

Ceramic Petrology and the Study of Anglo-Saxon and Later Medieval Ceramics

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A SURVEY of archaeological ceramic thin sections held by institutions and individuals in the United Kingdom was undertaken in the early 1990s by the City of Lincoln Archaeology Unit and funded by English Heritage. Over 6,000 thin sections of Anglo-Saxon or medieval date (or reports on their analysis) were located. For the Middle to Late Anglo-Saxon and the post-Conquest Periods, these studies have confirmed that pottery production was carried out in a limited number of centres and that most pottery, including handmade coarsewares, was therefore produced for trade. The distances over which pottery was carried vary from period to period but were actually as high or higher in the Middle to Late Anglo-Saxon Period as in the 13th to 14th centuries. However, for the Early Anglo-Saxon Period (and the Middle Anglo-Saxon Period outside of eastern England) the evidence of ceramic petrology is equivocal and requires more study. These 6,000-odd thin sections represent a resource which could be used for various future studies, some of which are discussed here, and as an aid to their further use a database containing information on the sampled ceramics, their location and publications of their analyses will be published online through Internet Archaeology.

CERAMIC PETROLOGY

HISTORY OF CERAMIC PETROLOGY

The use of thin sections of pottery and other ceramics to study the raw materials from which they were made and the preparation techniques employed has a long ancestry in archaeology and was used in the United States in the 1930s. Nevertheless, the use of this technique on ceramics from the British Isles was much later and almost entirely due to the work of David Peacock. In the 1960s and 1970s, Peacock produced a series of papers which demonstrated that coarse, often handmade, pottery, which had previously been assumed to have been produced domestically, was actually transported over large distances, from the Neolithic period onwards.¹ The implications of this work for the study of cultural history

¹ D. P. S. Peacock, 'Results of petrological examination', in D. P. S. Peacock and A. C. Thomas, 'Class 'E' imported post-Roman pottery: a suggested origin', *Cornish Archaeol.*, 6 (1967), 40-4; idem, 'A petrological study of certain Iron Age pottery from Western England', *Proc. Prehistoric Soc.*, 13 (1968), 414-27; idem, 'A contribution to the study of Glastonbury ware from south-western Britain', *Antiquaries J.*, 49 (1969), 41-61; idem, 'Neolithic pottery production in Cornwall', *Cornwall Antiquity*, 43 (1969), 145-9; idem, 'Roman amphorae in pre-Roman Britain', 161-79 in M. Jesson and D. Hill, *The Iron Age and its Hillforts* (Southampton, 1971); idem, 'Bricks and tiles of the Classis Britannica: petrology and origin', *Britannia*, 8 (1977), 235-48; idem, 'Pompeian red ware', 147-62 in idem (ed.) *Pottery and Commerce: Characterization and Trade in Roman and Later Ceramics* (London, 1977).

were far-reaching since much of the discussion of cultural attributes was actually based on ceramics and most of the discussion assumed that the movement of pottery styles reflected the movement of the people producing the pottery rather than the trade or exchange of finished products.

For the Anglo-Saxon and later medieval periods, however, the prevailing model before the widespread use of thin sections (at least for the Middle Anglo-Saxon and later periods) was that pottery was a specialist product. The far-flung contacts of major medieval ports and cities were already being explored by Dunning and Hurst, amongst others, long before. Nevertheless, ceramic petrology has had an impact on the study of trade and exchange, if only to show that even rural settlements remote from the coast or large cities were obtaining pottery by trade or exchange rather than making it themselves. Furthermore, any division of medieval ceramics into high-quality, often glazed and decorated, traded wares and low-quality, undecorated domestically-produced wares was shown to be a gross simplification.

Thin sections, therefore, have had more impact on the study of medieval ceramics and the economy through the detailed investigation of pottery supply and how this changed through time and location than through any shift of paradigm. The technique is particularly good for the study of certain types of medieval ceramics and for answering certain types of question and of less relevance for others.

ADVANTAGES OF CERAMIC PETROLOGY

It is sometimes possible to take a thin section from a single object, determine the identity of the rock fragments in that object's fabric and use this information to identify the source of the rock and, by implication, the object. For this method to work, the rock fragments in the section have to be sufficiently large to characterise the rock's composition and texture. They also have to indicate that the rock was weathered *in situ* rather than being detritus carried some unknown distance from the rock outcrop by natural agencies. These quite stringent conditions are rarely met in the Anglo-Saxon and medieval periods in the British Isles. They do hold true, however, for vessels containing the gabbro whose only outcrop in the U.K. is at the Lizard peninsula in Cornwall,² the gneiss and granite which forms the core of the Malvern Hills on the Herefordshire/Worcestershire border,³ and — arguably — vessels containing Mountsorrel granodiorite from the Charnwood Forest in North-East Leicestershire.⁴

It is more usual to take thin sections of a representative sample of objects which are known to have been produced at a certain place and to use these to produce a definition of the fabric of those objects — the range of inclusion types, their size, sorting and relative abundance — and to then compare other samples

² D. P. S. Peacock, 'The grass-marked sherd', 47 in C. Platt and R. Coleman Smith *Excavations in Medieval Southampton, Vol. 2* (Leicester, 1975).

³ A. G. Vince, 'The medieval and post-medieval ceramic industry of the Malvern Region: the study of a ware and its distribution', 257–305 in Peacock (ed.), *op. cit.* in note 1.

⁴ D. F. Williams and A. G. Vince, 'The characterization and interpretation of early to middle Saxon granitic tempered pottery in England', *Medieval Archaeol.* (1997), 214–20.

with this definition. Such a method can demonstrate that a putative example of a ware from a consumer site differs in its petrological characteristics from that of samples from a production site but unless the characteristics are unusual it cannot be used to demonstrate that the vessel was produced at a particular site. Even in cases where the samples differ this still leaves the possibility that the producers were using more than one fabric, perhaps because an original resource had been depleted.

In most cases, therefore, ceramic petrology is a factor to be considered in the determination of a vessel's source but not the only factor. The final conclusion will probably be based on a mixture of geological knowledge and archaeological knowledge of the period concerned.

DISADVANTAGES OF CERAMIC PETROLOGY

The two main disadvantages of ceramic petrology for the study of medieval ceramics are the fine texture of much medieval pottery and the use of detrital sands, often dominated by quartz, as temper. Grain size need not be a barrier to the use of ceramic petrology but conclusions will always be less certain and the amount of work required to achieve them will be greater for fine-textured wares. The rise of quartz sand as a temper starts in the 9th century and is steady from then on (with, in some parts of the country, a resurgence of other temper types in the later 11th and 12th centuries). By the late 13th century it is quite common to find that the overwhelming majority of the wares in use at a site were tempered with quartz sand.

By contrast, chemical characterisation, using techniques such as Neutron Activation Analysis or Inductively Coupled Plasma Spectrography, works best where the sample to be characterised comes from a homogenous, fine-textured fabric. The consensus amongst characterisation laboratories is that for these fine wares one would still require at least one thin section, to aid interpretation of the chemical data and perhaps to note differences in internal texture (such as lamination or relict clay) which might not be reflected in the overall chemical composition but which serve to distinguish or link samples.

A further disadvantage of ceramic thin sections for studying medieval pottery becomes evident towards the end of the period, with the trend towards higher firing temperatures. Calcium carbonate-rich inclusions when fired at temperatures in excess of 850° C disintegrate, unless there is salt (NaCl) in proximity, as there will be in briny clays, or unless the ceramics are fired in reducing atmospheres. In the presence of salt, the carbonate is still chemically altered but forms a calcium aluminosilicate which can be recognised because of its distinctive colour. All internal detail of the carbonate inclusions will, however, still be lost. Micas, too, are altered by firing, although in practice this reaction only starts to have an effect in ceramic bodies fired at over 1000° C. Not only do Late-medieval ceramics (i.e. those made after c. 1350) tend to have heat-altered inclusions, but the producers counter-acted these effects by deliberately selecting clays and tempers which could withstand higher firing temperatures. In the north of England there is a Late-medieval trend towards the use of reduction firing which may also have a technological explanation.

THE UKTS

By the mid-1990s the number of ceramic thin sections made of U.K. ceramics was in excess of 20,000. Many of the results of their study were published as specialist reports, or merely summarised in print with the report itself left in archive. Consequently, this material formed a vast but inaccessible archive. In 1995/96 the City of Lincoln Archaeology Unit was commissioned by English Heritage to undertake a survey of this resource. The aims of the survey were: a) to establish the location and conditions for access to collections; b) to make a record of thin sections of ceramic objects undertaken for archaeological purposes (the United Kingdom Ceramic Thin Section Database — abbreviated to UKTS); c) to make recommendations for the storage and recording of ceramic thin sections. The survey revealed the existence of over 20,000 thin sections and over a thousand reports.

This paper is one of a number surveying the use of ceramic petrology in U.K. archaeology which use the UKTS database.⁵ Edited versions of these papers, plus an interface to the online database will be published in *Internet Archaeology*.⁶ This online interface will allow users to construct their own, complex queries to the database using any combination of location, period, petrologist or source.

A further aspect of the project was to consider the usefulness of the data standard employed for the UKTS, to make recommendations for modifications to this standard for future entries and to consider the practical and ethical issues surrounding the storage and curation of ceramic thin sections.

LOCATION OF COLLECTIONS

Thirty-eight separate collections containing thin sections of Anglo-Saxon or later medieval artefacts were recorded (Tab. 1). A total of 6,761 thin sections are contained in these collections. Seven of these collections are housed under the same roof, at the University of Southampton, three are held by the author, and the remainder are held individually or in pairs. In most of these cases, the collections can be consulted on request although there are 248 thin sections whose current location is not known. The material is dominated by work undertaken by Dr D. Williams, English Heritage-funded Ceramic and Lithic Petrologist based at the University of Southampton,⁷ Drs Streeten and Vince whilst at the University of Southampton,⁸ work undertaken as part of the Lincoln publication project and

⁵ E. L. Morris and A. Woodward, 'Ceramic petrology and prehistoric pottery studies', *Proc. Prehistoric Soc.*, 69 (2003), 279–303; P. A. Tyers, 'Ceramic petrology and Romano-British pottery studies', *Britannia* (forthcoming); A. G. Vince, 'Ceramic petrology and Post-Medieval pottery studies', *Post-Medieval Archaeology*, 35 (2001), 106–18. These papers cover the earlier prehistoric (Ann Woodward), later prehistoric (Elaine Morris), Romano-British (Paul Tyers) and post-medieval ceramic thin sections (Alan Vince).

⁶ A. G. Vince (ed.), 'The United Kingdom ceramic thin-section database' *Internet Archaeol.*, <http://intarch.ac.uk> > (forthcoming).

⁷ 1,187 thin sections, mostly reported initially in Ancient Monuments Laboratory reports, prior to the publication of the fieldwork project for which the work was undertaken.

⁸ A. D. F. Streeten, *Medieval and Later Ceramic Production and Distribution in South-East England* (unpubl. Ph.D. thesis, University of Southampton, 1985), vol. 3, 988 thin sections; A. G. Vince, *The Medieval Ceramic Industry of the Severn valley* (unpubl. Ph.D. thesis, University of Southampton, 1984), 1,200 thin sections. The text of this thesis, minus the illustrations and appendices, is available online at <http://www.postex.demon.co.uk/thesis/index.htm>

TABLE I
LOCATION OF COLLECTIONS CONTAINING THIN
SECTIONS OF ANGLO-SAXON OR MEDIEVAL
CERAMICS

Name of Institution	Total
Southampton University Archaeology Department	2,242
Alan Vince — personal collection	1,367
City of Lincoln Archaeology Unit	1,004
Museum of London	986
Whereabouts unknown	248
Leicester University	225
Leicester University: Ann Woods Collection	175
Monmouth Archaeological Society	89
York Archaeological Trust	66
Northamptonshire Archaeology	65
Bradford University	54
Borders Museum Service	50
Bedfordshire County Archaeological Service	44
Bristol and Region Archaeological Services	37
British Museum	29
Ashmolean Museum, Oxford	24
Newcastle City Council Archaeological Unit	19
Clwyd-Powys Archaeological Unit	13
Cathy Freeman — personal collection	10
Hartlepool Museum	8
Susan Wright — personal collection	6
Grand Total	6,761

incorporated into the forthcoming corpus of medieval pottery from the city,⁹ and the City of London Medieval Pottery Corpus.¹⁰ Because of the history of the collections they do not cover provide an even cover, either geographically or chronologically. There is, in fact, a huge bias towards the high medieval period (i.e. later 13th to mid-14th centuries) and the southern part of England.

