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# The New Don Glass Works Excavations at Cliff Street Mexborough, South Yorkshire

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**The New Don Glass Works: Excavations at Cliff Street, Mexborough, South Yorkshire**

by Neil Dransfield with contributions by Hugh Willmott and Chris Cumberpatch.

**Abstract**

Archaeological excavations at the former site of the New Don Glass Works in Mexborough, South Yorkshire, uncovered the remains of two of buildings pre-dating the works and several larger structures constructed as part of the glassworks in 1891–2. There was no evidence for structural remains pre-dating 1839. The results provide an insight into the location and development of the individual buildings and allow some consideration of the likely process-flow within and between them. From the combined archaeological, cartographic, and documentary evidence, four principal phases of development were identified.

A small assemblage of glass and glassmaking debris was recovered, including bottles, jars and Codd-bottle marbles, most of which appears to derive from the bottle-works. The pottery assemblage included biscuit-fired wasters of late 18th- and 19th-century type and fragments of kiln furniture indicating that this was waste from a pottery. Notably, there is evidence to suggest that the waste has been transported some distance rather than from a pottery adjacent to the site.

**Introduction**

The site of the New Don Glass Works at Mexborough, South Yorkshire, centred on SK 4695 9975, lies 0.2km south of Mexborough town centre, between Greens Way to the north and the Mexborough New Cut of the Sheffield and South Yorkshire Navigation canal to the south (Fig. 1). The archaeological work followed desk-based assessment and trial trenching by ArcHeritage (2010; 2011) as part of a phased programme of research and investigation

which aimed to record the surviving elements of the structures and to enhance understanding of the development of the glassworks.

## **Historical background**

Mexborough derives its name from the Old English or Old Norse personal name *Meac* or *Mjuk* and the Old English *Burg* meaning fortified settlement (Smith 1961). Mexborough appears to have been established as part of a system of medieval fortified sites along the Dearne and Don valleys; the remains of a motte and bailey castle lie just over 1km to the east of the site. The site itself is likely to have been pasture or meadow due to its location close to the river Don and remained that way until the 19th century.

The Sheffield and South Yorkshire Navigation canal was constructed along the southern edge of the site in c.1836, providing Mexborough with navigable access to the rivers Don and Dearne and the wider waterway network. A 1839 tithe map depicts the site as fields with a pond. At this time the land immediately east of the site was occupied by the Mexborough Old Pottery; it was sold to the Barker family in 1844 and redeveloped as the Don Iron Works. The eastern side of the site was initially glebe land under the ownership of the local parish church (DA P43/9/1) and was later used as waste ground by the Don Iron Works. In the mid-19th century the western half of the site was owned by a brick- and tile-maker, William Cresswell. It was purchased by Thomas Scholey in 1872 and subsequently developed as a boatyard and a terrace of houses (Doncaster Archives ref. DX/HATT/1/42).

By the late 19th century the area possessed two established glassworks; the Don Works (formerly the Mexborough Flint Glass Works) and the Don Glass Works lay to the east of the site, beyond the Don Iron Works. There appears to be some confusion regarding whether these glassworks were under the same ownership (see Ashurst 1992, 73, 74, 127); however the 1892 and 1903 Ordnance Survey (OS) maps appear to show some physical separation of the two groups of buildings (Fig. 2).

Ashurst (1992) records a 'New' Don Glass Works constructed by Joseph Barron (Jnr) in 1857. It would appear that this was initially run as a partnership between two Barron brothers and production began by September 1858 (Ashby n.d.). Ashby's examination of Thomas Barron's obituary, which was published in the *Mexborough and Swinton Times* on 19th August 1887, also reveals that in 1864 the brothers, Joseph and Thomas, argued and they dissolved the partnership: Joseph took over the 'New' Don Glass Works and Thomas took over the old Don Works factory and renamed it the 'Phoenix Glass Works' in around 1876 (Ashurst 1992). It would seem, from the available evidence, that the 'New' Don Glass Works listed by Ashurst (1992) is actually Barron's Don Glass Works rather than the New Don Glass Works which is the subject of these investigations.

Following Thomas Scholey's death in 1891, his boatyard and land was bought by Peter Waddington, then partner of Hartley Barron at the Don Glass Works. Noted in the sale conveyance were several structures including a large house, docks, workshops, an office, two stables, a carriage house, an engine house, and nine domestic properties (DA DX/HATT/1/42). The 1892 OS map of the area was surveyed in 1890 and therefore shows the site at the time of Waddington's purchase. It depicts several structures including terraced dwellings to the west and two buildings appended to earlier field boundaries (Fig. 2).

Waddington's new factory (the New Don Glass Works) appears to have been constructed rapidly, as an agreement made in December 1891 to hire Frank Bennett as works' manager mentions glass furnaces, a bottle house, a yard, a smithy and a fitter's shop (DA DX/HATT/1/43). The agreement also describes Bennett's duties, including cleaning the 'working holes' and 'port holes' of the furnace and tanks, rather than features of the traditional conical furnaces; strongly suggesting that the new furnaces were of the Siemens regenerative type (ArcHeritage 2010, 9). Peter Waddington also took over the Don Glass Works in 1897.

The New Don Glass Works first appears on the 1903 OS map as an amalgamation of several buildings, including two of those evident on the 1892 OS map and a new large square chimney (Fig. 2).

The factory is thought to have closed in 1920 (Ashurst 1992) but the 1930 OS map depicts the works and new buildings to the north and east, suggesting confusion resulting from the names of the various works. Cartographic evidence indicates that the majority of the New Don Glass Works buildings were not demolished until the mid-20th century.

### **Glassmaking in South Yorkshire**

The following outline of the processes and historical development of glass production is intended to provide a context for the interpretation of the surviving factory structures and the process-flows within the buildings.

The earliest evidence of glass production in South Yorkshire was discovered during excavations of the Roman fort at Templeborough near Rotherham. A small smithy building just beyond the eastern corner of the fort contained quantities of glass drips, runs and clippings showing that clear soda glass was being produced at a secondary furnace in the building (Ashurst 1992).

There is no further evidence for glass production in the county until the 17th century. Giacomo Verzelini, and Jean Carre are credited by Ashurst (1992) with reintroducing glassmaking into England; working at a factory in Crutched Friars, London between 1550 and 1557 (Marson 1918). The huge demands for timber from even relatively small-scale glass manufacture meant that early production centres moved from woodland to woodland as the need for new fuel sources arose (Marson 1918). In the 16th century glass production slowly migrated from the original stronghold in the Weald, through the midlands to Newcastle. The southern part of the West Riding of Yorkshire (modern South Yorkshire) appears to have missed this industrial migration; probably because timber earmarked for

charcoal production was linked to the burgeoning metallurgical industries in the region (Ashurst 1992).

In 1615 the demand for timber led to legislation banning the use of wood in glass production (Crossley 1990). Ashurst (1992) points out that this legislation also provided Crown control over several industries (including glass production) by the issuing of patents and licences. The unpopular patent was controlled by Sir Robert Mansell until 1642 when the patent was withdrawn. Mansell's control of the patent may have contributed to the creation of a glassworks at Wentworth (near Rotherham, South Yorkshire): as an expediency to his own success Mansell licensed glass production to the extensive landowner and influential courtier Thomas Wentworth, Earl of Strafford (Ashurst 1992).

The sudden change of fuel source, from wood to coal, also resulted in a geographical shift in the focus of the industry, from the traditional centres in the south of the country to those with accessible coalfields. Bristol, Stourbridge, Newcastle upon Tyne, south Lancashire and South Yorkshire all developed as important glassmaking centres during the 17th century, although London also had a considerable number of glass cones (Ashmore 1969).

