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ARO55: Excavations at the site of Bell's Pottery, Stafford Street/Kyle Street, Glasgow.

By Keith Speller

With contributions from Bill Brown, Naomi Crawley, Michael Donnelly, Henry Kelly, Effie Photos-Jones and Michael Vaughan

Illustrations by Caitlin Evans and Keith Speller

Photographs by Keith Speller and Bill Brown

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Archaeology Reports Online, 52 Elderpark Workspace, 100 Elderpark Street, Glasgow, G51 3TR
0141 445 8800 | editor@archaeologyreportsonline.co.uk | archaeologyreportsonline.com

ARO55: Excavations at the site of Bell's Pottery, Stafford Street/Kyle Street, Glasgow

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Summary

This publication describes a developer funded excavation and subsequent watching brief on the site of the Glasgow Pottery, otherwise known as Bell's Pottery, which is recognised as Scotland's largest and foremost producer of popular ceramic wares during the nineteenth century. The excavations showed the pottery's structural remains to be in generally excellent condition below the contemporary ground surface. A number of well-preserved kiln bases were exposed and recorded. From these and the underlying deposits, a large assemblage of pottery sherds, moulds and kiln furniture was retrieved, along with raw materials, industrial residues and glass.

The excavation has shown that the pottery quickly grew in size from small beginnings. The pottery finds and plaster moulds have provided many previously unknown forms and designs, plus the opportunity to re-fire a Bell's jug from an original mould design. The scientific study of the industrial residues, wares and kiln furniture is pioneering work for this type of industry within Scotland.

'Probably no other factory in Scotland made a larger variety, or did more to establish the good name of Scottish pottery than Bell's Pottery' (Fleming 1923, 133).

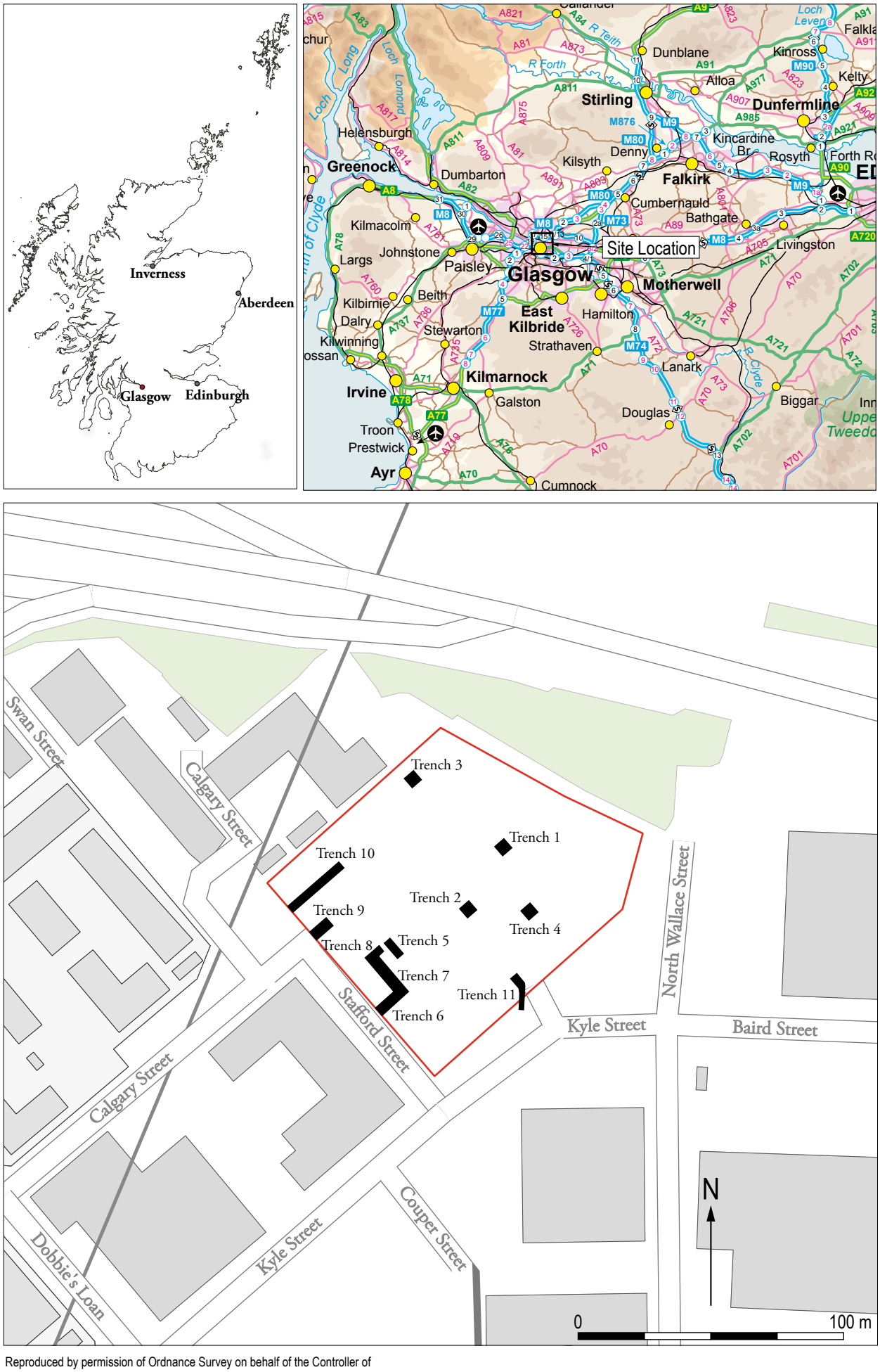

Figure 1: Location of the pottery in Glasgow.

Foreword

by Bob Will

Since this report was written two of the main contributors have passed way.

Keith M Speller 1955-2021

In the course of working on this publication we discovered that Keith had sadly passed away in 2021. Keith came to Scotland in 1986 to work on the excavation of Elginhaugh Roman Fort near Edinburgh, He had come up from Wessex as the supervisor in charge of illustration and he produced the illustrations for the Elginhaugh publication report. As well as a gifted archaeologist and photographer, he was an Ordnance Survey trained draughtsman with an excellent eye for detail which is clearly evident in his work. After Elginhaugh he worked for different archaeology organisations before he joined Glasgow University Archaeology Research Division (G.U.A.R.D.) and moved to Glasgow. Keith was passionate about trains and steam trains in particular and would often set up his camera and tripod when working near a railway line if he knew a 'special' train was due to pass. He was also interested in industrial archaeology, so when the opportunity to excavate Bell's Pottery came up he jumped at the chance. Soon after the post-excavation work was completed for Bells, Keith moved back to Somerset where he trained as a fireman on the West Somerset Railway where he worked for many years.

Henry (Harry) E Kelly 1931-2008

Henry (Harry) Kelly who worked on the historical background and the pottery report sadly passed away in 2008 but he published a definitive history of the Bell's Pottery in 2006 *The Glasgow Pottery of John and Matthew Perston* Bell (see Bibliography, for link to download). He also published *Scottish Ceramics* in 1999 which documents the history of industrial ceramics in Scotland which places Bell's pottery in a Scottish, UK and international context.

Publication update

When the excavations at Bell's Pottery in Glasgow took place in 1995 and 1996 it was the largest investigation of a nineteenth century industrial pottery undertaken in Scotland at the time. The subsequent report combined the results of archaeological excavation with historical research, study of the pottery and vessels forms along with an examination of the technology and techniques that were used. Over 25 years later as this report is brought to publication this integrated approach is still an important and valuable resource that has been used in subsequent excavation of other pottery sites particularly the Caledonian Pottery in Rutherglen (Nevell 2016) and at Morrison's Haven, East Lothian (Cressey and Johnson 2012). It is testament to the skill, expertise and knowledge of the excavation and post-excavation team that some of the elements in this report have been referred to and used in subsequent pottery reports. It is important that these elements are now published in their original context. Research into ceramics from this period is often studied from a collector's or 'antiques' point of view, or as historical research, and it is still unusual to see these different strands brought together in one report or even published together. The use of 'resource discs' has made vessel shapes, forms and types of decoration more readily available than when this research was undertaken, as has the digitisation of museum collections. This publication amply demonstrates the important contribution that archaeology can add to our understanding of the manufacturing and technology of large scale pottery production that is not often understood from the ceramics or historical research.

Editor's Note

The text and illustrations largely remain as they were compiled in 2002. Additional maps have been added to the text for clarity, and where possible the individual pieces illustrated as pottery, moulds or kiln furniture have been identified. This has not been straightforward and any errors rest solely with the editor. The specialists' reports were shortened by the author for the publication but the archive includes full copies of the excavation records, plans and photographic records, all specialists' reports and catalogues. This will be deposited with The Mitchell Library. All the finds from the excavation are housed in the Glasgow Museums Resource Centre.

Introduction

Between November 1995 and September 1996, Glasgow University Archaeological Research Division carried out excavations on the site of Bell's Pottery, Stafford Street/Kyle Street, Glasgow, NGR: NS 596 663 (Figure 1). The site had been acquired for development by Vico Properties (Scotland) Ltd and was subsequently developed by Appleyard Group plc. The project fell into three distinct parts. Firstly, a desk assessment (Speller 1995) and standing building survey was carried out in November 1995, followed by a period of excavation assessment in February 1996 (Trenches 1-5) (Speller 1996a). This was followed by a watching brief including limited excavation throughout July and August 1996 (Trenches 6-11) (Speller 1996b). A summary of the results of the fieldwork project were produced by Speller in 1996 for the *Scottish Pottery Historical Review.*

Historic Scotland funded the post-excavation analysis and preparation of this report, and Historic Environment Scotland has kindly funded the publication. As a result of the archaeological work carried out, the site has been designated as a Scheduled Ancient Monument (HES reference number 7353).

History of the pottery

The documentary evidence

In the early months of 1841, John and Matthew Perston Bell formed a partnership trading as *J & M P Bell, Earthenware Manufacturers*. This title soon became *J & M P Bell & Co*. because of the addition of a third party, Robert Clough, a man with considerable experience in the world of industrial potteries. It was Clough who may well have been the catalyst in the formation of the company (Kelly 2006).

Both brothers appear in the Glasgow Voters' Roll for 1840-41 (compiled in 1840), quoted as 'earthenware manufacturers' with a pottery variously described as on the canal bank and at the corner of Stafford Street and Pulteney Street. The land had been bought from William Stuart Stirling Crawfurd of Milton from the part of the estate of Milton known as Broomhill (Figure 2). The map of 1842 (Figure 3) show the area of the future pottery quite clearly marked amongst an area of projected and/or empty streets, as if destined for feu (Kelly 2006).

The land was acquired in 1842 but the agreement must have been reached beforehand since sasine

Figure 2: Allan & Ferguson. Title: Plan of the lands called Hundredacrehill, Broomhill, Physicwell Park, Spangsholm...1839 proposed street plan prior to the establishment of the pottery. The location of the future Bell's Pottery is highlighted. Reproduced with the permission of the National Library of Scotland.

was taken after the letter below was sent out. Although the sale was not completed until 1844, the pottery must have been erected speedily as at the beginning of 1842 it was already in production. The Martin map of the same year (Figure 4), an update of the 1839 Smith and Collie map indicates that the pottery was now in existence, albeit on a very small scale. The buildings shown became the north-west corner of the pottery in its final form (see Trench 3).

TO PURCHASERS OF EARTHENWARE

The Subscribers beg respectfully to inform Shippers and Purchasers of Earthenware, generally, that they have commenced Manufacturing cream-coloured, dipped, painted and Printed Earthenware, for Home Sale and Exportation, at their Works, recently erected on the Banks of the Cut of Junction Canal, between Port Dundas and St. Rollox. At the same time the Subscribers may be allowed to express the hope that, from the extent of their Works, the quality of their materials, and the advantage they enjoy in having the Manufacturing Department conducted under the immediate superintendence of their Mr. Clough, whose knowledge and experience as a Potter are well known to the Trade, they shall be able to give every satisfaction to those who may favour them with a share of their patronage.

They may add, that they have been at pains to select the newest and best shapes, and patterns for Tea, Toilette, and Table Services.

J & M P Bell & Co.

Glasgow Pottery

Glasgow 11th February 1842.

This notice was printed in *The Glasgow Courier*, 12th February 1842 but the first reference to china production appears in the *Glasgow Post Office Directory* for 1847 (Kelly 2006).

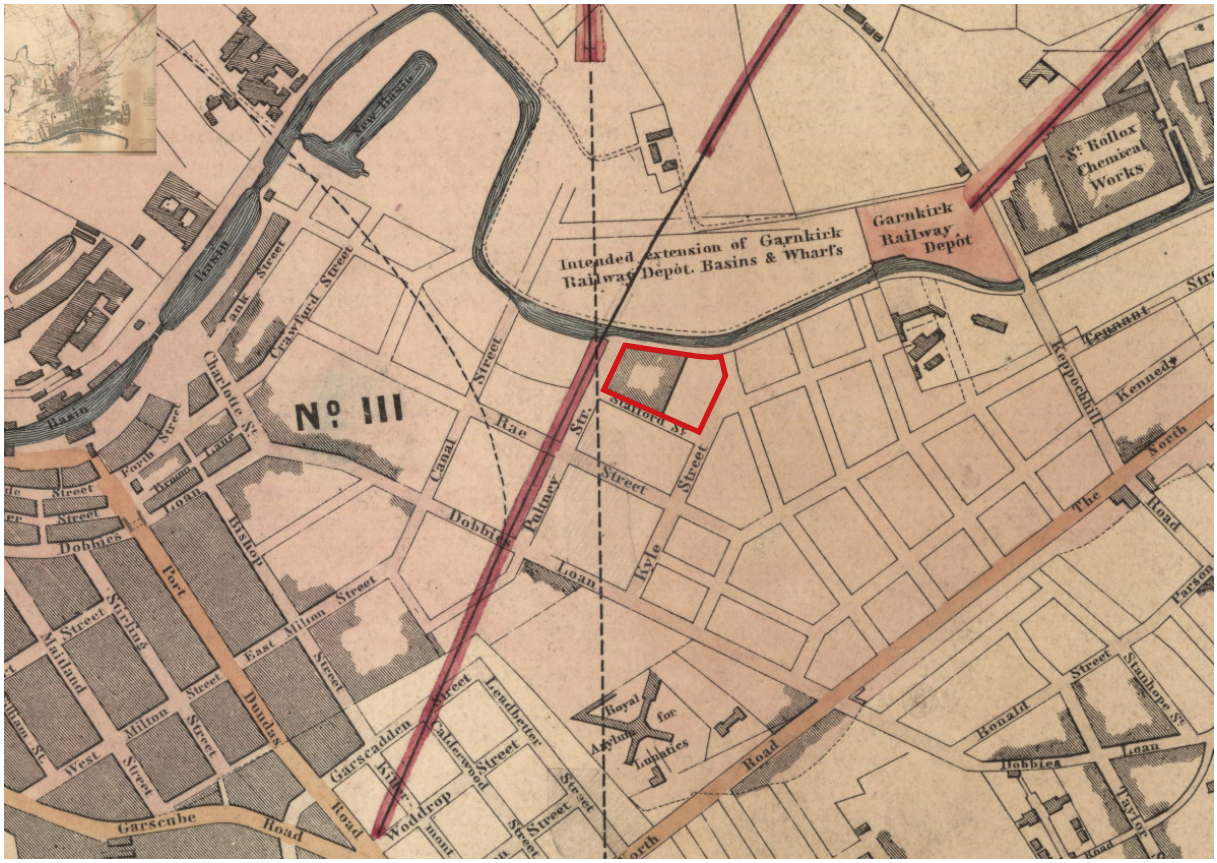

Figure 3: Extract from the Thomas Kyle map of 1842 Map shewing…estate of Milton. Shows the location of the pottery. Reproduced with the permission of the National Library of Scotland.

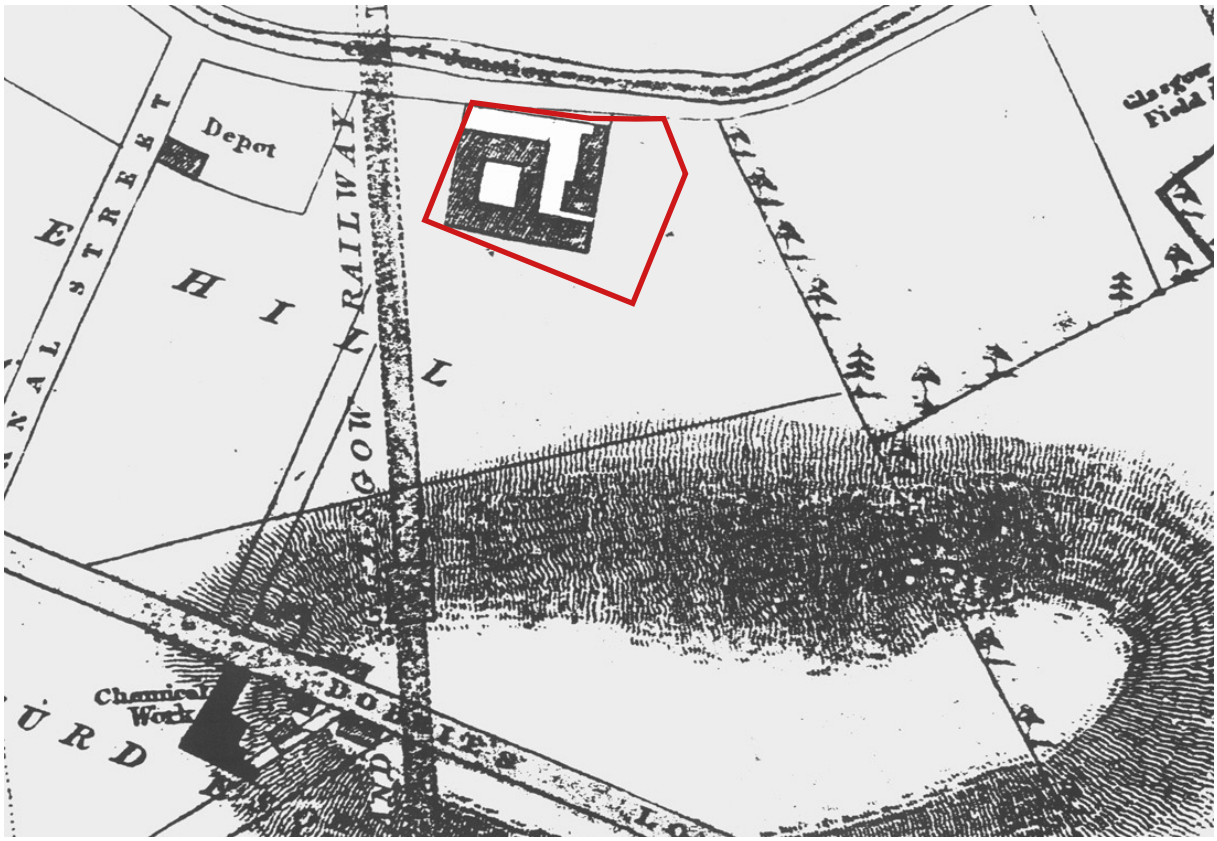

Figure 4: Extract from the George Martin 1842 map of the City of Glasgow showing buildings in existence in the north-west corner of the site (highlighted), although not labelled as a pottery (see Trench 3). ©CSG CIC Glasgow Museums and Libraries Collection: The Mitchell Library, Special Collections

The pottery was sited in an area of Glasgow known as Port Dundas, well served by both the Caledonian Railway and The Forth & Clyde to Monklands (Cut of Junction) Canal. The area became heavily industrialised during the second half of the nineteenth century, attracting a number of other potteries to the same area. These included the Milton, the North British and the Port Dundas potteries (see Impey n.d for locations). In all, there were twenty-five or more industrial potteries within the city limits, although none reached the size or carried the wide range of products that Bell's offered (Baker 1995; Boa *et al*. 1987; Denholm 1982; Hume 1974, 1976 and 1990; Kinhorn and Quail 1986; Quail 1982 and 1986; Historical Publishing Co 1888) (Figure 5). At the height of production, between six and eight hundred people were employed by the pottery and their fine wares were exported worldwide, especially to the Far East. The trademark of the firm was a 'bell', either impressed into the soft clay or printed on the piece. After 1870, when Matthew died, the trademark changed to include the letter 'B', and in some cases 'J.B.' placed inside the bell (Kelly 1994b, 58-60).

John Bell died in 1880, and the company was floated as a public limited company the following year. It was directed for ten years (until his death) by James Murdoch, after which Joseph Turner is recorded as the company secretary, working under an unknown manager. In 1910, the company decided to go into liquidation, a process that took until 1923 to complete. The operations of the surviving pottery became that of importer and exporter of other manufacturer's wares (known as the 'warehouse period'). It is uncertain whether any pottery production took place during this period or if the site was mothballed. During 1911, the western side of the pottery was reduced piecemeal (Figure 6) as the Caledonian Railway expanded its goods depot eastwards. The latest date of a known piece of pottery from Bell's is 1911-2 (Kelly 1996, 4).

The firm's name continued to operate on the Stafford Street/Kyle Street site until at least 1923 (Fleming 1923, 133), although the commissioning of the 1919 site plan shows that the Bergius Launch and Engineering Co (later Kelvin Engineering Ltd) certainly had their eye on the site, if not owned it by 1919. The firm's name subsequently appears

in the annual 'Industries of Glasgow' directories until 1940 under the direction of Joseph Turner and John Weir (*Glasgow Scrapbook No.28*, 23).

The cartographic evidence

A series of maps and plans have been researched and are listed at the end of the text. This list may not be exhaustive but it covers the beginning and the end of the company very well, showing that the site was first occupied between 1839 and 1842. It developed to its full size by 1858 at the latest, but was truncated by the railway expansion and possibly sold by 1919.

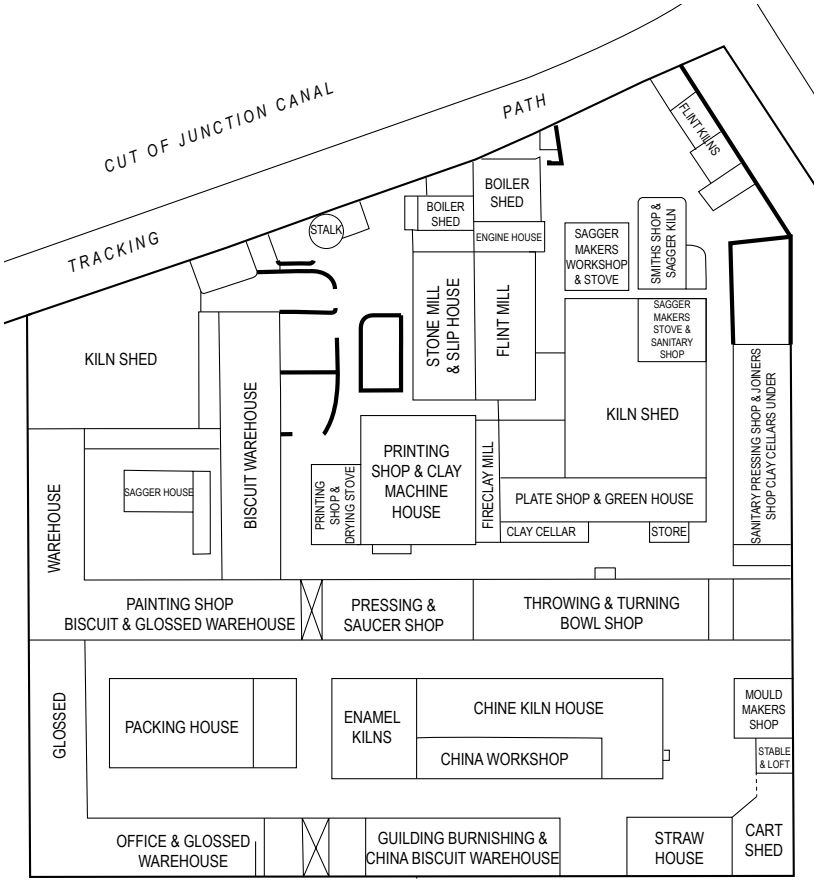

Figure 5: Redrawing of Kyle, Dennison and Hew's 1880 plan of the pottery in its fullest form before truncation of its west side.

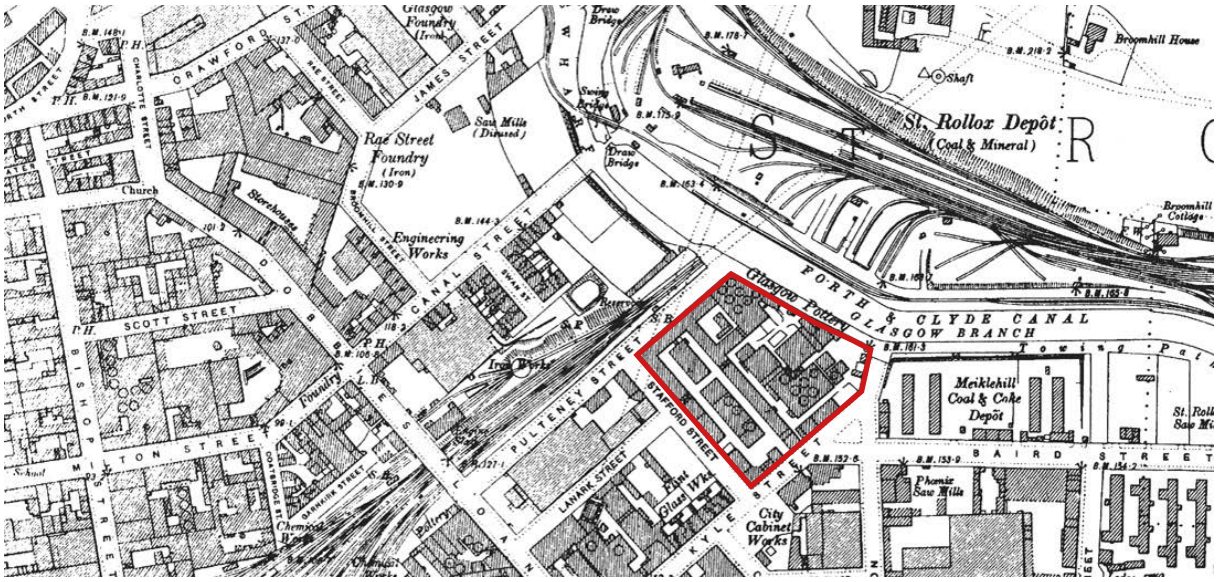

Figure 6: 1895 OS map. Reproduced by permission of Ordnance Survey on behalf of the Controller of His Majesty's Stationery Office. All rights reserved. Licence number 100050699.

Aims and field methodology

The principal aims of the field assessment were to determine whether or not significant archaeological remains existed on site, and if so, to establish their extent, condition, date and function, and thus by extension the importance of the site in a national, regional and local context.

The surviving Pottery remains, apart from portions of the exterior walls were eventually sealed by a 0.15 m concrete skin, levelled up to a consistent height of 44.80 m OD when the Bergius Launch and Engineering Co. factory was constructed c. 1919. Using existing site plans it was possible to select areas for trial excavation with a good degree of accuracy. Initially, five trenches were laid out. These were located as follows (Figure 7):

Trench 1 - Stone and Flint Mill and adjoining Slip House

Trench 2 - Sanitary Pressing Shop and underlying Clay Cellar

Trench 3 - North-West Kiln complex

Trench 4 - Central Kiln area

Trench 5 - China Kilns and Enamelling Shops

With the exception of Trench 2, archaeological remains were visible immediately below the concrete floor and its underlying make-up layer. Where possible, the make-up layer was removed by machine, otherwise it was removed by hand (Speller 1996a).

