The Limehouse Porcelain Factory

ITS OUTPUT, ANTECEDENTS & THE INFLUENCE OF THE ROYAL SOCIETY OF LONDON ON THE EVOLUTION OF ENGLISH PORCELAIN BASED ON COMPOSITION AND TECHNOLOGY

Ramsay, W. Ross H., Daniels, Pat, & Ramsay, E. Gael
THE LIMEHOUSE PORCELAIN FACTORY
ITS OUTPUT, ANTECEDENTS & THE INFLUENCE OF THE ROYAL SOCIETY OF LONDON ON THE EVOLUTION OF ENGLISH PORCELAIN BASED ON COMPOSITION AND TECHNOLOGY

Ramsay, W. Ross H.*, Daniels, Pat†, & Ramsay, E. Gael‡

* Southern Institute of Technology, Invercargill, New Zealand
uwhramsay@hotmail.com

† Faringdon, Oxford, United Kingdom

‡ Southland Museum & Art Gallery, Invercargill, New Zealand
CONTENTS

Abstract 6
Preface 7
Background to the Limehouse potworks 7
Previously published Limehouse ceramic recipes 9
Magnesium-phosphate recipe type attributed to Limehouse 11
Visual identification and compositional stratigraphy of the three recipe types 14
Technology pathway from Limehouse to Lund’s Bristol 16
Technology pathway from Bow to Limehouse 16
Recipe links to the Royal Society of London 20
Recipe links to the Burghley House jars 22
Recipe links to Si-Al crucibles from Hesse, Germany, and Stamford, Lincolnshire 25
Final comment 25
Conclusions 26
Acknowledgements 27
References 28

Appendix 1. The advancement of Porcelain Technology in England from Medieval time to the closure of the Limehouse factory with observations by the authors 31
Appendix 2. Porcelain chemical compositions 41
Appendix 3. Summary of the Burghley House jars 42
ABSTRACT

Three porcelain compositions attributed to the Limehouse porcelain manufactory are recognised and both body and glaze compositions of each are presented. Two of these compositions have been identified for the last 20 years, namely the silica-aluminium (Si-Al) and the silica-aluminium-calcium (Si-Al-Ca) bodies, whilst a third composition of the magnesium-phosphorus (Mg-P) type is newly documented and is tentatively attributed to Limehouse. Criteria to distinguish visually these three ceramic types are provided and a compositional stratigraphy for the Limehouse output is erected extending from late 1745 - early 1748. Preliminary results are presented which allow the compositional differentiation of Limehouse porcelains from Lund’s Bristol and a discussion on technology pathways linking Bow to Limehouse and thence to Lund’s Bristol and Worcester is given. Limehouse, far from being innovative, was in fact highly derivative at several levels both from Bow and earlier experimental firings, commissioned by members of the Royal Society of London dating back to the beginning of the 18th Century, if not earlier. We recognise that porcelain development in England was much more indigenous, diverse, and complicated than may have been realised to date in that the presence of high-fired Si-Al-Ca and Si-Al bodies coupled with the inferred use of china clay predate Meissen by some 30 years.

With information dating from before the change of the calendar from Julian to Gregorian in 1752; that is dates falling between 25th December and 25th March (Christmas Day to Lady Day - the latter being the start of the New Year under the Julian system) are shown in both styles. Hence 15th March 1744 in the old Julian style becomes on converting to the modern convention (Gregorian style) 15th March 1745 and is written as 15th March 1744/45.

In addition to discussing the new scientific work and its impact on the chronological development of early English porcelains, documentary evidence surrounding the establishment of the Limehouse Factory is reviewed in an attempt to determine the extent of its operating period and its place within the associated technology. Evidence discovered in parish registers, land tax assessments, insurances, letters, and newspaper advertisements recorded by earlier researchers and one or two recent discoveries not yet in the ceramic literature are co-ordinated, presented in chronological order, and evaluated.

This grand tradition in porcelain development based on rational English experimental science and technology has remained largely opaque to previous ceramic studies over the last 150 years predicated on the notion of the primacy of the artistic pursuit. In fact, as at least three recipe types used by English porcelain makers are unique, one wonders how any foreign technology could have influenced this development.

In conclusion, the new scientific work and its impact on the chronological development of early English porcelains, documentary evidence surrounding the establishment of the Limehouse Factory is reviewed in an attempt to determine the extent of its operating period and its place within the associated technology. Evidence discovered in parish registers, land tax assessments, insurances, letters, and newspaper advertisements recorded by earlier researchers and one or two recent discoveries not yet in the ceramic literature are co-ordinated, presented in chronological order, and evaluated.

PREFACE

The senior author is the recipient of generous research grants from the American Ceramic Circle and the Southern Institute of Technology to investigate the use of steatite in early English porcelains and this paper on the Limehouse porcelain manufactory is the second in the series. The first appeared on the range of ceramic compositions recognised for Lund’s Bristol (Fig. 1) (Ramsay et al., 2011a). Combining both historical accounts (Cammed Society, 1888) and modern analytical techniques, Ramsay and co-authors were able to demonstrate that Benjamin Lund produced at least three ceramic types, namely a high-clay porcelain (inferred crushed silica, ball clay +/- salt petre), a magnesian-plumbian (Mg-Pb) porcelain (inferred soapstone, crushed silica, and a lead-bearing frit) and a magnesian-phosphatic-plumbian (Mg-P-Pb) porcelain (inferred soapstone, bone ash, crushed silica, and a lead-bearing frit). The glaze composition employed on both the soft-paste porcelain bodies was broadly similar with moderate PbO, high Al₂O₃, distinct levels of MgO, and K₂O ≥ CaO. From this research the authors proposed a compositional stratigraphy for Lund’s Bristol with the Mg-P-Pb body being produced up till late 1750 and the Mg-Pb body occurring from that date until the Worcester takeover in early 1752. Based on composition these authors have suggested that a technology pathway can be traced extending back in time from Worcester, through Lund’s Bristol, to Limehouse, to Bow, and thence back to John Woodward (Secretary to the Royal Society of London) and his experimental porcelain firings of the 1720s (Woodward, 1728). From these observations Ramsay et al. (2011a) have argued that such compositional or technological pathways are likely to transcend linkages inferred from stylistic and decorative features.

The key raw material in this account is steatite, or soapstone, a generic name for a soft, easily carved stone, bone ash, crushed silica, and a lead-bearing frit). The glaze composition employed on both the soft-paste porcelain bodies was broadly similar, with moderate PbO, high Al₂O₃, distinct levels of MgO, and K₂O ≥ CaO. From this research the authors proposed a compositional stratigraphy for Lund’s Bristol with the Mg-P-Pb body being produced up till late 1750 and the Mg-Pb body occurring from that date until the Worcester takeover in early 1752. Based on composition these authors have suggested that a technology pathway can be traced extending back in time from Worcester, through Lund’s Bristol, to Limehouse, to Bow, and thence back to John Woodward (Secretary to the Royal Society of London) and his experimental porcelain firings of the 1720s (Woodward, 1728). From these observations Ramsay et al. (2011a) have argued that such compositional or technological pathways are likely to transcend linkages inferred from stylistic and decorative features.

This key raw material in this account is steatite, or soapstone, a generic name for a soft, easily carved talcose rock (Moffatt and Burtler, 1986) dominated by a hydrous magnesian silicate, typically talc (Jones et al., 2007). Bates and Jackson (1987) describe steatite as a compact, massive, fine-grained, fairly homogeneous rock consisting chiefly of talc; an impure talc-rich rock. Soapstone is essentially synonymous with steatite being a metamorphic rock with a massive, schistose, or interlaced fibrous or flaky texture with an unctuous feel composed essentially of talc. The most notable steatite locality in the United Kingdom is the Lizard Peninsula, Cornwall (Fig. 1), where several localities have been mined (Hobbs, 1999; Hills, 2011). Other localities include Anglesey, mainland Scotland, the island of Harris, and the Shetland Islands (Bray, 1994).
that Limehouse must have been located in Fore Street near Dick or Duke Shore in Limehouse. Mrs MacAlister (1933) announced the discovery of an early letter dated 28th December, 1745 from Mr. James Middleton of Shelton to, William Tams at the Potworks in Four-Street, nigh Duke-shore in Limehouse, London. For the next 60 years specula-
tion continued as to the type of wares produced by this est of London concern. Watney (1963, 1973) summarised the then existing knowledge, report-
ing that the Limehouse manufactory was believed to have been sited on the north side of the river Thames in that part of Narrow Street, then called Fore Street, close to Duke Shore, only a few miles south from the Bow manufactory, alluding to the New Canton site at Stratford Essex adjacent to the river Lea (Fig. 1). However, the present authors point out that they suspect that initially an earlier Bow site was established on the Middlesex side of the Lea, at a still unknown location. Further adver-
tisements were discovered by Nancy Valpy (1983).

From the Registers of St. Anne’s, Limehouse bap-
tisms A.J.V. Toppin discovered a John Wilson, pot-
ter, of Queen Street, Ratcliffe. Ratcliffe Stairs was at the western end of Narrow Street. This potter appears to be related to Joseph Wilson (the potter previously from Limehouse whom Pococke appar-
ently saw at a pottery in Newcastle-under-Lyme in 1750), as John is recorded in Fore Street near the factory site in the 1740’s and in the Rope Walk in 1752. J. P. M. Latham (1988, p. 148) records that both John Wilson and David Wilson were taxpay-
ers at Blakes Rents prior to 1744, (an address very

The real hero of Limehouse might appear to be John Potter, who in July 1853 learnt of a planning application for the demolition of 102-106 Narrow Street. He wrote to the London Docklands Devel-
opment Corporation requesting that archaeologi-
cal expertise be employed during any excavation

In summary, Owen (2000) confirms the pres-
ence of two types of Limehouse porcelain. What is assumed to be the earliest ware is the Si-Al type with low CaO (~0.5 wt%) and with lime-
alkali glaze. The second group is of the Si-Al-Ca type with a lead glaze. Both Freestone and Owen agree that in each case the clay used at Limehouse was a secondary clay and not a primary china clay. Freestone (1993) comments that based on analy-
ses of sherds from Limehouse there is no evidence for the use of soapstone, although unpublished XRD analyses of porcelains attributed to Lime-
house from private collections have indicated the presence of steatite or soapstone. Freestone con-
cludes that the absence of such magnesian wares from analysed sherds may reflect the vagaries of archaeological sampling. Watney (1993, p. 29) likewise asserts that analyses of ‘Limehouse’ pieces from collections show the presence of significant amounts of MgO. Unfortunately, unpublished analytical work lacking information as to the objects analysed, the name of the analyst, meth-
ods used, where analysed, and precision levels, analytically is used, and the precision levels, of analyses of ‘Limehouse’ may be constantly ‘bedevils’ English ceramic studies to the
detriment of progress in knowledge and may be regarded as verging towards hobby science (Ramsay et al., 2011b).

PREVIOUSLY PUBLISHED LIMEHOUSE CERAMIC RECIPES

Two compositional studies of wasters recovered from the Limehouse site have been published (Freestone, 1993; Owen, 2000). In the first publica-
tion Ian Freestone recognises two distinct composi-
tional groups with one assemblage referred to as ‘Limehouse early’ or ‘experimental ware’ and the second as ‘Limehouse porcellaneous ware’. The for-
ter is described by Freestone as showing evidence of vitrification, yet the body is still very porous of an earthenware type. Compositionally the body is that of a silica - high Al₂O₃ (assumed secondary clay type, ball clay) with a small addition of K₂O. Silica is ~78 wt%, Al₂O₃ -16 wt%, and K₂O ~1.5 wt% (Table 1) classified by Owen (2007) as the Si-Al type. Freestone demonstrates that the glaze associated with this group contains minimal lead oxide, with low K₂O, Na₂O, and MgO, and with CaO in the vicinity of 10 wt% (Table 2). This glaze can be explained by a mixture of 2 parts lime-alkali bottle glass and 1 part ‘experimental’ ceramic body. Freestone also notes that this glaze composition mirrors that recorded on Bow first patent porcelains, thus demonstrating a technol-

geny of lime-alkali bottle glass and 1 part ‘experimental’ ceramic body. Freestone also notes that this glaze composition mirrors that recorded on Bow first patent porcelains, thus demonstrating a technol-
ogy pathway from Bow to Limehouse as discussed below.

