Sheaf Square

Sheffield

South Yorkshire

Volume 1

Archaeological Excavation

Contents

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Summary

Two phases of excavation at Sheaf Square, Sheffield identified the partial remains of the New Tilt forge that was founded in 1793-4, including part of the wheel pit, dam and main building. The internal silts of the dam revealed a series of stake holes that may represent a platform. The building was extended to the south-east in the early 19th century, although the remains of this were generally elusive apart from an internal conduit structure that may represent a drain. This corresponded with changes in function for the building identified from documentary sources, and artefactual evidence of bone cutting and button making was recovered. These earlier structures were cut by later 19th century retaining walls and a large culvert that relate to the inception of the Midland Railway. A considerable depth of made ground was used to backfill the site over several stages and raise the ground level. This made ground was significant in its own right containing both industrial and domestic waste imported onto the site.

1. Introduction

1.1 Archaeological Services WYAS was commissioned by Interserve Project Services Ltd on behalf of Sheffield City Council to undertake a series of archaeological excavations at Sheaf Square, Sheffield (Fig. 1). This was in advance of the extensive redevelopment of Sheaf Square and Howard Street as part of the Sheffield Station Masterplan project, which includes the construction of a large water feature, the 'Cutting Edge'. The excavation targeted the Pond Tilt forge that has been suggested to survive in that area (Richardson *et al.* 2004). A project design for the excavation was produced by Archaeological Services WYAS after consultation with South Yorkshire Archaeology Service (Appendix VI).

1.2 The site is located in central Sheffield on the south-east side of the city centre (centred NGR SK 35785 86935, Fig. 1), and consists of a small triangular area of car parking located directly in front of the Midland Station (Fig. 2). The site was bounded by a pedestrian footpath and subway adjacent to Sheaf Street in the north-west, and a pedestrian footpath along the side of Sheaf House in the south. The Midland Station access road forms the edge of the site to the east, beyond which the station buildings are located. These structures have since been removed as part of the ongoing works. At the time of excavation the site topography was of a slight slope down to the east and the ground cover consisted of tarmac. The ground surface adjacent to the trench sloped downwards from *c.*56.34m OD in the south-west to *c.*55.30m OD in the north-east.

1.3 The archaeological excavation consisted of two stages of work. An initial trial trench was excavated in the north-east corner of the car park between the 25th May and the 7th June 2004. This trench was extended to the south and west during a second phase of excavation that took place between the 18th August and the 8th October 2004. Due to the continuity of archaeological features, the two stages of archaeological excavation are presented here in one comprehensive report. The work was monitored by Dinah Saich of the South Yorkshire Archaeology Service.

1.4 The underlying geology of the site is of Lower Coal Measures associated with a narrow band of alluvium (British Geological Survey 1974).

2. Historical Background

2.1 Sheffield, the name meaning 'field on the River Sheaf' (Smith 1965) is cited in Domesday Book with reference to the Halamshire Manors (Skaife 1896). Indeed, the name 'Sheaf' itself may derive from old term 'boundary' in reference to the river's suggested division of Mercia and Northumbria, and the later division between Yorkshire and Derbyshire (Smith 1961). The medieval settlement of Sheffield was small, and was situated south-west of the Saxon/medieval castle that was located at the convergence of the rivers Sheaf and Don to the north of the excavation site (Pybus 1994). Pond Mill, one of the original water powered town mills to the north of the site, was associated with the castle and dates to the 16th century, although earlier medieval origins are possible (Miller 1949). Other medieval activity within the vicinity also includes the Old Queens Head public house that has been dated to 1510, and

may have functioned as a hunting lodge for Sheffield Park (Jones 2004, Webster 1992). No medieval evidence is known for the immediate vicinity of the current site, and the area is likely to have consisted of fields as depicted on Harrison's redrawn surveys of 1637 (Scurfield 1986, not reproduced). Harrison's survey of the manor of Sheffield, dated to the same year, indicates that the area of the site was let to tenants by this time and was adjacent to an area known as Morton Banke (Jones 2004, 38).

2.2 It was not until the 17th century that the rapid development of Sheffield commenced as the industrial potential of local recourses was realised. A survey commissioned by the Earl of Shrewsbury indicates that the population of Sheffield was 2207 in 1615 (Pybus 1994). This rose to 10,000 in 1736, expanding to 42,000 in 1821, and then doubling to 83,000 at the time of the 1851 census (Crossley 1997). This huge population explosion led to the expansion of the city into the surrounding five valleys, and it appears that the area to the south-east of the parish church and castle was one of the first parts of the medieval Sheffield deer park to be developed.

2.3 The situation of the town with five rivers providing waterpower, the natural recourses of iron ore and an abundant supply of timber made Sheffield an ideal location for industrial growth. By 1637 water-wheel power was being manipulated to rotate the grindstones in at least nine corn mills and 29 cutlers' works, as well as to raise the hammers in the two forges making wrought-iron (Scurfield 1986). Early metal articles were made from 'shear steel' produced from local coal measure ironstone which was converted into 'blister steel' in cementation furnaces, although from the 16th century onwards this was supplemented by imported higher quality steel from Europe (Jones 2004). By 1794 there were over 111 wheels as sources of power for cotton, paper, glass, snuff, lead mills, rolling mills and forges (Scurfield 1986). Sheffield became famous for cutlery manufacture by the late 17th century, although this renown dates back to the 14th century or before (Jones 2004). In 1624 The Cultlers' Company of Hallamshire incorporated by an act of Parliament as a guild of craftsmen and independent 'Little Mesters' was formed. It governed the quality of goods, trademarks, trading and production and apprentice training (Howse 2001, Symonds 2002). Before the 1850s, light steel trades such as scissor and knife making were generally located around the town centre (Jones 2004).

2.4 The early industrial expansion around the town included the site of the Pond Tilt and associated Tilt Dam that was constructed in 1732-3. Recent research by Crossley (1989, 111-112) details the history of the Pond Tilt site from documentary evidence. George Marriott and partners constructed the Tilt soon after they built the nearby Marriott Wheel. The Pond Tilt is first depicted in Gosling's map of 1736, and later by Fairbank's surveys of 1771 and 1778 (not reproduced, ref. SheS 1S,). The construction of the Tilt Dam may have utilised the site of an earlier pond noted on Harrison's redrawn survey of 1637. The new tear shaped dam took water from the Porter Brook, west of its inflow into the River Sheaf, with the tilt forge located on the dam head to the north. By 1754 the partnership of Gilbert Roberts, Jonathan Moore and John Sykes took lease of the Tilt, but in 1788 a half share of the lease was offered, and the 1789 rate books show Moore and Ward as partners (Crossley 1989, 112).

2.5 As the name suggests, the Pond Tilt site was likely to have contained tilt-hammers that were used to forge steel. Surviving records indicate that tilt-forges were becoming common on Sheffield rivers after 1750, although the precise chronology of their development from more primitive techniques remains unclear (Crossley 1990, 180). Tilt-hammers were specifically used for blade forging and the manufacturing of larger steel tools. They utilised waterpower in turning large axles, often made from whole tree trunks, which had a series of squared pegs located around their circumference. When turned, the pegs jolted a pivoted wooden beam arm that had a steel hammer on the end. As the pegs raised the beam arm, it was repeatedly brought down onto an anvil usually mounted on a massive timber block. The weight of the beam arm was such that the hammer was brought down by gravity with considerable force onto the anvil. The forger held the heated steel item under the hammer, and altered its position during the split second the hammer was raised to forge its shape. Older mechanisms tended to be heavier and slower, but new innovations in gearing and the use of metal parts over timber greatly increased the efficiency of the process (Crossley 1990). At Abbeydale, two fast acting and light tilt-hammers were driven from one geared axle and were used for making scythes (Wray *et al.* 2001).

2.6 The heavier blow and more uniform strike of the mechanised tilt hammer made the process more efficient, and hammers varied from approximately 1,100 to 3,500 pounds, though for finer work hammers of 660 pounds were used at the rate of 60-120 strokes per minute. Lighter finishing hammers of 150-180 pounds were used at a rate of about 200 strokes per minute (Syson 1980, 35). The internal working space of these forges was carefully orchestrated often with the forge and wheel positioned at the periphery of the building, as seen at Wortley Top Forge and Abbeydale, allowing adequate internal space for the movement of people and materials (Wray *et al.* 2001). There is no mention as to the number of tilt-hammers in operation at the Pond Tilt from the documentary sources investigated by Crossley, although from the size of the building it is likely to be few, perhaps one or two. Similar cam and beam mechanisms were used in paper mills for pulping and wool mills for matting during the fulling process (Syson 1980).

2.7 Waterwheels were the most common mechanism for powering industrial works, until the use of steam powered engines started in the late 18th century becoming the norm in the late 19th century (Jones 2004). Small streams could not often provide the necessary power to ensure that the hammers were ‘held up’, and so ponds or dams were constructed to store water (Syson 1980). Waterpower was reliant on a fall in height that was generated by a weir and dam, from which water was directed to run past a water wheel within a wheel pit. Water was encouraged to fill the works dam during non-working hours, generally at night, and used to power the water wheel in greater volume when it was needed (Sloan 1995). The size of the dam and the volume of water it could hold had implications as to the size, power and duration of use of the wheel. The fall of water from the dam also had implications on the power and type of wheel used. If the fall was over approximately 10 feet, an over shot wheel was typically used (Crossley 1989) and was the most common type of wheel (Crossley 1990, Syson 1980). If the fall was less than 10 feet a breast wheel was typically used (Crossley 1989) where the water was fed to the

wheel at its mid point. Breast wheels were also divided into 'high' breast wheels and 'low' breast wheels where the water strikes the wheel at slightly higher or lower points from the axles height. In some cases, an undershot wheel was utilised where the fall was only slight, although a greater volume of water was required and the mechanism was less efficient. Overshot and breast wheels were more efficient and required less water to power (Syson 1980) and the latter were common on Sheffield rivers due the frequency of mills and the often limited fall of water (Crossley 1989). A timber box known as the pentrough channelled water from the dam tail end into the wheel pit. Set into the back of the dam wall the internal flow regulator or penstock was often controlled by a rack-and-pinion mechanism that allowed raising and lowering to be accomplished via levers from inside the building (Crossley 1989).

2.8 Wheel pits were generally constructed from stone blocks, although timber was sometimes used for the base and sides. The wheels themselves were usually constructed from timber, although metal parts became increasingly common, and were secured by bearings and mounted in the wheel pit on blocks of wood or stone. Precision was required in the instillation of water wheels if they were to run efficiently, and the correct entrance of the water onto the wheel, the release of the water from the wheel buckets and its outflow via the tail goit was important (Crossley 1990, 137-52). Breast wheels were considered reasonably efficient and were not as expensive to maintain or vulnerable during floods as overshot wheels (Syson 1980). Breast wheels were generally claimed to be around 55% efficient, and this was increased by constructing the upstream part of the wheel pit to fit the wheel closely thus reducing water spillage from the buckets (Syson 1980, 67). Recent experiments have shown that the efficiency of a modern breast wheel can be increased from 76% to 87% when the inflow and tailrace channel was altered (Muller 2005).

2.9 The late 18th century saw the start of a process of considerable change to this lower stretch of the Sheaf Valley. Along with the construction of the Pond Tilt and dam in the 1730s, the River Sheaf was straightened in 1780 with the construction of the Bamforth Dam from the course of an old river meander. A 1778 plan by Fairbank (ref. SheS 895S) details the new dam with a straight goit to the north towards the Forge Dam, and a feeder goit from the straightened Porter in the south. The Bamforth Dam was not linked to the Tilt Dam, and served as supply to the forges to the north.

2.10 In 1793-4 a second forge had been built adjacent to the original Pond Tilt on a 63-year lease to Moore and Ward, although Moore's share was advertised in 1799 (Crossley 1989, 112). The New Tilt was built at the peak of water-powered industrial sites in Sheffield that numbered 130 by the end of the 18th century (Jones 2004). A survey by Fairbank dated 1793 details the Tilt Dam, both the New Tilt and Old Tilt and the surrounding yards (Fig. 3), and they are clearly depicted in a slightly later larger scale Fairbank map of 1797 (Fig. 4). The 1793 survey shows a series of eight yards and associated buildings flanking the west side of the Tilt Dam and a detailed plan of the Tilts and surrounding area. The New Tilt was nearly twice the size of the Old Tilt and had a large wheel situated on the south-east side. The increase in size of the building is likely to represent an increase in production and perhaps a higher number of tilt-hammers, although there is no direct evidence to support this. The New Tilt was constructed into the Tilt Dam, and is stated by Fairbank in

his plan to have taken up 55 square yards (*c.*46 m^2) of the existing 5390 square yard dam, reducing it to 5335 square yards (*c.*4461 m^2). The compound for the tilts is stated as 1081 square yards (904m^2) exclusive of the 44 square yards of the tail goit. Interestingly, the yard to the north-west of the tilts and the area of garden to the east of the dam is depicted as being affiliated with Joseph Ward, Samuel Broomhead Ward and Jonathon Moor.

2.11 The tail goit to the north of the Old Tilt in Fairbank's plan (Fig. 4) is clearly angled to serve the outflow from this forge, and the plan does not indicate the direction of outflow from the New Tilt wheel. It is possible that the water entered the Bamforth Dam to the north-east via a culvert, or was channelled at right-angle north-west into the tail goit. The exit of water from wheel pits at right angles was not unknown, as seen at Low Mill in Yorkshire, and may indicate a lower volume of water used to power overshot or breast wheels (Crossley 1990, 145). Indeed, later records list the Pond Tilt with one breast wheel, but a later Fairbank map of 1808 (Fig. 5) shows a small tail goit flowing straight into the Bamforth Dam from the New Tilt. The efficient outflow of water from the wheel via the tail goit was important for the overall efficiency of the wheel (Crossley 1989). A valuation of the site in 1799 set a rateable value of £45 and listed a head and fall of 8 feet (Crossley 1989, 112). The head of water and fall of the wheel pit were carefully monitored for the purpose of taxation, as the greater they were the more power and therefore output the mechanism had (Sloan 1995).

2.12 There is no mention of grinding wheels and rolling mills having been used in conjunction with tilt-hammers at both the Old and New Tilts and grinding only occurred later in the buildings history. Grinding wheels are usually listed in directories and rate books and are not mentioned by Crossley. It is possible that the tilts were solely involved in the forging of larger steel tools and acquired rolled steel bars from other workshops, and then commissioned or sold on the rough-outs for grinding and finishing elsewhere. It is also possible that details of grinding wheels were omitted from earlier accounts, although this is unlikely. By 1799, Moore had advertised his share of the lease, and William Law partnered Ward certainly from 1814, but the Drury's ran the business (Crossley 1989, 112). Records show that Drury sold off some of the equipment from the tilt in 1825, including a beam, flywheel, hammerheads, and anvils etc. and later rate books refer to the site as only a sawmill, although a survey in 1830 refers to the 'Pond Tilt and Sawmill'. The latter lists one breast wheel, 14ft 8in diameter by 5ft 10in wide, generating six and a half horsepower. It seems that the use of the building was changing around this time. A valuation of 1836 shows the same Ward and Drury association listing the works as a 'grinding and sawmill', and rate book records from the 1840s an 1850s refer to a grinding wheel, although occupied by the Patricks (Crossley 1989, 112).

2.13 Cartographic evidence indicates that the Old Tilt had been demolished by 1808, as it was not depicted in a plan by Fairbank published at this time (ref. She 9L(6), Fig. 5). This survey also indicates that the layout of the New Tilt was the same as surveyed by Fairbank 15 years previously and earlier (Fig. 3 and 4), comprising a single square building with the wheel pit on the south-east side. By 1832, the Tilt was extended beyond the wheel pit to the south-east and is depicted with a series of smaller wings in Taylor's survey published

at this time (Fig. 6). These extensions may be contemporary with the change in use of the building in the late 1820s and early 1830s into a sawmill. The later building layout is most clearly depicted in the Ordnance Survey map of 1850 (Fig. 7). This clearly depicts the original building surveyed by Fairbank in 1794 (Fig. 3), with extensions to the south-east also shown by Taylor, and a new extension to the north-west. A chimney and boiler are also indicated on the north-east side of the 'Pond Street Saw Mills', although it is unclear whether steam power supplemented or replaced waterpower (Crossley 1989). No water wheel is annotated, although the location of the original wheel pit is depicted. The saw/grinding mills were closed in 1855-6 and a Midland Railway survey at the time shows a new street to be constructed through the site and that the Tilt Dam had been drained (Crossley 1989). The railway branch that was too connect Chesterfield and Sheffield was planned in the 1860s and in use from 1870 when the first station building adjacent to the site was completed (Crossley 1989).

2.14 An engraving dated to the early to mid 19th century of the view looking south along Granville Street, Park (including the engravers that commissioned the piece) also depicts the Bamforth Dam and its associated buildings (Plate 1). The Pond Tilt Dam is not visible, although a comparison with the Ordnance Survey 1850 map has revealed that the New Tilt building along with later associated modifications is visible. This shows the original forge building to have consisted of a high but single storey workshop with a broad single pitched ridged roof orientated north-east to south-west. The north-east facing wall of the building had a large arched doorway or window. The building extension to the left (south-east) consisted of a two-storey structure with three small square windows for the upper floor. A more shallow single pitched ridged roof was orientated the opposite was to the older part.

2.15 The 1891-2 second edition Ordnance Survey map (Fig. 8) shows the Bamforth and Tilt Dams had been filled in to make way for the new Midland Railway station that was completed in 1870. It was in the mid to late 19th century that the lower Sheaf Valley saw the most remarkable changes. The river was confined to a series of large culverts and the surrounding valley filled in to make way for the expanding city centre and railway. The area to the north of the former tilt was now occupied by the yard of Albion Saw Mills and the area of the dam was by now given over to an access road and yards associated with the station. The line of the access road was maintained until recently as the division, and footpath, between an area of car park and Sheaf House. The Ordnance Survey map of 1905 shows the area of the site to comprise an open public space in front of the station (Fig. 9). This space was maintained in part, even with modifications of the station and surrounding area, until the 1960s when Sheaf Street was formalised and a new subway constructed to the north.

3. Archaeological Background

3.1 Archaeological Services WYAS completed a desk-based assessment for the Sheaf Square area in September 2003 in advance of the proposed redevelopment of the area including Sheaf Square, Howard Street, parts of Paternoser Row and Shoreham Street/Leadmill Road, and including Sheaf House and Dyson House (Richardson and Whittaker 2003). It assessed the archaeological potential of the area and the likely impact of the development

on the archaeological resource, and highlighted the potential survival of the remains of two tilt forges and dam dating from 1732 and 1793-4 below the small area of car parking to the west of the Midland Railway Station. This comprised an area relatively unaffected by development since the early 20th century and the potential survival of organic deposits from the Tilt Dam was also highlighted. It was suggested that the proposed development might impact upon these buried archaeological remains.

4. Method

4.1 The work undertaken on the proposed development site at Sheaf Square involved an initial stage of evaluation followed by more extensive excavation at the request of SYAS. The investigations followed an approved project design produced by ASWYAS (Appendix VI).

4.2 The aims and objectives of the archaeological evaluation and excavation were:

- to confirm the results of the previous desk-based assessment, and to test for the presence of any archaeological deposits or features;
- to identify, as far as possible given the constraints of the trenching proposals, any archaeological deposits or features within the site not identified by any previous stage of investigation;
- to determine the date, nature, depth and stratigraphic complexity of any archaeological features and deposits within the site;
- to provide an assessment of the potential and significance of any identified archaeological deposits and features in a local, regional and (if necessary) national context.

4.3 The first stage of investigation consisted of a single evaluation trench that was located in the north-east corner of the car park (Fig. 2). This was initially proposed to be 20m by 6m and situated further south-west. The location of a 'live' service during scanning of the trench area necessitated the trench to be moved and shortened to 16m. Provision had been made within the project design for deep excavation and the stepping of the trench sides whilst still allowing for a reasonable trench base area at depth. Space also had to be maintained around the trench for adequate fencing and access.

4.4 The tarmac and upper solid surfaces (cobbles and concrete) were loosened with the use of a pneumatic breaker fitted to a small 360 excavator. A large 360 excavator fitted with a toothed bucket was then used to remove this solid upper overburden. No other archaeological deposits were disturbed during this process. A toothless ditching-type bucket was then used to excavate subsequent made ground layers. The trench was excavated in sections, with the removal of the solid upper layers followed by made ground. This was necessary due to issues of access and the reach of the machine arm. Machine excavation was undertaken to the level of the first significant archaeological deposits or structures. Due to the considerable depth of the excavation, the trench sides were stepped to maintain safe working conditions. Spoil was removed into a dumper and stockpiled on site.

4.5 The second stage of excavation was requested by SYAS following the significant results of stage 1, and involved the extension of the evaluation trench to the south-west and south-east. Careful archaeologically monitored trial excavation with a JCB revealed that the 'live' service was a charged former town gas pipe and could be removed and the trench extended to the south. An irregular 26.85m by 15.2m (maximum) shaped trench was then excavated, its shape due to the restrictions of space on site from boundary fencing and existing walls and pavements (Fig. 2). A similar excavation

technique as used in the evaluation trench was employed, with the breaking of the upper solid layers and subsequent removal of made ground to significant archaeological features or structures. Due to the large depth of the trench and the size of the machine bucket, some areas of made ground had to be removed by hand, and the location of structural features such as large walls hindered the regular maintenance of the stepped sides. In some areas this reduced the area of the trench base. Two machine-excavated sondages were used within the trench to investigate made ground in-between structural features in the north-east area of the trench. The first was within the trial trench phase of excavation and was used to investigate the considerable depth of made ground to the north-east of Wall 108 (see Fig 10). The base of these deposits was not located with this method within the required safe working depth, and hand auguring was later implemented in the base of the sondage. Unfortunately, this was unsuccessful due to the high frequency of stone inclusions in the deposits. A second sondage was machine-excavated along the south-west side of Wall 108 to investigate made ground deposits. A further machine excavated sondage was used in the southern area of the trench to the south of Wall 155 to clarify the presence of structural features, and was undertaken with the use of a JCB digger fitted with a toothless bucket. All spoil from the second stage of trenching was removed from site.

4.6 All machine excavation in both stages of trenching was archaeologically monitored to the required level. The resulting surfaces or structures were then manually cleaned, recorded and excavated accordingly.

4.7 The trench was planned in the first instance then excavated by hand in an archaeologically controlled and stratigraphic manner. A site grid was laid out using a series of base lines that were transferred to the trench base and side steps using a plum bob. Due to the varied nature of the archaeological features, excavation was undertaken to a degree deemed appropriate to establish form, function and any stratigraphical relationship to other features. Often this involved the 100% excavation of features or areas, although some sample excavation was used. In some instances, features were initially excavated by section, and completed by single context recording due to the identification of timber structures. These strategies were discussed with and approved by the South Yorkshire Archaeology Service.

4.8 A full written, drawn and photographic record was made of all archaeological remains in accordance with ASWYAS standard methods (ASWYAS 2003). The majority of plans were drawn at a scale of 1:20, with some drawn at 1:10 where finer detail was required. Larger sections, such as the trench sides and some features, were drawn at 1:20, with smaller features drawn at 1:10. Wall elevations were drawn at 1:20. The trench limits and grid were surveyed and fixed to local landmarks using a 600 series Geodimeter Total Station theodolite. The site archive contains all the information collected during the excavations and is indexed in Appendix I. Inventories of contexts and artefacts are listed in Appendices II and III respectively.

4.9 A soil sampling strategy was employed to ensure that a minimum of ten litres was collected from excavated deposits where appropriate. Further samples of timber or wood fragments were taken for potential dendrochronology and

species identification. An inventory of samples is represented in Appendix IV. Small finds are listed in Appendix V.

5. Results by Dan Lee

5.1 The results of the initial trial trench and later excavation have been incorporated to provide one coherent narrative for the site. An overall site plan is shown in Fig. 10 with three more detailed insets in Figs 11 to 14. A simplified phase plan is shown in Fig. 15 and the site matrix in Fig. 16. Schematic sections of the main trench sides are shown in Figs 17 to 20, and further relevant sections and plans in Figs 21 to 32. The excavation plan and historical map detail are combined in Figs 32 and 33.

5.2 The site has been divided into three main phases, with the last phase subdivided:

Phase 1: The New Tilt forge building, wheel pit and dam (1793-4 to *c.*1830)

Phase 2: Building extension: the saw mill phase of the building, including the use of the former Tilt forge and the construction of a new wing represented by a wall and conduits (*c.*1830 to *c.*1855-6)

Phase 3: Post building: **A)** the demolition of the building, subsequent backfilling of the area (*c.*1855-60), **B and C)** construction of retaining walls and large culvert (mid-late 19th century), and **D)** later levelling and cobble surface (*c.* 1905)

5.3 The phasing of the site has been achieved by the use of the site stratigraphic sequence in conjunction with cartographic sources. Further discussion of the site phasing is presented in Section 8. The discussion of finds will only be referred to when significant in this section due to the high quantities of artefactual evidence, and further detail is presented in Section 6 with discussion in Section 8.

Phase 1 (1793-4 to *c.*1830): Figs 10, 11, 12 and 15

5.4 Phase one consists of the remains of the New Tilt forge building and dam that were located in the north-west and southern area of the trench (Figs 11 and 15). This included the south-east corner of the forge building, part of the wheel pit, and associated wall slots. A clay layer was identified to the south-east of the wheel pit that may relate to activity associated with the building. Remains of the dam structure were identified to the south of the building and extending to the south-east beyond the wheel pit, although investigation of this structure was hindered by truncation from a later large retaining wall (155) and foundations that cut across this area. The internal lacustrine silts of the dam were investigated in the southern area of the trench revealing a right-angled stake setting.

The building

5.5 Excavations revealed the substantial remains of the forge building in the north-west of the trench. These have been divided into three elements for the purpose of discussion: the forge building, the wheel pit, and the wall slots and associated features.

5.6 **The forge building (Fig. 11):** Only a small part of the forge building was located during excavation. This consisted of two contemporary low set external stonewalls, (271) and (313), that formed the right-angled southern corner of the building. Both walls continued into the trench section to the north-west and north-east. Constructed from various sized roughly hewn sandstone blocks Wall 271 was two courses high, 0.88m wide and survived to a height of 0.4m. Wall 313 was lower at 0.23m in height and slightly narrower at 0.73m wide, and appeared to have been robbed. The two walls were bonded with a grey lime mortar with frequent white flecking. The presence of a wall slot [272] and associated deposits overlaying the south-west edge of Wall 271 indicates that robbing had not occurred due to the presence of the dam bank deposits (Fig. 18, S.48 and S.57, Fig. 22). Wall 271 consisted of larger sandstone blocks that were positioned on the internal north-east face, with smaller packing stones forming the remainder of the structure, whilst Wall 313 consisted wholly of larger slabs. Both walls were of relatively rough construction with little formal structure, perhaps suggesting that they represented a foundation level.

5.7 A small part of the internal space of the forge building was defined by Wall 271 and 313. The internal structural features consisted of a layer of mortared irregular sandstone fragments (315 and 317) that appeared to form a foundation level, a large sandstone slab (301), and a later wall (298). The sandstone slab (301) was well shaped with a level flat upper surface, but had been broken on the south-west side. A squared iron pin (0.05m wide) had been fitted to the slab towards the west side that appeared to locate a further stone slab on top. This was evidenced by the broken remains of such a slab to the north-west of the pin. The slab structure may represent a mounting block perhaps for machinery, although its true function remains unclear. Wall 298 was poorly constructed from three courses of roughly hewn sandstone blocks and overlay the south-west edge of 301. Surviving to 0.7m high and 0.68m wide, the wall continued into the trench section to the north-west. Whilst apparently representing a later structure to 301, the function of the wall remains unclear. No floor level was observed within the internal space of the building, although this maybe represented by structure 301, and no deposits relating to the use of the building were identified. Deposit 310, and possibly 311, may represent packing material used to fill in-between structures during the buildings use. The investigation of Slab 301, Wall 298 and the foundation layer (317) was limited by the edge of excavation. Unfortunately, the trench could not be extended further north due to the considerable trench depth.

5.8 **The wheel pit (Fig 11):** The southern corner of the wheel pit was located during excavation (Fig. 11). A total length of 2.5m and width of 1.75m was excavated with the remainder of the structure continuing into the trench side to the north-east. The wheel pit was constructed into a vertically sided channel evidenced by cut 248 that was visible on the south-east side. The channel was

excavated to a maximum depth of 1.88m from the top of the cut. The sidewall (249) was constructed from large squared sandstone blocks that were backed by a rough supporting wall (208) to the south-east abutting the cut side (Fig. 21, S.66,). At a maximum of 0.43m wide the sidewall of the wheel pit (249) was well constructed, although the coursing appeared to be irregular. The upper levels comprised four smaller courses of squared sandstone slabs between 0.07m and 0.24m high that were firmly mortared with a grey lime mortar with white flecking. The lower levels of wall 249 consisted of much larger squared blocks 0.46m high that probably formed the foundation. The wall was robbed of stone blocks to the north-east and the remains survived as a series of 'steps' down. The south end of wall 249 was not disturbed, evidenced by the survival of a wall slot [337] above it. The associated packing wall (208) was also robbed of material from above exposing the side of the wheel pit cut 248.

5.9 The south end of the wheel pit that formed the top of the dam tail race consisted of a stone foundation structure (250, Fig.17, S.36) comprising heavily mortared angular sandstone slabs and fragments that sloped steeply downwards *c.*1.25m north-east of a wall slot [338] which demarcated the wheel pit edge towards the dam. It is likely that this represents the foundation for a stone structure that directed the flow of water into the wheel pit, which has been removed.

5.10 No organic deposits were encountered in the excavated base of the wheel pit and it is likely that the true base of the structure was not located. This was largely due to the limited nature of excavation that was confined by the stepped trench sides.

