 204, 205, 206, 207	E	20/04/05
2:26	-	Trench 2 deposit 207	E	20/04/05
2:27	-	Trench 2 deposit 207	E	20/04/05
2:28	-	Trench 2 general shot	S	20/04/05
2:29	13	Trench 2 general shot	S	20/04/05
2:30	-	Trench 2 flue 202	SE	20/04/05
2:31	-	Trench 2 flue 202	SE	20/04/05
2:32	-	Trench 1 detail of rubble foundation 105	E	20/04/05
2:33	12	Trench 1 detail of rubble foundation 105	E	20/04/05
2:34	17	Trench 5 section with later buttress	E	21/04/05
2:35	-	Trench 5 section with later buttress	E	21/04/05
2:36	-	Trench 5 section with later buttress	E	21/04/05
2:37	-	Trench 2 sandstone blocks under 206 and 207	E	21/04/05
2:38	-	Trench 2 sandstone blocks under 206 and 207	E	21/04/05

Film 3 (Subsurface Excavations)					
Format	Black & white	**Type**	35mm	**Photographer**	S. Baker

Film & Frame	Report Plate	Description	Direction	Date
3:1	-	ID Shot	-	21/04/05
3:2	-	Trench 5 post-excavation	E	21/04/05
3:3	-	Trench 5 post excavation	E	21/04/05
3:4	-	Trench 5 post excavation	S	21/04/05
3:5	-	Trench 5 post excavation	S	21/04/05
3:6	-	Trench 5 extension to wall base	E	21/04/05
3:7	-	Trench 5 extension to wall base	E	21/04/05
3:8	-	Trench 5 extension showing possible furnace edge	S	21/04/05
3:9	-	Trench 5 extension showing possible furnace edge	S	21/04/05
3:10	-	Trench 6 general shot	E	21/04/05
3:11	-	Trench 6 general shot	E	21/04/05
3:12	-	Trench 6 general shot	W	21/04/05
3:13	-	Trench 6 general shot	W	21/04/05
3:14	-	Trench 6 wall 610, cut 604 east of trench	S	21/04/05
3:15	-	Trench 6 wall 610, cut 604 east of trench	S	21/04/05
3:16	-	Trench 6 contexts 606, 607	S	21/04/05
3:17	-	Trench 6 contexts 606, 607	S	21/04/05
3:18	-	Trench 6 context 606	E	21/04/05
3:19	-	Trench 6 context 606	E	21/04/05
3:20	-	Trench 6 context 606	E	21/04/05
3:21	-	Trench 6 cut 605 contexts 608 and 609	E	21/04/05
3:22	-	Trench 6 cut 605 contexts 608 and 609	E	21/04/05
3:23	-	Trench 6 contexts 608 and 609	N	21/04/05
3:24	-	Trench 6 contexts 608 and 609	N	21/04/05
3:25	-	Trench 7 general shot	E	21/04/05
3:26	-	Trench 7 general shot	E	21/04/05
3:27	-	Trench 7 detail of 701 and 702	S	21/04/05
3:28	-	Trench 7 detail of 701 and 702	S	21/04/05
3:29	-	Trench 7 detail of 704	S	21/04/05
3:30	-	Trench 7 detail of 704	S	21/04/05
3:31	-	Trench 7 north facing section	S	24/04/05
3:32	-	Trench 7 north facing section	S	24/04/05
3:33	-	Trench 7 south facing section	N	24/04/05
3:34	-	Trench 7 south facing section	N	24/04/05

Film 4 (Subsurface Excavations)					
Format	Colour slide	**Type**	35mm	**Photographer**	S. Baker