STANDARDISATION OF RECORDS

A major problem in using the results of ceramic petrological studies is the lack of any standardisation in the format of their published results. For example, in some cases a single description is published which integrates the results of binocular microscope study and thin sections whilst in others each thin section is individually

⁹ J. Young and A. G. Vince, *A Corpus of Anglo-Saxon and Medieval Pottery from Lincoln* (Lincoln Archaeological Reports, Oxford, forthcoming).

¹⁰ J. E. Pearce, A. G. Vince, R. White with C. M. Cunningham, 'A dated type-series of London medieval pottery Part 1: Mill Green Ware', *Trans. London Middlesex Archaeol. Soc.*, 33 (1982), 266–98; J. E. Pearce, A. G. Vince and M. A. Jenner, *Medieval London-type Ware: A Dated Type-Series of London Medieval Pottery Part 2: London-type Ware* (London Middlesex Archaeol. Soc. Special Paper 6, 1985); M. A. Jenner and A. G. Vince, 'A dated type-series of London medieval pottery Part 3: a late medieval Hertfordshire glazed ware', *Trans. London Middlesex Archaeol. Soc.*, 34 (1983), 151–70; J. E. Pearce and A. G. Vince, *A Dated Type-Series of London Medieval Pottery Part 4: Surrey White Wares* (London Middlesex Archaeol. Soc. Special Paper 10, 1988).

described. The traits in each thin section which are deemed worth describing also vary from report to report. To a certain extent this variability actually reflects the different questions which the analysis was designed to address but one consequence has been that it has not proved possible to extract petrological information from a sufficient number of published reports in a form which would be useful for retrieval and analysis using the UKTS. It is recommended that a published thin-section description should include:

- a statement of what information the description is based upon;
- a list of all inclusion types present;
- the size range, roundness, sphericity and other distinguishing characteristics of the inclusions;
- a description of the groundmass, including anisotropy, colour, fabric, homogeneity, structure and the identity of those clasts which are less than 0.1 mm.

Where editorial policy demands that the results of a ceramic petrology report are summarised then the possibility of publishing the full report electronically should be explored.

INTERNET PUBLICATION

Internet Archaeology will be publishing versions of the period surveys together with background information on the CLAU survey, a link to the online version of the UKTS, and recommendations for the format of any future records. The structure of the database will consist of three related tables, dealing with collections, publications (and 'grey literature' reports) and the thin sections themselves. The data for each section are divided into three parts: information on the identity of the site and archaeological context; information on the sampled object (such as vessel-class and type, period); and information on the petrological content of sample and its interpretation.

SURVEY RESULTS

A significant number of thin-section collections covering Anglo-Saxon ceramics could not be included in the UKTS. These include the author's own work on the early Anglo-Saxon pottery from Barrow Hills, Radley, the results of which are summarised in print,¹¹ Mark Brisbane's work on the Spong Hill cemetery, Norfolk, Ailsa Mainman's doctoral research on pottery from Kent,¹² and the work of Andrew Russel in East Anglia, also undertaken as part of his doctoral research.¹³ Furthermore, a large amount of work has taken place on the petrology of Early

¹¹ A. G. Vince, 'The petrography of Saxon and early medieval pottery in the Thames valley', 163–77 in J. Henderson (ed.), *Scientific Analysis in Archaeology* (Oxford, 1989).

¹² See, for example, A. J. Mainman, 'Studies of Anglo-Saxon pottery from Canterbury', 93–100 in I. Freestone et al. (eds.), *Current Research in Ceramics: Thin Section Studies, British Museum* (London, 1982); A. J. Mainman, *Anglo-Saxon Kent: A Ceramic Viewpoint* (unpubl. Ph.D. thesis, University of Sheffield).

¹³ A. D. Russel, 'Domestic Early Saxon pottery from East Anglia: an interim report, 101–4 in Freestone et al. (eds.), *op. cit.* in note 12.

and Middle Anglo-Saxon pottery since the completion of the CLAU survey. This includes work undertaken on the pottery of Yorkshire, surveyed as part of the West Heslerton publication programme,¹⁴ work on North Lincolnshire/East Yorkshire undertaken as part of the Flixborough publication programme,¹⁵ and the Ipswich-ware survey.¹⁶

EARLY ANGLO-SAXON POTTERY (5TH–7TH CENTURIES)

Minor differences in the typology and decoration of Anglo-Saxon pottery have been noted between Kent, Wessex and the area north of the Thames. The latter area, by the 7th century, was divided into four kingdoms (Northumbria, Mercia, East Anglia and Essex). These kingdoms were themselves subdivided into, or coalesced from, *regiones* or sub-kingdoms. None of these socio-political divisions have any correspondence with pottery-style zones or fabric distributions and it is notable that both Myres's typological/decorative groupings and Briscoe's stamp-distributions bridge these socio-political boundaries.¹⁷ It may be significant, however, that the three groupings visible in Early Anglo-Saxon ceramics do correspond to the three parent population groups, Angles, Saxons and Jutes, which the Anglo-Saxons themselves recognised, from at least as early as the early 7th century.

North of the Thames

The most noticeable feature of Anglo-Saxon pottery fabrics north of the Thames is the wide variety found at each site. The most distinctive fabric is that tempered with moderate to abundant angular fragments of acid igneous rock but it is by no means the only fabric found.¹⁸ In studies made of Early Anglo-Saxon

¹⁴ By A. G. Vince: not yet published.

¹⁵ J. Young and A. G. Vince, 'The Anglo-Saxon pottery', in C. Loveluck (ed.), *Flixborough: A High-Status, Middle to Late Saxon Settlement, in North Lincolnshire, AD 600–1000* (forthcoming).

¹⁶ P. Blinkhorn, *The Ipswich Ware Project: Ceramics, Trade and Society in Middle Saxon England* (Medieval Pottery Research Group Special Paper, London, forthcoming).

¹⁷ J. N. L. Myres, *A Corpus of Anglo-Saxon Pottery of the Pagan Period* (Cambridge, 1977); T. Briscoe, 'Anglo-Saxon pot stamps', 1–36 in D. Brown (ed.), *Anglo-Saxon Studies and Archaeology and History* (Oxford, 1981).

¹⁸ D. F. Williams and A. G. Vince, op. cit. in note 4; Gryspeerdt, 'The pottery', 37 and 42 in J. H. Williams and M. Shaw, 'Excavations in Chalk Lane, Northampton 1975–1978', *Northamptonshire Archaeol.*, 16 (1981); A. G. Vince, *Petrological Analysis of Some Anglo-Saxon Potsherds from Bedford Castle: BC 70 (34)* (Lincoln, 1993); idem, *The Petrology of Some Prehistoric and Anglo-Saxon Pottery from Carsington, Derbyshire* (Lincoln, 1995); D. F. Williams, 'Petrological analysis of Anglo-Saxon Pottery from Brixworth', 84–5 in P. Everson, 'Excavations in the Vicarage Garden at Brixworth 1972', *J. Brit. Archaeol. Ass.*, 130 (1976); idem, *Petrological Analysis of Saxon Pottery from Brixworth, Northamptonshire* (Ancient Monuments Lab. Rep., 2111, London, 1976); idem, *Petrological Analysis of Saxon Pottery from Northampton and Briar Hill, Northamptonshire* (Ancient Monuments Lab. Rep., 2288, London, 1977); idem, 'Petrological analysis of Saxon pottery from St Peter's and Briar Hill, Northants', 155 in J. H. Williams (ed.), *St Peter's Street Northampton: Excavations 1973–1976* (Northampton, 1979); idem, *Petrological Examination of Saxon Pottery from the East Midlands* (Ancient Monuments Lab. Rep., 4522, London, 1985); idem, *Petrological Examination of Saxon Pottery from Willoughby-on-the-Wolds, Nottinghamshire* (Ancient Monuments Lab. Rep., 4744, London, 1986); idem, *Petrological Examination of Pottery from the Anglo-Saxon Cemetery at Loveden Hill, Lincolnshire* (Ancient Monuments Lab. Rep., 207/87, London, 1987); idem, *Note on the Petrology of Some Pottery from the Saxon Cemetery at Great Chesterford, Essex* (Ancient Monuments Lab. Rep. 40/88, London, 1988); idem, *Note on the Petrology of the Pottery from the Saxon Cemetery at Great Chesterford, Essex* (Ancient Monuments Lab. Rep. 160/88, London, 1988); idem, *Note on the Petrology of Some Early Saxon Pottery from the 1974–1975 Excavations at Empingham, Rutland* (Ancient Monuments Lab. Rep., 132/90, London, 1990); idem, *A Petrological Examination of Some Early Saxon Pottery from Leicester* (Ancient Monuments Lab. Rep., 13/92, London, 1992); idem, *A Petrological Note on Pottery from Sancton Anglo-Saxon Cemetery, Humberside* (Ancient Monuments Lab. Rep., 15/92, London, 1992); idem, 'Petrological notes', 266–8 in J. Timby, 'Sancton 1 Anglo-Saxon cemetery: excavations carried out between 1976 and 1980', *Archaeol. J.*, 150 (1992); idem, 'The petrology of the pottery', 81–2 in V. Evison, *An Anglo-Saxon Cemetery at Great Chesterfield, Essex* (CBA Res. Rep. 91, London, 1994).

pottery from both cemeteries and settlements the norm is to find that the pottery was produced in several distinct fabrics, with inclusions of oolitic limestone, sandstones, rounded quartz for example. Most of these studies have taken place on a site-by-site basis and so the similarity of the range of fabrics between sites and the wide distribution that a number of these fabrics have has not been sufficiently appreciated.

South Central England

There has been comparatively little thin-section analysis of the Early Anglo-Saxon pottery of Wessex and what there has been suggests that the range of fabrics is much more limited than further north, with organic temper ('chaff temper') being the most common fabric found. It is likely that the visual similarity of this pottery and the lack of visible rock or mineral fragments that might be useful for characterisation has discouraged thin-section study whilst it has been suggested that the temper in these wares was introduced in animal dung, which further implied that the vessels were produced in a domestic situation where dung would be readily available. Given the contrast between this model and the emerging pattern north of the Thames, there is a good case for testing the model, either through the use of thin sections or chemical analysis.

South-East England

Studies of the Anglo-Saxon pottery from Mucking, other sites in the Thames basin and those in Kent, mainly by Dr Mainman, suggest that in the south-east of England the earliest Anglo-Saxon pottery was produced in a wide range of fabrics but that organic temper gradually became the norm.¹⁹

MIDDLE ANGLO-SAXON POTTERY (7TH–9TH CENTURIES)

For much of England, it is impossible to distinguish pottery of the 7th to 9th centuries from that of the preceding centuries with certainty. The same range of vessels was produced, using the same methods and treatments. Only independent dating evidence can determine the date of these assemblages and even then the range of probabilities sometimes leaves the date-range quite broad. In the east of England, however, there is a sharp break between the two periods, because of the introduction of two distinctive wares. These are Ipswich ware and Maxey ware. The first, Ipswich ware, takes its name from the Middle Anglo-Saxon *wic* at Ipswich where a potting quarter was established in the late 7th or early 8th century. Wares looking just like those found in the Ipswich kilns have been found throughout eastern England, as far north as York and as far south at Canterbury. Given its status as an item of long-distance trade, possible sherds of Ipswich ware have been thin-sectioned on an *ad hoc* basis over a number of years. However, in the mid-1990s a major campaign to record and establish the identity of 'Ipswich-type' wares over the whole country was instigated and a large number of thin sections

¹⁹ Op. cit. (1982) in note 12.