5.11 **Layer 143 (same as 215, 342, 405, Fig. 13):** An early layer of mixed firm mid greyish brown silty clay with occasional fragments of coal was identified to the south-west of the wheel pit that appears to be cut by all of the structures in this area. The layer was observed in the sides of Conduit A (Fig. 13) and within the machine-excavated sondage to the east. Similar layers suggested to be the same, were located in the south-west end of Conduit A (Contexts 342, Fig. 21, S.66 and 78, and Context 405). A similar layer was also noted in the machine-excavated sondage to the east (Context 415, Fig. 17, S.23).

5.12 The robbing of Wall 208 within the wheel pit revealed a similar layer (Context 342), although the relationship between the two was lost. It was not clear whether the layer butted the south-west face of the wall or was cut by the wall cut. The layer appeared to represent made or disturbed ground associated with the external area of the original forge building. It is also possible that the layer pre-dates the forge, although dating evidence was lacking. It may indicate the former ground level, with the upper layer surface located consistently between 52.34- 52.50m OD across the area around the conduits, although some truncation may have occurred. Few finds were recovered from the layer to facilitate in dating and the clay pipes recovered from Context 342 range in date from the late 17th to 19th century in date and may be residual and/or intrusive.

5.13 **The wall slots and associated features (Fig 11):** Linking the wheel pit and external building wall structures were a series of four large wall slots, [272], [337], [338] and [339] (Figs 10 and 11). These indicate that the stone

foundation walls of the forge building and wheel pit, Walls 271, 313 and 249, supported an upper structure probably of stone or brick. It is possible that they may also represent beam slots. All the walls or timbers had been removed during the demolition and robbing phase of the building (Phase 3A), but the distinctive slots where they formerly stood were preserved and backfilled with demolition material and made ground.

5.14 The wall slots associated with the external building walls were found to be larger in size than those associated with the wheel pit, and may suggest differing types of structure. Walls 271 and 313 formed the base for two large walls inferred by the vertical edges of the material that was packed along the south-west side that formed part of the dam structure. Wall slot 272 survived as a vertical edge *c.*0.55m high and 2.07m long and continued into the trench edge to the north-west (Fig. 18, S.48). An exploratory sondage to the south-west of the wall revealed that the wall was positioned *c.*0.1m in from the edge of the lower foundation wall. Wall slot 339 survived as a similar vertically sided 'notch' 0.38m wide at the south-east end of 272 (Fig. 11). The continuation of the wall, represented by Cut 339, was only visible as a 'notch' at the south-west end of Wall 313. It appears that both walls were bedded directly onto the level top of the stone foundation walls (*c.*51.55m OD).

5.15 Two wall slots associated with the wheel pit structure were also identified (Fig.10 and 11). Wall slot 338 was orientated north-west to south-east varying in width from 0.35m to 0.5m and was excavated to a length of 1.9m, although continuation into the trench baulk was noted to the north-west. The slot survived as a vertical edge along the south-west side 0.17m in depth, and as a slight step of *c.*0.1m down towards the foundation structure 250. It appears that the original wall was laid on a level bed of mortar (253, *c.*51.61m OD) and butted Wall 249 to the south-east (Fig. 21, S.39). This wall apparently formed the demarcation of space between the dam to the south and the wheel pit to the north, over which water flowed towards the wheel. Re-deposited clay (210) was used to pack up against the wall from the south, forming the wall slot edge located during excavation, and the absence of such an edge on the opposite side may suggest that the wall abutted internal stonework (above 250) that was removed during demolition. The wall represented by wall slot 338 may have supported the penstock that controlled the flow of water into the wheel pit, although no direct evidence for this was found.

5.16 The final large wall slot (337) was located above the south-west end of Wall 249 (Fig. 11). It consisted of a vertically sided square butt-end 0.41m in width and 0.21m in depth. The upper surface of Wall 249 was evenly mortared and formed the level bed for the wall (51.80m OD). The wall slot and mortar bed survived to a length of 1.8m, but was removed by the robbing of Wall 249 to the north-east. It is likely that the original upper wall continued for at least 3.55m along the side of the wheel pit. It is possible that this was a beam slot at the axle level of the wheel. The axle of a breast wheel at this level would be at or just slightly above, the dam water height.

5.17 Two minor beam slot ends, Contexts 220 and 221, were located set into the surviving surface of the south-west end of Wall 208 (Fig. 11). They were squared in shape and measured between 0.18m and 0.2m in length, and 0.18m and 0.27m in width with the beams apparently continuing to the north-west.

They survived to a depth of 0.02m and had residues of rotten wood on the base surface. Too little a sample survived of the wood for species identification, but due to the high nature of degradation it seems plausible that the beams were softwood. Three stake holes were associated with the beam slots (Contexts 216, 218 and 219) and may have formed part of the same structure. Stake holes 218 and 219 were between 0.07m and 0.09m in diameter and associated with the south-east sides of beam slots 221 and 220 respectively. Both appeared as voids, capped by the backfill material (197) that overlay them, and had residues of timber posts suggesting that the stakes were snapped off at ground level and left to rot *in-situ*. A depth of between 0.21m and 0.27m was recorded and both stake holes were constructed, probably by driving in the stake rather than the excavation of a hole, at the edge of Wall 208. Stake hole 216 was located further south-east and was filled by a dark greyish brown sandy silt deposit (217) that was similar to the overlaying layer (197). The stake hole was oval in shape with a maximum diameter of 0.12m and was excavated to a depth of 0.4m, suggesting, in contrast, that the post was wobbled and removed. The 'V' shaped profile of the stake hole (Fig. 22, S.94) indicates that a pointed stake was originally driven into the ground. The function of this group of features remains unclear, and it is not apparent if they formed part of the same structure. It is possible that they were related or part of the penstock mechanism that would have controlled the water flow into the wheel pit.

5.18 It is likely that the walls represented by the slots (272, 337, 338 and 339) were constructed from brick, due to the high concentration of bricks within the overlaying demolition deposits (e.g. 273, Fig. 18, S.48), although brick impressions in the upper mortar surface of the lower stonewalls was lacking. The presence of timbers cannot be ruled out, although no wood residues were located and structural timbers within foundation levels may have caused structural weakness. Slot 337 may have been the beam for the axle of the water wheel.

The dam (Figs 10 and 12):

5.19 Part of the dam associated with the forge and wheel pit was located in the southern area of the trench (Figs 10 and 12). The term 'dam' has been used here to represent the whole of the forge pond including the bank and internal space. The dam has been divided into two elements, the dam structure and the internal dam features, for the purposes of discussion.

5.20 **The dam structure (Figs 11 and 12):** The dam structure was identified in two locations: to the south-west of Wall 271 and to the south-east of the wheel pit. These formed part of the dam wall structure at the tail end of the dam. Truncation by the later foundation cut for Wall 155 (Contexts 161 and 267) and Culvert 133 (Context 132) hindered investigation. An exploratory sondage to the south-west of Wall 271 (Fig. 22, S.57) revealed a variety of deposits banked up against the foundation wall and upper wall of the forge building. The bulk of the structure was made up of a firm clay silt deposit (274) containing rounded pebbles that overlay Wall 271. Chemical weathering of the deposit appeared to have discoloured the lower area (318) and the south-west side may have been secured in position with boarding, suggested by a vertical

boundary, prior to the deposition of 320 and 319. No evidence of any boards survived and investigation was limited by space, although they could have been removed. It is possible that 319 and 320 were cut for the construction of the New Tilt. These deposits appeared to form the core of the dam structure, and were overlain by further layers of silty clay and sandy silt structural material (157 and 158). These deposits appeared to slope down to the south-west and were overlain by a layer of dark silty lacustrine material (Fig.19, S.13, context 159). This small area of 159 was the only internal dam silt to be located to the north of the later Wall 155 that cut across the area. The boundary between the dam silts and the building was lost due to the deep foundation cut for Wall 155 which extended into natural clay and destroying earlier features.

5.21 More substantial evidence of the dam structure was identified to the south-east of the wheel pit and beyond the later wall 155 (Fig. 10). Excavation to the south and north of the dam wall indicated a south-east to north-west alignment for the structure which continued into the trench side to the south-east and illustrated the often irregular nature of the internal deposits. Broadly, however, three main points can be made; the dam was constructed over existing deep layers of homogenous weathered silty clay material (e.g. 402, 403, 406 and 419, Fig 22, S.85 and 89) that are likely to represent previous lake deposits pre-dating the dam structure; the dam was constructed from rubble and mixed clay deposits (e.g. 400, 417) that were later overlain by internal dam silts (297, 401) on the south-west side; the dam bank showed evidence of structural features including stake holes, an edging wall (233), and was formalised on the north-east side by a substantial stone revetment (380). The material used to construct the dam was relatively clean, generally comprising re-deposited natural clay and lacking finds, although pottery recovered from context 400 has been dated to the late 18th to early 19th century. Spreads of material on the top of the dam structure (261, 262, Fig. 10) contained residual pottery dating to the late 18th century, but also later 19th century pottery and clay tobacco pipe, suggesting a 19th century date for the deposit.

5.22 The profile of the dam wall was broad with a convex internal side to the south-west and a convex retaining wall (380) on the opposite side (Fig. 23, S.81). The total width of the dam wall was recorded as approximately 3.8m and it appeared to broaden to the south-east, although the full extent of the north-east side was not located due to limitations of space and later truncation by Wall 155 and Culvert 133. The revetment structure (380) was at an angle of roughly 50 degrees, although the steepness varied with depth and was irregular in places. The structure consisted of a well built wall with un-bonded small to medium sized roughly hewn and irregularly coursed fine grained sandstone blocks with three bracing walls set at 90 degrees to the north-east, all of which seemed to represent the same phase of construction. The two north-west bracing walls were of a similar build to the main retaining wall, although the third south-east example consisted mostly of a large dressed course grained sandstone block set on end and keyed into the main wall. The block had a large notch within the centre and was similar in character to two blocks (115 and 398) that were identified within a later phase of the forge building (see Phase 2). A maximum height of 1.27m was recorded for the dam structure on the external side, although the base was not located. The upper levels of Structure 380 had been robbed of stone material exposing a construction cut

(391) in section. It is possible that the bracing walls formed a series of small bays along the north-east side of the dam wall.

5.23 The upper south-west side of the dam wall was demarcated with a line of roughly hewn stones (233) that appeared to form a single course edging wall 0.2m high. The dam structure, including Wall 233, was a maximum of 0.64m from the upper surface of 406 which formed the upper dam silt deposit from the original Old Tilt dam. The main stones within Wall 233 were un-bonded, although smaller stones had been used as packing, and all were bedded directly onto the internal clay deposits of the dam wall. A total length 2.08m was identified although the wall was cut by Wall 155 to the north and petered out to the south-east. Any formal upper surface or path was not located on top of the dam wall, and any other stone work above 233 had been removed.

5.24 Several stake holes were located within the dam wall structure and in the upper surface (Fig. 24). Four stake holes (411-3, 420) were identified within the dam wall structure that appeared as voids during the excavation of the box section to the south-west of Wall 233. These were located at different levels (cutting both 406 & 417) and probably did not form a single structure. Residues of heavily degraded wood were noted on the sides of the stake hole voids, and a more substantial sample from Stake hole 411 has been identified as trimmed willow roundwood (see Section 6.7). Three stake holes were identified in the upper surface of the dam (235, 237 & 255, Fig. 24). Again, these appeared as voids with residues of wood inside. A sample from Stake hole 235 (fill 234) has been identified as ash. Interestingly, all the circular stake holes were 0.08m in diameter, apart from 234 which was oval and 0.1m in width, but they varied in depth dramatically from 0.18-0.9m. It is possible that they represent temporary structures, perhaps supports or scaffold, used in the construction of the dam and associated features. They all appear to have been originally driven into the ground and then snapped off near to the base and left to rot *in-situ*. The stake holes located on the top of the dam wall (235, 237 & 255) were all set at a *c.*20-degree angle from vertical (Fig. 25, S.84,) and may have formed a contemporary structure.

5.25 **Internal dam features (Fig 12):** The internal dam features include the lacustrine silt layers that were located within the dam, and the wooden structural features identified within these. Two hand-excavated sondages were used to investigate the internal dam silts (Fig. 10), and the initial southern slot had to be extended to follow a series of stake holes. The lacustrine layers extended over a wide area within this part of the trench.

5.26 Five lacustrine layers (241, 302, 304, 305 & 306) were identified within the hand-excavated sondage along the southern lower trench edge (Fig. 20, S.63). These consisted of homogenous plastic black to dark grey brown silty clays containing occasional traces of decayed wood fragments and totalled 0.8m in depth. The upper layer (241) had an irregular upper boundary to the backfill deposits above (240, 244 & 246) that may indicate previous truncation, or that compaction and distortion may have occurred from the weight of the deposits above. A small patch of concreted iron panned gravel (335) was also noted on this boundary. It was considered that these layers were the result of water deposition as opposed to representing waterlogged preserved deposits. A thin lower layer (306) of more mixed silty clay containing sandstone rubble and a

relatively high concentration of finds, including pottery and clay pipe with the latter dated to between 1800-1860, was located above the natural clay (328). The pottery has a wider date range from the late 18th century to the late 19th century, suggesting that this layer of material may have accumulated at the bottom of the dam silt over time, and does not represent a single episode of deposition. A similar range of material was recovered from the upper silt layers, although in lesser quantities, which may indicate the migration of finds down through the layers.

5.27 Two similar layers of silt were identified to the north within a hand-excavated sondage adjacent to the later Wall 155 (239, 297, Fig. 25, S.62,). Six non refitting Oak bark chippings and the end of a radially faced shaft were recovered from layer 239, as well as a fragment of panel formed from interlaced radially faced laths found in layer 297 (Fig. 12, SF. 21, Plate 53, see Section 6.7). The boundary between silt layers 239 and 297 revealed a right-angle setting of seventeen stake holes that extended to the south-west and turned to the south-east (Fig. 12), the majority of which are likely to have formed a single structure.

5.28 The north-west line of five stake holes (323-7) appeared as voids with residues of heavily degraded wood noted on the interior surfaces (Fig. 12). The stake holes were between 0.14 - 0.32m long, 0.07 - 0.09m wide and up to 0.36m deep, and were sub-semicircular in shape with the stake originally set vertically (Fig. 25, S.62,). A small minor stake hole (323A) was adjacent to stake hole 323 (Fig. 25, S.80). A second line of stake holes (370A-F), set at right angles to the first, were more irregular in size and shape, although were broadly similar in form. Stake hole 370F was not vertical and was angled at 30 degrees to the north-east Both stake holes 323A and 369B were also angled to the same degree but to the south-west (Fig. 25, S.79 and S.80). A square stake hole (374) 0.04m wide and 0.07m deep was located towards the south-east end of the post line that contained the remains of a radially faced stake. The two lines of stakes converged at a corner post setting (369A-B) that had three conjoining sub-circular post sockets between 0.18 -0.23m long, 0.08 –0.12m wide and up to 0.31m deep. Again these were not vertical and were all angled at 45 degrees to the east. A larger sub-circular post hole 0.36m wide (maximum) and 0.42m deep was located at the south-east end of the stake setting and may represent an end post (Fig. 25, S.75,). The second line of stake holes and postholes contained the heavily rotted remains of wood.

5.29 The structure may represent some form of platform or jetty that was constructed into the dam. This appears to have been rectangular in shape and the stakes may have supported a planked area. The angled stakes and posts may have strengthened the structure. Perhaps the platform was for access to the area at the head of the wheel pit where control mechanisms for water inflow would have been situated. The continuation of the structure to the north-east appears to have been truncated by wall cut 267 associated with the later Wall 155 (Fig 25, S.61). Assuming all the posts and stakes were contemporary they would have enclosed an area 3m in length and 1.5m in width. The sub-semicircular shape in plan of the stake holes suggests they contained halved roundwood stakes. Generally these had not survived, however the remains of post 375B (stake hole 323) was box quartered heartwood. The partial survival of stake 377F (Stake hole 370F) indicates that

the base of the posts were likely to have been pointed (Fig. 25, S.79 and S.80). Samples of wood retrieved from within stake holes 323 (375B) and 373 (374) suggest that the structure was constructed from ash wood (see Section 6.7). The stakes appear to have been driven into the soft dam silts, and then broken off near to the base and left to rot *in-situ* when the structure fell out of use. The rotting stake and post bases had been capped by later silt (239) in most cases, and the wood had rotted to leave a void or spongy 'woody' fill. Lighter silt clay material (296) around the post setting suggests that chemical alteration of the silts around the stake and post holes may have occurred, alternatively this may represent a discrete silting episode around the timber structure during use.

5.30 The distinctive lacustrine layers that were identified in the southern area of the trench were not observed continuing to the north of the later truncating Wall 155 towards the building, with the exception of Layer 159 (see above). The packing clay layer (210) that was observed butting the stone structures of the forge building was test excavated within a small box section and was observed to overlay layers of weathered natural clay (321, 336). No continuation of the black silty internal dam layers was observed, and it appears that the later Wall 155 may have removed the boundary between the two.

Phase 2 (*c.*1830 to *c.*1855-6): Figs 13, 14 and 15

5.31 Phase two comprises the extension of the forge building that was identified to the south-east of the main building beyond the wheel pit (Fig. 10). Cartographic evidence suggests that the original building was extended during the early 1830s, although no precise date has been gained (see Section 2). The main features located within this area of the building were two large conduits and associated culverts that were located parallel to the east side of the wheel pit. The main structural walls for the building extension did not survive in any coherent form as the area had been cut by later walls and a culvert (108, 155, 133).

The building extension

5.32 The remains of the building extension mostly comprised internal features, such as the conduits, although some evidence for external walls was identified. For the purpose of discussion these features will be grouped into two main elements: the external wall, and the conduits and associated culverts.

External wall:

5.33 The remains of a possible external wall (392) were identified to the south-east of the wheel pit (Figs 10, 13 and 14). Orientated south-east to north-west the linear wall was 1.9m in length, a maximum of 0.4m in width and survived to a height of 0.35m. Constructed of large roughly hewn sandstone blocks it was one rough course high and heavily bonded with grey lime mortar. Similar mortar was removed from the south-west side of the wall where, along with small sandstone fragments, it had been used as packing. The wall was mortar bonded to Wall 208, but due to the different construction styles Wall 392 is likely to represent a later addition. The rough character of the wall and its peripheral location suggests it may have formed a foundation for an external

wall.. The wall follows the same alignment as the dam bank edging Wall 233 (Phase 1). The relationship between Wall 392 and the dam bank was cut away by Wall 155 (Phase 3).

5.34 No other external walls were identified for the building extension, and they were probably located outside the trench or were removed by the construction of the later walls and culvert that crossed the small excavation area.

The Conduits

5.35 Two conduits were located to the east of the wheel pit (Figs 10, 13 and 14). Conduit A was the larger at 8m in length and with an overall width of 1.4m. The feature was truncated by a later large culvert (133) that dissected it towards the north-east end although both ends were found. A second smaller conduit was located parallel to Conduit A to the east. Only part of this feature survived (2.4m) as it was cut by both Culvert 133 and Wall 155 (Phase 3) but it was slightly wider at 1.6m. The stages in use of the conduits consisted of the initial construction of two parallel channels; followed by the deposition of wooden planks in the base; then the joining of the conduits with a cut channel and the silting of the combined conduit bases from either stationary or slow flowing water during its use. The conduits were then backfilled in Phase 3. The structure of the conduits is described below followed by a discussion of their fills.

Conduit A

5.36 Conduit A was located *c.*1m to the to the south-west of the wheel pit. Orientated north-east to south west the linear channel consisted of a roughly square cut channel that had been cut into an earlier layer (143, see Phase 1) and natural clay. The channel had been lined with vertical sidewalls roughly constructed from various types of reused masonry material.

5.37 The walls of Conduit A were roughly built and varied greatly in character. The end walls (144 & 395, Fig. 14), however, were of similar construction consisting of roughly hewn sandstone blocks three to four irregular courses high and both with a slight slope to the north-east and south-west at the ends of the feature. Wall 144 survived at 0.45m in height, although truncation was evident, and turned to the south-west where its structure was more irregular. Wall 142 abutted the internal face of Wall 144 suggesting it was a later internal division demarcating the top of the internal channel slope (Fig. 14). At the south-west end, Wall 395 survived at a height of 0.43m and had a more distinct internal slope. The sidewalls of Conduit A consisted of various sections of brick wall (138, 352), stonewall (346, 397) and large stones (115, 343, 398).

5.38 Towards the ends of the conduit, and on opposing sides, two similar large sandstone blocks (115, 398) had been used to form part of the channel wall (Figs 13 and 14). These were broadly rectangular in shape and had been set on end with a large notch and furniture recess holes evident on the upper surface of both (Fig. 26, S.6 and 93). The upper surface of stone 115 showed evidence of a square central iron stained mounting point within the central notch, and a small square fixing point to the south-west. A leaded iron fixing was also

found. The central notch of stone 398 had been chopped out during the laying of a later ceramic drain (364) that passed over the conduit at a higher level. The stones appear to represent axle blocks, probably from grinding wheels, but they appear to have been reused from another structure to form part of the conduit wall. There were no corresponding axle blocks on the opposite side of the channel and the stones were merely bedded on clay suggesting that they did not operate as such in this location. A similar stone was observed within the stone revetment (380) on the north-east side of the dam wall (Phase 1) where again it appears to have been reused. A large roughly hewn sandstone block (343) formed part of the north-west wall of the conduit although this was not shaped.

5.39 The intermediate sections of sidewall (352, 397) at the south-west end of the conduit were roughly constructed from sandstone blocks and bricks with irregular coursing (Fig. 26, S.92). Surviving to a maximum height of 0.38m the materials appeared to have been reused. Wall 352 was more formalised with brickwork at the north-east end but this was truncated by the later culvert (133). To the south-west the wall was irregular in construction and appeared to have been cut by the small channel that linked the two conduits. It is likely that Wall 352 originally continued to form a corner with the end wall (395). A low roughly built internal wall (354, Fig. 14) was constructed from un-bonded sandstone fragments, and may have formed part of the internal channel. A short length of robbed brick wall (138) was located towards the north-east end of the conduit. Surviving at three courses high the wall was disturbed to the south-west, perhaps from the construction of the culvert, and ended adjacent to the internal low wall (142). The bricks were not bonded and some half bricks had been utilised suggesting they may have been reused. No continuation to the north-east was located.

5.40 The conduit narrowed at the north-east end that was defined by a rough three course high sandstone wall (346) that butted Stone 115 from the south. This appears to respect the small brick base structure (360) that consisted of irregular brickwork three courses high bonded with lime mortar. This discrete structure appeared to have been robbed of bricks and may originally have continued below the later culvert 133. Its function remains unclear, other than some form of foundation. Brick samples have been dated to the late 17th to late 18th centuries suggesting that the bricks were reused from a previous structure in this later part of the building. Alternatively, it is possible that 360 represents an earlier foundation dating to Phase 1 of the site that was incorporated into the conduit.

5.41 **The Fills: north-east end (Fig 13):** The silty lower fill (139) in the north-east end of Conduit A contained a large tangentially faced board (140) which overlay the edge of a small slatted structure (229) (Fig. 13). These were located below the silty layer 139 that was up to 0.11m thick (Fig.26, S.6), although similar deposits were located below. Artefacts recovered from layer 139 include a small quantity of 19th century pottery, fragments of other tangentially faced wooden boards, clay tobacco pipe dated to 1830-1860, worked bone including elephant ivory and off cuts of leather (SF.7, see Section 6.8). The highly degraded board (140) was 1.02m long, 0.4m wide and up to 20mm thick showing evidence of a sawn south-west end. The board sloped

down to the south-west and was constructed from Scots Pine (see Section 6.8). The slatted structure (229) consisted of six small wooden slats *c.*90mm wide and up to 10mm thick that were nailed to squared side lengths of timber (228, see Section 6.4 for the nails). These had all but totally rotted but appeared to be set in narrow cuts (303), although these may represent the imprint of the degraded timber into the deposits below. All six slats were constructed from Silver Fir (see Section 6.8). The slatted structure and the board were both rotted and decayed and had suffered compression and distortion from the surrounding deposits.

5.42 These wooden artefacts in the north-east end of Conduit A appear to mark the boundary between the silty use fills and lower earlier deposits that were used to raise the level of the base (e.g. 141). No semi-waterlogged silty layers were located in the base of the conduit, apart from the silty fill of the possible culvert (371). The slope of the north-east end of the conduit was certainly raised prior to the introduction of water, and this along with the wooden boards may have facilitated the movement of water to the south-west. A number of artefacts were recovered from directly below the timber board including off cuts of leather and a leather strap end (SF's 10, 14 and 15, Section 6.7), cut bone (SF. 17, Section 6.6) and metalwork (SF's 11-13, 16 and 19, see Section 6.4) that were within layer 139 that continued below the timber. This thin layer of silty material below the timber may have derived from water movement and the presence of finds indicates some deposition before the timbers were in place.

5.43 **The Fills: south-west end (Fig. 13)**: The south-west end of Conduit A also contained dark silty fills (359, 410, 414) that had preserved timbers, although the process of deposition appears to have been slightly different to that in the north-east end. A soft dark grey to black silt layer (359) *c.*0.1m thick overlay a series of five wooden planks (396A-E) that were orientated along the conduit length (Fig. 13, Fig. 25, S.79). All the boards were badly decayed and degraded and had suffered considerable compaction and distortion from the deposits above. Identified as Silver Fir timber (see Section 6.7) the larger planks varied in size from between 0.99-1.94m in length and 0.22-0.3m in width with a smaller example (396B) 0.11m in width and 0.36m in length. Plank 396C was below Plank 396D and both overlay the central gulley in the base of the conduit (Fig. 14).

5.44 As observed in the north-east end of Conduit A the planks sloped down gradually towards the centre of the feature as if to channel water. Below the planks the central gulley was filled with a soft dark silty layer (410) *c.*0.1m thick that was essentially the same as the upper fill (359). Clay tobacco pipe fragments were recovered from 410 with a date of 1830-1860, and several worked shell and bone fragments, some displaying evidence of button making, were recovered from Layer 359 (see Section 6.6). This suggests the conduit was used in the mid 19th century.

Conduit B

5.45 A second conduit was located parallel to Conduit A and the two were joined by a later cutting. Only part of the conduit was located as it was cut by the large culvert (133) at the north east end, although it did not appear to continue

beyond this later feature. The conduit was also cut by Wall 155 to the south-west, however it was likely to have ended at the same point as Conduit A.

5.46 Conduit B was situated *c.*0.6m to the south-east of Conduit A and appeared to form a similar structure, although only a limited part was investigated due to it being cut by Wall 155 and Culvert 133 (Figs 13 and 14). Both sidewalls (385, 386) were constructed from roughly hewn sandstone blocks that were bonded with lime mortar (Fig. 26, S.83). Wall 386 was more substantial and was 0.84m in height with seven fairly regular courses and a more highly finished internal face. Wall 385 was more irregular in construction with five courses and survived at 0.46m in height. It was flanked on the internal side by a small brick culvert (384). The culvert (384) consisted of parallel rows of bricks laid on their side used as sidewalls that were capped by horizontal bricks forming an internal channel 0.16m wide. The culvert appeared to have been disturbed at the south-west end. Both the culvert and Wall 386 overlay a stone foundation (416) that consisted of mortared angular sandstone fragments, although only a small area was visible.

5.47 A short length of culvert (201) was located within the machine-excavated sondage to the north-east of Conduit B beyond the later culvert (133). This consisted of a square cut channel (201) greater than 0.4m deep with two parallel side walls of reused bricks (200) capped by irregular shaped flat sandstone slabs (199). This created an internal channel *c.*0.26m wide and 0.27m high (Fig. 26, S.25). The culvert was partially filled with silt (203). A total length of 2.48m was observed and the culvert was cut by the later wall foundation (204) for Wall 108 and overlain by the large culvert (133) at either end. The culvert was on the same alignment as Culvert 384 within Conduit B and may represent the same drain, although both were of different construction.

5.48 **The Fills**: The lower silt fill 410 in Conduit A continued to the south-west within the cutting to Conduit B (Layer 414, Fig. 26, S.83). At 0.17m thick this overlay several fragments of thin softwood board (387, see Section 6.8) that were on the natural clay base of the conduit. Several leather artefacts were recovered from Layer 414 including strapping and off cuts (SF's 22-26, see Section 6.8).

The Linking Channel (Fig. 14)

5.49 The conduits were linked at the south-west end by a small channel that cut Walls 352 and 385. A small gulley in the base of the channel passed through the cutting from Conduit A to B. Cut into the natural clay the flat-bottomed gulley slopes down gradually to the north-east where it broadened out at the end of a low internal wall (354) (Fig. 26, S.92). The gulley was up to *c.*0.4m wide and 0.2m deep.

5.50 The north-east end of Conduit A also sloped towards the centre although no gulley was identified. The edge of a possible culvert (371) was located in the base although investigation was limited due to the large culvert (133). The gulley and sloping base of the conduits appeared to channel water into the centre where it was perhaps culverted into the wheel pit.

5.51 In general, the lower fills of the conduits (139, 359, 410, 414) consisted of dark plastic silts that represent the use of the conduits which were connected by a later linking channel. The final silting appears to have occurred after the two conduits had been linked together. The fills consisted of dark greyish brown to black silt that contained occasional sandstone fragments, ceramic building material and coal fragments. Frequent heavily degraded organic plant material was also noted although this was present as stains and impressions. The deposits were apparently laid down in a slow moving water environment with gradual silt accumulation that related to the use of the conduits. Semi-waterlogged conditions survived within the silts, greatly facilitated by seepage of water from the nearby brick culvert (133), resulting in the preservation of a number of wooden objects.