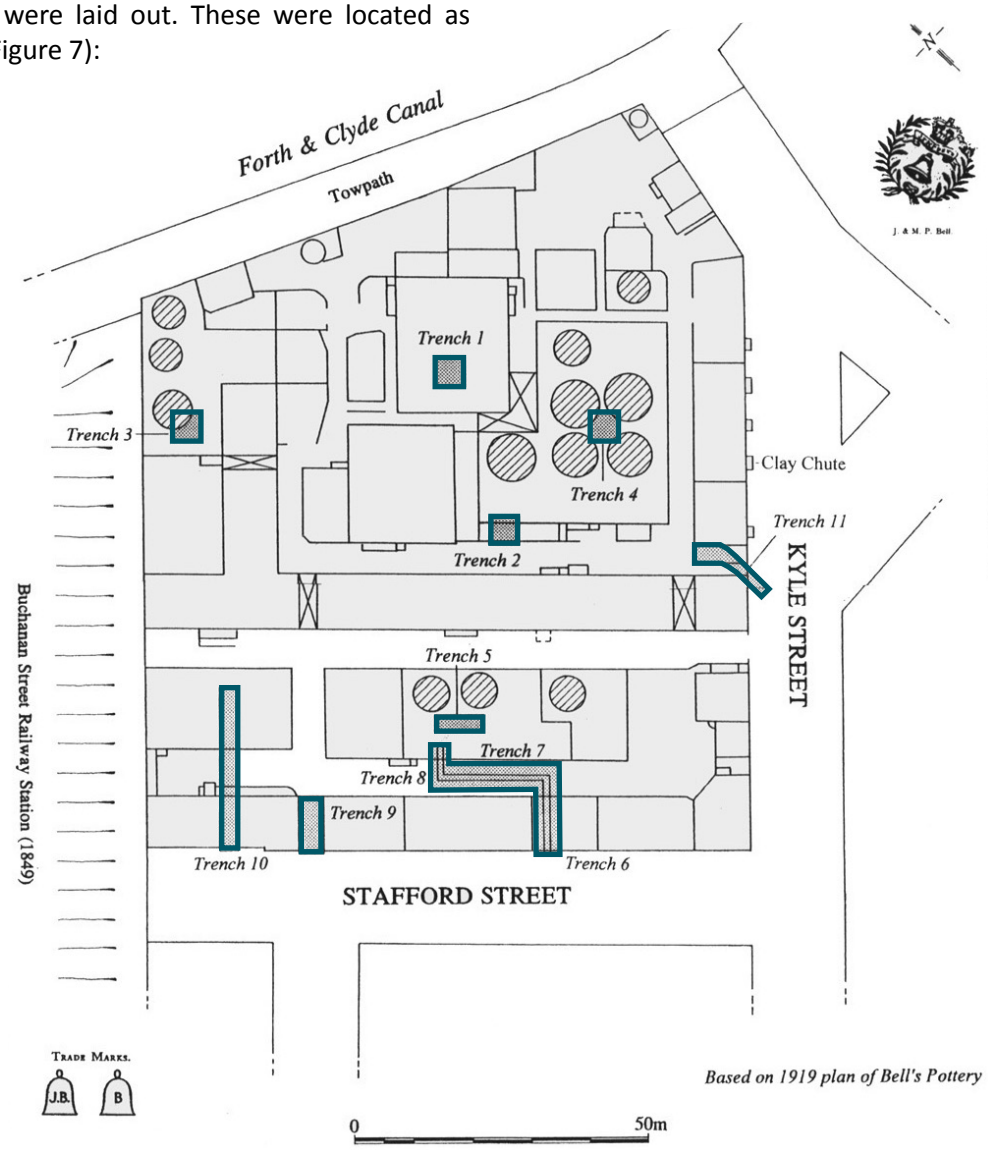

Figure 7: The pottery with the location of the trenches. Redrawn from a plan of 1919 by Wardlaw and Makins showing truncation by the railway.

The subsequent watching brief element of the fieldwork was carried out after the demolition of the factory (Speller 1996b). Development on the southern part of the site involved the cutting of a further six trenches through the concrete floor for services (Trenches 6-11).

The watching brief trenches were located as follows:

Trench 6 - Open area within the south range of buildings

Trench 7 - Internal cobbled road

Trench 8 - Hot Room and heating duct (see also trench 5)

Trench 9 - The Stafford Street entrance

Trench 10 - Warehouse and Packing House cellars

Trench 11 - Kyle Street and possible Mould Store

Excavation results

Trench 1 – Stone and Flint Mill and adjoining Slip House

The trench (Figures 5, 7 and 8), was positioned over the mill area in order to retrieve flint and slip samples and to try to identify any heavy machinery remains. Removal of the concrete factory floor and underlying make-up revealed five similar massive stone bases (102-105 and 112). They were formed of a mixture of sandstone and whinstone blocks that had been built directly over the top of the natural clay, to an average height of c. 1 m. Each had two wrought iron threaded studs measuring 900 m in length with a diameter of 40 mm, incorporated within them. These studs were positioned on square cast iron base plates measuring 160 mm by 50 mm (Figure 9). The stones were not mortared but soft clay and slip (106) had been used as a jointing medium in places. Base (105) was

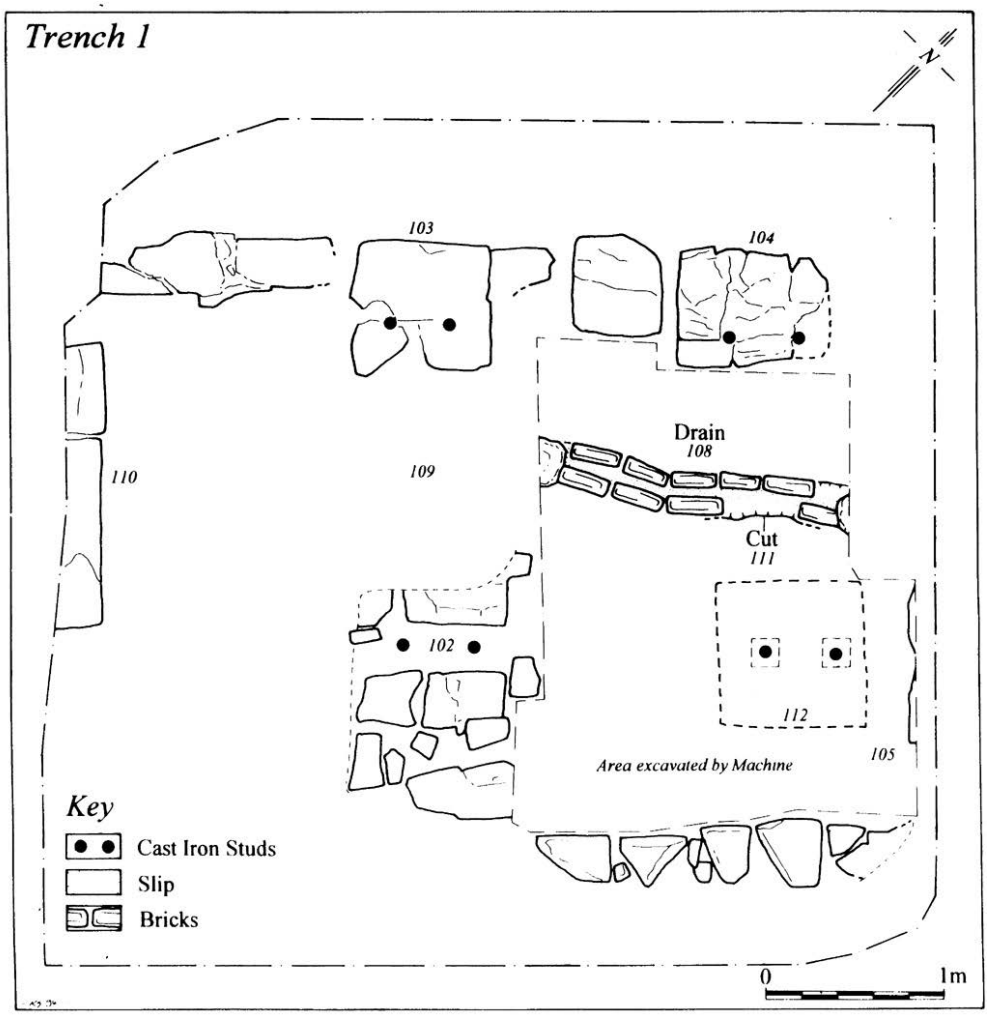

Figure 8: Trench 1 plan.

Figure 9: Trench 1 during the excavation the the fragmentary mill stone in the upper right of the image. From the east.

separated from the natural clay by a thin layer of clay and ash. A series of extremely hard-packed deposits (109) comprising soil, clay, ash, crushed calcined flint and slip mix, plus brick and stone, had then been in-filled to a point level with the top of the stone bases. To the south of the latter, two stone slabs (110) ran north-west to south-east, continuing outside the trench. Due to the hard-packed nature of (109), stone base (112) was removed by machine, during which one half of a large circular millstone was removed from (109), measuring 900 mm in diameter by 170 mm in thickness, containing an axle hole of 140 mm diameter.

Below this deposit (109), a simple drain (108) had been dug into the natural clay. The drain was formed by a double line of bricks, only one course high and capped with rough pieces of slate, laid in a cut (111). The drain channel was filled with clean, white, soft slip.

Significant finds and dates

Type	Group	Context	Date
Pottery	P1A	106	1850s-

Trench 2 – Sanitary Pressing Shop and underlying Clay Cellars

This trench (Figure 7), was positioned over the site of a clay cellar to assess the depth of preservation and to retrieve raw clay samples. It was also positioned to straddle part of one of the internal roadways within the pottery, in order to inspect the potentially less disturbed ground beneath the road for any earlier site evidence.

Removal of the concrete factory floor revealed a series of fairly compacted demolition deposits comprising ash, sand and building debris to a depth of 1.1 m. Removal of these deposits revealed a stone floor, covered with an asphalt surface and patches of calcined flint chips. There was no evidence for any surviving structures above the floor.

Trench 3 – The North-West Kiln complex

Between 1896 and 1919 the extension eastwards of the railway truncated this side of the pottery and resulted in the loss of three kilns in this area (compare Figures 5 and 7). Trench 3 was located to assess if any new kilns had been erected at this time of re-organisation and to establish their function.

Removal of the concrete factory floor exposed the well-preserved remains of a circular bottle kiln base, comprising c. 90° of a kiln base containing eight ash pits, which would have measured c. 8 m in diameter (Figures 10 and 11). The upper central portion of the kiln above the ash pit tops and the oven base had been removed. The kiln base was of refractory brick construction (310), surrounded by a floor surface of roughly faced whinstone blocks (303), the latter laid upon a make-up level of ash (314) and calcined flint chips (315) (Figure 12 A-A'). The three ash pits all contained a sloping outside edge and transverse triangular wrought iron firestays built into the side walls (Figure 12 B-B', Figure 13). To the south of the kiln base, an east-west running linear brick-built feature (304) ran in close proximity to ash pit 2. This feature was slightly stepped up in three places in order to compensate for the general slope of the floor to the south-east. The remains of sandy mortar adhered to the top of the bricks indicated that it had been reduced in height. Butting (304) was a large black slab (305), fabricated from crushed, calcined flint chips and an asphalt material, similar to floors in Trenches 2, 5 and 6.

The central area of the kiln was selected for limited excavation in order to answer two specific questions. Firstly, to investigate the existence of any earlier kilns which may have existed before the re-organisation in this area, and secondly

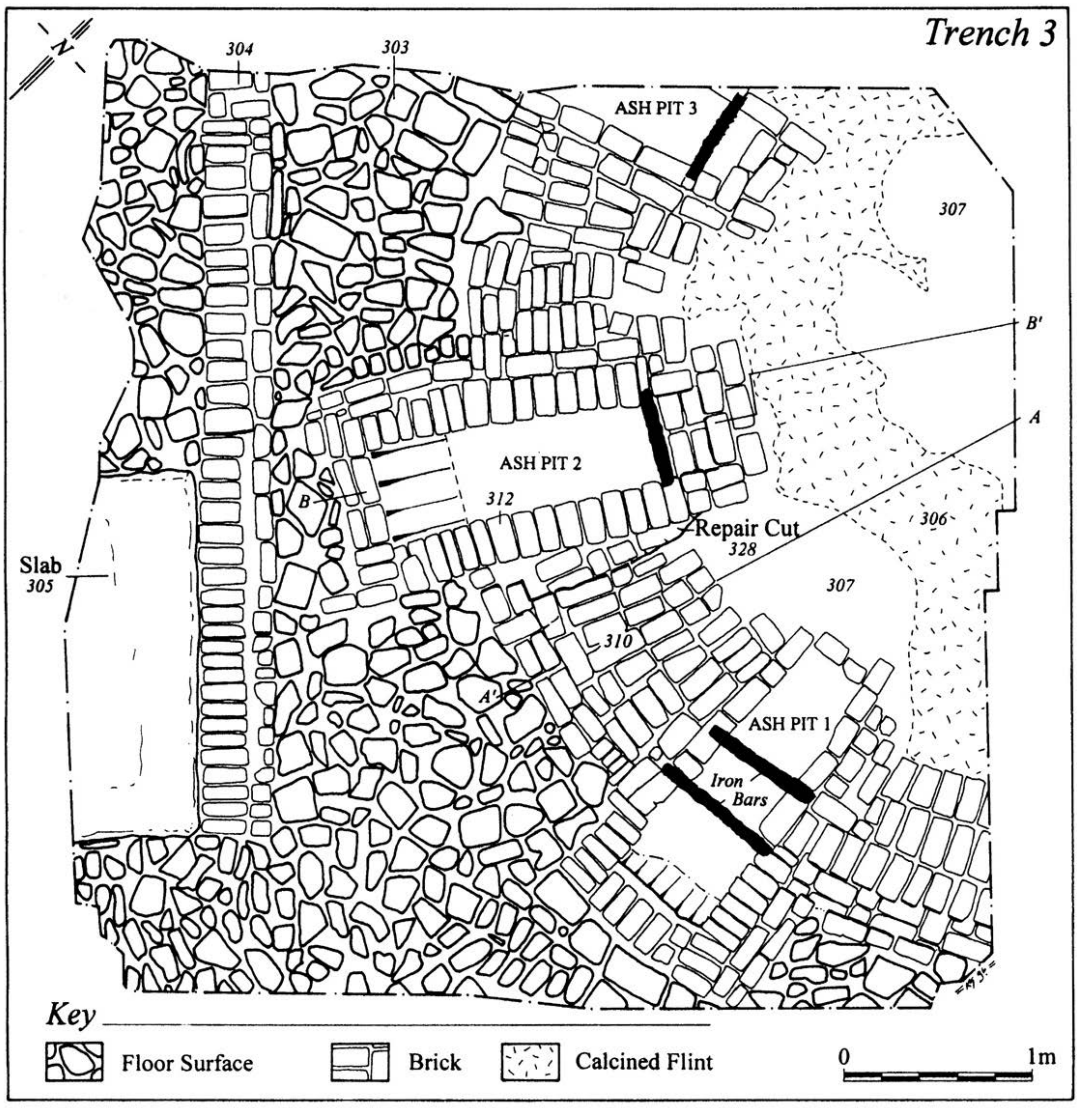

Figure 10: Trench 3 plan.

Figure 11: Trench 3 kiln base during its excavation. From the north.

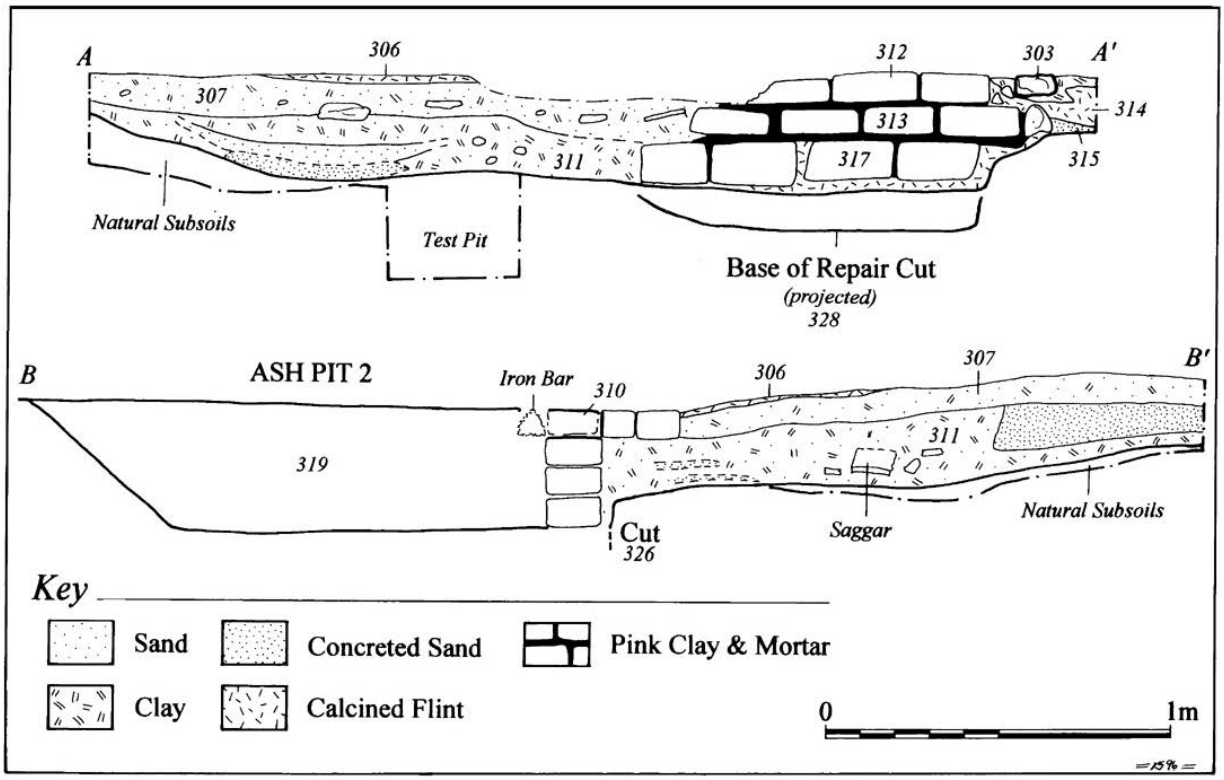

Figure 12: Trench 3 sections A-A' and B-B'.

to see if the baked clay deposits in the centre contained finds which could lead towards a chronological sequence for the kiln(s). This area comprised a thin layer of calcined flint chips (306) overlaying a sequence of reddened, baked clays (307 and 311). These deposits produced pottery sherds (both biscuit and glazed) and kiln furniture to a depth of 300 mm, below which the undisturbed natural clay subsoil was reached (Figure 14). A test pit cut into the natural clay showed red discolouration continuing for a further 300 mm before fading into natural yellow-brown clay. The reddening effect also extended outwards beneath the kiln base bricks (317) for c. 400 mm.

Figure 13: Trench 3 ash pit and section through the floor deposits. From the south-west.

Figure 14: Trench 3 kiln base after excavation. From the north-east.

Excavation through the brick kiln base (310), which at this point survived three courses thick (313, 317) and ash pit 2 produced evidence for localised repair (Figure 12 A-A') in order to gain access to the side of ash pit 2, consisted of the re-laying of three layers of brick make-up within a cut (328). Crushed calcined flint chips and saggar fragments, in a slip matrix, had been used to mortar the gaps within the repair bricks. The basal layers (309 and 321) of repair bricks had been laid slightly lower than the undisturbed basal brick apron layer (317). These bricks butted against the lower side bricks (319) of ash pit 2, which themselves sat in a cut (326). Excavation of ash pit 2 produced a large assemblage of kiln furniture.

Significant finds and dates

Type	Group	Context	Date
Pottery	PA3-P3F	307	1850s
	PSH, P3I-P3L	311	1850S
Kiln Furniture – Silts and Spurs	KF097-98 KF107A-108	307 311	1847-1847
Kiln Furniture – Saggars	KF01, 03	307	
Repair Bricks		309, 313, 319, 321	1873-

Trench 4 – Central Kiln area

This trench was located (Figure 7) to try to establish the state of preservation, nature and usage of as many kilns as possible in that part of the pottery where the density of circular kilns was highest.

Removal of the concrete factory floor and underlying make-up layers revealed the truncated remains of four circular kiln bases A, B, C and D (Figure 15). All were of refractory brick construction containing ash pits with vertical sides, unlike those in Trench 3. Kiln base A was chosen for further investigation as it was the most complete of the four, still retaining the oven floor (402), the oven wall base (403) and the disturbed outer apron (404). Ash pit 1 was slightly disturbed but not truncated, being four courses high with a vertical back. This ash pit was excavated.

The inter-kiln area comprised a series of clay and sand make-up layers (415, 425-428 and 433-435), upon which kiln base A had been initially constructed (Figure 16). The upper levels formed by deposits (406 and 411-414), provided make-up for the outer kiln elements and also for the disturbed and mostly removed whinstone flooring (422). Set into (406) and sitting upon (415) was a large, roughly-faced sandstone block (409). All the make-up deposits contained potsherds, kiln furniture and construction materials. The clay subsoil was encountered at a depth of 500 mm below kiln base A, sloping to the south and west.

Excavation of kiln base A revealed the following structural sequence:

a) Levelling up of the natural hill slope

b) Construction of the kiln interior base below the oven

c) Addition of make-up layers outside the interior base

d) Construction of the outer part of the kiln base

e) Subsequent repair below the oven wall between ash pits 1 and 2

Repair to the outer part of kiln base A between ash pits 1 and 2 was evidenced by a linear trench (431), measuring 900 mm wide by 500 mm deep (Figure 17). Backfill of this trench was in the form of roughly laid brick (420) and a dump of broken bricks (421) set in a clay and mortar matrix (418). This was topped by the partial re-laying of the oven floor bricks (417 and 429), the oven wall base (403) and the outer apron bricks (404) over a crushed, calcined flint chip (407) and ash/clay bedding layer (432).

A distinct set of (apparently) colour-coded bonding clays were used between the surviving kiln base bricks. The outer apron bricks (404), the outer edges of oven wall bricks (403), the oven base repair bricks (429) and the repair backfill bricks (420 and 421) were all bonded using a hard, light brown clay mortar (418). The kiln base bricks (423) were bonded with red coloured mortar. Blue coloured clay bonded the repair oven floor bricks (417), while the original oven floor surface (402) was bonded with red coloured clay (450).

Kiln base B was well preserved although more truncated than kiln base A, having lost the tops of the vertically backed ash pits that survived two courses high, and one or maybe two levels of the oven base and apron (437) bricks. Ash pit 1 was excavated and contained kiln furniture in an ash matrix.

A small portion of kiln base C survived in the northern corner of the trench. It was located by the severely truncated remains of one of its ash pits (441) and an underlying crushed calcined flint chip make-up layer (442).

Only a small area of the oven base bricks (443) of kiln base D survived.

Significant finds and dates

Type	Group	Context	Date
Pottery	P4F	411	1840-55
	P4G-P4I	413	1840-50S
	P4J-P4K	414	1847-
	P4M	421	early
	P4P-P4Q	425	1840S-
	P4R	426	early
	P4S	428	early
	P4T	433	early
Kiln Furniture – Cockspur	KF121	425	1840s or earlier (see Barker and Horton 1999, 47)
Bricks - Kiln A		402, 417	1861-
		417	1873-

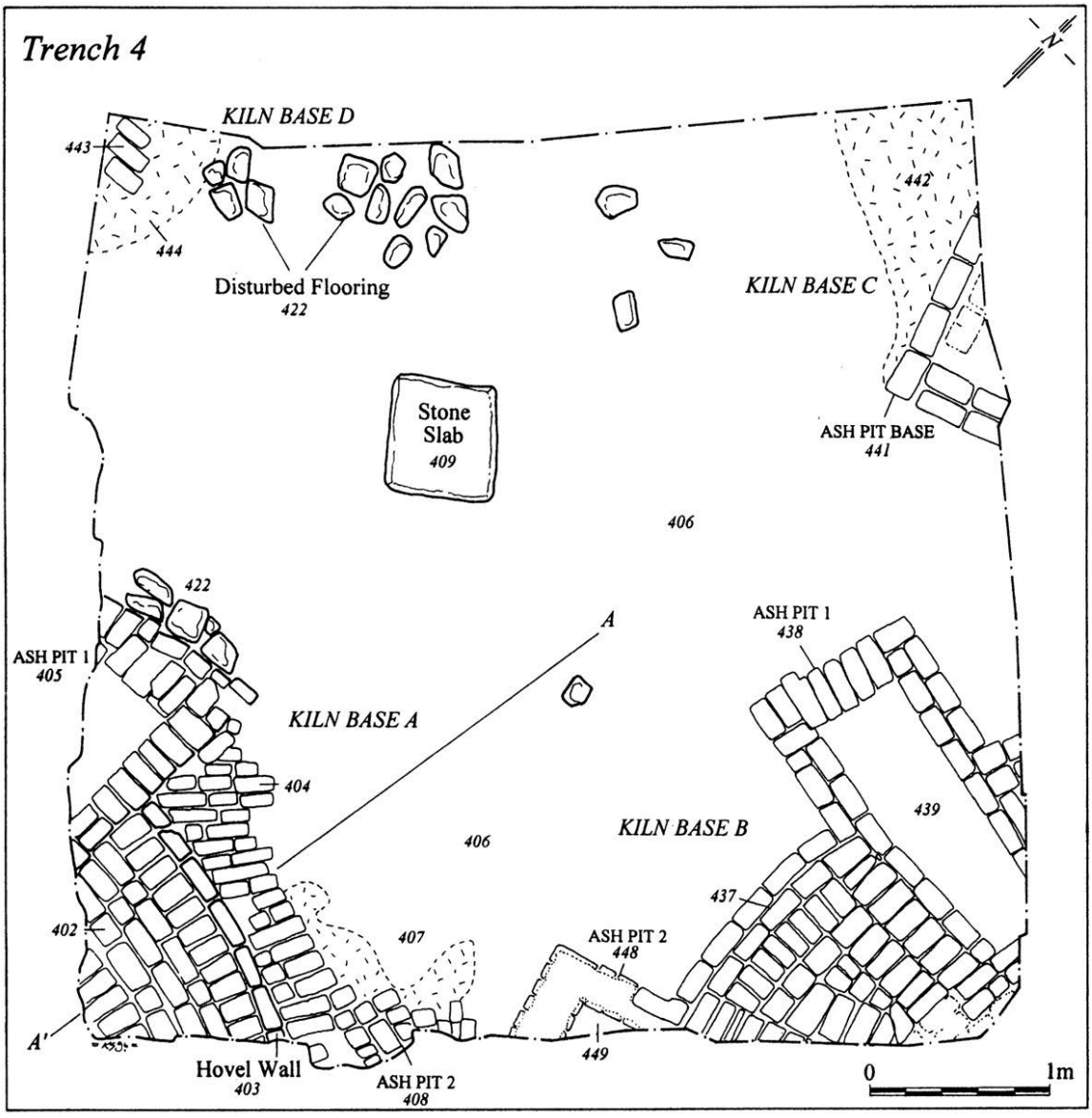

Figure 15: Trench 4 plan.

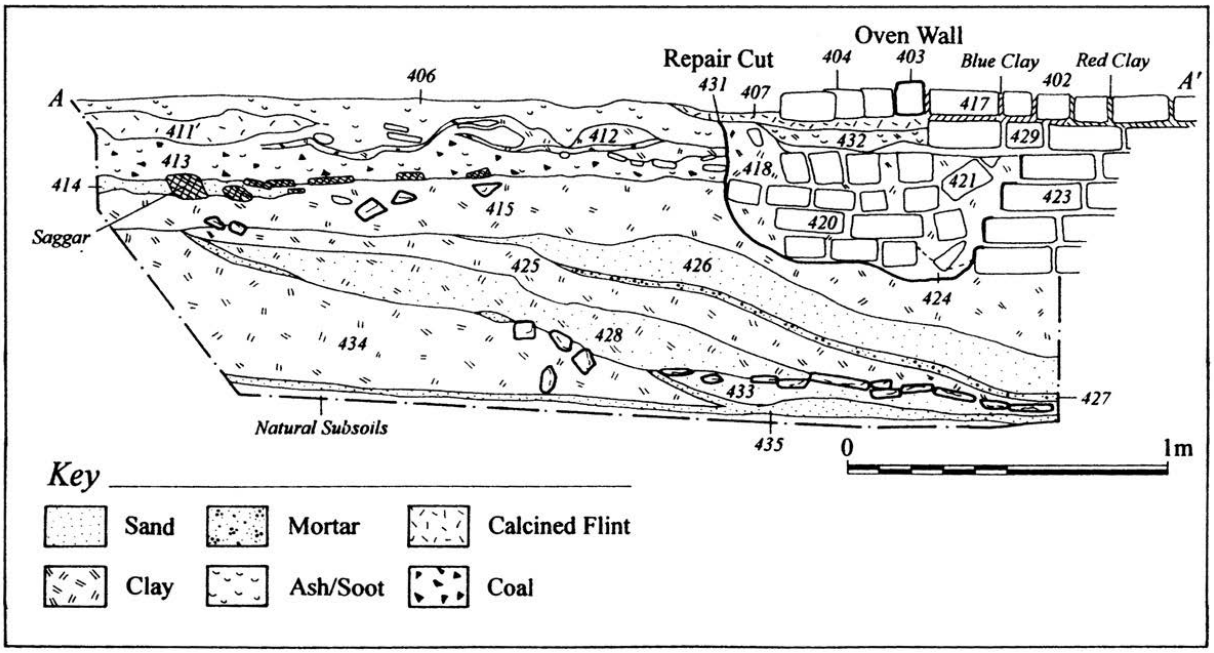

Figure 16: Trench 4 section.

Figure 17: Trench 4 linear trench through the kiln base A. From the north-west.

Trench 5 – Non-circular kiln and adjoining hot room (see also Trench 8)

This trench was positioned (Figure 7) to investigate two circular bottle kilns, annotated as China kilns on the 1919 plan. However, the trench was inadvertently positioned just to the south of these features.

Removal of the concrete factory floor and demolition infill deposits revealed a number of internal room spaces with well-preserved floor surfaces (Figure 18). Adjacent to these was part of a non-circular kiln base, complete with firing grate, cast-iron door and subterranean ventilation areas (Figure 19). A large assemblage of fineware wasters, along with kiln furniture and 297 pottery moulds was retrieved from this trench.

