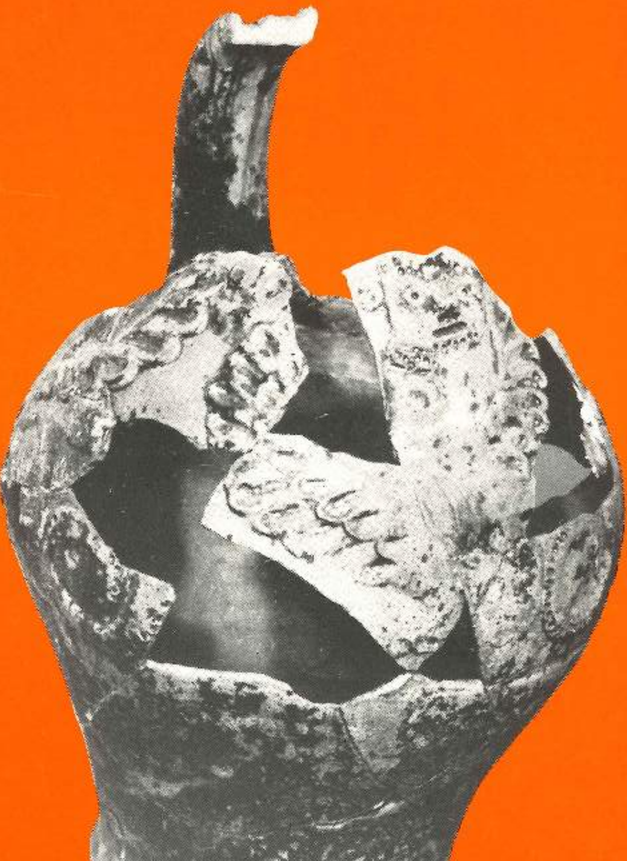
THE BRYGGEN PAPERS

Supplementary Series No 5



13th century jug from the London region decorated with applied figures of mythical monsters, a lion and small birds.

UNIVERSITY OF BERGEN

Scandinavian University Press

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give a scholarly presentation of the archaeological finds from the excavations at Bryggen – The German Wharf – in Bergen.

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CONTENTS

Foreword

The pottery from the Bryggen excavations includes imported wares from the London region and France, and this material is presented in two papers in this volume of the *Supplementary Series* of *The Bryggen Papers*.

In addition to the detailed analysis of the pottery itself, the study of the imported wares from London makes an important contribution to the dating of the Bryggen finds in general by substantiating the relative as well as the absolute chronology.

The physico-chemical analysis of the imported French pottery has led to new ideas concerning the origins of these wares. The authors also present some plausible views concerning the distribution of this group of finds – as a part of the French wine trade, and not as trade objects in themselves.

The canine bones recovered from the excavations – one of the largest assemblies in Scandinavia – included 897 whole or fragmentary bones from the period 1170–1476. The material illustrates the main trends in the physical development of the commonest dog types and also shows that dogs were not only kept as guard dogs or for hunting or as pets, but also provided a significant source of meat, especially in the period 1198–1413.

In the article on the 'cellar buildings' and privies recorded during excavation, the development and use of proper sanitary arrangements at Bryggen are discussed. This material covers the whole period from the end of the twelfth century right up to recent times.

The Bryggen Papers are published by the University of Bergen and financed by the Norwegian Research Council for Science and the Humanities (NAVF).

The Editorial Committee responsible for the series has consisted of Professor Knut Helle, Institute of History, University of Bergen; former Senior Curator Asbjørn E Herteig, Historical Museum, University of Bergen; and Senior Curator, dr philos Svein Indrelid, Historical Museum, University of Bergen.

The Norwegian text has been translated into English by Clifford D Long.

This volume is the last publication under the present Editorial Committee. The editor and his colleagues therefore take the opportunity of thanking all those who have contributed to the series over the past years. We would like to express our gratitude to the University of Bergen for helping to make the scientific analysis and publication of the material possible and to both the Norwegian Research Council and the University of Bergen for financial assistance. We also thank the Scandinavian University Press and our own colleagues in Bergen for their help and support.