5.52 **Discussion:** The function of the conduits remains unclear. They certainly channelled water and were allowed to silt up gradually. It is possible that they directed water from the south-west and north-east ends to the central area adjacent to the wheel pit. A possible culvert (371) was located in the base, although investigation of this was limited by the large later culvert (133, Phase 3) that cut through this area. It is probable that this flowed out into the wheel pit, but equally plausible that water was trapped and had to seep away gradually resulting in the collection of silt (139, 359, 410, 414). The varied walls of the conduits gave no indication as to their function, and the large stone mounting blocks (115, 398) were apparently reused from grinding troughs elsewhere. The upper levels of the conduits were filled with mixed backfill material that derives from the disuse of the feature that is discussed in Phase 3. The conduits may represent below floor drainage, perhaps specifically relating to some form of activity in the building space above, such as button making or bone working (see Section 7). Unfortunately no indication as to the level and character of the floor of the building extension was identified. Another theory is that the conduits were related to the wheel pit and acted as an overflow to the dam, and the relationship of the conduits to the dam head was cut by Wall 155 (Phase 3) and lost, and therefore could not be investigated.

Phase 3

5.53 Phase 3 represents the post-building phase of the site and has been sub-divided into four sub phases. These comprise the demolition of the building that occurred around 1855-60 and the subsequent backfilling of the area (Phase 3A). This backfill was then cut by two large retaining walls (108, 155, Fig.10) and a large culvert (133) and levelled for a yard surface (105) (Phases 3B and 3C respectively, mid-late 19th century). This was in turn levelled up for a cobbled surface (101) that was contemporary with the railway station extension completed in 1905 (Phase 3D). This sequence of events resulted in the considerable build up of made ground material on the site which raised the ground level by over 3.5m from the level of the forge building and dam in Phase 1. Phase 3 represented the largest volume of material excavated from site and produced the majority of the artefactual evidence.

Phase 3A: Demolition and backfilling of the building and dam (*c.*1855-60)

5.54 **The Forge Building:** The disuse and partial demolition of the forge building was evident in the main structural walls (271, 313) and the sidewalls of the wheel pit (208, 249, 250). The external walls of the building (271 and 313) which were perhaps of timber or brick (Phase 1) were removed down to the exposed foundation level. The mixed backfill deposit (273) that overlay Wall 271 (Fig. 18, S.48) contained a high frequency of brick material, and this demolition layer continued above Wall 313. The wheel pit walls (208, 249, 250) had also been robbed of their stone, most likely for reuse elsewhere. Only the south-west most stone blocks of the sidewall 249 were left, probably as these were butted by the foundation deposit 250 and would have been difficult to remove.

5.55 The backfill of the building and wheel pit may indicate three episodes of backfilling of the building area. The initial backfill is represented by the demolition layer 273, that overlay Wall 271, and various mixed layers containing brick, stone and some mortar fragments (292-4, Fig. 18, S.48). Clay tobacco pipe fragments suggest a date of deposition of 1830-60 for Layer 273 (see Section 6.2). This was then followed by an episode of silting (Layer 166). This appeared to have been deposited by water and may indicate a period of relative stability, demolition and re-development of the site. A similar layer to 166, but a more mixed dark clay silt rubble layer (197), was used to backfill the area to the south-west of the wheel pit (Fig. 21, S.39). The building materials recovered from this layer have been dated to 1790-1836. Fourteen fragments of pantile recovered may have derived from the roof (see Section 6.3). Clay pipe fragments suggest that the layer was deposited between 1850-60 (see Section 6.2). Layer 166 was overlain by a more extensive made ground layer (160) that appeared to have been tipped in from the south-west. Consisting of mostly angular sandstone fragments within a loose silty sand matrix this layer formed the upper deposit within the initial infill of the building area.

5.56 The initial backfill layers were cut to the north-east by a robbing cut (194, Fig. 18, S.48). This indicates that further salvage of building materials focused towards the west side of the wheel pit may have occurred after the building had been demolished and initially backfilled. The robbing cut was backfilled with rubble (195) and further made ground rubble layers above (168) that slumped down into the wheel pit (213, 212). These mass backfill layers largely comprising angular sandstone fragments with some soil matrix were likely to have derived from off site although some of the building materials may derive from the former forge building (Fig. 17, S.36). A brick sample from Layer 213 has been dated to between 1790-1836 which would be consistent with the date of the forge building (see Section 6.3). A thin lower layer of backfill, Context 214, was located in the base of the excavated part of the wheel pit. Although not from functional deposition, the clay pipe material indicates a date of deposition of 1800-60 (see Section 6.2). The high stone concentration in the backfill, especially within the wheel pit, may indicate an attempt to firmly backfill such deep structures. It is possible that quarried stone material was specially brought onto the site for this purpose.

5.57 **The building extension and revetment:** The demolition of the building extension was less obvious as the features identified were largely internal features. One possible external wall (392, Fig. 10) dating to Phase 1 or 2 was

certainly reduced to the foundation level. The robbing of building materials was most evident in the conduits where brick and stone material had been removed from the walls (138, 144, 352, 385, 386, 395, Fig. 14). Some truncation of stonework was evident in the upper levels of the revetment structure 380. However, the majority of damage to the conduits and associated structures was caused by the later construction of Wall 155 and Culvert 133 that cut across the site.

Backfilling:

5.58 **The Conduits:** The initial backfill of the conduits above the silt deposits consisted of several loose layers containing high concentrations of building material. The initial and main backfill of the north-east end of Conduit A (Context 120, Fig. 26, S.6) contained frequent sandstone, brick and mortar fragments within a loose brownish grey sandy silt matrix. This also contained 19 fragments of pantile, perhaps deriving from the roof of the building. This was overlain by a further thin demolition layer (151) and clinker deposits (114, 113, 117 etc.). The latter will be discussed below. Similarly, the south-west end of Conduit A was backfilled with deposits containing fragments of brick, sandstone and mortar (344), and a homogenous orangey brown sandy layer (345, Fig. 21, S.78). These deposits represent the rapid backfill of the conduit.

5.59 Conduit B was initially backfilled with compact sandy clay with a occasional sandstone inclusions (388) that was overlain by a layer of homogenous soft reddish brown sandy silt with sand patches and rare sandstone fragments (389) (Fig. 26, S.83). This was overlain by the more common demolition-type material, Layer 367, that was wide spread over this area and similar to Layer 344, and probably representative of the same episode of backfill. Both layers were overlain by a clinker layer (341), which was cut by both the later Culvert 133 and Wall 155.

5.60 **The Revetment:** The initial backfill of the revetment Structure 380 located on the north-east side of the dam bank structure may have occurred in two phases, firstly with the deposition of silty sand material (265) that appeared to have been cut (382) to the north-east and followed by the mass fill of Layer 378 (Fig. 23, S.81). The latter consisted of friable clay silt with frequent sandstone fragments that overlay the majority of the revetment structure. This was overlain by clinker material (383 and 266) that will be discussed below. All these deposits were truncated to the north by Cut 267 from the later Wall 155.

5.61 **Clinker layers:** An extensive series of layers consisting of clinker material was located backfilling the upper parts of the conduits and revetment structure in the north-east area of the site. As mentioned above, these overlay the initial demolition-type layers that filled the lower areas of these structures, and were utilised to continue the backfilling of this area. Although cut by Culvert 133 and the foundation cut for Wall 155 (161 and 262) it was essentially the same clinker layer that was identified tipping down from the lower trench baulk to the south-east of Revetment 380 across to north-east end of the conduits and continuing in the north-west trench baulk. Context 117 tipped down into the north-east end of the Conduit A and was noted in the section above as Context 175 (Fig. 17, S.2 and 11). Discrete layers were apparent within the clinker deposits although they were essentially the same layer, consisting of a loose

dark to mid pinkish purple gritty matrix largely comprising fuel ash and coal, and appeared to have been deposited within a short space of time.

5.62 A very large quantity of artefacts was recovered from these clinker deposits including pottery, clay pipes and some worked bone (see Section 6). Whilst too numerous to repeat here some finds aid in generally characterising these deposits. Several clinker layers were identified backfilling the north-east end of Conduit A (111, 113, 114 and 117, Fig. 26, S.6). Layer 112 consisted largely of unfired white clay with inclusions of artefacts, the former from clay pipe production. Clay pipe material from both contexts 111 and 113 provided a tight deposition date for the deposits of 1840-60, and whilst yielding a range of mid to late 19th-century pottery the former contained a fragment from the Don Pottery with a makers mark dated to 1850-5 (see Section 6.1). The same 1840-60 deposition date range has been proposed for the clay pipe material from the clinker deposits that backfilled the south-west end of Conduit A (341, Fig. 21, S.78) and were above the revetment structure 380 (266 and 383, Fig. 23, S.81) as well as portraying similar forms and marks (see Section 6.2). Most significant is the assemblage of clay pipe production waste (383) that contained unused fragments and unfired white clay similar to those in the other clinker layers along with some unused material derived from Leeds. This may highlight the mixed nature of the clinker deposits as they also included classically Sheffield-type material from the Don Pottery. This notion is strengthened by the presence of both ferrous and non-ferrous-type crucible fragments found in layers 111, 113 and 117 which also indicated the mixed domestic and industrial nature of deposits used in backfilling the site.

5.63 **Upper Backfill:** After the initial backfill of the building area more general layers of made ground were used to level the site. The wheel pit area was levelled by a slightly mixed mid brownish grey silty sand layer (110, 170 and 211) which was overlain by a similar extensive layer 131 (Fig. 17, S.2, 11 and 36). Inclusions within these layers consisted of brick, sandstone and clinker fragments and clay pipe material from Context 110 indicates a deposition date of 1840-60 (see Section 6.2). Layer 131 appears to have been introduced to the area after the construction of Wall 108 in Phase 3B. The latter appeared to also backfill the later foundation trench for Wall 108 (191/204, Fig. 17, S.2 and 23) although a boundary could easily have been overlooked within very similar deposits.

5.64 **The dam:** The backfilling of the dam area was of a similar pattern to the forge building area of the site consisting of a series of deposit layers. The first backfill layer was a bright orange clay silt deposit (240) that was tipped into the dam from the east side (Fig. 20, see S.63). This was then overlain by two associated layers of greyish brown silty clay (334) and loose orange silty sand (243). It appears that the dam was drained prior to backfill as there is no evidence of the mixing of the initial deposits that would be expected if water was present. These layers were also observed in the next section above (Fig. 20, S.41). Extensive purple-red and black clinker layers (244 and 246) were then tipped into the dam from the east. These clinker deposits differed from the similar deposits used to backfill the conduits and revetment by their distinct lack of artefact material, again highlighting the varied nature of this type of deposit on the site. The dam area was then levelled with an extensive mixed made ground deposit (247) of yellowish-grey brown silty clay

containing *c.*25% angular sandstone fragments and occasional brick and mortar fragments. Several other mixed layers of made ground were located above this (279, 280, 281 and 282, Fig. 20, S.41).

5.65 The deep made ground deposits to the west (247, 278, 280 and 283) were cut by the large construction cut (277) for the rear of Wall 155 (Fig. 19, S.19). Layer 247 yielded 30 fragments of late 18th-19th century pottery and clay pipe fragments dated to 1850+ (see Sections 6.1 and 6.2).

5.66 **To summarise**, it appears that backfill material of the forge building area and dam was tipped from the east and west sides. The initial backfill deposits tended to be more mixed and varied and contained more artefacts. The exception of this was the relatively 'clean' rubble deposits used to backfill the wheel pit area (e.g. 213), perhaps occurring after the removal of demolition material.

Phase 3B: Wall 108/275 (mid-late 19th century, Figs 10 and 30):

5.67 The backfill deposits of the building and dam were cut by two later walls (108/275) and a large brick culvert (133, Fig. 10). These features paid no respect to previous structures and cut through them. The first of these to be constructed on the site was the large retaining wall 108 that was orientated north to south and excavated to a length of 10.32m. The wall turned at right angle to the east at the southern end evidenced by similar build style (275, Fig. 30) and this section was later incorporated within the lower part of Wall 155. Constructed from irregular sized squared sandstone ashlar blocks with some smaller squared packing stones the wall was faced and battered on the eastern side (Fig. 28, S.4 and 21). The upper width of the wall was 0.75m. There was some evidence of reused stones within the structure (e.g. 196) and one stone displayed a possible square mason's mark (Fig. 28, S.4). The west face of the wall was vertical and built of unfinished roughly hewn angular sandstone fragments bonded by a dark grey mortar, originally having been hidden by made ground (Fig. 29, S.27). The wall served as a revetment to a raised area to the south and west with a fall to the north-east, the base of which was not located. The wall was excavated to a depth of 2.4m. The east-west section of the wall (275) that was incorporated into Wall 155 was of a similar construction and contained several reused ashlar blocks (Fig. 27, S.42). It is argued that Wall 275 was a continuation of Wall 108 due to similar construction styles of the finished faces. The difference in character to the lower structure of Wall 155 (Fig. 27, S.42) was also marked. There was no evidence, however, of a join in the south face of Wall 155, (Fig. 29, S.54), but the wall may have been widened.

5.68 A construction trench for Wall 108 (191 and 204, Fig. 17, S.2 and 23) was located along its western side. This shows that the wall post-dated the backfilling of the building as trench 191 cuts backfill layer 177 (S.2), and also cuts Culvert 201 (Phase 2). Finds located within the lower backfill of the foundation trench (205, see Section 6.1) are likely to be residual and derived from the surrounding made ground material that was used to fill the foundation trench. Layer 131 appeared to fill the upper level of the foundation trench and continued to the south-west (Fig. 17, S.2 and 2B, Fig. 18, S.16, and Fig. 19, S.17) and was overlain by a firm dark greyish brown sandy silt layer

(171) of made ground. This in turn was overlain by a compacted coal surface, Layer 105 (Phase 3C). Layer 131 appears to represent part of an episode of deposition introduced after the construction of Wall 108 in Phase 3B to raise the ground level to the west, however boundary definition within the mixed deposit was not clear, and the western part of the layer outside the wall foundation cut (191) may derive from earlier backfilling of the building in Phase 3A.

5.69 The upper courses of Wall 108 had been truncated and any associated surfaces on either side were not located. Hand auguring was attempted in the base of the machine-excavated sondage to the east of the wall to determine its depth, although this was unsuccessful due to the high frequency of stones in the backfill material.

Phase 3C: Wall 155, Culvert 133 and Surface 105 (mid-late 19th century)

5.70 Wall 108 was superseded by the large retaining wall (155) that dissected the site and was associated with a large brick culvert (133, Fig. 10). Again, these features did not respect any of the structures relating to the forge building or dam and truncated them. The linear culvert was constructed first and was curved slightly around the corner of Wall 108. The culvert was constructed within a steep sided trench (132, Fig. 17, S.2,11 and 36) and was domed in cross section. The direction of flow was to the north-west and the culvert still functioned as a main drain overflow. The structure was breached at the north-west end by the contractors for assessment. At 1.2m in width the structure consisted of mortared whole and half machine-made bricks orientated longitudinally that have been dated to 1840+ (see Section 6.3). Two layers of bricks were used providing the structure with considerable strength. The culvert cut through the central area of Conduit A and cut Conduit B. A rough construction area within Wall 155 was noted (232) where the culvert was incorporated into the structure (Fig. 27, S.42 and Fig. 29, S.54). The mixed backfill above the culvert consisted of stone and brick material within a mixed dark greyish brown silty sand matrix that yielded clay pipe fragments deposited between 1840-60 (see Section 6.2) although these may be residual. The upper clinker rich backfill above the culvert (130) contained a 'Clyde' pattern jug fragment dating from 1840-93 (Fig. 17, S.2, see Section 6.1).

5.71 The area to the north-east of Wall 108 was filled in around this time with a series of mixed made ground layers that appeared to have been tipped down from the top of Wall 108 towards the east (106, 107, 123 and 124, Fig. 17, S.1 and 2). The base of the lowest layer was not located as health and safety concerns restricted excavation and auguring failed to penetrate the layer due to stones. This made ground contained a Layer 109 (located abutting Wall 108 to the east, not illustrated) that contained a large quantity of crucible fragments, including a whole example, that were derived largely from ferrous production but also included some fragments from non-ferrous metal production (see Section 6.5). This material was certainly imported onto the site to use as backfill, and perhaps from more than one crucible shop.

5.72 Wall 155 was then constructed across the area incorporating the remains of the earlier retaining Wall 275. Constructed from large sandstone ashlar blocks the external face of the wall was to the north (Fig. 27, S.42) where it was heavily

tapered with a lower width of 1.12m and upper of 0.65m. A maximum height of 3.54m was exposed and a foundation level of various sized squared sandstone blocks (340) was located on the southern side (Fig. 29, S.54). Some of these blocks were very large and of a more coarsely grained sandstone and may have been reused from elsewhere. The ashlar blocks forming the visible external face of the wall were demarcated by a distinctive course within the wall construction, below which the face was less well finished, indicative of an intermediate foundation level. Wall 108 had been truncated to the level of this course, as had the made ground that backfilled the earlier building. It was at that level that a thick compacted coal surface (105) had been deposited abutting the external face of the wall. Consisting of small coal fragments and dust the surface was contemporary with the wall and extended over the whole area to the north (Fig. 19, S.17, Fig. 18, S.16, and Fig. 17, S.2). This surface was a maximum of 0.7m thick and formed a level yard area (Fig. 31). No surface associated with the south side of Wall 155 was located due to truncation.

5.73 Construction cuts for Wall 155 were observed on both the north and south sides. It appeared that the lower part of the wall was constructed from the southern side with the upper more highly finished, part of the wall constructed from both sides. The cut on the north side (161, Fig. 10, Fig. 19, S.13) is characterised by a steep sided trench backfilled with re-deposited material (162 and 163) observed within the surrounding made ground. Evidence of the northern cut was located below the level of Surface 105. On the south side the lower foundation level of the wall (340) was constructed in a narrow trench (267) into the natural clay and backfilled with re-deposited clay material (329). Two small stake holes (330 and 331, Fig. 12) were located adjacent to the south side of the walls foundation and may represent markers or scaffold bases used in construction. At between 50-70mm in length, 30-40mm in width and 80-160mm in depth the sub-circular holes were voids. The line of the wall cut was often lost due to the similarity of surrounding deposits and likely collapse during construction.

5.74 The main foundation cut (277) on the southern side of Wall 155 was far more substantial and extended virtually the height of the surviving wall (Fig. 19, S.19, 45 and 52). The foundation trench cut the mass backfill deposits within the former dam (247, 278, 280 and 283) suggesting the level on the southern side was high before the construction of the wall. Large amounts of material was cut away from the southern side to create the *c.*7m wide trench which was backfilled with a sandstone rubble with some brick fragments within a mixed light yellowish-grey brown sandy silt matrix (276).

Phase 3D: Upper levelling and cobbled surface (101) (*c.*1905)

5.75 The final episode of activity on the site is represented by the disuse of Wall 155 and Surface 105 and the infilling of the yard area it covered. The made ground consisted of various mixed layers of largely clay and silt sand material containing sandstone, brick, clinker and coal fragments (e.g. 104, 128 and 127, Fig. 17, S.3, and 172 Fig. 18, S.18). Other dumps of more mixed silty sand material (173 and 174, Fig. 18, S.16 and 18). These deposits appear to have been used to fill in the yard area to the north of Wall 155, which itself was

truncated having stone work removed and angled to slope slightly down to the east. This was to accommodate a new cobbled surface that was laid in this area. A brick and stone capped manhole to the south of Wall 155 (290) and gas mains to the north (179) were laid at this time (Fig. 18, S.18 and 19). The cobbled surface sealed the whole site, apart from some disturbance from a modern drain towards the southern upper baulk, and consisted of a layer of sandstone rubble and brick (103) forming a foundation, which was overlain by a 0.3m thick layer of rough concrete (102; Fig. 17, S.3; Fig. 18, S.18 and Fig. 19, S.19). This provided a flat and solid base for the cobbled surface (101) that comprised regular granite sets of various sizes that were orientated longitudinally north-east to south-west. The sets were between 85-90mm in width, 0.18-0.24m in length and 0.14-0.16m deep. The surface sloped down slightly to the north-east and the upslope edge of the sets was slightly raised presumably to aid in the grip of horses hooves. The sets were bedded in coal tar above the concrete with the gaps filled in with the same substance. The upper surface of the sets showed moderate wear.

5.76 A thin layer of modern tarmac (100) *c.*0.2m thick overlay the cobbled surface.

6. Artefact Record

6.1 **The pottery** by C.G. Cumberpatch BA PhD

Introduction

6.1.1 The pottery assemblage from Sheaf Square, Sheffield was examined by the author in December 2004 and January 2005. It consists of 1291 sherds of pottery from stratified contexts weighing 39,443 grams representing a maximum of 1171 vessels (Tables 1 – 4, Appendix III, Volume 3; a combined table listing the pottery in context number order forms part of the site archive). Unstratified contexts produced seventy-three sherds of pottery weighing 2581 grams representing a maximum of sixty-seven vessels (Table 5, Appendix III, Volume 3). Eight ceramic objects (seven balls and a ring) and a number of fragments from figurines form part of the ceramic assemblage (Table 6, Appendix III). Selected sherds are illustrated in Plates 19 to 43, Volume 2. A small number of fragments of tile and glazed sewer pipe were also included in the assemblage but have been omitted from the discussion (Table 7, Appendix III, Volume 3).

6.1.2 The pottery was not marked and this limited the extent to which a comprehensive search could be made for cross-context joins. A small number of such joins were noted because of the distinctive nature of the vessels involved and these may be indicative of a greater incidence of cross-context joining than is apparent from the data.

Type series

6.1.3 All of the pottery is of well-known and well-recognised types dating to the later 18th, 19th and early 20th centuries. The literature on the pottery of this period is both extensive and detailed (although generally concerned more with tablewares than with utilitarian wares) and for this reason the following type series is selective, focussing on issues of particular relevance to the Sheaf Square site and sites of a similar date in Sheffield. Where particular types have been described fully in published sources references are given rather than summaries of general information. A broader consideration of general issues related to pottery from industrial sites in Sheffield is currently in preparation, reflecting the author's opinion that the significance of 18th to 20th century pottery from such sites will only become apparent once substantial assemblages from sites across the city can be compared and contrasted (Cumberpatch in prep. 1).

6.1.4 The general impression is that the assemblage consisted of a wide range of domestic pottery, including domestic tablewares, decorative items and utilitarian wares. The tablewares were not limited to smaller items such as cups, plates and saucers, but also included large serving vessels. In this the assemblage is similar in character to many from the centre of Sheffield.

Utilitarian wares

6.1.5 The utilitarian wares from the site fall into two broad categories; stonewares and earthenwares. Of these two the former are better known and documented than the latter, although the Brown Glazed Coarsewares are one of the principal ware types recovered from sites excavated in Sheffield. The range of utilitarian vessel types is summarised in Table 8, Appendix III, Volume 3.

6.1.6 The stonewares fall into two main groups; bottles and flagons used for the transport and retail of beverages and bowls and dishes used for food preparation and serving. The majority of examples of the former (generally green or buff in colour) from Sheaf Square were unmarked, with the exception of a bottle from an unstratified context which is stamped with the words 'Old No. 12'. Other examples of this stamp have been recovered from the Sheffield Riverside site and it is believed to refer to a brand of Porter, although this has yet to be positively confirmed. Notable by their absence from the assemblage were the grey stoneware jam and marmalade jars which are normally a common feature of assemblages of this date.

6.1.7 The Brown Salt Glazed Stoneware bowls and dishes were generally decorated with parallel bands of short vertical lines apparently applied with a roulette wheel, often in combination with repeated stamped motifs; short wavy lines, wheel or star patterns. It is assumed that these vessels were used primarily for cooking; specifically cooking in an oven. Lid seated rims were noted in a number of cases although fragments of lids were scarce within this assemblage.

6.1.8 Stonewares were manufactured in a number of towns in north-east Nottinghamshire and north-east Derbyshire including Chesterfield, Alfreton, Bolsover, Nottingham and Derby. Marked examples are rare and it is impossible to determine precisely where the vessels from Sheaf Square were made. Drawing an analogy with the tablewares it may be suggested that a local source is more likely than one as distant as Staffordshire, particularly prior to the later 19th and early 20th centuries, but without marked examples and in the absence of any detailed typological study of the decorative motifs it is impossible to be certain.

6.1.9 The Brown Glazed Coarseware category is dominated by large earthenware pancheons and open bowls, generally with heavy rims. These vessels are a common find on sites throughout the city and are also found in significant numbers on rural sites. It is generally supposed that they were used for a variety of domestic purposes and the numbers of sherds from sites such as Sheaf Square suggest that they were in very common use. Similar fabrics were used to manufacture industrial vessels and it is possible that some sherds were derived from such vessels. Small numbers of Yellow Glazed Coarseware vessels were also recovered although these were extremely rare in contrast with the Brown Glazed wares which occurred in almost every context. Our knowledge of the manufacture of utilitarian earthenwares is relatively poor, although the excavated evidence suggests that this was a large and important industry, at least from the point of view of the local economy. Lawrence (1974) has noted those potteries which are recorded as having produced earthenwares but to date none of these has been excavated and the available historical information has yet to be interpreted in archaeological terms.

Tablewares

6.1.10 The range of tablewares from Sheaf Square is typical of that from the majority of industrial sites excavated in the centre of Sheffield and included a wide range of the types of pottery in daily use by the population in the later 18th to early 20th centuries within the city (Table 9, Appendix III, Volume 3). The question of how and why so much domestic pottery (presumably forming part of bodies of material consisting of a range of domestic refuse) is found on industrial sites is one that will be considered in greater detail elsewhere (Cumberpatch in prep. 1).

Creamware

6.1.11 Small quantities of Creamware were recovered from contexts 120, 159, 247, 302, 341, 400, 172/173 and 333/367. Possible Creamware sherds came from contexts 119 and 306. Only two sherds are decorated, one with underglaze paint, the other with a rilled band above the base. The date range for Creamware (broadly 1740/1760 – 1820) covers the earlier phases of the site and the Creamware sherds do not appear to have been derived from pre-existing refuse dumps as was suggested to have been the case at the nearby Suffolk Road site (Cumberpatch 2002).

Transfer Printed wares (Pearlware and Whiteware)

6.1.12 Transfer Printed wares form a substantial proportion of the total assemblage and of the tableware component. Both Transfer Printed Pearlwares (*c*.1780/1790 – *c*.1830/1840) and Transfer Printed Whitewares (*c*.1830/40 – early 20th century) were present and in some cases the distinction between the two was difficult to determine, either because of the inherent difficulty of classifying the sherds as either one or the other or because the sherds were crazed and discoloured as a result of the effects of the burial environment.

6.1.13 The range of decorative motifs and themes is typical of the period represented by the assemblage with two identifiable Chinese landscapes (Willow and Two Temples) present with a small number of other, unidentified, Chinese-style landscapes. European landscapes include examples of the Don Pottery Italian and Sicilian landscape designs (described below) and a number of other, unidentifiable European landscapes, predominantly rural scenes. Borders included unidentifiable floral and geometric styles in addition to those associated with particular ranges of named designs. Other designs include the common Asiatic Pheasants and Albion patterns, represented by both borders and by fragments of the complete design.

6.1.14 Only one transfer printed vessel bears a maker's mark, the base of a plate from context 111. This is part of a design featuring a rising bird within a multi-pointed outline, probably the upper part of a stylised shield (Plates 21A and 21B). The words IRONSTONE CHINA are printed above the device. This closely resembles an example illustrated by Lawrence (1974, 248, 251) and attributed to Samuel Barker & Son of the Don Pottery, located between Swinton and Mexborough. Lawrence dates the mark to *c*.1850 – 55 and notes

that it is uncommon. In a more recent and more comprehensive survey of the history and products of the Don Pottery, Griffin has illustrated an example of the mark (2001, 203, Mark number 3), describing it as an 'Eagle rising from a coronet within a shield'. He notes that, although Jewitt suggested that it was linked with the establishment of the partnership between Samuel Barker and his son Henry *c*.1851 (probably the source of Lawrence's dating), the issue is more complex than this and a definite date is impossible to ascribe on the basis of present knowledge.

6.1.15 The design in the centre of the plate appears to be very similar (but not identical) to an example illustrated by Griffin (2001, plate 276) which also bore the rising eagle mark. This apparently unnamed design has a distinctive floral border which occurred on a number of sherds from Sheaf Square (contexts 111, 205, 266 (two examples) and 341). The example from context 341 has a mark on the underside consisting of blue dots seeming to form the letter 'K'.

6.1.16 A particularly distinctive piece, the foot of a large vessel, bears an example of the oddly named 'Clyde' pattern (Plate 33). An example of the design has been published by Griffin (2001, 202, plate 273). This is a jug and, like the Sheaf Square example, is unmarked but a bowl in Doncaster Museum bears the same design (in blue) and a maker's mark naming the design and the Barker initials, suggesting a date between *c*.1840 and 1893.

6.1.17 The Italian and Sicilian Landscape designs (Plates 13, 16B and possibly 16A; contexts 266, 341 and possibly 134), with their distinctive borders incorporating cherubs and flowers (Griffin 2001, 106-7, plate 52), appear to be somewhat earlier than the design previously described and were introduced during the Green's ownership of the Don Pottery (1801 – 1834). Unfortunately (from the point of view of dating the individual items), the plates used to produce the transfers were bought by the Twigg's of the Newhill and Kilnhurst potteries at the Green's bankruptcy sale in 1834 and continued to produce wares with this design. Without the benefit of maker's marks it is difficult to be certain of the attribution of the pieces from Sheaf Square and consequently, of their date. Given that the date of deposition may well be considerably later than the date of manufacture, the stratigraphic associations of these sherds is of little assistance in determining their origin.

6.1.18 One feature worthy of note, albeit in a negative sense, is the absence of the distinctive dark blue borders of the Italian Landscape series (Griffin 2001, 111); this pattern is common on other sites in Sheffield (notably Riverside; Cumberpatch, in prep 2.). The significance of such apparent patterning in deposition across the city is, at present, unclear.