Several centres in South Yorkshire were ideally placed due to the accessibility of local resources required in the manufacture of glass. Abundant supplies of ganister (clay) for refractory material were available from several locations, including Mexborough, which were also being exploited by the local potteries. Silica (sand) sourced from weathered siliceous sandstone from the coal measure beds as well as the Basal Permian sands at Hampole and Bilham were readily available as the primary glass ingredient. Lime was also available from the magnesium limestone of the Permian beds.

Five coal-fired glassworks are known to have existed in this area in the 17th century: Wentworth, Silkstone, Bolsterstone, and Gawber (South Yorkshire) and Glass Houghton (West Yorkshire). The available evidence suggests that the majority of these early glassworks were probably involved in the production of window glass and bottle glass, and

fine quality lead (white) tableware (Ashurst 1992). The design of the early 17th-century furnaces is unclear as much of the archaeological evidence from the excavated sites at Gawber, Glass Houghton and Wentworth has been truncated by later activity (Ashurst 1992). The excavations at Bolsterstone however uncovered a deep airway leading to the furnace area with arches within the wall of the original building (Ashurst 1992). Analysis of the subsurface structure led Ashurst to conclude that the furnace was an early, experimental regenerative type of furnace, not seen again until the mid-19th century.

During the 18th century, conformity in the design and layout of the glassworks buildings led to the construction of a high, brick cone enclosing the entire furnace and its working area. The circular furnace was surrounded by openings where a number of people (usually four or five) could access the glass prior to working and annealing. The 'chairs', as they were known, were involved in various stages of production under the supervision of the gaffer who would sit in the glassmaker's chair (Jones 2006). New works were set up in Sheffield at Catcliffe and Attercliffe, and in Rotherham at Masborough, with the former factories adopting the new design which increased both production and economy. A wide variety of products ranging from table glasses to medical ware and window glass were produced but bottles for wine and mineral water were the mainstay of the South Yorkshire manufacturers (Ashurst 1992).

In the first half of the 18th century the effects of a glass tax introduced in 1745 may have led to the closure of the Gawber Works. Other factories, such as the Catcliffe Works, became highly specialised whilst others, like Masborough, switched to the production of medical and chemical glassware. The 19th century brought huge changes to the mode of production in most industries, along with a rapidly expanding labour pool, transportation system (canal and river initially and rail later) and technological advances. The repeal of the glass tax in 1845 led to an increase in the number of glassworks in the Mexborough district, from six in 1860 to twenty-five in 1900 (Ashurst 1992). Many of the glassworks were short-lived, leading to confusion with factory names and changes of ownership, however the South



Yorkshire glassworks gazetteer compiled by Ashurst (1992) contains at least sixty-two separate listings for the industrial period, and which we now believe does not include the New Don Glass Works.

The reason for the decline of glass production in the 20th century is complex. In the early 20th century, South Yorkshire glass production accounted for 28 per cent of all containers (16 per cent of the British glass-factory workforce) and output had increased 419 per cent compared with the national average of 312 per cent (Ashurst 1992). Marson (1918) was highly critical of conservatism in glass producers, particularly in their failure to adopt the regenerative furnaces common in Europe. He also criticised the role that the unions played in reducing working hours and its detrimental effect on almost perpetual production. Other factors, such as the fall from fashion of the Codd bottle, over-specialization of the manufacturers and, ironically, over-production leading to sales gluts, also were contributing factors.

It is perhaps unfair to tarnish the whole industry with lack of innovation. Kilner's factory (near Dewsbury, West Yorkshire) adopted the fully automatic Owen bottle machine. Whilst the conical brick-tower furnace system using the 'chair' system of production could perhaps produce around one hundred bottles per hour, the Owen machine could produce over two thousand bottles, virtually unattended. This level of production may however have saturated the market. After 1920 the number of working glassworks in the region fell from fifteen to eight and by 1990 none remained (Ashurst 1992).

## **The archaeological investigations**

### ***Introduction***

Five evaluation trenches targeted the buildings of the New Don Glass Works and a row of terraced houses (ArcHeritage 2011). Wessex Archaeology then undertook the detailed excavation of the glassworks within the new development area (Fig. 1).



The underlying natural geology consisted of pale greenish-yellow, alluvial clay over Pennine Middle Coal Measures Formation bedrock (British Geological Survey 1:50,000). Modern surfaces and made ground were removed by machine down to the top of the first archaeological horizon prior to hand excavation and recording.

The excavations uncovered the remains of two buildings depicted on the 1892 OS map, at the southern edge of the site, and the larger structures associated with the New Don Glass Works. There was no evidence for structural remains pre-dating 1839. The results of the investigations provide an insight into the location and structural development of the individual glassworks buildings and allow some consideration of the likely process-flow within and between them. From the combined archaeological, cartographic, and documentary evidence, four principal phases of development have been identified.

#### ***Phase 1: 1840–1892***

Much of the site was covered by a substantial 0.5–0.7m thick deposit of red and black clinker, ash, and consolidated slag deposits. It seems likely that during this phase the area was used as a dumping ground for industrial waste from the Don Iron Works located to the east of the site.

Excavation revealed two rectangular sandstone structures (Buildings A and B) in the southern part of the site which correspond well with the locations of two buildings shown on the 1892 OS plan (Fig. 3).

Building A was constructed from dressed-sandstone facing blocks with a rubble interior. The walls were at least 1.3m high, projecting 0.8m above the underlying natural clay. The building was subdivided into two rooms with clay and red-brick floors. The southern room was further divided by a red-brick wall and a sandstone block, which may have provided support for a bench or machine (Pl. 1). Two areas of Building A, including internal walls, had

been severely affected by heat, suggesting this was either an engine house, smithy or other building associated with Scholey's brick and tile works.

Building B was also constructed from dressed, faced sandstone blocks with a rubble interior, and two crudely constructed internal walls lined the eastern and western sides of the structure. Only one sandstone course survived; constructed directly onto made ground. No internal features were revealed to aid interpretation of this structure, however the 1892 OS map indicates that the building was attached to the wall of a yard associated with the Don Iron Works (Fig. 2).

Between the two structures, overlying the clinker and slag layer, was an extensive brick yard surface (7081).

### ***Phase 2 (1892–1903)***

Building C was revealed in the south-western corner of the excavated area adjacent to, and incorporating part of, Phase 1 Building A (Fig.3).

The eastern wall (7013) of Building C was abutted by a levelling deposit (7057; Fig. 4) that contained twenty-one sherds of late 18th-century or early 19th-century biscuit-ware wasters, thought to originate from the Don Pottery (rather than the nearer Mexborough Old Pottery; see Appendix). Similar deposits were identified across the site during the evaluation and excavation. This material was probably imported as a component of a levelling layer used during site preparations and the construction of the New Don Glass Works.

Building C contained the base of two chambers of a Siemens-Martin regenerative furnace; an innovative furnace that utilised waste heat and gases to heat the tanks, allowing for continuous glass production and fuel economy. Two brick chambers (7007 and 7012) were aligned north to south and measured 1.5m by at least 6m (Fig. 3). The chambers were constructed from fire bricks and showed evidence of arches (crowns) that would have linked the walls at a higher level. A further arch to the west of chamber 7007 indicated that at least

one more chamber lay beyond the western limit of excavation and typically these furnaces would have had four chambers. The internal faces of the bricks were heavily vitrified, demonstrating substantial heat and, with the lack of soot, indicating that these were the hot-air chambers of a regenerative furnace.

The chambers could be accessed through a brick-floored cellar (7018) at their northern end. Evidence of a thin coating of black soot was noted on the internal brick surfaces of the cellar. There was no evidence for the access pits or flues in the floor of the cellar that would suggest this was a switch room (to allow hot air to be directed into the base of the chambers and alternating the hot air flow between them). Therefore the switch room may have been located on the southern side of the hot-air chambers. The northern ends of the hot-air chambers were not sealed off from the cellar; recesses between the end walls of the chambers and the adjacent brick pillars indicated the location of rebates for a vertical sliding door. A sliding door would allow the chambers to be sealed when in use and, when raised, the chambers could be vented of waste gases via the flues within the cellar walls.