The work on the finds and the publication of results will continue under new leadership.

Bergen, January 1992
Asbjørn E Herteig
Chief Editor

PS. The Editoral Committee regrets that due to circumstances beyond its control the publication of this volume has been delayed for nearly three years.

MEDIEVAL POTTERY FROM SOUTH-EAST ENGLAND FOUND IN THE BRYGGEN EXCAVATIONS 1955–68

by

Lyn Blackmore and Alan Vince

PART 1

THE BACKGROUND TO THE STUDY

by

Lyn Blackmore and Alan Vince

Contents

1 Introduction

The archaeological investigation of Bryggen in Bergen following the fire of 1955 was the first large-scale waterfront excavation to be undertaken in Europe using the stratigraphic method (Herteig 1985a; 1985b; 1990; 1991). During the excavation a wealth of structural data and a vast number of artefacts of wood, leather, bone, stone, metal, glass and pottery were recovered, the intepretative potential of which is enhanced by three factors:

Firstly, due to the waterlogged nature of the site, timber and other organic material was well-preserved, and it has thus been possible to obtain both a series of dendrochronological dates spanning the period AD 882–1314, and a suite of radiocarbon determinations (Thun and Hafsten 1990; Gulliksen and Thun 1990).

Secondly, the sequence of fire layers discovered on the site is complemented by a considerable body of documentary evidence for fires in Bergen (Helle 1979; 1982a); even in the first years of the project it was realized that artefacts were being recovered from deposits which might be datable to single historic events.

Thirdly, as far as we know there was no local pottery production in medieval Norway. All the pottery found on the site was imported, and is thus of value not only for dating purposes, but also as an indicator of the trading connections of Bergen.

Once the analysis of structural and material evidence is complete, and the results are combined, it is hoped that it will be possible to establish a chronology for the site that is not merely relative but absolute (Herteig 1959, 186; 1969a, 30; 1975, 71–2; 1990, 12–16).

The importance of Bryggen for the development of international studies, particularly with regard to medieval ceramics, has long been recognized (Herteig 1958a, 135; 1959, 183–4; 1969b, 161–2; Helle 1982a, 319). Even after only four years of excavation, the amount of English and Continental pottery of eleventh- and twelfth-century date was unprecedented in Norway (Herteig 1959, 151); by 1968, over 160,000 sherds from many different production centres had been recovered. After discussions with specialists from England, Germany, Belgium and Sweden, it was eventually decided to publish the pottery by country of origin (Herteig 1982).

This work was begun in 1986, when a general overview of the entire ceramic assemblage from Bryggen and a detailed study of the early German stonewares (Pingsdorf and Olive Protostoneware) was carried out (Lüdtke 1989). For two reasons the study of the English pottery in 1987 was limited to wares from the London area. Firstly, this pottery had recently been researched in London (Vince 1985; Pearce *et al* 1985), and the London sequence potentially offered a good parallel for the Bryggen material. Secondly, the London-area pottery could be recorded in one short study visit, whereas that from other parts of England, particularly the large collection of Grimston-type ware, would require much longer to process.

THE AIMS AND METHODS OF THE PROJECT

The first objectives of this ceramic study were to examine the vertical and horizontal distribution of the London-area pottery on the site in order to establish the following:

1. When pottery from the London area was first used at Bryggen.
2. The latest date when this pottery was used at Bryggen.
3. What percentage of the total pottery was from the London area and how this percentage changed through time.
4. The range of pottery forms present and whether this differs from that found in London.
5. The distribution of the London-area pottery and the processes governing the formation of the medieval pottery assemblages on the site.

Two main classes of pottery from the London-area were studied in detail, the so-called London Shelly ware (cooking pots) and London Brown (mainly table wares). These were recorded by fabric, form, quantity, condition and by stratigraphic location, on paper and on computer; the dates suggested by the ceramic groups were then compared with the documented dates for the fires and with the dating evidence provided by dendrochronology. Since the stratigraphic analysis of the parts of the site is still in progress, the results of the distribution analyses presented here may change slightly, but the general conclusions regarding the date of the pottery will still stand.