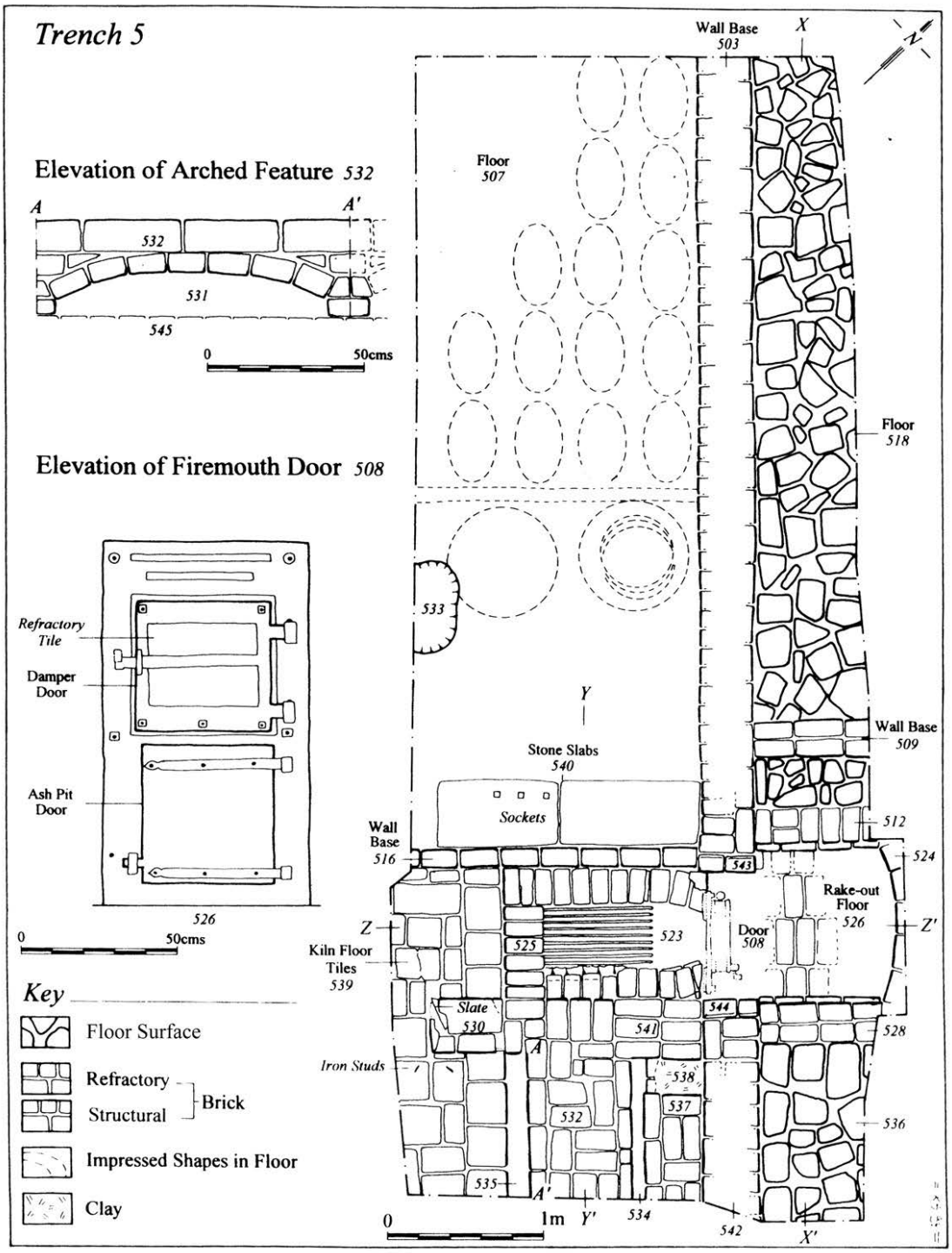

Figure 18: Trench 5 plan with (508) firemouth door and (531) arch elevation.

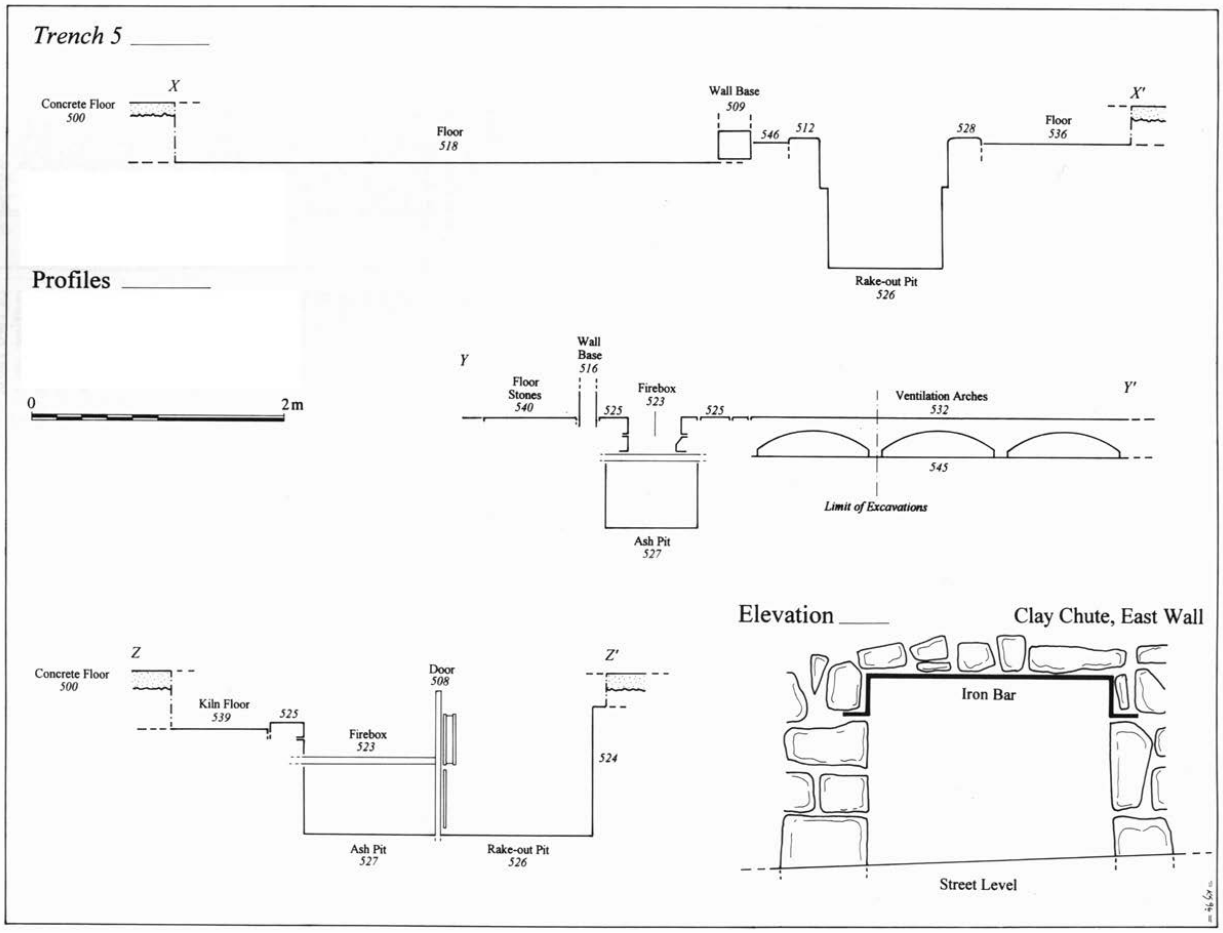

Figure 19: Trench 5 profiles x-x', y-y', z-z' and Kyle Street Clay Chute.

Hot room

Removal of the demolition deposits to the south-west of structural wall base (503) revealed a floor (507) consisting of black asphalt containing crushed, calcined flint chips, c. 50 mm thick and similar to floors located in Trenches 2, 3 and 6. This floor sat upon a series of make-up levels (see Trench 8 for full description).

Floor (507) had obviously been subjected to heat whilst having various objects, probably saggars, placed upon it, as they had left distinctive imprints upon the surface (Figure 20). The circular shapes were of two radii, 0.66 m and 0.45 m, their imprints c. 20 mm wide and cutting up to 20 mm into the floor surface. The oval shapes measured on average 500 mm by 300 mm and gave a wider (30 mm) and shallower (10 mm) imprint than the circular shapes. The overlaying of many of these imprints in approximately the same places signified their removal and replacement on many occasions. Feinter footprint marks also survived. A linear imprint traversing the room measured c. 100 mm in width with a depth of 10 mm. Two stone slabs (540) were positioned in the southern part of the room, both lying flush with the surface of (507), one containing a line of three square sockets, each 30 mm square by 50 mm in depth. The south-eastern boundary of this floor space was provided by a poorly made wall (516), of only a single brick width, surviving to a height of three courses.

To the east of structural wall (503), removal of demolition debris revealed a well-preserved whinstone floor surface (518), stained black with soot and identical to that within trench 3. This area was bounded to the south-east by a structural wall base (509), which had been built on top of the pre-existing floor. To the east of wall base (509), two similar floors (536 and 546) existed at a slightly higher level than (518).

Figure 20: Trench 5 with floor indents. From the north-west.

Non-circular kiln

Situated in the southern part of trench 5, were the remains of a non-circular kiln (Figure 18) which comprised the following elements:

a) A sunken rake-out pit with a brick floor (526) and curving back wall (524) enclosed on either side by stepped brick retaining walls (512) and (528). These retaining walls had worn tops, precluding their use as structural walls. Excavation of the rake-out pit fill (511) produced a total of 297 plaster moulds (514), some in near-perfect condition (Figure 21).

b) A complete firebox, comprising cast-iron door (508), (Figures 18 and 22), wrought-iron fireplate and firebars (523), built into refractory brick surrounds (525). Some of the bricks forming the eastern side of the firebox were chamfered. There was evidence of repair to this side of the firebox, comprising six re-laid bricks (541). The remains of a brick arch over the door (508) was evidenced by the survival of the two brick springers (543 and 544), positioned at the ends of wall bases (503 and 542). Filling the space (513) above the firebars was a dump of c. 1000 ceramic thimbles or plate-spacers (KF73). A deposit of partly-combusted coal debris was compacted against the back of the firebox. Below the firebox, the ash pit (527) still contained the ashes from the last kiln firing.

Figure 21: Trench 5 kiln base with collection and removal of moulds and kiln furniture.

Figure 22: Trench 5 with fire mouth door. From the east.

c) The internal kiln area was predominantly constructed of refractory floor tiles (539). Set beneath the floor area was an arched void (532) (Figures 18 and 19), constructed of refractory bricks, with two rectangular voids (535 and 534), delineating its extent. Use of a torch revealed two similar arches extending away to the south-east beneath the concrete factory floor, outside the excavated area. These arches were set upon a solid brick base (545). Partial excavation of the fill (531) provided a large assemblage of complete pottery pieces and sherds. Within the kiln interior, two iron studs were positioned within the floor tiles, apparently broken off at their bases, adjacent to a low, raised plinth (530), constructed of refractory tile and roof slate. Abutting the structural wall (542), a raised plinth (537) consisting of unmortared brick, one course high, was fixed to the kiln floor by a layer of ash and clay (538).

Significant finds and dates

Type	Group	Context	Date
Pottery	P5AJ-AN	511	1850-60s
	P5AS-AY	531	1856-8
	P8AJ	813	-1860
	P8AL-AN	819	1840-50s
Kiln Furniture - Thimbles	KF72A-B	511	1862-
	KF73A-B	513	1862-
	KF74-5	531	1862-
KF - Spur	KF125B	513	1847-
	KF130	531	1847-
KF - Tumblers	KF169-70	531	1857-
KF - Chairs	KF174-97	531	1857-
	KF198	810	1857
KF - Box	KF200	531	1857-
Bricks		806, 816	1835-63
Moulds		514	

Trench 6 – The south range

This trench (Figure 23) cut through the southernmost range of buildings running parallel to Stafford Street. The 1896 pottery plan (Figures 5 and 7) shows a gap between the buildings at this point, containing an unroofed structure on its eastern side.

Removal of the concrete factory floor and underlying make-up deposits revealed a deposit of stiff dark-brown clay, overlying in places deposits of pottery sherds. These deposits infilled an area bounded on three sides by wall bases and continued outside the trench to the west. A wall base (603), 600 mm in width, formed the southern perimeter of the pottery, bordering onto Stafford Street. A similar wall base (604) formed the northern boundary of this range of buildings, bordering onto an

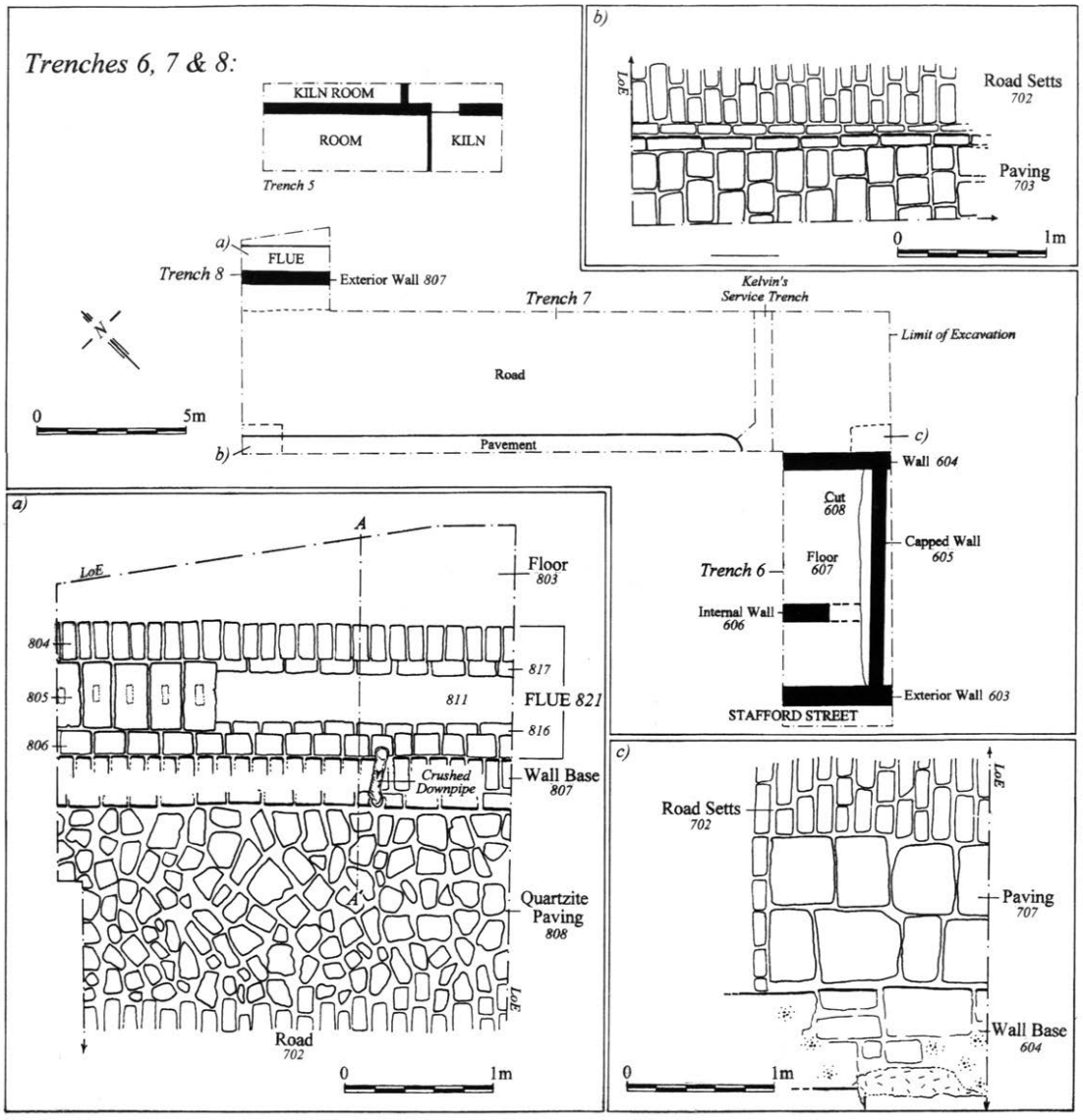

Figure 23: Trenches 6, 7 and 8 plans.

internal cobbled road (Trench 7). Both walls had dressed sandstone inner faces and rubble infill. Connecting the two wall bases on the east side of the trench was a more slightly built brick wall (605), set into a shallow cut (608). This wall was capped with a variety of coping stones, some of which had curved tops, indicating that it had not been truncated during demolition of the pottery. Removal of the infill deposits (602) revealed an asphalt floor (607), 1.15 m below the concrete factory floor. Running east-west across the floor was a brick-built wall base (606), 600 mm wide and surviving to two courses high. This wall base had also been removed as it neared the brick wall (605), leaving a mark in the floor surface to indicate that it had once extended further east, having been truncated by cut (608).

Trench 7 – The internal cobbled road

Removal of the concrete factory floor and leveling deposits exposed an extremely well-preserved length of cambered, cobbled road (702) with attendant pavement (703) on the south side (Figure 23b). The northern side of the road was bounded by a strip of whinstone paving (802) (see Trench 8, below). Most of the road surface was comprised of rectangular granite road setts. The setts used to construct the pavement were square in shape. At the eastern end of the trench, abutting the wall (604), was an area of hard-standing comprising large, roughly square cut stones (707), continuing eastwards outside the trench. Removal of these slabs revealed a dump of re-deposited natural clay (708), set into a cut, upon which the slabs (707) had been set. The cut had been excavated into the make-up levels (704]). It became apparent that the natural clay was gently dipping away to the east and that (704) was increasing in depth. At the easternmost point of the trench a machine excavated test pit revealed the make-up layer to consist almost totally of pottery wasters and kiln furniture in a matrix of ash. The test pit was stopped at c. 2 m in depth with no sign of the deposit ending.

Significant finds and dates

Type	Group	Context	Date
Pottery	P7H-AQ	704	-1850s
	P7AR-AU	708	-1850s

Trench 8 – Hot Room and Flue

This trench (Figure 23a) exposed part of the Hot Room (see Trench 5 above for further discussion). It comprised an exterior brick wall base (807) running parallel to the road (702), separated from it by whinstone paving (808). The wall base (807) was constructed in a pyramidic fashion, directly upon the natural clay subsoil. A brick-built flue (821), ran parallel and immediately to the north of the exterior wall (807). Immediately to the north of the flue, an asphalt floor (803) was exposed, a continuation of floor (507). Below the floor surface was a sequence of make-up layers (Figure 24). The lowest (813 and 814), overlay the natural clays in a possible cut (818). Lying above this were two levelling-up layers. The lower of the two (809), consisted of crushed calcined flint chips, which also capped the flue channel side bricks (817). Overlying (809), a layer of small angular stones, industrial waste and potsherds (812) formed the uppermost make-up for the floor (507/803). The flue side wall capping bricks (804) sealed this layer. On the south side of the flue, the side wall bricks (816) were not interleaved with the wall base (807), but bonded to the wall by means of upper side capping bricks (806). Some examples of these bricks were stamped. The lowest brick course for the wall (807) also formed the basal level of the flue. The flue complex was capped off by large, rectangular, firebricks (805), bearing an illegible makers' stamp. A compacted basal fill (810) formed of fine brick dust lay along the bottom of the flue channel. This derived from the lower side bricks. Some of which were well worn. Removal of the paving (808) to the south of the wall base (807) revealed c. 500 mm of make-up (819), comprising a grey ash and soot matrix containing small, crushed potsherds and kiln furniture fragments. Within the make-up (819), a cast-iron drain pipe lay *in situ*. It ran from within the base of wall (807), across the road in a south-westerly direction, sitting directly over the natural subsoil.

Significant finds and dates

Type	Group	Context	Date
Pottery	P8AJ	813	1860s
	P8AO-AV	819	-1840-50s
Kiln Furniture - Thimbles	KF80-3	802	1862-
	KF84	810	1862-
- Spurs	KF143-4	810	1847-
- Chairs	KF198	810 (see 531)	1857
Bricks		806/816	1835-63

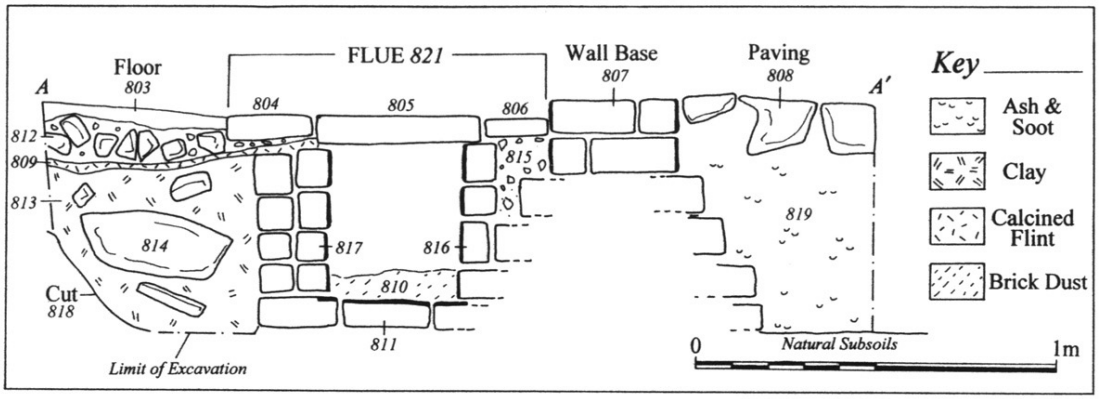

Figure 24: Trench 8 section through flue 821.

Trench 9 – The Stafford Street entrance

This trench (Figure 7) was situated over one of the two original entrances to the pottery. Excavated to a depth of c. 2 m below concrete level i.e. 1.15 m below Stafford Street road surface), it revealed a series of infill deposits (901), overlying the natural clay upon which the foundation of one of the southern range of buildings stood. Samples of pottery and kiln furniture were retrieved from these dumps. The lowest 1.95 m of the western entrance wall survived, truncated to a point level with the surface of Stafford Street. This wall was constructed of roughly faced sandstone blocks, standing on sandstone footings, directly overlying the natural clay. At a point 750 mm above the footings and 1.4 m below the surface of Stafford Street, a damp course existed, 30 mm wide and packed with mortar, slate and saggar fragments.

Trench 10 – The Warehouse and Packing House cellars

This trench (Figure 7) ran for 30 m across the south-western part of the pottery. A number of wall foundations were exposed, the trench ran across the southern range of warehouse buildings, through an internal road (see Trench 7) and into the packing house building. Within the warehouse the trench was excavated to a depth of c. 1 m into backfilled cellars. No internal floor levels were encountered. The backfill of the warehouse building (1008) comprised clay, soot and pottery debris. The southern perimeter wall and the northern external wall of the warehouse were of sandstone construction, similar in size and form to those described in Trenches 6 and 9.

Immediately to the north, the trench cut through an internal cobbled road. The underlying road make-up deposits (1004), c. 200-300 mm in thickness sat directly over the natural clay, and consisted of soot, soil and pottery debris. Immediately to the north of the internal road, the trench cut through the external southern wall of a packing building, again cutting into cellar backfill deposits (1007), similar to (1008), to a depth of c. 1 m. The southern wall was brick-built, similar in width to wall (807) in Trench 8.

Significant finds and dates

Type	Group	Context	Date
Pottery	P10M,	1004	early

Trench 11 - Kyle Street and possible Mould Store

This trench (Figure 7) was situated on the south-eastern side of the pottery, entering through the sandstone built perimeter wall on Kyle Street and continuing into the end room of a range of buildings used as the sanitary pressing shop and joiners shop. Due to pressure of work only minimal recording was possible here. The trench cut c. 3 m below the road surface, revealing a profile of pottery and other industrial make-up layers (1103). Within the Pottery, the trench cut into the southernmost building of the range, which had walls constructed of brick that were similar to those exposed in Trench 8. From within the confines of these walls, cellarage backfill (1106) had been removed to a depth of c. 1 m. This backfill consisted of pottery debris, amongst which a number of case moulds were revealed and retrieved.

Significant finds and dates

Type	Group	Context
Moulds - Case Moulds	CAM1, CAM2, CAM3	1106
	Whirler Head MISC 1	1106
- Multi-part moulds	MPM 94, 95	1106
- Press mould	PM18	1106
- Plate mould	PM18	1106

The assemblages

The pottery introduction

By Keith Speller

The large pottery assemblage retrieved from the site has added greatly to the Bell's catalogue, with many new and hitherto undocumented pottery forms and decorations coming to light for the first time. Although this assemblage forms a worthwhile discrete topic in its own right; its function here is as an augmentation to the structural and depositional history of the site.

The assemblage has provided a comprehensive chronology for Bell's Pottery throughout its existence, with certain pieces and discrete collections aiding clarification of the archaeological sequence of certain structures within the pottery. In some cases this has allowed a close date to be assigned to a specific event. In particular, the unique porcelain and earthenware cup shapes present within deposit (531) beneath the kiln in Trench 5 is closely dated to 1857. These have been described more fully below, along with a full description of the maker's stamps and marks known. Other significant dating evidence gleaned from this report and catalogue has been collated into a succinct form and has been included at the end of each trench description above.

The ceramic assemblage

By Henry Kelly

Patterns

These vary greatly in their usefulness as dating instruments. The more common types produced by Bell's, such as Willow, Triumphal Car and Italian Lakes were present throughout the life of the pottery and occurred in most contexts, relating to both occupation and the demolition periods. Other patterns, such as Bohemia, Fibre and Palestine and the centred circles found on spongeware were more useful as their period of production can be more closely defined (for spongeware see Cruickshank 1982; Kelly 1993).

Forms

Distinctive pottery forms such as Mocha, Parian, Banded and Dabbed wares were also helpful in dating terms. The sprigs found so abundantly in the assemblage retrieved from beneath the kiln in Trench 5 (531) proved to be very useful (Figure 25), as did the feathered edge on some wares.

Shapes

Cup shapes were also found to be useful in these dating terms. Material from the 'Warehouse' period was conclusive in providing a late date for a feature or confirming it to be a contaminated context.

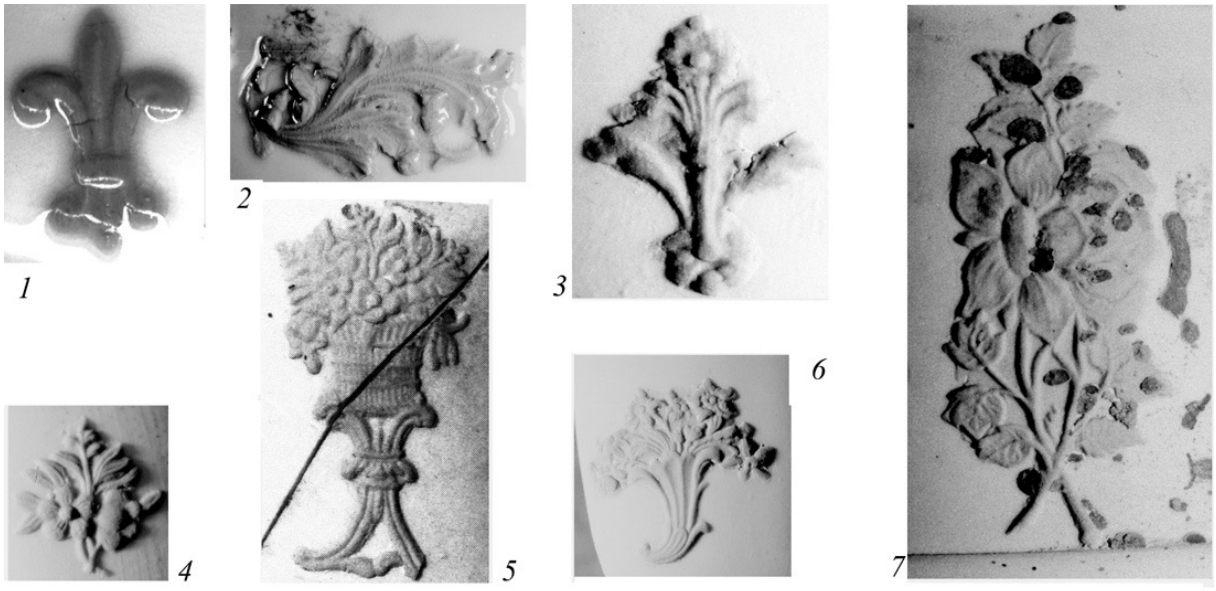

Figure 25: Sprig examples.

Maker's marks

With the addition of a new mark 'GRANITE' (Figure 26-5), retrieved from the excavations, there are now six recorded Bell's marks either impressed or printed. Bell's seemed to adopt a somewhat random policy for marking their wares and many examples were not marked at all, even amongst the more prestigious pieces. As a general rule, marks showing the initials 'JB' or marked 'J & MPB & Co' date to the period 1842-80 (the year of John Bell's death, Figure 26-7). Those showing the initial 'B' or marked 'J & MPB & Co Ltd' belong to the period after 1881. Mark descriptions and dates are as follows:

Initials 'JB' *within a bell outline*: This mark was always impressed into the piece. It was always applied to china and Parian ware (except the early Parian) and frequently used on earthenware. This mark ceases after 1880 (Figure 26-1).

Initial 'B' *within a bell outline*: This mark replaced 'JB' and was often impressed into printed export ware and stamped onto export Spongeware or Scottish Flow Blue decorated pieces (Figure 26-2).

English Royal Arms with lion and unicorn: Only recorded on white ironstone export wares. Undated at present (Figure 26-3).

Bell in a wreath: Always transfer printed, this mark was only used on deep or light blue Willow (but not Broseley) decorated wares. The company name ends in '& Co', therefore dating the wares to pre-1880 (Figure 26-4 lower, and possibly -6).

Garter (looped and buckled belt): Transfer printed onto all wares in association with various patterns (e.g. Fungus, Indian Cress). The company name ends in '& Co Ltd', therefore post-1880 (Figure 26-4 upper).

Company name and ware type impressed within a frame: This impressed mark for graniteware was a new discovery. This mark was present in the deposit (531) and may therefore date to 1860 or earlier (Figure 26-5).