A network of brick-built vaulted flues extended from Building C to the north and east, although a modern sewer cut had removed evidence of their full extent (Fig. 3). Flues 7021 and 7032 appear to have been incorporated into the cellar build (Pl. 2) but the insertion of flue 7021 also appears to have necessitated the partial demolition of the corner of Building A, leaving the former internal wall intact as an exterior wall. This redesign of the Phase 1 structure and its incorporation into the fabric of the larger New Don Glass Works building is visible in the stepped building outline shown on the 1903 OS map (Fig. 3).

To the south, flue 7021 may have connected with the furnace in Building A or with a flue leading to a building beyond the excavated area. Flues 7097 and 7171 vented air flow from flue 7021 towards the east where both were truncated by a later chimney (Pl. 3). Flue 7171 cut through the Phase 1 yard surface (7081). It may then have connected with a gas producer as discussed in more detail below.

Prior to truncation by a modern sewer, flue 7032 extended north and connected with a small, square, brick chimney base (7051; Pl. 4).

The position of chimney base 7051 corresponds with a chimney stack visible behind the large square chimney on a historic photograph of the works (Fig. 2; Pl. 5). Flues 7042 and 7046 also terminated in the area of chimney base 7051 (Pl. 4) and may have originally served a process in Building D or fed into a second chimney to the south which is depicted on the 1903 OS map and the photograph, but was removed by the insertion of a modern drainage system.

Building D was investigated within both the main excavation area and an evaluation trench (Fig. 3). In the excavation area two parallel walls, 7129 and 7131, incorporated brick pier-bases, and pier foundations were also identified in the evaluation trench to the north, both indicating that there had been an arched entrance or vaulted interior to the building. The historic photograph shows Building D (behind the tall chimney) with two openings in the upper storey of the southern gable end and a wooden door at ground level (Pl. 5).

The northern wall (6035) of Building D was exposed in an evaluation trench (Fig. 3). It was three bricks thick, implying at least two-storey load bearing and, like the southern wall, included a number of piers. This wall probably utilised pier-and-panel construction to allow air flow into the hot glass-producing part of the building.

A sandstone surface, 6079, to the east contained compacted cinder and glass marbles, suggesting that this was used for access to the front of Building D and, from there, into the western side of the building where glass production appears to have been focused.

The western side of Building D was dominated by two rectangular flues (6043) formed by three east–west oriented walls. The two northern flue chambers had internal, highly vitrified, fire-brick surfaces and structural red-brick exteriors. The upper brick courses survived to a

level where a slight curve in the brickwork indicated that the two chambers had originally been connected by a brick arch.

The third chambered flue to the south was also constructed with a double-fabric wall consisting of red brick and vitrified fire brick. Again, the curvature of the upper courses suggested that it was connected to another flue chamber, this time beyond the southern limit of the trench. This arrangement of two paired-flues is not dissimilar to the typical Siemens regenerative furnace; however these chambers contained no floor bricks, which is highly unusual.

To the east of the chambered flues were wall supports (6060, 6064) and a rectangular brick recess (6073) containing a chamber with two arched-flue entries. The interior of the rectangular structure was coated with a heavy soot residue indicating that it may have been used for the production of gas from coal. It is suggested that the flue connected with a tank furnace above the wall supports and fed heat into kiln structures above the pairs of chambered flues within Building D.

The other Phase 2 walls and brick floors within Building D could not be confidently interpreted.

### ***Phase 3 (1903–1930)***

Both the cartographic and archaeological evidence suggest that the southern end of Building E was part of the original glassworks but lay beyond the excavation area; it was extended northwards in the early 20th century.

The remains of Building E consisted of an east–west aligned brickwork block (7094). A recessed square flue was revealed in the western side of the structure, whilst the eastern side comprised a slightly raised platform, which was coated in a sooty residue. It is likely that the raised soot-coated bricks lay at the base of a furnace structure; possibly involved in the

production of soot-free hot air and linked to the recessed flue. A further wall and a suspended brick floor were also identified.

In this phase a brick-built flue (7052), incorporating two small, square, chimney bases, connected the corner of Building E to chimney 7051 near Building D (Pl. 3). The construction of flue 7052 rendered the Phase 2 flue 7171 redundant but flue 7097 was retained as part of the venting system for the regenerative furnace in Building C.

During this phase Building C was extended by the addition of two sections of red-brick wall (7170).

A new structure, Building F, was constructed opposite Building D between 1903 and 1930 and its south-western corner was recorded by the excavations. Building F may have had a covered entrance as represented by sandstone walls 7143 and 7060. Wall 7143 incorporated three concrete stanchions, which may have supported a roof or upper storey.

#### ***Phase 4 (1930 onwards)***

Historic maps indicate that the glasswork premises underwent a period of expansion between 1930 and 1958. The later OS map shows a small room appended to the north-eastern corner of Building C and this was confirmed by excavation (wall 7169; Fig. 3) and a modern red-brick structure and associated drainage (7139) was appended to Building F. The latter addition is not shown on any historic maps but the archaeological evidence indicates that it was added after 1930. Excavation also revealed that the yard/access area between Buildings C, D and F was severely truncated by the insertion of a large sewer and drain (7151); this is also assumed to have occurred after 1930 (Fig. 3).

#### **Glass artefacts, Hugh Willmott**

A small assemblage of glass and glassmaking debris was recovered from the site. Although some of the material is probably unrelated to the actual manufacturing processes taking

place on site, most appears to derive from the works and is entirely consistent with what would be expected from a bottle works of the late 19th or very early 20th century.

The glass can be divided into three broad categories: manufacturing waste, finished products, and glass not manufactured on the site. The surprisingly small assemblage is important in giving an insight into the output of the manufactory. All the glass manufactured on the site is a light blue/green in colour, the standard mix used for container vessels.

A small quantity of glassmaking waste was recovered that included: a sample of buff coloured sand, which is contaminated with clinker and other residues; four pieces of bubbly gall or glassmaking slag, which would have accumulated on the top of the tank furnace as the batch was melted and had to be removed before the glass could be worked; a single large lump of tank metal. The final fragments of waste are all portions of glass threads and pulls. Compared with free-blowing glass by hand as employed at earlier works, the process of press moulding used at the New Don Glass Works would have produced very few waste threads, pulls and drips, and it is likely that any that occurred would have been re-melted in the tank. Therefore it is unsurprising so little evidence for the technical aspects of the manufacturing process was recovered from the excavation.

Only four types of product can be identified from the glass excavated on site: lidded jars, sauce bottles, screw-top bottles and so-called Codd bottles. The evidence for jar manufacture comes from two complete lids. These came from 'clip top' jars, very similar to the hinged Kilner jar that is still available today. One of these still has a prominent moulding 'spur' on its underside showing that it was discarded before being fully finished. As with the jars, the evidence for sauce bottles comes from the stoppers rather than the main body of the vessel. The final two bottles are of the type patented by Hiram Codd in 1873, which use a marble to seal the neck. Codd manufactured many of his bottles at the Hope Glass Works in Barnsley, South Yorkshire, but other manufacturers quickly copied his design, especially after his patent expired shortly before his death in 1887. Interestingly, 111 marbles that were



pre-manufactured for insertion into Codd-style bottles were also found. These are formed in a two-piece mould and then roughly finished off with coarse abrading. This is an interesting and unusual find, and one that demonstrates that the Codd bottle was definitely made on the site rather than being brought in from elsewhere.

As is to be expected on any site of this date, a small amount of glass not manufactured there was recovered. Whether this was used by those employed at the glassworks, or is the result of later rubbish disposal, cannot be ascertained.