were produced as a consequence.²⁰ The provisional result of this work seems to be that there is no evidence for secondary sources of this ware, all of which may therefore have been produced at Ipswich. The second of these Middle Anglo-Saxon wares, Maxey-type ware, takes its name from a consumer site at Maxey.²¹ The distinctive features of this ware — its abundant shell temper and flat-based, vertical sided forms — enabled the ware to be recognised on several sites in Lincolnshire,²² as well as in the south-east Midlands. A thin-section study of this ware for the East Midlands Anglo-Saxon Pottery Project demonstrated that Maxey-type wares could be divided into at least two groups: Northern Maxey-type ware and Southern Maxey-type ware.²³ It also indicated that both groups were tempered with fossil shell but that in the northern group the shell fragments were disaggregated shelly limestone whereas those in the southern group were probably naturally-occurring in the clay. Other English wares of Middle Anglo-Saxon date have been studied, for example from the *wīc* sites at London and Southampton, but these wares are little different from their earlier predecessors; with the exception that Timby's study of the Hamwic pottery confirms earlier impressions that organic-tempered pottery ceased to be used early in the life of the settlement, to be replaced by wares with coarse quartzose tempers.²⁴

A notable feature of the pottery assemblages found on *wīc* sites is the range and quantity of imported wares. Those from Ipswich have been studied in detail by C. Coutts,²⁵ and those from Hamwic by R. Hodges.²⁶ Unfortunately, none of these imports, which are thought to have been produced at sites in northern France, eastern Belgium and the middle Rhine valley, contains distinctive inclusions and identification is mainly based on textural comparison. Such wares

²⁰ By D. F. Williams. There are at the time of writing no reports for these analyses since the work was thought to be close to publication. Earlier reports include D. F. Williams, *Ipswich Ware: A Preliminary Report* (Ancient Monuments Lab. Rep., 1583, London, 1974); idem, *Ipswich Ware: A Preliminary Report* (Ancient Monuments Lab. Rep., 4624, London, 1985); idem, *Petrological Examination of Middle Saxon Ipswich-type Ware* (Ancient Monuments Lab. Rep., 4669, London, 1985); idem, *A Thin Section Examination of Middle Saxon Ipswich Ware Pottery* (Ancient Monuments Lab. Rep., 50/94, London, 1994); idem, 'Petrological note on an Ipswich-type sherd', 104 in P. J. Huggins, 'The excavation of an 11th century Viking Hall and 14th-century rooms at Waltham Abbey, Essex, 1969–71', *Medieval Archaeol.*, 20 (1976), 75–133.

²¹ Excavated and published by P. V. Addyman with K. R. Fennell and L. Biek, 'A dark-age settlement at Maxey, Northants', *Medieval Archaeol.* (1964), 20–73. In that report the term Maxey ware, or Maxey-type ware, is not used but the Middle Anglo-Saxon shelly ware now known as Maxey ware is termed 'Group IV'.

²² P. V. Addyman and J. B. Whitwell, 'Some Middle Saxon pottery types in Lincolnshire', *Antiq. J.*, 50 (1970), 96–102.

²³ A. G. Vince and J. Young, *East Midlands Anglo-Saxon Pottery Project Annual Reports* (CLAU Archaeological Reports 1, 4 and 70, Lincoln, 1991, 1992 and 1993). Further thin sections have been made of this ware in connection with the publication of the Middle Anglo-Saxon site at Flixborough, South Humberside. Chemical analysis, using NAA and ICPS, carried out by M Hughes in general confirms this division.

²⁴ J. Timby, 'The Middle Saxon Pottery', 73–122 in P. Andrews (ed.), *Coins and Pottery from Hamwic* (Southampton, 1988).

²⁵ C. Coutts, *Pottery and the Emporia: Imported Pottery in Middle-Saxon England with Particular Reference to Ipswich* (unpubl. Ph.D. thesis, Sheffield University, 1991).

²⁶ R. A. Hodges, *The Hamwic Pottery: A Contribution to the Study of Eighth- and Ninth-Century Ceramics Trade and Economics* (unpubl. Ph.D. thesis, Southampton University, 1977); idem, 'The Pottery', 40–57 and appendix 4, 98–9, in P. Holdsworth, *Excavations at Melbourne Street, Southampton, 1971–1976* (CBA Res. Rep., 3, London, 1980).

first occur in Early Anglo-Saxon contexts but except at some Kentish sites they are always rare.²⁷

LATE SAXON/ANGLO-SCANDINAVIAN POTTERY (9TH–11TH CENTURIES)

In the late 9th and early 10th centuries, on either side of the Danelaw boundary of Watling Street, there was a break in ceramic traditions, related to the major social and economic changes which swept through lowland Britain at this time. Investigations at most medieval county towns show evidence for a growth in population, accompanied with the setting out of new streets and, in some cases, the establishment of pottery industries. Fieldwork also shows a reorganisation of the rural landscape, varying in character and detail from region to region, but probably implying an increase in population. These settlements seem in many cases to have relied on urban centres for the supply of pottery, especially where the pottery was wheelthrown, and sometimes glazed.²⁸

The handmade wares used in the late 9th to 11th centuries can be divided into two groups: those that are similar in form and technique to the preceding Middle Anglo-Saxon wares, and those which are ancestral to the post-conquest medieval cooking wares, which Dunning termed 'early medieval' wares. The former include bag-shaped, everted rimmed cooking pots found on sites in south-central England (such as Southampton, where they are clearly successors to the Hamwic coarsewares) but also at Gloucester, where wasters were found in the centre of the town.²⁹ There is no doubt that the Gloucester kiln was set up by immigrant potters from Hampshire or Wiltshire. Another possibly similar movement might have taken place in Cornwall, where bar lug pottery is found in 11th-century contexts. Thin-section analysis shows that there are at least two distinct fabrics, one of which was produced at the Lizard peninsula and there may in fact be more production sites.³⁰ The forms and technology, however, have been compared with northern Irish wares (Souterrain ware), east Midlands wares (the bar lug itself is found on Maxey-type wares and Middle Anglo-Saxon chaff-tempered wares) and Low Countries wares.³¹

Despite these hints that handmade wares in the Late Saxon period were being produced by specialist potters, who may have moved some distance with their

²⁷ A. C. Bishop, 'Report on examination of thin-sections of early pottery', 95 in V. Evison, *Wheel-thrown Pottery in Anglo-Saxon Graves* (London, 1979); D. F. Williams, *Petrological Analysis of (?)Frankish pottery from Mucking, Essex* (Ancient Monuments Lab. Rep., 3206, London, 1980).

²⁸ Production evidence has been found at Torksey, Newark, Lincoln, Norwich, Thetford, Ipswich, Stafford, Gloucester and Exeter, and is suspected at York and Derby. Rural production centres, such as Michelmersh (Hants.) or Langhale (Norfolk) seem to have appeared slightly later than these urban centres.

²⁹ A. G. Vince 'Appendix I: the pottery', in C. M. Heighway, A. P. Garrod and A. G. Vince, 'Excavations at 1 Westgate Street, Gloucester', *Medieval Archaeol.*, 23 (1979), 170–81. Vessels which were probably produced at Gloucester, possibly in the 1 Westgate Street kiln, have been identified at Hereford, Frampton-on-Severn and Winchcombe, but only the Gloucester and Hereford pieces have been compared in thin section.

³⁰ D. P. S. Peacock, 'The grass-marked sherd', 47 in C. Platt and R. Coleman Smith, *Excavations in Medieval Southampton, Vol. 2* (Leicester, 1975); D. F. Williams, *Roman and Post-Roman Pottery from Trethurgy, Cornwall* (Ancient Monuments Lab. Rep., 2576, London, 1978); idem, *Petrological Analysis of Iron Age, Roman, and Dark Age Pottery from Halangy Down, Isles of Scilly* (Ancient Monuments Lab. Rep., 2984, London, 1979); idem, *A Dark/Early Medieval Sherd from Goonhilly Down, Lizard, Cornwall* (Ancient Monuments Lab. Rep., 4138, London, 1984); idem, *A Petrological Examination of Medieval Pottery from Launceston Castle, Cornwall* (Ancient Monuments Lab. Rep., 38/90, London, 1990).

³¹ G. Dunning, 'Anglo-Saxon pottery — a symposium', *Medieval Archaeol.* (1959), 1–78.

skills, plus the thin-section evidence for the trading of this pottery, it is in the area of wheelthrown pottery production that the clearest break with the past is seen.³² Although it has been suggested that at Ipswich one can see the adoption of the potting wheel by an indigenous group of potters and whilst a similar model is possible at Lincoln, where the fabric of the Late Saxon shell-tempered ware is petrologically identical to that of the Middle Anglo-Saxon Northern Maxey ware, in general there is a complete break in tradition — including fabric — between the Late Saxon wheelthrown wares and the Middle Anglo-Saxon pottery previously used in the production areas. In many cases very close parallels can be found for the vessel-forms and their methods of preparation and decoration in various areas of western Europe. The curvilinear, stamped strips found on Michelmersh-ware vessels is paralleled at Rouen and in the Middle Rhine (Badorf ware). The globular profile with hand-formed base and small everted rim found on some jars (e.g. at Northampton and Lincoln) is paralleled in the Middle Rhine and is very different from the flat bases and roughly cylindrical profiles found on Northern Maxey-type ware whilst the use of roller-stamped bands, mainly on vessel rims and shoulders, is paralleled at several sites in northern France, eastern Belgium and the Rhineland but is unknown in Britain and Ireland until this period.

Thin-section analysis has been used to try and characterise these Late Saxon wares but in many cases the results are open to different interpretations. This is because there is a strong similarity to wares produced at different centres, not only in form and decoration but also in the appearance and firing of the fabrics. Presumably, the potters were trying to achieve particular finishes or following traditional procedures. An exception is the ware produced at the Bedford Garage kiln in Exeter, which has a distinctive detrital sand temper which includes local volcanic rock fragments.³³ Although white-firing, untempered vessels are universally ascribed to Stamford, very similar wares were being produced at Northampton and neither ware contains distinctive inclusions.³⁴ Furthermore, white-firing clays of similar geological age outcrop in North Yorkshire and may well have been used to produce the majority of the lead-glazed wares found at Coppergate, York.³⁵ If so, it is unlikely that no unglazed cooking wares were produced in the same industry.³⁶ Reduced, sand-tempered wares were produced over a wide area of the Midlands and East Anglia. There is similar uncertainty as to their characterisation. A study of samples of Torksey-type ware from sites in York and from kiln sites at Torksey concluded that there might be production of this ware north of the

³² A. G. Vince, 'Forms, functions and manufacturing techniques of late 9th and 10th century wheelthrown pottery in England and their origins', 151–64 in D. Piton (ed.), *Travaux du Groupe de recherches et d'études sur la ceramique dans le nord — pas-de-Calais* (Boulogne, 1993).

³³ A. G. Vince, 'The petrology of the products of the Bedford Garage Kiln', 32 in J. P. Allan, *Medieval and Post-Medieval Finds from Exeter 1971–1981* (Exeter, 1984).

³⁴ J. G. Hurst, 'Saxo-Norman pottery in East Anglia: part III. Stamford ware', *Proc. Cambridge Antiquarian Soc.*, 51 (1957), 37–65; K. Kilmurry, *The Pottery Industry of Stamford, Lincs c. AD 850–1250* (BAR 84, Oxford, 1980); idem, 'The manufacture of Stamford Ware: an application of thin-sectioning and neutron activation analysis', 105–11 in Freestone et al. (eds.), op. cit. in note 12; M. Gryspeerdt, op. cit. in note 18.

³⁵ A. J. Mainman, *Anglo-Scandinavian Pottery from Coppergate* (The Archaeology of York 16/5, London, 1990), 444–62.

³⁶ This possibility could easily be investigated, most profitably by a combination of chemical analysis and thin sections.