The second ceramic group recognised by Freestone (1993) shows lower SiO₂ levels (~73 wt%) and lower Al₂O₃ (~11 wt%) assumed to reflect lesser amounts of introduced secondary clay into the ceramic body. CaO varies from 5-7 wt%, Na₂O from 2-3 wt%, and K₂O around 3 wt% (Table 1; Figs. 2a, b, c, d). Based on the classification pro-
vided by Owen (2007) this body is of the Si-Al-Ca type. The glaze used contrasts with that found on the experimental Si-Al wares in that it is a moder-
ate lead-bearing glaze with PbO ~30 wt%, SiO₂ ~48 wt%, Al₂O₃ ~6 wt%, with low K₂O, Na₂O, CaO, MgO and SiO₂ (Table 2).

Subsequent work by Owen (2000) broadly con-
firms the earlier work by Freestone and again rec-
ognises two distinct ceramic bodies from wasters and sherds recovered from the Limehouse excava-
tion. One of the bodies identified by Owen con-
forms to the experimental Limehouse body and is referred to by Owen as ‘proto-porcelain’ of the
TABLE 1: ANALYSES OF LIMEHOUSE, LUND'S BRISTOL, AND BOW PORCELAIN BODIES

<table>
<thead>
<tr>
<th></th>
<th>Limehouse</th>
<th>Lund's</th>
<th>Bow</th>
<th>Wares?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>wt%</td>
<td>wt%</td>
<td>wt%</td>
<td></td>
</tr>
<tr>
<td>MgO</td>
<td>8.8</td>
<td>5.6</td>
<td>10.8</td>
<td>2.2</td>
</tr>
<tr>
<td>TiO₂</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>0.6</td>
<td>0.3</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>CaO</td>
<td>18.3</td>
<td>18.3</td>
<td>18.3</td>
<td>18.3</td>
</tr>
<tr>
<td>FeO</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>15.4</td>
<td>15.4</td>
<td>15.4</td>
<td>15.4</td>
</tr>
<tr>
<td>SiO₂</td>
<td>69.0</td>
<td>69.0</td>
<td>69.0</td>
<td>69.0</td>
</tr>
<tr>
<td># S as SO₃</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

1. Single bulk analysis of Si-Al porcelain body (Owen, 2000) - total as Fe₂O₃.
2. Average analysis of 6 Si-Al porcelain bodies (Freestone, 1993).
3. Average analysis of 4 Si-Al-Ca porcelain bodies (Owen, 2000) - total as Fe₂O₃.
4. Average analysis of 4 Si-Al-Ca porcelain bodies (Tyler et al., 1993).
5. Si-Al-Ca body from underglaze blue pickle dish, Freemans Museum, Cambridge (see Fig. 2a).
6. Si-Al-Ca body from underglaze blue sauce boat (Kidston Collection, Barnham, 2010, Sale No. 16495, Lot 63, see Fig. 2b).
7. Si-Al-Ca body from underglaze blue pickle dish with Chinese vase decoration (private collection; see Fig. 2c).
8. Si-Al-Ca body to broken underglaze blue pickle dish with Chinese vase decoration (Kidston Collection).
9. Si-Al-Ca body to porcelain shard - ribbed underglaze blue sauce boat (Watt Collection - Phillips, 2004; Sale No. 30504, Lot 538; see Fig. 2d).

TABLE 2: ANALYSES OF LIMEHOUSE, LUND'S BRISTOL, AND BOW GLazes

<table>
<thead>
<tr>
<th></th>
<th>Limehouse</th>
<th>Lund's</th>
<th>Bow</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>69.0</td>
<td>69.0</td>
<td>69.0</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>15.4</td>
<td>15.4</td>
<td>15.4</td>
</tr>
<tr>
<td>MgO</td>
<td>5.6</td>
<td>5.6</td>
<td>5.6</td>
</tr>
<tr>
<td># S as SO₃</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Based on the excavations at 20 Fore Street no Mg-P sherdswere recovered. At the time Freestone (1993) suggested that this absence represented the vagaries of an archaeological excavation. However we note that in addition, in all three reports of the excavation (Draakard, 1993; Porter, 1998; Tyler et al., 2000), no remains of steatitic clay, animal bones, or calcined bones were reported. These absences suggest to us one of the following possibilities:

1. The vagaries of an archaeological excavation, or
2. Mg-P porcelains were not produced in the 20 Fore Street site.

If the latter is correct then two further possibilities arise:

1. The Mg-P wares described here are not Limehouse in origin, or
2. These Mg-P wares may be attributed to Limehouse but were manufactured on the 20 Fore Street site.

In each case we assume that the source of the magnesium was steatite as suggested by the low Al₂O₃ content in both analyses with typical steatite having the general composition of SiO₂:Al₂O₃:3MgO:7H₂O. However we note that in the case of analys 10, Table 1 the Limehouse porcelain shell dish has a CaO:O₂:O₃ ratio (mol Proportions) of 5.3, well above the established ratio of 3.3 (Owen, 2001) and this could indicate the addition of further calcium oxide and above that required to account for bone ash, as either a lime alkali glass or as dolomite (Ca, MgCO₃). If the latter then some of the magnesium could have come from dolomite, however that could explain but part of the magnesium source.

Owen (1998) has recorded a sherd from the lowest level of Warminster Yard (W12) having a comparable Mg-P body and lacking in lead (Table 1). Although the associated glaze has a high PbO content we speculate whether this sherd is of Limehouse origin on the basis of the absence of lead in its body.
Fig. 2. Images of various porcelains from Limehouse, Lund’s Bristol, and Bow.

Fig. 2a. Octagonal plate in underglaze blue. Limehouse Si-Al-Ca porcelain, c. 1746 - May 1747, 21 cm long. Formerly Geoffrey Godden Collection, (Bonhams, 2010: Sale No. 18425, Lot 63). Bonhams report that a fragment from a saucer with an identical scene of a distant cottage was recovered from the Limehouse site and illustrated by Tyler et al. (2000). Photograph courtesy of Bonhams. Table 1, No. 6; Table 2, No. 7.

Fig. 2b. Large saucer in underglaze blue. Limehouse Si-Al-Ca porcelain, c. 1746 - May 1747, 21.5 cm long. Formerly Geoffrey Godden Collection, (Bonhams, 2010: Sale No. 18425, Lot 64). Bonhams report that a fragment from a saucer with an identical scene of a distant cottage was recovered from the Limehouse site and illustrated by Tyler et al. (2000). Photograph courtesy of Bonhams. Table 1, No. 7; Table 2, No. 8.

Fig. 2c. Pdckle dish in underglaze blue. Limehouse Si-Al-Ca porcelain, c. 1746 - May 1747, ~10 cm long. Private collection. Photograph by the owners. Table 1, No. 10; Table 2, No. 11.

Fig. 2d. Ribbed polychrome coffee cup. Limehouse Si-Al-Ca body, c. 1746 - May 1747, 5.9 cm high. Formerly Warner Collection (Phillips, 2008: Sale No. 50326, Lot 898). Possibly outside decorated. Photograph by the authors. Table 1, No. 1; Table 2, No. 10.

Fig. 2e. Pdckle dish in underglaze blue. Limehouse Mg-P porcelain, c. June 1747 - early 1748, 10.7 cm high. Private collection, formerly Warner Collection (Phillips, 2008: Sale No. 50326, Lot 898). Photograph by the authors. Table 1, No. 7; Table 2, No. 11.

Fig. 2f. Pdckle dish in underglaze blue. Limehouse Mg-P porcelain, c. June 1747 - early 1748, 10.2 cm high. Private collection, formerly Geoffrey Godden Collection (Bonhams, 2014: Sale No. 19195, Lot 254). Photograph courtesy of Geoffrey Godden. Table 1, No. 11; Table 2, No. 12.

Fig. 2g. Teapot in underglaze blue, Lund’s Bristol Mg-P-P porcelain, c. 1749 - 1750, 9.5 cm wide. Private collection, formerly Warner Collection (Phillips, 2008: Sale No. 50326, Lot 914). Phillips attributed this teapot to Limehouse though they drew attention to the presence of similar painting on a Lund’s Bristol coffee can in the same sale (Lot 917). Based on the distinctive amount of lead in the body of this teapot (Table 1) we attribute this teapot to Lund’s Bristol. Only recently has it been realised that Benjamin Lund used bone ash in a group of his porcelains as well as steatite (Ramsay et al., 2011a). Phillips also notes that a number of similar examples are in the collection of George II bust group. However the octagonal root patterned plate (the one shown in Fig. 2h) and the octagonal platter in underglaze blue (Table 2, No. 6) are amongst a small group of porcelain items attributed by us to Bow dating to the 1730s. By the early to mid-1740s, if not earlier, the Bow concern was utilizing a range of porcelain body types including a unique hard-paste body based on imported Chinese clay from the Carolinas, the use of steatite, and the use of bone ash. Potting forms included moulded, turned, and slip-cast varieties reflecting their Staffordshire heritage. Decorative idioms display an eclectic range of both indigenous (London scene and engravings by Gravelot/Bickford) and exotic including Aesop-inspired underglaze blue designs, ‘sprigged’ decoration derived from blanc de Chine porcelain, famille verte, famille rose, famille noir, Kakiemon, and European influences including fables, harbour scenes, and indiscernible Chinese motifs all interpreted through the prism of Bow. Yet because of the yellowware syndrome (Ramsay et al., 2011a) and a reluctance to consider composition and integrate with contemporary documents, these pioneering advances by Bow (compositional, technical, and artistic) commencing from the 1730s have largely gone without comment. Photograph by the authors. Table 1, No. 1; Table 2, No. 14.

Fig. 2h. Polychrome covered sugar bowl, Bow Si-Al-Ca hard-paste porcelain, c. 1744-7, 8 cm high. Collection of the Melbourne Cricket Club Museum, accession No. M5599.1. This bowl comprises inferred Ch’ien-lung clay (59 wt%) and a lead-free, lime-alum glass (41 wt%) and it represents the stellar technical, artistic, and commercial heights reached by Bow by the mid 1740s (Ramsay and Ramsay, 2007a, 2007b). It was this English hard-paste composition coupled with the high-style decoration found on this bowl decorated with human figures, which galvanized the French in 1745 to obtain Royal assent to the Vincennes Privilege (Daniels, 2007). Likewise, although these porcelains were clearly referred to in the 1744 patent of Heylyn and Frye (Ramsay and Ramsay, 2006) and the Thomas Frye Tribute (not to be confused with the Fryes Epitaph), such contemporary accounts have been overlooked or misinterpreted and for the last half century contributions for these dalituting porcelains have been sought in Italy or Scotland. Photograph by Eora O’Brien. Table 1, No. 14; Table 2, No. 15.

Fig. 2j. Polychrome bowl decorated after the Chinese in famille rose colours, Bow Al-Mg-P porcelain, c. 1742-1744, 12.1 cm diameter. Private collection. The body of this bowl has a high-fired appearance as demonstrated by the very high content of aluminium (33 wt% Al₂O₃), K₂O is well balanced with five per cent fine-grain glass distinctive of Bow, and is highly translucent with a greenish hue. The distinct amount of P₂O₅ and MgO have been found to be in the range of 25 wt% and 6% to 8% MgO and MgO. The decoration on this bowl is characteristic Bow glass (Ramsay et al., 2011b) with high PbO, K₂O, CaO and low Al₂O₃ and MgO. The decoration on this bowl belongs to a stock pattern produced at Bow over a long period of time, but at the design of the prunus root pattern (Fig. 2h) is inscribed very indistinguishably by a painter whose hands has only been found on one or two other typically Bow examples, although visual examination indicates the paste composition found in these other bowls differs from the example. Whilst an insatiable degree of discussion is found in the literature regarding the visual appearance of Bow glasses which might appear to be less than diagnostic, little attention has been afforded a range of Bow body types (Al-P-S, Al-P-Pb, Al-Mg-S, Mg-Pb, Al-P, Al-Mg-P-Si-Al-Ca) and Si-Al-Mg-P compounds which are visually distinctive and highly informative regarding the early development of Bow from the 1730s. The visual appearance and chemical composition of the inferred high-fire body contained in this bowl resonates with that of Al-Mg-S Bow tea canister decorated with the Island Abbey pattern (Ramsay and Ramsay, 2005, 2007a, 2007b). Photograph by the authors. Table 1, No. 15; Table 2, No. 16.
Of note is a subsequent advertisement in The Daily Advertiser for October 28th, 1747 (Gardner, 1928) where it is stated that Mr Pinchbeck on his return from Tunbridge Wells has furnished himself among other things:

...... with great Variety of useful & ornamental Goods in the New Limehouse Ware, which for strength and enduring the Fire, far exceeds China, or any other Ware hitherto invented.