Figure 26: Bell's Maker's marks 1-7.

The 'sub-kiln'assemblage

This discrete assemblage was retrieved from beneath the arched flues (531) of a non-circular kiln (see Trench 5). The group consisted of a mixture of bodies and types, both glazed and biscuit. The majority of the sherds came from tea and dinnerwares: cups, saucers, tea plates, dinner and soup plates, ashets, egg cups and hoops. Jugs and bowls were also present. Numerous different bodies were represented; many of which were porcelain with violet sprigs. There was also white earthenware, graniteware (an improved white earthenware body), semi-porcelain and Parian wares.

Cups

More than 30 different shapes of cup were present in (531), very few of which are previously known (Figure 27). Very few earthenware teawares are known from Bell's Pottery at any period (for a full catalogue of these cups, and more, see Kelly 1997, 29-39). This is not too surprising since earthenware teacups, etc., were not highly valued and were subject to continual use. Even so, only two or three cup-shapes known out of so many is less than one might expect.

Porcelain teaware was produced by Bell's from 1847 onwards, and was more highly prized. They are first mentioned in the Glasgow Post Office Directory for that year, and exhibited at the Great Exhibition of 1851. It would be expected that some of the shapes presented in this group (Figure 27) would have been previously known; yet *none* were. The most famous Bell's cup shape is undoubtedly the elegant porcelain cup with a pedestal base and high handle. This was not represented in the assemblage, inferring that it dates to a later period.

The 'tendril Parian jug

J. & M.P.Bell & Co. registered this jug J2 (Figure 28) in the 1850s. It was not particularly popular, judging by the number of surviving examples. No other examples are known with a violet background, but earthenware examples are known with gilding on the mouldings (Kelly 1989). The pattern 'The Gem' is known in a variant in which the central motif is removed and replaced by the Prince of Wales feathers and an inscription that transforms it into a souvenir of the wedding of the Prince of Wales to Princess Alexandra. The wedding took place on 10 March 1863, so 1857 is a feasible date for the pattern to have been in existence.

Dating

Great confidence can be taken in assigning a date of deposition between late 1856 and early 1858 to this assemblage. The first and firmest piece of evidence for this is a cup sherd C13 bearing the coat of arms of the 'European & Australian Royal Mail Company Ltd' (Figure 27-C13). This firm had a very short life. Formed in October 1856 with a directorate of Glasgow businessmen to carry the Royal Mail between Europe and Australia, it succeeded in winning the contract, although its tender was £45,000 higher than anyone else's was (Kelly 1994a). It acquired at least two ships: the *Oneida*, a new ship built in Greenock in 1855 and the *Tasmanian* built in 1857 in Glasgow, another single screw vessel. However, the business ended "in chaos, recrimination and bankruptcy" in July 1858 after an abortive attempt at amalgamation with the Royal Mail Company (see West Register House, Edinburgh).

It is possible that this group represents an experimental set of shapes that were latterly discarded. Another possibility is that most of the wares were destined for export, since Bell's Pottery even at this early date seems to have had a large export market. Soft paste porcelain decorated with lilac or blue sprigs was widely made in Britain over a great number of years and was rarely marked by their makers.

Discussion of the pottery assemblage

A large variety of wares have been retrieved from the excavations, up to 70% of the pieces considered to be unknown or new types. Many new body types, patterns and shapes (particularly cups) have been added to the catalogue. A considerable amount of early transfer printed wares were retrieved from Trench 7. Overall, though, transfer printed wares were under-represented on the site, which is probably due to the small percentage of the site excavated. Three types, Apsley Plants (Figure 29), Broseley and Fibre were dominant amongst these wares.

Figure 27: Cup shapes C1-3, C6-8, C9, C11, C13, C14, C16 and C22.

The assemblage recovered from Trench 5 is of note. The types, forms and their proportions are atypical. The Spongeware was generally of a lesser sophistication than pieces from other trenches and are most likely examples from the early years (Figure 30). The full range of known wares that Bell's produced is represented to a greater or lesser degree, although the Parian wares were discrete to deposit (531). The range of bodies represented was substantial. A large amount of porcelain and earthenware and a number of pieces that fall somewhere between the two and are likely to have been marked 'Semi-Porcelain' when completed.

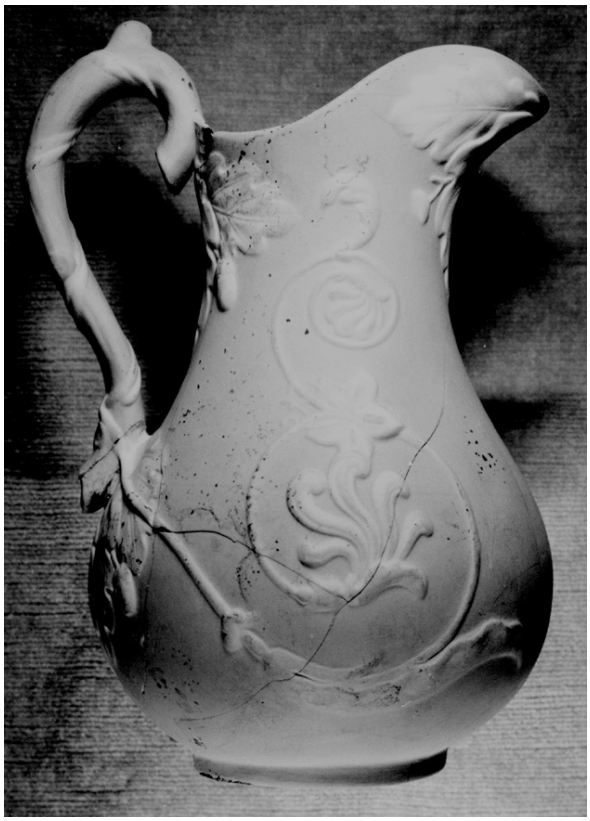

Figure 28: The tendril Parian jug.

Figure 29: Apsley plate.

Figure 30: Spongeware examples.

Of some concern is the fact that the vast majority of the sherds from Trenches 1-5 date either from the early period of operations (1847-58) or from the warehouse period after the pottery had closed down (1912-c.1923). The only certain example of an interim period deposit occurs in deposit (519). A possible explanation occurs since most of the sherds found came from the south side of the site. It is known that the initial building of the pottery took place on the northern part of the site and that sherds were dumped on the downslope south side, for convenience and to aid levelling up of the site for further construction. The extension of the pottery in 1858 necessitated that sherds be dumped elsewhere. Certainly dumps of Bell's wares are known from other parts of the city. The People's Palace has collections of sherds from Buchanan Street and from Whitehill. The latter contains many Bell's sherds of a later date. The banks of the River Kelvin and the various canals in the City have many similar dumps.

Some of the material from the watching brief part of the fieldwork (Trenches 6-11), which probably represent spoil heaps, is generally divisible into the same two date groups as the material from Trenches 1-5. The sherds from the Warehouse period when Turner and Weir were in charge (1912-c.1923) were exactly the same as those from Trenches 1-5, but the sherds from the earlier period (pre-1860) were of a different nature. In general, there was a greater percentage of glazed sherds and there were few or no complete pieces. Transfer-printed wares were in greater supply, with several patterns recorded that were previously unknown. These patterns may date from before 1860. One, showing the stalks of flowers or corn in biscuit came from a ewer shape known to have been on show at the Great Exhibition of 1851. There were also several patterns with a mixture of flowers. A recent specimen discovered in a private collection has confirmed these as a previously unknown pattern (Kelly 1997, 29-39).

Throughout their period of operation, Bell's produced an enormous variety of products and the influences on them were immensely varied, as was their reaction to those influences. Interaction between the production-based knowledge gained and the wares retrieved have resulted in each modifying the other.

The pottery moulds

By Bill Brown

During the nineteenth century the pottery industry came to rely increasingly on plaster moulds as a means of speeding up the production of complex wares and keeping a reasonably consistent quality as the scale of production grew. The moulds used in a large factory such as Bell's contained a great deal of information, not only about the types and variety of the ware but also about the methods and management of its manufacture. Mould making is one of the key areas in pottery production and mould makers will design the moulds to respond to the needs of the whole production process as well as to respond to aesthetic changes in the design of the ware. Moulds have been used for ceramic production of various sorts since the earliest times. By the nineteenth century this had developed to a highly sophisticated level in both the scale and complexity of the wares that could be produced, and in the variety of production processes which were used to make them. The number and variety of the moulds found at the Bell's Pottery excavation provides a unique opportunity to gain some insights into these processes at work.

The main aim of the mould analysis from Bell's Pottery was to attempt to establish the methods that may have been used in the production of the wares and whether this may have differed during the lifetime of the pottery. Comparisons have been made between the finds from Bell's and various other excavations in Scotland and England, and examples of wares from Bell's and other manufacturers have been compared to search for evidence pertaining to the production methods. As the details of the surfaces, seam lines, variations in wall thickness, etc. can all help in clarifying the practices of the period.

In total 272 plaster moulds were recovered from the site. Most of these were in surprisingly good condition and have been classified and the type of ware produced from them established with a degree of certainty. The vast majority were recovered in excellent condition from Trench 5 (514), an area free from attack by water and weathering (Figure 21), and deposited during

the life of the pottery (see below). The plaster fabric was in most cases consistent and free from obvious impurities. Several of the moulds were close to usable condition, although most of them appeared to have been discarded because of loss of detail due to wear or to breakage during use. Some mould fragments were recovered from Trench 2 in much poorer condition. A third group, in good condition, was recovered from Trench 11. With a few exceptions it has been possible to identify the type of piece produced from each of them - some advertised their purpose, helpfully scribed on the back - but identifying moulds with *specific* pieces from Bell's was considerably more difficult. This was due to the number and variety of pieces, discrepancies caused by shrinkage and firing, and the possibility that particular wares may have been destined for export. They were therefore more difficult to trace.

More than half (149), were moulds for cups, side plates, saucers and soup plates. All of these were jigger moulds, forming the inside surfaces of the pieces, as opposed to jolley moulds, which formed the outside surface. The moulds appear to have fitted a series of standard cupheads on the machines, with the sizes of the bases falling into four groups; 80 mm; 99 mm; 136-140 mm and 194 mm. The tapered bases of the moulds would have been subject to a fair amount of wear and tear, and small discrepancies in size may have occurred for that reason. There were a large number of different individual styles of piece, the 69-cup moulds representing 15 different forms of cup, the 22 saucer moulds representing 15 different saucers, and the 58 plate moulds representing 17 different types of plate.

Cup, plate and saucer moulds

Several of these were very similar in profile; cup moulds CM2 and CM2B (Figure 31), for example, had identical profiles but different rims on the mould. Plate moulds PM4, PM5 and PM10 all had very similar profiles, but PM5 showed a decorative moulding on the edge of the plate and PM10 had a faceted rim and a smaller cuphead size (Figure 32). It seems likely that, to save time, moulds from the earlier pieces (e.g. as represented by SM3 and PM4) had been re-modelled or modified when a new series of pieces was required. The saucer moulds SM3 and SM4 were identical in profile, but SM4 had relief decoration (Figure 32).

Several of the moulds also represented different pieces from the same range of ware, PM1 and PM2, for example, being a side plate and a soup plate with identical decorative relief on the rims. The saucer mould SM1, may be matched to the section from a saucer S27 among the pottery assemblage (Harry Kelly, pers. comm.), but otherwise the moulds and the finds of pottery sherds provided no certain matches.

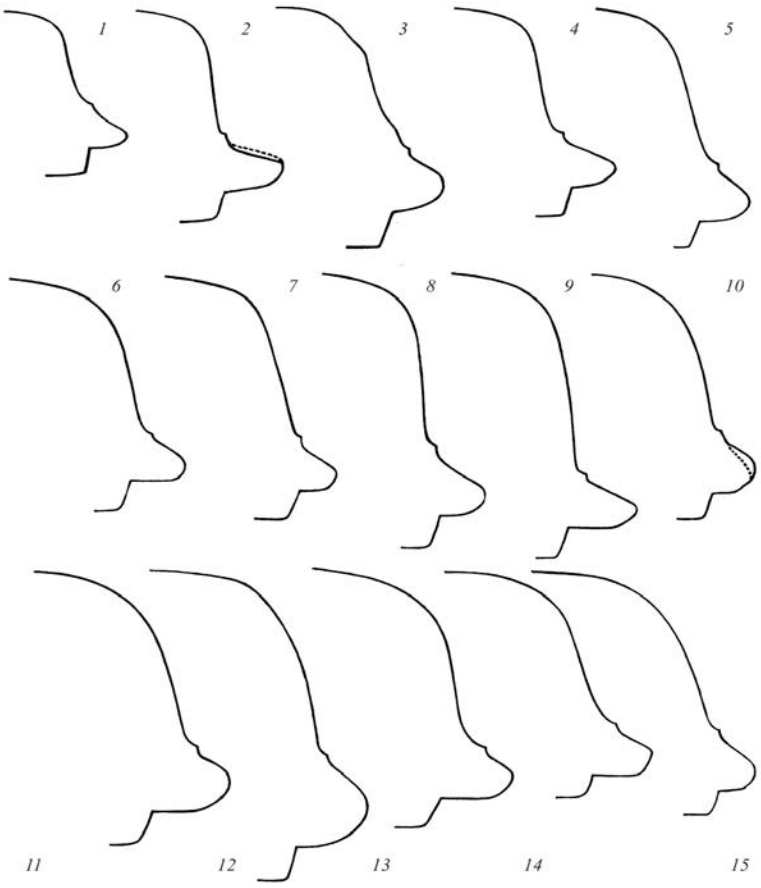

Figure 31: Cup moulds CM1-CM15.

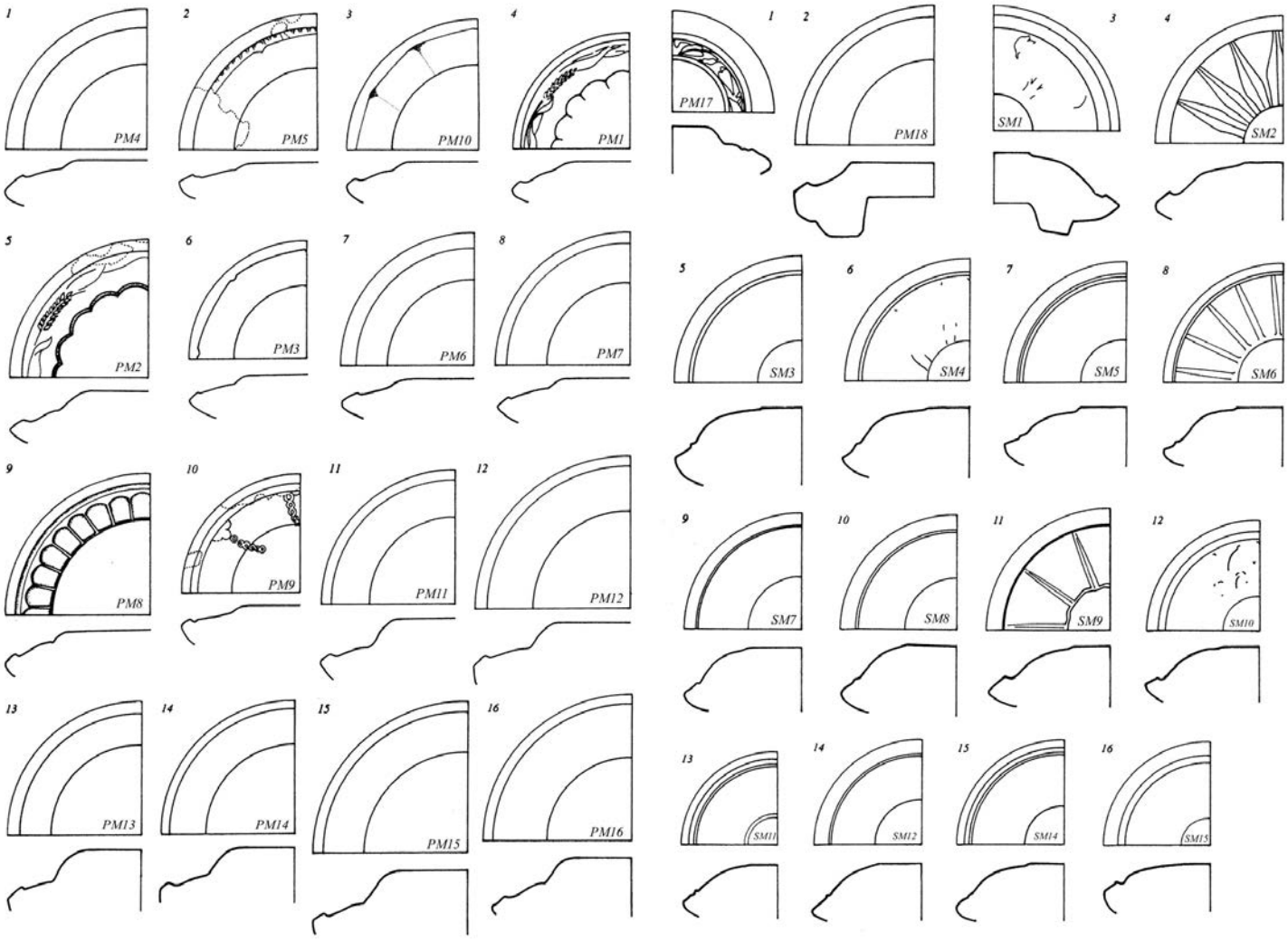

Figure 32: Plate moulds PM1-PM18 and saucer moulds SM1-SM15.

Press moulds

The second type of mould represented in the finds was used to produce simple pressed pieces using only single mould sections. These moulds were for flat dishes or lids that were produced by pressing a slab of clay onto the face of the mould and finishing the back with a 'rib' or a shaped profile tool. A sharp, well-defined ridge round the outside of the mould provided a scrapping edge, producing a definite groove on the cast to assist in trimming the finished piece. This technique remained in use in the pottery industry until relatively recently, although becoming increasingly uncommon. There were 20 moulds of this type from Bell's, ranging from large oval dishes to small, simple moulds for components. Several of these can be identified very easily by the names on the backs of the moulds. The rectangular dish PR05 has 'Sauce Tureen Stand' (Figure 34-1). The large oval mould PR01 has '8 inch Tureen Stand' scratched on the back (Figure 34-2). This piece is the largest complete mould in the group, forming a cast 350 by 255 mm. Other moulds had shorter or more cryptic identification marks; PR04 a '10', PR02 a '9' or a 'g'. Some of these pieces were fragments or parts of larger moulds that may have been broken when they were discarded. PR06-08 fitted together to form a mould for a deep square dish and PR03 was a broken mould (Figure 33-3), probably slightly less than half, of an oval ashet which may well have been more than 400 mm long when cast.

The dishes produced from these moulds may have had no footrings, as was often the case, or a one may have been formed in some instances by a hand-held profile tool used to smooth the back of the cast. The unusual small oval mould PR20 may represent another method of forming a high

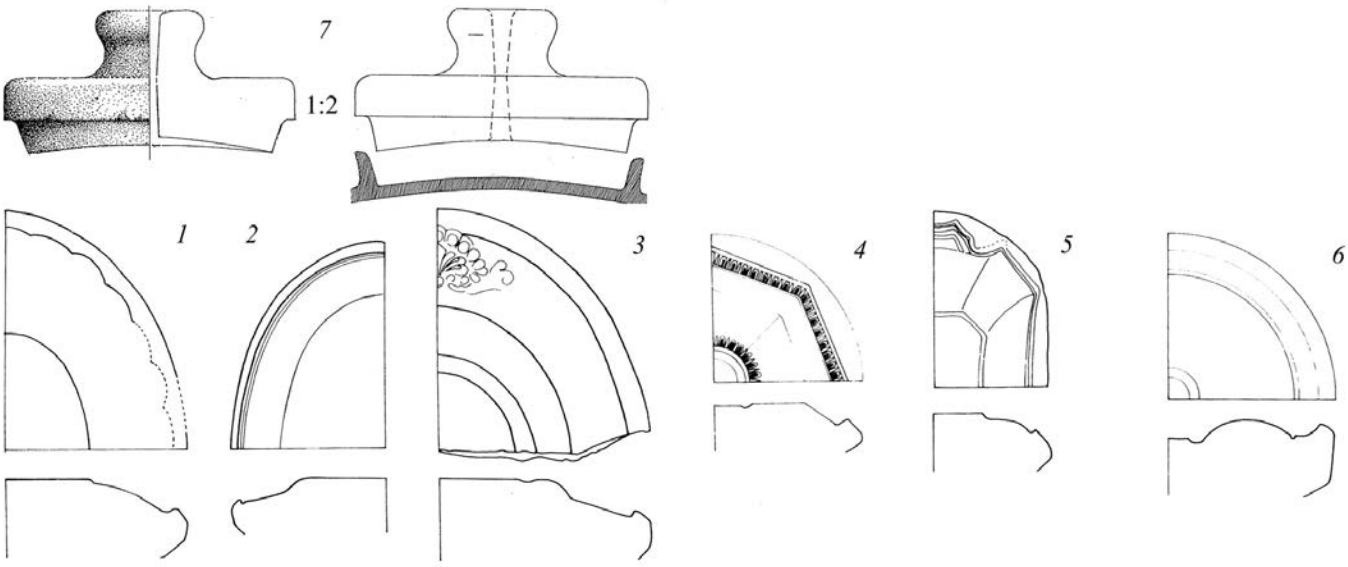

Figure 33: Press moulds probably PR09, PR10, PR04, PR13, PR05, PR11, and footing mould PR20.

footring (Figure 33-7). The mould would have been placed on the back of the clay dish before it was removed and a coil of clay forced into the recess under the edge to form the inside of the footring. A profile tool would then be used to smooth the clay round the outside using the outer edge of the mould as a guide and forming the outside of the footring. The handle like projection would be used to work the mould loose from the base of the dish before clay shrinkage caused cracking. A hole was then drilled through the centre of this mould, emerging at the top of the handle, in order to prevent suction tearing the soft clay during the removal of the mould. The positioning of the hole suggests that it may have been used to blow air in and so release the mould more easily. Two of the moulds in this group, a small round mould PR15 (Figure 33-6) and possibly an octagonal dish PR11 (Figure 33-4), appear to be component parts for other pieces.

A small circular mould PR21 from Trench 11 was difficult to identify (Figure 34-3). The mould was of simple design, with no natches, and would have produced a small flat disc of clay with a handle-like lug on one surface. Although it appears superficially like a lid, the piece produced would be a simple flat shape, and seems unlikely to have been a piece of ware. The most likely explanation is that the discs were used to place in the necks of vessels during the biscuit firing in order to prevent distortion (R Copeland pers. comm.). A light tap on the lug would release the disc after firing.

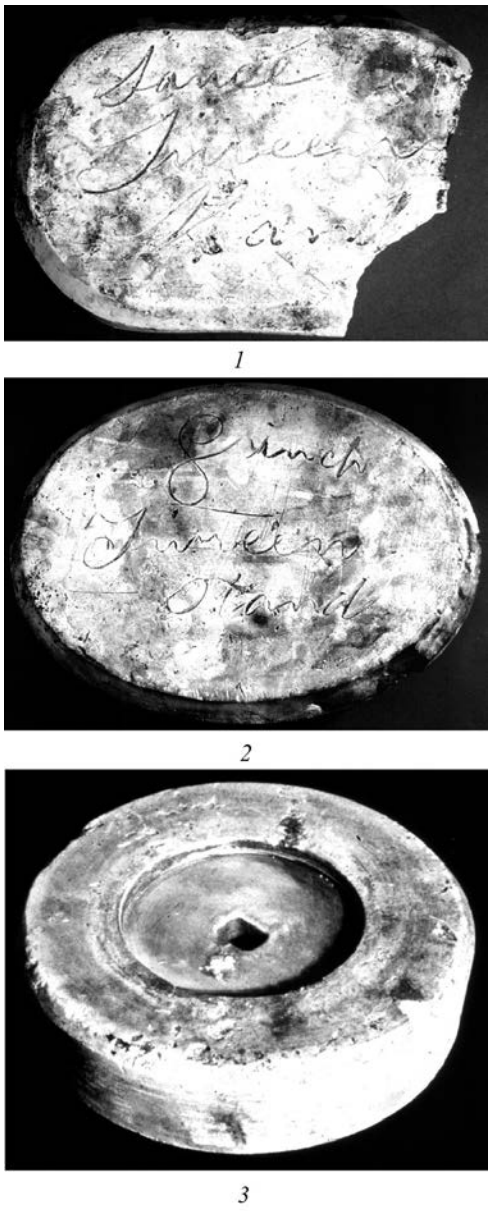

Figure 34: Inscription moulds PR05, PR01, PR21.

Multi-part moulds

Over 90 pieces of the assemblage were for complex moulds comprising more than one section. These were identified by having natches or locating keys fitted into the faces where the sections joined, in order to locate them accurately. These natches normally consisted of a small hemisphere shaped positive on one half of the mould and a corresponding negative on the other. Many of the moulds from Bell's Pottery had ceramic natches set into the joining faces to avoid the problems of wear when plaster alone was used. This minimised the risk of mould halves not being properly located and leaving prominent seam lines on the finished ware. The arrangement on a symmetrical mould was often irregular or asymmetric in format to avoid confusion when the mould is being assembled. Sometimes reference marks were also added to assist in locating sections of the mould together. At times these consist of a cross or other mark scratched into the joining face of the mould, but the usual practice at Bell's seems to have been to cut two grooves into one of the plaster natches while the first part of the mould was being made. These grooves would then give positive ridges when the second part of the mould was formed. Some of the joining faces on these moulds were plain apart from the natches, but many of them had a 'rigget' or channel cut into the joining face of the mould along the inside edge so that a scrapping edge was formed when the sections were joined together. This feature is rarely seen in modern practice, not normally being necessary for slip casting, and indicates that the moulds were used for press moulding. The two (or more) mould sections would have clay pressed into them separately, leaving a slight excess at the edges to form a tight join. The mould sections were then forced together and any excess trimmed off by the scrapping edge, leaving a minimal seam line requiring as little trimming as possible on the finished piece.

Twenty-nine of the finds of mould sections were from handle moulds; all designed for press moulding and fairly substantial in construction. All had a rigget and most of them had ceramic natches. Several of the sections joined to give both halves of a handle mould MPM15 and MPM16 (Figure 35- 1, -2) and in some instances more than one match can be found, giving a choice of sections for one of the halves MPM23, 24 or 25 (Figure 35-5), MPM26, 27 or 28 (Figure 35-6, -7) and MPM29, 30 or 31. These handles were from a variety of vessels, several from tureens or serving dishes, being symmetrical in form and judging by the angles of the joining ends intended to be fixed horizontally. Some were probably from lids, being designed to join on to lugs cast onto the main piece. Some appear to be the right scale for cups and several are for jugs. A few of the moulds appear to have been used to produce components for more complex pieces of ware, including one MPM06 (Figure 36-

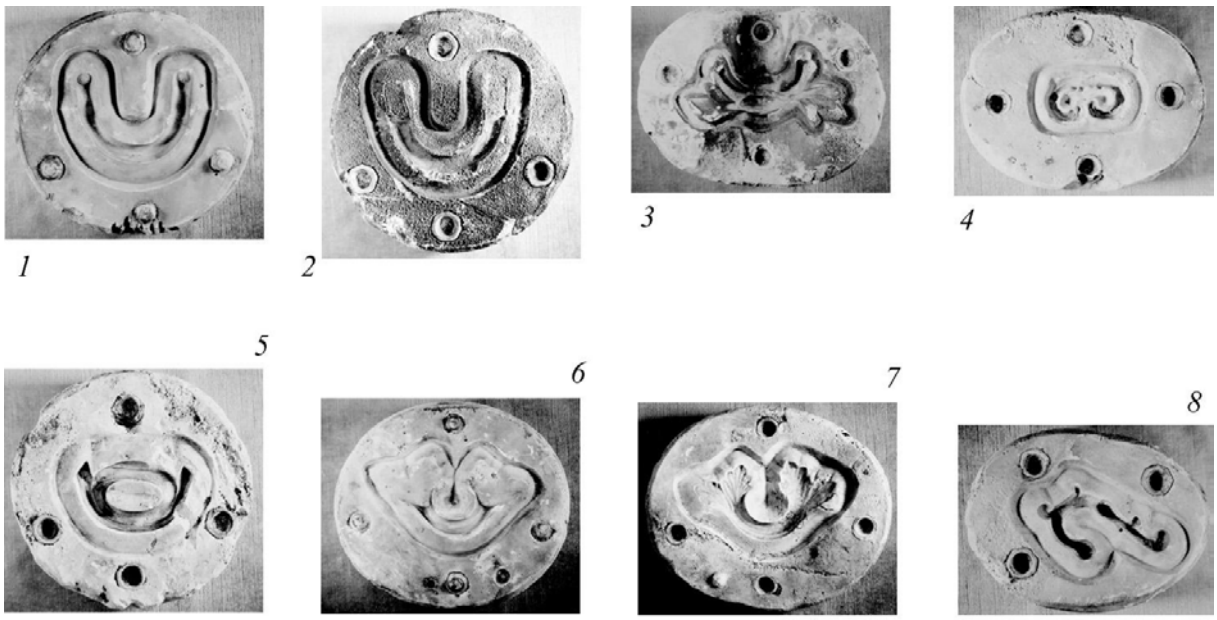

Figure 35: Handle moulds MPM15 & MPM16, MPM32, MPM36, MPM23, MPM26-MPM29, MPM09.