Another aim was to consider whether the quantity and range of forms and fabrics exported from London to the Bryggen area of Bergen differs from that found elsewhere in the city or elsewhere in Norway. The London-area wares from Bryggen, and their place in the Bryggen assemblage as a whole, were thus considered both in the local and in the wider context to establish:

6. Whether Bryggen is exceptional for Bergen and/or for Norway, or merely reflects the scale of the excavation.
7. To what extent the imported medieval pottery found in southern Norway reflects the general pattern of trade.

Comparison of the finds with those from other sites in Norway was hindered by the fact that the pottery from Oslo has been processed using a different method of classification (Molaug 1977; 1979; 1982; 1987), and research on the pottery from the other major sites is still in progress, although some reports have been published: Trondheim (Reed 1983; 1986; 1988), Borgund (Lossius 1977), Tønsberg (Reed forthcoming), and Skien (Myrvoll 1982). Despite this it was nevertheless possible to draw some general conclusions regarding the above questions.

The initial recording of the London-area pottery took place in June–July 1987 when the joint authors were Guest Researchers working for the University of Bergen at the Bryggens Museum. The collected data were then studied in London where the illustrations were completed and the text was coordinated by Lyn Blackmore. Subsequent visits to Bergen by Lyn Blackmore took place in July 1989 and December 1990.

THE STRUCTURE OF THIS REPORT

The different aspects of this study are presented in three parts. The first comprises an introduction to the archaeological background in Bergen, with comments on the parameters and provisos applied in this project, and a summary of the London ceramic sequence.

This is followed in Part 2 by the analysis of London-area pottery from Bryggen and a discussion of the distribution and significance of these wares on the site. The illustrations of the London-type ware presented here concentrate on new forms or better examples of forms known in London (Pearce *et al* 1985) or on new types. The analysis of the Shelly-Sandy wares found in London is still in progress, and the Bryggen study is of importance as the first detailed analysis of this ware.

Part 3 comprises an introduction to Anglo-Norwegian trade in the medieval period, a brief survey of the medieval pottery found in other major towns in Norway, and a brief discussion of pottery as an indicator of trade.

The bulk of this report was completed in December 1991; following changes to the stratigraphic data, the distribution analyses and discussion were finalized in April 1992. No account has been taken either of any publications or any changes to the stratigraphic information since those dates.

ACKNOWLEDGEMENTS

The authors wish to express their sincere thanks to Asbjørn Herteig for making the study of the London wares possible, and to the staff of the Bryggens Museum who helped with the project and made their stay so enjoyable, in particular Inge Kløvfjell, who entered and sorted the data on computer, and Egill Reimers for his invaluable help in the latter stages of this project.

Especial thanks are due to Ian Reed (Riksantikvarens Utgravningskontor for Trondheim), who carried out much of the initial sorting of the pottery, for his help and advice throughout the project. Considerable thanks are also due to Siri Myrvoll and Rory Dunlop (Riksantikvarens Utgravningskontor for Bergen) for allowing aspects of their finds to be published in advance of their own reports; we are grateful to all the above and Knut Helle for their helpful comments on drafts of different sections of the text. We are also indebted to the following members of staff of the Museum of London: to Jacqui Pearce, Anne Jenner, Beverly Nenk and Julie Edwards for their help in the early stages of the project, to Sue Hurman for assistance with mounting up the pottery illustrations, to Ian Riddler for the translation of computer disks, to Trevor Brigham and John Schofield for their comments on Section 3.4 and to Francis Grew for permission to reproduce figs 8–11 and 31 from the 'Corpus of London-type ware'.