This reference to Limehouse porcelains having a refractory body refers to the former Si-Al-Ca body of which we suggest Mr Pinchbeck was able to acquire a bulk purchase of this now discontinued line. We propose that this October advertisement does not refer to the inferred lower-firing, greatly improved Mg-P body, as advertised previously in June, 1747. Ramsay and Ramsay (2007b) and Ramsay et al. (2011b) have used recipe types to erect a compositional stratigraphy through the Bow soft-paste, phosphatic output and more recently Ramsay et al., (2011a) have subdivided the Lund’s Bristol production into a pre late-1750 group and a post late-1750 group based on composition. Likewise Owen (2003) has traced the compositional changes in the porcelain body through time at Worcester and Middleton and Cowell (1993) for Longton Hall.

To the PUBLICK THE NEW-INVENTED LIMEHOUSE WARE, consisting of a great Variety of useful and ornamental Vessels, which as to Duration etc. is in no way inferior to China, being now greatly improved...........

We take this date of June 20th, 1747 to mark the change in production from the less technically accomplished, more refractory Si-Al-Ca body to the more translucent, whiter, lower-firing body of the Mg-P type. We suggest that the failure of Limehouse may not have been because of the production of dirty, messy, and speckled porcelains (Sandon, 2009), as these ‘greatly improved’ Mg-P wares are typically whiter, cleaner looking, and more translucent.

# Fitzwilliam platter (Fig. 2a) has 0.4 wt% Al2O3.

**TABLE 3: CHEMICAL AND PHYSICAL FEATURES ASSOCIATED WITH THE THREE LIMEHOUSE CERAMIC BODIES**

<table>
<thead>
<tr>
<th>Raw materials used in the body</th>
<th>Nature of the glaze</th>
<th>Nature of the body</th>
<th>Refractory body</th>
<th>Firing faults</th>
<th>Translucency</th>
<th>Extant examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball clay, crushed silica, crushed lead-free glass frit.</td>
<td>Poorly translucent in shades of brown or orange in thinner parts.</td>
<td>Mostly grey in appearance.</td>
<td>Medium-fired</td>
<td>Underfired with poorly vitrified body.</td>
<td>Non-existent.</td>
<td>Only recognized from factory wasters.</td>
</tr>
<tr>
<td>Raw materials used in the body</td>
<td>Nature of the glaze</td>
<td>Nature of the body</td>
<td>Refractory body</td>
<td>Firing faults</td>
<td>Translucency</td>
<td>Extant examples</td>
</tr>
<tr>
<td>Late 1745 - early 1746</td>
<td>Well-fitting, well-controlled glaze.</td>
<td>Mostly grey in appearance.</td>
<td>Medium-fired</td>
<td>Underfired with poorly vitrified body.</td>
<td>Poorly translucent in shades of brown or orange in thinner parts.</td>
<td>Examples recognised.</td>
</tr>
<tr>
<td>Late 1750 - early 1752</td>
<td>Well-fitting, well-controlled glaze.</td>
<td>Mostly grey in appearance.</td>
<td>Medium-fired</td>
<td>Underfired with poorly vitrified body.</td>
<td>Poorly translucent in shades of brown or orange in thinner parts.</td>
<td>Examples recognised.</td>
</tr>
</tbody>
</table>

**TABLE 4: COMPOSITIONAL STRATIGRAPHY FOR LIMEHOUSE, LUND’S BRISTOL, AND SOME BOW RECIPE TYPES**

<table>
<thead>
<tr>
<th>Bow</th>
<th>Limehouse</th>
<th>Lund’s Bristol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Late 1750 - early 1752</td>
<td>Mg-P body and moderate Pb-glaze</td>
<td>Mg-P body and moderate Pb-glaze</td>
</tr>
<tr>
<td>1749 - late 1750</td>
<td>Mg-P body and moderate Pb-glaze</td>
<td>Mg-P body and moderate Pb-glaze</td>
</tr>
<tr>
<td>June 1747 - early 1748</td>
<td>Mg-P body and moderate Pb-glaze</td>
<td>Mg-P body and moderate Pb-glaze</td>
</tr>
<tr>
<td>Early 1746 - June 1747</td>
<td>Si-Al-Ca body and moderate to high-Pb glaze</td>
<td>Mg-P body and moderate Pb-glaze</td>
</tr>
<tr>
<td>Late 1745 - early 1746</td>
<td>Si-Al body and Si-Al-Ca glaze</td>
<td>Mg-P body and moderate Pb-glaze</td>
</tr>
<tr>
<td>1743 - early 1746</td>
<td>Si-Al-Ca body and glaze</td>
<td>Mg-P body and moderate Pb-glaze</td>
</tr>
<tr>
<td>Early - mid 1740’s</td>
<td>Al-Mg-P body and high-Pb glaze</td>
<td>Mg-P body and moderate Pb-glaze</td>
</tr>
<tr>
<td>1750’s - early 1750’s</td>
<td>Si-Al body and high-Pb glaze</td>
<td>Mg-P body and moderate Pb-glaze</td>
</tr>
</tbody>
</table>
The first author to recognize a Limehouse - Lund's Bristol linkage in modern literature appears to be Wallace Elliott (1929) though strangely he dismissed a Bow - Lund's Bristol connection and by implication a Bow - Limehouse link; apparently predicated on the belief that Bow commenced its phosphatic (and magne- sian) output around 1748 and hence post-dated Limehouse. This view that the Bow ceramic output was on the one hand broadly contemporary with Benjamin Lund at Bristol and on the other hand post-dated the inception of Limehouse continues today (Tyler et al., 2000; 5; Young, 1999: 197; Gabszewicz, 2000; Spero, 2005; 26, 2011: 10; Christies, 2010; Pietsch, 2010) with Spero (in Spero and Burt, undated: 64) arguing that in three particular respects production at Limehouse stood apart from both contemporaneous Bow and the Chi- nese importations - an innovative use of moulded ornamentation, a series of models associated with silver forms, and almost certainly, the first use of soaprock on a commercial scale, probably intro- duced only during the final stages of the factory's brief existence. Moreover Spero (1995: 20, 2002: 28, 2005: 26, 2011:10) and Brian Haughton Antiques (2004: 61) have argued that Limehouse was the first to produce underglaze blue porcelains in England, thus initiating a resonant tradition. From these concepts has arisen the notion that Limehouse was a ceramic innovator with respect to porting, moulding, the use of steatite, and even the inception of the earliest underglaze blue deco- ration, whereas in contrast Bow, by implication, has been cast as being derivative from Limehouse. Tyler et al. (2000) describe Limehouse as being in the vanguard with Chelsea in attempts to manu- facture porcelain in England. Based on the concept of technology pathways there is a Limehouse - Lund's Bristol link by way of the Mg-P body and a broadly comparable mod- erate lead glaze (Table 1, Table 2, Figures 2e, f, g). Whilst Elliott (1929) may have been the first to rec- ognize a Limehouse - Lund's Bristol linkage based on historical documents, we can now recognize stylistic linkages and based on this contribution a compositional pathway between the two concerns. The key linking composition with Lund’s Bristol is the Mg-P recipe, which is dated by us at Lime- house from at least June, 1747 to closure around early 1748, and at Lund’s Bristol from commence- ment in 1749 through to late 1750.

**TECHNOLOGY PATHWAY FROM LIMETHOUSE TO LUND’S BRISTOL**

The three Limehouse compositions and the Si-Al-Ca glaze composition discussed in this paper can be shown to be derivative from Bow. Firstly the Limehouse Si-Al experimental body (Table 2, Nos. 1 and 2) is to be found in a compar- able Bow body (Table 1, No. 13, Figure 26) having the distinctive Bow glaze (Table 2, No.14) as characterised by Ramsay et al. (2011b). Based on the distinctive body and glaze analyses obtained from this gadrooned plate with underglaze blue prunus root decoration we propose that this exam- ple represents an early phase at the Bow factory when a crushed silica or calcined flint - ball clay - potassic flux (possibly calcareous - KNO3) body was being produced, most likely in the late 1740s. Comparable porcelain bodies, or possibly porcella- neous stoneware bodies, have also been recognised as a product from Lund’s Bristol (Camden Society, 1888, Ramsay et al., 2011a), the lowest level at Warmstry House (Owen, 1998), and from Wil- liam Reid of Liverpool (Owen and Hillis, 2003); however in each instance the associated glazes do not accord with early Bow glaze compositions as found on this plate (Ramsay et al., 2011b). A closely comparable underglaze blue octagonal plate with the same decoration is contained in the collections of the Victoria and Albert Museum (C591-1924) catalogued as of unknown factory and dated c. 1750. A discussion on both plates and their relationship with one another is given in Fig. 2a and Appendix 1.

The Limehouse Si-Al-Ca body (Table 1, Nos. 3-9) is derivative from Bow hard-paste, first pat- ent porcelains which were made using refractory Cherokee clay (Table 1, Figure 2). Unlike Bow, Limehouse was unable to source Cherokee china clay and settled instead for a ball clay, most likely from Dorset.

In addition, Limehouse added crushed silica or calcined flint to the body and the resultant Lime- house body was covered with a lead-based glaze, whereas Bow employed on its first patent wares a Si-Al-Ca glaze, which itself was subsequently utilised by Limehouse on its Si-Al experimental body (Table 2, Nos. 1-2). These Bow porcelains (A-marked wares) by early 1745 had reached a high degree of sophistication, as recorded in the Vincennes Privilege (Daniels, 2007). Although this Privilege dates unequivocally the manufac- ture of the so-called high-style porcelains from this group, Daniels’ recognition of this significant date in relation to Bow first patent porcelains based on absolute dating is still ignored in the literature in favour of relative dating based on inferred stylistic linkages on the unsubstantiated assumption that the assumed artist went from Bow to Chelsea. If from Chelsea to Bow, then this would date these Bow first patent porcelains to the late 1740s if not the 1750s .

Lastly the Limehouse Mg-P body finds its possible antecedents in Bow (Table 1, Table 2, Figure 2) but here Bow used in addition a high-clay compo- sition, no doubt influenced by its first patent body (Ramsay et al., 2005) covered with a distinctive Bow lead glaze (Ramsay et al., 2011b). This Bow Al-Mg-P body contains a high level of ball clay, possibly from Dorset, as indicated by its marked TiO2 content (0.5 wt%). The phosphorus in the body (2.7 wt% P2O5) is assumed to represent the addition of bone ash and the magnesia (3.1 wt% MgO) is suggested to reflect the use of steatite in the body. Other possible sources of magnesium could have been magnesite (MgCO3) or more likely dolomite (MgCaCO3) as discussed above for the Limehouse pickles (Table 1: 1). The notion that Bow never used steatite: comprehends the mindset of a decade ago that Bow could never have produced the ‘A’-marked porce- lains and this current opposition to the use of stea- tite by Bow is now the foundation for resistance to the view that the George II busts could have a Bow provenance as proposed by Dumbell (2007). Hobbs (1995) summarises much of the evidence available on the early use of steatite and Daniels (2007) dis- cusses the possibility of its use at Bow. Some of this information is included in Appendix 1.