6.1.19 Other designs were impossible to ascribe to particular manufacturers although given the presence of both Don Pottery and Newhill / Kilnhurst products (the latter described below) it is probable that some of the Chinese Landscape and other common designs were made at these potteries. Identifiable examples of specific common designs include Asiatic Pheasants (contexts 104, 111, 128, 266, 273), the Albion pattern (context 266) and other rural landscapes and floral 'still life' style designs which were too fragmentary to identify.

6.1.20 Context 197 produced a marked piece of late date (Plates 23A and 23B). The ring foot base and lower body of a bowl bears the 'Sultan' design in black on a thick white body. The mark on the underside named the design and identifies the maker as G. Bennett & Co. of the Victoria Works, Stoke, indicating a date of manufacture between 1894 and 1902 (Godden 1991, 69).

6.1.21 Context 266 produced a body sherd from a small jug (Plate 25). This is decorated with a transfer printed panel with simple flower and leaf motifs surrounding a phrase, only part of which survives. The words read:

It is good f…

To draw near … The full phrase is unknown.

6.1.22 Two marked sherds were noted in unstratified contexts. The first of these bears a maker's mark which can not be identified with a specific manufacturer (Plate 37) but appeared to indicate an origin in Staffordshire. The sherd is abraded and discoloured but most probably dates to relatively late in the history of the site, given that other evidence points to a later 19th and early 20th century arrival of Staffordshire pottery in Sheffield (Cumberpatch in prep. 1). The second sherd is from a commemorative vessel produced to mark the Diamond Jubilee of Queen Victoria in 1897 (Plate 38).

6.1.23 In addition to the purely decorative transfer printed designs, two pot lids were identified bearing information about the product and the retailer. One of these is too fragmentary to be identified (context 396; Plate 29) but the other is substantially complete. This contained a preparation called Bell's Sicilian Cream 'for improving the growth of hair' (Plate 19). In addition to a brief description of the contents, the lid also bears the address 'No. 49 Church Street, Sheffield'. A similar lid was recovered from the excavations at Sheffield Riverside (Cumberpatch in prep. 2) and a brief search of the relevant trade directories has produced the following list of occupants of 49 Church Street:

Date	Proprietor	Products
1839	C. Hinde	Tortoiseshell comb, razor and penknife maker
1841	C. Hinde	Comb manufacturer
1849	Chas. Hinde	Tortoiseshell comb manufacturer and perfumer
1854	C. Hinde	Comb manufacturer
1856	C. Hinde	Comb manufacturer
1860	J.H. Wilson	Comb manufacturer
1862	J.H. Wilson	Fancy goods retailer

6.1.24 The product, Bell's Sicilian Cream, has not been traced specifically, although Dale (1977) has identified a Thomas Bell who worked at 131 Norfolk Street, Sheffield and is known from a reference on a shaving cream pot lid.

Edged ware

6.1.25 Edged ware, also known as 'shell edge ware', was a style popular between *c*.1810 – *c*.1830 and which declined sharply in the 1840s although it persisted as a minor style until the 1870s – 1890s. The typical earlier patterns have moulded relief decoration and wavy or scalloped edges, with the later types being plain with simple painted decoration (Barker nd.). The examples from Sheaf Square (contexts 111, 197, 205, 247, 291, 305, 306, 341) are of the earlier type with both relief moulding and wavy edges and a significant number appear to be Pearlwares, suggesting a date in the earlier third of the 19th century. An example of the later, plain painted type was noted amongst the unstratified material.

Sponged ware

6.1.26 Two variants of sponged ware have been distinguished in the data tables. Sponged ware covers the majority of sherds which are decorated with random patterns of sponging forming no particular pattern (contexts 104, 111, 112, 117, 119, 128, 130, 134, 162, 197, 222, 266, 268, 273, 341 and 333/367) while Sponge Stamped ware describes those sherds decorated with designs based upon the use of shaped sponges including leaves, fronds and baroque motifs (contexts 111, 128, 135, 247). Sponged ware, one of the cheapest varieties of decorated whiteware, was popular from the 1830s/1840s until the later 19th century (Barker nd.) and was manufactured widely throughout Britain. A particularly notable sherd from Sheaf Square is that from context 197. This bears an impressed maker's mark on the underside: 'TWIGG / K – P' (Plates 20A and 20B). The mark relates to the firm of J. Twigg Brothers who operated the Kilnhurst Pottery (indicated by the 'K-P' element) between 1839 and 1884 (Lawrence 1974, 109-110. Godden dates the mark to the period between 1839 and 1881 (1991, 628).

Cane Coloured ware, Slip Banded and Mocha wares

6.1.27 Cane Coloured wares, both plain and decorated are a common element within the assemblage. Plain Cane Coloured wares were comparatively rare and the numbers of undecorated vessels is also distorted by the inclusion in the undecorated category of undecorated bases which probably belonged to vessels which most probably bore decoration on the upper surfaces. The principal decorative elements were slip bands, principally white but also blue and brown. In addition, Mocha wares are also present, the commonest colours being blue on white bands on cane coloured bodies. According to Barker (nd), slip banding on Cane Coloured wares was popular from the 1830s/1840s until well into the 20th century although it occurs somewhat earlier on Creamwares and Pearlwares. Like Sponged ware, slip decorated wares were generally cheaper than transfer printed wares and were readily available from a large

number of producers. Production was widespread and individual pieces are impossible to attribute to specific factories unless marked. A wide variety of vessels can bear slip decoration, but, as Barker has noted (nd.), from *c*.1830 until the end of the 19th century, the numbers of decorated mugs and other forms declined while bowls, particularly the distinctive carinated or 'London' shape, became more common. This form was certainly common amongst the Sheaf Square assemblage in both Cane Coloured and Blue Banded wares, although the numbers of splayed bases suggest that other forms were also of some significance. Jugs are also amongst the types identified and may be under-represented because they are only positively identifiable from the spouts.

6.1.28 Mocha wares first appeared around 1795, but there is no reason to suppose that the examples from Sheaf Square are as early as this; the majority are probably of mid to later 19th century date, contemporary with the slip banded wares. As with these wares, bowls appeared to be the principal vessel type, although one jug was also noted (context 273). One sherd of marbled slipware was noted (context 305).

Blue Banded wares

6.1.29 Blue Banded wares, distinguished by the presence of blue bands and lines on whiteware bodies, are a common element within the assemblage, as they are in other assemblages from the city. Vessel forms included carinated bowls of 'London' form, mugs, jugs and other unidentified hollow wares. The date range appears to be similar to that of the Cane Coloured wares and a mid to later 19th century date range is indicated by the fact that the majority of these vessels are whitewares rather than Pearlwares.

Whiteware

6.1.30 Undecorated whitewares formed a substantial part of the assemblage, although it is possible that in a number of cases the lack of decoration is due to the part of the vessel represented rather than the fact that it was not decorated. Thus the numbers of vessels apparently present may over-represent the actual proportion of plain whitewares in the original population. The vessel types identifiable included a wide range of tablewares as well as a smaller number of utilitarian types including small jars.

6.1.31 A distinctive type of whiteware, Relief Banded ware is characterised by alternating raised and recessed bands around the vessel, typically found on jugs and small jars. The type appears to belong to the latter part of the 19th and early to mid 20th century, a dating borne out by its presence in contexts 104, 128 and 130.

Colour Glazed wares

6.1.32 The term Colour Glazed ware has been used to describe vessels with a white or pale buff body and dark, often very shiny, glaze internally and externally. The group includes vessels with the distinctive very shiny brown 'Rockingham' style glazed finish, although it should be emphasized that there

is no evidence that any of the sherds recovered were actual Rockingham products. Teapots are a common type in this category but other, unidentified, hollow wares are also represented.

Minor types

6.1.33 A variety of wares are represented by small numbers of sherds. *White Salt Glazed Stonewares* were present in context 263 only, most probably an indication that the assemblage as a whole post-dates the mid to late 18th century when such wares were in widespread use. *Black Basalt type ware* is represented by a sherd from context 396. This was not the authentic 18th century Black Basalt ware but a later 19th century type with a shiny finish. Similarly the sherds of *Jasper type ware* (contexts 172/173, 266, 305, 341) were later versions of an earlier type, distinguished by their whiteware refined earthenware bodies and shiny blue glazed finish. Two vessels, both relief decorated stoneware jugs or vases, represented a category of *decorative stoneware*. Sherds of one vessel were found in contexts 341 and 367 with a second vessel also represented in context 341.

6.1.34 *Blackware type ware* is defined as having a hard, dense, dark red fabric and black glaze, normally internally and externally. The type is more familiar from 18th century contexts where it appears to be a development of the more familiar 17th century Blackwares. Its presence amongst the Sheaf Square assemblage (contexts 110, 134, 297, 302 and 172/173) suggests that the type continued in production into the 19th century.

Ceramic objects and utilised sherds

6.1.35 A number of ceramic objects and fragments of objects were recovered. The details of the ceramic balls (Plates 39 – 41) and ring (Plate 42) are summarised in Table 3, Appendix III, Volume 3. Other objects included fragments of decorative figurines from contexts 266 and 172/173 and three utilised sherds with deliberately abraded edges from contexts 139 (Transfer Printed Whiteware) and 306 (Brown Glazed Coarseware). The latter are illustrated in Plates 24, 26 and 27.

6.1.36 Of these objects the figurines are the most straightforward to account for; they are decorative figurines of a type manufactured in huge quantities in the later 18th and 19th centuries and, although often referred to as 'Staffordshire figurines', were in fact made at potteries throughout the country. The fragments from Sheaf Square are too small to allow the form or character of the individual pieces to be determined, but their presence supports the implication inherent in the nature of the remainder of the assemblage, that it was largely or wholly derived from domestic refuse and had little to do with the industrial activities that were carried out on and immediately adjacent to the site.

6.1.37 The utilised sherds appear to have been deliberately smoothed on the edges in order to be suitable for some undetermined function. Such objects (usually referred to as 'pot discs') are a common find on archaeological sites of all periods throughout Europe, but their functions remain unknown.

6.1.38 Suggestions as to the function of the ceramic balls are numerous and include both domestic and industrial applications. It has been suggested that they may be components in a stoppering mechanism for stoneware bottles similar to the glass marbles used in the glass Codd bottle. It has been suggested that stoneware bottles were manufactured with a similar type of neck and stopper and although this may well be the case, no fragments of such vessels have yet been found on sites in Sheffield.

6.1.39 Industrial uses, including applications in the chemical industry and in polishing or smoothing processes have also been suggested. The lack of extensive wear or abrasion patterns on the surfaces suggests that this is not a wholly satisfactory explanation, as is the common presence of such balls in domestic assemblages.

6.1.40 Perhaps the most plausible explanation has been supplied by Geoff Preece and Peter Robinson of Doncaster Museum. This is that the balls were used in a popular game called 'Knurr and Spell', the Knurr being the ball and the Spell being a small cup on a spring used to launch the balls into the air from where they would be struck with a wooden bat in the direction of a hoop or a marked target, the aim being to place the ball as close to the target as possible. The game was extremely popular and was played on a league basis, teams being assembled from the clientele of public houses. It appears to have developed in the mining areas of South and West Yorkshire but on the evidence from Sheaf Square, may also have been popular in Sheffield.

An account dating to 1814 describes the game as follows:

> This is no doubt the same game, a little varied, which Strutt, in his Sports and Pastimes of England, denominates *Northen,* or *Northern Spell*. The little wooden ball is in Yorkshire called the Nor, and the receptacle, in which it is placed, the Spell. A sight of the Plate will sufficiently explain the nature of the game, which is necessarily played upon an open piece of ground. Upright sticks or stones, placed at certain equal intervals of about twenty yards, serve to regulate the score by determining the distance to which the ball is struck. The player uses a long stick of cane or hazel, to the end of which is fixed a thick solid piece of wood. With this instrument he raises the ball by tipping the sharp end of the spell, and he strikes it while it is in the air. Strutt describes the spell as hung upon a pivot considerably above the ground, the ball as made of leather, and much larger, and the stick as resembling in form the bat used for cricket. In short, it approaches more nearly to the modern game of Trap-ball, and by no means admits of the skill required in the one here represented. (Walker 1814)

6.1.41 It is possible that the presence of the knurrs on the site might indicate that at least some of the refuse deposited on the site was derived from public houses, but two considerations cast doubt on this suggestion. The character of the pottery assemblage, with few mugs or tankards and relatively few stoneware flagons and bottles is perhaps more likely to represent domestic refuse that that from public houses. Finds of knurrs are occasionally made in entirely domestic contexts, including an example recovered by the author from beneath the floorboards of his early 20th century terraced house.

6.1.42 Further examples of Knurr and Spell balls have been found at Suffolk Road (Trench 8, unstratified and context 2020, Cumberpatch 2002), Riverside

(Trench 4, context 4010, Cumberpatch in prep. 2) and Wellgate, Conisbrough (Trench 8, context 814, Cumberpatch 2003). Examples were also noted by the author on an unexcavated site at Silkstone, adjacent to the glasshouse (Cumberpatch, pers. obs.).

Vessel form and function

6.1.43 The range of vessel forms, listed by ware type, is summarised in Table 10, Appendix III, Volume 3. The extent to which the assemblage represents a cross-section of the domestic pottery in use in Sheffield in the later 19th century is unclear at the present time, although it is anticipated that a comparison of material from different sites within the city will cast light on this and related issues (Cumberpatch in prep. 1). In advance of this review, it may be noted that the cheaper kinds of tableware (Sponged, Cane Coloured and Banded wares) form an important element within the assemblage, although not to the exclusion of transfer printed wares. The general categories of Flatware and Hollow ware both relate to unidentifiable tableware forms, although it has generally been possible to distinguish individual vessels (particularly plates and saucers) from serving vessels on the basis of the thickness of the sherds and it may be assumed that the majority of flatware sherds are from plates and saucers although some smaller serving vessels (cake stands and similar) may be included in this group.

6.1.44 It is the common presence of significant quantities of domestic pottery and, in particular the larger vessels designed for the serving of food (tureens, carvers, servers etc.) which has been decisive in establishing that the majority of pottery assemblages are unrelated to the function of the industrial sites excavated in the centre of Sheffield. In the present case the fact that the material was dumped was clear from the character of the deposits (Lee, pers. comm.), but the similarity of the assemblage profile leads to the same conclusion, an observation that will be discussed in greater detail elsewhere (Cumberpatch, in prep. 1).

The pottery assemblage by context and phase

6.1.45 The phasing of the site used to structure the pottery report is presented in Appendix II. The greater part of the assemblage was derived from deposits apparently dumped on the site from elsewhere. In this regard, the assemblage is typical of most from industrial sites in Sheffield, a phenomenon to be discussed in greater detail in a forthcoming synthesis (Cumberpatch, in prep. 1). The date ranges ascribed to the phases are based upon documentary and cartographic evidence which provides far closer chronological resolution than is possible on the basis of the pottery.

6.1.46 This section has been kept deliberately short as the data is summarised in the tables (see Appendix III, Volume 3). The overwhelming impression is that the assemblage as a whole spans the period between the later 18th or early 19th century and 1905 but that within this there is little within the pottery assemblage to distinguish between the individual contexts or even the phases. The problems of dating unmarked tablewares and utilitarian wares which remained substantially unchanged throughout the period means that it is

difficult to achieve the levels of chronological resolution possible in the case of clay tobacco pipes or even, in the case of this particular site, the dating of structures with reference to cartographic data. Added to this the fact that the material appears to have been brought from elsewhere and dumped on the site, much of it in a lacustrine environment in which hydrological processes may have contributed to the mixing of deposits means that any attempt to draw definite conclusions on the basis of the composition of individual context groups would be over-ambitious and might risk pushing inference beyond the bounds of plausibility. The following notes are intended to highlight particular characteristics of the assemblage, and should be read in conjunction with the tables and with the evidence form other classes of artefacts, particularly the tobacco pipes (the report on which was not available to the author at the time of writing). As so often on sites in the centre of Sheffield, we are dealing with a particular kind of deposition and a range of site formation processes which are not conducive to the types of interpretation possible on other sites, rural or urban (Cumberpatch, in prep. 1).

Phase 1 (1793 – c1830)

6.1.47 Three contexts (157, 342 and 400) formed the earliest phase of the site (Table 1, Appendix III, Volume 3). These were mostly associated with the dam deposits. The pottery included some later 18th or early 19th century wares, (notably the Creamware from context 159 and the Transfer Printed Pearlwares from context 306) although these were alongside later (mid to later 19th century) material. Context 400 produced a relatively early sherd of pottery (Creamware) and 342 included two sherds of Mottled ware but the remainder of the group was difficult to distinguish from the rest of the assemblage and showed no particular signs of being earlier in date than other groups.

Phase 2 (c.1830 – 1855)

6.1.48 The contexts ascribed to the second phase of the site produced a small assemblage of pottery, the overwhelming majority of which was of mid 19th century date or later (Table 2, Appendix III, Volume 3). Although a date range of 1830 to 1855 has been proposed for the phase, a certain amount of the pottery, including both tableware and utilitarian ware, appears to be of later 19th-century type.

6.1.49 Contexts 139 and 359 were associated with a conduit feature linked with the 1830 – 1855 sawmill building, but the pottery showed little significant difference from the groups from other contexts and groups of contexts in terms of the range of types recovered from them.

6.1.50 Context 393, produced a small quantity of very late material, which seemed to belong to the final phase of activity on the site prior to 1905.

Phases 2 & 3 (c.1830 – 1905)

6.1.51 The phase designated here as 2 & 3 consists of material from contexts 333 and 367 (Table 3, Appendix III, Volume 3). These sherds were mixed up at the analysis stage and so are presented as coming from context 333/367. One

sherd, part of a decorated stoneware jug or vase was definitely from context 367 and has been noted as such. It is included with the data relating to Phase 3 as other sherds from the same vessel were recovered from context 341. The possibility that this particular context group contains later material should therefore be considered when referring to the data. The original records indicate that context 367 produced nine sherds of pottery while 333 produced twenty sherds.

Phase 3 (c.1855 – 1905)

6.1.52 Phase 3 produced the largest group of pottery from the site (Table 4, Appendix III, Volume 3). Much of this came from deposits dumped on the site and included ash, clinker, slag and other waste material from industrial processes (notably in contexts 111, 117, 266 and 341). The pottery clearly derives from domestic activity and it seems clear that it was brought to the site from elsewhere and used alongside industrial waste to fill features associated with the sawmill phase of the site. The date range of the material from these contexts is wide and includes material of mid to late 19th century date as well as later 19th to early 20th century types and small quantities of 18th century and later 18th to early 19th century material.

6.1.53 No clear distinctions could be made between the groups from the individual contexts in terms of the types or date range of the material represented but this group of contexts is the only one to display chronological characteristics which are significantly different to those of other phase groups from the site.

6.1.54 A number of contexts (104, 106, 107, 109, 110, 111, 128, 197 and possibly 266 and 341) appeared to be significantly later than others on the site and included substantial groups of late 19th to early 20th century material. Context 114, which belonged stratigraphically to early in phase 3, produced very late material, seeming to belong to the final phase of activity on the site prior to 1905. In contrast other contexts produced groups of later 18th and early 19th century pottery, including, in the case of context 263, the only sherds of White Salt Glazed Stoneware from the entire site. Contexts 119 and 283 were unusual in seeming to include a larger than normal proportion of later 18th to early 19th century wares, but the relatively small size of these groups and the presence of similar pottery in the larger groups from the phase, means that it would be hazardous to make assertions about the nature of the deposits based upon this evidence. Context 119 was also notable for the lack of crazing and discolouration on the sherds, in contrast with the situation found elsewhere.

Unstratified pottery

6.1.55 Seventy-three sherds of pottery were from unstratified contexts (Table 5, Appendix III, Volume 3). The group showed little variation from the pattern established elsewhere although it included two marked sherds (see sections 6.1.12-24 above).

Discussion

6.1.56 The close dating of the deposits enabled by the cartographic and documentary evidence available for the site means that the assemblage may be of some considerable significance in allowing later 19th and early 20th century pottery assemblages from Sheffield to be characterised, in contrast to those of earlier date, but the full significance of the assemblage will only become apparent when it is compared with others from the centre of Sheffield. While it is premature to attempt this in the present context, some comparison with assemblages from two nearby sites is of interest. These sites are the Leadmill (Cumberpatch 2004) and Suffolk Road (Cumberpatch 2002).

6.1.57 The assemblage from Suffolk Road includes material of an earlier and a later date than that from Sheaf Square. The Suffolk Works appears to have been built upon a site which was in use for the casual disposal of domestic refuse prior to the construction of the works in 1834. The quantities of Creamware were thus considerably greater than found at Sheaf Square, but White Salt Glazed Stoneware was as scarce as at Sheaf Square, perhaps suggesting that dumping only began relatively late in the 18th century. The later phases of the site post-date 1905 so that the assemblage also included early to mid 20th century lithograph decorated wares for which there is no parallel in the Sheaf Square assemblage.

6.1.58 The Leadmill site produced only a small assemblage of domestic pottery, the earlier component of which included Tin Glazed Earthenwares, White Salt Glazed Stonewares and Mottled ware. This appeared to be of residual character, consisting as it did of small, highly fragmented sherds. The 19th and early 20th-century wares generally resembled the material from Sheaf Square in that Sponged ware, Cane Coloured wares, Mocha ware and Transfer Printed wares were all present. The documentary and cartographic evidence suggested that the deposition of this material was connected with the demolition of the Leadmill and the construction of the tram depot on the site. A parallel can be drawn here between the Leadmill and Sheaf Square sites, although the precise relationship between the construction of the tram depot and the railway station forecourt is beyond the scope of the pottery report.

6.1.59 The principal difference between the assemblages from the three sites lies in the utilitarian wares. Both the Leadmill and Suffolk Road produced significant groups of industrial ceramics, specifically Brown Glazed Coarsewares. Both sites produced cylindrical and conical vessels and shallow unglazed dishes. In the case of the Leadmill many of the sherds bears a thick white deposit, believed to be related to the manufacture of white lead. A small number of vessels from Suffolk Road bore similar deposits, although it was far from general. The precise function of these vessel types is unknown and they are entirely absent from the Sheaf Square assemblage where pancheons, believed to be a primarily domestic and agricultural form, are the commonest type of Brown Glazed Coarseware vessel. In this, the Sheaf Square site more closely resembles Sheffield Riverside where domestic pottery of all types was predominant and specifically industrial vessels were absent.

Conclusion

6.1.60 As with most of the assemblages from sites in the centre of Sheffield, the significance of the group will only become fully apparent once it has been placed in its wider context through a process of comparison with others from the city, but even without this it clearly exhibits a number of specific features of interest, in addition to the general importance of the assemblage as an indication of the types of wares in use in Sheffield households in the mid to late 19th century. Amongst the specific items of interest are:

- The presence of a significant group of wares which were manufactured at the Don Pottery;
- The presence of a marked Sponged ware vessel from the Kilnhurst Pottery;
- The presence of a late mark relating to pottery from Staffordshire, the late date tending to confirm the impression from elsewhere that Staffordshire products only began to appear in Sheffield at the end of the 19th century as the local industry declined;
- Further evidence of the regular use of domestic refuse for the levelling and infilling of industrial sites in the centre of Sheffield.

6.2 **Clay tobacco pipes** by S. D. White PhD

Methodology and treatment of the material

6.2.1 The pipe fragments from the excavations have been individually examined and details of each fragment logged on an Excel spreadsheet. The layout of the spreadsheet has been based on the draft pipe recording system, which has been developed at the University of Liverpool (Higgins and Davey, 1994). Copies of the spreadsheet and the draft recording system have been deposited as part of the site archive. A Context Summary is presented as Table 10, Appendix III, Volume 3 of this report and a context summary by phase is shown in Table 11 below. Stem-bores for the bowl fragments and marked stems have been measured to the nearest 64th of an inch using a rule. In the case of the plain stems, only the surface treatment and a count have been given, i.e., the bores of plain stems have not been measured.

6.2.2 As none of the fragments were marked a pencil number has been written on the inside of the bowl so that individual fragments can be linked back to the spreadsheet. Where individual mould types can be identified, an alphanumeric code is used. A letter code denotes the mould type (for example A, B, C…..AA, AB, AC…..BA, BB, BC etc.) followed by a number to indicate each example of that particular mould. For example, a fragment marked A2 indicates that it is the second example of mould type A and BA4 would be the fourth fragment of mould type BA. These references are given in brackets throughout the text, for example (Ref. A5). Where the fragment is too small to

be assigned a specific mould type, a simple running sequence of numbers has been used, for example 1, 2, 3 ….etc.

The clay tobacco pipes in context

6.2.3 Clay tobacco pipes are probably the most useful dating tools for archaeological deposits of post-medieval date. They are found almost everywhere, were short-lived and were subject to rapid change in both size and shape. They can often be tied to a specific production site or, at the very least, to a regional centre. Subtle differences in their style and quality enable them to be used as indicators of social status as well as a means by which trade patterns can be studied.

6.2.4 The excavations produced a total of 923 clay tobacco pipe fragments consisting of 174 bowls, 695 stems and 54 mouthpieces from a total of 53 pipe bearing contexts and one unstratified deposit. The excavations produced a very small number of residual fragments – one plain 17th century stem from Context 318; two plain stems from the late 17th or early 18th century from Context 342; a single 18th century plain stem fragment from Context 306 and seven plain stem fragments of late 18th or early 19th century date (one from each of Contexts 306, 378 and 410 and four from Context 341). Of the remaining 911 fragments, 907 (99%) date from the 19th century with the most likely date of deposition being *c.*1840-1860. The final four fragments, all decorated bowls, date from *c.*1870-1920.

6.2.5 In addition to the clay tobacco pipe fragments, the excavations produced a small group of pipe clay objects associated with production waste, all from Context 383 (see below for a discussion of the kiln material).

6.2.6 Forty-four of the pipe bearing contexts and the single unstratified pipe bearing deposit yielded 10 or less fragments each. The dating of these individual deposits is, therefore, difficult to determine, particularly given that 21 (or 47%) of these deposits only produced plain stem fragments. Having said that, the majority of these deposits appear to contain fragments that have originated from long-stemmed pipes suggesting a deposition date of *c.*1800-1880.

6.2.7 The largest groups of pipes from the site come from those deposits that relate to the backfilling activity on the site following the closure of a sawmill/grinding mill *c*1855-6 (Phase 3A) but prior to the construction of a railway station *c*1870. The main deposit is Context 383 but overlaying this were contexts 111, 117, 266 and 341, which are described in the excavation notes as being the same as one another. Each of these five main contexts is discussed below.

6.2.8 **Context 111** produced one of the largest groups from the site consisting of a total of 148 fragments comprising 25 bowls, 112 stems and 11 mouthpieces. None of these fragments is marked but a total of 22 fragments are decorated. The date range for this deposit is *c*1820-1880, based on the diagnostic fragments, with the most likely date of deposition being *c*1840-1860.

6.2.9 **Context 117** produced just 13 plain stem fragments, 12 of which appear to have originated from long stemmed pipes that are most likely to date from

*c.*1800-1880. The remaining fragment is quite sharply tapering and would appear to have come from a shorter cutty style pipe, which would date from *c.*1860 or later (Fig. 35.16). This particular fragment has been broken and subsequently re-used. The tooth-wear on the fragment suggests that it continued to be used for some time before finally being discarded.

6.2.10 **Context 266** produced a total of 84 fragments comprising 17 bowls, 64 stems and three mouthpieces. These fragments include a Henry Tunstall marked stem (Fig. 34.9) and a bowl with a moulded ring mark on the sides of the spur (Fig. 35.8). There were also a total of 13 mould decorated fragments. This deposit overlay Context 383, which yielded the pipe production waste, and bowls made from the same mould were recovered from both contexts. Also, a number of the long pieces of plain stem from Context 266 have slaggy material adhering, suggesting they were waste products. The two latest fragments from this context, a fragment of a basket weave design (Fig. 35.11) and that of a branch design (Fig. 35.12) are slightly later in date than the rest of the material (*c.*1870-1910). The overall date range for this context is given as *c.*1800-1910 but the most likely date of deposition would be *c*1840-1860 (Table 11, Appendix III)..

6.2.11 **Context 341** produced a total of 42 fragments comprising 6 bowls, 32 stems and four mouthpieces. Only one marked fragment was recovered – a spur with a moulded ring and dot symbol on either side of the spur (not illustrated). A total of six mould decorated fragments were recovered from Context 341 including a possible acorn design (Figure 35.3) and one of six bowls from the site with a very elaborate floral motif on the front seam (similar example illustrated in Fig. 35.9). Context 341 was one of the few contexts that yielded earlier residual material consisting of a single abraded stem fragment dating from 17th or early 18th century. In addition there were four fragments of late 18th century date but the rest of the material was clearly 19th century. The overall date range for this context, therefore, is *c.*1630-1880 but with the most likely date of deposition, based on the diagnostic fragments, being *c.*1840-1860.

6.2.12 **Context 383** yielded by far the largest and most interesting group of material recovered from the site. This discrete deposit of clay pipe material includes production waste, and produced a total of 443 fragments, comprising 82 bowls, 333 stems and 28 mouthpieces, which accounts for almost half of the total assemblage. Two of the stem fragments are marked H TUNSTALL LEEDS. A total of 57 (or 70%) of the bowl fragments from this context are mould decorated. In addition to the actual pipe fragments production waste, comprising 37 fragments of clay sheeting and nine rolls or wads of pipe clay used within the pipe muffle, were recovered. See below for a discussion of the production waste.

6.2.13 There is little doubt that the material from Context 383 is clay tobacco pipe production waste from a kiln site. There are large numbers of un-smoked bowls that were produced in the same mould and the group contains large pieces of freshly broken pipe stem, some of which have glaze over the broken ends, and large numbers of them have slagging adhering. There is also a mouthpiece fragment that has not had either its tip or seams trimmed (Fig.

36.1). What is particularly interesting are the fragments of clay sheeting, some with traces of rim impression clearly visible.