2 The archaeological background

2.1 THE DEVELOPMENT OF URBAN ARCHAEOLOGY IN NORWAY

Until *c* 1950, medieval archaeology in Norway was concentrated on research into important monuments such as churches, castles and palaces. Excavations had also been carried out on an ad hoc basis in Bergen, Oslo, Tønsberg and Trondheim since the nineteenth century, but rarely had the archaeological remains been adequately recorded (Lunde, 1989, reviews the work between *c* 1860 and the present day). From 1912 the field was led by Gerhard Fischer (1890–1977), whose excavations included the church of St. Mary at Borgund (Sunnmøre), the castles at Tønsberg and Bergen, and sites in the medieval area (Gamlebyen) of Oslo. In 1941 excavations were carried out by Per Fett at the abandoned market settlement of Borgund. The main aim of these excavations was to study the evolution of the buildings investigated; the associated material culture was not considered important except to further the study of a building or to understand the topography of a town (Herteig 1969b, 157; Lunde 1985, 121; Lunde 1989, 46).

In the 1950s the Central Office of Historical Monuments and Sites (Riksantikvaren) began to take an interest in the excavation of settlement and urban sites. The first to be properly investigated were the abandoned market settlements (kaupanger) at Veøy in Romsdal and Borgund in Sunnmøre, where excavations commenced in 1953 and 1954 under the auspices of the Romsdal Museum in Molde and the Historical Monuments Office respectively. In 1955 the great fire at Bryggen, the medieval wharf area of Bergen, led to the first large-scale systematic medieval urban excavations in the country (Lidén 1977, 89–92; see also below). This marked the turning point for urban archaeological excavation and research, both technically and in changing the public attitude towards the archaeology and history of Bergen (Clarke 1989, 25–7; Nordhagen 1989; Lunde 1989, 44–45).

In Trondheim, Oslo, and Tønsberg, however, it was not until 1970/1971 that organized excavations began to be carried out in advance of development (Lunde 1989, 47–8). The degree of preservation of the archaeological deposits demonstrated by this work, and the historical importance of the medieval towns, was officially recognized in the Cultural Heritage Act of 1978, which allowed for the whole of the medieval urban area of a town to be designated as a protected monument and led to the formal establishment of archaeological units to cater for rescue archaeology in these towns (Lunde 1985).

At first the emphasis was on excavation, so that until recently few final publications have been available; now, however, many reports are in preparation which will greatly enhance our knowledge of medieval Norway.

2.2 MEDIEVAL ARCHAEOLOGY IN BERGEN

Bergen is situated on the Byfjord on the western coast of Norway, just north of the sixtieth parallel. The heart of the city lies on the north-east side of a natural harbour known as Vågen (fig 1). The history of Bergen, based on the archaeological and historical evidence available up to 1979, has been discussed in depth by Helle (1982a), while the development of the city has been most recently considered in Myrvoll and Roald (eds, 1990). The topographical development of the area from the prehistoric period has been described by Krzywinski and Kaland (1984) and by Herteig (1985b). The following summarizes those points which are necessary to view the Bryggen excavation and the pottery from it in a wider historical and archaeological context.

Until 1980 the archaeology of Bergen was catered for by the University of Bergen, on behalf of the Central Office of Historical Monuments and Sites, through the Medieval Section of the Historical Museum. Since 1976 the Medieval Section has been located in the Bryggens Museum. Following the major Bryggen excavation of 1955–68, two smaller investigations were carried out on adjacent sites. The first of these, in 1972 at Dreggen 10-12, bordered on the north-east corner of the Bryggen site (Harris 1973); the second, partly contiguous with the south-eastern edge of the 1972 site, was excavated in 1979 (Marstrander 1983). In 1980 a new excavation unit for Bergen was established by the Historical Monuments Office (Riksantikvarens Utgravningskontor for Bergen), which since then has investigated some thirty sites within the town (fig 2; Myrvoll 1987). These have supplemented the existing data and offered some new ideas regarding the original shoreline and the development of the settlement. The pottery assemblages from seven of these sites and from the 1979 excavation are summarized in Part 3, Section 12.