Humber whereas thin-section study of wasters from Newark showed that these were difficult or impossible to distinguish from Torksey products.³⁷ By contrast, there are differences between some of the products of the various Thetford-type ware kilns of East Anglia, of which that at Ipswich is the more distinctive. Furthermore, the Thetford-type wares found at Bedford are petrologically distinguishable from those from known production sites, as were some of those from London.³⁸ The oxidised sand-tempered Late Saxon pottery found at sites along the Welsh border, from Chester in the north to Hereford and Worcester in the south, is also difficult to characterise using thin-sections. Production sites for this ware have been found at Stafford and examined in thin section whilst samples of pottery from consumer sites in Chester and Hereford have also been thin-sectioned. No differences have been observed between these three groups. However, all of the inclusions found in the ware (which has been given several names, including Chester ware and Stafford-type ware) are of types which occur widely in the West Midlands.³⁹

Finally, there is a range of Late Saxon shell-tempered wares all of which have been studied in thin section. If the shell-fragments were large enough it might be possible to identify species with limited chronological ranges, and thus narrow down the range of potential sources.⁴⁰ However, in most cases the fragments are far too fragmentary for such study. Those studied at Lincoln have been stained using Dickson's method.⁴¹ This staining distinguishes ferroan (stained blue) from non-ferroan calcite (stained pink) and dolomite (unstained). This method allows Late Saxon shell-tempered wares to be broadly divided into those in which the non-ferroan shell is encased in a ferroan calcite matrix and those in which the non-ferroan shell has no such coating. The former are identified as fragments of shelly limestone temper whereas the latter might be shell-sand temper or naturally present in a shelly clay. Several varieties of shelly limestone tempered ware were used in the Late Saxon period in Lincoln but all are petrologically similar and most are now known from production sites in the city.⁴² Those wares with shell sand/

³⁷ C. Brooks and A. J. Mainman, 'Torksey Ware viewed from the North', 63–70 in P. V. Addyman and V. E. Black, (eds.), *Archaeological Papers from York* (York, 1984); A. G. Vince, *The Petrology of Some Anglo-Saxon Pottery from Newark, Nottinghamshire* (Lincoln, 1995).

³⁸ J. G. Hurst, 'Saxo-Norman pottery in East Anglia: part II. Thetford ware'. *Proc. Cambridge Antiquarian Soc.*, 50 (1956), 42–60; K. Wade, *The Thetford Ware Tradition with special reference to Norfolk* (unpubl. undergraduate diss., University of Southampton, 1973); D. F. Williams, *Petrology of pre-Norman Pottery from Bedford* (Ancient Monuments Lab. Rep., 2441, London, 1977); A. G. Vince and M. A. Jenner, 'The Saxon and Early Medieval Pottery of London', 19–119 in A. G. Vince (ed.), *Aspects of Saxon and Norman London 2: Finds and Environmental Evidence* (London, 1991).

³⁹ A. G. Vince, 'The ceramic sequence', 73–8 in R. Shoemith, *Hereford City Excavations: Vol. 3, The Finds* (CBA Res. Rep. 56, London, 1985); D. F. Williams, 'Appendix 1: the petrology of Chester Ware', 55–56 in D. J. P. Mason, *Excavations at Chester: 26–42 Lower Bridge Street, 1974–6* (Chester, 1985); idem, *Late Saxon 'Chester Ware' from Chester* (Ancient Monuments Lab. Rep., 3674, London, 1982).

⁴⁰ J. Cooper, 'The research potential of molluscan shell-tempered pottery', 162–2 in Freestone et al. (eds.), op. cit. in note 12.

⁴¹ J. A. D. Dickson, 'A modified staining technique for carbonates in thin-section', *Nature*, 205 (1965), 587.

⁴² J. Young and A. G. Vince, *A Corpus of Anglo-Saxon and Medieval Pottery from Lincoln* (Oxford, forthcoming); D. F. Williams, *Petrological Analysis of Pottery from the Lincoln Kiln Block* (Ancient Monuments Lab. Rep., 2094, London, 1976); idem, *Petrological Analysis of Pottery from the Lincoln Kiln Block* (Ancient Monuments Lab. Rep., 2261, London, 1977); idem, *Petrological Examination of Saxon Pottery from Lincoln* (Ancient Monuments Lab. Rep., 3570, London, 1981); idem, 'Petrological analysis of pottery from kiln 200', B8 in P. Miles, J. Young and J. Wachter, *A Late Saxon Kiln Site at Silver Street, Lincoln* (London, 1989); A. Woods, 'The Silver Street Shelly wares', *ibid.* A6–A10.

natural shell inclusions can be subdivided into St Neots ware, where the calcareous inclusions are varied and include nacreous bivalve shell, echinoid shell, punctate brachiopod shell and thin-walled bivalve shells,⁴³ and the Late Saxon Shelly ware found at Oxford, London and other sites in the Thames valley, which by contrast contains almost exclusively fragments of *gryphaea*, a bivalve with nacreous structure.⁴⁴ Whether these petrological groups represent individual production areas or a wider grouping containing distinct sources is disputed.⁴⁵

At various times within this period glazed wares were produced. Only one major production site is known, at Stamford, whilst vessels with sparse splashed glaze are known from a kiln site at Exeter and on locally-produced wasters from Lincoln. Otherwise, evidence for the source of these early glazed wares depends on scientific analysis. Examples of pre-Conquest glazed wares from York, London, Hereford, Silbury Hill and elsewhere have been examined in thin section and can be used to group together vessels which might be produced using the same raw materials, and in some cases broad production regions can be suggested.⁴⁶ However, there is no evidence from these thin-sections which actually identifies any source.

It has been suggested that there may be a link between these rare glazed wares and the contemporary production of glazed floor tiles. These are known from several sites throughout England, from Winchester in the south to York in the north and several have been examined in thin section.⁴⁷ However, no clear evidence for their provenance has been found, although as with the contemporary glazed vessels there is clearly more than one source.

This period saw a shift in the pattern of pottery imports. There are very few imports known which date to the late 9th or early 10th centuries, an exception being the York Early Glazed wares which may be imports or a specialised local product. In the later 10th and 11th centuries imports are found again. They include a range of wares from the Middle Rhine, the Meuse valley, and northern France.

⁴³ R. Hunter, 'Appendix: St Neots type ware', 230–40 in J. H. Williams (ed.), *St Peter's Street Northampton: Excavations 1973–1976* (Northampton, 1979); J. G. Hurst, 'Saxo-Norman pottery in East Anglia: part I. General discussion and St Neots' ware', *Proc. Cambridge Antiquarian Soc.*, 49 (1955), 43–70; D. F. Williams, *Petrological Analysis of St. Neots Type Ware and Lyveden Ware* (Ancient Monuments Lab. Rep., 2306, London, 1977); idem, *Some Late Saxon/Early Medieval Pottery from West Cotton, Northamptonshire* (Ancient Monuments Lab. Rep., 59/92, London, 1992); Vince and Jenner, *op. cit.* in note 38.

⁴⁴ Vince and Jenner, *op. cit.* in note 38.

⁴⁵ For example by M. Mellor, who believes that there are typological/manufacturing differences between the Late Saxon Shelly ware found at Oxford and nearby sites and that found in the Lower Thames valley in and around London. Hunter's NAA major study of St Neot's type ware, based on 365 analyses, included samples of shell-tempered ware produced at Lincoln and samples of shell-tempered ware from Lower Bishopshill, York, which subsequent work on the York shell-tempered wares has shown to be likely to be of Lincoln origin. Despite this, Hunter concludes that the differences found in both petrology and chemistry between the Lincoln and York samples and the rest are probably due to sampling error. Furthermore, analysis reveals no systematic differences between the samples from Northampton, Oxford, Bedford, St Neots, Lyveden or South Witham: Hunter, *op. cit.* in note 43. It does not seem, therefore, that NAA will be able to answer this question although it may be that a combination of stained thin sections and ICP-AES would characterise these wares.

⁴⁶ Those from Hereford have a micaceous silty fabric indistinguishable from later medieval and post-medieval wares produced in Herefordshire. A source in Hereford itself is highly likely for these. South of the Thames most of the pre-conquest glazed wares can be classified as Winchester-type ware but their source is unknown.

⁴⁷ I. M. Betts, *A Scientific Investigation of the Brick and Tile Industry of York to the Mid-Eighteenth Century* (unpubl. Ph.D. thesis, University of Bradford, 1985); idem, 'Analytical analysis and manufacturing techniques of Anglo-Saxon tiles', *Medieval Ceramics*, 10 (1986), 37–42.

These wares often share features, such as the use of light-coloured clay and red painted decoration, and it is therefore difficult to attribute sherds on the basis of visual characteristics. Most of these wares have been examined in thin section and some differences in fabric have been established.⁴⁸ None, however are petrologically distinctive. More promising are pre-Conquest imports found at Exeter, which are probably from north-western French or Breton sources.⁴⁹ Even here, though, the majority of the early imports contain petrologically undiagnostic inclusions.

SAXO-NORMAN/‘EARLY MEDIEVAL’ POTTERY (11TH–12TH CENTURIES)

During the 11th century, and definitely before the Norman Conquest in some places, there was an abrupt change in pottery sources, often accompanied by a change in form and technology. This change can be observed from the north of England right through to the south-west. However, there are significant regional differences which make it difficult to draw social or economic inferences.

In East Anglia there is little evidence for a break in tradition during this period. New production sites, such as those Langhale and Grimston, produced vessels of similar form and decoration to those used in the 10th century although at Blackborough End handmade vessels with globular bodies and everted rims were made.⁵⁰

In the East Midlands, and north of the Humber, the Late Saxon wheelthrown wares in use in the 10th century ceased production in the 11th century. In their place handmade shell-tempered ware (Lincoln Fine Shelled ware) was used in Lincolnshire but at both Lincoln and York there is an increase in the quantity of Stamford ware used. There may in fact be a short phase in York when only Stamford wares were used, but this phase was rapidly succeeded by the use of Gritty ware in Yorkshire. Whether the earlier York, Lincoln and Torksey industries collapsed through pre-Conquest economic pressures, or through the harrying of the north, is unclear. However, the wares which replaced them were sometimes urban products (as at Stamford), sometimes wheelthrown and kiln-fired, and sometimes handmade and probably bonfire-fired. Thin-section analysis and visual identification suggests that the successor wares were distributed over similar distances to those they replaced.⁵¹

Further south, there is a different pattern, typified by that found in the City of London. In dated deposits excavated at the bridgehead, Late Saxon Shelly ware forms the majority of assemblages dated c. 1020. Yet within 20 years, at Billingsgate

⁴⁸ Examples of Rhenish red-painted ware (Pingsdorf-type), late Badorf-type amphorae, blue-grey ware (alias Paffrath-type ware and Blau-grau ware), Andenne ware and northern French imports have been thin-sectioned. Most of these were found in the City of London. Vince and Jenner, *op. cit.* in note 38, BLGR, PING, NFRE, ANDE.

⁴⁹ R. A. Hodges and A. J. Mainman, ‘The Saxo-Norman imported pottery’, 13–18 in Allan, *op. cit.* in note 33. Thin-sectioned vessels include one example with metamorphic rock inclusions and another containing black and white micas.

⁵⁰ Both Blackborough End and Grimston wares have been examined in thin section and contain mineral suites characteristic of the lower Cretaceous, such as polished quartz grains and glauconite.

⁵¹ Lincoln Fine Shelled wares have been identified at York and Pontefract, and Yorkshire Gritty ware has been identified in thin section at Lincoln.

Lorry Park, this single ware had been replaced by assemblages where a range of wares were found. Thin-section analysis of these wares and comparison with those found in surrounding areas showed that the market supplied by the earlier ware was now being supplied with pottery from six or more centres.⁵² A survey of 11th-/12th-century pottery distribution patterns in the West Country has hinted at a similar pattern of small-scale, but nevertheless probably commercial, production in Wiltshire and Gloucestershire.⁵³ Whilst the absolute date of most of these wares is unclear some appear to be substantially post-Conquest (e.g. Malvern Chase ware was first produced c. 1100) whilst others are most likely pre-Conquest (handmade wares of this type were found in layers predating the early Norman castles at Bristol, Gloucester and Oxford).

In the south-west and along the Welsh border a slightly different pattern again is found at this period. Sites such as Exeter, Chepstow and Hereford were entirely supplied with pottery from sources further east. At Exeter, this pattern was superimposed upon a town which had previously had a pottery industry, in what appears to be a pre-Conquest change. At Chepstow, the early Norman town was supplied with pottery from Bristol (and rarely further afield) but without any locally-produced wares. At Hereford, the late 11th-century pottery was obtained from the Vale of Gloucester whereas previously pottery had been obtained from Stafford and Gloucester.⁵⁴

Alongside these handmade wares, most of which were used for cooking, a small range of handmade glazed wares was produced. These handmade glazed wares were of two main forms: globular tripod pitchers, and jugs.

In many cases these handmade wares continued to be produced into the 12th century, when they were superseded by wheelthrown wares, some of which were produced in centres that had previously produced handmade wares. In a few cases, however, these hand-forming traditions continued for several centuries. Much of the pottery produced in the south-west was made without the use of the wheel to the end of the medieval period. Similarly, in the Kennet valley, handmade wares continued to be produced into the 15th century. In the East Midlands, the wheelthrown urban pottery industry of Stamford was replaced by handmade Lyveden/Stanion wares during the 13th century (although other wheelthrown

⁵² Vince and Jenner, *op. cit.* in note 38, EMS, EMSS, ESUR, EMCH, EMSH, EMFL.