Film & Frame	Report Plate	Description	Direction	Date
4:1	-	ID Shot	-	21/04/05
4:2	-	Trench 5 post-excavation	E	21/04/05
4:3	-	Trench 5 post excavation	E	21/04/05
4:4	18	Trench 5 post excavation	S	21/04/05
4:5	-	Trench 5 post excavation	S	21/04/05
4:6	-	Trench 5 extension to wall base	E	21/04/05
4:7	-	Trench 5 extension to wall base	E	21/04/05
4:8	-	Trench 5 extension showing possible furnace edge	S	21/04/05
4:9	-	Trench 5 extension showing possible furnace edge	S	21/04/05
4:10	-	Trench 6 general shot	E	21/04/05
4:11	-	Trench 6 general shot	E	21/04/05
4:12	19	Trench 6 general shot	W	21/04/05
4:13	-	Trench 6 general shot	W	21/04/05
4:14	20	Trench 6 wall 610, cut 604 east of trench	S	21/04/05
4:15	-	Trench 6 wall 610, cut 604 east of trench	S	21/04/05
4:16	-	Trench 6 contexts 606, 607	S	21/04/05
4:17	-	Trench 6 contexts 606, 607	S	21/04/05
4:18	-	Trench 6 context 606	E	21/04/05
4:19	-	Trench 6 context 606	E	21/04/05
4;20	-	Trench 6 context 606	E	21/04/05
4:21	-	Trench 6 cut 605 contexts 608 and 609	E	21/04/05
4:22	22	Trench 6 cut 605 contexts 608 and 609	E	21/04/05
4:23	-	Trench 6 contexts 608 and 609	N	21/04/05
4:24	21	Trench 6 contexts 608 and 609	N	21/04/05
4:25	-	Trench 7 general shot	E	21/04/05
4:26	-	Trench 7 general shot	E	21/04/05
4:27	-	Trench 7 detail of 701 and 702	S	21/04/05
4:28	-	Trench 7 detail of 701 and 702	S	21/04/05
4:29	-	Trench 7 detail of 704	S	21/04/05
4:30	-	Trench 7 detail of 704	S	21/04/05
4:31	-	Trench 7 south facing section	N	24/04/05
4:32	-	Trench 7 south facing section	N	24/04/05
4:33	-	Trench 7 north facing section	S	24/04/05
4:34	-	Trench 7 north facing section	S	24/04/05

Film 1 (Building Recording)					
Format	Colour	**Type**	Medium format	**Photographer**	S. Jessop

Film & Frame	Report Plate	Description	Direction	Date
1:1	29	General view of east facing elevation	W	12/01/06
1:2	30	View of wooden battened doors	W	12/01/06
1:3	31	View of blocked large arch	W	12/01/06
1:4	33	General view of north facing elevation	SE	12/01/06
1:5	34	View of blocked arch in west elevation	E	12/01/06
1:6	35	General view of west facing elevation	E	12/01/06
1:7	36	Detail view of fireplaces in west wall	E	12/01/06
1:8	37	Detail view of exposed flue in west wall	SE	12/01/06
1:9	38	General view of barn	NE	12/01/06
1:10	32	Remnant of hearth in east facing elevation	W	12/01/06

Film 2 (Building Recording)					
Format	Black & White	**Type**	35mm	**Photographer**	O. Jessop

Film & frame	Report plate	Description	Direction	Date
2:1	-	I.D. Shot	N/A	12/01/06
2:2	65	Conjunction of principal and tie beam in N part of building	NW	12/01/06
2:3	66	Conjunction of tie beam and wall in northern part of building	NE	12/01/06
2:4	-	Detail of conjunction between tie beam and principal	N	12/01/06
2:5	78	Conjunction of tie beam and principal, N part of building	NW	12/01/06
2:6	64	Detail of joggled king post in northern end of building	N	12/01/06
2:7	68	Detail of lapped scarf joint in ridge piece of northern part of building	N	12/01/06
2:8	-	Detail of king post in northern end of building	N	12/01/06
2:9	-	General view of truss in northern end of building	NE	12/01/06
2:10	-	General view of truss in northern end of building	NW	12/01/06
2:11	63	Detail of roof truss in northern end of building	N	12/01/06
2:12	-	General view of rafters beyond dividing wall	S	12/01/06
2:13	-	General view of rafters beyond dividing wall	S	12/01/06
2:14	-	Detail of joint between common rafters and wall	SE	12/01/06
2:15	-	General view of dividing wall at eves level	SE	12/01/06
2:16	-	General view of conjunction between purlins and principal	NE	12/01/06
2:17	-	General view of joint between purlin and principal	NW	12/01/06
2:18	-	Detail of lapped joint between common rafter and ridge piece	NW	12/01/06
2:19	74	Conjunction of ridge and gable in northern part of building	N	12/01/06
2:20	-	Terminus of purlin in northern gable wall	NE	12/01/06
2:21	-	Terminus of purlin in northern gable wall	NW	12/01/06
2:22	-	Detail of peg hole in strut	N	12/01/06
2:23	-	Detail of peg in strut	N	12/01/06
2:24	-	General view of western side of roof	W	12/01/06
2:25	62	Detail of purlin in northern end of building	NW	12/01/06
2:26	61	Detail of ridge piece in northern end of building	N	12/01/06
2:27	69	Half lapped joint of purlin and principal in N part of building	E	12/01/06
2:28	-	Half lapped joint of purlin and principal in N part of building	E	12/01/06
2:29	70	Half lapped joint of purlin and principal in N part of building	E	12/01/06
2:30	72	Halved joint of purlin and principal, northern part of building	W	12/01/06
2:31	67	Detail of top of king post in northern part of building	N	12/01/06
2:32	-	General view within northern end of roof	N	12/01/06
2:33	-	General view of truss in northern end of roof	N	12/01/06
2:34	-	General view within northern end of roof	N	12/01/06
2:35	-	General view of truss in northern end of roof	N	12/01/06