3) which forms three separate small components and two mould halves which fit and seem to have formed an octagonal stem or neck MPM07 and MPM08 (Figure 36-1). There are also two which may have produced footrings MPM01 and MPM03 (Figure 36-1, -2). These last moulds had holes drilled through them, possibly to allow in air to release the casts more easily.

The majority of the mould sections were for hollowware forms. These included vases, jugs, and tureens as well as some forms, which were difficult to identify. Some of these hollow ware moulds had the scrapping edges usually found on press moulds but a number had plain joining faces, suggesting that they were intended for slip casting. At least one of the moulds, one for a tall-necked octagonal flask, MPM41 (Figure 37-1) may have been altered, as it appears to have had riggets cut fairly crudely into the production mould rather than having them built into the case mould (J Hand pers. comm.). This example also has a deep groove cut across the back, probably to hold a cord which tied it together for casting or for storage.

One of the jug moulds, originally a mould with two halves and a base, is particularly interesting for being the best represented MPM52-58 of all the individual items in the group which comprised a total of 5 sides moulds and a base mould (Figures 37 and 38). The piece itself formed a medium sized jug with a cut away rim and a prominent spout. There was a bead or cordon round the belly and above this a stag hunt scene modelled in relief. Below the bead is a repeated leaf motif, also in relief. This set of moulds can be matched with a known example of pottery from Bell's, a Parian ware jug dating from the 1860s ('Stag Hunt Jug' in the collection of Glasgow Museums at the Peoples' Palace. Photograph No 1020.89.26). From a photograph of this example (Figure 38-4), it was possible to match the jug mould with a handle MPM32, shaped like a stag's antler, from among the finds (Figure 38-3). Although two of the jug mould halves MPM52 and MPM53 were for the left side and three MPM54-57 (Figure 37-2-4) were for the right side, the number and arrangement of the natches varied widely and only sections MPM52 and a broken section MPM55 and MPM56 could

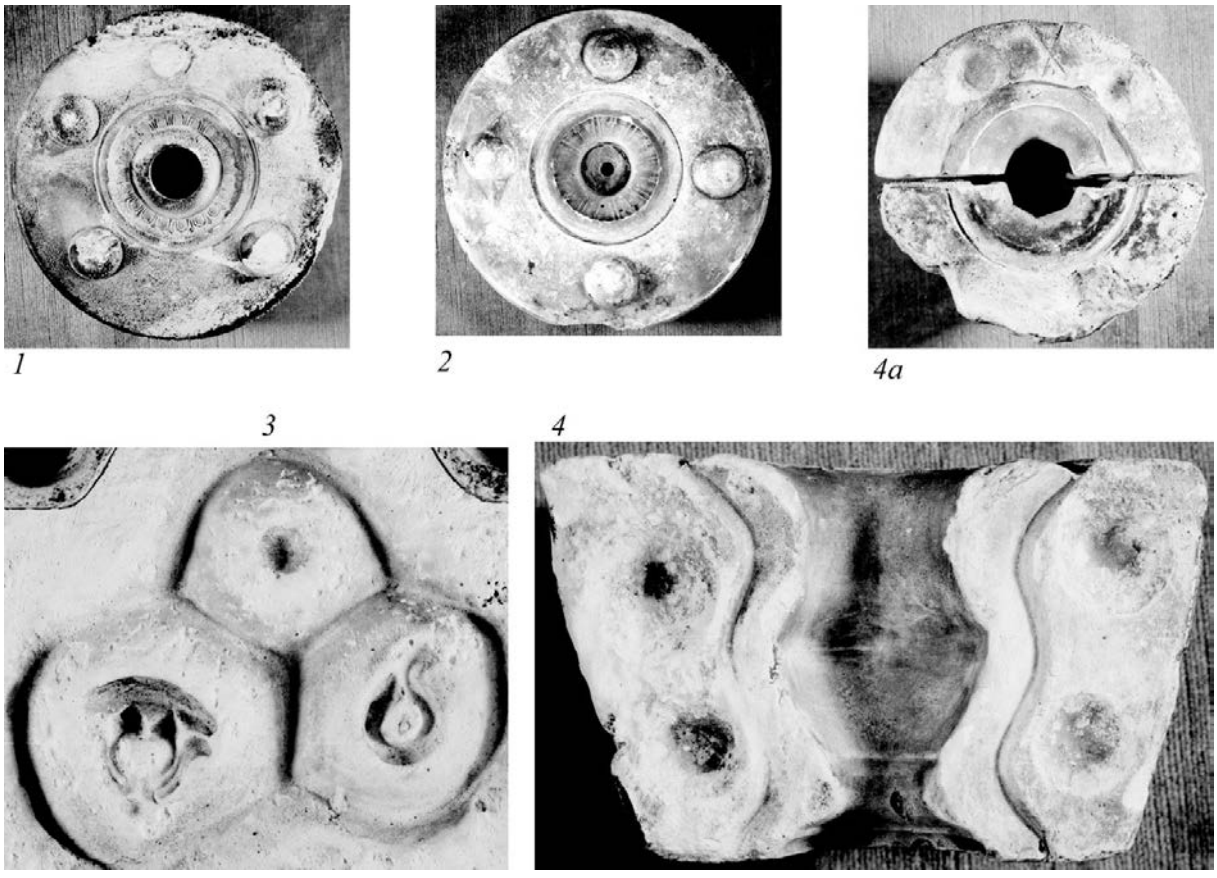

Figure 36: Foot rings MPM01, MPM03, MPM06, MPM07 & MPM08.

be fitted together to form both halves of a jug. The remaining section MPM58 (Figure 38-2) was a base, and fitted all the other pieces. The mould had plain joining faces on both the sides and the base and the top curves to follow the profile of the jug rim. The plain joining faces suggest that the piece might be slip cast, but the space at the top of the mould does not provide enough of a 'spare', or reservoir for the casting slip to rise above the top of the cast. Several of the other moulds, including those for a tall vase MPM72-74 (Figure 37-5) and for several smaller jugs MPM61 and MPM79 had similar arrangements of plain joining faces but spares which were too short to allow easy slip casting.

One of the more intriguing moulds was one that formed the side of a tall piece that appeared to be open at both ends MPM90–93 (Figure 39-1). Assuming that this mould section was the side of a symmetrical piece, the cast would be more or less rectangular in section with slightly rounded corners, tapering slightly towards one end. On the two narrow sides there would be an inverted 'T' shape in relief. This piece was presumably part of a larger more complex piece built from several individual casts.

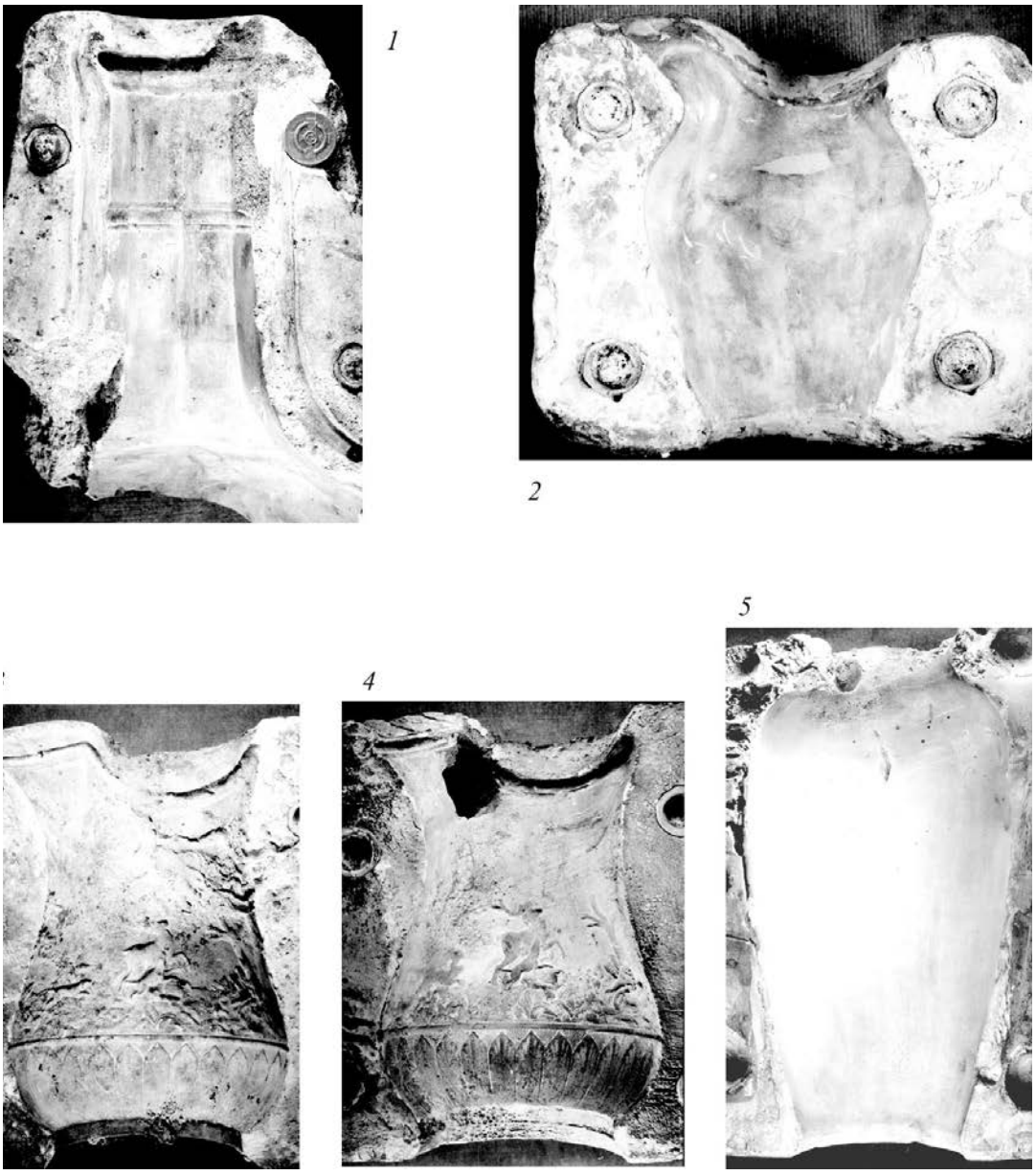

Figure 37: Jugs MPM41, MPM52-58, MPM72-74.

Case moulds

The small group from Trench 11 contained several moulds for a handle, a plate mould, part of a jug. There were also three moulds, which can be identified as 'cases', or the master moulds used to make a series of moulds for production. One of these was for a handle CAM1 (Figure 39-2) and clearly showed the piece itself, in positive, as well as the rigget for press moulding and the arrangement of plaster natches. The other case CAM2 (Figure 39-3) was for a jigger mould for a small dish. This case had '5ins Ice Saucer' scratched on the back (Figure 39-4). A third example from this group CAM3 (Figure 39-5), may be a case mould for the underside of a jigger mould, forming the tapered section which would fit into the cuphead of a jigger machine. It can also be interpreted as being an outer sleeve intended to hold two mould sections together.

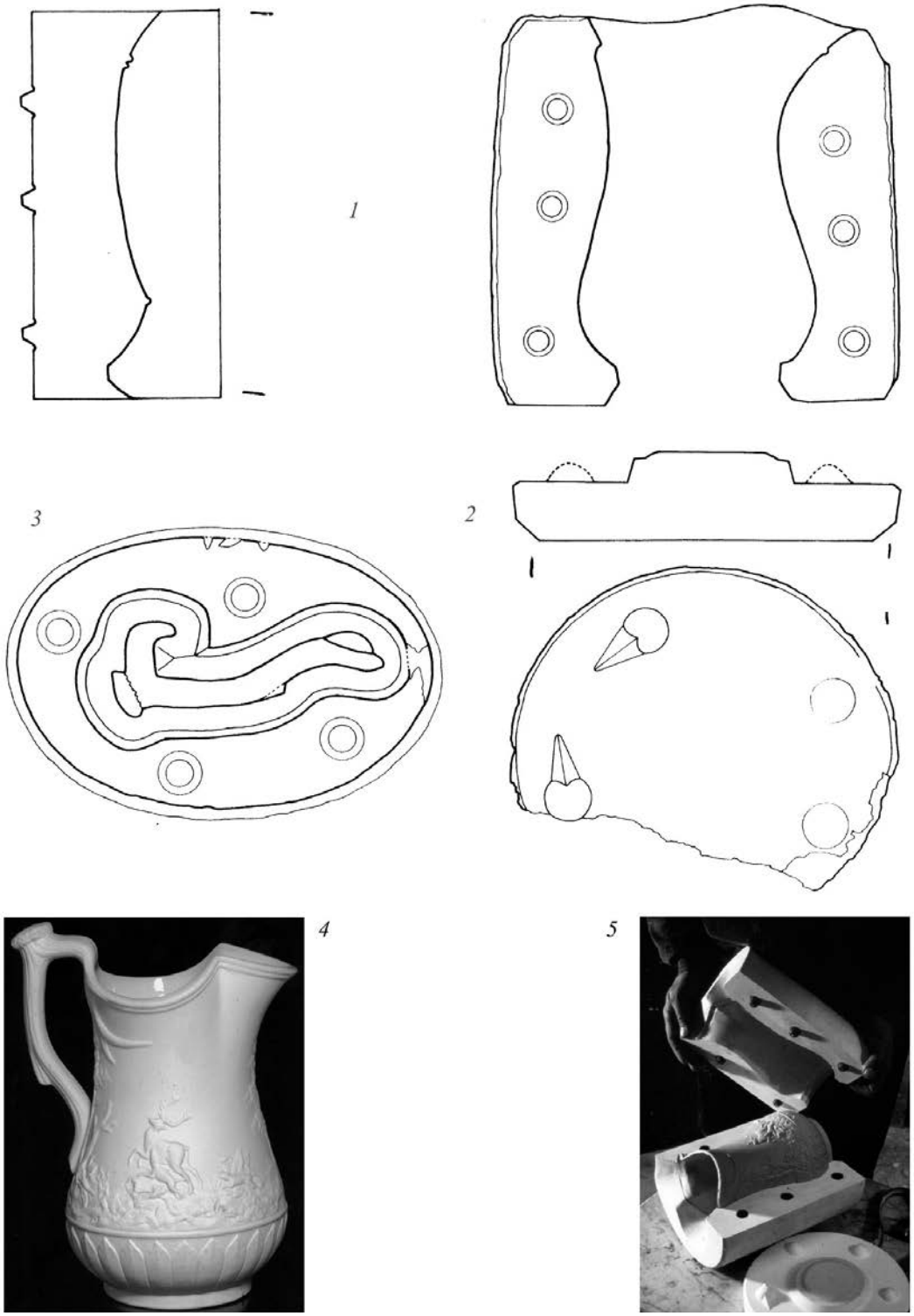

Figure 38: Stag jug MPM52-58, MPM32.

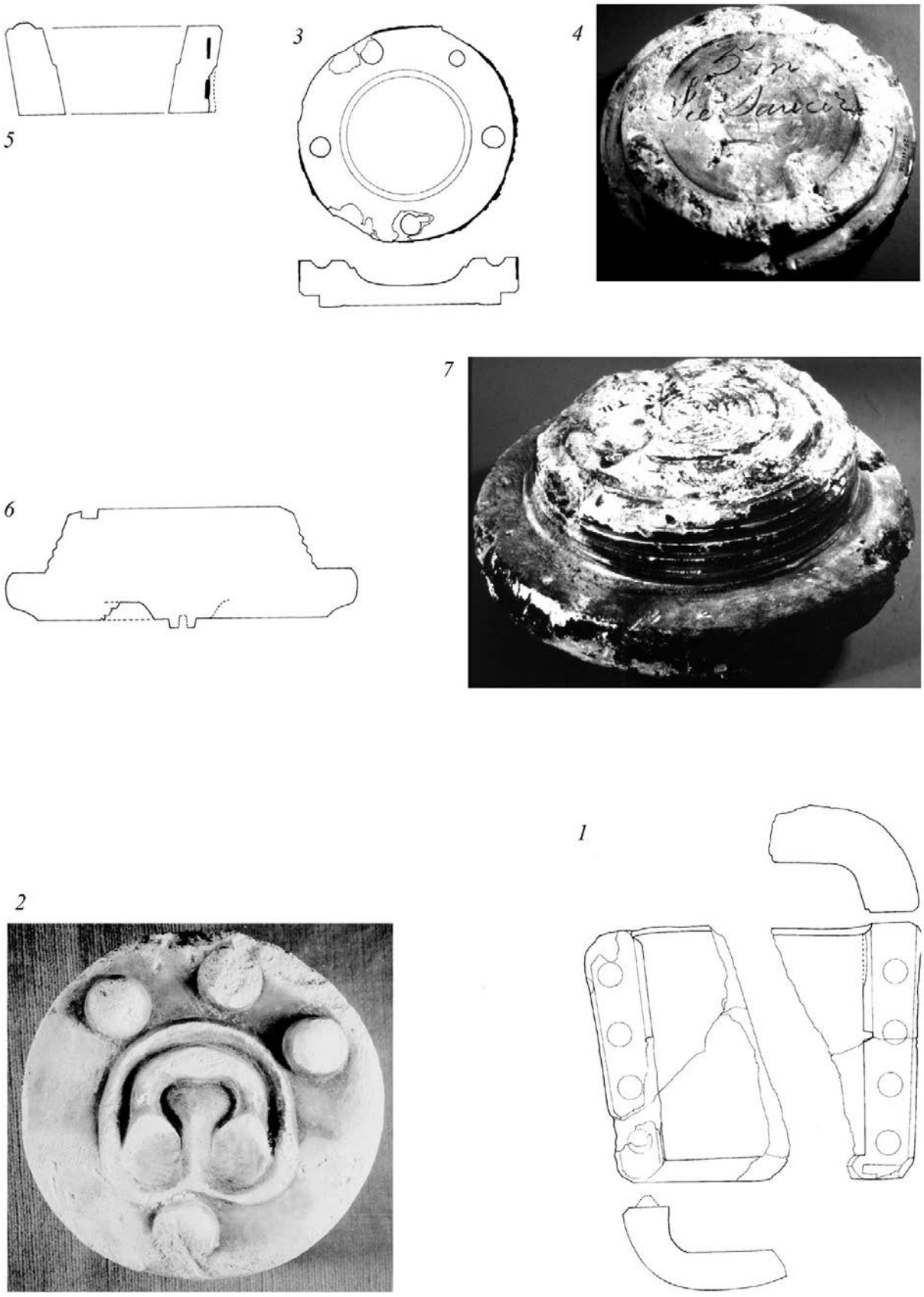

Figure 39: Case moulds MPM90-93, CAM1, CAM2, CAM3, MISC1.

Miscellaneous

A final piece from this area was a large disc or circular block of plaster MISC1 (Figure 39-6, -7) with a shoulder half way up its height. The top section had a smaller diameter and horizontal grooves around its circumference. The top surface had a number of concentric rings. On the underside of the block was the remnant of a cross-shaped piece of iron, which would have secured the plaster to a shaft or spindle. This device is almost certainly the head from a mould maker's 'whirler', a horizontal wheel for turning circular models and moulds. The grooves round the upper part may have been intended as guides for coiling a length of rope around the whirler. When the end of the rope was pulled sharply, the whirler, with its heavy plaster head acting as a flywheel, would rotate long enough for a swift and confident mould maker to turn the form required from a rapidly setting block of plaster on the top surface.

Trench 11 was located north-east of the mouldmakers' workshop (Figure 7), and it is not too surprising that some of the items retrieved would certainly have originated there. Case moulds and mouldmakers' equipment from this period are likely to be encountered very rarely, and in view of the quality of the finds from this part of the Bell's site it is very unfortunate that this particular area could not be excavated more fully.

Discussion of the pottery moulds

While some of the hollow ware moulds clearly seem to have been intended for press moulding, having scrapping edges to remove excess clay when the moulds are joined, others are more ambiguous in construction. These have plain joining faces, suggesting a slip casting mould, but spares (the spaces at the tops of the moulds which act as reservoirs for the casting slip) which are too small to have allowed the moulds to slip cast easily. Examination of wares from Bell's, and from other potteries in the mid-nineteenth century, suggests that some of these pieces may have been press moulded. The walls of these pieces are often very well constructed but not as even and consistent in thickness as modern slip cast pieces usually are. Slip casting was not unknown in the mid-nineteenth century. It was used for small items such as teapot spouts in even earlier times but some of the evidence may indicate that the casting slips used were composed of a clay and water mixture alone and that the addition of deflocculents was uncommon. The addition of deflocculents, such as soda ash (sodium carbonate) or 'waterglass' (sodium silicate) increases the fluidity of the slip without the necessity of adding large amounts of water and by this means the shrinkage of the casts and consequent warping and distortion can be much reduced. The speed of the process is also increased, since the casting time in the moulds is shortened and the drying of the moulds between casts becomes faster. Descriptions of early Parian ware in the 1850s (see description in the Staffordshire Advertiser, July 1851; Atterbury 1989) relate that the shrinkage rate was 25% or even higher and that distortion in the firing was a very common problem giving high loss rates for the ware. Parian, a type of clay which was formulated to imitate marble, was mainly used for producing figures which were finely detailed but on a fairly small scale, and slip casting with a water/clay slip was probably the most practical means of making these pieces despite the shrinkage problems.

A small Parian ware piece from Bell's Pottery in the collection of Paisley Museum and Art Gallery, (Parian salt cellar, reg. No 1915/19d, and exhibited in the Great Exhibition of 1851), is thought to date from about this period and does show evidence of having been cast. It is however on a small scale, of quite thin construction, and might easily have been cast from a water/clay slip rather than one using deflocculent. In the 1860s both Copeland and Minton introduced Parian bodies with a shrinkage rate reduced to one twelfth and a very much reduced loss rate in the ware (Batkin and Atterbury 1989). This might very well indicate that the use of deflocculents in the casting slips was introduced by these manufacturers at this time, and that the casting process had become simpler and more reliable.

One of the most striking features of the collection of moulds from the Bell's Pottery site is the diversity of the examples, even the large number

of jigger moulds containing a surprisingly large number of different forms. A pottery on the scale of Bell's could be expected to use a large number of moulds for any one piece in order to minimise the changing of profile tools on the jigger machines for example, and generally to make production of the ware efficient. The moulds themselves might be used 50 or 60 times, probably less for the moulds with detailed relief, and would then have to be discarded. Replacement of moulds must have been a fairly common event and disposal of them must have presented a fairly regular problem.

A number of kiln furniture items were absent from the site assemblage. There were no biscuit fired clay moulds retrieved from the site. The site of Belfield's in Prestonpans, East Lothian (Dalgleish 1990) has produced a number of these types of moulds (G Haggerty, pers. comm.). It may be that they were not part of the particular manufacturing tradition to which Bell's belonged. Other omissions are the sprig moulds, which would have been used for many small details and decorative additions, and also moulds for dinner plates, which must have formed a significant proportion of the factory's output. A possible reason for the lack of plates may simply be that the building marked 'Plate Shop' on the plan is slightly further away from the site of the finds than the 'Pressing and Saucer Shop' (Figure 5). It is more likely, however, that these perceived absences are indicative of the small percentage of the site excavated. Taking this fact into consideration, it remains puzzling that so few of the moulds can be matched with the finds of kiln wasters and pottery sherds, or even with known pieces of pottery from Bell's. This is in spite of the fact that the factory had a considerable output and that examples of the wares are held in so many collections.

The mould construction, while very similar to modern practice in many respects, differs in a number of respects which suggests that they were used in ways which are now little known. At first sight it would seem more logical to make cups by using the 'jolley' system of forming the clay into a concave mould, (many pieces were press moulded into moulds and the technique can hardly have been unknown). After the clay has been formed over a mould and the plaster has removed some of the water content, the piece begins to shrink. If it is left too long the clay will begin to tear as the mould prevents this shrinking from taking place. A cup formed in a jolley mould will shrink away from the mould, a jiggered cup will shrink onto it, and it would seem to be preferable to use the former method if possible. The flared footring, which was a common feature on Bell's cups, is presumably the reason why the cups were formed in the way they were. The angle of the foot and the delicacy of the material would make them extremely difficult to form in one operation. Rather than add the foot to the cup as separately cast pieces it seems more likely that the cups were jiggered with excess thickness on the base which could then be turned to shape when the cup had partly dried. A good deal of ware is known to have been produced by throwing on the potter's wheel and then turning the pieces to their final shape on a lathe, and the same process may well have been used for the jiggered ware. It may be the case that some of the press-moulded wares were also finished on a lathe, to refine the shapes and to conceal any seam lines.

Experiments carried out with a reconstructed mould at the Glasgow School of Art during the post-excavation analysis (see B Brown. The re-casting of a jug from Bell's Pottery Report in Bell's Pottery Project Archive, Figure 38-4, -5) were inconclusive in that no one method worked significantly better than another. They do show that it is possible, and even relatively easy, to press mould a jug by a combination of techniques which most potteries were known to use at the time. If these methods of press moulding, throwing and turning were the main methods employed by Bell's, then some of the problems encountered in the development of finer clay bodies become much more understandable. All these forming methods require the clay to have a certain degree of plasticity – the ability to stretch and form easily, without excessive shortness or cracking. China clays, and many of the other essential ingredients of white firing clays, are notoriously lacking in plasticity, and a white firing, translucent clay which could be formed by these methods would be difficult to achieve and keep consistent.

The number of different moulds and the diversity and complexity of the pieces they represent suggests that a sizeable effort went into developing wares and widening the range of products. Some of the details of the finds may also be significant in suggesting that new pieces or techniques were being tried out. The various mould halves for jugs have a variety of joining arrangements and only one match can be produced from the five sections found. These cannot all have been made from the same case mould, as would be likely today, and it seems unlikely that a series of case moulds would be made for a single piece. The various mould halves may have been made as experiments or apprentice pieces or used for a very limited production of the piece. It is possible that if more examples of multi-part moulds are traced in the future then any variations may show whether a series of different moulds were used to produce them. The practice in earlier times seems to have been to cast production moulds individually from a fired clay model of the piece and this may also be a possible interpretation of these non-matching mould halves, although a more unlikely one. The joining faces of the tall flask mould MPM41 (Figure 37-1), show roughly cut riggets, apparently cut directly into the production mould, which are at variance with the quality of craftsmanship evident in most of the mould making. This may also indicate experiments in casting or an attempt to solve a making problem. The piece has a long, narrow neck and could only be slip cast or press moulded as two separate halves which were subsequently joined. It is possible that the mould was modified to test out various making methods.

The overall impression is that the moulds are very close in general appearance to those, which could be found in a modern factory. They are more heavy in construction than is commonplace in modern practice, but this may be accounted for by the fact that press moulding is now fairly common and that moulds do not usually have to accommodate a scrapping edge. The fragments of plaster moulds found at the site of Belfield's appear to be heavier still in construction (G Haggerty, pers. comm.) and it may be that the tendency in the intervening period was to make plaster moulds lighter, possibly to assist with drying them between casts. The conditions in most nineteenth century pottery buildings probably did not encourage rapid drying, although the hot room identified in Trench 5, close to where the majority of the moulds were found, may have been an attempt to counter this.

A final observation is that whether or not the moulds found were typical of all those in use at Bell's Pottery or in the pottery industry generally at that time, they do appear to be typical of each other. They share many small features of making detail, such as the grooves cut as reference marks or the trimming of the outside surfaces. Even the names written on the backs of a few of the moulds show a few features in common. Was it commonplace to abbreviate inches as ins. rather than “”, or was this an idiosyncrasy of a particular individual?

The casting practice at Bell's appears to be well tried rather than innovative. It relied on press moulding rather than slip casting, with a consistency which suggests a high point in the development of the forming techniques which the industry had relied on for a century and more. The skill and experience of its workforce was the crucial factor here in the quality of production. The mould making was probably the responsibility of a relatively small number of people and it would be interesting to know whether they had been trained at Bell's, at another local pottery, or whether they had been brought in from Stoke-on-Trent or one of the other major pottery centres. The mid-nineteenth century seems to have been a time of very rapid change and fierce competition in the pottery industry. It seems likely that a factory such as Bell's would be anxious to obtain new skills and technology from outside as well as relying on the skills of the people within the factory.

The kiln furniture

By Bill Brown

Kiln design and the technology of firing provide the greatest contrast between the practices of the nineteenth century and those of today. The coal-fired bottle kilns, which were the standard means of firing until well into this century, shaped many aspects of the industry both in technological and economic terms. By the middle of the nineteenth century this design had undergone several hundred years of development and although the basic principles remained more or less the same, the growth of the industry and the growth of individual potteries provided an impetus for experiment and accelerating refinement of the whole process. The aim of this study of the kiln furniture from the Bell's Pottery excavation is to gain as full an understanding as possible of this changing technology and its practical application in one of the largest Scottish potteries of the period.

Saggars

The saggars used at Bell's were of a fairly standard construction. The vast majority had a fairly consistent wall thickness and fabric. They were made from a coarse fireclay which appeared to have a high proportion of fireclay 'grog', (an aggregate made from fired clay, ground to various sizes of grit and added to the plastic clay to improve handling and to reduce shrinkage) and was of a fairly friable texture. Most of the fragments found at Bell's were fairly small and it is difficult to be certain about the size and shape of the individual saggars. A few of the larger fragments formed oval shapes, similar to the imprints in the asphalt floor of the hot room in Trench 5. All of the saggars had smooth surfaces and appear to have been built round a mould or wooden former from slabs of clay. There was no evidence of any of the typical surface marks, which appear on the wheel-thrown saggars from earlier potteries.