⁵³ A number of small-scale industries were identified, succeeding widely-distributed wares such as Cheddar E ware: A. G. Vince, 'The medieval pottery industry in southern Britain: 10th to 13th centuries', 309–22 in H. Howard and E. L. Morris, *Production and Distribution: A Ceramic Viewpoint* (BAR Int. Ser. 120, Oxford 1981).

⁵⁴ D. H. Brown and A. G. Vince, 'Petrological Aspects; the Medieval Pottery of Exeter under the Microscope', 32–4 in Allan, *op. cit.* in note 33; D. H. Brown and A. G. Vince, 'The petrology of the local pottery', 92–3 in D. M. Griffiths and A. N. Griffiths, 'An excavation at 39 Fore Street, Totnes', *Proc. Devon Archaeol. Soc.*, 42 (1984); A. G. Vince and D. H. Brown, 'The petrology of some pottery from Lydford', 135–6 in P. J. Weddell, 'Excavations at Southgate Cottages, Lydford', *Proc. Devon Archaeol. Soc.*, 39 (1981); *idem*, 'The Petrology of some pottery from Okehampton', 101–3 in R. A. Higham, J. P. Allen and S. R. Blaylock, 'Excavations at Oakhampton Castle', *Proc. Devon Archaeol. Soc.*, 40 (1982); A. G. Vince, 'The pottery', 93–140 in R. Shoesmith (ed.), *Excavations at Chepstow 1973–1974* (Cardiff, 1991); *idem*, *op. cit.* in note 39, 73–8.

industries flourished, as at Nottingham and Lincoln). Despite their outmoded method of production, these wares were traded over large areas.⁵⁵

WHEELTHROWN UNGLAZED WARES (12TH–16TH CENTURIES)

A feature of the medieval pottery of the south-east of England was the Reduced Ware tradition. Potters working in this tradition made no use of glaze but did produce jugs, usually large rounded vessels with prominently-decorated handles. The surfaces of these vessels are usually dark grey and it is likely that the potters were trying to achieve as dark a surface as possible, for the firing pattern sometimes indicates that the pots were firing in an oxidising atmosphere before the kiln was clamped down. A survey of the pottery in this tradition in the Thames basin is in preparation and has been accompanied by an intensive thin-section and ICPS analytical programme. Samples of reduced wares from kiln sites in Hertfordshire, Middlesex and Surrey have been analysed and major differences found between those made close to the Chilterns, those produced on the London clays of north Middlesex, and those produced in the Limpsfield area of Surrey.⁵⁶ Despite this, it has not been possible to identify specific production sites.

WHEELTHROWN GLAZED WARES (12TH–16TH CENTURIES)

Until the middle of the 12th century glazed vessels for serving or storing liquids were rare and either supplied by the Stamford industry or one of the industries producing handmade tripod pitchers described above (apart from Stamford, the pre-Conquest wheelthrown glazed-ware industries all seem to have ceased production at or before the Norman Conquest). From the middle of the 12th century onwards, however, industries producing (mainly) wheelthrown jugs are found. Stamford itself switched over to the production of green-glazed jugs, Developed Stamford ware, and the Beverley ware, Nottingham Splashed ware, Lincoln and London-type ware industries may begin at about the same time. These industries spread over the following century, gradually supplanting most of the earlier handmade ware industries.⁵⁷ There appears to have been a considerable overlapping of the markets of these glazed-ware industries, together with the rapid copying of forms and decorative schemes. In some cases the similarities between industries may be due to a movement of potters and in others to copying finished products (or even producing skeuomorphs of vessels in other materials such as cast metal or coopered wooden vessels). Furthermore, there seems to have been an

⁵⁵ Both contain a distinctive range of inclusions. North Devon medieval ware is tempered with a mixed gravel composed of biotite granite and medium-grained sandstone fragments: A. G. Vince, 'The Petrology and Source of the Medieval Pottery from Meldon Quarry, Devon', 235–6 in D. Austen, 'Excavations in Oakhampton Deer Park, Devon', *Proc. Devon Archaeol. Soc.*, 36 (1978); Newbury B ware is tempered with a gravel consisting of calcareous algae nodules, flint and rounded quartz: idem, 'The Pottery', in A. G. Vince, 'Excavations at Nos 143–5 Bartholomew Street, 1979', 45–68 in A. G. Vince, S. J. Lobb, J. C. Richards and L. Mephram, *Excavations in Newbury, Berkshire 1979–1990* (Salisbury, 1997). The fabric of Lyveden/Stanion wares is characterised by abundant ooliths and examples have been identified at Trondheim and Bergen in Norway.

⁵⁶ L. Blackmore and J. E. Pearce, *Medieval Coarsewares of the London Region: A Dated Type-series of London Medieval Pottery Part 5: Shelly-sandy Wares and the Greyware Industries* (forthcoming).

⁵⁷ In some cases existing industries adopted the technology and forms of these new industries, as at Malvern Chase, in the parish of Hanley Castle, Worcestershire. In other cases, as at Ham Green, on the south bank of the Bristol Avon, handforming techniques were used to produce the new glazed jug-forms.

attempt to produce the appearance of white-firing pottery, even in areas where white-firing clays do not occur. This encouraged the use of white slip (at Worcester, for example, the slip was employed mainly around the inside of the jug rim, the only part of the unglazed body to be seen during use). Because of this intense competition and the overlap in style, appearance and decoration between centres it is not possible to identify much of this pottery without the use of fabric analysis. A considerable number of thin sections have been produced of later medieval wheelthrown glazed-wares but in most cases no distinctive rocks or minerals have been noted. Even in the south-west of England the later medieval wheelthrown glazed-wares found contain few diagnostic inclusions and are generally very fine-textured. Exceptions to this general rule are the Malvern Chase industry, where sparse fragments of acid igneous and coarse-grained metamorphic rocks are found in the wheelthrown glazed ware, and the Potters Marston industry of Leicestershire, where the pottery has inclusions of syenite. In all other cases, detailed comparison of inclusion characteristics is required to identify wares securely and even then similar mineral suites occur in pottery made in widely separated areas. The identification of these wares is therefore likely to have to rely on a range of criteria, not least archaeological probability.

There is a great disparity in the amount of thin-section analysis which has taken place on these wares. Two regional studies have been carried out, in the Severn Valley and the south-east of England.⁵⁸ Elsewhere, work has taken place on an excavation-by-excavation basis, which does not allow for comparison between different wares (required to establish the distinguishing characteristics of a ware) to be made.

Much of the Late-medieval pottery of the south-western peninsula is handmade coarseware, some glazed but often not. Wheelthrown glazed wares are relatively rare and unlike the coarsewares often do not have distinctive mineral suites.⁵⁹ Nevertheless, at the end of the medieval period there are some distinctive wheelthrown Cornish wares, such as those produced at Lostwithiel which contain metamorphic inclusions and abundant muscovite, and those from St Germans, which contain a fine shell and sandstone sand. Even then, however, St Germans ware is not glazed but decorated with white slip and incised lines.

An unexpected conclusion from the UKTS survey is that the wheelthrown glazed medieval wares of the Midlands have been the subject of a considerable number of thin-section studies, many connected with the post-excavation work

⁵⁸ Streeten, *op. cit.* in note 8; Vince, *op. cit.* in note 8.

⁵⁹ A. G. Vince and D. H. Brown, '4.3 Pottery: Petrological analysis of some pottery from south Cornwall', 165–7 in D. Austin, G. A. M. Gerrard and T. A. P. Greaves, 'Tin and agriculture in the Middle Ages and beyond: landscape archaeology in St Neot Parish, Cornwall', *Cornish Archaeol.*, 28 (1989); D. F. Williams, *Petrology of Ceramic Samples from Mawgan-in-Meneage, Cornwall* (Ancient Monuments Lab. Rep., 3423, London, 1981); *idem*, *Petrological Analysis of Medieval Pottery from Exeter* (Ancient Monuments Lab. Rep., 3651, London, 1982); *idem*, *Petrological Analysis of Pottery and Tiles from Exeter* (Ancient Monuments Lab. Rep., 3652, London, 1982); *idem*, *Petrological Analysis of Thirteenth Century Pottery from Exeter* (Ancient Monuments Lab. Rep., 3650, London, 1982); *idem*, *Medieval Stamped Vessel from Halligey Fogou, Cornwall* (Ancient Monuments Lab. Rep., 3990, London, 1983); *idem*, *Medieval/Post-Medieval Pottery from Woolley Barrow, Cornwall* (Ancient Monuments Lab. Rep., 4410, London, 1984); *idem*, *A Petrological Examination of Medieval Pottery from Launceston Castle, Cornwall* (Ancient Monuments Lab. Rep., 38/90, London, 1990).

carried out at towns such as Northampton, Coventry and Oxford.⁶⁰ Unlike the Severn Valley or the south-east, however, this work has been carried out by numerous researchers, many undertaking their work as part of their studies at the University of Leicester. Within the Midlands, only the pottery of Oxfordshire has been subjected to a synthesis, by Mellor. Clearly, the mass of work which has taken place in the remaining Midland counties calls for synthesis.

The counties bordering the middle and lower River Severn have been extensively studied and it has proved possible to correlate the results of neighbouring counties, to produce a synthetic account of pottery production and distribution. Given this background it is possible to then recognise the unusual and