Film 3 (Building Recording)					
Format	Black & White	**Type**	35mm	**Photographer**	A. Rose-Deacon

Film & frame	Report plate	Description	Direction	Date
3:1	73	Ridge detail	NW	08/02/06
3:2	-	Detail of principal, southernmost truss	NW	08/02/06
3:3	77	Southernmost truss, notching-in of purlins	NE	08/02/06
3:4	80	South end wall, corbel supporting purlin	SW	08/02/06
3:5	79	South end wall, conjunction with ridge piece	S	08/02/06
3:6	-	Southernmost truss, detail of king-post base	S	08/02/06
3:7	75	Southernmost truss, detail of king-post	S	08/02/06
3:8		Southernmost truss	S	08/02/06
3:9	76	Southernmost truss	S	08/02/06
3:10	48	Shot up north end wall	NW	08/02/06
3:11	-	Timber wall plate in north end wall, overlapping east wall wall-plate	NW	08/02/06
3:12	47	Shot up northernmost truss	W	08/02/06
3:13	-	Hay caught beneath beams, east wall	NW	08/02/06
3:14	46	Common rafters resting on arch, east wall	SW	08/02/06
3:15	45	Shot up central wall from east side	W	08/02/06
3:16	-	Shot up central wall from east side	W	08/02/06
3:17	-	Bedding-in of the common rafter over central wall, east side	SW	08/02/06
3:18	-	Detail of top of king-post, southernmost truss	SW	08/02/06
3:19	41	Shot up southernmost truss	W	08/02/06
3:20	44	Conjunction of south tie-beam and wall plate, east wall	W	08/02/06
3:21	-	Notch holding common rafter, wall plate, east wall	W	08/02/06
3:22	-	Notches in lintel over opening in east wall (south end)	W	08/02/06
3:23	42	Notches in lintel over opening in east wall (south end)	W	08/02/06
3:24	-	Shot up final common rafter and end wall, south end of building	W	08/02/06
3:25	40	Shot of wall plate, east wall (northernmost end)	SW	08/02/06
3:26	-	Shot of wall plate, east wall	W	08/02/06
3:27	-	Shot of wall plate, east wall	S	08/02/06
3:28	-	Shot of wall plate, east wall	S	08/02/06
3:29	-	Shot of wall plate, east wall	S	08/02/06
3:30	-	Shot of wall plate, east wall	S	08/02/06
3:31	43	Shot of wall plate, east wall	SW	08/02/06
3:32	-	Shot of wall plate, east wall	SW	08/02/06
3:33	-	Shot of wall plate, east wall	SW	08/02/06
3:34	39	Shot of wall plate, east wall (southernmost end)	SW	08/02/06
3:35	-	Shot of wall plate, east wall (southernmost end)	SW	08/02/06

Film 4 (Building Recording)					
Format	Black & White	**Type**	35mm	**Photographer**	A. Rose-Deacon