Investigations have shown that the area to the east of Vågen was occupied in the prehistoric period, while a certain scattered settlement existed along the eastern shores of Vågen in the seventh–eighth centuries AD (Kryzwinski and Kaland 1984, 3–36; Herteig 1991, 111–113). Continuity between this occupation and the medieval settlement is debated. It has been argued that the foundation of Bergen in the reign of Olav Kyrre (1066–93), as chronicled in the sagas, was the official recognition of an existing settlement, with the granting of rights and privileges. Others have claimed that the creation of a new town was followed by a rapid expansion (Krzywinski and Kaland 1984, 1).

Archaeologically there is insufficient evidence to support either theory. At present there is no ceramic evidence from Bryggen for a settlement prior to 1100 (Lüdtke 1989, 34), while the fact that three timbers from Bryggen have been dated by dendrochronology to AD 1043–1044, AD 1051–1052 and AD 1079–1080 (Thun and Hafsten 1990, 138) cannot be taken as proof of an eleventh-century town. It is clear, however, that there was an increasing amount of activity throughout the twelfth century, with over thirty timbers dated to pre-1150 and a considerable number to pre-1170; together with the archaeological evidence (Herteig 1991, 112–113) and the pottery, this supports the statement in the Orkney sagas that Bergen was an important trading centre by 1127 (Gulliksen and Thun 1990, 149).

The first medieval settlement was on a narrow strip of habitable land between the hillside and the shore on the north-east bank of the fjord (Herteig 1969a, 98–9; 1990, 132). This appears to have been divided into two areas by a rock outcrop termed by Myrvoll as a 'steeply sloping rock' (*fjellknaus*) (Myrvoll 1987, 105, 107; Myrvoll 1990, 8) but which may be more accurately described as a short stretch of low rocks (Herteig pers comm), situated just to the north of the present road of Nikolaikirke-almenning, where the church of St Nicholas was constructed in the first half of the