⁶⁰ G. Brine, used in fabric descriptions in A. Pinder and B. Davison, 'The excavation of a motte and bailey castle at Chalgrave, Beds, 1970', *Bedfordshire Archaeol.*, 18 (1988), 40–3; V. Denham, P. Farmer, and N. Farmer, microfiches 63, 64 and 67 in M. Shaw, 'Excavations on a Saxon and medieval site at Black Lion Hill, Northampton', *Northamptonshire Archaeol.*, 20 (1985); V. Denham, 'Notes on specific fabrics', microfiche 34: 41–8, 70–5 in M. Shaw, 'Excavations on a medieval site at Derngate, Northampton', *Northamptonshire Archaeol.*, 19 (1984); J. Groves, 'The Pottery from the Medieval Kiln Site at Yardley Hastings, Northamptonshire' (unpubl. M.A. diss., Leicester University, 1980); M. Gryspeerdt, untitled microfiche, in F. Williams, 'Excavations on Mayfair, Northampton 1977', *Northamptonshire Archaeol.*, 14 (1979); idem, untitled microfiche in J. H. Williams and M. Shaw, 'Excavations in Chalk Lane, Northampton 1975–1978', *Northamptonshire Archaeol.*, 16 (1981), Fiche 43–70; idem, 'The pottery', 37, 43 and 108–21 in J. H. Williams and M. Shaw, 'Excavations in Chalk Lane, Northampton, 1975–1978', *Northamptonshire Archaeol.*, 16 (1981); idem, untitled microfiche in J. H. Williams, 'Four small excavations on Northampton's Medieval defences and elsewhere', *Northamptonshire Archaeol.*, 17 (1982); D. Hall, 'The Analysis of Pottery from a Late Medieval Kiln Site at Everton, Bedfordshire, with a Comparative Study of Late Medieval Reduced Ware Traditions in the South Midlands' (unpubl. M.A. diss., Leicester University, 1993); M. A. Jenner and A. G. Vince, 'A dated type-series of London Medieval pottery Part 3: a late Medieval Hertfordshire glazed ware', *Trans. London Middlesex Archaeol. Soc.*, 34 (1983), 151–70; A. Martin-Hoogewerf, 'Analysis of samples of Much Park Street pottery type 5', 131 in S. M. Wright, 'Much Park Street, Coventry: the development of a medieval street. Excavations 1970–74', *Birmingham Warwickshire Archaeol. Soc. Trans.*, 92 (1988 for 1982); Pearce, Vince and Jenner, op. cit. in note 10; Pearce and Vince, op. cit. in note 10; Pearce, Vince, White with Cunningham, op. cit. in note 10; M. Redknap, 'Twelfth and thirteenth century Coventry wares, with special reference to a waster group from the Cannon Park Estate (Lychgate Road), Coventry', *Medieval Ceramics*, 9 (1985), 65–77; T. Royal-Dawson, 'An Examination of some Medieval Pottery from the Denham Kilns' (unpubl. B.A. diss., Leicester University, 1984); K. Steane, 'Excavations at Ratley Castle 1968–73', *Trans. Birmingham Warwickshire Archaeol. Soc.*, 96 (1988–90), 5–25; idem, 'Medieval pottery fabrics: thin sections', in K. Steane, 'Ratley Castle excavations 1968–1973' (unpubl. M.A. diss., Leicester University, 1987); A. G. Vince, pls. 10–7 and pp. 206–7 in M. Mellor, 'A synthesis of Middle and Late Saxon, medieval and early post-medieval pottery in the Oxford Region', *Oxoniensia*, 59 (1994); idem, *The petrology of some medieval Pottery from Everton, Bedfordshire* (Lincoln, 1995); idem, *The Petrology of some medieval Pottery from Stratton Village, Bedfordshire* (Lincoln, 1995); D. F. Williams, *Petrological Examination of certain Pottery from Breedon-on-the-Hill, Leicestershire* (Ancient Monuments Lab. Rep., 2084, London, 1976); idem, *Petrological examination of Clay and Pottery from the Chandler's Cross Kiln, Hertfordshire* (Ancient Monuments Lab. Rep., 2055, London, 1976); idem, *Petrological Analysis of some medieval and Post-medieval pottery from Buckinghamshire* (Ancient Monuments Lab. Rep., 2196, London, 1977); idem, *Petrological Analysis of early medieval Pottery from Oxford* (Ancient Monuments Lab. Rep., 2487, London, 1978); idem, *Petrological Examination of Pottery from Oxford* (Ancient Monuments Lab. Rep., 3067, London, 1980); idem, 'Petrological examination of medieval pottery dating from the late twelfth–sixteenth century from Oxford', microfiche 2 Bo6–8 in N. Palmer, 'A Beaker Burial and Medieval Tenements in the Hamel Oxford', *Oxoniensia* (1980); idem, *Petrological Examination of Pottery from the medieval Kilns at Chilvers Coton, Nuneaton* (Ancient Monuments Lab. Rep., 3568, London, 1981); idem, *Petrological Examination of medieval Pottery from the 1982 Excavations at George Street, Aylesbury* (Ancient Monuments Lab. Rep., 3957, London, 1983); idem, *Petrological Examination of medieval Pottery from Tamworth* (Ancient Monuments Lab. Rep., 4312, London, 1984); idem, 'Petrological examination of pottery fabrics', 196–7 in P. Mayes and K. Scott, *Pottery Kilns at Chilvers Coton, Nuneaton* (Soc. Medieval Archaeol. Mon. Ser., 10, 1984); idem, *Note on medieval Pottery from Potters Marston and Coventry* (Ancient Monuments Lab. Rep., 4603, London, 1985); idem, *Note on the Petrology of a medieval Sherd from Tamworth* (Ancient Monuments Lab. Rep., 4865, London, 1986); idem, 'Petrology', 45 and 50 in M. Farley and J. Lawson, 'A fifteenth-century pottery and tile kiln at Leyhill, Latimer, Buckinghamshire', *Rec. Buckinghamshire*, 32 (1991); idem, 110–22 in P. Rahtz and R. Meeson, *An Anglo-Saxon Watermill at Tamworth: Excavations in the Bolebridge Street Area of Tamworth Staffordshire in 1971 and 1978* (CBA Res. Rep., 83, London, 1992).

atypical, and to compare patterns found at different types of settlement.⁶¹ The one glaring omission, however, is a serious study of the ceramics found in Bristol.

Following on from Streeten's pioneering work in Kent and Sussex, thin section analysis of medieval ceramics has concentrated on imported wares. The one exception to come to the attention of the UKTS researchers is a study of the pottery from kilns excavated in Canterbury.⁶²

Within the counties of south-central England, Wiltshire, Dorset and Hampshire, thin-section studies are very much concentrated at two of the main ports, Southampton, where the long-awaited addition to Platt and Coleman-Smith's work is expected soon, and Poole.⁶³

Little work seems to have been published on the medieval wheelthrown glazed wares of East Anglia, despite the fact that East Anglian ports, such as Kings Lynn and Great Yarmouth, were major trading centres in the 12th – 14th centuries. Major publications of medieval pottery from Kings Lynn and Norwich have appeared but neither was accompanied by thin-section reports. The recent publication of the Colchester later medieval pottery goes some way towards redressing this situation.⁶⁴

Although nominally part of the Midlands, Lincoln requires separate note here, mainly because of the very large programme of thin-section analysis which has taken place on the later medieval pottery from the city. The majority of this pottery was produced in and around the settlement but Lincoln wares were traded

⁶¹ C. Gerrard, 'Petrography of Medieval Pottery from Avon and Somerset: Part 1 Cheddar Palaces; Part 2 Bristol Type Series; Part 3 Local Avon Wares' (1987); E. L. Morris, 'Petrological report on an unusual medieval fabric', f11–12 in S. Woodiwiss (ed.), *Iron Age and Roman Salt Production and the Medieval Town of Droitwich* (CBA Res. Rep., 81, London, 1992); A. G. Vince, 'The medieval pottery, fabric types', 27–31 in B. W. Cunliffe, *Excavations in Bath 1950–1975* (Bristol, 1979); idem, op. cit. in note 8; idem, op. cit. in note 39; idem, 'The late Saxon, Medieval and Post medieval pottery', 13–23 in A. Saville, 'Salvage recording of Romano-British, Saxon, Medieval and Post-Medieval remains at North Street, Winchcombe, Gloucester', *Trans. Bristol Gloucestershire Archaeol. Soc.*, 103 (1985); idem, 'The Petrology of some Medieval pottery from the Buttermarket, Leominster, Hereford and Worcester' (unpubl. rep. submitted to Hereford and Worcester County Archaeol. Service, 1995); D. F. Williams, *Note on the Petrology of medieval Pottery from the 1988–89 Excavations at Eckweek Farmstead, Avon* (Ancient Monuments Lab. Rep., 7/91, London, 1991); idem, *A preliminary petrological Examination of medieval to early-post medieval Pottery from the Buttercross site, Leominster, Herefordshire* (Ancient Monuments Lab. Rep., London, 1995).

⁶² D. F. Williams, *Medieval pottery from Stonar, Kent* (Ancient Monuments Lab. Rep., 2241, London, 1977); idem, *Medieval Pottery, Wingham, Kent* (Ancient Monuments Lab. Rep., 2227, London, 1977); idem, *Petrological Analysis of medieval Pottery from Stonar, Kent* (Ancient Monuments Lab. Rep., 4116, London, 1983); idem, *A petrological Examination of Pottery from two later twelfth century Kilns in the Area of Canterbury, Kent* (Ancient Monuments Lab. Rep., 110/90, London, 1990).

⁶³ D. H. Brown, *Pottery in Medieval Southampton c 1066–1510* (CBA Res. Rep., 133, York, 2002); B. P. Harrison and D. F. Williams, 'Sherborne Old Castle Dorset; medieval pottery fabrics', *Proc. Dorset Nat. Hist. Archaeol. Soc.*, 101 (1979), 93–5; idem, *Sherborne Old Castle, Dorset; medieval Pottery Fabrics* (Ancient Monuments Lab. Rep., 3165, London, Sept 1980); D. F. Williams, *Petrological Analysis of some medieval Pottery from Sherborne Old Castle, Dorset* (Ancient Monuments Lab. Rep., 2559, London, 1978); idem, *Sherborne Old Castle: medieval Pottery Fabrics* (Ancient Monuments Lab. Rep., 2712, London, 1979); idem, *Petrological Examination of medieval Pottery from Faccombe Netherpton, Hants* (Ancient Monuments Lab. Rep., 3415, London, 1981); idem, *Medieval Pottery from Christchurch and Poole* (Ancient Monuments Lab. Rep., 4438, London, 1984); idem, *Petrological Examination of medieval Pottery from Poole, Dorset* (Ancient Monuments Lab. Rep., 4364, London, 1984); idem, *Note on the Petrology of some medieval Pottery from Excavations at Carisbrooke Castle, Isle of Wight* (Ancient Monuments Lab. Rep., 78/91, London, 1991); idem, 'The petrological examination of the pottery', in K. Jarvis (ed.), *Excavations in Poole 1973–1983* (Dorchester, 1992).

⁶⁴ J. P. Cotter, *Post-Roman Pottery from Excavations in Colchester, 1971–85* (Colchester, 2000).

widely, both within the county and via Boston to Continental Europe and Scandinavia.⁶⁵

Given the huge size of Yorkshire, the amount of thin-section study that its glazed wheelthrown later medieval pottery has received is very low.⁶⁶ Much of this work is connected with the major pottery production site at Scarborough but even here it seems that a more intensive, larger-scale study would prove valuable. Medieval wheelthrown glazed wares from West Yorkshire and South Yorkshire are hardly represented in the UKTS database.

The north-east of England is similarly poorly dealt with, with the exception of Crowdy's work on the Eshott kiln and the pottery from Eyemouth.⁶⁷ This lack is particularly unfortunate because the underlying geology includes basic igneous intrusions which potentially make it possible to separate locally-produced and pottery from regional and Continental imports.

The north-west of England is very poorly covered. There is, in fact, insufficient information even to assess the potential of the region for petrological studies, despite the varied local geology and the presence of large collections of medieval pottery from sites such as Carlisle and Lancaster.⁶⁸

Scotland, theoretically, should prove very suitable for petrological analysis but recent studies by the British Geological Survey suggest that whereas red earthenwares contain distinctive mineral suites white-firing ones are less diagnostic, although both can be profitably studied using chemical analysis.⁶⁹ A considerable

⁶⁵ L. Adams, *Medieval Pottery from Broadgate East Lincoln 1973* (London, 1977); D. F. Williams, *Lincoln: a Preliminary Report on Petrological Examination of Pottery* (Ancient Monuments Lab. Rep., 1578, London, undated); idem, *Medieval Shell Tempered Pottery from Lincoln* (Ancient Monuments Lab. Rep., 2260, London, 1977); Young and Vince, op. cit. in note 9.

⁶⁶ R. Tomber and D. F. Williams, *Petrology of selected medieval Sherds from Scarborough, Nottingham, and Lincoln* (Ancient Monuments Lab. Rep., 3062, London, March 1980); A. G. Vince, 'Petrological and Inductively Coupled Plasma Spectroscopy (ICPS) analysis', 64 in C. Cumberpatch, 'A Medieval Pottery Kiln in Hallgate, Doncaster, South Yorkshire', *Medieval Ceramics*, 22–3 (1998–99); D. F. Williams, *Thin section Examination of some 'York white ware' Pottery* (Ancient Monuments Lab. Rep., 3700, London, 1982); idem, 'Petrological examination of Scarborough ware and other medieval pottery', 111–9 in P. G. Farmer and N. C. Farmer, 'Symposium on Scarborough ware', *Medieval Ceramics*, 6 (1982); idem, *Petrological Examination of Scarborough Ware and other medieval Pottery* (Ancient Monuments Lab. Rep., 3829, London, 1982); idem, *Petrological Examination of medieval Pottery from Scarborough and York* (Ancient Monuments Lab. Rep., 4553, London, 1985); idem, *Petrological Examination of possible Scarborough, Staxton, or associated medieval Pottery from Lodose, Sweden* (Ancient Monuments Lab. Rep., 4613, London, 1985); idem, *Note on the petrology of a medieval Sherd from Beverley* (Ancient Monuments Lab. Rep., 4875, London, 1986); idem, *Petrological Analysis of medieval Pottery from Beverley and Grimsby, Humberside* (Ancient Monuments Lab. Rep., 109/90, London, 1990).

⁶⁷ A. Crowdy, *The pottery from the medieval kiln site at Eshott, Northumbria* (unpubl. M.A. diss., Leicester University, 1986), 38–56; A. Crowdy, 'The pottery excavations in the fishing town of Eyemouth 1982–1984', in P. Dixon, *Excavations in the Fishing Town of Eyemouth 1982–1984* (1986); C. O'Brien, L. Bown, S. Dixon and R. Nicolson, 'The pottery', 00–00 in (eds.) *The origins of Newcastle Quayside; Excavations at Queen Street and Dog Bank* (Newcastle, 1988).