Film & frame	Report plate	Description	Direction	Date
4.1	-	VOID	-	-
4.2	-	VOID	-	-
4.3	-	VOID	-	-
4.4	-	VOID	-	-
4.5	-	VOID	-	-
4.6	-	VOID	-	-
4.7	-	VOID	-	-
4.8	-	VOID	-	-
4.9	-	VOID	-	-
4.10	-	VOID	-	-
4.11	-	VOID	-	-
4.12	-	VOID	-	-
4.13	-	VOID	-	-
4.14	-	VOID	-	-
4.15	-	VOID	-	-
4.16		VOID	-	-
4.17	-	VOID	-	-
4.18	-	VOID	-	-
4.19	-	VOID	-	-
4.20	70	Scarf joint, purlins	E	08/02/06
4.21	49	General shot of roof	NE	08/02/06
4.22	55	'VI' carpenter's marks, purlin ends	E	08/02/06
4.23	56	Shot up southernmost truss	E	08/02/06
4.24	58	Chimney in west wall	N	08/02/06
4.25	53	Detail, wall-head at inserted wall	E	08/02/06
4.26	50	General shot of roof	SE	08/02/06
4.27	51	Shot of wall plate, west wall	E	08/02/06
4.28	-	Shot of wall plate, west wall	SE	08/02/06
4.29	52	Shot of wall plate, west wall	SE	08/02/06
4.30	-	Shot of wall plate, west wall	SE	08/02/06
4.31	54	Shot of wall plate, west wall	SE	08/02/06
4.32	-	Shot of wall plate, west wall	SE	08/02/06
4.33	57	Shot of wall plate, west wall	SE	08/02/06
4.34	59	Shot of wall plate, west wall, southernmost end	SE	08/02/06
4.35	60	Shot of wall plate, west wall, southernmost end	SE	08/02/06

APPENDIX 11: GLOSSARY OF TECHNICAL TERMS

Glass manufacture

Annealing.....The process whereby the finished glass vessel is slowly cooled in a controlled way to prevent the build-up of internal stresses that could lead to the shattering of the vessel.

Batch.....The mixture formed in the crucible when silica, alkali and lime are fused in the furnace.

Clinker.....A mass of incombustible matter fused together.

Crucible.....A container of refractory material employed for heating substances to high temperatures.

Cullet.....Scrap glass from old vessels collected by the glassmaker for recycling. Cullet also served to lower the melting temperature of batch.

Lehr.....An alternative glassworking name for an annealing oven.

Pot-metal.....Glass that has gone through initial vitrification, but which still requires secondary melting to remove further impurities and gases.

Siege.....The bench inside the furnace on which crucibles sit.

Architectural

Ashlar.....Squared stone walling brought to a fine finish

Bond.....Arrangement of masonry in a wall.

Carpenter's marks.....Numbers marked on timber to indicate to the carpenter the intended position.

Common rafters.....Inclined lateral timbers sloping from wall-top to apex and supporting the roof covering.

Coping.....Finishing protective course of an exterior masonry wall.

Corbel.....Stone or timber projecting from wall to support e.g. a roof truss.

Coursing.....Setting masonry in regular lines.

Dendrochronology.....Dating technique for wood such as oak, which measures the annual growth rings that can be cross referenced to established chronologies for producing a felling date.

Dry-stone.....Stone walling technique in which mortar is not used.

Eaves.....Junction where roof overhangs wall

Gable.....Vertical end of a roof in line with the wall

Halving.....Timber joint in which half of each timber is cut away and

resultant seatings faced together and pegged.

Header.....Brick laid so that the small end appears on the wall face.

King post.....In a roof truss, a post standing on the tie-beam to support the ridge-piece.

Kneeler.....Shaped stone block projecting to support the end of the gable-coping at the eaves of a stone or brick house.

Lap-joint.....Timber joint in which members are overlapped and pegged together.

Lintel.....Horizontal member at the top of a structural opening.

Mortise.....Slot into which a tenon fits.

Padstone.....Stone onto which a post is set.

Principal.....The pair of inclined lateral timbers of a truss which support the purlins.

Purlin.....A horizontal longitudinal roof timber that carries the common rafters.

Quoin.....Cornerstone forming an external solid angle of a wall.

Ridge-piece.....A timber running along the ridge of the roof supported on trusses.

Rubble.....Walling stone roughly cut, unsquared.

Scarf.....A joint for extending the length of timber.

Sill.....Horizontal member at the base of a window.

Slabby.....Broad flat walling stone.

Straight joint.....Vertical or horizontal break in the build of a wall.

Stretcher.....Brick laid so that its long side appears on the wall face.

Strut.....Subsidiary supporting timber, usually set at an angle.

Tenon.....Projecting end of a timber narrowed to fit into a mortise.

Truss.....A rigid framework of timbers which is placed across the building to carry the roof.

Wall plate.....A timber laid longitudinally on the top of a wall to receive the ends of the rafters.