6.2.14 What is unclear is where this material came from. There is no evidence to suggest that pipe production ever took place on the site itself. The only marked fragments associated with the production waste are three stems that can be attributed to a maker from Leeds, Henry Tunstall, but it would seem odd for a maker from Leeds to be disposing of waste in Sheffield. However there is precedent for this, particularly in association with a site close to a railway development. Excavation of a railway embankment in Durham produced a group of production waste that can be attributed to Thomas Holland, a Manchester maker who was registering designs in the 1870s. It has been suggested that this material was used as a fill or hard core and may well have been transported on the railway system (D. Higgins *pers comm*). It is possible that a similar situation existed in Sheffield and that suitable hard core was being obtained from some distance away, possibly Leeds.

Summary

6.2.15 The clay tobacco pipes recovered from this site provide a rare opportunity to date a large group of pipes, and it's associated kiln waste, very closely. The vast majority of the pipes derive from a dump of production waste that was deposited as back fill material following the demolition of the sawmill/grinding mill. All of the contexts that were described as "the same as", i.e., 111, 117, 266 and 341, produced elements linked to the main deposit of production waste, Context 383. Many of these pipes were made from the same mould and some do not appear to have been smoked and a large number of the stems had slaggy material adhering. The only marked fragments to have been recovered from the contexts associated with the kiln waste bear the name of the Leeds maker H Tunstall. The most significant fact is that these marked pipes have not been smoked suggesting that they are also waste pipes. The presence of a large group of kiln waste that may have come from as far away as Leeds raises some interesting questions over how such material was being disposed of during the 19th century, particularly in an urban setting. However, the discovery in Durham of a group of Thomas Holland production waste from Manchester suggests that disposal of waste via the railway network may not have been so unusual. The majority of the diagnostic fragments recovered from Sheaf Square have an end date of *c.*1860 but given that the documentary evidence shows that backfilling activity could have commenced on site *c.*1855/6, it is suggested that the material from the five main contexts (111, 117, 266, 341 and 383) should be considered as a single group of kiln waste dating from *c.*1855-60. It is further suggested that this material be attributed to Henry Tunstall of Leeds and that it was transported to Sheffield specifically for use as backfill material prior to the construction of the new railway.

The clay tobacco pipes themselves

6.2.16 Having considered the clay tobacco pipes in context, the following sections look at the clay tobacco pipes themselves under two main headings – the *Clay Tobacco Pipe Production Waste* and the *Other Clay Tobacco Pipes*.

Clay Tobacco Pipe Production Waste of *c.*1855-60 (Figs 34.1 to 36.4)

6.2.17 One of the most exciting features about this particular assemblage is the clay tobacco pipe production waste, the majority of which was recovered from Context 383. This context is described in the excavation account as a 'distinctive deposit of loose clay pipe material' and appears to be associated with the back filling activity on the site following the demolition of a sawmill/grinding mill *c.*1855 in Phase 3 of the site. Above Context 383 were four other contexts, which the excavation notes describe as being the 'same as' one another - these are 111, 117, 266 and 341. These contexts all contain unsmoked pipes from the same mould as the main group (i.e. Context 383) and so they can all be considered a part of the same kiln dump.

6.2.18 When combined, these five contexts accounts for a total of 735, or 80%, of the total assemblage, comprising 130 bowls, 559 stems and 46 mouthpieces. Analysis of the material had identified 38 different mould types present in the production waste together with a further 14 bowl fragments that were too small to be assigned a specific mould type.

Plain Bowls (Figs 34.1 to 34.11; Moulds G-H, J-Q, and T-U)

6.2.19 A total of 32 plain bowls were associated with the pipe production waste. A total of 13 different mould types have been identified but examples were only recovered from Contexts 266 and 383. The table below gives the number of examples of each type recovered from these two contexts. There are only two types that were too fragmentary to be worthy of illustration.

Fig	Mould	266	383	Total
34.1	H		2	**2**
34.2	M		1	**1**
34.3	L		1	**1**
34.4	P		1	**1**
34.5	G		6	**6**
34.6	O		1	**1**
34.7	Q		1	**1**
34.8	N		1	**1**
34.9	U	1		**1**
34.10	J		2	**2**
34.11	T		1	**1**
	K		1	**1**
	S		1	**1**

6.2.20 A range of plain forms represented in the kiln group has been illustrated in Figs 34.1 to 34.11. An interesting feature of the majority of the plain bowls recovered is the 'pinched' waist at the bowl/stem junction, making them appear quite narrow in the lower part of the bowl and bulbous in the top part.

Context	Phase 1	Phase 2	Phase 3
109			2
110			9
111			148
112			1
113			3
117			13
119			25
120			2
128			2
134			19
139		7	
162			1
166			1
195			1
197			12
197/251			3
205			9
211			1
214			2
225			1
238			1
247			4
251 (338)			9
256			1
260			1
261			1
265			1
266			84
268			3
273			3
282			1
288			1
302	3		
305	1		
306	6		
307		4	
316		1	
318		1	
341			42

Context	Phase 1	Phase 2	Phase 3
342	3		
343		1	
345			1
347			1
353			3
359		10	
361			1
367			1
378			1
383			443
388			5
390			1
396 (410)		1	
410		13	
Total	*13 (2%)*	*38 (4%)*	*864 (94%)*

Table 11. Summary of clay pipes by phase (eight un-stratified finds have been omitted)

6.2.21 Three of these plain bowls had the lettering H TUNSTALL LEEDS along the stem (Figs 34.9 to 34.11). Two came from Context 383, with the third from Context 266. All three stems can be attributed to Henry Tunstall who was working in Leeds *c*1836-61 (Oswald 1975, 202). A Tunstall stem is also known from the Riverside Exchange site in Sheffield (White 2002).

6.2.22 One of the fragments (Fig. 34.11) also has a moulded shield on either side of the spur. This motif is a degraded version of the arms of Gouda, one of the principal pipe production sites in Holland and renowned for quality pipes. Simplified, or degraded, versions of these arms quite often appear on English pipes during the nineteenth century. It is possible that the English makers were trying to draw on the association that Gouda had with quality pipes. Interestingly, a similar mark was recovered from the Riverside Exchange site and it is possible that this was part of another Tunstall pipe, as evidenced by a marked stem from the site (White 2002).

Mould Decorated and Marked Bowl Fragments

6.2.23 The excavations at Sheaf Square produced 122 mould-decorated bowls dating from the 19th and early 20th centuries of which 98 (or 81%) came from those contexts associated with the production waste. This accounts for 70% of the 174 bowls recovered from the site as a whole, or 75% of the pipes represented in the kiln group.

6.2.24 The mould-decorated bowls represent a wide range of patterns from simple leaf decorated seams to bowls with floral motifs; flutes; acorns and more decorative designs such as intertwined grape vines; Napier bust and a possible depiction of St. Christopher. A discussion of the various patterns represented follows in alphabetical order.

6.2.25 **Acorn (Figs 35.1 to 35.3; Moulds B, C and AR):** Three different acorn designs are represented in the kiln group (Fig. 35.1, 2 and 3) with a total of 13 examples being recovered. The table below gives the number of examples from each context for the three mould types.

Fig	Mould	266	341	383	Total
35.1	C			1	**1**
35.2	B	1		10	**11**
35.3	AR		1		**1**

6.2.26 The first (Mould C), of which there is only one example recovered from Context 383 (Fig. 35.1), has a large oak leaf up the front seam of the bowl - that is the seam away from the smoker. The spur of the pipe is in the form of an acorn. The second acorn form (Mould AR) was recovered from Context 341 (Fig. 35.3). This is a very small spur fragment that has been rather roughly finished. Only traces of the dots that appear on the lower part of the bowl can be seen but it is almost certainly of an acorn type. The third design (Mould B), of which there are 11 examples, has a group of three large oak leaves up the front seam of the bowl and small simple leaves on the upper part of the bowl on the seam facing the smoker (Fig. 35.2). All 11 examples were produced in the same mould - 10 came from Context 383, which also yielded the production waste, with two recovered from Context 266. This third type is interesting in that there is evidence to suggest that these pipes were produced in a mould that has been modified. Above the top of the large central oak leaf, on the seam away from the smoker, a small leaf can clearly be seen and may originally have been one of a number of leaves that ran down the front seam of the pipe, but only visible on the smokers left. Also, the lower part of the bowl is decorated with a series of raised dots, imitating the lower part of an acorn. This created a ridge in the profile of the pipe between the decorated lower part and the plain upper part. The large oak leaves up the front seam of the pipe appear to be later additions as the ridge is still clearly visible and some of the raised dots can be seen between the veins of the leaves.

6.2.27 **Basket weave (Fig. 35.11; Mould AM):** A single fragment of a pipe decorated with a basket weave pattern was recovered from Context 266 (Fig. 35.11). Although only a small fragment of this bowl survives it is most likely that this would have been a short, cutty-style pipe, common in the later part of the 19th century and into the early 20th. Its presence in the kiln group is interesting since this style is usually attributed to the period *c.*1870-1910. This example suggests that the basket weave motif was, in fact, already in production by the 1850s.

6.2.28 **Branch (Fig. 35.12; Mould AN):** One example of a branch motif was recovered from Context 266. As with the basket weave bowl above, the branch motif is one that would usually be dated from *c.*1870-1910.

6.2.29 **Claw (Fig. 35.13; Mould Z):** A single and very fragmentary part of a claw bowl that would originally have represented an eagle's claw holding an egg was recovered from Context 111. As with both the basket weave and the

branch motifs discussed above, the dating of this fragment would usually be from *c.*1870-1920.

6.2.30 **Cornucopia (Fig. 35.9; Mould W):** The excavations in Sheaf Square produced six fragments of an elaborately decorated bowl in the form of a stylised cornucopia, five from Context 111 and one from Context 341 (Fig. 35.9). The basic form of the bowl is very similar to the plain examples also recorded from this site, with the lower part of the bowl pinched in slightly at the bowl/stem junction. On the seam away from the smoker there is a very elaborate and rather stylish, decorative motif in the form of scrolls and flowers. The scrolls extend below the bowl terminating in a swirl where the heel or spur would be. On one of the examples the wire that was used to form the stem bore has been pushed through the front of the bowl and the pipemaker has applied a 'blob' of clay to disguise the hole. Unfortunately this repair resulted in the scroll work being obscured at this point but did mean that the pipe would be useable.

6.2.31 **Cup (Figure 35.4; Mould E):** A single example of a bowl with a cup or trophy on the smokers left surrounded by a floral spray that appears to consist of shamrocks and thistles, from Context 383. There is a rose motif above the cup, completing the emblems for England, Scotland and Ireland. Unfortunately the other side of the bowl is missing.

6.2.32 **Flutes and Scallops (Figs 35.14 and 35.15; Moulds X, Y, AE, AW and BA):** One of the most common forms of decoration on bowls of the late 18th and 19th centuries were flutes and scallops. Broader flutes, or scallops, which were thicker at the top tapering to a pointed tail, were common at the end of the 18th century. These were sometimes enclosed with a row of dots or a loop. Narrow flutes tend to become more common in the mid 19th century.

6.2.33 A total of 10 bowl fragments with fluted or scalloped designs were recovered from the excavations at Sheaf Square, six of which were recovered from those contexts associated with the production waste. Five different moulds were identified amongst the kiln debris and the table below gives the number of examples from each context for each mould type. Three of these types are too fragmentary to warrant illustration.

Fig	Mould	111	266	341	Total
35.14	Y	1	1		**2**
35.15	X	1			**1**
	AE	1			**1**
	AW			1	**1**
	BA			1	**1**

6.2.34 **Foresters Arms (Not illustrated; Mould AB):** A single bowl fragment decorated with the Foresters' Arms was recovered from Context 111 (not illustrated). Although the Sheaf Square example is only fragmentary originally there would have been a standing figure holding a bow and arrow on the smokers left with a second figure holding a club, with a hunting dog at his

feet, on the smokers right. On the seam facing the smoker is a depiction of the arms of the Ancient Order of Foresters. This was a society formed in 1834 with the aim of providing help and support to their members, in the form of benefit for the sick or funerals, in return for a subscription (Tatman 1995, 26). A complete bowl of this particular design was recovered during the excavations at Riverside Exchange (White 2002) and is almost certainly from the same mould as the Sheaf Square example. Similar examples have also been recovered from Lincoln (Mann 1977, 39, fig. 213) and Bristol (Jackson and Price 1974, 138).

6.2.35 **Grape vines (Fig. 35.10; Mould AD):** A single bowl fragment decorated with grape vines was recovered from the excavation (Context 111). On the smoker's left are intertwined grape vines. On the right is a barrel surrounded by more grape vines. The seam away from the smoker is decorated with small leaves. The rim of the bowl has moulded milling above a band of small hearts.

6.2.36 A similar pipe was recovered from the excavations at Riverside Exchange (White 2002, fig. 21) although in this particular instance a band of stars appears below the moulded milling rather than a band of hearts. A further example can be seen amongst the collections of Sheffield Museum. The main difference is that the museum example also has moulded lettering, which reads J. DEE on one side and SHEFFIELD on the other. Joseph Dee is a maker known to have been working in Sheffield *c.*1833-41 (Oswald 1975, 199). The presence of at least three different but very similar designs from Sheffield suggests that this may have been a decorative motif that was popular with the Sheffield makers.

6.2.37 **Leaf decorated seams (Figs 34.12, 34.13, 35.7 and 35.8; Moulds I, F, AA, AC, AF, AL and AU):** A total of 37 bowl fragments with leaf-decorated seams were recovered from the contexts associated with the production waste. Twenty-five of these bowls were produced in the same mould (Mould I; Fig. 34.12). One identifying feature of this particular group is a faint mould line that runs parallel with the rim, which would suggest that the mould itself has been repaired. During the manufacturing process a knife was pushed across the top of the pipe, whilst it was still in the mould, in a slot specially design for this purpose. This gave the pipe its clean-cut rim, but the continual action of the knife on the slot itself eventually caused the mould to become slightly dished at this point. This wear was repaired by inserting a new piece of metal into the mould, but often this new insert left a tell-tale line around the top of any pipes that were subsequently produced from it. A further seven mould types were identified and the table below gives the number of examples from each context for the different types. In addition the table gives a count of those bowl fragments with leaf-decorated seams that were too small to assign to a specific mould type.

Fig	Mould	111	266	341	383	Total
34.12	I		3		22	**25**
34.13	F				2	**2**
35.7	AC	1				**1**
35.8	AL		1			**1**
	AA	2				**2**
	AF	1				**1**
	AU			1		**1**
	AY			1		**1**
	Unident.		2		1	**3**

6.2.38 Two of the bowl fragments in this group also had moulded symbol marks on the sides of the spur. The first mark is in the form of a relief-moulded ring on a fragment from Context 266 (Fig. 35.8). The second mark is a ring and dot, also in relief that was recovered from Context 341 (not illustrated).

6.2.39 **Napier/Ship bust (Fig. 35.5; Mould A):** This is the largest group of mould-decorated bowls to be recovered from the production waste with a total of 29 examples – seven from Context 111, two from Context 266 and 20 from Context 383. All of the examples were produced from the same mould (Mould A) and depict a ship in full sail on the smokers right and the bust of a high-ranking sailor, possibly captain or an admiral, with the name NAPIER below, on the smokers left (Fig. 35.5).

6.2.40 The identity of the particular 'Napier' depicted is unclear, but given that the bust of this person appears on one side of a pipe bowl with a ship on the other it is most likely that there is some naval connection. There are a number of prominent figures by the name of Napier in the early 19th century that may be commemorated on these pipes. These include Sir Charles Napier (1782-1853), a British field marshal who served in India during the Sikh Wars; Robert Napier (1791-1876), a shipbuilder and engineer responsible for some of the first ironclads and transatlantic liners and Sir William Napier (1785-1860) who was a soldier and military historian who wrote the *History of the Peninsular Wars* (Gardiner and Wenborn 1995, 533). However the most likely candidate is Captain Lord Napier who, in the 1820s, captained his majesty's ship *Diamond,* said to be one of the country's finest frigates. The exploits of Lord Napier appear in a number of contemporary newspaper articles (see the Times Digital Archive) and include the retrieval of the passengers and crew from the wrecked ship *Francis Mary* in 1826 as well as escorting a Spanish ship from Manilla, bound for Corunna and fearful of Columbian privateers, to within 400 miles of Corunna. Stylistically these bowls are of an earlier form but one that was clearly still in use at the time of the kiln dump.

6.2.41 **St Christopher (Fig. 35.6; Mould D)** The excavations produced a single bowl fragment decorated with a figure that may represent St Christopher. The fragment was recovered from Context 383, which is the context associated with the production waste, although this is the only piece bearing this particular decoration to be recovered. Only part of the design survives, that which would have appeared on the smoker's right. It clearly shows a draped

figure carrying a long staff. The seam facing the smoker is also decorated with small leaves. This particular piece has been very well engraved and would have been a good quality product when complete.

Mouthpieces

6.2.42 Of the total 54 mouthpiece fragments recovered from the excavations at Sheaf Square. Forty-six (or 85%) came from those contexts associated with the production waste. All of them had cut ends and would have originated from long stemmed pipes. Twenty-three of these have glazed tips (50% of the kiln group), that range in colour from pale yellow, through green to a pale brown colour. One interesting mouthpiece fragment recovered from Context 383 had neither its tip nor side seams trimmed prior to firing, suggesting that it is production waste (Fig. 36.1).

Modified stems

6.2.43 The modification of stems can take a number of forms but usually occurs for one of two main reasons: the grinding or scraping of the stem for reuse after the original mouthpiece has broken off; or modification when the stem has been used as a medium with which to draw or write graffiti resulting in the formation of distinct facets at one, or both ends of the stem.

6.2.44 The former type of modification is characterised by even grinding around the end of the stem and, occasionally, by the appearance of tooth wear on the stem. One of the stems from the kiln waste deposits shows this type of modification (Fig. 35.16). This particular stem fragment is quite sharply tapered and almost certainly from a cutty style pipe. Although the broken end of the stem has not been ground there is very clear and distinct tooth wear showing that the pipe was in heavy use following the original break. This piece is important in showing that the kiln group certainly includes a small percentage of pipes that have been smoked. What is uncertain is whether this represents smoked pipes from the pipeworks discarded with the kiln waste or a small degree of contamination of the kiln waste with other material.

6.2.45 A second stem exhibiting a more unusual form of modification is discussed in section Section 6.2.75 below (see Fig. 36.15).

Clay Sample (Sample No. 14)

6.2.46 Context 383 also yielded a sample of unfired clay, which contained a small number of clay tobacco pipe fragments as well as pieces of ashy material. The clay is a pale grey colour and is most likely to be pipe clay that would become white when fired, especially given that it came from a deposit containing pipe manufacturing debris of *c.*1855-60. Documentary evidence shows that in the 17th and early 18th centuries local clay sources were being exploited specifically for the production of tobacco pipes in Yorkshire. For example in the Quarter Sessions Records for Potovens, near Wakefield, for the year 1680-81 reference is made to potters digging up the common for 'getting of clay for making pipes, potts and other earthenwares' (Brears 1967, 8) and at Wortley, near Leeds, in 1715 reference is made to a vein of fine clay being used for 'the making of tobacco pipes, a manufacture but lately begun in Leeds' (White

2004c, 28). These clays were, however, mainly coal measure clays that could have had coarse inclusions in them and would fire to a slightly off white colour, which could appear pale cream through to pale pink. Some of the finest, and whitest, pipe clay is found in Dorset, Devon and on the Isle of Wight. By the nineteenth century, pipemakers in many parts of the country, including Yorkshire, relied almost exclusively on imports of clay from the south-west for their pipe production. Although it is most likely that the clay sample recovered from Sheaf Square is an imported clay, chemical analysis of the sample would be required to confirm its source.

Production Waste Summary

6.2.47 At least 38 mould types associated with the production waste have been identified, 25% of which were plain forms. The majority of the pipes were long-stemmed varieties with some types, such as the Napier bowls, probably being up to 30 years old. Other types recovered represent distinctive local styles, such as the grape vine, the acorn and the cornucopia, while the plain bowl forms provide a useful reference point for dating mid 19th century styles. There are some unexpected forms amongst the kiln group, such as the basket weave, branch and claw motifs. These particular designs would normally be dated later than *c.*1855 but if they are part of the kiln group this suggests that they should have an earlier start date. All three forms, however, were recovered from contexts that overlay the main deposit (Context 383) and could be contaminated with a small element of other, intrusive, material. The evidence suggests, however, that most of the mould types can be reliably dated to *c.*1855-60 and represent a wide range of products from a single workshop, which appears to have been H. Tunstall of Leeds.

The Kiln material

6.2.48 In the 19th century clay tobacco pipes were usually fired within a specially constructed chamber called a muffle. This chamber was intended to protect the white pipes from the fumes and gases that might discolour them during the firing process. With reference to Peacey's publication on the development of pipe kilns in the British Isles (1996) it has been possible to identify the various fragments of kiln structure recovered from the excavations at Sheaf Square.

6.2.49 The excavations produced a small, but interesting group of kiln material comprising 37 fragments of clay sheeting, one ring wad, seven applied strips and two unidentified fragments that are almost certainly also some form of kiln material. All of the fragments were recovered from Context 383.

6.2.50 The fragments of clay sheeting were often produced by smearing white firing clay over sheets of paper, often newspaper, or sometimes cloth. These clay-covered sheets were then used to either separate different layers of pipes within the muffle structure or to produce a cone-shaped lid for the muffle itself. Once fired the paper or cloth burned away leaving thin sheets of brittle clay that could be easily broken to remove the pipes. On some of the Sheaf Square examples of the reversed casts of typeface and decorative borders, presumably around advertisements, can still be made out. These were caused by the fine pipeclay taking up the slight indentations created when the

printer's type was pressed against the paper during the original printing process. Some individual letters and words can be made out but not enough to determine the date of the original printed paper.

6.2.51 Occasionally these clay sheets also bear the impression of the top of the bowls over which they had been laid. There are three examples of this from Sheaf Square (Fig. 31.2) and interestingly the bowl fragment that created one of these marks survives. This is a fragment of one of the Napier decorated bowls and clearly links this bowl form with the production waste recovered from this site.

6.2.52 A single ring wad was also recovered from Sheaf Square (Fig. 36.3). Peacey describes ring wads as a piece of clay that was used to provide packing between various elements within the muffle structure. They are identified as having impressions of the objects they were pressed between on their opposing surfaces. Once fired they could not be reused and so were discarded as production waste.

6.2.53 Applied strips were also discarded after firing. This particular type of kiln material was formed from a roll of clay that was pressed against some other part of the muffle structure and therefore can be distinguished from a wad by virtue of the fact that it only has contact impressions on one side. Often the opposing surface had slight impressions of the stems or bowls that had rested against the strip during firing. These features can clearly be seen on all seven examples recovered from Sheaf Square (one of these strips has been illustrated - see Fig. 36.4).

6.2.54 A further two fragments of kiln material were recovered from the excavations but it has not been possible to identify which elements they represent. The first had clearly been hand formed from a roll of pipe clay and has been pressed against a flat surface forming a short 'lug' shaped protrusion. It is not discoloured and so was probably used within the muffle structure itself. Although there are no impressions of pipe stems or bowls on it, it is possible that it acted as some kind of support, similar to the applied strips, within the muffle. The final fragment is discoloured and has partially vitrified, suggesting that it originated from outside the muffle structure and was exposed to the fumes and gases during firing. It is clearly made of pipe clay and there are traces of clay sheeting within its structure but it is unclear what its original purpose was.

Other Clay Tobacco Pipes (Figs 36.5 to 36.15)

Bowls

6.2.55 In addition to the kiln group discussed above, the excavations in Sheaf Square produced a further 44 bowl fragments of which 21 were plain and 23 were decorated. All range in date from the very end of the eighteenth through to the early 20th century with the vast majority falling within the second and third quarters of the 19th century. The various different styles of bowl recovered are described below.

6.2.56 **Plain Bowls (Figs 36.5 to 36.7):** In addition to the 31 plain bowls that were associated with the production waste, the site yielded a further 21 plain bowl

fragments, a number of which represent different forms to those found in the kiln group. Three of the most complete examples have been illustrated (see Figs 36.5 to 36.7).

6.2.57 **Acorn (Not illustrated):** In addition to the acorn designs discussed above and single additional fragment was recovered from Context 110. The lower part of this particular fragment has a pattern of raised dots and appears to be part of an acorn. Unlike the other 'Acorn' bowls (Figs 35.1 and 35.2) there is no large oak leaf up the front seam but there are traces of some other moulded decoration suggesting that the upper part was decorated with some other, unidentified, motif.

6.2.58 **Basket weave (Fig. 36.13):** The site yielded a second bowl fragment with a basket weave motif. Unlike the other example (see Section 6.2.27) this fragment, from an unstratified deposit, is clearly a cutty pipe as the full length of its stem and the nipple mouthpiece survive.

6.2.59 **Flutes and Scallops (Figs 36 and 36.11):** A total of 10 bowl fragments with fluted or scalloped designs were recovered from the excavations at Sheaf Square. Six were recovered from those contexts associated with the production waste but the remaining four include a bowl fragment from Context 306, which has enclosed wide flutes or scallops, divided by rows of dots. The tallest of the scallops is on the seam away from the smoker, gradually getting shorter, or falling, as they come closer to the smoker (Fig. 36.10). The other fluted designs from the site comprise two joining fragments from Context 109 of a bowl covered with narrow flutes (Fig. 36.11) and a fragment from a design that includes a band of stars running around the rim above the flutes from Contest 353 (not illustrated).

6.2.60 **Leaf decorated seams (Plate 44 and Fig. 36.8):** In addition to the examples recovered from the contexts associated with the production waste, a further 10 bowl fragments with leaf decorated seams were recovered from the site. One of these bowls, comprising two joining fragments, from Context 338, has a rather interesting manufacturing flaw that has been previously noted by the author from material recovered from excavations in Suffolk Road, Sheffield (White 2004a). One of the results of producing clay pipes in a metal mould is that the clay took up any small nicks, scratches or surface defects on the mould's surface, thereby producing a unique 'fingerprint' for that particular mould. Identification of these mould flaws can help to identify the pipes produced in the same mould and, by studying marked pipes or kiln groups, this can give some indication of the number of moulds an individual pipemaker may have been using. The flaw identified on one of the pipes from Sheaf Square, and which matches some of those from Suffolk Road, is different in that it was not introduced to the pipe from the mould itself but appears to have been caused by something being pressed or knocked against the pipe bowl during the manufacturing process (Plate 44).

6.2.61 When comparing the known examples it is clear that the position and exact nature of the flaw varies slightly, therefore whatever created the mark is not being pressed into the bowl side in exactly the same way each time. It would appear that whoever was finishing the pipes was knocking or catching the pipe on something that left a distinctive impression prior to firing. The similarity

of these marks clearly links the Sheaf Square example and the Suffolk Road examples to the same workshop.

6.2.62 Another bowl with leaf decorated seams was recovered from Context 305 (Fig. 36.8). This particular example not only has large leaves that are crudely executed but the two halves of the mould do not fit together properly causing a marked step along the seams and on the spur.

6.2.63 **Masonic (Fig. 36.9):** A single bowl bearing Masonic motifs was recovered from Context 139. The lower half of the bowl is decorated with a series of narrow enclosed flutes. Both seams are decorated with small leaves. Around the rim is the lettering WARRINGTON / ROTHERHAM (see discussion of marked fragments below). On the upper part of the bowl there are Masonic motifs. On the smokers left a pair of columns flank a crossed square and compass. On the smokers right is the heart-in-hand motif flanked by two sprigs of foliage.

6.2.64 **Other decorated bowls (Fig. 36.14):** In addition to those decorative motifs described above, the excavations at Sheaf Square produced two small fragments from bowls with other designs. The first is a fragment with the remains of a large leaf running up the front seam of the pipe from Context 197 dating from *c.*1850-1880. This particular fragment is interesting as it has some moulded detail on the stem in the form of a 'tulip'-like feature out of which the bowl appears to be emerging. The second from Context 197/251 has large wide leaves or petals covering most of the bowl, with traces of a floral wreath, or swag just below the rim (not illustrated).

Marked Bowl fragments

6.2.65 A further three marked bowls were recovered from Sheaf Square. These included two sets of initials moulded on either side of the spur and one moulded name around the rim of the bowl. Each mark is discussed in detail below.

6.2.66 **IN Initial mark (Fig. 36.7):** A single bowl dating from *c.*1830-1880 was recovered from Context 410 with moulded initials on the sides of the spur. The surname initial is clearly N but the Christian name initial is a little unclear, although it is possibly an I. This mark is unusual in that the initials have been placed upright on the spur. There are currently no known makers from the 19th century operating in or around Sheffield with the initials IN.

6.2.67 **FO Initial mark (Fig. 36.12):** A single spur fragment was recovered from Context 272, dating from *c.*1830-1860, with moulded initials FO on the sides of the spur. Interestingly, the surname initial appears to have been re-cut but it is difficult to determine what the original initial may have been although a C seems most likely. The initial F is quite distinctive in that it has rather fine serifs. A spur fragment with a similar F Christian name initial and the surname initial C was recovered from excavations on the Riverside Exchange site by ARCUS (White, 2002). This particular fragment was attributed to Fredrick Cartwright, a Sheffield maker who is recorded as working from at least 1854-60 (Lawrence 1973, 190). It would appear that the original mould has changed hands and been re-cut for use by a maker with the initials FO.

6.2.68 There are currently no known makers with the initials FO from Sheffield at this date and there are only three documents makers with an O surname initial, so far recorded, who were working in Yorkshire in the mid 19th century. The first is Edward O'Neil from Rotherham (*fl.*1867) (Lawrence 1973, 192) and the other two are members of the Ogden family from Leeds, John (*fl.*1837-53) and Mary (*fl.*1842) (*ibid*).