⁶⁸ D. F. Williams, *Petrological Examination of medieval Pottery from Aldingham and Carlisle* (Ancient Monuments Lab. Rep., 3739, London, 1982); idem, *Note on the Petrology of a medieval Sherd from Park Hill, Barrowford, Nelson, Lancashire* (Ancient Monuments Lab. Rep., 201/87, London, 1987).

⁶⁹ P. Cheer, 'Scottish medieval pottery: a review', *Medieval Ceramics*, 14 (1990), 19–22; E. M. Cox, *A Trial Petrographic Study of Pottery from Various Scottish Sites* (unpubl., University of St Andrews, 1978); idem, *Thin section programme 1980, in Summary of Thin Section Records Held by SUAT* (unpubl., Scottish Urban Archaeological Trust, 1980); idem, 'Pottery', 463–4 in R. M. Spearman, 'Excavations at 17–21 Castle Street, Forfar', *Proc. Soc. Antiq. Scotland*, 112 (1982); idem, *The Petrological Examination of Medieval Pottery from Kelso Abbey, Roxburghshire* (unpubl., 1983); idem, 'Petrological examination of ceramic material from pits BY and AQ', 386–95 in C. Tabraham, 'Excavations in Kelso Abbey', *Proc. Soc. Antiq. Scotland*, 114 (1984); idem, *Petrological Examination of Scottish medieval Pottery Shards* (unpubl., University of St Andrews, 1979); idem, *Petrological Examination of Scottish medieval Pottery Sherds* (unpubl., University of St Andrews, undated); E. R. Phillips, *The*

amount of work was undertaken in the late 1970s/early 1980s by Cox, but much of this remains in note form and would repay further study and publication.

The petrological study of wheelthrown glazed wares in Wales is heavily biased towards the English border and the south coast, with Monmouthshire being particularly well-covered.⁷⁰

The potential of the wheelthrown, glazed medieval ceramics of Northern Ireland is clear, following McCorry's analyses of the pottery from the two known later medieval kilns, at Carrickfergus and Downpatrick.⁷¹ No analyses of pottery from consumer sites has taken place, however.

IMPORTED POTTERY

Pottery imports from Continental Europe and the Mediterranean littoral are common finds at medieval ports and rarer finds inland, where they may be related to overland trade routes or to the purchasing power or status of their owners. Wares from present-day France, the Low Countries, the Rhineland, the Iberian peninsula, the Mediterranean and, exceptionally, further afield, have been identified. There are, however, several problems. Firstly, the majority of these wares have been identified on the basis of visual comparison with published Continental material. As with British medieval glazed wares, there is a tendency to ascribe too precise a source to imported vessels. An example is 'Merida ware', a micaceous red earthenware named after a locality in south-western Spain. Subsequent study, based on finds from Armada wrecks whose provisioning history was known, demonstrated that it is in fact Portuguese in origin, and quite possibly obtained from several sources in the hinterland of Lisbon.⁷² Similarly, highly decorated glazed red earthenware found in the British Isles is usually known as Aardenberg ware, after a locality in Flanders which might, or might not, be a production site, although very similar wares are known from a kiln site in Bruges. In both of these examples, from an insular perspective the difference in source might be dismissed as of little importance. There are, however, much more serious problems in the identification of lead-glazed whitewares since the range of possible

Petrography and Micromorphology of a Suite of Scottish Medieval Pottery Sherds (Edinburgh, 1998); N. H. Trewin, 'fabric descriptions', 118–21 in J. C. Murray (ed.), *Excavations in the Medieval Burgh of Aberdeen 1973–81* (Edinburgh, 1982); D. F. Williams, *Petrological Analysis of Late Norse Pottery from Freswick Links, Caithness* (Ancient Monuments Lab. Rep., 3632, London, Mar 1982); idem, *Petrological analysis of Late Norse pottery from the Brough of Birsay and Beach View Studio site, Birsay, Orkney* (Ancient Monuments Lab. Rep., 3646, London, 1982).

⁷⁰ S. Clarke, 'Recent discoveries in Monmouth, Gwent', *Medieval and Later Pottery in Wales*, 9 (1986); idem, 'Recent discoveries in Monmouth, Gwent', *Archaeol. Wales*, 27 (1987), 29–31; idem, 'Archaeological work in Monmouth in 1991', *Archaeol. Wales*, 31 (1991), 7–9; idem, 'The origins of medieval pottery in south east Wales', *Medieval Ceramics*, 15 (1991), 29–36; P. Courtney, 41–77 in J. Britnell and N. Jones, 'Pool Rd, Montgomery, excavations within the medieval town', *Montgomeryshire Collect.*, 77 (1989); idem, 'Medieval pottery', 60–94 in W. J. Britnell, 'Capel Maelog, Powys: Excavations 1984–87', *Medieval Archaeol.*, 34 (1990); E. J. Pieksma and D. F. Williams, 'Petrological Examination', 134–8 in H. Quinnell and M. R. Blockley, *Excavations at Rhuddlan, Clwyd, 1969–1973: Mesolithic to Medieval* (CBA Res. Rep., 95, 1994); Vince, op. cit. in note 54; D. F. Williams, *Note on the petrology of a Roman/medieval sherd from Rhuddlan, Clwyd* (Ancient Monuments Lab. Rep., 4832, London, 1986); idem, *Petrological examination of pottery from a medieval 13th century kiln at Rhuddlan, Clwyd* (Ancient Monuments Lab. Rep., 4890, London, 1986).

⁷¹ M. McCorry, 'Petrological analysis of sherds from the medieval kiln at Carrickfergus', in M. L. Simpson, P. S. Bryan, T. G. Delaney and A. Dickson, 'An early thirteenth century double-fired pottery kiln at Carrickfergus, Co. Antrim: an interim report', *Medieval Ceramics*, 3 (1979), 49–51; M. McCorry, 'A petrological examination of the Downpatrick kiln pottery', *Medieval Ceramics*, 4 (1980), 47–50.

⁷² D. F. Williams, 'Petrology report', in C. Martin, 'Spanish Armada pottery', *Nautical Archaeol.*, 8 (1979), 298–9.

sources stretches from Gascony to Picardy, taking in much of the western seaboard of France. Some, such as Normandy Gritty wares, are easily confused with English wares (such as Coarse Border Ware, from the Surrey/Hampshire border).

Some thin-section analysis has been undertaken of Continental imports from sites in Britain and Ireland but with the exceptions of some Breton and Iberian wares the mineral suites found are not distinctive.⁷³ Nevertheless, detailed comparison of inclusions and textures can be a help in identification. Breton imports are uncommon in Britain and Ireland and are only likely to occur at southern ports and cities, such as Exeter, Poole, Southampton and Dover, and of course in the Channel Isles. Iberian wares are more common and can be divided into three classes. Firstly, there are medieval 'Merida ware' costrels, which appear to be limited to port sites and are in any case rare (almost all examples of this ware in the British Isles are of 16th-century date). All contain distinctive minerals, principally large sheaves of muscovite, and are worth thin-sectioning so as to establish the chronology and distribution of the fabrics. Secondly, there are high-quality tin-glazed wares, mostly lustre and cobalt painted. These occur throughout Britain and Ireland and appear to have been used as status symbols by merchants and the aristocracy. Only those from Malaga contain petrologically distinctive mineral suites (red Malaga schist fragments). Finally, there are a range of wares, mostly but not all tin-glazed, produced in Seville in the late 16th century, some of which may have medieval antecedents. These are collectively known as Morisco wares and although found throughout Britain and Ireland are much more common on the south coast, and especially in the south-west peninsula, than elsewhere. Although mostly fine-textured with few inclusions visible to the naked eye, in thin section a distinctive sand, incorporating rocks and minerals from a range of geological environments, can be observed.

CERAMIC BUILDING MATERIAL

With the exception of the glazed, often polychrome decorated floor and wall tiles of the Late Saxon period, there is no documented production of brick or tile in the British Isles until the middle of the 12th century.⁷⁴ Thin square bricks were used in many Late-Saxon and Norman structures but all appear to have been looted from Romano-British structures. From the mid-12th century onwards brick and tile was used at various sites in Britain and Ireland. Fabric analysis has shown

⁷³ J. C. Echallier and J. Bonnet, 'Characterisation des productions de potiers Parisien du XIII^e au XIX^e siècle', *Medieval Ceramics*, 13 (1989), 17–30; C. Gerrard and A. Gutierrez, 'The thin-section analysis and macroscopic characterisation of some medieval and post-medieval pottery from northern Spain', 113–35 in A. Middleton and I. Freestone (eds.), *Recent Developments in Ceramic Petrology* (London, 1991); T. Mannoni, 'Present-day knowledge of Mediterranean pottery after ten years of thin-sectioning at the University of Genoa', 89–91 in I. Freestone et al. (eds.), op. cit. in note 12; R. B. Mason, 'Petrography of Islamic ceramics', 185–210 in Middleton and Freestone (eds.), op. cit. above; A. G. Vince, 'Medieval and post-medieval Spanish pottery from the City of London', 135–44 in I. Freestone et al. (eds.), op. cit. in note 12; idem, 'Spanish medieval pottery from the City of London', 329–31 in C. M. Gerrard, A. Gutierrez and A. G. Vince (eds.), *Spanish Medieval Ceramics in Spain and the British Isles* (Oxford, 1995); D. F. Williams, *Imported 'Merida-Type' ware from Exeter* (Ancient Monuments Lab. Rep., 3654, London, 1982); idem, *Initial Report on Thin Sectioning medieval Iberian Pottery* (Ancient Monuments Lab. Rep., 3577, London, 1982); idem, *Petrological Examination of medieval Pottery from Sluis, Netherlands* (Ancient Monuments Lab. Rep., 4024, London, 1983); idem, 'The petrology of the possible Breton sherds', 37 in Allan, op. cit. in note 49.

⁷⁴ Unpublished roof tiles from Coppergate, York, may prove to be the exception, but until both the tiles and their archaeological context are fully published they have to be discounted.

that there are links between the production of pottery, flat roof tiles, ridge tiles, bricks and floor tiles but that nevertheless the various artisans concerned often, probably mainly, concentrated on the production of a single class.⁷⁵

In the 12th century various styles of flat ceramic roof tile were produced. Some copied Roman-style *tegula and imbrex* roofing but are usually differentiated from actual Roman tiles by the use of glaze, and often by the presence of peg holes at one end of the curved, *imbrex*, tiles.⁷⁶ Others were skeuomorphs of wooden shingles.⁷⁷ By the middle of the 13th century, however, the simple rectangular form, present from the beginning, had become ubiquitous. Little fabric analysis of medieval flat roof tiles has been published. In the Severn Valley, for example, they were used in parts of Worcestershire but were otherwise a post-medieval introduction.

Identifiable ridge tiles occur first in the late 12th/early 13th century. Presumably ridge tiles were used on earlier 12th-century roofs with ceramic flat roof tiles but may have been indistinguishable from the curved roof tiles. From the beginning, ridge tiles had decorated crests and were glazed, although the type of decoration varies from area to area. It may be because of the use of glaze and decoration that in many cases where thin-section analysis has been carried out ridge tiles have proved to be more similar in fabric to contemporary wheelthrown glazed pottery than to flat roof tiles. There may also have been practical reasons concerning the loading of kilns why ridge tiles and pots should have been produced at the same sites.⁷⁸

The earliest documented use of non-Roman brick is probably that at the Tower of London.⁷⁹ Nevertheless, bricks were used in some parts of north-western Europe from the 12th century onwards and it is not impossible that either the technology or actual bricks were imported to Britain at that time. Much of the documented trade in bricks is from Flanders or other parts of the Low Countries. Unfortunately, the geology of this area is similar to that of many parts of eastern England and the identification of Flemish bricks is likely to require detailed comparison rather than being based on the presence of diagnostic mineral suites. Nevertheless, it is still of considerable interest to establish whether or not the medieval use of brick in Britain and Ireland was based on local production or importation, even if the exact source of imported bricks is difficult to establish.