## **Conclusions**

### ***The local context***

The 19th-century industrial revolution had a dramatic impact on the development of Mexborough. Although the village was already noted for its potteries the population in the 1830s, prior to the establishment of the Don Iron Works and the three glassworks, was thought to number around 1,270 (White 1833). In 1901, White recorded Mexborough's population as over 10,000.

### ***Location***

The siting of the New Don Glass Works on the canal was critical for a number of reasons. Firstly, the new factory had access to the existing water transportation system. This was not only crucial for importing the large quantities of coal required to produce gas for the furnaces and the subsequent smelting of glass, but also for easy access for exportation of a highly fragile end product. Secondly, the site was within an already concentrated industrial area with the Don Iron Works but, more importantly, the Don and Phoenix Glass Works located just to the east. It would seem that the glassmaking fraternity within the Mexborough region were quite closely associated; owners, apprentices, partners, and those with familial links moved to, from, and between, premises and associations to an often confusing degree (Ashurst 1992). It seems that the factory owners, managers, and accompanying workforces

probably knew each other very well. Whether this made for close working associations or intense rivalries is another matter entirely.

### ***Site development before the glassworks***

The earliest excavated buildings on the site, dating between 1839 and 1891, are Buildings A and B. It is not possible, with the available evidence, to determine the function of Building B but it appears to have been built on land belonging to the Don Iron Works. The interior fabric of Building A displayed severe heat discolouration. Whether this building corresponds with the engine house or smithy mentioned in the sale conveyance and hire agreement of 1891 is unknown. The evidence for a bench in the southern room is suggestive of a smithy but the level and extent of heat would seem excessive for a small-scale smithing operation. Of the original building, as depicted on the 1892 OS map, it would appear that the footprint of the small northern square and the dividing wall between this and the longer, thin rectangular building to the south was recorded in the excavation area. From the depth of the foundations it is clear that the building had a fairly substantial load-bearing capacity. It has not been possible to determine with any confidence, when the considerable heat discolouration occurred in the life of the building. Whilst it is certain that some discolouration was caused by the later insertion of flues and furnaces, all of the early structural elements had been heat affected to some degree and it is possible that some of this occurred during the Phase 1, pre-glassworks, use of the building.

### ***Development of the New Don Glass Works***

It seems likely that the New Don Glass Works was built soon after the land was purchased in 1891 and the factory was probably constructed as shown on the 1903 OS map. The works was divided into three separate buildings, one large square building in the south (Building C), a smaller square building to its east (Building E) and a large T-shaped building to the north (Building D). It was clear from the excavations that the inclusion of the Siemens style hot-air furnace was an original feature of Building C. An existing structure (Building A)

was incorporated into the new factory and may have provided space to introduce glass into the furnace or for accessing the glass at its furnace end. Waddington would have known about the Siemens regenerative furnace from his close association with the Barron family at the Don Glass Works and their close familial ties to the Phoenix Works where two of the furnaces had already been installed.

The Siemens brothers originally developed their regenerative furnace design in 1856 for the smelting of metal but it was first used for smelting glass (Jones 2006). Initial experiments in the design were first adapted in 1860 for an un-named Rotherham glass manufacturer and Chances of Birmingham (Krupa and Heawood 2002). It is unclear which of the Rotherham works this related to and unfortunately William Siemens himself makes no mention of the Rotherham glassmaker in his treatise to the Institute of Mechanical Engineers in 1862. The earliest furnace of this type in West Yorkshire is understood to be at the Kilner Works in Castleford as early as 1873 (Ashurst 1992) and it is noted in Thomas Barron's obituary (Ashby n.d.) that Barron had installed two Siemens regenerative furnaces at his Phoenix Glass Works by 1885. The adoption of the furnace type spread rapidly through South Yorkshire (Ashurst 1992)

The introduction of this technology transformed the glass production by improving the removal of heating contaminants from the glass. The expulsion of dust and cinders coupled with the sustainable higher heat, results in a more consistent colour and quality of glass (Siemens 1862). Other advantages to using regenerative furnaces were; the smaller floor space required by the furnace; much greater heat; quicker melt time; the ability to use a larger proportion of cheaper sand (silicate) in the mix; the ability to melt the glass overnight in preparation for manual labouring during the day, and substantial increases in the levels of production.

Typically the design for the furnace involved four underground brick chambers which were filled with a lattice of refractory bricks to maintain and hold heat. Superheated gas was

normally introduced to the chambers through a flue system below the tanks, from a switch room located in a cellar to one side of the chambers. Once the chambers had reached the specified temperature then air was directed into the heated chambers to act as the furnace gas until the fall in temperature meant that hot gas was re-introduced to raise the temperature again. The superheated gas was then channelled up through the chambers over glass-smelting crucibles, which were sealed by a refractory-brick roof, before being channelled back down into the chambers for reuse and reheating. From the structure above, glass can be worked from the sides via working holes in the furnace dome, or moved down the furnace structure either to take advantage of the differing properties at each part of the furnace or to anneal the glass beyond the hottest part of the structure.

The excavations revealed at least two underground chambers, 7007 and 7012. Interestingly these chambers did not contain a lattice of bricks. These were often replaced due to damage caused by continual heating and therefore may have been removed, however, where these structures have been excavated, the lattice bricks are normally fused to the internal walls of the chambers (e.g. Davies *et al.* 2011). It is clear from Siemens (1862) that many experiments were taking place with this type of furnace and Ashurst (1992) notes that these results were not always successful, often leading to explosive results. The lack of evidence for catastrophic destruction at this site indicates that the furnace at the New Don Works was a success.

The hot-air input into the chambers at the New Don Glass Works also deviated from the norm. Excavation of the chambers did not locate the hot-air flues leading to the underside of the chambers and recesses in the doorways leading into the chambers from the cellar suggest that air was pumped to and from the chambers from the sides.

Removal of contaminants from the furnace by the hot-air system would have required the production of gas from heating coal. The photograph of the works (Pl. 5) quite clearly shows a large quantity of coal on the roof of a small square building (part of Building E) in the

foreground. The photograph also shows a rotating crane and bucket to offload coal from the canal-side barges and, interestingly, what appears to be a cylindrical tank at the south-eastern corner. This may have been the location of a gas producer for the works. Gas producers typically involved feeding coal gravitationally to the heat source. The heated gas was then fed to a cylindrical tank prior to pumping through flues to the furnace proper (Siemens 1862, fig. 1).

It is possible that Phase 2 flue 7171 vented waste gases from this gas producer towards the large square chimney, and the clean gas may well have been pumped from the producer, along the canal side, to the switch room and reheating furnace which was probably located on the southern side of the regenerative furnace flues in Building C. From the switch room the reheated, and contaminant-free, gas was pumped through chambers below the glass kiln. It is also possible that gas could also have been directed to Building C through flue 7021.

The furnace was probably located in the north-eastern corner of Building C. It was from the cellar chambers here that the exhaust gases were vented to the large chimney located between Buildings C and D. The main, heating part of the furnace would have fitted within this corner of Building C and it is entirely possible that the upper part of the furnace extended further to the west than the chambered area, providing a cooler area for glass to be annealed. It is also possible that other furnaces were located within the Building C, outside of the excavated area.

Interpretation of Building D has been more difficult. It seems clear that the eastern side of the building included rows of iron columns to support the lower mono-pitched roof shown on the historic photograph. Wide doorways are likely to have provided access to the yard to the east and the thick build-up of waste furnace material and glass in the yard was probably dumped from this building. The photograph indicates that the western side of the building was higher with a hipped, pitched roof and louvered, central vent, supported by pier and

panel walls. It was within this side of Building D that the evidence for glass production was uncovered. One, possibly two, paired rectangular chambers were identified to the west of a probable tank furnace and small gas producer. The chamber pairing is much smaller and shallower than would be expected of a Siemens-type regenerator and the flooring was devoid of bricks. However, the internal faces of the chambers did contain heavily vitrified refractory bricks and had obviously been subjected to immense heat. The top of the chambers contained truncated arches which are not dissimilar to that of a regenerative furnace, and the structure appears to be contained within outer walls which hints at an upper furnace area in which glass could be smelted.