6.2.69 The excavations in Sheaf Square have produced other marked fragments that can be attributed to makers from both Rotherham and Leeds – Warrington of Rotherham and Tunstall of Leeds. It is therefore possible that the maker with the initials FO may also be from either a Rotherham or Leeds maker.

6.2.70 **WARRINGTON / ROTHERHAM bowl mark (Fig. 36.9):** A single bowl with the mould imparted design of Masonic motifs was recovered from Context 139, dating from *c.*1830-1860, with the relief-moulded lettering WARRINGTON ROTHERHAM around the rim. At first sight this is quite unusual in that it appears to have two place names around the rim. However, the usual convention for lettering applied to the bowl in this position is for the makers name to appear on the smoker's left and the place name to appear on the smoker's right. This would suggest that the word WARRINGTON refers to a maker himself rather than the place of manufacture. There are currently no known makers with the surname Warrington working in Rotherham at this date, and so this bowl appears to represent the product of a previously un-recorded maker.

Internal bowl marks

6.2.71 Internal bowl crosses, or marks, are formed by a cut or a mark on the end of the stopper that was used to form the bowl cavity during the manufacturing process. In their study of bowl crosses found in pipes from London, the Jarzembowskis suggested that one of the purposes of these marks was to prevent the stopper from sticking when pressed into the bowl (1985, 394). In Jung (2003) an account is given of the manufacturing process employed by the pipe maker Gordon Pollock of Manchester. When describing the stopper Gordon Pollock refers to 'roughing up scars' on the tip of the stopper which were produced by 'firm taps of a crisp heavy steel file' (Jung 2003, 11). The account presented by Jung goes on to explain that these 'scars' were to help prevent the walls of the pipe being sucked in when the stopper was removed, and the internal bowl crosses may well have served the same function.

6.2.72 A total of seven bowls with internal bowl crosses was recovered from the excavations at Sheaf Square. All of these appear to be of an unusual type with a double cross bar (see Figs 36.5, 36.6 and 36.8) and are associated with bowls dating from *c.*1800-1880. This particular type of internal bowl cross has also been noted in bowls from a number of sites in Sheffield including Riverside Exchange (White 2002); Nursery Street (White 2003); Suffolk Road (White 2004a) and the Ring Road (White 2004b). Although no systematic survey has been carried out on the internal bowl crosses nationally it does appear that this particular type, with the double cross bar, is a feature used by a maker, or makers, from Sheffield during the 19th century.

Plain Stems

6.2.73 The majority of the stems recovered from the excavations are plain and therefore extremely difficult to date accurately. However, the general appearance of the stem fragment and the size of the stem bore can give an indication of the likely century in which it was produced. Stem dates should be used with caution since they are much more general and less reliable than dates that can be determined from bowl fragments or from stems that are decorated or marked by known makers.

6.2.74 A total of 695, or 75% of the total assemblage from Sheaf Square, are the plain stems. The earliest is a small fragment from Context 318 dating from *c.*1610-1680 and is almost certainly residual in this context. Two fragments of mid 17th to early 18th century date were recovered, one each from Contexts 341 and 342. Only one stem fragment of 18th century date was recovered, this came from Context 306, although there were seven fragments that could date from either the end of the 18th or early 19th century (one each from Contexts 306, 378 and 410 and four from Context 341). The rest of the stems recovered from the site date from the mid to late 19th century.

Modified Stem

6.2.75 Only two modified stems were recovered from the excavations at Sheaf Square. The first, from Context 117 (Fig. 35.16) has already been discussed above, as it was recovered from the production waste deposits. The second, from Context 378 and dating from *c.*1780-1880 (Fig. 36.13) is of a type of modification that has only previously been recorded from sites in Sheffield, in particular the Riverside Exchange site (White 2002). This form of modification is where the broken end of the stem has been cut or ground down by some mechanical means. In the case of the examples from Riverside Exchange it was suggested that the workers operating sharpening stones were idly pressing their broken pipes against the stones during the course of their work before discarding them. One of the stems recovered from the excavations at Sheaf Square appears to have been modified in this way (Fig. 36.15).

Mouthpieces

6.2.76 A further seven mouthpiece fragments were recovered from the site. Five of these have cut ends, only one of which is unglazed, and would have come from long-stemmed pipes dating from *c.*1800-1860. The remaining two mouthpieces are of nipple type that dates from *c.*1850 or later and would have been associated with a short cutty style pipe. It is interesting to note that none of the production waste deposits contained fragments of this type of nipple mouthpiece.

Conclusions

6.2.77 This group of clay tobacco pipes and production waste from Sheffield is an extremely interesting and useful assemblage on a number of counts. In the first instance it adds to our knowledge of pipe production and consumption in

and around Sheffield during the mid 19th century. It has increased our understanding of the range of bowl forms that were being produced at this time and provides additional information regarding manufacturing techniques and workshop practise, for example the distinctive internal bowl crosses and the post-manufacturing flaws.

6.2.78 Moreover, this assemblage has provided evidence for at least one previously unrecorded pipemakers working in or around Sheffield – the bowl marked with the initials IN - as well as a maker by the name of Warrington from Rotherham.

6.2.79 Perhaps the most exiting element of this assemblage, however, is the production waste from Context 383 and the associated backfill deposits (111, 117, 266 and 341). Well dated production waste is rare from anywhere in the country, but particularly from Yorkshire. The cartographic evidence for this site suggests that the backfill deposits were laid down after the closure of the Sawmill/grinding mill *c.*1855/6. Although it is always possible that the backfill material could be earlier than this date, on the whole pipe production waste is something that was disposed of quite quickly and it is unlikely that it would have been 'stockpiled' for any length of time. The overall date range for the majority of the bowl forms from the site is *c.*1840-1860 so the date of the backfilling activity falls nicely in this date range and almost certainly took place *c.*1855-60. The other important feature about this assemblage is the presence of three 'Tunstall' fragments amongst the production waste. The fact that these pipes have not been smoked adds weight to the suggestion that all the production waste belongs to Henry Tunstall of Leeds. It is most likely that this material was transported, via the rail network to Sheffield specifically for use as backfill material prior to the construction of the new railway areas.

6.3 **Ceramic and other Building Material** by John Tibbles BA (Hons) AIFA

6.3.1 The brick assemblage shows typical evidence of hand-pressed and machine-made brick manufacture. Although the firebricks and half-round coping bricks are conducive with industrial buildings the majority of the brick sizes relate to the late 18th-19th centuries. However, the brick sizes from layer 360 are of a size comparable with late 17th century Hull deposits.

6.3.2 Two substantially different pantile manufactures were recorded, the coarser fabric and the crude cut-aways likely to be of an earlier date, possibly imported.

Introduction and methodology

6.3.3 A visual scan of the building material assemblage recorded a total of 79 fragments weighing 48120 grams. It should be noted that the diversity of size and colour within brick and tile caused during the manufacturing process must be taken into consideration when comparing examples within collected assemblages and local typologies. The varying sizes and colours can be attributed to the variation in the clays used, shrinkage during drying, firing

within the kiln or clamp and the location of the brick/tile within the kiln. The dating of ceramic building material can be highly contentious due to its re-usable nature.

6.3.4 Bricks and tiles alone cannot provide a firm date because of their re-usable nature but it is possible to date types of brick and roof tile by their earliest occurrence within dated contexts. The identification of new brick or tile types would supplement the existing regional typology and there is potential for comparison with CBM assemblages from elsewhere in the region. The presence or absence of hip and ridge tile suggests a variety of roof forms.

6.3.5 The assemblage was examined using a x15 magnification lens were applicable to aid dating, though fabric analysis was not undertaken as this was considered beyond the scope of this assessment. Information regarding the dimensions, shape and fabric (were applicable) was recorded and catalogued accordingly and a Munsell colour code has been incorporated where appropriate. The presence of the original surfaces was also taken into consideration to aid identification.

6.3.6 A catalogue for the assemblage is presented in Table 12, Appendix III, Volume 3, and fabric descriptions in Table 13, Appendix III. The assemblage summarised in Table 14 and is presented by phase in Table 15 below.

The Assemblage

6.3.7 The assemblage comprised of post-medieval brick and roof tile of which the majority of fragments were pantile (Table 14). A single fragment of stone floor tile and air-brick was also recorded.

Material	Fragments	Weight gm
Pantile	58	10850
Ridge tile	1	130
Brick	19	36940
Stone floor tile	1	210
Air Brick	1	270
Total	**80 No**	**48390 gms**

Table 14. Summary of ceramic building material assemblage

Bricks

6.3.8 Of the eighteen examples of standard brick within the assemblage, ten were complete examples ranging in date from the late 17th-19th century. The non-diagnostic fragments, based upon their fabrics are likely to be of a similar date.

Fire-Brick

Firebricks were bricks specially manufactured for use within fires or hearths and furnaces, and could withstand very high temporatures. Two fragments of *'fire-brick'* one non-diagnostic and one 68mm thick were identified from backfill 367. The *firebricks* were manufactured in a coarse pale brown/grey fabric.

6.3.9 There was at least one firebrick maker (Thomas Gillot) working in Sheffield in the early part of the 19th century in Harvest Lane (Baines 1822).

Context	Phase 1	Phase 2	Phase 3
103			1bs
119			2t
120			19t
133			1bs
141		1t	
197			1bs, 14t
213			1bs
241	1b		
251			1t
266			1b
268			2t
305	2t		
306	2bs, 7t		
333 (306)	1b		
360		2bs	
362			5t
367			3bs, 3t
383			2b
384		1bs	
389			1t
414		1t	
415		1bs	
Total	*13*	*6*	*58*

Table 15. Summary of ceramic building material (brick and tile only) by phase (one un-stratified fragment and a single stone floor tile fragment have been omitted, b = brick fragment, bs = brick sample, t = tile)

Half round/Coping brick

6.3.10 Half-round or coping bricks are generally made of different sizes to suit walls of varying thickness. Copings, which overhang walls, generally exhibit throats for water expulsion. They are also used within platforms, retaining and wing walls. The complete brick within the assemblage measured 235mm by 115mm

by 65mm, displayed no throats and was recorded from within rubble 103. The example was machine-made and manufactured in a F4 fabric (Table 13, Appendix III), with residual mortar adhesions suggesting a post 1840 date.

6.3.11 Such bricks could be found incorporated in structures within an industrial complex where rounded projections would be desirable to help prevent abrasions and damage to wall terminals by impact.

Perforated Air Brick

6.3.12 Perforated air-bricks were manufactured in stoneware and terracotta and are usually built into walls to ventilate store rooms etc., often on the underside of a wooden floor. They are pierced with different patterns and were generally considered to be better than iron grating as they were cheaper, more durable, required no painting and did not stain walls with rust. Sizes vary but were generally 228mm by 76mm (9" by 3") to 457mm by 457mm (18" by 18") (Rivington 1919). The partial example recovered displayed residual dimensions of 97mm by 57mm by 32mm and was manufactured in terracotta suggesting a provisional date of a mid-late 18-19th century.

Roof tile

Pantile

6.3.13 Fifty-seven fragments of pantile were examined, the majority of the assemblage from conduit backfills 120 and 225. Seven examples displayed complete or part suspension nibs of which two bore the letter 'A' impressed. A further five fragments displayed corner *'cut aways'* of which two examples were of a crude manufacture. At least two fragments displayed moulding lips and the majority of fragments displayed the residual elements of moulding sand. Sixteen fragments displayed heavy staining (i.e. ingrained soot) and four fragments residual mortar adhesions.

6.3.14 Three broad fabrics were identified (Table 13, Appendix III) of which FI was the most common within the assemblage. A smaller assemblage from contexts 305, 306 and 362 was identified with an unusual coarse fabric F2.

Ridge tiles

6.3.15 The single fragment of ridge tile 30mm thick recorded from rubble layer 306 exhibited sharp arrisses and was manufactured in F2 fabric. It also displayed the heavy weathering. Although ridge tiles have been recorded from the 13th century (Armstrong and Ayres 1987) the manufacturing characteristics and fabric suggest a provisional 18th century date.

Stone Floor tile

6.3.16 A single fragment of sandstone floor tile 20mm thick was recorded from the clinker backfill 341. One surface displayed a worn appearance.

The Assemblage Discussion

6.3.17 The diversity of brick/tile colour and size caused during manufacture must be allowed for when making comparisons with typologies. The majority (75%) of the assemblage is of ceramic roofing tile comprised of pantile and ridge tile whilst the brick assemblage (24%) shows typical evidence of hand-pressed and machine-made brick manufacture.

6.3.18 Whilst the firebricks and half-round coping bricks are conducive with industrial buildings or complex the majority of the brick sizes relate to the late 18th-19th centuries. However, the bricks from layer 360 are of a size comparable with late 17th century deposits at Hull (Foreman 1997). The single fragment of perforated air-brick would have originated within a wall, often on the underside of a wooden floor, to ventilate a store room or similar chamber where ventilation was paramount. Similar bricks containing small perforations were recovered from a late 18th-century malthouse at Coalbrookdale near Ironbridge, possibly from the malting floor (Belford & Ross 2004). Fragments manufactured in stoneware were recorded from possible late 18th-19th century deposits during excavations of a dry dock at St Aidens on the River Aire, Yorkshire (Buglass forthcoming). The present fragment manufactured in terracotta and not stoneware maybe earlier rather than later within the date range given.

6.3.19 Although Pantiles were imported into Britain by the 16th century there is no evidence for their manufacture in this country before 1700 (Neave 1991). Pantile roof covering within the eastern counties of Britain during the 18th and 19th centuries became popular and is often difficult to differentiate between the imported Dutch tiles (Dakpannen) and English pantiles manufactured locally.

6.3.20 However, pantiles with the more coarse fabric (F2, Table 13, Appendix III) and the crude cut-aways are likely to be of a much earlier date, possibly imported, although generally, imported tiles from the Low Countries are likely to be of a finer fabric. Towards the end of the 19th century pantile cut-aways were much more refined. All the nibs impressed with the letter A are manufactured in F1 fabric and possibly imported into Sheffield although at least two brick and tile-makers were operating from Hull in the first half of the 19th century (Whites Directories 1822-1846) where A impressed tiles have been recorded.

6.3.21 The ridge tile manufactured in the F2 fabric and displaying the weather staining similar to that of the pantile would be from the same manufacturing source and most likely from the same building.

6.4 **Metalwork** by Daniel Lee and Alison Morgan

6.4.1 A total of ninety-eight metal objects were recovered during excavations at Sheaf Square, Sheffield. The assemblage consists of fifty ferrous (iron) objects, thirty-six copper alloy objects, and twelve lead objects. The metal artefacts are discussed below by material and are presented in catalogues shown in Tables 16 -18, Appendix III, Volume 3. Artefacts refered to in the text are cited by catalogue number followed by context number. The catalogue number refers to the objects within the primary archive. A summary of the metal artefacts by phase is shown in Table 19 below, and selected artefacts are illustrated in Figures 37 and 38.

Iron objects

6.4.2 The iron objects were x-rayed prior to examination and the resulting x-ray plate was used in the analysis. In general, the majority of iron objects are in very poor condition and only discernable from the x-ray due to heavy corrosion and adhesions. The catalogue of iron finds is shown in Table 16, Appendix III, Volume 3.

6.4.3 The assemblage of iron metalwork was dominated by sixteen heavily corroded masses and undiagnostic fragments. These objects were indistinguishable, even with the aid of the x-rays, and probably represent ferrous objects that have all but corroded away in the burial environment. Indeed, it was apparent that several concreted fragments have little ferrous material within them (e.g. Cat. 37/307), and represent a conglomeration of leached ferrous material and fragments of the surrounding deposit matrix. Several of the iron objects have traces or fragments of wood attached. This survival is due to preservation by ferrous corrosion products as organic remains, such as wood, normally decay in the burial environment and are lost. When in contact with ferrous material, however, corrosion products can sometimes impregnate the organic material filling the spaces left by the wood cells within the decayed organic component causing mineralization (Cronyn 1990; Watkinson and Neal 2001).

Nails

6.4.4 Ten iron nails were identified within the assemblage. These ranged in size from between 34mm to 105mm in length and 4mm to 7mm in width, although the dimensions of some nails is unclear or exaggerated by corrosion. Some details of the nail shank, such as square cross sections (e.g. 31/307, Fig 37), and tapered shanks (38/341 and 48/390) were visible. Details such as a rounded circular head (e.g. 20/228, Fig 37), and a squared head (e.g. 21/229, Fig. 37) are also evident, although heavy corrosion limited the identification of detail in most examples. Smaller nails with a flat head were recovered (24/273 and 41/343). Larger examples of nails within the assemblage include 21/229 (Fig. 37) and 48/390. The majority of nails are likely to have been used in woodwork, and 20/228 and 21/229 were associated with a wooden slatted structure.

6.4.5 Iron nails are common finds on post-medieval industrial sites and were used in a wide variety of contexts, most commonly in woodworking. Early nails were hand forged and varied greatly in form, but often with a characteristic rose head (Taylor 1999). Cut nails with more regular profiles were introduced in the late 16th century and were common until the early 19th century when, in 1811, machine-cut nails were first produced. These are generally flat and headless and taper to a point on two sides only (Taylor 1999). Stamped nails with a simple head were introduced in the mid 19th century and were superseded by wire nails in the late 19th century that are still used today, although cut nails were still produced until the 1930s (Taylor 1999). The detail from the assemblage is limited although it is likely that the majority are machine cut or stamped nails. It is possible the larger examples were hand forged for specific jobs. Nail making was a common cottage industry in the Sheffield area throughout the 18th and 19th centuries (Taylor 1991) and two nail manufacturers and four cut nail manufacturers are listed in the 1839 trade directory (Robson 1839), falling to four in number in the town by 1888 (Kelly 1888).

Tools

6.4.6 One example of a file was recovered from excavations which consists of an incomplete half round engineers file (50/104/105, Fig. 37). Although its surfaces are heavily corroded, the lack of deep pitting, characteristic of the punched teeth on rasps, suggests an engineers file (Ken Hawley pers. Comm.). Other fragments of tools include a possible tapered file end (15/197) and five undiagnostic iron bars (Cats. 4/139, 14/141, 25/273, 27/292 and 35/307) that may represent the heavily corroded remains of files or plain bars.

Other iron objects

6.4.7 The second most frequent group of iron objects after nails is consists of eleven corroded strips. These ranged in thickness between 1.4mm and 9mm, with most examples being between 4mm and 5mm thick. Identification was hindered by heavy corrosion and adhesions and the strips are likely to represent off cuts or corroded fragments of other objects such as buckets or equipment.

6.4.8 Other iron objects include a large circular washer (6/139), an iron washer with a copper alloy 'hook' (47/389, Fig. 37) and a large square nut (34/307). Two bolts were recovered: one with a broad rounded coach-bolt type head (11/139, Fig. 37) and the other a large tapered bolt with a squared head and tread visible in the x-ray on the final 31mm before the end (32/307, Fig. 37).

6.4.9 A large diamond shaped iron plate (12/139), measuring 227mm as the long axis, was recovered from the conduit feature, although the x-ray revealed no detail and its function remains unclear.

Copper Alloy Objects

6.4.10 The copper alloy assemblage consists of thirty-six objects. Copper alloys have the advantage of more limited degradation compared to iron objects and can

be cast and in some cases worked cold (Cronyn 1990). The objects within the assemblage from Sheaf Square are generally in good condition with some surface decay in the form of green coloration and thin crusts indicative of malachite and other mineral crystal formation, and patinas formed mainly by oxidation in the burial environment (Cronyn 1990). Identification of the metal beyond an alloy of copper is outside the remit of this study. The copper alloy objects have been divided into four broad groups and are summarised below. The catalogue of copper alloy objects is shown in Table 17, Appendix III, Volume 3, and are summarised by Phase in Table 19.

Rivets

6.4.11 Rivets were the most frequent group of finds from the copper alloy assemblage and included twelve rivet heads and two complete examples. The rivet heads are characterised by a small flat sub-circular disc of metal often with a central scar where the central rivet shaft has detached (e.g. 62/139, 63/139 and 74/309 Fig. 38). The two complete examples (e.g. 59/139, Fig 38) show that the central shaft was hollow, presumably to attach to second male head before being hammered together. Both examples were apparently formed by moulding and been used as the shaft was at an angle suggesting percussion, and the upper surface of the heads, as on several examples, was worn smooth. Rivets were commonly used to bond metal, leather and clothing, although the examples in this assemblage are rather large for the latter.

Off cuts

6.4.12 Six off cuts of thin sheet copper alloy were recovered which ranged in thickness between 0.8mm and 1.8mm thick. Most showed evidence of trimming in the form of slightly lipped edges where they were snipped or sliced. One example (51/109) was trimmed from both sides, whilst the majority were trimmed only from one side. The off cut strips represent waste pieces from the trimming of larger sheets in some form of metal working/cutting process. The undiagnostic nature of the pieces limits interpretation, although it is possible that the main body of the sheet was to be pressed or stamped.

Buttons

6.4.13 Two buttons are present within the assemblage and are illustrated in Figure 38. The larger is a copper alloy shanked button comprising a disc 22mm in diameter with the front surface plain and worn smooth, and a single small wire loop or shank soldered to the rear (72/223, Fig. 38). The second button is a small sew-through concave plain button with four central holes (84/410, Fig 38). Buttons were commonly used to fasten items of personal clothing and were often made from metal or bone during the 19th century.

Other copper alloy objects

6.4.14 Several other diagnostic copper alloy objects were identified including the bowl of a tea spoon (52/111) that had been broken at the shoulder, a small

possible stopper from the same context (53/111), a small eyelet (68/159), a ring, probably from a rail (69/205). Part of a small concave backing plate with two fixing holes was identified (71/205, Fig. 38), and also three screw or bolt caps all from the same context (65, 66, 67/139, Fig. 38). Other items include an oval disc (57/ 131), a cable tie (58/139) two small lengths of wire (70/205, 79/341) and a washer (83/410). These represent a range of possible activities that would correspond with an industrial context.

Lead Objects

6.4.15 Twelve lead objects were recovered which fall into two main categories: window lead and roofing lead. The catalogue of lead objects is presented as Table 18, Appendix III, Volume 3, and they are summarised by Phase in Table 19.

Roofing lead

Five pieces of roofing lead were recovered. These consist of irregular scraps of formerly flat lead sheeting that have been bent or deformed prior to or during burial. No diagnostic patterns or attributes were observed. Lead sheets were originally formed by casting over smooth sand beds, but later during the industrial revolution 'chill' moulds were used where the lead solidified over a cool cast iron surface, and the resulting sheet was then milled or rolled (Fillary and Taylor 1999). Lead sheets were commonly used in the 19th century for roofing for sealing edges, apexes and gutters, and in more elaborate decorative work.

Window lead

6.4.16 Four lengths of window lead were identified and the majority displaying central longitudinal ridges or lips to locate windowpanes. Lead was commonly used from the medieval period onwards to fix panes of glass within window frames, a tradition that continued into the early 20th century. Window lead was more likely to have been moulded. Moulds were usually in two or three parts and made of iron formed from a cast of the original object (Fillary and Taylor 1999).

6.4.17 Three undiagnostic pieces of lead were recovered that may represent more irregular items of roof or window lead.

	Phase 1			Phase 2			Phase 3		
Type	**F**	**C**	**L**	**F**	**C**	**L**	**F**	**C**	**L**
Context									
109								1	
111								2	
120							1	3	
131								1	
139				11	10				
140				1					
141				1					
159		1							
197							1		1
205							2	3	
222							1		3
223							1	1	
228							1		
229							1		
263							2		2
273							2		
288								1	
291							1		
292							1		
302			1						
305			3						
307				10					
309					3				
341							2	3	
342	1								
343				1					
345								1	
359				3					
364							1		
388							1		
389							1		
390							2		
410					6				
104/105							1		
197/251									2
Subtotal	*1*	*1*	*4*	*27*	*19*	*0*	*22*	*16*	*8*
Phase total	*6*			*46*			*46*		

Table 19. Summary of the ninety-eight metal objects by phase (F= ferrous, C= copper alloy, L= lead)

Discussion

6.4.18 A small number of metal artefacts recovered from Sheaf Square excavations derive from Phase 1 of the site, corresponding with the construction and use of the New Tilt building. The majority of these finds, mostly comprising window lead strips, are derived from the dam silt deposits. Whilst these may date to the earliest phase of the site it is conceivable that the finds sank down gradually in the silts and were from later demolition. The remainder of the metal finds are divided equally between Phases 2 and 3. Phase 2 represents the building extension phase and the conduits with a large number of metal finds associated with the latter. Thirty-two percent of metal finds were recovered from the functional use fills of the conduits (Contexts 139, 359 and 410) or were associated with wooden plank or slatted structures within these fills (Contexts 140 and 141). A further thirty percent of the metal artefacts were recovered from the upper backfill of the conduits in Phase 3, although this high recovery rate is likely to be biased by more detailed hand excavation of made ground deposits in this area. Certainly a large proportion of finds were associated with the use of the conduits and hint at its function or activities in the vicinity.

6.4.19 The most significant group of finds consisted of variety of metal artefacts that originated from the lower fills of the conduits (Contexts 139, 307, 309, 359 and 410), although the majority of the iron objects were heavily corroded from the semi-waterlogged burial environment. The commonest copper alloy objects from the same deposits were rivets or rivet heads that are relatively quite well preserved. Twelve copper alloy rivets were recovered from the conduits suggesting that tasks involving riveting occurred nearby. The type of material that was riveted remains unclear although due to their larger size the riveting of leather or sheet metal is likely.

6.4.20 Forty-six metal objects were derived from Phase 3 (Table 19). Whilst these artefacts are of some interest in their own right they derive largely from deep made ground deposits or layers that were likely to have been imported onto the site. The limited number of lead artefacts from this demolition phase may indicate that, as was common, the material was recycled.

6.4.21 The ninety-eight metal objects recovered from excavations at Sheaf Square are consistent with the 19th century date range for the site. Whilst the majority of objects are not intrinsically dateable in themselves, apart from the cut nails (although these were in poor condition), such artefacts were typically made from these materials during this period. The iron assemblage as a whole is of limited significance due to the heavily corroded and undiagnostic nature of the objects, but the varied nature of the copper alloy objects, especially those relating to the use of the conduits, reflect a variety of activities discarding objects into that feature. The waste off cuts and lengths of wire are indicative of wrought metalworking (i.e. cold working, Bayley *et. al.* 2001). It is likely that riveting was undertaken nearby.

6.5 **Crucibles, Slag and Industrial Residues** by Roderick Mackenzie PhD

Crucibles

6.5.1 The crucible assemblage is predominantly composed of fragments of steelmaking crucibles, although there are a small number of fragments from crucibles used to melt non-ferrous metals.

6.5.2 The steelmaking crucible fragments are all from used crucibles, most have traces of slag adhering to their inner surface. None of the fragments has significant traces of metal from their last use. The majority of fragments are from the walls of crucibles, although a small number are from crucibles bases. Some of the base fragments have the crucible stand still attached, this is fairly common with used crucibles, as the stands would often fuse to the crucible during firing. Two crucible lids and one crucible stand were recovered, although these were from unstratified layers.

6.5.3 The 183 steelmaking crucible fragments found are summarised by context and phase in Table 20 below.

Context	Quantity	Phase	Description
109	96	3	wall and base fragments
109	1	3	base fragment with stand attached
113	2	3	wall fragments
117	2	3	wall fragments
135	12	3	wall fragments
197	1	3	base fragment
205	1	3	wall fragment
222	1	3	wall fragment
262	1	3	lid (complete)
297	1	1	wall fragment
U/S	1	-	stand
U/S	1	-	lid (complete)
U/S	62	-	wall, base and stand fragments
U/S	1	-	base fragment with stand attached

Table 20. Summary of steelmaking crucible finds

6.5.4 Sixteen crucible fragments and one complete crucible are from non-ferrous metal melting (Table 21). The fragments are all from used crucibles and some have small traces of metal attached from their last use. The residues adhering to the inside of these crucibles suggest that they were being used to melt either brass or bronze.

6.5.5 One complete 'non-ferrous' crucible was recovered from Context 109, this measures 242mm (9.5") tall by 153mm (6") wide. Its dimensions, together with the context in which it was found, suggest that the crucible probably dates from the late 19th or early 20th century.

Context	Quantity	Description
109	1	Whole crucible
109	10	Wall fragments
111	2	Wall fragments
117	3	Base and wall fragments

Table 21. Summary of non-ferrous crucible finds

Slag and industrial residues

6.5.6 The slag assemblage contains a mixture of non-ferrous and ferrous metal slags, vitrified refractory materials, fuel ash slag and a few pieces of unburnt coal. The ferrous slags are mainly blast furnace slag, although some may relate to bulk steelmaking processes. A bulk unsorted sub-sample residue from Context 266 (Sample 13) was analysed and is predominantly composed of coal and fuel ash. The sample also contains a number of clay pipe stem fragments (not included in the clay pipe report).

Summary and recommendations

6.5.7 Steelmaking and non-ferrous metal crucibles are a common find on 'brownfield' redevelopment sites within Sheffield. At its height, during the 19th and early 20th centuries, the crucible steelmaking trade alone would have disposed of thousands of used crucibles every week. The majority of used crucibles were broken up and used as hardcore or backfill when sites were redeveloped and it is common to find crucible fragments out of context, on sites where metal production was not carried out.

6.5.8 The slag assemblage contains materials typical of the period. In a manufacturing centre, such as Sheffield, the number of coal and coke fuelled hearths, boilers and furnaces in use during the mid 19th century would have produced a huge amount fuel ash (cinders) every day. The ash and sweepings from both domestic and industrial premises were commonly used as backfill or levelling material.

6.5.9 The contexts and type of material in both crucible and slag assemblages suggest that all of the material was brought in as backfill to re-level the site. Although the assemblages contain some interesting pieces, the contexts in which they were found mean that it is not possible to justify further analysis. It is therefore recommended that no further work is carried out on the material.