The first evidence that Bow may have been utilis- ing steatite came from an analysis of a polychrome tea canister decorated with the Island House pat- tern in the collections of the National Gallery of Victoria (Ramsay and Ramsay, 2005). At the time the authors believed that the Bow porcelain out- put could be regarded as compositionally bimodal (Bow first patent, high-Al body and the Bow second patent bone ash body) and consequently they classified this canister with its high-Al body (infected high-clay) as being a member of the for- mer group (‘A’-marked group). However by 2007 (Ramsay and Ramsay, 2007a, 2007b) it became obvious that the Bow recipe types were composi- tionally polygonal and that a number of porce- lain bodies were being produced by Bow by the early 1740s. The authors specifically recanted and described this porcelain canister as having its own distinctive high-alumina - high silica - sulphate - recipe (Al-Mg-S) and hence not conforming to the ‘A’-marked or Bow first patent body. Initially the authors (Ramsay and Ramsay, 2005) were uncertain as to the source of the magnesium in the tea canister body and consequently they pro- vided two possible recipe formulae to account for the bulk chemical composition of the tea canister, with Recipe 1 requiring the addition of magnesite (magnesium carbonate). The second theoretical formulation (Recipe 2) required the addition of talc or steatite to the porcelain body. Subsequent to that publication, discussions were held with Professor Ian Freestone and the consensus that arose was that there is more than one likely source for the magnesium. We contend that Bow magnesian porcelains using steatite would have to date no later than 1747 when the Kynance Cove occurrence had been exhausted, as recorded by Borlase, and the Gwe Graze deposits used by Ben- jamin Lund at Bristol had not yet been discovered.

Currently the use of steatite is postulated to have commenced at Limehouse, with Warney (1993: 29) stating that the potters who left Limehouse may have taken them with the secret of making soapstone porcelain. Based on the Warney model a number of technology pathways have been proposed from Limehouse to Lund’s Bristol, to Newcastle-under-Lyme (Pomona), and to Vauxhall (Warney, 1995; Appendix III), yet the crit- ical question that has not been asked is how did this short-lived, little known, unsuccessful factory manage to find the resources to invent and develop the use of steatite (and bone ash), together with two other body types, all internationally innova- tive compositions, in so short a period? Today it is still almost universally accepted that Limehouse
Limehouse porcellaneous wares have a compositional phylogenetic tree from the Burghley House jars to Lund’s Bristol. Some compositions listed with 4 components do not follow the classification advocated by Owen (2007).

<table>
<thead>
<tr>
<th>Location</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>LUND’S BRISTOL</td>
<td>Mg-Pb and Mg-P-Pb</td>
</tr>
<tr>
<td>BOW</td>
<td>Si-Al, Si-Al-Ca, Mg-P</td>
</tr>
<tr>
<td>JOHN WOODWARD</td>
<td>Magnesian body pre-1729</td>
</tr>
<tr>
<td>SIR HANS SLOANE PAPERS</td>
<td>Si-Al, Si-Al-Ca</td>
</tr>
<tr>
<td>BURGHELEY HOUSE JARS</td>
<td>pre-1683</td>
</tr>
</tbody>
</table>

Fig. 3. Compositional phylogenetic tree from the Burghley House jars to Lund’s Bristol. Some compositions listed with 4 components do not follow the classification advocated by Owen (2007).
A key feature in this discussion on Limehouse porcelain and its associated technology pathways relates to the origins of the English porcelain tradition, the development of which has been typically based on the long-held view that earlier Continental technology provided the English with the secrets of porcelain manufacture. In numerous overviews of the early years of the English porcelain industry (Honey, 1939; Savage, 1952; Warney, 1963; Fisher, 1965; Sandon, 1989, 2009; Young, 1999; Spero, 1998, 2006; Godden, 2004) little or no attention has been afforded the role and influence of the Royal Society of London, other than passing reference, for example, to Dr Martin Lister (Honey, 1939; MacKenna, 1948; Tilley, 1957) or to the use of cobalt found among Robert Hooke’s papers (Warney, 1963, 1973). This remained so until Daniels (2007) brought into focus the driving role of the Royal Society of London behind English porcelain development, most likely stretching back to John Dwight and Robert Boyle in the 1650s (Appendix 1). The traditional view held by many English ceramic historians and connoisseurs is that the Royal Society was primarily a purely scientific organisation and although some practical applications may have been attempted, the Society acted more often as an observer than as a promoter (Mallet, pers. com., July, 2009). In contrast Daniels (2007: 21) argues that the Royal Society was vitally interested in the firing of porcelains and by the late 1720s was in possession of technical information that detailed the materials and methods of four major types of porcelain made in Britain before the last quarter of the 18th Century - hard-paste, bone ash porcelains, magnesian porcelains, and the glassy French type. The Royal Society was originally named by the founding members The Invisible Society. From the very beginning funds were used to support financially any particularly promising industrial or commercial project proposed by private individuals (Appendix 1). One of the earliest promotions, if not the first, was towards the development of lead glass.

Further support for Daniels comes from the private papers of Sir Hans Sloane, President of the Royal Society of London. The Sloane Manuscript No. 5636 housed in the British Library, records a large number of experimental porcelain recipes, glazes, and colours, which appear to have been undertaken or commissioned by members of the Royal Society, during the general period 1708-1713 and contemporary with the development of Meissen porcelain (Table 5) and prior to, or contemporary with, the first of d’Entrecolles’ letters. The absence of any mention of bone ash or steatite in the recipes suggests to us that these experimental firings took place prior to ~1720 as indicated by two of the folios - Folio 70 recto, dated February 28th, 1707/8 and Folio 66 verso, which is headed “For Potters Colors things T ryed in y’ year 1713 & found to be good”. These recipe formulations were discovered by Margaret Macfarlane on September 11th, 1985 (pers. com., 25th February, 2011). In particular we draw attention to Folio 76 Recto, Experiment X, which contains the following recipe: Crown glass (2-12), Tob. Pipe clay (2-12), and Calcined flints (2-12) (Table 5). Although the person who conducted this firing was less than impressed with the final product, noting that the porcelain body was ‘not good’ (Table 5), its composition and the raw materials used are closely analogous with the Limehouse Si-Al-Ca body (Tables 1, 6), thus demonstrating a distinct technology pathway from these experimental firings, commissioned, or undertaken by members of the Royal Society dating to the early 18th Century. Compositional parallels can also be drawn with the Bow Si-Al-Ca body (Table 6) although here Cherokee china clay was substituted for pipe clay and crushed silica was not included. Further there are a number of experimental firings listed in the Sloane papers exploring various ratios of calcined flints, ball clay, and salt petre (KNO3), whose compositions are analogous to the Bow and Limehouse Si-Al bodies (Table 1, Table 6).

**TABLE 5. SELECTED PORCELAIN FORMULATIONS FROM THE SIR HANS SLOANE DOCUMENTS**

<table>
<thead>
<tr>
<th>Folio</th>
<th>Verso/Recto</th>
<th>Number</th>
<th>Raw materials</th>
<th>Proportions</th>
<th>Observations Recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
<td>Recto</td>
<td>N</td>
<td>Crown glass</td>
<td>2 - 12</td>
<td>not good</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tob. Pipe clay</td>
<td>2 - 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Calcined flints</td>
<td>2 - 12</td>
<td></td>
</tr>
<tr>
<td>76</td>
<td>Recto</td>
<td>M</td>
<td>Pipe clay</td>
<td>2 - 12</td>
<td>good for nothing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Calcined flints</td>
<td>2 - 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Common salt</td>
<td>2 - 12</td>
<td></td>
</tr>
<tr>
<td>76</td>
<td>Recto</td>
<td>T</td>
<td>calcined Flint</td>
<td>3 -</td>
<td>not good</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Clay pipe</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Salt petre</td>
<td>2-12</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Zaffier</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>76</td>
<td>Verso</td>
<td>1</td>
<td>4 to 1 Flints calcined pipe clay</td>
<td>6 3 2.6f°</td>
<td>thu best &amp; must liken a China Earth but not very white nor but little transprnt</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Salt petre</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>76</td>
<td>Verso</td>
<td>3</td>
<td>Flints calcined</td>
<td>2 - 12</td>
<td>This is Greenish white Half</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>pipe clay</td>
<td>2 - 12</td>
<td>Transparent &amp; Glassy pretty good</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Salt petre</td>
<td>2 - 12</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 6. CHEMICAL COMPARISONS OF SI-AL-CA AND SI-AL BODIES

<table>
<thead>
<tr>
<th>Si-AL-CA bodies</th>
<th>Si-Al bodies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>SiO2</td>
<td>77.2</td>
</tr>
<tr>
<td>TiO2</td>
<td>0.4</td>
</tr>
<tr>
<td>Al2O3</td>
<td>10.3</td>
</tr>
<tr>
<td>FeO</td>
<td>0.4</td>
</tr>
<tr>
<td>MgO</td>
<td>0.13</td>
</tr>
<tr>
<td>CaO</td>
<td>5.3</td>
</tr>
<tr>
<td>Na2O</td>
<td>2.7</td>
</tr>
<tr>
<td>K2O</td>
<td>3.6</td>
</tr>
<tr>
<td>P2O5</td>
<td>0.1</td>
</tr>
<tr>
<td>SO3</td>
<td></td>
</tr>
<tr>
<td>PbO</td>
<td>1.3</td>
</tr>
<tr>
<td>Other #</td>
<td>0.5</td>
</tr>
<tr>
<td>Total</td>
<td>100.03</td>
</tr>
</tbody>
</table>

1. Theoretical Hans Sloane composition, Folio 76 recto, Experiment N (1/3 crown glass, 1/3 Tob. pipe clay, 1/3 calcined flints). Recipe calculated using Warham Basin ball clay (Ramsay and Ramsay, 2007b) and crown glass (CaO 15%, K2O 7.5%, Na2O 7.5%).
2. Average analysis of four Limehouse Si-Al-Ca bodies (Freestone, 1993).
3. Burghley House lid to small jar (Spataro et al., 2008).
4. W. W. Winkworth Bow first patent teapot (X mark) (Ramsay and Ramsay, 2007b; Table 4, Fig. 4a).
5. Burghley House ‘Virtues’ Jar (Spataro et al., 2008). ‘Other’ includes SiO2 0.3%, BaO 0.1%.
6. Burghley House small jar (Spataro et al., 2008). ‘Others’ includes SiO2 0.4%.
7. John Dwight’s Fullam fine white ware, FP3 (Tietje et al., 1986; Spataro et al., 2008).
8. Bow gilded underglaze blue plate. (This account Table 1, No. 13; Fig. 26).

To our way of thinking the Virtues Jar, based on the Spataro et al. analyses reflects the use of ball clay and whilst the body of the smaller Burghley House jar does reflect a composition comparable to 17th Century Japanese porcelains it also reflects a Si-Al body known to have been produced in England dating back to crucible makers of Medieval times (Freestone and Tite, 1986) and experimentally by the Royal Society in the very early 18th Century (Hans Sloane papers). Moreover the marked presence of lead in the body of the Virtues Jar, the smaller jar, and its lid, links all three bodies and does not reflect a Far Eastern derivation to us. In addition the presence of both a moderately high K2O content and sulphur expressed as SO3 in the body of the Virtues Jar (Table 6) supports the addition of alum as recorded by Robert Hooke in his diary of 16th May, 1674 (Appendix 1). We doubt that the lid of the smaller jar is a later replacement as it too has evidence of both a lime-alkali glaze and a lead-based glaze suggesting the same origin as the Virtues Jar. We also note that the lid to the smaller of the Burghley House jars has a number of features which resonate with the bulk chemistry of the Royal Society experimental Si-Al-Ca body, the Bow first patent Si-Al-Ca porcelain body and the subsequent Limehouse Si-Al-Ca body (Table 6).

We suggest that the Virtues jar, the smaller jar, and its lid, are linked by the distinct presence of lead in the body of all three items and the presence of a mixed Si-Al-Ca glaze and a lower-firing lead glaze on the Virtues jar and the lid to the smaller jar. In the case of the smaller jar itself, one analysis only of the glaze is currently available and this is strongly lead-bearing. The overall impression, based on the analyses of the Burghley House jars, is that they are of English derivation with both the Si-Al and Si-Al-Ca bodies traced through to recipe types experimented with in the Hans Sloane papers dating back to 1708. Moreover a future study of the lid to the small jar looking for the addition of a lime-alkali glass frit may further establish the local origin of this item. A micro-textural and compositional study of a Bow first patent teapot lid in the white, recovered from the Bow New Canton site in Essex (Owen, in press) has recognised the presence of resorbed glass frit in the body of the lid.
This resorption of the lime-alkali frit is interpreted by Owen to comprise a two-part process involving (1) diffusion of (principally) alkalis and lime into the clayey matrix at subsolidus temperatures and then (2) partial melting near the interface between the relict glass fragments and the adjacent, fluxed (alkaline) clay. We suggest that a similar study of the lid to the smaller jar may likewise establish comparable features if a lime-alkali glass frit was used as we suspect.