APPENDIX 12: SUMMARY OF ARCHAEOLOGICAL ARCHIVES

The following summary of archive material pertaining to Bolsterstone Glass House is based on information received by ARCUS in July 2008.

Western Park Museum, Sheffield

Accession	Description	Accessibility
SHEFM:1996.146	Archive from Ashurst late 60s/early 70s and 1985/6	Part accessible
SHEFM:1996.147	Cast of lost seal matrix	Accessible
SHEFM:1996.149	Saggar frags from pot kiln (1 box)	Accessible
SHEFM:1996.149.1	Kiln debris, crucibles, siege furnace etc (18 boxes)	Part accessible, some boxes very heavy
SHEFM:1996.149.1.1-7	Partly reconstructed glass crucibles	Not accessible
SHEFM:1996.149.2	Glass frags (13 boxes)	Accessible
SHEFM:1996.149.3	AE button	Accessible
SHEFM:1996.149.4	AE thimble	Accessible
SHEFM:1996.149.5	AE pin	Accessible
SHEFM:1996.149.6	Iron objects (x6)	Accessible
SHEFM:1996.149.7	Clay seal matrix	Accessible
SHEFM:1996.149.8	Claypipe (x 30)	Accessible
SHEFM:1996.149.9	Wig curler	Accessible
SHEFM:1996.149.10	Worked bone object	Accessible
SHEFM:1996.149.11	George III halfpenny	Accessible
SHEFM:1996.149.12	Leather (x 1)	Accessible
SHEFM:1996.148.13	Glass marble	Accessible
SHEFM:1996.149.14	Stone kiln closure plug (x 2)	Accessible
SHEFM:1996.149.15	Pot working plug (x 2)	Accessible
SHEFM:1996.149.16	Stone former	Accessible
SHEFM:1996.149.17	Samples (1 box)	Probably accessible
SHEFM:1996.149.18	Pot sherds (2 boxes)	Accessible
SHEFM:1998.460	Archive from 1998 work by Ashurst	Part accessible
SHEFM:1998.460.1	Pottery (7 boxes)	Accessible
SHEFM:1998.460.2	Pottery (1 box)	Accessible
SHEFM:1996.480	Panel of leaded glass allegedly made at Bolsterstone	Probably accessible

The fieldwork archive from the 2005-2007 period of investigations by ARCUS will be deposited with Western Park Museum

South Yorkshire Archaeology Unit fieldwork archive 1985/6

To be deposited with Western park Museum **SHEFM:1996.146**

No.	Description
11x	Boxes of colour slides
2x	A4 excavation notebooks
8x	Loose A4 sheets of excavation notes
2x	Loose A4 sheets of notes relating find bags to the contexts from which the finds were derived
1x	Loose A4 sketch plan
10x	Loose A4 sheets of photocopied plans and elevations
5x	Loose A4 computer printouts of colour slide index forms
1x	Loose computer dot-matrix printout of context information

South Yorkshire SMR, Howden House, Sheffield

Material	Description	Date
Correspondence	From Denis Ashurst to Sarah Whiteley, RE: Sewer Trench report	30/09/97
Watching Brief Report	Investigation of Barn foundations	31/10/97
Watching Brief Report	Excavation of sewer trench	02/10/97
Correspondence	From Denis Ashurst to Sarah Whiteley, RE: submission of report on watching brief	21/10/97
Report	Ashurst, D. *Report on "Watching Brief" – Conversion of Barn*	20/10/97
Photographic Print	Pot house Farm, Stocksbridge: trench to South of Barn	06/08/97
Photographic Print	Pot house Farm, Stocksbridge: trench to South of Barn	06/08/97
Photographic Print	Pot house Farm, Stocksbridge: trench to South of Barn	06/08/97
Photographic Print	Pot house Farm, Stocksbridge: trench to South of Barn	06/08/97
Listed Building Description	Description of monument and assessment of its importance, with location map	01/12/86
Listed Building Description	Description of monument, with map	15/01/85
Listed Building Description	Record of amendments and additions to Listed Building Description of Bolsterstone Glasshouse	17/01/91
Listed Building Description	Record of amendments and additions to Listed Building Description of Bolsterstone Glasshouse Potteries	17/01/91
Listed Building Description	Description of monument and assessment of its importance, with brief bibliography	14/01/87

Note: Additional reference works held by the SMR have been included in the bibliography of this report