### ***Products and decline of the works***

Very little evidence of the finished products from the New Don Glass Works was recovered. This is unsurprising as any waste glass can be remelted and reused in glass manufacture.

Two Kilner-style clipped lid jars, sauce bottles, screw top bottles were identified. Only two Codd bottles were recovered and these were typical of the type of bottle in production at that time. Codd's patent ran out in 1885 and Codd bottles were being produced at the Hope Glass Works (Barnsley) whilst some works, such as Tomlinson's (Stairfoot) were specialising solely in the production of the marbles alone (Ashurst 1992). The glass marbles were used to stopper the crimped Codd-bottle neck and would seal the bottle against a rubber ring under pressure from the aerated water in the bottle. The recovery of glass marbles and un-stopped bottles from the site confirms that both were produced at the glassworks.

The decline of the popularity of the Codd bottle may well have led to the closure of the New Don Glass Works if it had specialised solely in the production of that type of bottle. The bottles suddenly went out of fashion in the 1920s in favour of screw caps and the resulting collapse of the market proved disastrous for the Hope Glass Works (Ashurst 1992). The New Don Glass Works does not appear to have suffered severely during the early 20th-

century decline of the South Yorkshire glass industry. Both the excavated evidence and the 1930 OS map indicate that the works underwent significant changes in the first three decades of the 20th century; a new, large, rectangular building was constructed in the north of the works, and a range of new buildings and a chimney were built on land formerly occupied by the Don Iron Works.

Historic trade directories indicate that the nearby Don Glass Works closed in 1920 and historic maps indicate that that its buildings were demolished by the end of that decade. Although the adjacent Phoenix Glass Works continued under the ownership of the Barron family until 1989, the majority of the buildings had been cleared from the site by the 1930s.

It is unclear precisely when the New Don Glass Works finally closed. Perhaps the end of Waddington's interest in the Don Glass Works facilitated the late expansion of the works between 1903 and 1930; but by the late 1950s Buildings D and F and the early 20th-century additions had been demolished and the site was no longer labelled as a glassworks on the 1958 OS map. The site was subsequently used as a scrap yard and, since the early 1970s, has been occupied by a plant and machinery dealers.



## Appendix

### Ceramic artefacts, Chris Cumberpatch

The pottery assemblage from the site of the New Don Glass Works consisted of two principal components: 1,112 sherds (14,854g) of pottery which included biscuit-fired wasters of late 18th- and 19th-century type with a small quantity of utilitarian ware, and 110 fragments (588g) of production waste which included rod fragments, tripod stilts and spurs. The evidence of the wasters and kiln furniture strongly suggested that the majority of the tableware sherds arrived on the site as a result of the dumping of waste from a pottery factory. Although such waste is known to have been moved over considerable distances when required as hard-core or levelling material, the most obvious source in this case is the Mexborough Old Pottery which was located adjacent to the site from c.1808–1844 (Griffin 2012, 127–30). It should be noted that other potteries existed in Mexborough in the first half of the 19th century including the Mexborough Rock pottery and Emery's Pottery, and several others, including the Don Pottery, in the wider locality. A less well-known pottery of late 18th-century date was located on Dolcliff Common (Griffin 2012, 126–38) but whether this was a 'country pottery' or a factory producing refined earthenwares is unknown.

Three categories of utilitarian ware were identified; Brown Glazed Coarseware, Yellow Glazed Coarseware and Brown Salt Glazed Stoneware. None of these wares was present in any significant quantity and there was no indication that any of them were manufactured on or close to the site. The proportion of tableware to utilitarian ware was high and the overall character of the assemblage (even without the evidence of the biscuit-fired wares and other production waste) suggested that it was not a typical late 18th- or 19th-century assemblage.

A substantial proportion of the pottery consisted of biscuit-fired refined earthenwares of which a small proportion bore transfer-printed designs and were therefore identified as Pearlware and/or Whiteware. The two commonest surviving designs were Wild Rose (Griffin 2001, 206, pl. 276; Griffin 2012, 125, pl. 273) and the ubiquitous Willow. More distinctive

were those sherds that carried the Barker's Gem design (Griffin 2001, 205, pl. 271; Griffin 2012, 124, pl. 267), a pattern used principally in the Don Pottery during the Barker period (1839–1893) but also found on the site of the Denaby Pottery (Cumberpatch 2004; Griffin 2012, pl. 330). Although Creamwares were represented amongst the finished sherds, it was impossible to distinguish such sherds amongst the biscuit-fired fragments given the inherent similarity of the refined earthenware bodies. A small number of biscuit-fired sherds in a pale buff body attested to the manufacture of Cane Coloured ware, both plain and slip banded. Only one marked sherd was identified (Pl. 6). This was part of a plate with a double footring base and the Wild Rose pattern internally. The underside bore the distinctive 'eagle rising from a coronet within a shield' design over the initials 'S.B & S.'. Griffin has illustrated examples of this mark in connection with the Don Pottery (Griffin 2001, 203) and has noted that while Jewitt links the mark with Samuel Barker taking his son Henry into partnership c.1851, there is no firm evidence for the earliest or the latest use of the mark (*ibid.*, 185). He does, however, note that the initials S.B & S. were certainly in use in the 1860s (*ibid.*, 203). If the waste material derived from the Mexborough Old Pottery (which was run by Samuel Barker from c.1828 until its closure in c.1844), then this would suggest that the mark was in use some considerable time before Henry Barker's partnership with his father, given that the Mexborough Old Pottery closed in 1844. This would imply that, assuming the waste was derived from the Mexborough Old Pottery, it dates (at least in part) to the period of Samuel Barker's ownership between 1828 and 1844 although this would seem to be difficult, if not impossible, to reconcile with the start of Henry's partnership in 1851. This sherd must therefore cast some doubt upon the interpretation of the waste as deriving from the Mexborough Old Pottery and might suggest that it came directly from the Don Pottery (Lawrence 1974, fig. 8; Griffin 2001, 27, pl. 2) and was perhaps brought to the site in connection with building work or for some other purpose that required hardcore.

The presence of Edged ware of late 18th- to early 19th-century type and the split between Pearlwares and Whitewares points to a date in the late 1830s or 1840s. This is consistent

with the material being waste from the Mexborough Old Pottery and a date prior to 1844, but it cannot be said to be inconsistent with the post-1851 date which is implied by the evidence of the marked sherd, particularly if the waste material was derived from a dump which had accumulated over a period of time.

The glazed transfer-printed Pearlware included examples decorated with a similar range of designs to those seen on the biscuit-fired sherds. The range of identifiable vessel forms was limited but included a server or carver alongside flatwares (mainly plates) and hollow wares. The plain Pearlwares included a similar range of vessel types. A small number of sherds, the majority from cups or bowls, bore hand-painted stylised floral designs.

The finished Edged wares included sherds with moulded rims similar to the biscuit-fired examples but also included some later examples with plain edges decorated only with blue paint.

The finished transfer-printed Whitewares were more diverse in character than the biscuit-fired wares with a wider range of both designs and vessel forms. Transfer-printed designs included Willow, Asiatic Pheasants, Barker's Gem (in blue, green, sepia and black), Albion and Wild Rose, in addition to unidentified oriental and European landscapes, floral and geometric borders. Patterns in the 'Flow Blue' style were not uncommon. Vessel forms included the normal range of flat and hollow wares together with servers/carvers, tureens, drainer/dish warmers and pie dishes. None of the vessels were chronologically diagnostic although a number had direct parallels amongst the biscuit-fired wares and the Flow Blue technique only became common after c.1840. Whether it was amongst the products of the Mexborough Old Pottery as it was at the Don Pottery (Griffin 2001, 212, pl. 299) is unclear, although the closure of the Old Pottery in the 1840s places it close to the date of the start of Flow Blue manufacture.