The use of a high clay - glass /+/- crushed silica is a feature of early to mid 18th Century English recipes, as initially suggested to us by Professor Ian Freestone (personal communication 2009). Nigel Wood notes that this recipe type finds its antecedents in the 11th Century Middle East in attempts to copy Chinese porcelain. In more 'recent' times this recipe formulation seems to have been a feature of Italian porcelains such as the Medici wares and later types. In summary we are of the opinion that all three members of the Burghley House trio (Virtues Jar and one of the two analysed jars with its lid) are contemporaneous and closely related although different clays were used. The distinctive lead content in the body of each (2.2, 1.7, and 1.7 wt% PbO) indicates the presence of moderately high K2O ball clay (Appendix 1) could date back to 1674. Moreover the presence of moderately high K2O has been noted by Spataro et al., (2008) have noted different clays were used. The distinctive lead content in the body of each (2.2, 1.7, and 1.7 wt% PbO) strongly indicates the use of alum by Dwight, again as recorded by Robert Hooke in his diary (Appendix 1) for 16th May, 1674. In contrast, based on the inferred use of china clay in the smaller of the Burghley Jars (Table 6: 3, 6) we would date this jar and lid to c. 1678, again based on the report by Robert Hooke to the Royal Society of 5th December, 1678, that Mr. Dwight had made some heads of earth as big as the life and that his earth used was as hard as porphyry and that the excellence of the China earth was that it would endure the greatest fire without vitrification. From previous observations by Hooke (Appendix 1) it is understood the difference between tobacco clay (ball clay) and china clay. Moreover Hooke records that this china earth was highly refractory. This feature, coupled with the fact that Hooke made this observation, differentiates it from the more typical clays then known in England. Hooke's comments at the Royal Society meeting of December 1678 resonate with an earlier record of a Royal Society meeting of 25 February, 1674/75 as when Robert Hooke, brought in an artificial head resembling china made in England of English clay so hard and solid that he said nothing would fasten on it except a diamond and that it received its polish in the fire (Appendix 1). The fact that Hooke specified that this ceramic head was of English derivation made using English clay, we assume by Dwight, tends to suggest that by early 1675 Dwight had access to other clays and materials, not of English origin and Hooke was aware of it.

If there is any basis for these observations based on chemistry and historical eyewitness accounts by various highly reputable scientists, all members of the Royal Society, then the smaller jar and its lid would represent the earliest example in the Western world of a high-fired, aluminous body using china clay dating to c. 1678, some 30 years before Meissen. The reference to ‘China earth’ by Robert Hooke in early December 1678 and ‘China Earth’ in the Sloane papers (Folio 76 verso, No. I - see Table 5) dating to the period c. 1708-1715, coupled with the fact that Dr William Sherrard FRS, brought back samples of china clay and china stone from Paris around 1712, demonstrates that the Royal Society was fully aware of primary china clay and its applications to porcelain manufacture.

The problem may have been not so much a technical one but rather a problem of access to a secure primary clay source. Our research questions the long-held view that the discovery of china clay and the production of a hard-paste body in England commenced with William Cookworthy in Plymouth by the third quarter of the 18th Century (Martraire, 1868; Burton, 1996c; Eccles and Racketham, 1992; Mackenna 1946; Warney 1963, 1973; Sandon 1989; Spero, 1998; Young, 1999; Hillis, 2001; Godden 2004; Pietsch, 2010) as discussed by Ramsay and Ramsay (2006, 2007b, 2008).

RECIPE LINKS TO SI-AL CRUCIBLES FROM HESSE, GERMANY, AND STAMFORD LINCOLNSHIRE

Two locations in Europe have been identified where refractory Si-Al crucibles were being produced since the 15th Century, namely from Hesse and the region a Bavaria (Martrín-Torres and Rehren, 2009). The Hessian examples were characterised by having very high Al2O3 contents for unused crucibles (average of 9.9 wt%). Apparently Medieval high-Al crucibles were also being made in Stafford, UK (Freestone and Tite, 1986). However, these Stamford crucibles did not attain the success achieved by their Hessian contemporaries and Martrín-Torres and Rehren (2009) suggest that the English crucibles were never subjected to the high-temperature pre-firing, which gave the Hessian variants their prized refractory properties.

Pearce and Tipton (2011) record that during the reign of Elizabeth I continental ceramic technology arrived in England by three different routes:

1. Migration of tin-glazed technology to Aldgate in London from Urbino in Italy via Antwerp and Norwich;
2. Design and technology brought by a single immigrant potter, Herman Reynolds, from the Rhineland; and
3. Development of industrial ceramics, essential to the refining of noble metals, in London and the Blackwater Valley and used alongside imports of Hessian crucibles.

According to Pearce and Tipton (2011) in the case of the third development, the Tower of London had a pottery set up well before 1560 to manufacture ceramics for the Royal Mint’s own use. With problems associated with Henry VIII’s debased currency the new Upper Mint was built in the Tower in 1560 and two new refining houses were constructed; one located within the Tower in Coldharbour and the other, outside the Tower in East Smithfield. The German firm of Wohlstadt was given the contract for metal refining and introduced new technology in the 1560s. A local potter, Richard Dee, apparently commenced making various specialised ceramics needed for metal refining capable of being resistant to concentrated acids at high temperatures (Pearce and Tipton 2011) question how he came to produce such wares. One possibility they suggest is that Dee took on an employee of the pottery at the mint or even an immigrant from Wohlstadt. Another possibility is that Bastian Miller joined Richard Dee after 1586.

Regardless, we have good evidence of Medieval Si-Al ceramics being produced in Stafford with Al2O3 levels in the order of 38 wt% (Freestone and Tite, 1986). Subsequently, alumina ceramics were being produced by the late 1500s both in London and the Blackwater Valley.

FINAL COMMENT

Wesley (2008) states that the high Al2O3 body of the ‘Burghley House’ trio did not represent a stage in the development of other English bodies as did Börger’s porcelain in the development of later Meissen and other German porcelain bodies. We contend that the compositions found in the Burghley House porcelains, in tandem with Dwight’s recipe type by Richard Dee, the porcelain experimental work by John Dwight in the latter part of the 17th Century, to the experimental firings recorded in the Hans Sloane documents of the early 18th Century, the 1720s experimental work by John Woodward on magnesium porcelains, through to the brilliant
high-fired, hard-paste wares of the Bow first parent Si-Al-Ca body, Bow’s associated higher-fired Al-Mg Si-P P bodies, and a range of bone ash types. This development can in turn be traced to Limehouse’s three recipe types and Pomona’s Si-Al-Ca and Si-Al bodies, to Lund’s Mg-P-Pb and Mg-Pb bodies (Fig. 3), and thence to William Reids Si-Al body in Liverpool. Nicholas Cripp at Bovey Tracey (if not earlier at Vauxhall), and finally in Cookworthy’s high-fired Si-Al body in Devon. Likewise, Professor Ian Freestone (pers. com., June 2008) has suggested the idea that glass can be added to clay to make porcelain is an important link between Bow, Limehouse, Pomona, and several other ceramic types dating from the late 17th to the mid 18th Century.

These compositional links give considerable credence to the views of Daniels as to the role of the Royal Society of London and we opine that English porcelain development had less to do with alchemy or foreign technology and more a reflection of rational English science and technology.

CONCLUSIONS

It is concluded that three porcelain compositions were produced at Limehouse. Two of these ceramic bodies (Si-Al and Si-Al-Ca recipes) have been recognised for the last 20 years from wasters and sherds, while a third recipe (Mg-P) is newly identified and tentatively attributed to Limehouse. The Royal Society of London and we opine that English porcelain development had less to do with alchemy or foreign technology and more a reflection of rational English science and technology.

Criteria, both visual and chemical, are provided to separate the three bodies and based on limited data it is proposed that Lund’s Bristol wares may be differentiated from Limehouse bodies based on the high levels of lead found to occur in the former. A technology pathway based on the ‘Limehouse’ Mg-P body extends to the Lund’s Bristol Mg-P-Pb body. Likewise, we conclude that Limehouse was derivative from Bow by means of the Si-Al experimental body, Si-Al-Ca body, the Mg-P body, and the use of a Si-Al-Ca glaze on the Limehouse experimental body. We affirm that Limehouse, a failed, infant potworks, was highly derivative from Bow and thence from earlier experimental porcelain firings, supported or undertaken by Fellows of the Royal Society of London, stretching back to the early 18th Century and thence to the 17th Century. In fact the Si-Al refractory body can be traced back to Medieval times at Stamford, Lincolnshire.

Other derivative features found in Limehouse from Bow, in addition to the use of steatite and bone ash, include the use of moulded forms, the production of a variety of silver shapes, and the use of underglaze blue decoration. We note that the Si-Al-Ca body has an intrinsic English character and this body can be traced to the lid of a small jar at Burghley House, which we suggest was made at least 30 years prior to Meissen by John Dwight, through experimental firings of this body type by the Royal Society during the early 18th Century, to the brilliant, high-fired, Si-Al-Ca body found in Bow first patent porcelains (c. 1743-1746), and thence to the Limehouse Si-Al-Ca type (c. 1746-1747). Evidence is presented to suggest that the English were producing high-fired, hard-paste bodies using both an inferred primary china clay and a secondary ball clay prior to 1683.

This contribution demonstrates that the Royal Society of London was vitally interested in the development of an English porcelain industry from the time of its inauguration, even before the Charter of 1662. Its constant contact with John Dwight, compositional observations by contemporaries, and facts surrounding Dwight’s ‘China’ lead us to the conclusion that the Fullham potter was responsible for the Burghley House jars. Visits to London and contact with Society Fellows by Tschirnhaus in 1675 and Helvet in 1740 may even suggest technology transference from England to Continental Europe. This interest continued right up to the time of the involvement of leading Fellows in the development of an English industry through the Bow Factory commencing in the early 1730s. We have also shown that the Bow Factory was well established and producing highly sophisticated porcelains before the Limehouse Factory even commenced production in mid to late 1745. This output by Bow includes the technically and artistically brilliant first patent (‘A’-marked) wares, the early portrait figures, and the magnificent busts of King George II in 1745-46, as will be discussed by the authors in some detail in a forthcoming monograph.

Based on our research that Bow was producing commercial, high-fired, hard-paste porcelains by 1743-1744 we propose that many notions and beliefs that have sustained English ceramic connoisseurship over the last 100 years (Chelsea being the first to manufacture porcelain and the only porcelain to compare with Meissen, Cookworthy the first to manufacture a hard-paste body, the 1744 patent of Heylyn and Frye being ‘hesitant’ and ‘not worth the paper it was written on’, Bow producing bone ash wares only from the late 1740s for the middle classes, the innovative nature of Limehouse, and notions regarding wandering Continental potters) need to be rethought. We contend that by the 1730s London had become the world-leader in porcelain research and technology, yet these developments have remained opaque to previous ceramic studies over the last 150 years.

A feature of this contribution on Limehouse has been that less emphasis has been afforded notions as to the primacy of the artistic pursuit (Fisher, 1947) and more reliance placed on historical context, contemporary documents, and porcelain composition. To rephrase Pawson and Brooking (2002: 5).

It has not been seen as of sufficient interest when a belief in the separation of form, decorative idioms, and the shade of grey observed in the glaze, from materials science, composition, and even contemporary documents renders the former central to the enquiry and the latter unproblematic.

ACKNOWLEDGEMENTS

This inquiry into the use of steatite has been generously supported by research grants from the American Ceramic Circle and the Southern Institution of Technology, New Zealand. The authors record their appreciation for these grants. Considerable discussion was had during the preparation of the manuscript with Geoffrey Godden, Dr Bill Jay, Margaret Macfarlane, Victor Owen, and Nigel Wood and we thank these people for their time and interest. We also thank most sincerely the active support received from Alison Cooper, Paul Crane, Geoffrey Godden, Julia Poole, Karin Walton, and private collectors, who generously allowed the authors to micro-sample key porcelain items in their collections. Without this support this paper could not have been written. We also record our gratitude to Margaret Macfarlane for advising us of her discovery in September 1985 of the Sir Hans Sloane papers, which contain records of early porcelain experimentation. Likewise, Nigel Wood kindly furnished us with an unpublished manuscript written by him in May, 2010 on the Burghley House jars.