Many of the saggars had glazed surfaces on the insides of the walls or the undersides of bases, indicating that they are likely to have been used in glost firings. Lead glazes were common in the nineteenth century and glazes made from 'raw' lead compounds would have a tendency to become slightly volatile at high temperatures. The glazing on the insides of the saggars and on some of the other kiln furniture was probably a combination of glazes. This would have been deliberately applied to prevent the highly porous fireclay surface from 'starving' the ware of glaze and in many cases glaze migrating from the pottery surfaces adding to this coating over a succession of firings. The fragments from the bases of the saggars may also have had a layer of grit, probably coarsely ground flint or quartz, on the upper internal surface to prevent the ware and the kiln furniture inside the saggars from becoming stuck by the molten glaze. The remainder of the saggar fragments were unglazed, but often had a shiny, slightly glaze-like coating on the outside surface from the ash deposited there during the firing. A few fragments showed signs of the saggar walls having distorted or collapsed in the firing.

The fragments from Trench 3 were mainly ones which had glaze or the quartz-like grit on their surfaces, suggesting that the group of kilns indicated on the 1880 and 1919 plans of the factory were probably the glost kilns. The finds from Trench 4 and from Trench 5 were mainly unglazed. The finds from the later trenches were less consistent in distribution, but those from Trenches 6 and 10 were mainly glazed, while those from Trench 9 showed both glazed and unglazed pieces.

Fireclay wadding

As well as the saggars themselves the finds also included numerous examples of fireclay wadding, the fireclay used to seal the joins between the saggars when they were stacked. Most of the wadding material had clearly been formed as coils and then flattened by being compressed by the weight of the saggars as they were stacked in the kiln. There were also some roughly formed coils of clay of various sizes which appeared to be made from a finer clay body, perhaps one of those used for the ware itself. These appeared to have been used for some other purpose than as wadding for saggars. They show no signs of being compressed, and may perhaps have been used as supports for some of the pieces of ware, made from the same clay in order to shrink in the firing at the same rate.

Another group of finds, which may be related in function to the saggars was a group of six small extruded bricks KF199 from Trench 10. There were two types of these, both c. 75 mm long but forming slightly different types of construction when placed together. Four of the bricks were slightly curved and would have formed a circular structure and two were rectangular, slightly larger, forming a straight wall. All of them had a tongue projecting from one end and a corresponding groove on the other end. They had obviously been intended to key together to form a fairly tight and stable structure, but had no residue of clay wadding on the surfaces which would have been necessary to make the structure fully sealed and flame or flue gas tight. No absolute identification of their use can be offered at this stage. Although it seems likely that they must have acted as a temporary wall or supporting structure that could be built and dismantled at each kiln firing, possibly to retain the sand, which would have been used to support some of the pieces in higher temperature firings.

Thimbles

By far the most numerous of the individual items of kiln furniture were the 'thimbles' used for setting plates and other items of flatware. Hundreds of these were recovered, KF 72, KF73A, 73B from the kiln firebox in Trench 5 weighing 8.6 kg (Figure 40-2,-3). The thimbles all appeared to have been pressed by specialist makers of kiln furniture. Some bore a maker's mark 'G & Co.'

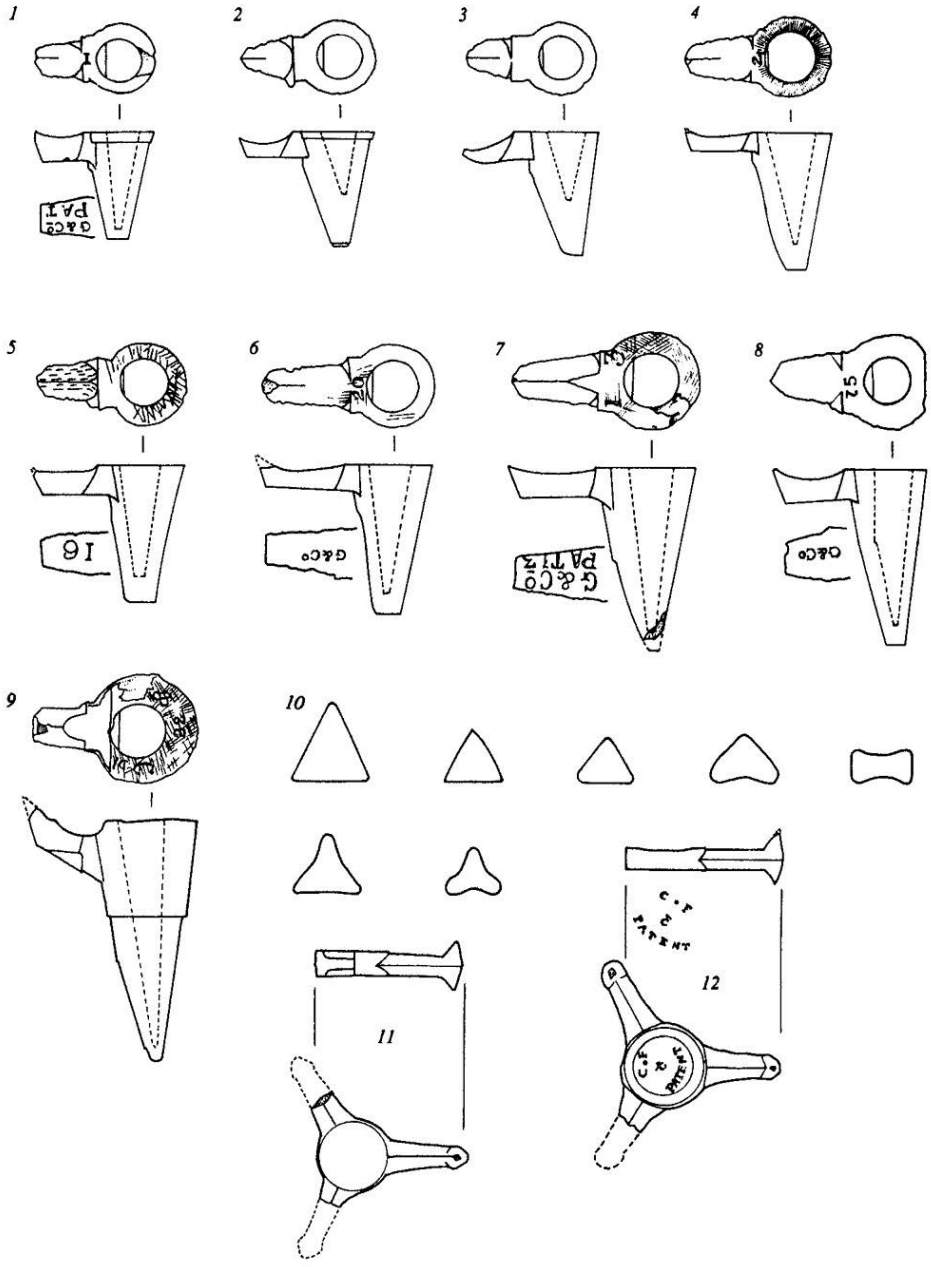

Figure 40: Kiln furniture 1: thimbles KF75, KF73A, KF72, KF77, KF70, KF78, KF74, KF79, KF83, saddles (10), and stilts KF132 and KF151.

KF71, 78-80 and KF74 also has 'PAT' included in the pressing (Figure 40-7). Most of the thimbles had size numbers on their surface, a '1' in the case of the smallest thimble KF75 (Figure 40-1), '2' on KF77 (Figure 40-4), '16' on KF70 (Figure 41-5) and a '22' on the largest KF83 (Figure 40-9). The numbers did not always follow a logical sequence, with a thimble stamped '13' KF74 being larger than '20' KF78 (Figure 40-6) or '25' KF79 (Figure 40-8). All of these examples are marked 'G & Co.'

The thimbles, which appeared most frequently, those from Trench 5, were actually a mixture of two slightly different types - one (type A, as represented in KF73A) being slightly longer than the other (33 mm as opposed to 31 mm) and from a different mould. The second type KF73B also had a ridge round the top edge (Figure 40-2). Both types fit interchangeably in stacking. The latter type is represented in finds from the pottery of William Baker in Fenton, Stoke-on-Trent, dated to the 1850s (City Museum Stoke-on-Trent, Ac. No. K22.1996.).

Very few of the thimbles had a pronounced coating of glaze and the vast majority appeared to be completely unglazed. Only two thimbles came from Trench 3 KF70, (Figure 40-5) and KF 71. Trench 8 had nine groups of thimbles, but all contained small numbers of oddly assorted sizes.

Saddles

These are short bars of triangular section used for setting glazed ware, and appeared fairly frequently (again, these were sampled for type). Some of these were very regular and consistent in manufacture, made from buff-coloured clay and had the appearance of having been made by a specialist manufacturer. Other examples had a variety of triangular or v-shaped cross sections, made from white firing clay, and were probably made in the factory itself by extruding the clay from a 'wad box', or extruder. These did not possess any terminal 'feet' at the end of the bars. The extruded v-shaped stilts, which did not appear to have terminal 'feet', may be explained by the fact that they are multi-purpose objects. The v-shaped stilts were all connected centrally by a piece of hand moulded clay. These items would most likely have been produced to a specific length, in order that they could be cut to size and tailored to the specific job required. They could also be used on their own as saddles (Figure 40-10).

Stilts

These are three legged supports for glazed ware, and appeared in various forms. Many of these had been fashioned fairly crudely by joining three of the v-shaped extrusions together so that they radiate out from a central point KF126 and KF129 (Figure 41-10, -8). These were made from the same white-firing clay as the saddles. Apart from the hand-made stilts, several different types of pressed stilts were represented, a few in undamaged condition. These had points on the ends of the arms, three facing up and three down. KF108, KF132 (Figure 40-11) and KF151 had the three arms radiating from a central disc with 'C.F. & PATENT' stamped on it (Figure 40-12). Among the more unusual examples were two tall stilts trimmed from Y-shaped extrusions KF109, KF201. These also had the appearance of having been made by a specialist manufacturer, although there are no marks on the surface other than an '8' pressed on the base of KF201 (Figure 41-7). Identical examples of both of these types of stilt have been recovered from mid-nineteenth century pottery sites of Podmore, Walker & Co. in Tunstall (City Museum Stoke-on-Trent. Ac. No. K3.1996), and Livesey, Powell & Co. and Pankhurst, Hanley (City Museum Stoke-on-Trent. Ac. No. K18.1996). It seems certain that they were manufactured in that area (David Barker, pers. comm.). It is possible to identify the manufacturers of these items with a reasonable degree of certainty (unpublished research by Rodney Hampson). The 'G & Co.' which appeared on many of the items seems very likely to be the mark of Gimpson & Co., a company, which is still well known as kiln furniture makers and who are listed as manufacturers of kiln furniture at Market St. Hanley, Stoke-on-Trent in the 1860s (Slater's Directory 1862). The 'C.F. Pat' is almost certain to be the trade mark of Charles Ford (at Palmer St. in Hanley in 1855) who was granted a patent for kiln furniture in on June 14th 1847, and appears in the Staffordshire Advertiser' of 23rd of June 1849, and pursuing a court action against Buller's, another kiln furniture maker, in July 1850. That the supply of kiln furniture was a competitive and presumably a lucrative business can be attested by the various court actions undertaken by manufacturers in this period.

A range of decoration was present, in the form of raised, angled pecks KF137A, B (Figure 41-5 and -6) or parallel pecks KF137D, E, F and KF139B (Figure 41-1, -2, -3 and -11). Others showed a star figure KF137C, KF139A (Figure 41-4, -9). These also contained size numbers, some KF137B (Figure 41-6) printed in reverse! Some of the smaller items seemed to be more typical of earlier practice. These were made from white firing clay and were mainly coated with a heavy layer of glaze. Although some of these items appeared to have been made by pressing, the majority had been formed by hand, sometimes in a fairly crude and hasty fashion. Among the finds of this type was a single example of a ring stilt KF140 (Figure 42-4). This comprised a ring of clay, probably made on a potter's wheel, with three small points added to the top surface in order to support a glazed piece of ware. Ring stilts of various types seem to have been widely used from the mid-eighteenth century until the 1820s (David Barker, pers. comm.), and this example

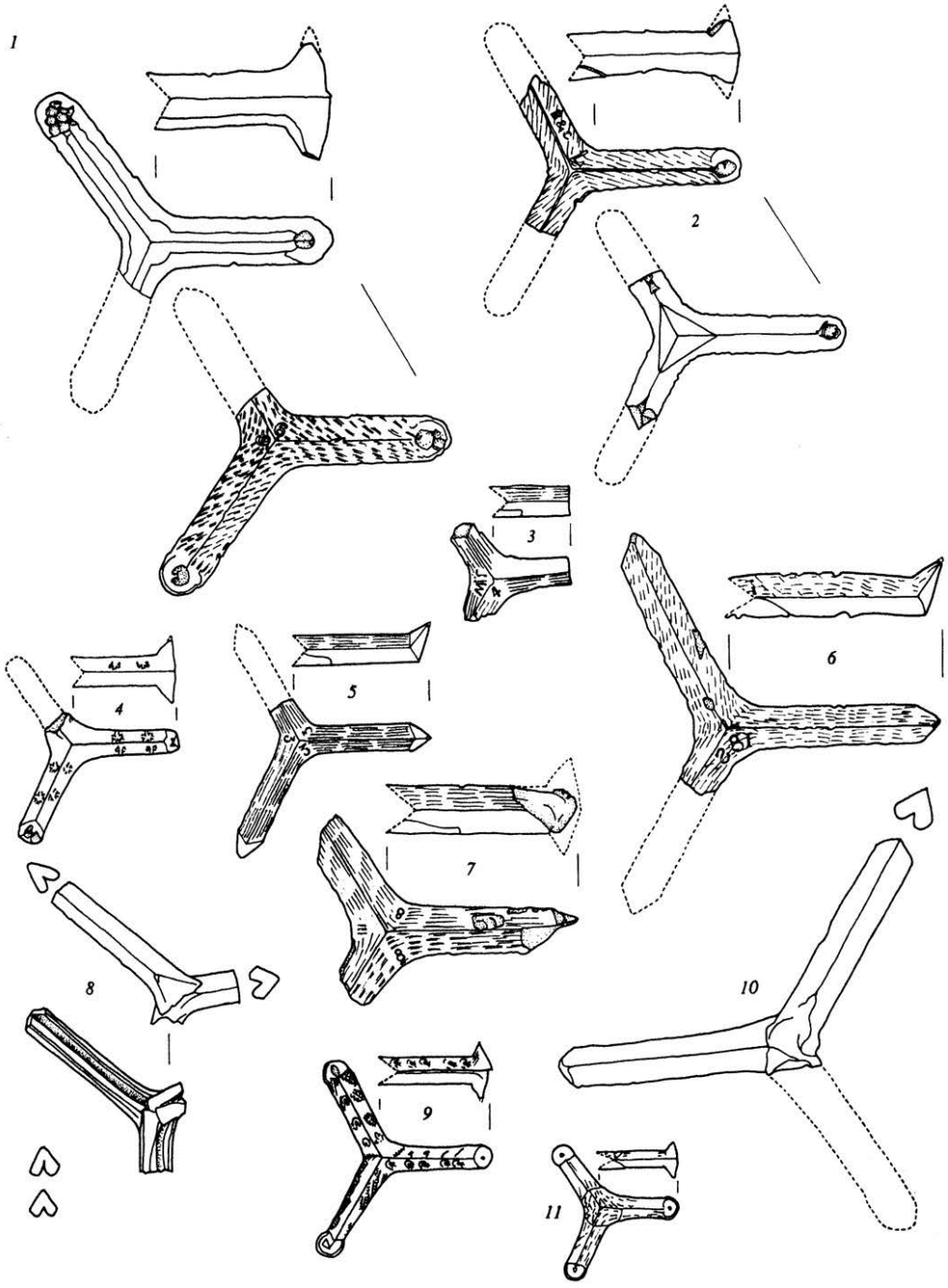

Figure 41: Kiln furniture 2: stilts: KF137D, E, F, KF137C, KF137A, B, KF129, KF201, KF139A, KF126 and KF139B.

may be from an early phase of the Bell's site. A fragment from the end of a hand-modelled stilt KF155 (Figure 42-2) also seemed to be typical of an earlier practice. A short length of clay KF136B (Figure 42-5), extruded with a diamond shaped cross-section and trimmed to a chisel shape at one end may also be a piece of kiln furniture, possibly a pin for supporting a glazed plate Both these items were made of the same white, heavily glazed clay as the ring stilt.

Spurs or 'Craw's Taes'

These are small, mostly pressed, tripod shaped supports for glazed ware which were present in fairly large numbers. A fairly small number were of the handmade 'cockspur' type common in earlier potteries, most of them being made from white coloured clay with a fairly heavy coat of glaze (Figure 43). The majority of the pressed spurs, however, was similar to types

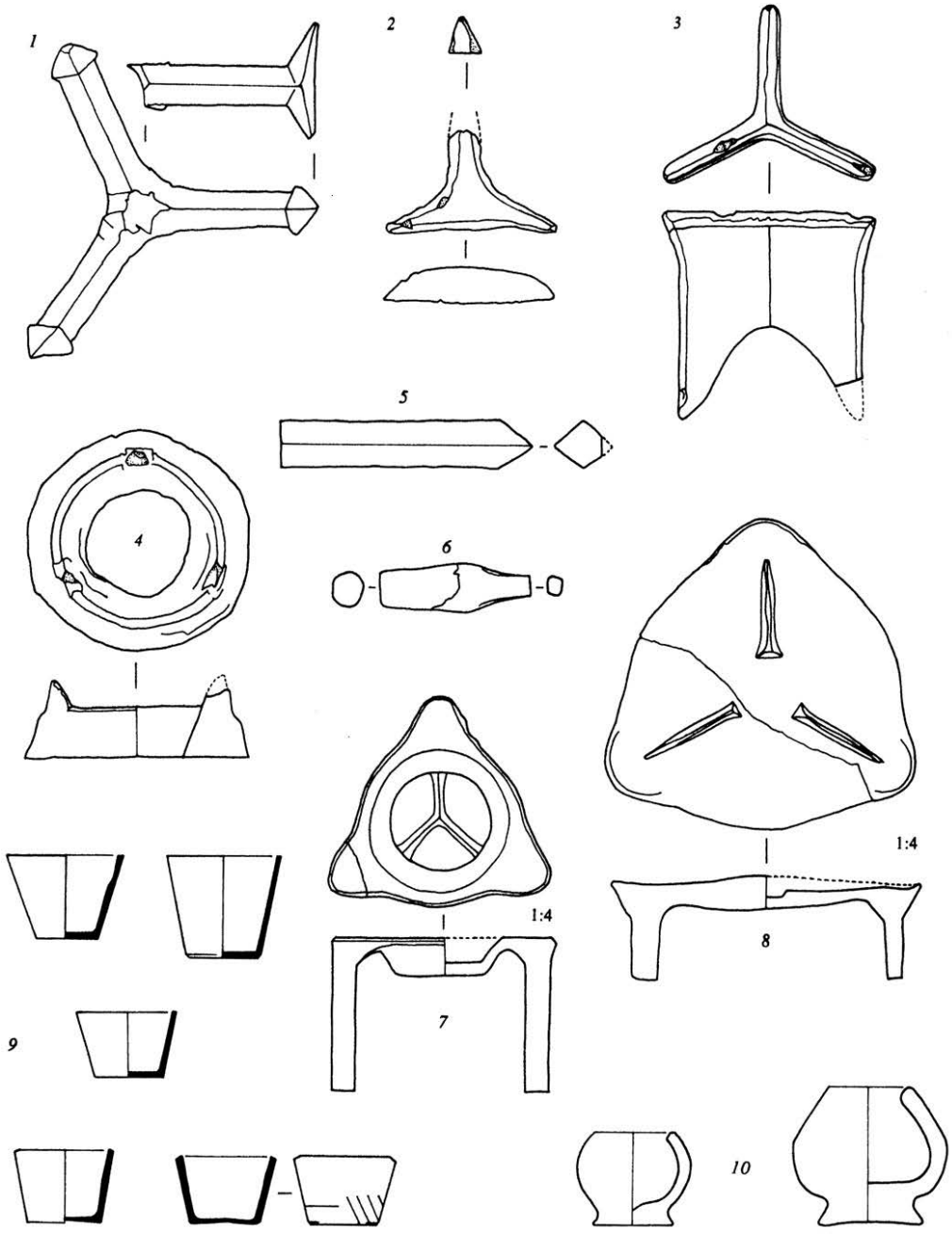

Figure 42: Kiln furniture 3: stilt? KF155, ?, ring stilt KF140, pins KF136B, KF133, chairs KF197, KF 182, tumblers KF169, miniature pots KF170.

still commonly in use today and will have been bought in from manufacturer (Figure 44). These were made from buff-coloured clay similar to the pressed stilts and saddles and had a variety of marks - usually size numbers - but several had the maker's mark 'C.F.' stamped on the underside. Identical examples to these spurs have also been found on sites in the Stoke-on-Trent area (Barker, in preparation), and at Coalport Chinaworks in Shropshire (Barker and Horton 1999, 49). Apart from those described above there were several small pieces of more ambiguous design.

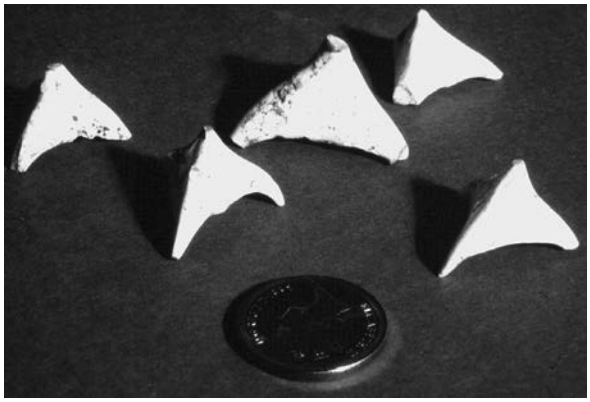

Figure 43: Craws taes examples.

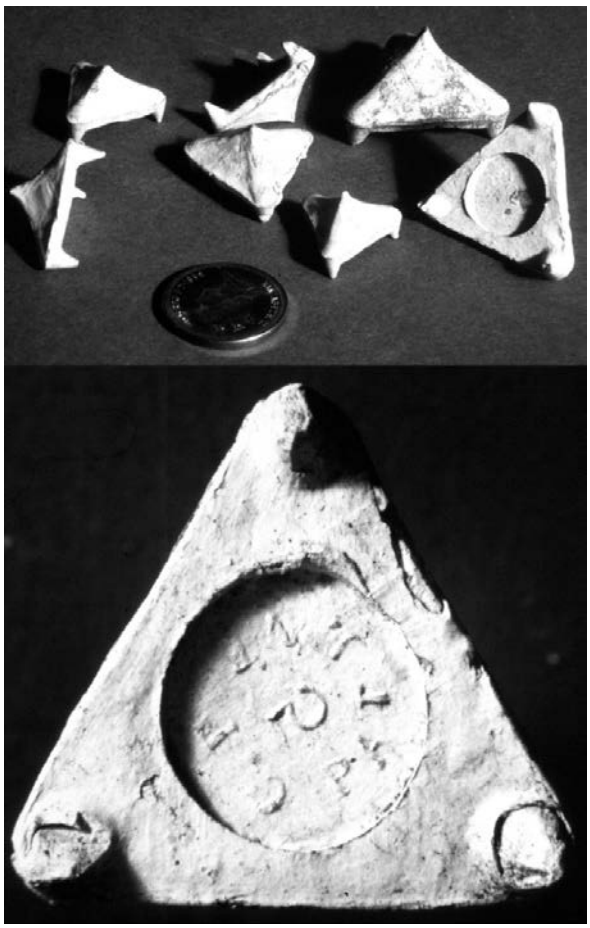

Figure 44: Spurs KF201.

Two T-shaped items of kiln furniture KF100 remain unidentified so far. These were unglazed and did not have the sharp edges or points, which were usually, present on supports for glazed ware. Other unidentified items included two fired clay pins KF133 (Figure 42-6), which had wide middle sections and tapers, one wider than the other, towards either end. These may possibly be pins, fitting into a saggar with holes pierced in its sides, and acting as a type of support for glazed plates, etc.

Chairs or Cranks

A type of support for glazed ware; these items were well represented among the finds with twenty-five individual pieces. However, they all came from one location, beneath the under-kiln arch (531) mixed in with the large pottery collection from that deposit. The chairs consisted of a saucer-like bowl with a triangular rim extending out to three rounded, evenly-spaced points KF182, KF197 (Figures 42-8, -7). A leg was attached to each of the points so that the chairs could be stacked in the kiln. In the centre of the dish were three radiating ridges to support the footring of the glazed pot, but to present as small a surface as possible for glaze to stick to (see City Museum Stoke-on-Trent. Ac. No. K3.1996).

Two sizes of chair were represented; a type which had a broad surface and short legs KF182 (Figure 42-8), probably intended for saucers; and a type which had a small surface but much taller legs, probably for cups KF197 (Figure 42-7). The former had sides which were approximately 180 mm long and were c. 70 mm tall, the latter c. 120 mm long. Their heights varied, presumably to accommodate different sizes of cup, and were 70 mm – 100 mm tall. Their centres were more deeply dished so that the cups could be placed to use the space more efficiently. Most of the chairs were glazed to some degree, in a variety of colours, and had the central area coated in kiln wash to prevent the ware from sticking to the surface. The glazes on the chairs, as on the saggars, may have been applied to prevent the porous surfaces absorbing too much of the glaze coating from the ware. The variety of colours may indicate that any leftover glazes were used for this purpose rather than a specific one. The points of the rim were also coated in kiln wash so that the chairs could be stacked in the kiln and

one of the better preserved of the small chairs KF196 still had wads of clay attached to the feet. This was probably the usual practice when the chairs were stacked in a kiln, the raw clay helping to stabilise the stack during the loading of the ware and the fireclay wads remaining soft enough after the glaze firing to enable the stack to be knocked apart easily.

The fabric of the chairs varied. Most were made of fairly fine fireclay type of body but some were coarser and others a more reddish colour. A few of the chairs were unglazed, which may mean that they were used in biscuit or enamel firings or that they were damaged and discarded before being used. They appeared to be from two standard moulds and were probably made in the factory itself using any suitable material that was available at the time. The legs had been extruded and could be varied in length to give a range of heights for different sizes of ware.

Other items of kiln furniture

Among the finds of kiln furniture there were several curious items which were more difficult to identify. A group of miniature pots KF170 were composed of a number of sherds or broken pieces of small thrown pots, all very similar in shape but of slightly different sizes (Figure 42-10). These had all been made fairly quickly, without much attention being paid to trimming or finishing to the standard which would have been required of a piece of production ware. All of the pieces had a clear glaze applied in a fairly haphazard fashion, some with added areas of copper green. The surfaces were heavily crazed or crackled, and the fabric of the pots was fairly coarse. These were most likely test pieces, testing either glaze quality or the progress of the firing itself. They bear a striking resemblance to some fragments of small red earthenware pieces found at the excavation of the eighteenth century Greatbatch Pottery in Fenton, Stoke-on-Trent (Barker 1990), from all three phases of the Greatbatch Pottery (City Museum Stoke-on-Trent. Ac. Nos. K1, K2, K3. 1984). Although the pieces from Bell's were from a much later period they may indicate some continuity in practice.

The second group KF169 was a group of five small, tapered, tumbler-shaped pieces, made from white firing clay (Figure 42-9). They all had a thin, regular wall section, which probably indicates that they were slip cast. Most of these were unbroken and of a variety of sizes, the tallest being 28 mm and the smallest 18 mm high. Four of the pieces had been biscuit fired, one had been glaze fired and one had a powdery surface, which may be unfired glaze. Several series of deliberate score or tally marks were visible on the surfaces of two of the pieces, which may indicate that these were also made as tests of some description.

Another curious find was a group of sherds which had come from a rather crudely made rectangular vessel KF200, 227 mm long by 90 mm wide by 65 mm high (Figure 45-4). This vessel, which had been hand-built rather than made in a mould, was made of fairly refined, grey-coloured clay covered in a greenish glaze. Six evenly spaced divisions had been built into the piece. It is too crude to have been a piece of ware, but no further explanation can be offered. Finally, a series of button shaped fired clay pieces KF162 of various sizes were present in the demolition layer of Trench 3 (Figure 45-1). Again it is uncertain as to their purpose.

Discussion of the kiln furniture

One of the conspicuous gaps in the list of finds was any item, which could be identified positively as a device for measuring temperature. In the nineteenth century a number of systems for measuring the heat applied to pottery were developed. These used either the shrinkage in clay materials when heated to high temperatures or the deformation of various ceramic materials when they begin to melt, as a basis for a standardised 'pyroscope' or visual system of measuring the effects of heat in the kiln. The latter type, e.g. the Seger Cones developed in the 1880s, are designed to be observed through spy-holes in the kiln wall during the firing, allowing its progress to be monitored by watching a series of conical ceramic pieces deform in turn as the temperature inside the chamber rises. The former type of test, standardised as Buller's Rings in the 1900s, are retrieved with a hook from inside the kiln and as the temperature increases the increasing shrinkage of the test rings can be measured against a standard scale. In addition to

these more sophisticated systems many potters make use of 'draw trials', rings of clay which can be hooked out of the kiln in the latter stages of firing to see the progress of the colour and glaze quality. The normal practice in the Staffordshire potteries in later times was to use a series of thick clay rings which could be drawn from the kiln easily with a metal hook (R Copeland, pers. comm.) and it is likely that some similar system was used in the nineteenth century. Any of these test pieces would normally be used in some quantity and could be expected to be a common find on a kiln site so it must be assumed that much of the temperature measurement was done by experience and by judging the heat of the kiln by eye. The small pots KF170, which appear to be test pieces, may have been drawn from the kiln with tongs in the course of the firing to see the progress of the glaze melt. The usual practice in this case would probably be to quench the red-hot piece in water to see the results, and this may explain why these pieces have all been broken, in spite of being quite small and sturdy in form. It seems unlikely that these small pots represent the usual method of judging temperature, since the numbers found were fairly small.