⁷⁵ Betts, *op. cit.* in note 47; *idem*, 'Thin section and neutron activation analysis of brick and tile from York and surrounding areas', 39–61 in Middleton and Freestone (eds.), *op. cit.* in note 73; I. Freestone, 'Petrological examination of roof tile', 137 in G. Astill, *A Medieval Industrial Complex and its Landscape: the Metalworking Watermills and Workshops of Bordesley Abbey* (CBA Res. Rep., 92, London, 1993); J. Lilley, *Tiles from a Late Medieval Site at Brill, Buckinghamshire* (unpubl. M.A. diss., Leicester University, 1985).

⁷⁶ Sometimes known as flanged and curved roof tiles: J. M. Lewis 'Roof tiles: some observations and questions', *Medieval Ceramics*, 11 (1987), 3–14; K. Armitage, J. E. Pearce and A. G. Vince, 'Early medieval roof tiles from London', *Antiq. J.*, 61 (1981), 359–62; P. Drury, 'The production of brick and tile in medieval England', 126–42 in D. W. Crossley (ed.), *Medieval Industry* (CBA Res. Rep., 40, London, 1981).

⁷⁷ Sometimes known as shouldered tiles: T. P. Smith, 'London's earliest medieval roofing tiles: a comparative study', *Medieval Ceramics*, 22–3 (1998–9), 66–7, fig 1.

⁷⁸ Thin-sectioned instances are quite widespread, ranging from Bristol, Minety (on the Wiltshire/Gloucestershire border), Worcester and the Malvern Chase.

⁷⁹ D. F. Williams, *Petrological Examination of 13th Century Bricks from the Tower of London* (Ancient Monuments Lab. Rep., 4454, London, 1985).

The use of ceramic floor tiles was limited during the 12th and early 13th centuries to the production of tile mosaic pavements for the Yorkshire Cistercian abbeys and to the rare use of incised and relief-decorated tiles, as at St Alban's Abbey, Abbey Dore, Talley Abbey and Whitland Abbey.⁸⁰ It is assumed that these tiles were produced on-site and, indeed, a study of the Abbey Dore relief tiles has shown that they were manufactured using locally available raw materials. However, the discovery of flanged and curved roof tiles in the same fabric at the nearby settlement at Kilpeck suggests that in this case both roof and floor tiles may have been produced together, almost certainly by an immigrant tiler.⁸¹

From the middle of the 13th century onwards, however, tilers were present in Britain and Ireland. A review of the documentary and archaeological evidence suggests that there was no sudden change in production from itinerant production to supply via permanent 'factories' but that tilers operated in both manners from the beginning, depending on circumstances.⁸² This is well illustrated by the Great Malvern 'school' of tilers where thin-section analysis has shown that pavements were produced at Great Malvern and supplied to other sites, as far afield as Raglan Castle, but that the same tilers occasionally set up kilns elsewhere, as at Monmouth and Lenton Priory (on the outskirts of Nottingham, where they also appear to have produced pottery!). Thin-section analysis is invaluable in charting the movement of tilers and their stamps but is limited in many cases because many floor tiles are still laid, or re-laid, in floors.⁸³

INDUSTRIAL CERAMICS

Ceramic mould and crucible fragments are common finds on Late-Saxon and later medieval sites but considerably rarer on Early to Middle Anglo-Saxon

⁸⁰ J. M. Lewis, *The Medieval Tiles of Wales* (Cardiff, 1999), Groups 1 and 2.

⁸¹ A. G. Vince, 'The Floor Tiles', 77–84 in *A Definitive History of Dore Abbey* (Hereford, 1997). The roof tiles were found on an excavation immediately north of the church and may have originated on that structure. Excavation on the site of the nearby motte and bailey castle did not reveal any similar tiles. A single fragment of what may be a flanged tile of this type was found on a site in Hereford but not recognised at the time: Vince, op. cit. in note 39, 65–6, fig 60.1.

⁸² J. Stopford, 'Methods of production among medieval tilers', *Medieval Archaeol.*, 37 (1993), 93–108.

⁸³ J. A. Axworthy Rutter, 'Appendix 2: petrological analysis of thin-sectioned fabrics', 280–280 in S. W. Ward, *Excavations at Chester: The Lesser Medieval Religious Houses Sites Investigation 1964–1983* (Chester, 1990); D. H. Brown and A. G. Vince, 'A note on the petrology of the other floor tiles', 247 in Allan, op. cit. in note 33; D. H. Brown and A. G. Vince, 'The petrology of the valiant soldier kiln wares', *ibid.* 246–7; A. Carey, 'An Archaeological Analysis of the Decorated Medieval Floor Tiles from Laude Abbey, Leicester (unpubl. B.A. diss., Leicester University, 1986); S. Clarke, R. Jackson and P. Jackson, 'The discovery of a medieval encaustic floor tile kiln at Monmouth, Gwent', *Medieval Ceramics*, 16 (1992), 72–6; M. Garner and D. F. Williams, *Petrological Analysis of medieval Floor-Tiles from Hailes Abbey, Glos.* (Ancient Monuments Lab. Rep., 3444, London, July 1981); M. J. Hughes, J. Cherry, I. Freestone and M. Lease, 'Neutron activated analysis and petrology of medieval English decorated floor tiles from the Midlands', 113–22 in I. Freestone et al. (eds.), op. cit. in note 12; A. G. Vince, *Gloucester Blackfriars: Petrological Examination of the medieval Floor Tiles* (Lincoln, 1994); *idem*, *The Petrology of the Goodrich Castle Floor Tiles* (Lincoln, 1995); *idem*, *The petrology of the medieval floor tiles from Cleeve Abbey, Somerset* (Lincoln, 1996); D. F. Williams, *Medieval Tiles from Beaulieu Abbey* (Ancient Monuments Lab. Rep., 2355, London, 1997); *idem*, *Petrology of medieval Pottery and Tiles from Norton Priory and Norton Village, Cheshire* (Ancient Monuments Lab. Rep., 2454, London, 1978); *idem*, *A medieval inlaid Tile from Little Pickle, Bletchingley, Surrey* (Ancient Monuments Lab. Rep., 4642, London, 1985); *idem*, *Petrological Examination of medieval Pottery and Tiles from Haughmond, Shropshire* (Ancient Monuments Lab. Rep., 65/90, London, 1990); *idem*, *Note on the Petrology of some medieval Floor Tiles from Poole and other sites* (Ancient Monuments Lab. Rep., 34/91, London, 1991); *idem*, 'A note on the petrology of a medieval inlaid tile from Otterbourne, Hampshire', 73–89 in D. A. Hinton, 'Excavations at Otterbourne Old Church, Hampshire', *Proc. Hampshire Field Club Archaeol. Soc.*, 46 (1991).

settlement sites. So rare, in fact, that no thin-sectioned examples of Early to Middle Anglo-Saxon moulds or crucibles are recorded in the UKTS database. Studies of crucibles from Lincoln and London show that in the 10th century the majority were produced at Stamford. In fact at both places crucibles were initially the most common Stamford ware form found, suggesting perhaps that the glazed pottery was secondary in importance to industrial ceramics. In London in the later 11th to 13th centuries the crucibles found have a coarse-textured white-firing fabric, at present unsourced but by the middle of the 13th century the London crucibles were mainly produced in Surrey whiteware, probably from Kingston-upon-Thames. The supply of crucibles following the demise of the Stamford industry has not been studied and so it is not possible to say whether their production as a minor product of pottery kilns is typical.

At Gloucester, Lincoln and York specialist vessels were used for melting lead glass, used in the production of trinkets and settings for jewellery. Thin-section analysis of the heating trays from Gloucester shows that they were produced in the same limestone-tempered fabric as the contemporary pottery, produced on the same site, despite the fact that limestone inclusions would have started to alter to slaked lime at temperatures of 850° C. It is likely in the Gloucester instance that the same artisan was responsible for producing the pottery, heating trays and lead glass objects but despite this there is no evidence for the production of glazed ware by the Gloucester potters.

Ceramic moulds for the production of cast copper-alloy brooches and pendants are known from Viking-age towns in Scandinavia (for example Ribe and Birka). Thin-section analysis shows that these moulds were produced from locally-available raw materials, selected for their high silt content and perhaps for a natural high organic content.⁸⁴ Evidence for the production of similar artefacts was recovered from Flaxengate, Lincoln, and the moulds would repay thin-section analysis.⁸⁵

At both Birka and Ribe, alongside the fragments of moulds used for the production of copper-alloy and silver objects were found some fragments initially thought to be of similar character. Further study, however, showed that they were the remains of clay wrapping used in the production of composite iron objects, such as padlocks and keys, which had been brazed (i.e. soldered with a copper-based rather than a lead-based alloy). No evidence for this process has yet been recognised in Britain and Ireland although this is as likely to be due to the fragments not being recognised as it is to be due to the use of a different solder.

⁸⁴ The results of the thin-section analysis of these moulds, and the Birka crucibles, will appear in *Birka Studies*.

⁸⁵ These moulds are being studied by Justine Bayley, English Heritage.

Thin-section analysis of the Birka fragments shows that they too utilised locally-available raw materials, but that less care was taken to produce a fine-textured fabric.⁸⁶

POTENTIAL

There is no doubt that the use of thin sections in the study of Anglo-Saxon and later medieval ceramics has paid dividends. In some cases the results have been unexpected and in some cases still require further thought as to their interpretation. A general result, however, has been to recognise that throughout the Anglo-Saxon and post-Conquest periods ceramics were usually produced by specialists and traded or exchanged to surrounding areas. Positive evidence for domestic production at any time has yet to be proven (and in the view of the author probably never occurred). In such circumstances it is impossible to ignore the local or regional context of any assemblage of ceramics and for this reason if for no other an objective means of describing pottery fabrics is required. Where they have been used as part of an integrated study of the ceramics thin sections have provided this objectivity. However, to ensure that the maximum value is obtained from these studies not only should descriptions be published but the sections themselves should be made available for consultation. Ideally, this would mean that they would be placed in the same museum or archaeological store as the ceramics themselves and that facilities for their study (i.e. a petrological microscope) should be available. The UKTS survey showed that in Britain and Ireland we are a long way from that ideal and that in the most heavily studied areas (such as the Midlands) there is likely to have been considerable duplication of effort. It is to be hoped that the use of the UKTS database will make it possible in future for ceramic researchers to establish quickly what work has taken place previously in their proposed field of study. However, unless the database continues to be updated its value will steadily diminish.

This survey demonstrates an obvious fact: that the potential of thin-section analysis depends on the quantity and size of the inclusions present in the fabric and in their natural occurrence. Areas of complex geology, unaffected by glacial deposition, have the highest potential. For the Early and Middle Anglo-Saxon Periods this is unfortunate, since pottery is rare in both the south-western peninsula and in Wales. For the late 11th century and later, however, these areas undoubtedly have the highest potential for the characterisation of production sites and the subsequent mapping of pottery distribution patterns. Elsewhere, there is still considerable potential for the use of thin-section analysis but the interpretation of thin-section evidence requires a knowledge of the petrological composition of

⁸⁶ The process is described in T. J. Holback, 'Svårtolkade spår efter metallurgisk process — ett danskt exempel och dess paralleller i omvärlden', *By, marsk og geest*, 11 (1999), 5–12. The results of thin-section analysis of the casing fragments will appear in *Birka Studies*. A similar technique appears to have been used at Tønsberg in the late 12th to mid-14th century to weld together iron fragments: S. Jakobsen, *Hersker og Smed: Smedarbeider i Tønsberg i perioden ca. 1150–1350* (Tønsberg, 1991); and also at Birka and Sigtuna to coat iron weights with bronze: A. Söderberg, *Schmelzkugeln — Identifikation av en Handverksprocess: Fyndmaterial från Birka och Sigtuna* (unpubl. C-uppsats, Stockholms universitet, 1996).

quaternary deposits, such as boulder clay and terrace sands and gravels. In many cases petrological studies of these deposits have concentrated on establishing the catchment area of early river systems and the origin and chronology of ice sheets and therefore are based on erratics and large pebbles, which are often not typical of the finer fraction. The sampling and thin-sectioning of potential raw materials needs therefore to be built into projects.

The UKTS survey has shown that for both the Anglo-Saxon and post-Conquest periods that are variations in the use of thin-section analysis that are not entirely governed by the potential of the method. There is a general paucity of work in Northern England at all periods and in particular a lack of work in the north-west. Even further south, there are some remarkable lacunae, such as the whole of East Anglia in the 12th century and later. This contrasts strongly with the neighbouring Midlands, where there has been a large amount of work, but little synthesis or correlation of results.

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