6.6 **Worked Bone and Shell** by Sonia O'Connor

6.6.1 A total of 57 worked bone and shell objects were recovered from Sheaf Square excavations. These have been divided into to categories, osseous finds totalling 31 and shell finds totalling 26. The are presented in catalogue form in Tables 22 and 23 (Appendix III) and are shown by phase in Table 24 below.

The osseous finds

6.6.2 Thirty-one objects were submitted for study from 18 contexts and are listed in catalogue form in Table 22, Appendix III, Volume 3. The worked bone objects are also listed by phase in Table 25 below. The majority of finds seem to relate to the conduits and its various use fills in Phase 2 and backfilling in Phase 3. Taken together, these objects represent bone and ivory working waste. Twenty-five of the objects are bone cut from large mammalian longbones, probably mostly cattle, and six of are ivory from both elephant and hippopotamus. There are only four finished objects, all of which are bone buttons. Two activities can be identified; button making and the production of handle scales.

Button making

6.6.3 The buttons are drilled from plaques of bone sawn from the surface of short sections of longbone shafts. The humerus waste core from context 378 might have provided two or three plaques suitable for this purpose, similar to those from context 390. Larger bones, such as cattle metapodials would have been required to provide wider plaques, such as that from context 316. These plaques were then held in some form of clamp and, depending on their diameter and the width of the plaque, two or four button blanks were drilled out of them.

6.6.4 The button blanks have been cut from both surfaces leaving a thin, narrow ridge part-way down the cut on the bone plaques where the two cuts meet. The ridge is wider when viewed from the upper surface of the bone, but less than half this when viewed from below. This is not because the cuts are out of line, but because the cutting tools were of slightly different diameter and shape. The sides of the upper cut are parallel and the base of the cut is flat, but that produced by the lower cutter slopes inwards towards the ridge, making a cut slightly inside the upper one. This would have produced a neat cut rather than snapped a edge to the disc.

6.6.5 It cannot be determined from the evidence available if the cut for each disc was made from the two surfaces simultaneously or serially. However the overlapping cuts for the two discs on 359 suggests that one disc was cut before the other. This would hold true if the cutters were tubular, as they could not occupy the same space at the same time, but if the discs were cut out using points, or burins, coordinated to cut along the circumference of the discs at the same speed, the two discs could be cut simultaneously. These blanks may have been cut out as featureless cylinders which were then mounted on a lathe and turned to give them their final form and polish or they may have been cut

out of the bone plaque and turned in one operation. Finally the stitching holes were drilled.

	Phase 1		Phase 2		Phase 3	
Context	Bone	Shell	Bone	Shell	Bone	Shell
105					1	1
111					1	
112					1	
113					1	
117						4
119						2
139			8			
166						1
195					2	
197						2
223					1	
246					1	
247					2	1
266					1	3
291						1
306	1	1				
316			1			
341					2	2
359			2	7		
367						1
378					1	
390					2	
407	2					
410			1			
Total	*3*	*1*	*12*	*7*	*16*	*18*

Table 24. Summary of worked bone and shell objects by phase (one unstratified object has been omitted)

6.6.6 The dished bone disc from context 405 is probably an unfinished button, discarded when the edge was damaged during lathe turning. The disc with the large central perforation from context 223, the unfinished button from 405 and the finished button from 410 could conceivably all have been cut from drilled plaques like those from contexts 359 or 195. The small brown button from context 112 is just a little larger than the discs that were cut from the plaques found in contexts 390 and 247. Bone buttons can be dyed a variety of colours and this small brown button may be an example of this, although it may have become stained during burial. The pale green colour of the perforated bone disc from context 223 is most likely due to staining from copper salts in the burial environment.

Handle making

6.6.7 Scale handles, like the blank from context 105, require longer plaques of bone than those used for the buttons but the preliminary preparation is very similar. The tapering plaques are sawn from the shafts of the longbones leaving waste cores like that from context 359, and wedge shaped strips like that from 246. These cores are very similar to those from the 2nd and 3rd phases of the button working waste from the massive deposits described by T.A. Spitzer in his article at the URL www.baac.nl/bonebead.htm. This is a call for information about finds of a similar nature, entitled 'Late Medieval bone-bead and button production: Economic Strategies of a Late Medieval Craftsman Based on Material from Constance, Germany'.

6.6.8 The plaques are further shaped with a saw and then a file or knife to form the roughly shaped scale blanks. The thickness of material available will vary from bone to bone and also on different sides of the same shaft, producing blanks suitable for different handle forms such as the very contrasting examples from contexts 105 and 247. The latter scale is quite thin and delicate, and the positions of the perforations for the rivets suggest that it is a rough for a clasp knife or folding fork, several 19th century examples of which are illustrated by Moore (1999). There are no finished examples of scale blanks from the Sheaf Square site.

Off-cuts and waste pieces

6.6.9 The third group of finds are all off-cuts and waste pieces but encompass all the ivory finds, including a tip of a hippopotamus incisor from context 111, a section of hippopotamus canine from context 113 and two thin strips of elephant ivory from context 341.

6.6.10 Another piece of elephant ivory and the remaining bone items come from a single context, 139. Totalling eight, this is by far the largest group of objects from a single context. These are mostly blocks or chips with a mixture of cut and un-worked surfaces. The lump of brown material on the end of the ivory block is particularly intriguing and warrants further research which is outside the remit of this report. It may have been used to attach the ivory to another object during cutting.

6.6.11 The block of elephant ivory and three sections of bone have been sawn and snapped in the same manner and bear the impressions of work clamps. These three bone sections show the same surface pathology and may even come from the same bone. All the pieces from this context are stained green but the take-up of the colour varies greatly from piece to piece, and from area to area on individual finds. The distribution of staining on find 18 from context 139 is particularly interesting. This staining is strongest on the periosteal surface and one transverse face but is restricted to the edges on all the other faces. This pattern is difficult to explain but looks more accidental than deliberate. The staining of all the finds from this context was probably due to corroding copper alloy in the semi-waterlogged burial context, rather than deliberate dying. Unless dyeing can be guaranteed to penetrate throughout the bone it is more likely to be applied to a near-finished item. In addition, objects from

other contexts have patches or spots of green staining which are clearly accidental.

6.6.12 The oval plaque of ivory, small find 13 from context 266, does not appear to be related to button or handle manufacture. It is a decorative piece and is probably only partly finished as its surfaces are mostly very roughly worked and it was, perhaps, discarded when one end broke.

6.6.13 Although most of the finds have came from fills associated with the conduits relating to the sawmill phase of the building, it is not altogether certain that they have originated from the same industrial activity. The four finished buttons may just have been lost from garments, although none of them shows any signs of wear around the stitch holes, and may not necessarily have been made on the site.

Working processes

Sawing

6.6.14 All the primary shaping seems to have been done using either hand or mechanical saws. The bone core from context 378 has particularly clear examples of both. Saw cuts on many of the worked surfaces show an irregularity in depth and alignment that indicates sawing by hand. On these the individual saw marks are not always continuous across the surface and sometimes overlap each other. However on one of the facets the sawing is markedly different. These saw marks are regularly curved, never cross over each other, all lie in the same plane and have produced a flatter surface. These features are more characteristic of a mechanically driven, blade that does not suffer from the variations in pressure between strokes seen in the hand-sawn sections. The distinct curvature of the cut marks on the plaque from 316 in particular would seem to indicates that a rotary saw was being used. On several of the pieces, such as the waste strip from 246, there is a regularly repeating pattern to the saw cuts. This may reflect variations in the quality of the cutting edge of a rotary blade or may indicate a mechanically driven saw with a rocking action.

6.6.15 On the only complete facet that has been machine-sawn on the core from 378, it is notable that the saw marks are more widely spaced towards the opposing corners, at the beginning and end of the cut. If the blade and bone are presented to each other with a constant force, the speed with which the blade will pass through the bone will be determined to a great extent by the length of bone presented to the cutting edge. The longer the interface, the greater the resistance, and the slower the saw will cut the bone, assuming that the density of the bone is relatively constant. The pattern of cutting observed on the machine sawn surface shows that the cutting rate was slower across the main body of the face, where the cutting edge is at its longest, than at the corners. This is evidence that the hand sawn facets had been cut to provide a rectangular outline before this plaque was removed. That the other facets were not cut with the same care suggests that these plaques were not suitable for the same purpose, presumably because of the morphology of the bone. They would either be seen as waste or would be used in the manufacture of smaller objects following further preparatory shaping.

6.6.16 In conclusion the bone shaft was probably first trimmed to length and then shaped on three sides to determine the width of the plaque, to provide a lower surface at right angle to the plaque (on which the bone rested when presented to the vertical face of the saw), and a flat surface opposite the plaque (possibly to register in a block held by the operator distancing his hands from the saw during cutting). If this was cut with a rotary blade positioned in a bench directly in front of the operator, and the blade was spinning towards him, so that the bone dust is forced downwards away from the face, the bone was presented to the saw with narrower end first and from the right, i.e. by a right handed operator.

Other working processes

6.6.17 Bone can be worked using the techniques and tools of woodworking. When fresh it can be whittled with a knife or carved with a chisel. Two of the bone chips from context 139 and the block of elephant ivory all have score marks from a knife blade. A file has been used to refine the shape of the knife scale from context 247. The file marks can be distinguished from the saw marks not only because they are finer but because the sawing is done at an angle to the edges of the work piece, creating diagonal cut marks on the surface, whereas the file marks lie at right angles to the ridge which is being smoothed. Several of the pieces have also been smoothed or polished with a fine abrasive.

6.6.18 The buttons also provide several examples of drilling and turning. Turning marks and radial lines from tool 'chatter' (damage caused when the cutting tool bounces on the surface of the work piece) are generally lost from the surface of the finished object due to polishing. However, the unfinished button from context 405 has retained these features which can be seen when viewed in a raking light. Preservation of this object is so good that, using a hand lens, it is possible to see the sharp edged radial cuts left by three separate blades (used to shape the curves of the back, front and rim) when the lathe was stopped.

The Shell finds

6.6.19 A catalogue of the Tortoiseshell and shell finds is shown in Table 23 (Appendix III, Volume 3), and are shown above by phase in Table 24.

Tortoiseshell

6.6.20 Although packaged with the shell finds, the thin strip from context 225 is not shell but tortoiseshell. Shells of terrestrial and marine molluscs are calcareous structures but the main constituent of tortoiseshell is the protein keratin and this rarely survives on archaeological sites unless conditions are very dry or waterlogged and anoxic. Tortoises and turtles secrete plates of this material over the boney shell of their bodies. The most commonly commercially used material comes from the hawksbill turtle, *Eretmochelys imbricata,* because it produces relatively large and thick plates of attractively mottled amber and brown tortoisehell. This piece may have been intended as a decorative veneer for a handle. Tortoiseshell was often applied to objects such as handles, boxes

and furniture, in thin sheets over a white backing so that incident light was reflected back through the tortoiseshell, showing off its natural mottled colouration.

Mother-of-Pearl

6.6.21 All the shell finds that could be positively identified to species were fragments of the bivalve *Pinctada maxima*, also called the gold-lipped or silver-lipped pearl oyster. The features of all the other fragments were also consistent with *Pinctada maxima*.

6.6.22 Oysters are bivalves having two shells, or valves, which are almost mirror images of each other. These calcium carbonate valves are joined along a hinge line near which is a bulge termed the umbo. This is the oldest and thickest part of the shell. *Pinctada maxima*, is the largest of the oysters and can reach up to 30cm in diameter. It has a light brown outer surface of overlapping scales, which are worn away in older oysters leaving a roughly laminated surface. These layers are made of columnar prisms of calcite arranged perpendicular to the surface of the shell. The inner surface is composed of a different form of calcium carbonate arranged in thin laminae parallel to the surface of the shell. These are the sheets of aragonite that form the nacreous layer commonly termed mother-of-pearl. *Pinctada maxima* is valued both as a source of pearls and for the shell itself, which provides exceptionally large, thick plates of mother-of-pearl with either a gold or silver-white colouration towards the margin of the valve.

6.6.23 Only a few fragments, such as those from contexts 266, 291,357 and the smaller fragment from 117, show the characteristic gold margin, whilst others, particularly the larger fragment from 117, are the silver-lipped form.

Working

6.6.24 Most of the fragments seem to relate either to button making, handle scale production or, perhaps, strips for decorative inlay of objects such as boxes or furniture. All the shell fragments show evidence of drilling and or sawing. The shells seem first to be cut to provide slabs of material for working into large or long objects, utilising the flattest or most consistently thick areas. The thick discs or 'plugs' are then drilled out of the off-cuts, generally towards the margins of the shells, where the shell is heavily sculptured or, as in the case of the fragment from context 117, where the mother-of-pearl is flawed. This piece has the scar of the adductor muscle attachment at one edge and the rest of the surface is covered with pimples, which have probably formed in reaction to the presence of grit. The outer surface has been damaged by boring sponges that have produced holes in a honey comb-like pattern.

6.6.25 The disc from context 117 and the three examples of partly cut discs, from contexts 117, 266 and 341; do not have a central hole. They are not, therefore, beads but button blanks. The drilled shell waste does not show the break-ridge typical of the bone button waste because they are not cut from both sides to form a single button as in bone button production. Instead the shells were drilled from one surface only, generally the inner surface of the shell, to produce a straight-sided stub of mother-of-pearl. In many instances the brown

outer layers show a rough broken edge. Each plug of material is then probably split, utilising the finely laminated structure of the aragonite, to provide several button blanks. Next the blanks were ground to uniform thickness, drilled with stitch holes and finally polished to a pearly sheen. The concentric grooves cut around the partly finished discs indicate that the cutting tool, perhaps a hollow drill or burin point, was just under 1 mm wide. This means that a c10 mm hole produced a blank of c 8mm diameter. The range of holes indicate that the discs produced would have ranged in size from about 6 mm to 17 mm diameter.

6.6.26 The unstratified strip and those from contexts 359, may be waste from the production of other items, such as the rather worn handle blank from context 306, or for box and furniture inlay, fan sticks and other decorative items. The broken, rectangular plaque from context 306 is too thin to be used as a handle, as it stands. It may be a lamination that has flaked off the surface of a thicker handle blank, or it may have been deliberately split and used as a thin veneer or inlay supported on another material.

Identification of the materials

6.6.27 All the materials have been examined under low magnification and identified using the criteria outlined in O'Connor (1987) and through comparison with the authors reference collection or the shell reference collection at Leeds Museum Resource Centre. The species identification of the oyster shell was confirmed by the conchologist Andrew Norris.

Material sources

6.6.28 The bone objects and working debris are most likely to have derived from butchery or knackers waste, a local and cheap source of raw material. However the ivory was imported, probably as whole, un-worked tusks. Historically, hippopotami (*Hippopotamus amphibious*) have been found throughout all of sub-Saharan Africa, although large populations now only survive in the Nile River valley of East Africa. Both African elephants (*Loxodonta africana*) and Asiatic elephants (Elephas maximus) bare tusks. Historically African elephants were found from south of the Sahara to the southern tip of Africa; from the Atlantic coast to the Indian Ocean. Although the Asiatic elephant is now restricted to parts of India and Southeast Asia, including Sumatra and Borneo, they were distributed more widely across Southeast Asia, south of the Himalayas, and into China as far as the Yangtze River. African elephant ivory if often preferred for carving and was even exported to India to be carved. It is not possible to determine whether the fragments from Sheaf Square are from African or Asiatic elephant.

6.6.29 Marine turtles are widely distributed across the world's oceans. The hawksbill turtle, *Eretmochelys imbricata*, is found mainly in the tropical regions of the Pacific and Atlantic oceans, most commonly in hard-bottomed and reef habitats. The gold-lipped pearl oyster, *Pinctada maxima* is a bivalve which lives in marine and estuarine waters. These oysters are found off the coast of Australia, New Guinea, Indonesia, Burma, the Philippines and Polynesia.

6.7 **Wood and Leather** by Steve Allen

Procedures

6.7.1 The objects were delivered to the Wet Wood Laboratory wet packed. Most of the wood was wrapped inside self-seal plastic bags of varying sizes. The larger pieces had been placed inside plain plastic bags sealed with drafting tape and fastened with the latter to thin wooden boards or planks to provide support. The leather finds were wrapped in self-seal plastic bags.

6.7.2 Each object was in turn removed from its packaging, washed under cold running water to remove adhering burial deposits. The objects were examined, wood species identification was carried out on the wooden objects, and each object was returned to its original packaging. The wood and leather artefacts are summarised in Tables 25 and 26 (Appendix III, Volume 3) which includes a breakdown by phase. Sixty-six percent of the wood objects originated from the silty fills of the conduits in Phase 2 of the site along with 86% of the leather assemblage. The remainder was mostly retrieved from the semi-waterlogged dam deposits in Phase 1.

Condition

6.7.3 The wood was generally in a very poor state of preservation. Waterlogged anoxic conditions may have been present in those contexts in which the material survived up to the time of excavation, but these conditions have either broken down recently or have not been continuously maintained. Much of the wood was soft and decayed with few original surfaces left. In some cases, the wood structure had deteriorated to such an extent that species identification was no longer possible.

6.7.4 Several of the larger pieces had been block lifted owing to this poor condition and the form of the object had been maintained by the burial deposit adhering to it rather than the wood structure. Indeed the bond between the soil matrix and the wood was often stronger than the wood structure, and required very careful cleaning. The form of these pieces could not be maintained even where known. As soil was removed it became clear that firstly, fragments no longer rejoined (having lost the intervening wood through decay) and secondly that parts of the soil block had shifted within the bags, losing their positions relative to each other.

Wood

6.7.5 There is very little woodworking technology represented in the assemblage. The prevalence of thin tangentially faced softwoods and the occasional hint of sawn faces suggests a relatively recent origin for the wood, certainly post dating the sixteenth century AD. No joints were observed though some metal nails or studs survive to indicate that these fastenings were in use. Species

represented are Scots Pine (*Pinus sylvestris L.*), Larch (*Larix decidua Mill.*), Silver Fir (*Abies alba Mill.*), Ash (*Fraxinus excelsior L.*), Willows (*Salix spp.*).

6.7.6 Ash and Willow are native species and could have been found in the local landscape. Scots Pine did not become a widespread timber tree until the early modern period, and the remaining softwoods later still. The assemblage would seem to date from the eighteenth century onwards and to judge from the condition of the wood alone, some of it could be as late as the twentieth century. That said, there is nothing in the assemblage which would contradict the suggested contextual dating.

6.7.7 Apart from the few chippings, most of the wood derives from a structural context but there is nothing intrinsically diagnostic which would say what activities they were used for or associated with.

6.7.8 None of the wood is suitable for dendrochronology. A sample of the assemblage was retained consisting of the single peg (Context 139/1, Fig. 39.C), an offcut from Context 414 (Fig. 39.B), the turned object (Context 139, SF03, Fig. 39.A) and the fragmented panel (Context 297, SF21, Plate 53). The remainder of the wood assemblage was discarded.

Leather

6.7.9 The small collection of leather is mostly waste material from the recycling of other leather artefacts with a small number of worn pieces of debris. As such it is probably derived from a workshop and represents waste discarded as having no further value.

6.7.10 Very few of these objects are of intrinsic interest and were discarded following 1:1 drawing (Figs 39-42). The exceptions are the two pieces; the Offcut (139, Fig. 40.F) is clearly from a larger artefact and ought to be retained, and the child's shoe sole (Context 104, Fig. 40.A) is an unusual find from an excavation, even of this late date and as such it is one of a class of artefacts significantly underrepresented in the archaeological record. The technology (i.e. nailing with cu alloy pins) is unusual and may represent some particular fashion or an association with a particular trade or occupation.

6.8 **Glass** by Daniel Lee and Alison Morgan

Introduction

6.8.1 Sixty-two pieces of glass were recovered from the excavations at Sheaf Square, Sheffield and were examined on 31st August 2005. A description of the assemblage is presented below and a catalogue in Table 27, Appendix III, Volume 3. Examples of artefacts given during discussion are referred to by catalogue number followed by context number. The catalogue number refers to the objects within the primary archive. A summary of the glass artefacts by phase is shown in Table 28 below.

The assemblage

6.8.2 The assemblage can be divided into two main categories; glass bottles (whole and part) and window glass. Of the sixty-two fragments, thirty-four are from bottles (with only one whole example), twenty-six are window glass, and the remaining two fragments are of unclear function.

6.8.3 Glass bottles and window glass are common finds on later post-medieval sites, especially in urban areas. South Yorkshire was famed for its glass industry that was centred on Barnsley, but also found in Rotherham district and Sheffield (Ashurst 1991). The South Yorkshire glass industry was initially exclusively concerned with crown window glass production in the 17th and 18th century, only later diversifying to mass bottle production in the 19th century. The 'crown' glass method involved the hand turning of glass panes, which was later superseded by the blown cylinder process. The 19th century saw an explosion in glass bottle production with improved manufacturing techniques and increased demand (Ashurst 1991). Window glass, and especially glass bottles, were often recycled to provide the 'cullet' (old glass) that was essential in the process of melting new glass, although much glass was discarded entering the archaeological record.

The bottles

6.8.4 Over 50% of the glass assemblage from Sheaf Square is comprised of bottle fragments. These varied from those bottles missing only the neck and top (e.g. 53 and 54/104/105), and those which represent a body sherd (e.g. 39 and 40/306). The majority of the assemblage dates to the mid to late 19th century, although some of the undiagnostic body sherds may fall outside this range. The oldest and only complete bottle is a small sheared lip sauce bottle (2/104). Sheared lip bottles were made when the top of the bottle was cut off with a pair of shears when it had been blown into the mould (Hedges 2002). The lip was reheated and rolled if required and in the mid 19th century a separate moulded lip was applied. The assemblage is dominated by sherds or partial bottles used to store mineral water and beer. Only two possible wine bottle fragments were identified one with a characteristic deep kick up in the base (3/104). The partial lip of a blue medicine bottle with a ground inner surface for a glass stopper (9/111) and a possible fragment of a scent bottle were recovered (10/111). The colour of glass was determined by the quantity of iron oxide impurities in the sand ingredient, with increased levels colouring glass from pale green to brown or even black (Ashurst 1991). Blue glass was obtained by adding cobalt. The majority of the bottle assemblage was of pale green glass, most commonly used for mineral waters and liquid foodstuffs, and the twelve brown glass fragments were more commonly used for beer.

6.8.5 Advances such as the production of carbonated mineral water provided new challenges in bottle production. The Hamilton, or egg, bottle was invented in 1814 so bottles could be stored on their sides, thus keeping the cork moist, preventing shrinkage and loss of seal and thus carbonation (Hedges 2002,). Two part examples of these were recovered from Sheaf Square (30/226 and 52/104/105). In 1875 the distinctive Codd bottle (53 and 54/104/105) was introduced (invented by Dan Ryland of Barnsley), and was in regular use until around 1930 when the crown cap became more popular and suited to mass

production (Hedges 2002, Talbot 1974). The Codd bottle style used a marble to form a seal against a rubber ring in the lip of the bottle (Talbot 1974). Five incomplete examples of Codd bottles were recovered, the marbles all missing-most likely liberated by children! Egg and Codd bottles were used for the storage of mineral waters and soft drinks, and it wasn't until 1872 that the internal screw stopper was introduced for the successful bottling of beer (Hedges 2002). One incomplete example of a screw top bottle was recovered from Context 172/173 (52) with part of the stopper still in place.

6.8.6 The majority of the bottle fragments are plain with the exception of eight examples that are embossed. The more informative of these are outlined below:

- a probable beer bottle with 'DON BREWERY SHEFFIELD' (1/104), a body sherd with 'MINERAL WATER' (4/104). The Don Brewery was in operation between 1832 and 1916 and was on Penistone Road.
- a beer bottle embossed 'THE…Co BREWERY SHEFFIELD' (15/134),
- a Codd bottle with 'SHEFFIELD CAFÉ COMPANY LIMITED' (53/104/105)
- a Codd bottle with 'MANUFACTURED BY WHEATLEY & BATES LIMITED, SHEFFIELD' (54/104/105). A John Wheatley and Son is listed in the trade directory of 1879 as a manufacturer of black beer, cordials and aerated water at 9, Henry Street, Broomhall with the characteristic broom trade mark as on the bottle (White 1879). By 1888 Kelly's directory lists them in the Dantzic brewery in Napier Street.
- a Codd bottle with '18 EARSHAM ST SHEFFIELD' (58/U/S). This address is listed in Kelly's trade directory of 1888 as occupied by W. and A. Oxley manufacturer of aerated water. The company is not listed in White's directory in 1900.
- a Codd bottle with 'J. OXSPRING PYEBANK SHEFFIELD' (61/U/S). Kelly's 1888 trade directory lists the company as ginger beer manufacturers, although by 1900 it is listed under a Mrs Sarah Ann manufacturing aerated mineral water (White).

6.8.7 Makers initials and names hint at the large quantity of bottles produced in the Barnsley area at the time. Two bottles are inscribed 'RCB' which may represent an unknown local maker (1/104 and 53/104/105). An unstratified Codd bottle (58/U/S) is embossed 'J.W. DOBSON'S PATENT BARNSLEY' and a known maker Dobson and Nalls was in production between 1881 and the 1920s in Barnsley (Ashurst 1991, 125). A Codd bottle embossed 'REDFEARN BROS MAKERS BARNSLEY' (54/104/105) was manufactured at Old Mill works Barnsley bought by the J. and S. Refearn brothers in 1862 in operation until 1946, and also possibly the Aldham Bridge works, Wombwell, in operation by the brothers from 1895 until the early 1900s (Ashurst 1991, 126).

Context	Phase 1	Phase 2	Phase 3
104			5
106			1
110			1
111			3
112			1
117			2
119			1
134			2
139			4
197			5
205			3
225			1
251			1
266			1
273			2
288			1
292			1
302	2		
305	1		
306	8		
307		1	
345			1
359		4	
104/105			3
172/173			1
197/251			2
Total	*11*	*5*	*42*

Table 28. Summary of glass artefacts by phase (four un-stratified finds have been omitted)

Window glass

6.8.8 The twenty-six window glass fragments all represent small broken fragments of flat window panes. The exceptions are two 'bulls eyes' from the earlier crown glass making process (14/134 and 47/345). The traditional 'crown' glass method is described by Ashurst:

'Glass was gathered on the blowing iron and blown into a bubble. This was then punctured, and, keeping it malleable using the flames from the gathering hole or a separate furnace was spun out into a disc about two or three feet long. After annealing [slow heating and reheating] the outer part was cut into small squares or diamonds leaving the centre as waste. [This was]… in fact rarely used, being too thick to cut and usually impure'. (1991, 38)

6.8.9 The remaining twenty-four window glass fragments are plain sherds generally of clear glass. The majority range in thickness between 1.3mm and 1.9mm, with 1.5mm thick glass the most common numbering five examples. Whilst it is more difficult to identify the manufacturing technique from such sherds it is likely that most derive from the blown cylinder process that superseded the crown glass method in the late 1830s and early 1840s (GL 2005). The ridged window glass from Context 117 (12) may represent new rolled plate glass with a ribbed finish that was introduced in 1847 and commonly used in glazed roofs (LCG 2005).

Other sherds

6.8.10 Two glass fragments with an unclear function were recovered. The first, a small emerald blue sherd with one surface ground smooth (5/104). This may have formed part, perhaps the base, of a larger vessel. The second is a decorative fragment with a possible scallop shell design that may have formed part of a decanter or decorative ornament (32/273). The piece is unfortunately badly damaged limiting further identification.

Conclusion

6.8.11 The small assemblage of glass from excavations consists largely of bottle fragments with only one whole example. Whilst many of the bottle fragments are small, they all broadly fall within a 19th century date range. The sheared lip bottle from Context 104 (2) and perhaps some of the more patinated larger beer and wine bottle fragments from Context 306 (Phase 1) may be late 18th to early 19th century. The bottle assemblage appears to derive largely from domestic waste although bottles were discarded in a wide range of circumstances such as at places of work or around public houses. Two examples of crown glass were noted consisting of waste fragments from this 18th and early 19th century industry. No evidence of glass manufacturing or production was identified on site and the crown glass fragments are most likely to derive from the former 18th century works at nearby Attercliffe and Catcliffe. The other window glass fragments are small fragments with no whole panes present. The ribbed design on the two sherds from Context 117 from the backfill of Conduit A are likely to post date 1847 when this design technique was introduced. The majority of glass fragments derive from the made ground or demolition deposits in Phase 3 of the site and so are likely to have been imported from elsewhere. The frequency of local references embossed on some of the bottles suggests that this provenance was mostly within Sheffield.

6.9 **Textile** by Penelope W. Rogers

6.9.1 A single fragment of light brown textile, S.F. 20, was recovered from context 297 (Phase 1), a soft silt deposit associated with the Tilt Forge dam of AD 1793-1855. The textile is a curving strip of silk, 190mm long and 44-53 mm wide. It has the imprint of a seam along the two longer edges and also at one end, while the fourth edge is torn or cut. The fabric is a very fine tabby, probably undyed, 70-80 threads per cm in one direction and 36 per cm in the

other. The yarn is silk throughout, but there is a difference between warp and weft. In the closer-set system the silk filament has been fully de-gummed and used without any twist, but in the other system (probably the warp) the yarn has been twisted in the Z-direction and the silk filaments are in pairs, held together in a sleeve of gum. When the silk moth, *Bombyx mori*, forms its cocoon, it exudes a twin filament coated in sericin, or silk gum, but when the silk is collected, it is usual to remove this gum and separate the filaments. Gummed silk is rare, but is generally used where a stiff, less lustrous yarn is required.

6.9.2 This is almost certainly a garment part and its cut, diagonally across the weave, is typical of small dress pieces, especially facings, while the shape suggests a neck facing. The slight stiffness imparted by the silk gum would have made it especially suitable for a facing. It is most likely to be from a woman's dress, although male eveningwear is also a possibility. As such it has no obvious connection with the Tilt Forge, although fabrics of this quality were in use throughout the 18th and 19th centuries and it may well be contemporary with the Forge.