The kiln furniture finds appear to be from several phases in the life of the pottery and are remarkable in that while some of the small items show strong similarities to those from earlier sites, a great many are much more modern in appearance. In particular the ring stilt and the cockspurs are very similar to those from the Greatbatch Pottery (Barker 1990) and the Coalport Chinaworks (Barker 1999, 60), in existence at least 70 years and 45 years respectively, before Bell's. The stilts and spurs, which appear to have been made by specialist manufacturers, are very similar - sometimes indistinguishable - from those still used in the pottery industry today. In general, the kiln furniture, which appears to be more recent, is also less heavily coated in glaze and it may be that less volatile glazes were being used in the later period.

It appears that the period represented by the finds may be one in which the pace of growth of the industry, and the emergence of specialist suppliers within it, had led to a greater conformity in practice. This came as a result of some of the more successful innovations of the previous century. The overall impression from the finds is of a very different industry, in scale and

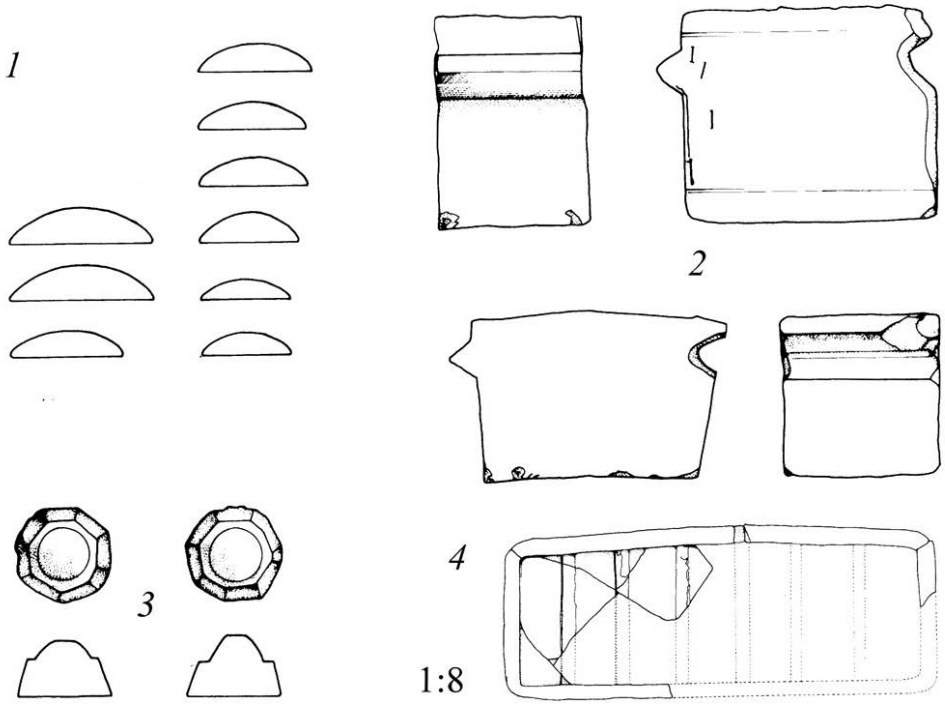

Figure 46: Kiln furniture 4: buttons KF162, bricks KF199, natches KF 166, and box KF 200.

character, from that represented by earlier sites. The finds of kiln furniture from the eighteenth and early nineteenth century give an impression of self-sufficient workshops experimenting and perfecting on a fairly small scale. While the quantity and consistency of the majority of the finds from Bell's gives an impression of a well-tried system applied on a large scale. Many of the tasks of innovation may have been passed on in this period from the individual potteries to the growing ancillary industry supplying materials to the potteries. There are, for example, many thimbles from Bell's but none of the various plate stacking systems made and used in the smaller potteries of earlier periods. It seems likely that while Bell's employed several hundred people in the making of the ware itself; the proportion employed in ancillary tasks such as kiln furniture-making may have been much smaller than in earlier potteries. That Bell's used the same types of stilts, spurs, thimbles, etc., as the potteries in Stoke-on-Trent may be significant as it indicates the increasing focus of the industry in Stoke. Although Bell's was clearly not too tardy in adopting innovative practices where they could, the centralisation of the supporting industries and the consequent advantage to those manufacturers located closer to the centre must inevitably have made potteries situated further from the sources of materials and services peripheral in a way which was unknown in earlier times. While the potteries of the eighteenth and early nineteenth centuries had been largely self-sufficient and had made most of their own kiln furniture as required, the practice in later times was clearly to buy in these items ready-made. Although this was obviously a much more cost-effective system it seems likely to have fostered conformity of practice. This was probably not significant in the specific area of kiln furniture, but became more significant when applied to more of the services, which individual factories employed - with glazes, clays, decorating colours, etc. all being supplied by specialist manufacturers rather than made in the potteries themselves. This made technical innovation within individual potteries a more exceptional phenomenon.

The glass

By Michael Vaughan

Glass remains were all recovered from the uppermost levelling layers associated with the laying of the concrete factory floor of Kelvin-Bergius & Co., which succeeded the pottery site.

Types ranged from ordinary window glass to a pressed glass sheet. Each of the bagged lots was catalogued by context and probable use. The objects collectively are consistent with those from a demolished site of general offices or hospitality site given the presence of wine glasses, decanters, wine bottles, pen holders, vases, etc.

The bright, gaudy coloured pieces ranged from bright orange to red, cased with clear glass with cobalt blue trailing and were particularly impressive. Their bright palette is typical of glass of the Art Deco Era. Probably of continental origin, this type of ware was produced by such firms as Schneider Frieres & Wolf and found a trendy market in this country amongst lovers of the new style (Cooke 1986; Klain and Lloyd 1984). It has been suggested that these gamely specimens, as well as simply being decorative, could also have been used as colour pallets for the various colour types employed in the pottery manufacturing side of the business.

There is no evidence to suggest that glass was being manufactured on site. The bulk of the coloured glass fragments can be dated 1910-1920, placing them firmly within the Warehouse period of operations of the Company, with the rare example dating to the beginnings of the enterprise.

Scientific examination of the wares, kiln furniture and industrial waste

By Effie Photos-Jones

Introduction and methodology

The application of scientific techniques in the study of pottery is aimed at establishing the chemical and mineralogical composition of materials to elucidate questions relating to industrial processes, their products and waste. Very little is known from archaeological evidence about materials used in the numerous nineteenth century potteries in Scotland, therefore any relevant information is extremely valuable in setting the industry in its proper context rather than by extrapolating information from industries in England.

Three different methods of analyses were undertaken on three different types of materials, Bell's wares, kiln furniture and industrial waste. Although the report set out to discuss all three types in detail, limitations of space and the need for further work have restricted the discussion primarily to Bell's wares. The scientific techniques included:

a) Petrographic examination of thin sections.

b) X-Ray diffraction analysis (XRD) aimed at providing mineralogical information of the non-glassy phases. The results of all three techniques are meant to complement each other in the better characterisation of the materials.

c) Scanning electron microscope examination combined with energy dispersive analysis (SEM-EDAX) of polished blocks and freshly fractured surfaces aimed at providing quantitative and semi-quantitative chemical analysis respectively as well as surface morphology.

Petrographic examination was carried out with the polarising microscope viewing in plane polarised light and with cross polars at x100 magnification. The following features were investigated: the presence of glaze, the nature of the fabric - isotropic/anisotropic - presence of voids, and the identity, shape and size of the mineral inclusions. Essentially, quartz and to a lesser extent feldspar constitute the main mineral inclusions. As the results below show, the former, derived from calcined flint, is crucial, in the sense that its different attributes - shape, size and form - are potentially diagnostic or informative about technology and materials.

Little work has previously been done using the petrographic microscope on relatively modern high-fired pottery. The reasons are simple: the high-fired pastes are usually fine-grained and moreover the reactions taking place within the paste give rise to the porcelain or related ware are such that some level of vitrification will have occurred. In turn, this means that the groundmass will exhibit a corresponding level of alteration, from anisotropic to fully vitreous, that is isotropic. It may be predicted therefore that the content of the petrographic examination of such pottery may be limited. On the other hand, the situation should be different when examining the lower fired and/or coarser fabrics such as the earthenware and kiln furniture. Here there is much more to go on.

X-ray Diffraction was undertaken only when the mineralogical composition of specific materials/ ingredients needed to be resolved. The technique involves crushing of the sample and is informative only for crystalline, non-glassy materials.

The scanning electron microscope is by far the most informative technique in characterizing pottery. SEM examination and analysis of a polished block or thin section of a ceramic ware is a very powerful technique in providing quantitative information of individual mineralogical phases whether glassy or crystalline within the fabric or glaze of the pottery. Area analyses over the whole polished section can be considered as equivalent of bulk chemical analysis given the fine nature of most Bell's Pottery wares. This provides a rough idea of the chemical composition of the raw materials. SEM-EDAX analysis of freshly fractured surfaces is a means of acquiring relatively quickly information relating to surface features both from the point of view of texture and composition. Surface features include degree of vitrification/sintering, surface decoration, pigment identification etc. However the analysis of a freshly fractured surface can only be considered semi-quantitative.

The analytical investigation of the wares

This section presents the analytical data for twenty-six samples of Bell's wares (and other contexts) examined in the course of this study. The materials are divided in the typological groups outlined below as established by Henry Kelly. This classification has been kept throughout the text, in order to ensure continuity of discussion, even though analytical evidence may not always corroborate the given typology.

Porcelain: HK1, HK3, HK4, HK5, HK6, HK7, HK11, HK13, and HK16.

Parian wares: HK10, HK12, HK14, and HK20.

Granitewares: HK2, HK15.

Earthenwares: HK8, HK9, HK17, HK18, HK19, HK21, HK22, HK23, HK24, HK26, and HK27.

Discussion of the wares

The technical characterisation of the Bells' Pottery wares represents a preliminary attempt at establishing the range of compositions of the different wares, the relative temperatures they were fired at and methods and materials of their underglaze decoration. The present work is seen as preliminary only. It concerns characteristic examples rather than a detailed overview of the material and techniques available to Bell's and focuses primarily on the earthenwares.

A select number of samples is discussed here. These include the following:

1. HK11 (S21), a semi-porcelain saucer sherd with Broseley designs.
2. HK14 (J2), an unusual sherd of an unglazed jug classified as Parian with slip (?).
3. HK16, a cup sherd of glazed porcelain with sprig decoration (from Loudoun Hall, Ayr: Speller 1997 - thought to have been produced at Bell's).
4. HK18, a sherd from a blue transfer printed glazed bowl.
5. HK19, a multicoloured glazed earthenware sherd.
6. HK22, a sherd of an unglazed earthenware bowl with unfixed blue transfer.
7. HK23, a sherd from a sanitary earthenware piece with a gold strip.
8. HK26, a sherd from a plate with mulberry transfer (H Kelly private collection).

Fabric and glaze morphology

Three types of fabrics can be seen in SEM photographs, the highly vitrified bone china HK14 (Figure 46-1), the vitrified porcelain body with glaze HK19 and the unglazed biscuit low fired earthenware HK22 (Figure 46-3). Compared to HK14, HK22 appears merely sintered, i.e. not fired at high temperatures. Biscuit firing temperature is normally above that for glost firing. Yet the fabric of HK22 shows only sintering. It is possible that the ware was not fired prior to the application of the underglaze decoration or the biscuit firing took place at a lower temperature than 1100 degrees centigrade. For HK19 (Figure 46-2), a glazed earthenware, moderate vitrification is obvious.

On the basis of the evaluation of these SEM photographs it is suggested that the last or glost firing of these fabrics must have been at a higher temperature than the biscuit firing. This assumption can only be true if the composition of all three samples is the same. The data available here is not sufficient to draw conclusions and further work on the morphology of these wares as a function of their composition and firing temperature is needed.

Composition of fabrics and glazes can be seen in (Table 1 in the site archive). HK14 fabric contains considerable amounts of calcium and potassium suggesting the addition of bone ash but also silica and alumina, pointing to the original material being a slip. HK22 is an unglazed earthenware with c. 50% SiO2 and 20% Al2O3 with small amounts of calcium (4% CaO), the rest being the cobalt from the pigment used in the transfer printing.

Glaze surface texture can be seen in SEM photographs. Hairline 'cracks' on the surface are intermixed with inclusions and surface irregularities. Crackling occurs as a result of differential adherence between glaze and fabric. HK11 (Figure 46-4) and HK18 (Figure 46-5,-6) both are glazed with cobalt-rich underglaze decoration. Lead and (cobalt) contents are variable with

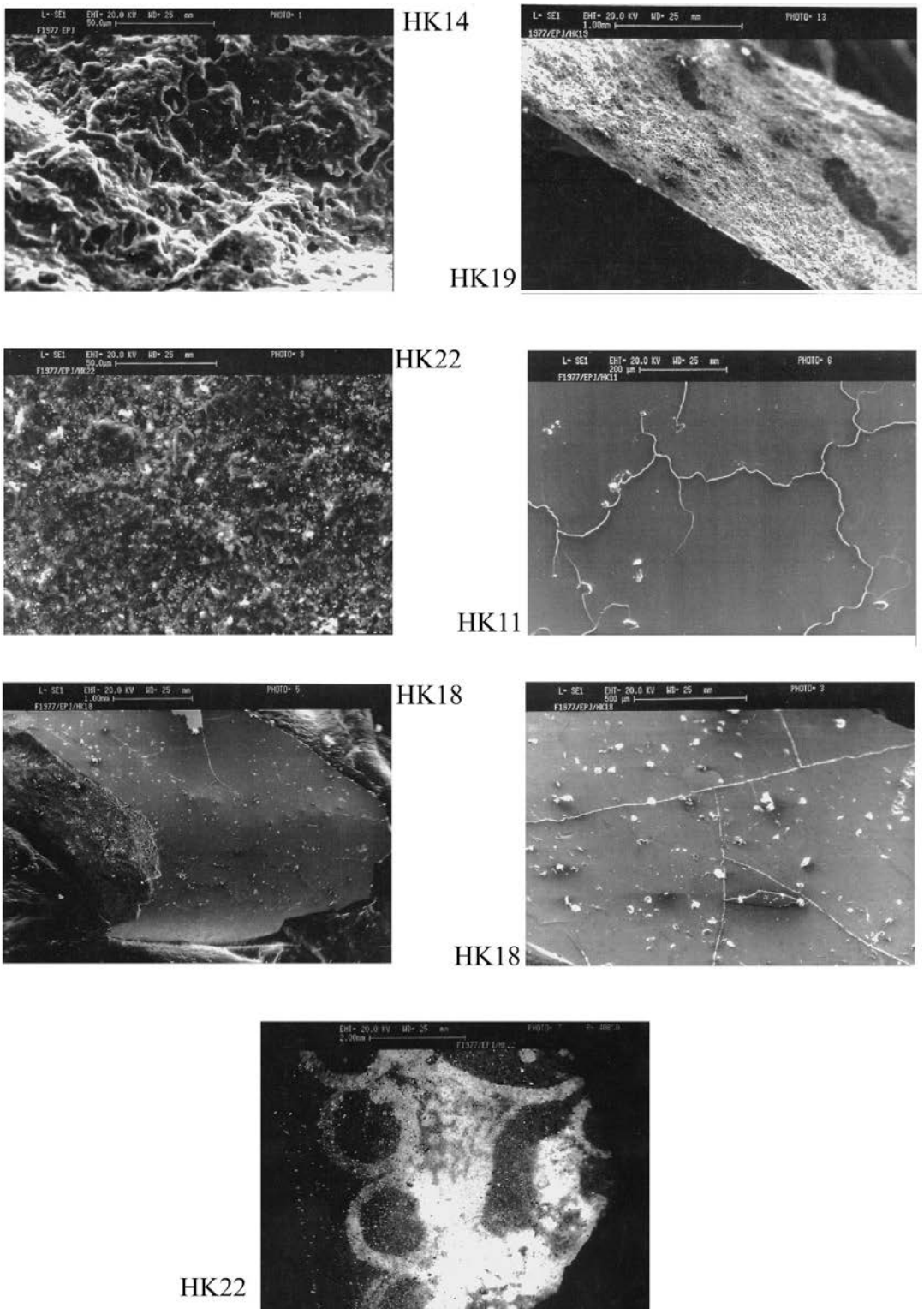

Figure 46: SEM 1.

semi-quantitative analysis and depending on the spot on which analysis was taken, (PbO varies between 10 and 17% PbO and cobalt ranges between 0.5% CoO and 2.5%). The variation of lead oxide per point analysis suggests that the pigment is not evenly distributed throughout the glaze or in other words not adequately mixed. Glazes originating from a frit are not thought to have been used at Bell's (B Brown, pers. comm.).

In HK14, less than 1% cobalt (as oxide) is sufficient to give the body its characteristic warm purple blue colour. In HK22 (Figure 46-7), the high cobalt concentration derives from the pigment, presumably CoO, although the presence of lead is rather puzzling.

Phase analyses in porcelain and other fabrics and glazes

Most of the sections analysed with the SEM were those of earthenwares. Only one porcelain sample was examined HK16. Closer examination of the body of the porcelain can be seen in SEM photograph HK16.9 (Figure 47-1). The following mineralogical phases have been analysed and labelled: DK1 (dark grey) is a partially reacted silica grain, GR1 and GR2 are calcium alumina silicates with some phosphorus, LT1 and LT2 are bone ash inclusions. Most of the inclusions have lost their angularity as a result of reaction with the surrounding matrix at high temperature. The HK16 matrix photo HK16.9 should be compared with that of earthenwares HK23 photo HK23.6 (Figure 47-3), HK24 photo HK24.3 (Figure 47-4) and HK26 (not illustrated). HK26 originates from a different context than Bell's and is presented here for the purpose of comparing Bell's earthenware with other that from other potteries. On the basis of the SEM photographs it can be deduced that the matrix of the earthenwares is more 'open' i.e. showing sintering with high porosity in between the different grains which remain for the most part angular.

Table 2 (in the site archive) shows bulk chemical composition for a number of earthenwares. They are high in silica with small amounts of potassium (c. 2%) and little else. Iron is present in trace amounts. The amount of potassium is slightly high (c. less than 1%) for some samples only suggesting the addition of small amounts of bone ash. On the other hand the glaze composition is different in the amount of potassium, sodium and calcium present. Lead content (for PbO read SO3, Table 2) is not substantial suggesting either the use of frit or excessive losses due to glost firing.

The thickness of the glaze in the three samples HK16, HK23 and HK26 is also discussed. The thickness of the glaze is a critical factor in its appearance after firing. If it is thin it will fail; if

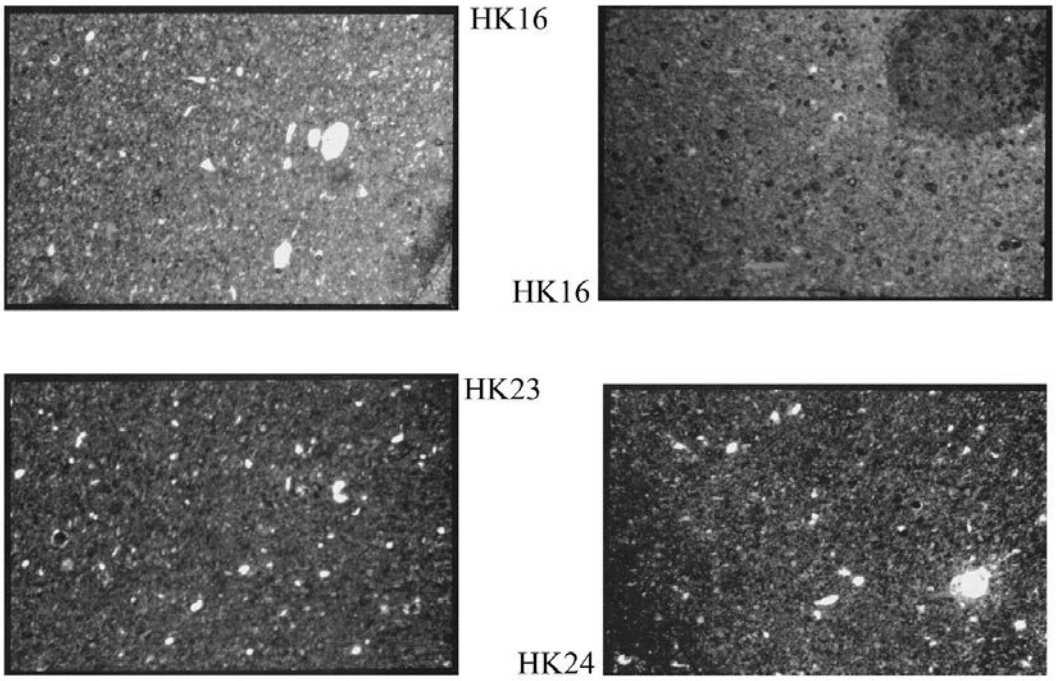

Figure 47: SEM2.

it is thick it can peel, or craze. In Bell's porcelain, glaze thickness is c. 50-100 microns. Lead glaze penetrates deep into the fabric and fuses well with it (see HK16, Figure 46-2). It consists of grains of lead oxide in a silicate matrix. This will make it a frit rather than a litharge based glaze proper where the composition of the lead oxide is expected to be closer to 60% (Fournier 1992). Glaze thickness in earthenwares HK23 and HK26 is also less than 100 microns. A thin reaction zone is evident between fabric and glaze, with the glaze perhaps not penetrating as deeply as in the case of porcelain.

Underglaze decoration

Biscuit wares with underglaze decoration range in colour from dark blue to ink black and black. Perhaps this range of colour is suggestive of the fact that the wares indeed have been fired. The pigment cannot then be scratched off since it has been fully absorbed by the body of the ware. Bell's wares were transfer-printed, as it is known from the numerous patents taken out for the Prints (Cruickshank 1987). An oil-based medium must have been applied which was then removed between the biscuit and glost firing.

Transfer printed sherd HK22 is outlined in cobalt, mixed with lead and silica. HK21 and HK22 are both blue transfer-printed and must have been air dried since the pigment is coming off. It is interesting to note that the air-dried technique of applying the transfer is used primarily for earthenwares. On the contrary HK5 and HK13, porcelain and a semi-porcelain respectively, have oil-based transfers since the pigment is well absorbed within the body.

Petrographic examination: Porcelain, Parian and Granite wares.

Macroscopically, their fabrics resemble each other, yet microscopically there are some potentially interesting differences. First of all, there is the issue of petrographic uniformity of each ware. The examples of porcelain are *not* uniform in that the size and shape of the quartz vary. The majority contains a scatter of small quartz grains but the remainder is somewhat different.

Parian

A feature here is the frequency of the quartz with incomplete, unusual extinction. This is interpreted as quartz, which has reached a higher temperature than the porcelain - this would tie in with the marble-like vitreous appearance of the paste.

Granite

This ware, albeit with only two specimens examined, appears different from the others by virtue of the greater density of small quartz grains. This is perhaps a reflection of its different recipe.

Earthenware

This is a difficult group. Many samples in the group are porcelain-like, while others are clearly earthenware, with anisotropic fabric. The nature and quantity of quartz is variable overall so it is difficult to see trends.

The violet 'tendril' jug

HK14 (J2) is an unusual piece (Figure 28). The object appears to have been slip cast. A cobalt rich slip was prepared and poured into a mould, excess poured out and the slip was then allowed to harden before a second batch of unpigmented slip was applied in the same mould. Moulded clay decoration (in white clay) was applied onto the surface of the pot before it was fired. As with all Parian wares, no glaze was applied. Most of the cast objects at Bell's are thought to have been prepared with clay in its plastic state, applied onto a mould, rather than slip cast (B Brown, pers. comm.). In that respect HK14 is exceptional.

Discussion of kiln furniture and industrial waste

Kiln Furniture

For the purposes of this report, discussion on kiln furniture is kept to a minimum. However, these materials merit individual attention and in many respects they represent a topic in their own right. Roughly they would be classified as coarse wares, with c. 55% SiO2 and 35% Al2O3. They

contain minor quantities of iron and potassium and coarse inclusions, some of them within the glaze itself as shown in saggar fragment BB10. Since kiln furniture is presumed to have been made both locally and imported for the specific purpose intended, variations in composition can be expected.

Industrial waste

Industrial waste can be difficult to characterize because it usually consists of materials of different compositions, which have fused together by the mere chance of lying intentionally or unintentionally close to each other. If, as a result of heating, vitrification is complete, then the composition of the new material is usually homogeneous, but this is not always the case. In analysing a composite material different areas may be derived from different materials and thus the reported composition does not reflect the entire sample but only the area of the sample under investigation. Partly fused industrial waste normally requires the need for detailed investigation, which is often beyond the scope of an archaeological materials characterisation.

A small number of samples of industrial waste deriving from different contexts at Bell's have been examined and characterized. In addition, demolition and non-demolition levels have been examined and the waste material characterised in a general way.

The samples analysed were divided into the following groups:

a) Iron slag from blast furnace/foundries BPOT4 and BPOT6.

b) Glass wasters BPOT5 and BPOT11.

c) Frothy black and relative light material BPO7, BPOT8, derived from any high temperature process.

d) Partly molten firebricks and saggars BPOT9 and BPOT12.

e) Compact earths BPOT2 and BPOT3 of different origin as well as coal at different stages of heating BPOT12.

Groups a) and b) have clearly been brought from the outside to act as fillers in the demolition layer but the majority of the industrial waste material appears local, as would be expected. This industrial waste represents the product of the reaction of the coal with firebricks from the kiln fireboxes. Although normally essential in the characterisation of the processes on a site, the Bell's industrial waste takes secondary place to the other types of waste revealed on site, namely the pottery wasters and kiln furniture discussed in previous sections.

Questions raised

As in the case of all vitreous materials, firing at high temperatures destroys the mineralogy and therefore the ability to identify directly the raw materials used. To that has to be added losses in the course of firing. Composition of the Bell's glazes shows the use of PbO. However, the amounts recorded are rather small, ranging from 5-10% (occasionally higher c. 20%) and do not account for PbO having been used as a base (Fournier 1992 reports 60% PbO). Is it merely a case of PbO loss during firing?

Petrographic examination is not a very informative technique given the isotropic ground mass of the fabric. There is little evidence of feldspar in the samples taken. However, there are definitely areas with high Al and Na in SEM spot analyses, which are presumably feldspar, or possibly mullite or some other high-temperature al-silicate. The dark round stains visible on some of the sections are possibly fly ash?

Although petrographic examination of porcelain may not be very informative, the thin sections prepared can and have been used for SEM analyses and can reveal more phase-related morphology and composition. Is there a real compositional difference between Bell's porcelains and earthenwares or is it simply a matter of firing temperature?

Comment on the scientific analysis

By Bill Brown

The scientific analyses have provided some extremely valuable and useful results. Photos-Jones questions some of our assumptions concerning the working practices of the pottery industry during the nineteenth century and it is important that this work should proceed further in the future, to a stage where it can be deemed to be more conclusive. More 'standards' are needed to put the work from Bell's into context. The next logical research step would be to perform comparative studies with materials from other contemporary British and European sites. This type of study would eventually form a baseline framework, a springboard for future scientific study of nineteenth century pottery manufacture techniques.

On a more specific note, Parian ware is worthy of a separate comparative study. This is an important class of wares in the development of the industrialised production process. Although Parian ware has been widely studied by art historians, it has never been examined on a scientific and technical basis. This process was at the forefront of technical development in the mid-nineteenth century and any insights gained would be relevant to the industry as a whole.

In the absence of a secure potting clay sample from the site, the slip sample from drain (108) in Trench 1 becomes a valuable sample. Bulk chemical analysis of the slip should supply information concerning the raw composition of the clay used, which will help in establishing the geographical source of the clays used by Bell's.

The glaze analysis shows lead inclusion figures of 5-10% with occasional peaks to 20%. This is well below the expected content and very puzzling. A lead loss of 30-40% is difficult to account for even in the case of litharge-based (lead monoxide) glazes and highly unlikely in the case of fritted lead glazes. Many of our assumptions about nineteenth century pottery manufacture presume that raw lead was used. Further analysis may resolve this apparent ambiguity.

The bonding agents from Bell's Pottery

By Naomi Crawley

Mortar and clay samples

Six samples of mortar were collected from the features in Trenches 3, 4 and 8 and five samples of clay were collected from the features in Trenches 1, 4 and 7. These were all initially examined using a binocular microscope, at a magnification of x20, to identify the different types present. Four representative mortar samples were selected for further analysis by removal of the lime-based fraction. This involves dissolving a cleaned, dried and weighed sample in 20% hydrochloric acid to remove the lime binder. The percentage of lime to aggregate can be calculated and the size distribution and geological nature of the aggregate determined. The results provide a detailed archive of the mortars, allowing comparison between different mortars and characterising the types of mortar and clay mixes used in different parts of the site.