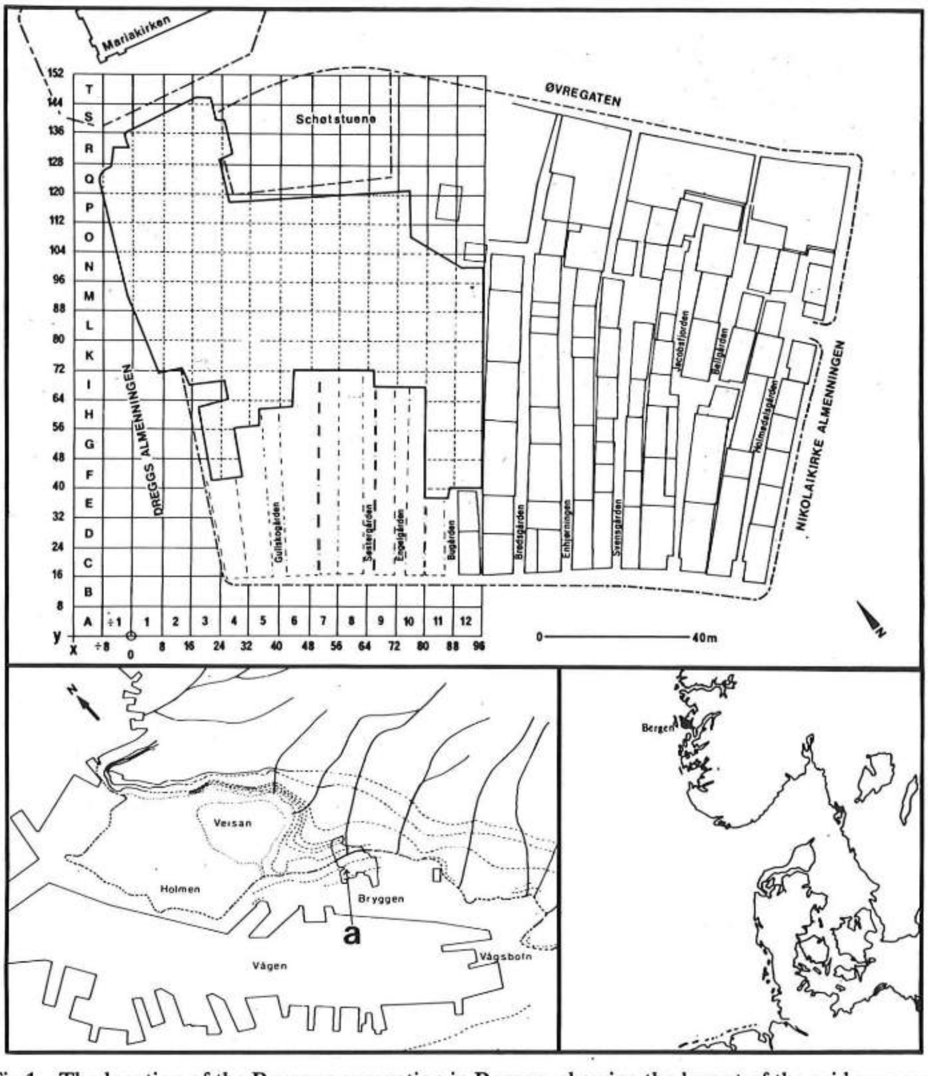

Fig 1 The location of the Bryggen excavation in Bergen, showing the layout of the grid squares.

twelfth century. The Bryggen excavation lies in the northern part of the town, which is bounded on the north-east side by the marshy area known as the Veisan (Herteig 1985a, fig 4). The earliest excavated structures (Period 1, pre *c* 1150) comprise traces of an enclosure, within and outside which are posts or structures which are assumed to date to *c* 1110–1115 at the latest. These were superseded by a rectangular wooden building, possibly a boathouse or warehouse, and other stuctures thought to have been constructed *c* 1125–1130 and to have gone out of use *c* 1140–1150 after Fire VIII (Herteig 1991, 92–8). These structures were located just to the west of the mid-twelfth-century church of St Mary, beneath which are traces of an earlier church (Lidén 1961, 117–118; Helle 1982a, 134).

In the northern part of the town, the Period 1 beach was used for landing and loading/unloading craft, but in Period 2 the beach was built over and the first post-borne quays were erected along the edge of an underwater shelf some 20–30m out from the originally habitable area. On the landward side the new buildings were constructed directly on the contemporary ground surface; over the beach, however, they stood on posts, or were supported by stone-filled log-built caissons (*kar*) which stood directly behind the quays fronting the different properties. Access to the buildings behind appears to have been by means of raised walkways serving individual properties, with no means of crossing laterally from one to another (Harris 1973, fig 12; Herteig 1985b, 69–73, fig 6; Herteig 1991, 91–92; 98–99; 114).

The width of the Period 1 enclosure corresponds closely to that of the double tenement which was laid out in the Gullskoen area in Period 2, and it is therefore possible that the tenement method of building, with parallel rows of narrow properties up to 90m long with the gable end facing out to sea, dates to the early twelfth century (*ibid*, 98; 113). Some single tenements existed, but these are rare and the double unit with a central passageway was the norm; each tenement was separated from the next by an eaves drip (for full description see Herteig 1990; 1991). Documentary sources suggest that two-storey buildings were in use before *c* 1150, although the earliest archaeological evidence dates from the latter half of the twelfth century. Along the waterfront it is thought that the warehouses were of single-storey construction during Bryggen Periods 1 and 2 and possibly later (Herteig 1985a, 29). By the early thirteenth century, however, the tenements comprised warehouses at ground level, and living quarters above, normally with an overhanging gallery (Herteig 1975, 78). Several merchants may have lived together in the same tenement, which when the passage gates were closed would form a self-contained community or '*gård*' (Herteig 1969b, 161). On the landward side, the buildings in both parts of the town were until the late medieval period bounded by Stretet, the original medieval road which lies beneath the present-day Øvregaten (Myrvoll 1990, 12). The excavations on Bryggen have provided evidence for a considerable amount of stone-dressing and lime-slaking throughout the medieval period, but this was probably for the maintenance of the neighbouring ecclesiatical buildings dedicated to St Mary, St Catherine and St Lawrence; it was not until the late fourteenth century that stone buildings were interspersed with wooden structures at Bryggen.