In addition to the transfer-printed wares a variety of other types were present in either a finished form, as biscuit-fired wares or both. Slip Banded ware (plain and cane coloured),

Blue Banded ware, Cane Coloured ware and Mocha ware were all present in both finished and unfinished forms while Sponged ware and Sponge Printed ware were present in the finished form only. The same was true of Colour Glazed wares and Relief Banded ware although given the small size of the assemblage it would be unwise to draw any far-reaching conclusions from this observation. Colour Glazed and Relief Banded wares had a long life and are found throughout the late 18th and 19th centuries. Sponging was adopted as a decorative technique in about 1830 while cut sponges for printing were introduced c.1840 and so could have been produced in either the Mexborough Old Pottery or the Don Pottery.

Bone China, for which there is no evidence of manufacture at either the Don Pottery or the Mexborough Old Pottery, was represented by a very small number of sherds and in one case at least seemed to be of a much later date than the bulk of the assemblage.

The kiln furniture consisted of fragments of red and white fired clay rods, tripod stilts and spurs (as defined by Barker 1998) with two small, solid ceramic cylinders of unknown function. The spurs and tripod stilts were represented by both hand-made and machine-made examples with one of the machine-made tripod stilts bearing a moulded maker's mark (B & Co.) and two the numeral '8'; the latter probably an indication of the size of the stilt. Two different types of feet were represented; sliced feet and double-cone feet. The sliced feet have a simple angled-cut end while the double-cone-type terminate in pointed feet which minimise the area in contact with the objects being fired. A similar distinction was identified amongst the material from the Top Pottery in Rawmarsh (Cumberpatch unpublished). The identity of the company represented by the moulded mark 'B & Co.' has not been confirmed but examples are known from Staffordshire (Barker 2008, 14, fig. 5) suggesting that wherever they were located, B & Co supplied pottery manufacturers nationally. The hand-made stilts and spurs may have been made locally from the same refined clay as was used for the vessels.

In spite of its small size the pottery assemblage is of considerable interest in that it includes waste material derived from one of South Yorkshire's less well-known but economically significant industries which is the subject of ongoing research and publication. The assumption that the waste originated from the Mexborough Old Pottery is not unreasonable given the proximity of the sites in question but does not seem to be supported by the (admittedly limited) evidence that the Don Pottery was the source. This conclusion rests on the evidence of a single transfer-printed, biscuit-fired sherd bearing a maker's mark which apparently post-dates the closure of the Mexborough Old Pottery. The quantities of Creamware and Pearlware suggest that the assemblage included late 18th- and early to mid-19th-century material as well as that dating to the mid-19th century. This evidence, like that from the Denaby Pottery (Cumberpatch 2004) would seem to indicate that complex and counter-intuitive site formation processes were operating on sites of all types in South Yorkshire during the 19th century (Cumberpatch 2005) and must be considered as a significant factor when such sites are under investigation as well as at the post-excavation stage.

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The report was researched and written by Neil Dransfield and edited by Andrea Burgess, with glass analysis by Dr Hugh Willmott and pottery analysis by Dr Chris Cumberpatch. The illustrations were drawn by Elizabeth James. The photograph of the pottery sherd is by Dr Chris Cumberpatch.

The archive is currently stored at Wessex Archaeology's Sheffield office under the project codes 78450–2 and will be transferred to Doncaster Museum Service for long-term storage.

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#### **Documents held at Doncaster Archives (DA)**

1839 Mexborough tithe map and apportionment (DX/BAX/MAP 24; P43/9/1)

1891 Conveyance of land and business premises to Peter Isaac Waddington (DX/HATT/1/42)

1891 Draft agreement of employment between Frank Bennet and Peter Isaac Waddington (DX/HATT/1/43)

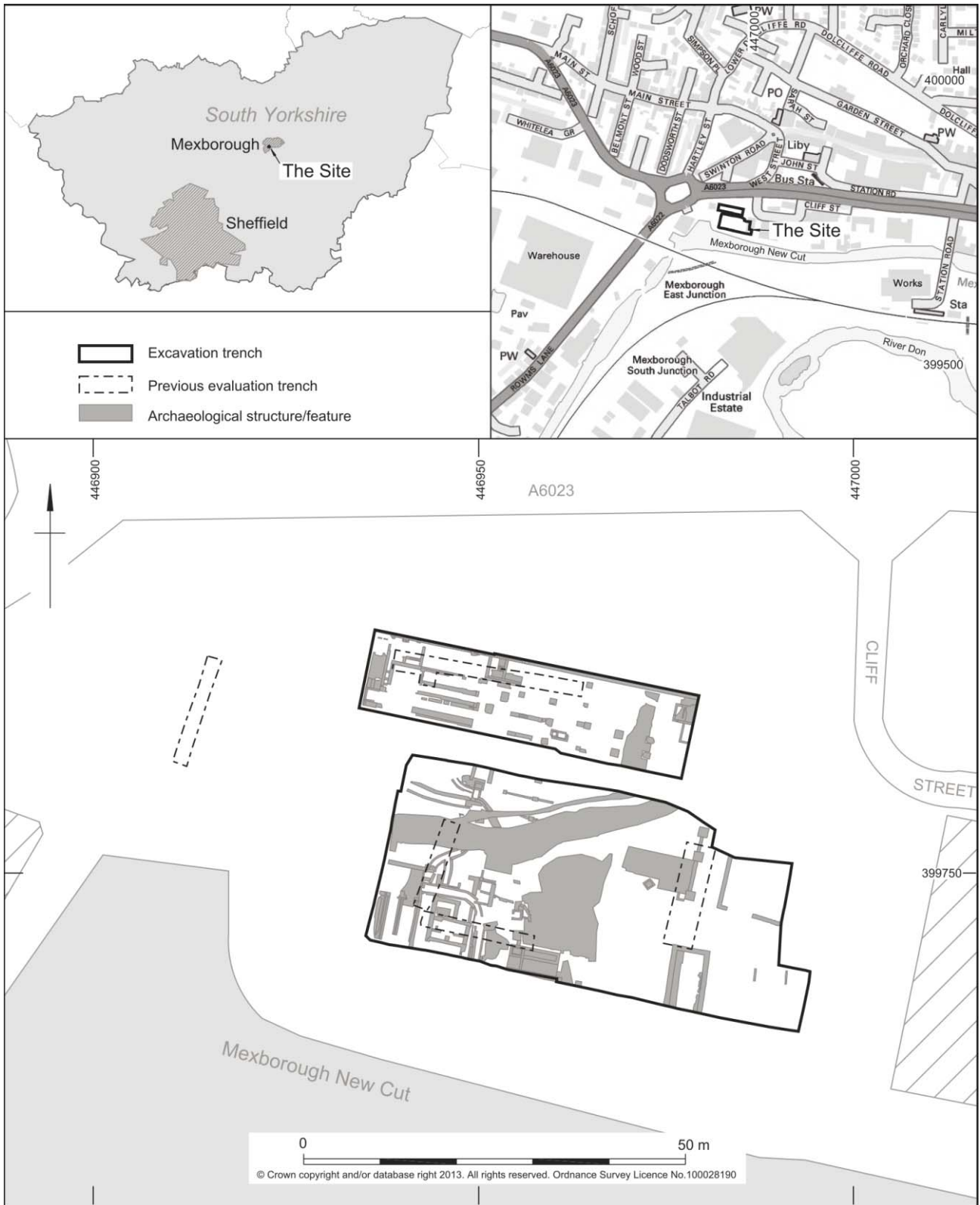
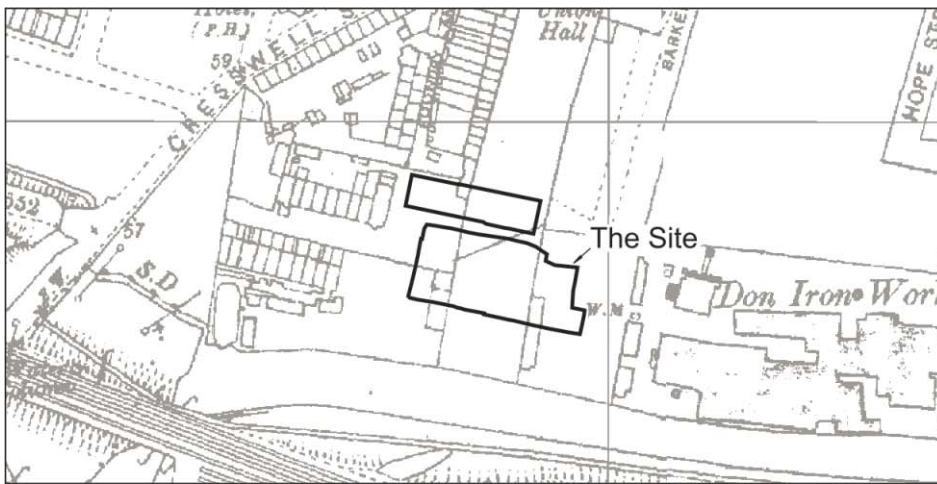
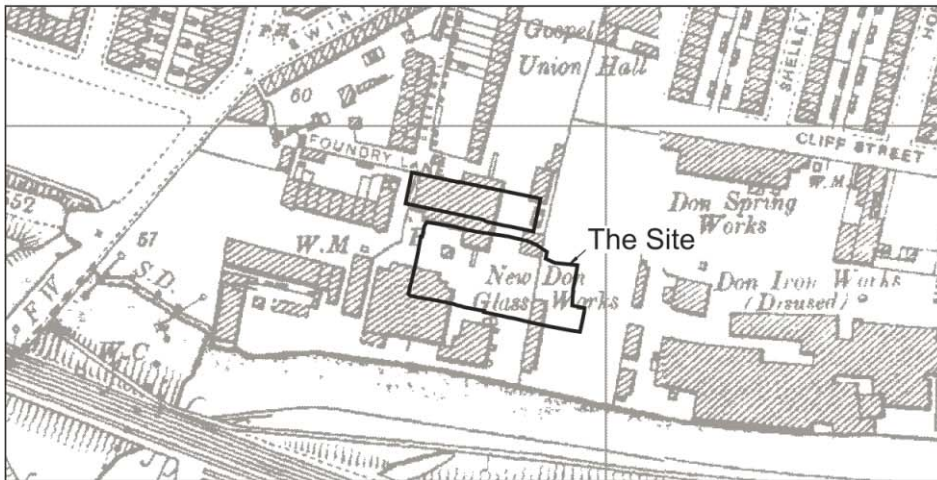