Acknowledgement is given to the British Library to quote from the Hans Sloane papers in its collections.

The authors record their gratitude to Jon Culverhouse of Burghley House and to Joanna Corden, archivist to the Royal Society of London for their interest and help.
REFERENCES


Dakin, R. H., 1937: John Dwight, some contemporary references. Transactions English Ceramic Circle, 5, pp. 30-37


Owen, V. J., 2003: Geochemistry of Worcester porcelain from Dr. Wall to Royal Worcester: 150 years of innovation. Histor- ical Archaeology, 37, 84-96.


APPENDIX I: THE ADVANCEMENT OF PORCELAIN TECHNOLOGY IN ENGLAND FROM MEDIEVAL TIME TO THE CLOSURE OF THE LIMEHOUSE FACTORY WITH OBSERVATIONS BY THE AUTHORS

Medieval
High-alumina refractory crucibles being made in Stafford (Freestone and Titus, 1986).

1565:
Arrival in London of German technology associated with refining metals at the Royal Mint through the German firm Wohltzard (Freestone and Titus, 1986).

By the late 1560s Richard Dee was producing alumina refractory crucibles possibly in London and the Blackwater Valley (Freestone and Titus, 2011).

1581 – 1596:
Dates on surviving pieces of Medici Porcelain (so-called). A manuscript giving the formulae which included a glassy frit and some kaolin from Vincenza, is preserved in the Biblioteca Magistrale Veneta. Apparently the manufacture was successful in 1575 after 10 years of experimentation.

Wenley, B. M., 1993: ‘The documentary evidence: In D. Drake, Editor, Limehouse Ware Revealed, Chapter 1. Published by the English Ceramic Circle.

Wenley, B. M., 1993: Limehouse, its relationship to New- castle-under-Lyme (Fornace) and other manufactories. In D. Drakard, Editor, Limehouse Ware Revealed, Chapter 6. Published by the English Ceramic Circle.


1626:
On the 24th October 1626, Roux and Cullen, merchants of London obtained a patent for the sole right to manufacture, Stone, Pots, Jugs and Stone Bottles, in England or in Dominions of the same for a period of 14 years (Toppin, 1937).

1646 – 1672
In 1632 Mr. Arundell Esquile pointed out that the recipe for Chinese porcelain and information as to the source of their clay had been known in England through various editions of Sir Thomas Browne’s Prognostica Epidemica published be- tween 1646 and 1672.

1651/52
Johann Rudolf Glauber (1604-1680) publishes A Description of New Philosophical Pharmaceuticks, and the English translation appeared in London in 1651/52. This work was largely devoted to the science of distillation and the making of chemi- cal equipment. As Halsgrove and Murray (1979) point out, Dwight working under Boyle could hardly have failed to be familiar with this work.

1655 or early 1656
John Dwight arrives in Oxford to live (Maddison, 1669), as does Robert Boyle.

1660/61
23rd February, 1660/61. John Dwight marries Lydia Parker in London. As at the same time Dwight is appointed Secre- tary to Bishop Walter Wason of Chester.

1661
The Royal Society of London receives an eye witness account of porcelain-making in Nankin, including a description of clayworks and the information as to the source of the clay, how they were mined, and prepared at the site before transported to the numerous potters working some distance away at Jing- dezhou (China). The methods of forming, firing and finishing are also given and it is noted that a percentage of each potter’s production was reserved for the Emperor. This involved regular inspections by each potter by government servants (Royal Society of London, 1660-1741).

Samuel Pepys describes in his diary a journey down the Thames to visit a Porcelain Factory at Limehouse, alighting at Duke Shore Steps. The coincidence of the date with the letter containing the above description of china-making and the use of the word Porcelain by Pepys makes us wonder whether Pepys had been aware of its contents and whether porcelain experimentation at a site in Limehouse dating to 1661/62 was being carried out. Pepys was already on familiar terms with several Fellows of the Society, including Robert Hooke, and it is worth noting that the instrument-maker Ralph Cavendish took Pepys to the recently set-up Gresham College in Janu- ary 1660/1. Among the founding members were his past and future bosses, Lord Sandwich and Brouncker and William Coventry, John Evelyn, destined to become a friend, Penn, Hooke, and Wren; John Wilkins, John Wallis, and William Crooke (Tomalin, 2003). Actually the Zoological Society, as first named and formalized for the purpose of learning by experimen- tal science and sharing of knowledge was inaugurated at Wad- ham College, Oxford University and early experiments were carried out in the grounds of the College. John Dwight and Robert Hooke were contemporaries at Oxford at that time with Hooke being appointed the first curator of experiments. Other founding members of the Royal Society were the Duke of Buckingham, 1661, the Earl of Devonshire, 1660, and

Ramsay, W. Ross H., Daniels, Pat, & Ramsay, E. Gaile, 31
soon afterwards Prince Rupert, all associated with early porcelaine art in England. On obtaining a Royal Charter from Charles II in 1662 they became known as The Royal Society of London. Robert Boyle FRS publishes, The Sceptical Chymist but this account does not describe the work carried out at Oxford (Ha- selgrove & Murray, 1979).

29th June, 1661 John Dwight is appointed Registrar and Scribe to Bishop Warton. September, 1661 John Dwight arrives in Chester to take up his position at the Bishop before setting up his experimentat potttery at Wiggen. 17th December, 1661 BCL degree conferred on John Dwight.

1665 The Royal Society’s Transactions include notice of An Intimation of the Way, found in Europe, to make China-dishes. Samuel Pepys is admitted as a Fellow of the Royal Society. 4th December, 1665, Philosophical Transactions of the Royal Society Volume 1, 1665 & 1666, page 127. An introduction of a way found in Europe to make China dishes. Secret of Signor Sepradu a Canon of Milan making ‘as good Porcelaine as is made in China itself, and transparent, adding that he had seen him make some.

Page 249 (undated). The Embassy of the Dutch into China. A Geography of China by Mon. Thomas. The way that making Porcelaine is this: (Which is the rather inserted here, because it agrees so well with an account, we received a while since from an intelligent person of Amsterdan). There is a Province of Nankin, a Town, call’d Giaozow, whence they draw the Earth for Porcelaine, which is found betweens the Rocks. The Earth they boil very small and stamp it to a very Fine Powder and then put it into Pipes filled with water, where the finest part sinks to the Bottom. Afterwards it is kneaded in the form of small Cubes of the weight of about 3 Catts (a Catt being 20 Manes). These pieces thus wrought are sold in the people, that commonly in great numbers fetch them, called ‘China’.

On 23rd April 1662 John Dwight of Fulham is awarded Patent No. 164 for the manufacture of transparent earthenware commonly known by the names of Porcelain or China and Persian ware and also for Stoneware vulgarly called Cogene Ware.

1667 John Dwight resigns from his position as Registrar and returns to London.

1672 April, 1667 John Dwight of Fulham is issued a warrant for the grant of Patent No. 164 at Whitehall and granted under the Great Seal on 23rd April for the manufacture of transparent Earthenware commonly known by the names of Porcelain or China and Persian ware and also for Stoneware vulgarly called Cologne Ware.

1667 Samuel Pepys is elected to the Council of the Royal Society and continues to serve for over a period of twenty-seven years.

1667 An amount of someone attempting to make porcelain by crushed bottle glass though it is uncertain as to whther this person was John Dwight as recorded in a notebook which finally came into the possession of Sir Hans Sloane (British Library, Sloane Manuscript 1998 f.166-7).

1667 From the diary of Robert Hooke on 17th February, 1667/7. Saw Mr. Dwight’s English China, Dr. Willis his head. A little the more of it is of different Tartine (a Tartine) in the Porcelaine of Kiiyote, being about 50 miles distant from Winting, near the City of KIAINZ, which people transport them to their homes, and burn them in this manner. They hasten their work so for the space of 15 Days and more and make Blocks for burning them so as that no Air may get in, and after 15 other days are past by they open the oven in the Presence of an Officer who takes every fifth need of each block for the Service of the European Earth. Earth is not preserved in Nankin where it is found because the people of that Province have not the skill of working it as Kanghi who also alone had the skill of melting.

On 29th December, 1667 from the diary of Robert Hooke, Met Dwight and discussed of pipes. He told me he could perfectly make and paint the china ware, that several times during the winterest heat would make it perfectly. I suppose his way is mixing the powder of tobacco pipe clay once burnt and with other wunder tobacco pigments to make the body that the greatnes of the fire is the secret, and the way of making the forner. As to the account by Dr. Pepys given above, it might appear that there is little or no Porcellaine tradition in the body, which was subsequently decorated with colours. A key feature was the necessary kiln technology and the ability to high-fire the porcelain body.

1668 September, 1678, Royal Society meeting at which Robert Pepys reports that Mr. Dwight had made some heads of earth as big as the life and that his earth used was as hard as porphyrite and that the excellence of the China earth was that it would endure the greatest fire without vitrification. Previous diary entries by Robert Hooke clearly recognised tobacco clay so this record by him of a highly refractory China earth resonates with the argument given by the authors in the body of this paper that ‘Romine China clay’, or possibly china clay from the New World, was being obtained at about this time.

1669 Samuel Pepys FRS includes ‘Soap-Stone, Stratis’, which are not at all dissoluble in Oil or Water. Nor in any indiffernt Fire; by which it only becomes somewhat harder and whiter’, in his Catalogue and Description of the Natural and Artificial Rarities belonging to the Royal Society.

1672 In 1677, two tiny jars with lids (now known as the Burghley jars owing to their place of discovery) and a larger jar (labelled the ‘Virtues’ jar because Prudence, Fortitude, and Fidelity are symbolised in polychrome enamels around the side) were reinserted because it matches an account, we received a while after that no record was found of the same name.

1677 Plot of the Ashmolean Museum, writes John Dwight, and had found out ways to make a Earth white and transparent for the Manufacture of Porcellane or China and Perce wares, and also by Experimentes that have been purposely made to try wherein they disagree. To this earth he had added the colours that are usual in the colour of china-waare, and divers other. As before the skill that had been wanting to set up a manufacture of this transparent Earthenware in Europe, like that of China, is the glazing of the Royal Society’s Virtues Jar, although this cannot have been of a ware that could itself endure the greatest heat.

1677 From the diary of Robert Hooke, Met Dwight and discussed of pipes. He told me he could perfectly make and paint the china ware, that several times during the winterest heat would make it perfectly. I suppose his way is mixing the powder of tobacco pipe clay once burnt and with other wunder tobacco pigments to make the body that the greatnes of the fire is the secret, and the way of making the forner. As to the account by Dr. Pepys given above, it might appear that there is little or no Porcellaine tradition in the body, which was subsequently decorated with colours. A key feature was the necessary kiln technology and the ability to high-fire the porcelain body.
account of these jars and their history we refer readers to the excellent series of papers in Transactions English Ceramic Cir-

A note inscribed, Duke of Buckingham's China, in the hand of the 9th Earl of Exeter (1725-1793) was discovered inside one of these tiny jars, where they were previously

known as the Buckingham jears. However, a now lost note saying, Patronized by the Duke of Buckingham, has also been recorded. It is likely that the Duke was only the financier of the project. Buckingham's period of exile and hectic life in politics and the military preclude any possibility that he was ever involved in the manufacture of porcelain. Projects, as well as Royal Society schemes, were regularly sponsored by wealthy Fellows of the Royal Society (see Pepys and Halley be-

low). In 1684 the Society employed Dwight for a considerable time in his laboratory in Fore Street later to be occupied by Joseph Wilson and Co. (Britten, 1991). 1685.

Dr. Martin Lister FRS published in the Philosophical Trans-

actions (1697) An ingenious paper in a new Set of Maps together with Tables of Sands and Clays. 19 May 1684, a warrant for the issue of John Dwight's sec-

ond patent is issued at Windsor. The list of articles included, transparent Porcelain. 1686.