The analysis has characterised the mortar and clays from different but representative parts of the site. The mortar used in the kiln structure in Trench 4 conforms to classic refractory mortar mixture containing crushed fired and raw refractory clay. The reason for the different red and blue-grey coloured clay mortars used to bond the bricks of the oven floor is unclear. The mortar from the kiln in Trench 3 contained cement and so is a late repair in the life of the kiln. The mortar used in the flue in Trench 8 was a poorly bound soft mortar with no refractory nature.

Bricks

A total of 34 brick samples were collected from eighteen contexts within the kilns and associated structures in Trenches 3, 4 and 8. This data was correlated with the site stratigraphic sequence. The majority of the bricks were refractory types. All were machine pressed and most of standard sizes (225-242 mm long, 107-120 mm wide and 58-88 mm thick), although there were some examples of 'specials' such as plinth, voussoir shaped, narrow bricks and wide, flat bricks with grooved edges. Many of

the examples were stamped with the name of the brickworks where they were made, such as 'GLENBOIG' or 'GARNKIRK', which were based in Lanarkshire. These were two of the largest producers of firebricks in Central Scotland during the nineteenth century (Douglas and Oglethorpe 1993; Douglas *et al.* 1985).

Refractory bricks

These were of a hard cream to yellow coloured fabric with visible dark red to black iron oxide inclusions. They were made from fireclay, which contains 28% to 43%, alumina and is low in alkali fluxes. This occurs naturally in the Carboniferous Millstone Grit series in the Midlands of Scotland and was frequently mined with coal, especially in open cast operations. Bricks made from this fireclay were capable of withstanding and containing intense heat and stress and so were used in many industrial processes; hence their use in the construction of the pottery kilns on this site.

Standard sized bricks

These bricks were mostly machine pressed with smooth faces and sharp corners and edges. One example, stamped with 'FM & CO HEATHFIELD', was hand-moulded and did not have such sharp edges. A number had a thumb print added to the surface. This was the brickworks attempt to make the bricks appear hand-moulded as it was thought that hand-moulded bricks were of a higher quality than machine pressed ones.

Special shapes

The assemblage also contained a number of special-shaped hand-moulded bricks including:

- three half width bricks measuring 235 mm by 73-80 mm by 50-76 mm.
- one plinth brick; three arch (or voussoir) bricks.
- three flat bricks, one measuring 460 mm by 227 mm by 53 mm.

These were made for a variety of uses such as in arches and flues.

Manufacturers marks

Many of the bricks were stamped with the name of the brickworks where they were made. Where possible, the works have been identified and dated. All the brickworks supplying the bricks for the pottery structures were in Lanarkshire, which dominated the industry. For example, Garnkirk was by 1850 one of the most important firebrick companies in Scotland and by 1882 the Glenboig Union Fireclay Company had become the largest. The 'FM & Co HEATHFIELD' stamp is the only stamp that can be closely dated as it is known that Ferguson Miller & Co owned the company from 1835-1863. The other stamps are dated to the known production dates of the works. However, it is likely that the machine pressed bricks date from the last two decades of the nineteenth century when this technique of manufacture was standard.

Non-refractory bricks

There were four examples of non-refractory brick collected from the site. These were all in a hard, fine, red-coloured fabric containing moderate quartz and dark red iron oxide inclusions. These were made from clay that came from the same Carboniferous geological series as the fireclay. The bricks are all standard size.

Discussion

Trench 3: North-West Kiln complex

This circular bottle kiln base was constructed mainly with refractory bricks. Basal brick layer (317) consisted of non-refractory bricks. The brick layer (313) above this contained refractory bricks including a half width brick stamped with 'STARWORKS GLENBOIG' and a standard size brick stamped with 'GARTCRAIG PATENT GLASGOW'. This stamp also occurs on bricks from (309 and 321), repairs to the brick apron. The Glenboig Star Fireclay Works and Gartcraig Works, which manufactured these bricks, were operating from 1873 and 1876 respectively, dating the repair of the kiln to after this date. The rebuilding of the upper ash pit sidewall (319) contained a refractory brick stamped with 'GARNKIRK' from Garnkirk Firebricks Works, which was producing from 1837-1911.

Trench 4: Central Kiln area

The four circular kilns uncovered in this area were constructed with refractory bricks. Samples of bricks were taken from Kiln A. The original oven floor (402), the part relaying of the oven floor (417), plus the outer brick apron (404) all contained bricks stamped with 'CARDOWAN'. The Cardowan Works were producing from c. 1861 -1911. The brick repair (417) also contained a brick stamped with 'STARWORKS GLENBOIG', dating this repair to after 1873. Repair infills (420 and 421), contained bricks and broken bricks, including a non-refractory brick, a flat refractory brick, and standard refractory bricks, one stamped with 'GLENBOIG', produced between 1836 and 1950. Demolition fill (445) of the ash pit contained a mixture of stamped bricks including 'STARWORKS', 'GLENBOIG' and 'GARNKIRK'. Two bricks stamped with 'BLOCHAIRN' were sampled from the carpet of bricks that were laid over this part of the site after the demolition of the structures.

Trench 8: Flue complex

Flue capping (805) consisted of large flat rectangular refractory bricks measuring 460 mm by 227-231 mm by 50-53 mm. These were stamped but the stamp is so faint that all attempts to identify it have proved impossible. On the south side of the flue, the capping bricks (806) and the sidewall (816) contained standard size refractory bricks stamped with 'FM & CO HEATHFIELD'. These bricks were produced at Heathfield Fireclay Works and the stamp dates them to 1835-1863.

Conclusions

The kiln and associated structures were constructed using refractory bricks due to their heat resistant properties and the high temperatures required by the firing of the pottery. They were all from brickworks in Lanarkshire and the study of the manufacturers brick marks suggests that the circular bottle kiln in Trench 3 was repaired after 1876, Kiln A in Trench 4 after 1873 and the flue complex in Trench 8 between 1835-1863, perhaps as part of the original pottery.

Other raw materials

Flint

By Mike Donnelly

Complete and split flint nodules, up to c. 50 mm in length were retrieved from layer (411), part of the floor make up in Trench 4. They were all of a blue-grey colour internally and are associated with chalk series deposits, the closest deposit occurring in Yorkshire. Generally this flint type is denser and less likely to fracture than other types, therefore allowing it to be crushed and ground more evenly and efficiently. This flint would have been imported by Bell's, by sea and canal. The split nodules resemble struck flints but exhibit massive bulbs of percussion unlike hand-struck pieces.

Coal

By Keith Speller

A coal deposit (519), left *in situ* at the base of the firing space to the kiln in Trench 5 was sampled for identification. It was high quality anthracite and was mined at the time of Bell's operations at many sites throughout the UK. Kilns needed a type of coal which was quick to reach a very high temperature and thereby remove volatiles, slow and even-burning to minimise temperature fluctuations within the kiln, and when spent, leaving as little unburnt material or waste deposits as possible, so that rake-outs were kept to a minimum. Traditionally, the best coal for this effect has always been Welsh coal, used until 1968 by the railways that desired much the same results as did the potteries. High quality coal of this type is also found in Yorkshire and the east coast of Scotland (Trueman 1954).

Interpretation and discussion

By Keith Speller

Trench 1 - Stone and Flint Mill and adjoining Slip House

The cartographic reference to this area being within the flint mill and slip house area (Figures 5 and 7), combined with the recorded evidence of the stone bases, (of which there may be more beyond the trench), suggests their use as a strong base to hold securely in position one or more heavy flint-crushing machines, involved in the preparatory processes before throwing etc. The millstone fragment re-used as part of infill (109), itself composed of pottery working debris provides evidence for re-organisation within this area. The machinery situated on these plinths must therefore be a later addition.

Only one sherd of diagnostic pottery was retrieved from a secure deposit (106). Wedged securely beneath one of the machine blocks, it dates the setting of that machinery to the 1850s or later.

Trench 2 - Sanitary Pressing Shop and underlying Clay Cellar

This trench differs from the others in that it is the only one to display destruction of all structures, including a road surface, to any major extent. The asphalt flooring to the cellar may be for insulation purposes. No account of this type of heat resistant flooring has been forthcoming from other sites. It also occurred in the hot room covered by Trenches 5 and 8 and was used to line the base of the tank in Trench 6.

Trench 3 - North-West Kiln complex

No evidence was available to suggest the presence of an earlier discrete kiln base. The repair to ash pit 2 is most likely a response to damage caused by everyday use, although the extent of any repair from the top of the ash pit upwards into the oven wall can only be guessed at, due to the truncation of the kiln (Figure 48).

The function and positioning of the wall base (304) as related to the working of the kiln is more difficult to understand. The wall was not investigated by excavation therefore there is

Figure 48: Trench 3 during excavation, recording of ash pit 1.

no stratigraphic proof that the feature is a later addition. Clarity may be found by looking at the map of 1842 (Figure 4). If the pottery, as it existed when mapped, stood as a discrete entity for any length of time prior to further expansion of the pottery, it may be that (304) is a relict exterior wall, levelled after expansion of the pottery or possibly becoming an internal wall. If it was an internal wall base, then it is so close to ash pit 2 that it would have been impossible to gain access to rake out or bait the kiln properly, so it is possible that it was demolished to ground level and not totally removed. It may also be in some way associated with the large rectangular slab (305), especially as it butt ends parallel to the eastern end of that slab. The stepping up of this wall base is interpreted as an attempt to keep it as flush as possible with the gentle slope of the floor to the south. The positioning of this feature plus the continuation of the whinstone floor right up to the oven wall makes the existence of any outer hovel wall hard to establish. This leads to the conclusion that this kiln formed part of a 'potbank' arrangement, with one central flue serving all the kilns.

The construction style of the kiln base is much slighter than that of kiln A in Trench 4, being only three bricks deep from floor level as compared to six. It also forms a much narrower ring base, capable of supporting less weight, again pointing to a potbank arrangement in this area. The re-deposited central make-up area contained pottery dating to the 1850s only, but can be dated most securely by the presence of the stamped kiln stilts, giving a date of deposition post-1847. This, points to a re-organisation of this area at a point early in the life of the pottery. The repairs to ash pit 2, (and by implication the possible complete rebuilding of the kiln due to the need for removal of the oven wall to gain access to the ash pit) can be dated to 1876 or later by the brick marks. If the glazed saggar fragments from the central area originate from the kilns in this part of the pottery then it is possible to assume that this area contained the glost kilns. However, the presence of biscuit ware in the same contexts argues against this use. Finds within the demolition deposits gave no indication that the kiln was taken out of use until the very end of operations on the site.

Trench 4 - Central Kiln area

As with Trenches 3 and 5, demolition of the kilns in this area had been undertaken in a delicate fashion, with the notable exception of the whinstone floor. Although this surface had been largely removed - and presuming that the four kilns were of similar construct - the differing levels of truncation recorded between the four kiln bases shows that the kilns were terraced into the natural slope of the hillside to the south. Large amounts of make-up and levelling deposits were laid down on the site beforehand. Kilns A and D appear to have been at the same level, with kiln B sitting slightly higher and kiln C the highest of the four.

Due to the close proximity of the kiln bases to each other, and especially bases A and B, there was no room for the construction of individual hovels, leading to a potbank arrangement of the kilns, as in the north-west kiln area. The apparently colour coded clay mortars used between the upper kiln base bricks of kiln base A and those in Trench 3 may denote their ability to withstand high temperatures. The use of the blue-grey clay marked the extent of the re-laying of bricks (417) after the repair was carried out. The two clay mortars (416 and 450) were confined to bonding the oven floor, whereas the less plastic mortars were used in areas of lower heat intensity.

The reason for the repair to kiln base A is not evident, although the oven wall would have been partly taken down for this to take place. Brickmarks from the oven floor repair date this event to 1861 or later. Brickmarks from the undisturbed oven floor (402) also give a date post 1861 and may themselves be replacements.

The make-up levels upon which the kiln bases were constructed all contained debris associated with the day to day running of an industrial pottery (Figure 49). The pottery and kiln furniture retrieved from these levels dates to the 1840s and 50s suggesting that these deposits are waste dumps from the earliest form of the pottery, as depicted in Figure 7. These kilns, therefore, belong to the secondary period of expansion.

Figure 49: Trench 4 showing make-up levels and the the undisturbed oven floor (402), the bricks in the centre of the image above the string.

Trench 5 - Non-circular Kiln and adjoining Hot Room

The kiln recorded is not alluded to at all on any of the contemporary site plans of the pottery. Only part of the kiln was exposed, but a number of the features present enable a hypothesis as to its overall shape to be made. The positioning of the firebox in the corner of the kiln would, (if this were the only firebox), cause thermal problems within the kiln, all the heat being concentrated in one corner. It is more likely that there are at least four of these firemouths, one situated at each corner of a square or rectangular kiln. The underfloor arched ventilation voids would extend the kiln southwards by another 2 m. If it were accepted that another firemouth existed beyond these arches, then the length of the kiln would be c. 5 m. Again, assuming that the same ground plan was duplicated (in the interests of even firing) to the south-west i.e. another line of arched ventilation voids with another two firemouths at each end, then the whole rectangular kiln complex would measure c. 5 m by at least 3-4 m.

All the above presumes that the fragile cross-wall (516) was a fixed boundary to the kiln. As stated above, this wall was not well constructed and was only one brick wide. This gives the impression of it being of a more temporary nature i.e. some sort of 'clammins' wall, constantly being rebuilt and dismantled to seal up the kiln before and after each firing. It is also possible, although less likely, to be a form of bag wall to protect items standing on the hot room asphalt floor from direct heat. This second interpretation would incorporate this floor as part of the kiln interior, which is unlikely. It is most likely that the hot room was used to pre-heat saggars before stacking in the kilns and also to allow slower and therefore, more even cooling after firing. The asphalt floor would retain heat, thereby counteracting the thermal shock of standing saggars on a cold stone floor. The flue system running along the south wall was bonded using mortar with no refractory element, its purpose to circulate hot air around the room. Objects of different shapes and weights had formed the impressions within this floor. The circular impressions relate to a heavy, grooved object, a modern analogy being an oil drum. The oval shapes do not bite so deep and show no signs of more than a single placement. They could possibly be inverted saggars. The linear impression running across the floor is presumably some kind of temporary division.

The function of the kiln is uncertain, a similarly shaped example being 'Broome's Improved Porcelain or Parian Kiln', invented by Mr Isaac Broome of Trenton, (Figure 50), unsourced print in B Brown personal collection). This kiln exhibits similar elements and it is known that Bell's' were one of only a few potteries producing Parian ware. Alternatively the kiln may have been an enamelling or muffle kiln, the enamel kilns being annotated as existing in nearby rooms (Figure 5). It is of note that these kilns are not shown as being circular on the plans. Rectangular enamelling kilns are recorded at Coalport Chinaworks and other Staffordshire potteries (Barker and Horton 1999, 73-75).

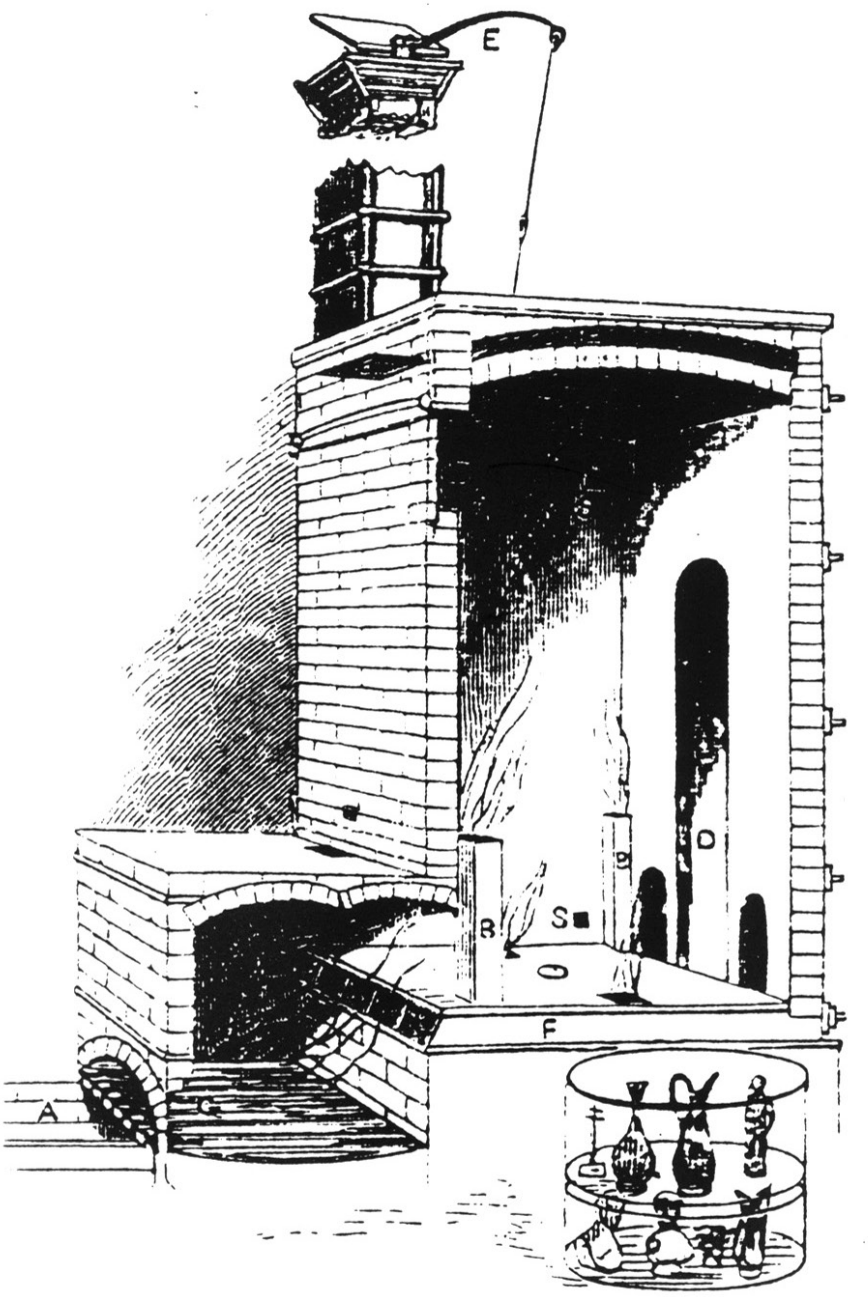

Fig. 29. — Broome's Improved Porcelain or Parian Kiln. A, ash-pit; G, grate; F F, flues; B B, bags for the flames; D, door for filling the kiln; E, damper, or draught regulator; S S S, spy-holes for watching, or trials while burning.

Figure 50: Broome's Improved Porcelain or Parian Kiln. Unsourced print in B Brown personal collection.

Figure 51: Trench 5 with pottery found during the excavation.

The stamped bricks from the flue construction were in production between 1835 and 1863, and the pottery from the make-up layers below this room and those overlying the exterior of the wall base date to the 1840-50s, allowing this building to be an early construction (Figure 51).

The pottery finds from the large deposit (531) under the kiln arches gave a date of deposition close to 1857. If the arches had been backfilled at the time of final demolition of the pottery, then this closely dated deposit must have been brought in from a sealed deposit, elsewhere on the site, a most unlikely event. Finds from the lower matrix of the mould deposit in the rake-out pit show nothing later than 1860s. It is, therefore, possible that this kiln went out of use at about this time. Deposition of debris under the arches would stop airflow and therefore, not allow the kiln to function properly in the way that it had originally been designed.

Trench 6 - Open area within the south range of buildings

The structure exposed is, in its final form, an open-air clay bunker or tank, derived from a once larger area or building. The brick cross-wall (605) is a later and rather crude insertion as is indicated by the variety of damaged capstones used to top it. This is also evidenced by its slightly curved nature in plan, along with the truncation and demolition of internal wall (606) and the cutting away of the pre-existing asphalt floor (607). The potting clay deposit (602), being dark brown in colour, is probably for the production of earthenware.

Trench 7 - The internal cobbled road

The existence of pottery sherds dating to the early period, 1840-50s, of the pottery, retrieved from beneath the road surface in some quantity, agrees with evidence elsewhere that the pottery grew piecemeal down the hill, dumps of Bell's wasters being used to stabilise and level up the natural slope. Also of interest is the reason for such a deep dump of wasters and other pottery debris at this point. As the sides of this feature were never exposed, it is not possible to say with certainty.

Trench 8 - Hot Room and flue

This flue complex would have been situated within, and been a part of, the hot room described in Trench 5. The make-up sequence and its relation to the flue side wall bricks indicates that the flue is earlier or contemporary with the laying of the internal floor, provided that this is the original floor surface. Outside the wall, everything would appear to be of a single construction event, the wall being built first, followed by the make-up, and finally the paving and road cobbling.

Trench 9 - The Stafford Street entrance

This original entrance area had been heavily disturbed, with the loss of the cobbled road surface. Proof that the dumps had been recently re-worked was forthcoming in the retrieval of a 1967 penny from the lower infill. However, it is possible to suggest a re-build of the pottery office and warehouse building to the west of the entranceway on the basis of the horizontal gap (904), with its crushed saggar fragments, was far too low in relation to Stafford Street to be a damp course. This possible re-construction may well be related to the truncation of the pottery by the railway in 1911.

Trench 10 - Warehouse and Packing House cellars

This trench showed the general preservation of the pottery buildings in the south-west corner of the site to be very good. The internal road surface remained *in situ* and the cellars had been carefully backfilled, with minimal damage to walls etc. Pottery retrieved from beneath the road is early, broadly corresponding to that from a similar deposit in Trench 7.

Trench 11 - Kyle Street and possible Mould Store

The trench cutting through Kyle Street suggests that the road building was a later event, happening after construction of the pottery perimeter wall, rather than the pottery being cut into the pre-existing natural hillslope. It was not possible to ascertain the specific function of the small room into which the trench then cut, although the overall use of this range of buildings is known. The most important find is the retrieval of master case moulds.

Conclusions

Since the excavation of Bell's Pottery, a number of other industrial potteries within Scotland have been investigated and recorded. These potteries have been variable in size (number of kilns) and situated in both small and large communities. Bell's, however, is the largest to have undergone archaeological recording.

On the basis of existing documentary evidence, coupled with contemporary professional interest and opinion both within and outside Scotland, Bell's Pottery was already accepted as the foremost pottery in Scotland of its time. It was the only one large and powerful enough to compete successfully with the monopoly held for over a century by the Staffordshire potteries. A considerable catalogue of wares already existed prior to this project, all from the artistically based collectors market. However, although recognised as such, very little was actually known about the site, its people and its operations. It was Henry Kelly who decided to correct this anomaly in the first instance and he spent a number of years researching the family and aspects of their work (not only as potters) before the fieldwork took place (Kelly 2006).

Before the fieldwork was carried out, it was thought that a fairly complete typographic and chronological sequence existed for the fine wares even though only some pieces were stamped. It was also recognised that there was a dearth of knowledge (as is often the case) concerning the more common and day to day wares e.g. the sponge and hand-painted wares. Export of fine wares to the Far East is again well covered, but little is known about types and forms which are known to have been exported to America, Australia and other parts of the world. With over 70% of the wares retrieved providing new patterns and forms of both export and home wares, we now know that the company produced a far wider range of products than had previously been accepted, and these wares have now been catalogued.

As concerns the site itself, the predominant question to answer concerned the sequence of events from the initial construction and subsequent phases of re-organisation within the pottery. A combination of documentary and

cartographic evidence had supposed that the pottery was erected piecemeal during the period 1842-1858 and continued production up until 1911-12. There followed a period as a warehouse and sales shop, importing and exporting both pottery and glassware, before the business closed completely and the site changed use in the early 1920s. The excavations have re-enforced this evidence. Deposits forming the final demolition levels contained large quantities of non-Bell's wares, both home and foreign, plus the presence of a large quantity of imported glassware. Almost every make-up or levelling layer contained Bell's pottery debris within it, and set with the physical evidence of repair to the kilns in Trenches 3 and 4, suggests that almost every structure recorded was partly of a secondary nature. This in itself is not too surprising - potteries are well known for their almost constant re-organisation due to a combination of production problems plus the ebb and flow of markets, although not on such a wholesale nature as seemed to be the case here. However, the dateable wares and kiln furniture from these levels gave a very tight period, no later than c. 1860, a period of eighteen years. Debris dumped down the slope until the site could take no more was probably an act of intention. It is likely, then, that the pottery remained for a number of years at or close to the size depicted on the 1842 map. While the company tested its expertise before quite quickly spreading down the hill once the brothers had become convinced that the business would be a success and that the full site would be put over to pottery production.

Bell's was by no means an innovative firm. They did not dabble in the *avant-garde*, preferring a more classical approach to their designs, in the Wedgewood tradition. The technology that they used was well established during the previous century in the Staffordshire Potteries, as the examples of Greatbatch and Coalport have shown. Bell's quite purposefully imported what they needed in terms of kiln furniture, raw materials and human expertise. It is most likely that the brothers first saw a market and then filled it, as they might have done with any other industry they chose to immerse themselves within. On the basis of the high quality of the fabrics and the artistic decorations applied to their wares, Bell's quickly became, and remained, a centre of excellence within the trade.

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Primary Sources

Cartography with comments

1828 - David Smith. Greenfield site. Plan of the city of Glasgow and its environs with all the latest improvements accurately surveyed by Mr. David Smith. Scale 13.7" = 1 mile. Engraved by R. Scott, Edinburgh. Reference No EGM52, Mitchell Library, Glasgow.

1838 - David Smith. Existing and proposed street plan. Overlaying the 1896 plan onto this map shows that Pulteney Street and Kyle Street are laid out accurately. Stafford Street bounds the pottery to the south and is most likely established after the full extent of ground that the pottery was to occupy had been firmly established in the 1840s.

1839 - Allan & Ferguson. Plan of the lands called Hundredacrehill, Broomhill, Physicwell Park, Spangsholm & Cowcaddens, all comprehended in the entailed estate of Milton, situated within the Barony Parish of Glasgow and County of Lanark; and belonging in Property and Superiority. Shelfmark: EMS.s.577, Available from the National Library of Scotland. https://maps.nls.uk/estates/rec/7695 (Figure 2)

1839 - David Smith & James Collie. Same map as 1828 but with revisions. Plan of the city of Glasgow and its environs accurately surveyed and brought down to the present time by David Smith and James Collie. A very large scale map with a lot of detail. Individual buildings shown, landowners given, many factories, foundries, churches and proposed developments named. Shows the area of the pottery with the proposed street plan and the track of the Edinburgh – Glasgow rail line and bridge across the canal and basin. See Martin's 1842 map for an updated version. 24"= 1 mile. Engraved and published by J. Scott…Edinburgh and John Symington & Co., Glasgow. Reference No. EGM68a. Updated on Martin's 1842 map.

1842 Thomas Kyle 1827?-1864, Map shewing… entailed estate of Milton. And the location of the pottery within the proposed street plan. Glasgow. Shelfmark: EMS.s.579, , Available from the National Library of Scotland. Available from: https://maps.nls.uk/towns/rec/440 (Figure 3).

1842 - George Martin Esq, Civil Engineer and Surveyor. Map of the city of Glasgow … including the Parliamentary boundaries, division of parishes, police wards of the city & suburbs… with intended improvements. 14.8"=1 mile. Shows some of the buildings of the early layout of the pottery. Engraved by W. & A.K. Johnston, geographers to the Queen, Edinburgh. Reference No. EGM73 Mitchell Library, Glasgow. (Figure 4).

1842 - David Smith. Uses the 1828 base map. Shows the north-west corner of the later pottery site see Trench 3).

1848 - Caledonian Railway. 1828 base map showing the proposed route of the railway north-east from Buchanan Street. The Pottery lay out is the same as the 1842 map.

1858 - Ordnance Survey 1st Series, Lanarkshire Sheet VI. 7. 6" to the mile. Shows the Pottery almost in its final form. The flint mills in the north-east corner are not built and there is a building to add in the south-east corner, immediately to the east of trench 6. Available from the National Library of Scotland

1880 - redrawn from a photocopy of Kyle, Dennison and Hew, 1"=25 feet. The Pottery plan in its fullest form (Figure 5). Location of the original drawing has not been traced.

1895 - Ordnance Survey 2nd Edition. Lanarkshire Sheet VI. 7. 6" to the mile. Shows the pottery as shown in the 1880 plan, not yet truncated by the railway expansion (Figure 6). Available from the National Library of Scotland.

1919 – redrawn from Wardlaw and Makins for Bergius Launch and Engineering Co. Ltd. 6 cm=100 feet. *'Plan of Bell's Pottery shewing levels'*. Shows the pottery after truncation by the railway (Figure 9), and shows very minor differences to the 1880 site plan e.g. removal of the kiln shed the north end. Compare with Figure 5. Location of the original drawing has not been traced.

1920 - Site Plan by James Barr & Sons, Surveyor; purpose unknown. Similar to the 1919 plan.

1922 - Bergius Site levels plan *'Sketch of positions of Bench Marks in old Pottery'.* University of Glasgow Archives.

1933 - Ordnance Survey. Lanarkshire Sheet VI. 7. 6" to the mile. Shows the northern part of the site owned and roofed by the Kelvin Engineering Works. The southern range of pottery buildings still stand, in slightly altered form (see Trench 9).

Others

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52 Elderpark Workspace
100 Elderpark Street
Glasgow
G51 3TR
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Fax: 0141 445 3222
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