During the twelfth and thirteenth centuries, the settlement grew rapidly in size, despite extensive fires, of which that in 1248 destroyed the whole town. At least seven major fires and other smaller ones are recorded in documentary sources, while archaeological evidence for other, unrecorded fires also exists. The most important fires took place in 1170–71, 1198, 1248, 1332, 1393, 1413, 1476, 1527 and 1702 (Helle 1979; see also Section 2.3.3 below). Following a fire, the new building was invariably erected on the same site as its predecessor (Herteig 1975, 78), although the opportunity was taken in every building phase to build out further into the bay (see Table 1), thus increasing the habitable area and space available for warehouses and offices, and taking advantage of a deeper, more efficient harbour capable of accommodating the changing shape and increasing number of medieval trading vessels.

During the excavations of 1955–68, nine successive waterfronts were found, most with post-borne quays and associated buildings supported by a series of log-built caissons. From Period 3 onwards these box-like constructions were filled with earth not stone (figs 3, 4; see Herteig 1990, 17–19); the gaps between and behind the caissons were filled with similar dumped material (Herteig 1985a, 28). The same pattern was observed on the 1972 Dreggen excavation (Harris 1973, fig 12). The 1979 excavations were less deep than the main site, but revealed a sequence of five

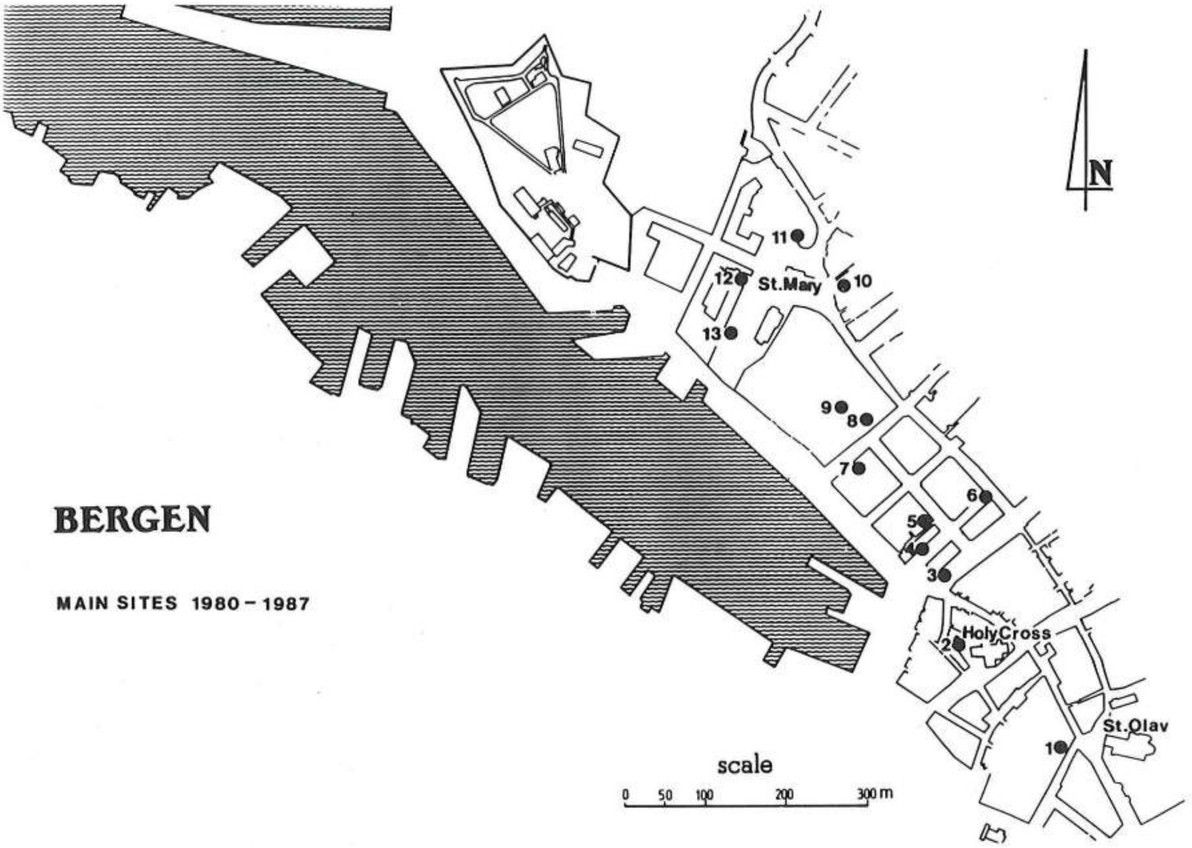

Fig 2 Plan of Bergen showing sites mentioned in the text (from Myrvoll 1986).

1 Domkirkegaten 6
1 Korskirken
2 Vetrlidsalmenningen
4 Finnegårdsgate 3a
5 Finnegårdsgate 6a
6 Øvregaten
7 Rosenkransgate 4
8 Nikolaikirkealmenningen
9 Svensgården, Stallen
10 Øvregaten 39
11 Kroken 3
12 Dreggsalmenning 14–16
13 Dreggsalmenningen

superimposed planked roads with foundations for wharves on either side (Marstrander 1983, 29, fig 2). The earliest level is thought to date to Bryggen Period 4 (ie after 1248). The road may have been the public thoroughfare of Mariakirke-almenning (Helle 1982a, 196; Herteig 1985a, fig 12; Herteig 1991, 77).