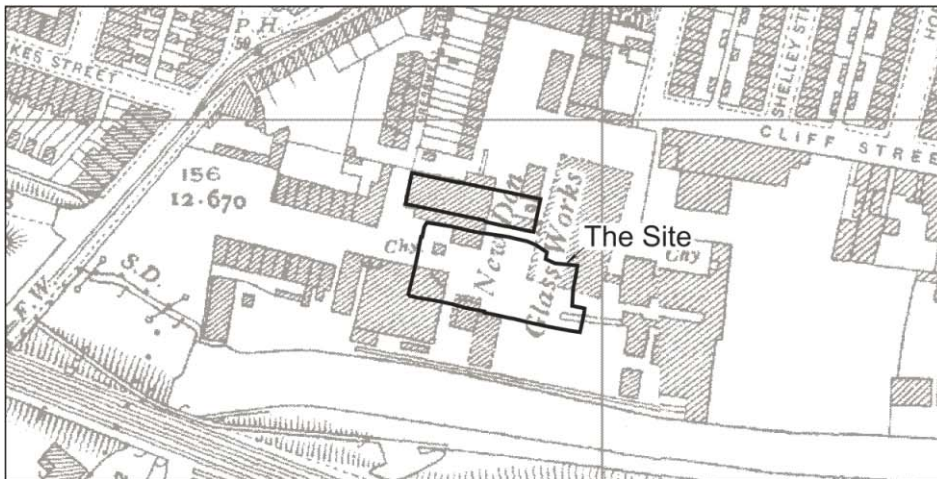
Figure 1: Site and trench locations



1892



1903



1930

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Figure 2: Ordnance surveys maps published in 1892, 1903 and 1930 © Crown Copyright and Landmark Information Group Ltd (all rights reserved 2013).