December 1684 Samuel Pepys is elected President of the Roy-

al Society chosen for his administrative skills and influence. The Society's finances were in trouble but Pepys soon put things right, expelling members in arrears with their sub-

scriptions, about sixty were dismissed, including the Duke of Buckingham in 1685. Pepys himself always paid his subscrip-

1687-1698 The Royal Society recorded in its archives a description, Of China Ware and Porcelain. How it is made (Royal Society, 1687-1698). This account is in quite different language but has a description of porcelain making in China by another unknown correspondent similar to that noted at 1661 above. This account is published, but is entered between two letters each dated 1687.

1688 John Clayton FRS reported on his success in finding a satis-

factory clay for making crucibles in Virginia, where he had been sent to seek for suitable clays for the manufacture of various kinds. In his report he states, I have observed that at five or six Yards deep, at the Breaks of some Rands, I have found Vessels of admirable goodness, made of Pipes, or the like hard earth whereupon I suppose the Indians make their Pipes, and Pots, to boil their Meat in, which they do handsomely, and will endure fastenings the Fisher than any that I have yet seen. I have found earth in several Dresses, in the Soil, powdered, sifted, and sifted Dishes, and Glasses, three parts, two parts and one part as I remember, and therewith made a Large Crucible, which was the best yet ever tried in my Life; I took it once red hot out of the Fire, and slaps it immedi-

ately into Water, and it started not at all. 1691 July 1691 an extract from the will of Robert Boyle FRS, I give and bequeath unto Mr John Dwight and Mr John Whis-

 tame two notes written by each of them to the use of Five pounds, each of which notes was in the hand of the late Mr John Crosse's house. Based on the work of Maddison (1986) it appears that Dwight came to live in Oxford late in 1655 or early 1656. 1697/1698 Dwight's proposal to William Gilpin of White-

haven, ... Artificially the white China being as Claret and transparent as that which comes from China but for want of En-

forcement is partly given over, there being in a high Duty on All Earthen wares. 1698 Dr. Martin Lister FRS shows his continuing interest in the manufacture of porcelain when he writes in his, An Account of a Journey in France in the Year 1698 a description of the potteries of Sarthe Clay, including details of the decoration and glazing, describes a substance and the Matter of the Pots and notes that it took twenty-five years to perfect. This time-lag has relevance to our current enquiry into the development of porcelain. 1706.

As Mortimer finishes his kiln, Andrew Duchè moves to Sa-

ton, or the land route to London. 1714.

With improvements made famous by instrument makers, George Graham FRS and John Elliot FRS, Jackson builds Mortimer's machine. Mortimer has invented a self-filling kiln with an arbor and wind-furnace that allows him to reg-

ister temperatures to the point of melting iron (~1550 °C). Mortimer writes to Boerhaave informing him of his success (Chaldecott, 1969; Daniels, 2007).

The above quote demonstrates the close relationship enjoyed by Dwight with members of the Royal Society and may ex-

plain why the Boughay Jas, its tile, and the Verans Jas all have containing compositions as discussed in this contribution. Sir John Lowther FRS in 1698 was MP for Cumberland. 1707-1713 Experiments carried out apparently in London by an un-

known chemist/potter, to develop porcelain bodies, glazes, and colours. The tone of the recordings of this experimental work suggests that these experiments were conducted under the patronage of the Royal Society or Fellows of it. A range of compositions are included including Si-Al bodies and Al-

Ca body using ball clay, crushed silica, and glass. Comparable recipes find their expression at both Bow and Limehouse some 30 years later. These experimental results are preserved in the Hans Sloane Manuscript No. 3636 housed in the British Library as pointed out to the authors by Margaret Macfarlane and as discussed in more detail in this account by the authors. 1708.

Chimneys of Tchilmassanu and Boriesh manage to develop a hard paste porcelain in Sanomy from a local impure kaolin clay known as Shimor's white earth and slaked alabaster. 1710 Production of hard-paste porcelain at Meissen commences us-

ing slaked alabaster and an impure kaolin clay. 1712 The first two letters written by François Xavier d'Entrecolles, who traveled and worked at Jingelode in 1712. He wrote accounts of Chinese ceramic practices in 1712 and 1722. These letters were in turn published in Paris in 1717 and 1722 in Jean-Baptiste Du Halde's The General History ....... of the Empire of China, Chinese Tartary, Corea and Tibet, with the English edition appear-

ing 1717. However, Dr. William Sheard FRS had already communicated the information in these letters to the Royal Society and provided specimens of the native rocks of China and of the prepared clay. We note that although this first of two letters by d'Entrecolles is widely quoted by writers as a first account of Chinese porcelain manufacture available in the West, the Royal Society had comparable information available to it by 1661 (if not earlier through Brown's Pseudo-

edentia.) 1722 A surrogacy copy of Herman Boerhaave's New Chemistry is published in London by Shaw and Chambers. This includes Boerhaave's discovery of the term 'tire of clay' [bone ash] as a compo-

nent of a type of porcelain. Dr. Cromwell Mortimer FRS, who studied for five years in Leyden under Boerhaave, becom-

ing M.D. in 1724, was one of many of the Professor's students who attended his original lectures in Latin and carried his theories abroad. 1728 John Woodward FRS completes his experiments on soaprock from Cornwall and the results published posthumously in the Royal Society's Transactions in 1729.

Dr. Cromwell Mortimer FRS is appointed assistant to Sir Hans Sloane from 1729-1740 and moves to Bloomsbury Square. It occurs to us that the appointment of Mortimer after Woodward's death on the 23rd April, 1728 is auspicious and suggests that Mortimer may have been selected to carry on with Woodward's experiments. 1729/1730 25th March, 1729/30 Alexander Cameron FRS, sponsored by colleagues, Fellows of the Committee of the Royal Society of London, visits the Colonies in the proposed new Colony of Georgia (Daniels, 2007). 1732 Andrew Duchi, a potter from Philadelphia, is in London. We suspect that while in London he was appointed agent for the Colonial Bowing concern. On 6th October 1735 he proceeded to Charleston, South Carolina in 1734. By around April 1735 Duchi was in New Windsor, South Carolina lo-

cated adjacent to the Savannah River. On 4th October 1735 he applied for 150 acres of land at New Windsor (Rauschen-

berg, 1991). We suggest that the move from Philadelphia to New Windsor was planned in advance and the location where slates could be used, was procured as to act as a site for upgrading Cherokee clay before shipment via the water route or the land route to London. 1735 Hand-on-hand insurance company Policy No. 6095 was taken out by Griffith Care, a driller, on 20 Fore Street, Lime-

house. This Policy was discovered by Frank Britten, which enabled him to identify the exact location of the site at 20 Fore Street later to be occupied by Joseph Wilson and Co. (Britten, 1991). 1735 Dr. Cromwell Mortimer FRS succeeds with his thermometer for measuring and controlling a high temperature furnace. William Borlase sends a further sample of soap-

rock to Leyden at the request of John Andrew. 1740.

With improvements made famous by instrument makers, George Graham FRS and John Elliot FRS, Jackson builds Mortimer's machine. Mortimer has invented a self-filling kiln with an arbor and wind-furnace that allows him to reg-

ister temperatures to the point of melting iron (~1550 °C). Mortimer writes to Boerhaave informing him of his success (Chaldecott, 1969; Daniels, 2007). As Mortimer finishes his kiln, Andrew Duchè moves to Sa-

ton, or the land route to London. 1740.

William Borlase sends a further sample of Cornish soaprock to Boerhaave at Leyden and continues to distribute samples elsewhere until 1748. Edward Heylign and Benjamin Lund declared bankrupt. 1748.

Edward Heylign, one of the original Bow proprietors, attends a meeting of the Royal Society when a visit was being paid to London. In Savannah, Georgia, Andrew Duchi shows a sample of por-

celain to William Stephens, Secretary to the Trustees. Ste-

phens is not impressed. 1749 Hand-on-Hand Insurance Policy No. 6095, 16th June, 1740 to, James Desmound of an Ann Mile Distillery on a Br House sold £300 © a Still House & Stable sold £75 in a yard on South
In Savannah, Georgia, Andrew Ducâl shows a further sample of porcelain to William Stephens, who describes the cup as transfixed and compatible to the finest porcelain in everyday use, which we assume to be of Chinese origin. We suspect that cup was an example of experimental A-mark porcelain made at Bow.

1744/5 10 February, 1742/3. At a meeting of the Royal Society, as a guest of Dr. Cromwell Mortimer, Thomas Bryand shows a sample of porcelain to William Stephens, who describes the cup as transfixed and comparable to the finest porcelain in everyday use, which we assume to be of Chinese origin. We suspect that cup was an example of experimental A-mark porcelain made at Bow.

1745/6 20 cows (1 ton) of earth unsorted imported into London from Carolina between Christmas 1743 and 25th March, 1744. We regard this clay as Cherokee china clay. Daniels (2007).

1st assessment for Land Tax in July (Vol. 21, p. 11), is marked Empty late James Dunsart. Rent £20, Tax £4.6.0.

2nd assessment for Land Tax in March (Vol. 21, p. 5), Thomas Ward, Rent £9, Tax £1.6.0.


In Savannah, Georgia, Andrew Ducâl shows a further sample of porcelain to William Stephens, who describes the cup as transfixed and compatible to the finest porcelain in everyday use, which we assume to be of Chinese origin. We suspect that cup was an example of experimental A-mark porcelain made at Bow.

1746 Andrew Ducâl is apparently informed that clay is no longer required at Bow. He departs Charleston in June and Savannah in September 1746.

1st assessment for Land Tax in June (Vol. 25, p. 5), Empty late Thomas Ward, Rent £9, Tax £1.10.0.


25th July 1746. Possible date inscribed in blue on the base of a waster bowl recovered during excavations on the Newcastle-under-Lyme (Pottery) pottery site (Bennett, 1975).

December, 1746. William Ball is included in the Bow baptism register for 1745/6 when his first daughter, Mary, born in the Land Tax Assessments for St. Mary, Bow in 1746 (Adams), 1969).

Interestingly, Edward Heylyn and Alexander Dick were both signatories to a Petition to the King (London Gazette 25/17(456)) in which the merchants of London offered to raise a regiment of troops for the defense of the City, to prevent the Jacobite army advance on the City. Anti-Gallican Stephen Theodor Jansen also signed the Petition. A similar contemporary Petition to the King by popular actors on the London stage, such as David Garrick, James Lacy, Peg Woffington, and poet laureate Colby Cibber, is celebrated in a print titled A Measure of Bay Toys (Daniels, 2007).

28th December 1745. Letter from Mr. James Middleton of Shelton in Staffordshire to Daniel & William Zor, at the Pan-paw in Four-street (sic), nigh Ditchie-shore in Limehouse, London. This letter mentions the arrival of the Stuart Army in Shelton, where Middleton’s relations was held pris

1745/6 5th February, 1745/6 Thomas Bryand, previously at Bow, signs a contract to make porcelain with Joseph Farmer of Lan Delph in Staffordshire. (Mountford, 1969; Daniels, 2007).

21st March, 1745/6. Before this date William Steers departs his house in Hoxton, Middlesex, for Bell’s Pottery at Newcastle-under-Lyme (Bennett, 1975). We note that Bryand’s contract with Farmer was signed on 24th February, 1745/6 and that this letter represents the earliest eyewitness account of an English porcelain concern.


27th July, 1745 (not May as still widely asserted in the literature) William Cookworthy wrote to his friend Richard Hingston describing a meeting with the person who had discovered the chine earth. Cookworthy makes it clear that from there on he was to be known as Andrew Ducâl (visited by Hingston) as he saw at Bow. Cookworthy had been in Eastern journey and had been absent from Plymouth for three weeks so he must have interviewed Andrew Ducâl during this period in London. We contend that during this meeting in London Ducâl gave Cookworthy the opportunity of examining samples of Bow 1st Patent porcelain (Daniels, 2007).