6.10 **Glass Artefacts** by Holly Duncan

6.10.1 The small glass bead and glass button recovered from the excavations are summarised below and presented in a catalogue. The finds are illustrated in Plate 55, Volume 2.

6.10.2 The button from the drain fill deposits of Phase 2 is an example of the 'ball and dome' variety of glass buttons, made to imitate hardstones, bird's eggs, and cat's eyes (Peacock 1978, 23-4). These buttons were in the main for use on waistcoats and children's garments. The colour of the green glass and opaque white threads on the Sheaf Square button create an affect resembling malachite and may have been made in a similar manner to marbles (1972, 54). Ball and dome buttons were generally poured into a mould and metal-shanked while hot (Peacock 1978, 23-4). The Sheaf Square example however is perforated and has a through shank, the shank head decoratively stamped and gilded. This form of shank is known as the pin head shank, in use in the 19th century and later (Peacock 1972 glossary). Albert and Kent illustrate examples of glass buttons with metal pins through the body and note that sometimes the pin head has a decorative top (1949, 102-3 no.11). Although ball and dome buttons were being manufactured in Birmingham in the mid-19th century many were also made, as a cottage based industry, in Bohemia (Peacock 1972, 54; 1978, 24; White 1977).

6.10.3 The small red bead from the made-up ground deposit (124) is closely paralleled in colour and composition by a bead from excavations at Ferrybridge*. Energy dispersive x-ray fluorescence indicated that the bead from Ferrybridge contained small quantities of arsenic, which did not become a constituent of glass until the early post-medieval period, with the first literary reference in 1679 (Turner 1956). More refined dating than this however is not possible.

* The Ferrybridge bead was found in context 2290 Pit2107; Group 129 (part of pit alignment); Phase 3. It was intrusive in this context, introduced through worm or rodent activity. EDXRF was carried out by Matt Nicholas of English Heritage Lab

Catalogue

6.10.4 **Button**. Glass and copper alloy. Globular bead, oval in cross-section, of translucent emerald green glass with swirls of opaque white glass threads set within the matrix. The bead had been threaded onto a copper alloy shank, the head of the shank is flattened and stamped with a flower head design (width of shank head 6mm). The outline of the stamped head retains four of the probably six original pointed petals, which are decorated with radiating grooves. The petals surround a circular 0.5mm wide border of ridging, which encircles four central dots. Traces of gilding survive. The opposing end of the shank has been folded over, the ends tucked inside the bead, to form the button loop. Bead width 11.7mm, thickness 11.3mm; height 10.7mm; length of shank 18mm. 139 Fill of drain; Phase 2, Plate 55.

6.10.5 **Bead**. Glass. Short cylinder bead of red opaque glass wrapped round a white opaque inner core. Height 3.4mm; diameter bead 4mm; diameter of central perforation 1.1mm. 124 Made-up ground. Phase 3, Plate 55.

6.11 Other Artefacts

6.11.1 The other artefacts in the finds assemblage not included in the specialist reports, including stone, slate, mortar and plaster are listed as a catalogue in Table 29 (Appendix III, Volume 3).

6.11.2 The two slate pencils (u/s, 172/173, Plate 54) and pencil lead (288) were recovered from made ground deposits and may have been used in domestic or industrial contexts.

7. Environmental Record

7.1 **Animal bones and marine shells** by Jane Richardson PhD

7.1.1 In total, 116 animal bone fragments and 95 marine shells were recovered. These are summarised in Table 30 below and listed in Tables 31 and 32, (Appendix III, Volume 3) and. The data are presented by phase as follows, although too few bones and shells were retrieved to allow comparisons between the phases.

- Phase 1: forge (1793-*c.*1830s)
- Phase 2: sawmill (*c.*1830s-*c.*1855)
- Phase 3: post sawmill (between *c.*1855-*c.*1905)

7.1.2 The bone fragments were typically well preserved, with few eroded surfaces and only scant evidence for gnawing by rodents.

7.1.3 Only a minority of the animal bones represent food rubbish. These are the cattle, sheep, pig, domestic fowl and fish fragments and probably also the rabbit bones. Butchery marks on cattle, sheep, pig and domestic fowl bones certainly attest to the reduction of their carcasses and often to meat removal. Unfortunately, too few bones were recovered to allow for the analysis of age data and a subsequent assessment of secondary production (e.g. milk), although both sub-adult and adult sheep were noted.

7.1.4 The meat component of the diet would have been supplemented by shellfish, in particular oysters and very occasionally crab. All of the shellfish identified can be found in estuarine waters or at the mouths of estuaries. The closest source to Sheffield is the River Humber, from which these animals were probably imported.

7.1.5 In contrast to the relatively few fragments from the meat-producing animals, many of the bones recovered came from a partial sub-adult cat skeleton that was associated with a possible yard surface (105). In addition, the presence of foetal and juvenile cat bones and a dog skull indicate that work animals (e.g. in terms of vermin control), pests and/or pets were also disposed of in the area.

7.1.6 Unfortunately too few bones and shells were recovered to facilitate further analysis and interpretation. In summary, it was only possible to identify some domestic food waste and the presence of a few disarticulated dog and cat bones, and a partial cat skeleton.

	Phase 1	Phase 2	Phase 3
Cattle		1	3
Sheep			4
Pig		1	1
Dog			2
Cat	2		63
Rabbit	4		4
Domestic fowl	1		5
Bird sp.			2
Fish sp.			3
Large mammal			5
Small mammal	3		11
Undiagnostic bone		1	
Oyster (*Ostrea edulis*)	7	6	61
Mussel (*Mytilus edulis*)	2		5
Cockle (*Cardium edule*)		3	9
Otter (*Lutraria lutraria*)			1
Crab			1
Total	19	12	180

Table 30. A summary of the animal bones and shells by phase

7.2 Environmental Sample Summary

7.2.1 Seventeen soil samples taken for analysis included eleven for general biological analysis (GBA), two spot samples for specialist material analysis, and four pollen samples (Appendix IV). The GBA samples were subjected to a system of floatation in an Ankara-style floatation tank equipped with a 300μm sieve and a 1mm mesh. The floating remains (the flot) and the heavy residue (the retent) were sorted, identified and quantified.

7.2.2 The results of this analysis for the residues are presented in Table 33, and the flots in Section 7.2 below. Sample No. 13 was taken in order to analyse the clinker and ash content and was subjected to the same floatation technique, although a sub sample of the residue was not sorted and sent to the slag specialist for analysis (Section 6.5). Sample 14 was taken for clay identification purposes and was sent unprocessed to the clay pipe specialist for analysis (Section 6.2). The pollen samples (No's 4, 8-10) were not processed as they were deemed of low potential due to the recent nature of the deposits and their urban location (J. Richardson pers comm.).

7.3 **Environmental Remains from the Sample Flots** by Diane Alldritt

Introduction

7.3.1 A total of 10 sample flots were inspected by the author for identification and analysis of carbonised plant macrofossils. Charcoal fragments were also identified in order to give an indication of the range of possible fuel types present, and to provide material suitable for radiocarbon dating.

Methodology

7.3.2 Bulk environmental samples were processed by ASWYAS using an Ankara style water flotation system (French 1971). Dried flots were forwarded to the author, where they were sorted with the aid of a low powered binocular microscope at magnifications of x4-45. Large quantities of industrial material in the form of slag / hammerscale and a highly vitritifed glassy material, possibly clinker, were present in the majority of samples. This material was quantified approximately by volume and left within the flots for analysis by an appropriate specialist.

7.3.3 All charcoal fragments suitable for identification were removed from the samples and examined using a high powered Vickers M10 metallurgical microscope. Charcoal was subsequently bagged by type. The reference photographs of Schweingruber (1990) were consulted as an aid to charcoal identification.

Results

7.3.4 The results from the samples are presented in Table 34, Appendix III, Volume 3.

Discussion

7.3.5 The environmental samples produced an abundance of industrial material, mostly in the form of waste products from industrial processes. Every sample contained fragments of hammerscale / slag, and a glassy vitrified industrial material which may be clinker, in amounts varying from <5mls to up to 50mls. The hammerscale material has been examined by Jane Cowgill (see below)

7.3.6 No carbonised plant remains in the form of cereal grain or seeds were recovered from the site, however a small amount of charcoal was present. Samples 3 (239), 5 (297) and 15 (414) all produced identifiable fragments, which were found to be *Quercus* (oak), *Corylus* (hazel) and *Betula* (birch) respectively. These three charcoal types were all most likely used as a fuel source for the various industrial processes occurring at the site. Hazel and birch suggest scrub or more open woodland edge habitats probably in the vicinity of the site, whereas oak, albeit recovered here in a very small amount, does suggest access to more substantial woodland in the area. Sample 2 (203) produced two fragments of very brittle and glassy, almost vitrified, indeterminate charcoal, which indicates that this material had been subjected to extreme heat.

7.3.7 Samples 5 (297), 6 (241) and 7 (302), all produced modern material in the form of seeds and earthworm egg capsules which indicated that these features were either relatively modern or stratigraphically quite near to the surface / subject to bioturbation processes.

Summary and Conclusions

7.3.8 Overall the environmental samples from Sheaf Square, Sheffield have indicated a site with deposits exclusively involved in industrial activity, most likely using charcoal as a fuel source. Both oak and birch produce a high temperature and long lasting heat, although oak has the best overall properties as a fuel source. Hazel charcoal could have been used as kindling or on smaller fires. No other carbonised plant remains were found.

7.4 **Hammerscale** by Jane Cowgill

Recording Methodology

7.4.1 The magnetic element of six retents were submitted for recording. These were emptied onto a petri dish and examined with the aid of a x10 binocular microscope. They were recorded on a *pro forma* recording sheet and this information was entered directly into the catalogue below (Table 33).

Context	Sample	Count*	Weight	Comments
139	1	100+	1g	Most plate hammerscale, few spheroidal, some prill.
309	12	8	<1g	Plate hammerscale, most iron flakes.
266	13	1000+	2g	Crushed plate hammerscale and iron flakes, few spheroidal.
414	15	5	<1g	Plate hammerscale and iron flakes.
359	16	2	<1g	Plate hammerscale and 3 prill.
410	17	*c*. 25	<1g	Plate hammerscale and 1 prill.

* Hammerscale count.

Table 35. Catalogue of hammerscale from the sample retents

Discussion.

7.4.2 Hammerscale was present in all of the six samples submitted in very varying quantities. Most of it was crushed to some extent suggesting that it had been trampled on the forge floor, but this also means that the individual pieces are small enough to move down through the soil and therefore where very little is present (for example context 359) it could be intrusive. As would be expected all the samples are dominated by plate scale, the most common kind, spheroidal scale forms during the welding of iron and therefore is always less common. Hammerscale is always a good indicator that iron was being worked

nearby, but with the presence of a Tilt Forge on the site during the first phase of occupation, it would have been strange for none to be present.

8. Discussion

Phase 1:

8.1 The excavations at Sheaf Square successfully identified part of the remains of the New Tilt building and wheel pit and the Pond Dam constructed in 1793-4. Parts of the external walls of the building and wheel pit (Phase 1) were located although the majority of the structure lay outside the trench to the north. The walls of the building and wheel pit were stratigraphically among the earliest structures on site. No deposits associated with the internal use of the building were identified and dating is reliant on documentary sources alone. Some finds material was recovered from the associated dam and pottery from the dam structure (400) has been dated to the late 18th century to early 19th century. Clay pipe fragments recovered from the lower internal silts of the dam have a deposition date of 1800-60, although these reflect the continued use of the dam during the 19th century rather than a date for its construction. Finds from the internal dam silts could well have migrated from upper silt levels and from later overlaying made ground over time.

8.2 Phase 1 represents this initial stage in the buildings history when the New Tilt was constructed. Fairbank's detailed plan of the New Tilt dated at the time of its construction in 1793-4 (Fig. 3) clearly shows how the building was constructed into the existing dam built previously for the Old Tilt and indicates that a new dam bank was constructed to the south-east of the wheel pit. This dam structure was located during excavation (Fig. 22, S.85) and the dam deposits (e.g. 399-401) were observed overlaying lower re-deposited or perhaps weathered natural layers (402). The internal dam silts (239) in turn were observed overlaying the dam bank material. The cartographic evidence and the date of the pottery from Context 400 suggest that the dam bank located in the trench was that relating to the New Tilt. It is puzzling that no dark silty material underlay the new bank, which might have been expected as it was built into the existing Old Tilt dam, although modification of the area and the removal of silt may have occurred. It is unlikely, however, that the internal silts of the dam would have been markedly altered during the construction and transition period between the two tilts, and some of the early finds material such as 18th century pottery may originate from the continued use of the dam from the early 18th century.

8.3 The original forge building (Phase 1) is known to have functioned as a tilt forge, certainly during its earlier stages of use. The New Tilt was constructed to replace the Old Tilt in the late 18th century and there is little to suggest that the new building was dissimilar in function to its predecessor where it appears that waterpower operated tilt-hammers in the process of forging steel. It seems plausible that the New Tilt was simply a more efficient updated version of the Old Tilt in which machinery and resources were concentrated until the demolition of the Old Tilt in the early 19th century. Fairbank's 1793 plan (Fig. 3) shows the increased size of the New Tilt which may have been a reason for

its construction. The main reason may have been the need for increased production which was reliant on the power derived from the waterwheel. It is possible that the fall of the wheel of the Old Tilt from the Tilt Dam to the tail goit in the north was low, and an increase in production was not possible due to low power. The Bamforth Dam was constructed in 1780 to the north-east of the Tilt Dam and this may have provided a larger fall and therefore the opportunity for more power. The New Tilt may have taken this opportunity and the Old Tilt fell out of use. The precise nature of the activities and processes undertaken during the early use of the New Tilt, other than to suggest an association with the steel trade and the hammering of steel items, are not known. Later documentary sources list equipment that was sold from the premises in 1825, including a beam, a flywheel hammerheads and anvils (Crossley 1989, 112). These were typical of a tilt hammer workshop which would also have contained a forge to heat items prior to hammering. No evidence of tilt-hammers, the forge or working debris or waste was located within the excavation, although hammerscale from the sample retents indicates hammering activity in the area.

8.4 Phase 1 of the site generally consisted of structural remains, such as the building walls and dam bank with the exception of the internal dam silts. Artefacts recovered from the internal dam silts represent domestic and some more industrial-type waste that may simply highlight the use of the dam to get rid of certain types of material by passers by or the workers at the tilt. They represent causal periodic deposition events rather than mass purposeful disposal. It is likely that dumping waste into the dam was discouraged by the owners or workers as this would eventually effect the efficiency of the waterwheel. The finds recovered from the dam included pottery, clay pipes, crucible fragments, a woven wooden panel and silk textile. The survival of the latter organic finds was facilitated by the semi-waterlogged anaerobic conditions within the silts. The remains of the timber platform (Phase 1) identified in the dam silts appeared to derive from an earlier rather than later stage in the use of the building due to the presence of a layer of silt above the stake hole remains. The lack of stratigraphic relationships to the building and dating material precludes any more accurate dating of the structure. It is possible that it derives from Phase 2 and it may relate to the structure depicted in the 1850 map in that area which relates to the building extension (Fig. 32).

8.5 It is argued in Section 5 that the four main structural slots (271, 337, 338 and 339) located above the external stonewalls of the building (Phase 1) represent wall slots that formed the structural base of the building (Fig. 11). This is open to debate as no direct evidence for walls was identified and it is possible that they represent beam slots. The two slots associated with the wheel pit (338 and 339) may represent beams forming part of the wheel axle and penstock mechanisms although no residues of timber were located and the beams were removed in Phase 3A. Large structural timber beams were common in the base structures of watermills contemporary with the New Tilt (David Crossley pers comm.). The presence of a ‘notch’ indicates a possible timber joint between beam slots 271 and 337 although a masonry corner may also have caused this impression. The demolition layers above the building (e.g. Layer 273, Fig. 18, S.48) certainly contained high concentrations of bricks, but no bricks were found *in-situ* within the main forge building walls in Phase 1 and no imprints

of bricks were noted in the exposed mortar surfaces. It is of course possible that that some of the slots, associated with the wheel pit for example, represent beam slots, and the remainder were formed from brick or stonewalls. This argument will remain unresolved, although brick walls are proposed. The removal of building materials during demolition for reuse or resale has limited interpretation, especially as such a small portion of the building was located. It was unfortunate that the internal space of the building and the base of the wheel pit was not excavated, although these are likely to be preserved outside the trench to the north.

Phase 2:

8.6 The building extension in Phase 2 of the site has mainly been characterised by cartographic sources. The building was extended to the south-east beyond the wheel pit between the surveying of Fairbank's 1808 map and Tayler's 1832 map where an extension is first depicted. The extension is most clearly depicted on the 1850 Ordnance Survey map (Fig. 7). Documentary sources indicate that a change in use of the building occurred during this time with the selling of some anvils and hammerheads etc in 1825 and the naming of the building as the 'Pond Tilt and Sawmill' in the rate books in 1830 (Crossley 1989). It seems likely, therefore, that the extension was constructed between 1825 and 1832. Excavations revealed little evidence for the external walls of the building extension, largely due to later disturbance by features, although two interconnecting conduits were located. This is assumed to have been located inside the building extension which may have formed a workshop. Power may have been transferred to the workshop from the adjacent water wheel via a system of belts.

8.7 At Sheaf Square excavations, the structural remains generally related to the building with a small number of use deposits identified that date to the later Phase 2. The majority of the artefactual evidence originates from Phase 3 of the site where the area was landscaped and used as a series of yards. The site chronology is also usefully capped by the cobbled surface that sealed the area dating to *c.*1905. The artefact record from the excavation has provided some information for the use of the building and dam in Phases 1 and 2, however, the vast majority of finds derive from the disuse of the building and the modification of the area in Phase 3. The artefacts can be split into two broad categories; artefacts that provide accurate deposition dates such as pottery and clay pipe fragments but do not relate to the function of the building providing insights into more general Sheffield life at the time, and artefacts that only provide broad dating evidence but may indicate specific activities within the building, such as cut and worked bone.

8.8 There are several plausible functions for the conduits. It is possible that the structure was used to house grinding wheels, although due to the ad hoc construction of the sidewalls apparently little strength and the lack of wheel-swarf within the channel, this theory seems unlikely. The large mounting stones (115 and 398) within the sidewalls also had no opposite stones required to support an axle, and appeared to have been reused from a grinding wheel trough to form part of the walls.

8.9 The silts (139, 359 and 410) within the conduits appeared to have accumulated slowly and contained preserved soft wood timbers and a range of finds including cut and worked bone. The cut bone and waste from button manufacture may indicate that the building extension, and perhaps the area above the conduits, was involved in this trade. It is possible that light machinery, such as small powered saws and drills were rented out to smaller manufactures to provide added income to the sawmill. The Sheffield button industry was famous in the 18th century and although in decline during the 19th century was still common (Smith 1997). Whilst many of the small button makers used simple hand-powered machinery, such as pedal driven laths (Smith 1997), it is probable that advantage was also taken of the increased mechanisation during the 19th century with the use of powered sites for sawing and perhaps lathing, whilst still maintaining small workshops for most of their tasks. The leather strips, trimming waste and straps found within the conduits may originate from light belt driven machinery within the building extension, or hint at other trades using the workshop. The frequency of copper alloy rivets within the silts hints at this activity nearby. Clay pipe material suggests that the conduit was in use between 1830-60 which corresponds with the cartographic evidence. Whist this cannot be used to date the building extension as the conduits may have been a later addition, it gives an indication that the extension was constructed in the late 1820s to early 1830s. Hammerscale from the silty fills suggests that tilt hammers may have still been operating at this time.

Phase 3:

8.10 The series of walls and culverts constructed across the site in Phase 3 are likely to represent a series of yards that may relate to the surrounding works (e.g. the Albion Saw mills to the north) and almost certainly the inception of the railway. Wall 155 is a typical railway-type wall in its construction. It is likely that this wall was constructed before the opening of the original in 1870, and fell out of use with modifications around the turn of the century and the final extension to the west completed in 1905 that saw the area cobbled. A recent watching brief undertaken to the south of the trench (ASWYAS in prep) identified a parallel wall of the same size and construction *c.*11.5m to the south, indicating that they formed the raised station access roadway first depicted in the Ordnance Survey map of 1891-2 (Fig. 8). Accurate dating of these structures is problematic as the material used to back fill the wall foundations or above the culvert was derived from the surrounding made ground and so artefacts are likely to be mixed and residual. The fact that Wall 108 is not depicted may again illustrate the rapid and frequent changes that occurred on the site after the demolition of the saw/grinding mill building in the 1850s.

8.11 The Ordnance Survey map of 1850 is shown overlaying the phased site plan in Fig. 32. Whilst some useful insights can be gained from this exercise, there are several inaccuracies in scale and orientation that must be borne in mind. With the lack of detail of the forge/sawmill building exposed during excavation it was difficult to orientate and scale the map overlay from essentially two points; the building wall corner and wheel pit edge. The resulting plan must therefore be viewed as a best fit, but some useful inferences can be drawn. The

wheel pit may have been partitioned with only the north-west side adjacent to the forge building housing the wheel. The remainder may have been used for access and maintenance. This suggests, however, that the north-west wall of Conduit A may have been a more significant structural wall, although excavation suggested that not to have been the case. Excavation has indicated that the structure depicted to the south-west of the building extension in the Ordnance Survey map consisted of a jetty or platform in the dam constructed from wooden stakes. The dam bank structure located during excavation ties in with the south-west external wall of the building extension although the precise nature of this is unclear. The other walls of the extension were not located during excavation and it is possible that they were more ephemeral than the main building (perhaps constructed from timber) or that they were removed by later disturbance from the construction of the large retaining walls and culvert.

Artefacts:

8.12 The artefactual evidence recovered from Sheaf Square has not only provided useful dating but also insights into the lives of people who lived within the town during the early 19th century. The large assemblage of clay tobacco pipes has provided tight date ranges for the deposition of key layers on the site. Also of note is the significant assemblage of clay pipe production waste recovered from Context 383 that has been dated to *c.*1855-60 and appears to have derived from a maker in Leeds. The clay pipe analysis indicates that similar production material was identified in all the main associated clinker layers (111, 117, 266, 341 and 383) and that they from part of the same single group of kiln waste. This illustrates the importing of production material from another city, and may highlight a more complex regional pattern of deposition of waste or artefacts at the time. It is also useful to consider, the imported material aside, how the local element of the assemblage came to be included in demolition deposits and made ground. Not all the fragments can represent causal discard and a more structured discard pattern of domestic waste, perhaps along with the pottery, may have occurred. Beyond dating and origin, the clay pipe assemblage indicates the frequency of this form of material culture, even if the production waste is excluded, on this predominantly 19th century site and the implications for public health and habit at the time. Assuming the smoked pipes were used for tobacco, the detriment to health of Sheffield inhabitants is clear, especially when combined with the general smoke, smog and dust prevalent at the time. Whilst representing only part of the 'tobacco consumption package' the used clay pipes from the Sheaf Square excavations would have formed part of the daily lives of the local inhabitants and may have formed part of social competition among the working classes (Cressford 2001).

8.13 The pottery assemblage consisted of a wide range of domestic wares dating to the late 18th, 19th and early 20th centuries. Whilst different types originated from outside Sheffield, a significant proportion can be attributed to local production, and the assemblage illustrates the use of domestic refuse for backfilling and levelling industrial sites in central Sheffield. The clay pipe assemblage has also indicated the importing of this material from Leeds, but Don Pottery wares within the deposits demonstrates a degree of mixing

between Sheffield refuse and the imported material, and highlights the complex pattern of deposition of such material.

8.14 The pottery assemblage has also afforded a rare insight into leisure time in the 19th century with the retrieval of several whole or fragmented ceramic balls used in the game called Knurr and spell. The knurrs (balls) would have been used in a variety of contexts including open spaces where the game was most likely played (Plate 43), and domestic dwellings and public houses where the balls were most likely stored or frequented. Their inclusion within domestic refuse is therefore not surprising but can only hint at a fraction of their life histories that may extend beyond simple discard or loss.

8.15 If we assume that the backfilling and levelling deposits excavated on the site derive largely from domestic refuse, a few inferences as to the diet of Sheffielder's during the 19th century can be made. Although the assemblage of animal bones and marine shells was small, it indicates that a wide variety of meat products were consumed including imported shellfish, confirmed by the presence of this typical domestic waste within the backfill and levelling deposits on the site. The small size of the assemblage may indicate the varied nature of the discard of domestic refuse in this context, but also may be biased by varied recovery rates with the use of a mechanical excavator to remove much of the upper made ground.

8.16 The finds from the Sheaf Square excavations imply flaws in our readiness to classify sites as 'domestic' or 'industrial', and highlights the need to place so called 'industrial' sites into a wider socio-economic context (Cranstone 2001). Whilst the varied nature of the industrial complex at Sheaf Square, that originated as a Tilt Forge and developed into a saw and grinding mill and workshop during the first half of the 19th century, the majority of artefacts derive from an apparent domestic setting and backfilling and levelling of the site with deposits containing both domestic and industrial refuse. This interweaving of contexts highlights the complex set of events prior to deposition and may typify deposits in the lower Sheaf Valley, and further comparative interpretation on sites within Sheffield City Centre as a whole. Moreover, the mixing of industrial material and domestic waste may emphasis the more blurred boundary between these social contexts that existed in Sheffield during the 19th century, contexts that we tend to more readily separate today. The complex set of social conditions within the Crofts area of Sheffield, to the north-west of the city centre, is well documented (Belford 2001) where courts and industrial works also contained residential dwellings and were serviced by schools. This trend was similar for much of the areas around the town centre and it is likely that during the 18th and 19th centuries many workers lived and worked within close proximity. It is inevitable that domestic and industrial waste became mixed. At Sheaf Square we have the end deposition of this relationship as there was no evidence of domestic dwellings on site as domestic waste was not found *in-situ* implying the waste material was mixed and imported from elsewhere.

9. Conclusions

9.1 Excavations at Sheaf Square identified the remains of the New Tilt forge including the south-east corner of the building and the edge of the wheel pit (Phase 1). These were all constructed from sandstone, and demolition material indicates that brick may have formed part of the structure and pan tiles the roof. No detailed remains of the building interior were located and its function as a tilt forge, containing tilt hammers, anvils and a forge, has been gained from documentary and cartographic sources only (see Crossley 1989). The site was water powered and the edge of the wheel pit was located during excavation although no evidence of the wheel or its mountings was found. The tail end of the dam was also identified along with internal silts and the remains of a possible timber platform. A combination of cartographic, documentary and stratigraphic evidence has been used to phase the site. The site history as revealed by excavation did not contradict the cartographic and documentary evidence. The building was extended to the north-east in the early 19th century (Phase 2). Documentary history of the building in the late 1820s to early 1830s indicates that it functioned as a sawmill although no evidence of this was located during excavation. Artefactual remains from two conduits that were located within the extension have suggested that the building was perhaps used for a variety of activities. Evidence of button manufacturing may suggest that small trades may have used the powered facilities for part of their production process. The building as a whole was referred to as a saw mill in the early 19th century with reference also to grinding in the 1840s and 1850s (Crossley 1989). It seems that activities in the building diversified greatly under the management of the Drury's in 1820s to 1850s from tilt hammers, to a saw mill, grinding and perhaps button manufacturing. This frequent shift of a workshop from one trade to another was common in Sheffield (Wray *et al.* 2001) although in the case of the Tilt it may relate to economic pressures from nearby more efficient steam powered sites as the building remains under the same managers during this period. Later conversion of the site to steam power remains unclear. A lack of investment in the site may also have occurred in the mid 19th century with knowledge of the planned new Midland Railway.

9.2 The majority of deposits identified at Sheaf Square were made ground and post dated the building (Phase 3). Artefacts found within these deposits, mainly fragments of clay tobacco pipe, have dated the demolition and back filling of the building to between *c.*1840-60. This is supported by documentary evidence that indicates the works were closed in 1855-6 and it appears that demolition and initial backfill occurred relatively quickly, and certainly between 1855 and 1860. Of interest is the high concentration of domestic waste in an apparently 'industrial' context, and the importing of material into Sheffield as was suggested from the characteristic clinker and ash deposits used to backfill the building that contained kiln waste material from Leeds. Evidence of the Sheffield metal trades was in the form of ferrous and non-ferrous crucible fragments and copper alloy wrought metalworking waste, although these artefacts were apparently imported onto the site. The made ground deposits also contained high concentrations of domestic waste especially pottery with typical Sheffield designs present (e.g. Don Pottery) and also cut and worked bone typical of Sheffield button industries and glass

bottles from Sheffield companies, but also more unusual objects from everyday life such as Knur and Spell balls and slate pencils. This clearly illustrates the variety of material included in made ground from apparently different social contexts.

9.3 The importing of clay tobacco pipe material from Leeds also adds another dimension to the narrative, and suggests the demand for spoil material could have been so great that it was imported into the city, perhaps by road but more likely by the expanding railway network, mixed with local material and used to landscape the city periphery in the mid 19th century. Certainly the volume of material required to fill the lower Sheaf Valley from its confluence with the River Don to the present Queens Road roundabout would have been huge. It is interesting to consider how the domestic waste was included into the made ground. Was ceramic and more solid household waste deposited at certain sites within the city and was then mixed with spoil or was the waste included when the made ground was deposited on the site? The small number of animal bones found (indicative of food waste) might indicate the selective deposition of artefact types, although oyster shells were also found. The large quantities of made ground that overlay the building and dam structures at Sheaf Square might indicate the presence of other buried 18th and 19th century sites along the lower Sheaf valley. The site at Sheaf Square has indicated that significant 18th and 19th century industrial remains may be preserved at depth along the lower Sheaf Valley, even with later development, and that contemporary made ground deposits themselves can be of considerable archaeological value.

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