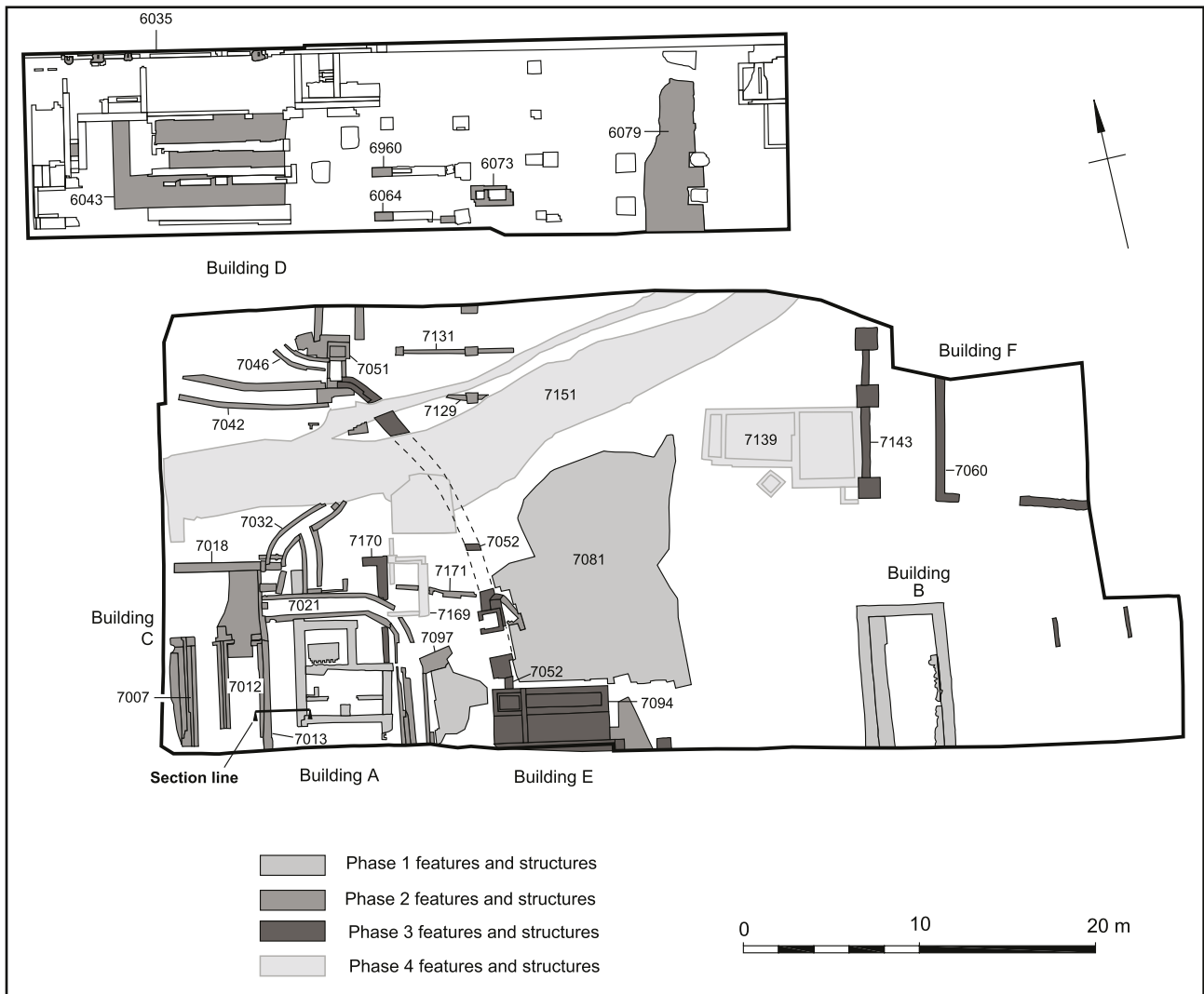


Figure 3: Phased site plan

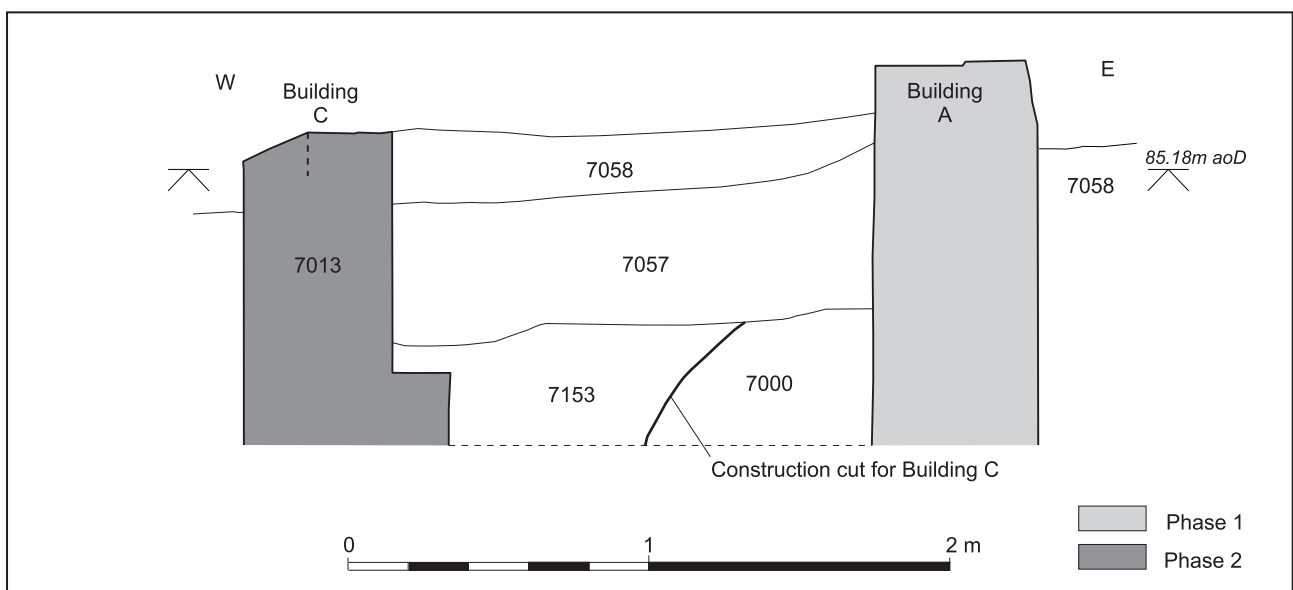


Figure 4: Section through Buildings A and C showing levelling deposit 7057



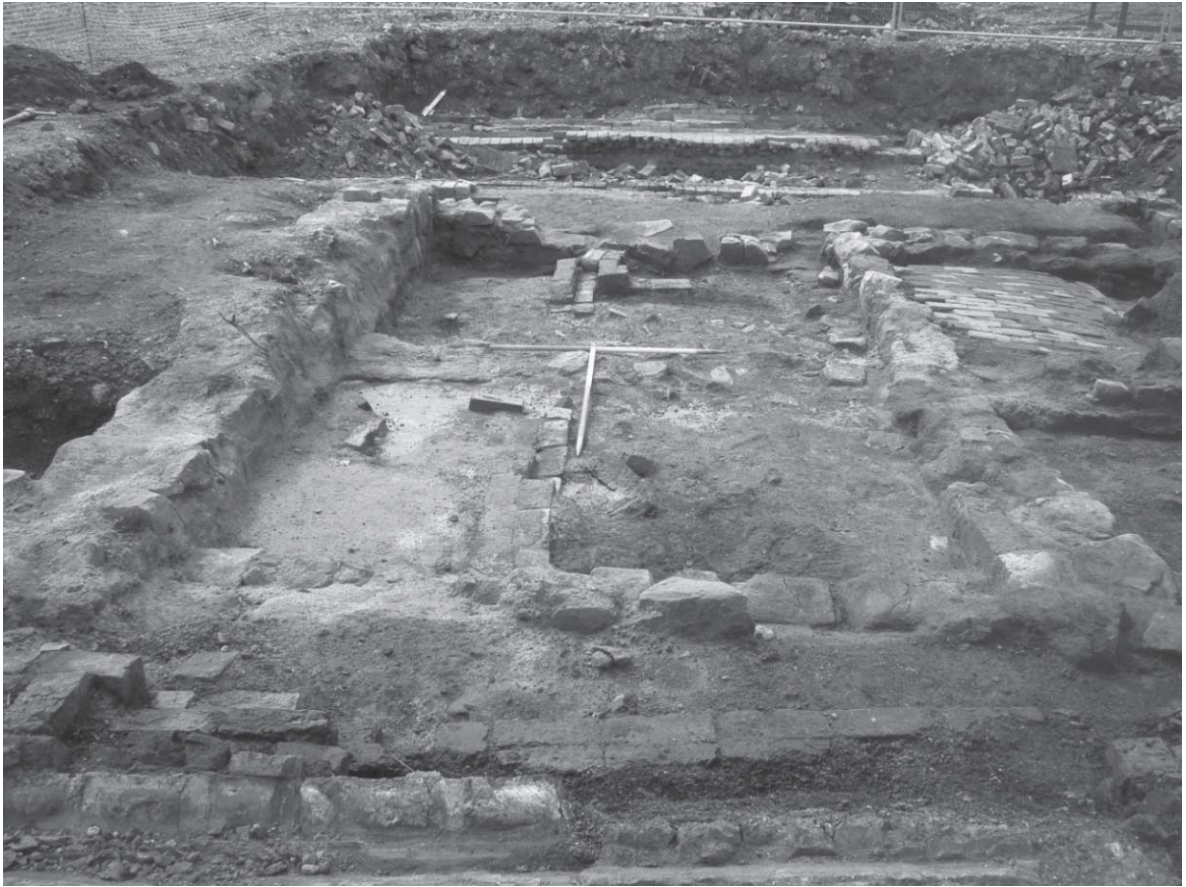


Plate 1: Building A



Plate 2: Building C, flues 7021 and 7032 beneath the furnace structure





Plate 3: Building C, flue 7171 truncated by later chimney and flue from Building E



Plate 4: Building D, chimney 7051 and associated flues

# Not available due to copyright

Plate 5: Postcard showing the New Don Glass Works from the river.  
Reproduced by kind permission of Andrew McGarrigle



0 50 mm

Plate 6: Pot sherd. Biscuit-fired and transfer printed but not glazed.  
The underside is marked with a shield design over the initials 'S.B & S.'.





Wessex Archaeology Ltd registered office Portway House, Old Sarum Park, Salisbury, Wiltshire SP4 6EB  
Tel: 01722 326867 Fax: 01722 337562 info@wessexarch.co.uk www.wessexarch.co.uk



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