24th July, 1745. In the midst of war with Britain, Louis XV signs the Vincennes Privilege in a military camp, seeking to protect the French from a new establishment which has just been formed in England, of a porcelain manufacture which seems finer than that of Saxony by the nature of its composition. This indicates hard-paste porcelain and must relate to the ‘A’ marked group being manufactured at Bow (Daniels, 2007). Again referred to by the French to such an establishment had nothing to do with glossy, soft-paste Chinese porcelain as has been continually claimed in the ceramic literature. Moreover the Privilege refers to decoration with human figures which militates against Chelsea triangle porcelain of 1745 and provides us with an absolute date for the production of high-style Bow first patent porcelains.

In searching for people who were declared bankrupt in 1748 and may therefore have been associated with the failure of the Limehouse concern, Aubrey Tippin considered the name of Alexander Dick, but could not connect him with Limehouse. Tippin goes on to say that Richard Hingston was the person Dick was known to, there was a strong connection between this London merchant/sea captain and Edward Heylyn of Bow, as he commanded Edward Heylyn’s ships at times speak Heylyn’s of Bristol for many years. The ship was captured by enemy privateers in early 1745 and destroyed.

The authors are now aware that Dick was declared bankrupt in 1745. His bankruptcy was reported in the London Gazette, 13rd August 1745 and the St James’s Evening Post, 17th August, 1745. The bankruptcy was announced on 30th September and 9th October, 1745 the sale of Dick’s household goods, at his house, Head-Court facing the Stell-yard in Thomas Street and reveals that he was quite wealthy, so perhaps his bankruptcy was caused by the loss of the ship and its cargo. It was not unusual for wealthy merchants to own or part-own ships, as was the case with Edward Heylyn for Daniels 2007 for Hey-lyn’s ownership of several merchant ships recorded in Savan- nah, Georgia and Charleston, South Carolina in the 1730s and 1740s. As Edward Heylyn and Benjamin Lund were also declared bankrupt in 1745 could all three merchants have been in partnership with the vessel and its cargo?
The various advertisements connected with the Limehouse Factory, all from *The Daily Advertiser*, (Tippnin, 1743). Välpy, 1993) which have so far come to light appear as Appendix 1 of *Limehouse Porcelains 2012*, editor RAMSAY, W. ROSS H., DANIELS, PAT, & RAMSAY, E. GAEL.

22/23 September, 1746.

POW, Pot, or Bone Painters, may meet with very great Encouragement at the Poo-Works at Limehouse.

4th, 6th, 7th and 8th October, 1746.

POW, Pot, or Bone Painters, wishing Employment, will meet with great Encouragement by applying to Mr. Wilson, at the MANUFACTORY near Duke-Street, Limehouse.

1746. The Newcastle-under-Lyme Pottery, which included an over-tall building, both a large Plate-works and China-outbuildings and a commodious House (late in the Occupation of Mr. Bell, and now in the possession of Mr. Steers) is advertised to be LETT, at Lady-day next’. For further particulars enquire of Mr. Steers as available to rent from Ladyday the 25th September, 1746.

22/23 September, 1746.

POW, Pot, or Bone Painters, may meet with very great Encouragement at the Poo-Works at Limehouse.

4th, 6th, 7th and 8th October, 1746.

POW, Pot, or Bone Painters, wishing Employment, will meet with great Encouragement by applying to Mr. Wilson, at the MANUFACTORY near Duke-Street, Limehouse.

1746. The Newcastle-under-Lyme Pottery, which included an over-tall building, both a large Plate-works and China-outbuildings and a commodious House (late in the Occupation of Mr. Bell, and now in the possession of Mr. Steers) is advertised to be LETT, at Lady-day next’. For further particulars enquire of Mr. Steers as available to rent from Ladyday the 25th September, 1746.

22/23 September, 1746.

POW, Pot, or Bone Painters, may meet with very great Encouragement at the Poo-Works at Limehouse.

4th, 6th, 7th and 8th October, 1746.

POW, Pot, or Bone Painters, wishing Employment, will meet with great Encouragement by applying to Mr. Wilson, at the MANUFACTORY near Duke-Street, Limehouse.

1746. The Newcastle-under-Lyme Pottery, which included an over-tall building, both a large Plate-works and China-outbuildings and a commodious House (late in the Occupation of Mr. Bell, and now in the possession of Mr. Steers) is advertised to be LETT, at Lady-day next’. For further particulars enquire of Mr. Steers as available to rent from Ladyday the 25th September, 1746.
1749
1st Land Tax assessment (Vol. 29) in June 1749, all missing as in the August assessment 1748.

1750
1st Land Tax assessment (Vol. 30, p. 128) Prudence Kirkland, Rent £10, Tax £2-6-0. This is the Joseph Wilson site on the north side of Fore Street, which, before Wilson’s occupation, was in the possession of George Kirkland, perhaps Prudence’s late husband.

So, the last advertising offering goods for sale at ‘the House’ was June 20th, 1749, and with the cancellation of the insurance on 21st July 1749. From then on advertisements and advertisements were all to do with Creditors meetings and disposal of the remaining stock at leading dealers in town and country, but apparently not at the Factory. We can safely say that manufacture at 20 Fore Street ceased by July 1749, but may have continued on the North Side of Fore Street 1748-1749.

The use of soapstone at Bow was discussed by Daniels (2007) at some length, including information regarding the involvement of William Borlase, the Cornish scientist, who, as shown above, tested numerous samples starting with two shipments to Leyden in 1735 and 1737 at the request of John Andrew and Gommonus, one of Bow’s tutors. Borlase continued the despatch of samples to various interested parties from 1738 to 1748. Of particular interest are a series of letters that passed between Borlase and Emmanuel Mendes da Costa FBA. ‘These reveal that, Mr. Fry (sic) the Painter who makes the London Chine had knowledge of stoneware and may supply da Costa with, many useful things. Borlase also revealed to da Costa that the soaprock was located at Kynance Cove. A letter written on the 18th July, 1748, informed da Costa that he had sent him, a small box with several sorts of the Soap-rock and that, it is from a new discovery of the same soap substance in a creek about a mile in the WIN W of Kynans (sic) Cove and in every respect at least equal to what more than once is now eaten out by the sun and other (Hobbs, 1995).

This situation was confirmed by da Costa when he published his Natural History of Porcelain in 1757, in which he made the following remark about soapstone. ‘This is a beautiful white clay...found lying in veins and loose masses, in the new soap rock at Ginz Grove (sic) Cove, about a mile from the old soap rock in Cornwall, where it is also found running in veins, about two fingers in breadth (Hobbs, 1999).

What is important to us in the Limehouse context is the fact that the clay at Ginze Cove, where Benjamin Land obtained his licence, was not discovered until at least the early summer of 1748 and that the earlier deposits at Kynance Cove were more or less depleted. Apparently Land of Bistol took out a licence with John West of Bury St Edmonds to quarry soaprock from Ginze Cove in the 2nd March, 1748.

As both Limehouse premises were abandoned in mid 1748, if soft paste porcelain was produced the soaprock was either rescued in small quantities from Kynance Cove, or trial consignments were supplied to Land at Joseph Wilson from Ginze Cove from the spring of 1747 when land tax on their 2nd premises on the north side of Fore Street was first paid. This would explain the lack of any evidence of stoneware porcelain production following the 20 Fore Street site excavations. Removing soon, the House going to be pulled down) At Mr. Underwood’s, the Upper End of Pall-Mall, near St. James’s House, the Price being greatly reduced, ALL, the Goods in Trade of the Limehouse Manufactories, Wares of various Sizes.

Limehouse Ware Tea-Pots, Sauceboats, and Potting-Pots of various Sizes.

Limehouse Ware Tea-Pots, Sauceboats, and Potting-Pots of various Sizes.

In the St. Anne’s Limehouse baptisms for March 8th, 1747-8, Toppin found the baptism of ‘Elizabeth, daughter of William Ball, Potter, Fore Street and Mary….

In the St. Anne’s Limehouse baptisms for March 8th, 1747-8, Toppin found the baptism of ‘Elizabeth, daughter of William Ball, Potter, Fore Street and Mary….

In the St. Anne’s Limehouse baptisms for March 8th, 1747-8, Toppin found the baptism of ‘Elizabeth, daughter of William Ball, Potter, Fore Street and Mary….
APPENDIX 3: SUMMARY OF BURGHLEY HOUSE JARS

We summarise below our view as to attribution, maker, and approximate dates of manufacture for the Burghley House jars.

• The Burghley jars are of English derivation;
• the Burghley jars were made by John Dwight;
• the Virtues Jar, the analysed smaller jar, and its lid each has a different composition;
• the Virtues Jar comprises ball clay, crushed silica, minor lead (added as lead oxide?), and a flux comprising alum - a hydrated potassium aluminium sulphate (Table 6);
• Robert Hooke in 1674 recorded the possible use of alum in Dwight’s ceramic bodies (Appendix 1);
• the mention by Hooke in May 1674 (Appendix 1) of Dwight using ashes in his glaze resonates with the suspected imperfect lime-alkali glaze found on both the Virtues Jar and the lid of the smaller jar (Spataro et al., 2008, 2009);
• based on the observations by Robert Hooke we would date the Virtues Jar to c. 1674 or later;
• the smaller jar and its lid were not made using ball clay (Dorset?) but rather using a china clay/china earth that was highly refractory, as recorded by Robert Hooke in 1678 (Appendix 1);
• the flux in the smaller jar looks to have been saltpetre (KNO₃) whilst the flux in the lid appears to have been a lime-alkali substance - possibly a lime-alkali bottle glass + minor lead oxide (Table 6);
• we propose, based both on their chemical compositions and on Hooke’s comments of 1678, that this small jar and lid were made using refractory china clay;
• the china clay (Rome china clay), was most likely that which was imported from the East into Rome around 1680 or slightly earlier. Pat Daniels considers that the china clay possibly came not from the east but from the New World;
• whilst the lid does have a different composition to the small jar this does not mean that it is a later (19th C) replacement. Rather we argue that John Dwight made numerous bodies and in this instance we see an example of mix and match by Dwight;
• the lime-alkali glaze covered by a lead-based glaze on both the lid and the Virtues Jar (Spataro et al., 2009) links both items and militates against the former being a later replacement;
• we date the smaller jar and its lid to c. 1678 based again on Robert Hooke’s observations (Appendix 1);
• the recipe used in the Virtues Jar possibly has its antecedents in the Si-Al crucibles made at Stamford in Medieval times and the Si-Al crucibles made in the late 16th C by Richard Dee in London/London Basin (Pearce, & Tipton, 2011);
• the recipes used in all three items analysed resonate with experimental recipes of the Royal Society in 1708 (Table 5);
• the recipe in the lid finds its subsequent expression in what must be regarded as England’s most important and significant porcelains of the 18th C, namely Bow first patent Si-Al-Ca porcelains (Ramsay et al., 2003);
• however Bow dispensed with crushed silica and used various mixtures of Cherokee clay and lime-alkali bottle glass ranging from 1:1 to 4:1 (Ramsay et al., 2006);
• subsequently Limehouse, which did not have access to Cherokee clay/china clay, resorted to a mixture of ball clay, crushed silica/calcined chert, and bottle glass;
• the Bow first patent Si-Al-Ca body we date to 1743-1746;
• the Limehouse Si-Al-Ca body we date from early 1746-early/mid 1747; and
• we suggest that the Burghley jar and its lid represent the earliest known high-fired porcelains in the Western world made using china clay.
Our understanding of the development of English porcelains underwent a major watershed during the early years of this millennium with the recognition that by the early to mid 1740s the Bow porcelain manufactory was producing a commercial, hard-paste porcelain using a china clay (Cherokee clay) imported from the New World. Concomitant with this has been the re-examination of many notions and beliefs that have sustained English ceramic studies over the last 100 years or so. It is now recognised that the 1744 ceramic patent of Heylyn and Frye, far from being hesitant, experimental, or not worth the paper it was written on, is in fact a highly significant document in English ceramic history. In addition it is now realised that William Cookworthy was not the first to fire a hard-paste body, that Bow was operating much earlier than recognised to date using a range of ceramic recipes, and the pre-eminent position previously enjoyed by Chelsea needs to be reassessed. This contribution on the Limehouse manufactory continues this enquiry, further establishes the leading position played by Bow, and develops the arguments initiated by Pat Daniels as to the importance of both the Royal Society of London and rational English science and technology back to the 17th Century in the development of the English porcelain industry.