In the southern part of the town, south of Nikolaikirke-almenning, a second zone

Table 1 Correlation of Fire layers, Periods and waterfront extensions in the Bugården tenement.

Fire	Date	Period	Phase	Extension	Distance
Ia	?				
I	1702				
Ib	?				
		8			
II	1476				
		7			
III	1413				
IIIb	1393				
		6			
IV	1332				
		5	5.1	into bay	*c* 13m } *c* 25m
			5.2	into bay	*c* 12m
V	1248				
		4		into bay	*c* 3.9m
VI	1198				
		3	3.2.1, 3.2.2	into bay	*c* 6.5m } *c* 20.5m
			3.1.1, 3.1.2	into bay	*c* 14m
VII	1170				
		2		over beach	*c* 20m
VIII	pre-AD 1170	1			

of occupation has been identified which would also appear to date from the twelfth century. This is centred on the gently shelving beach at the head of Vågen, in the area known as Vågsbotn where the twelfth-century churches of the Holy Cross (Korskirken) and St Olav (the present cathedral) are located (Myrvoll 1990, 8–9). It is not known whether this area was first settled earlier, later or at the same time as the northern part of the town. The equivalent of the earliest waterfront found on the Bryggen site has not been located in this area, but the series of waterfronts to the south of Nikolaikirke-almenning otherwise closely resembles that in the northern area (Myrvoll 1987; 1990, 8–13). It has been suggested (Myrvoll 1987, 107) that it was not until after the fire of *c* 1248 that the two parts of the town merged and there was a single, unbroken waterfront, but this remains to be proven. The layout of the town in *c* 1300 is shown in fig 5. The topographical development of the Vågsbotn area, where the main residential area and most craft workshops were located, has been discussed elsewhere (Myrvoll 1990).

2.3 THE BRYGGEN EXCAVATION

2.3.1 The 1955 fire

The fire of July 1955 swept through the northern half of Bryggen, totally destroying four tenements, from Gullskoen to the north to Bugården to the south. Bugården and Engelgården were double tenements, Søstergården was a single tenement with a side annexe, while Gullskoen was a double tenement with a side annexe (fig 1). The site is now mainly occupied by the SAS Royal Hotel and the Bryggens Museum.

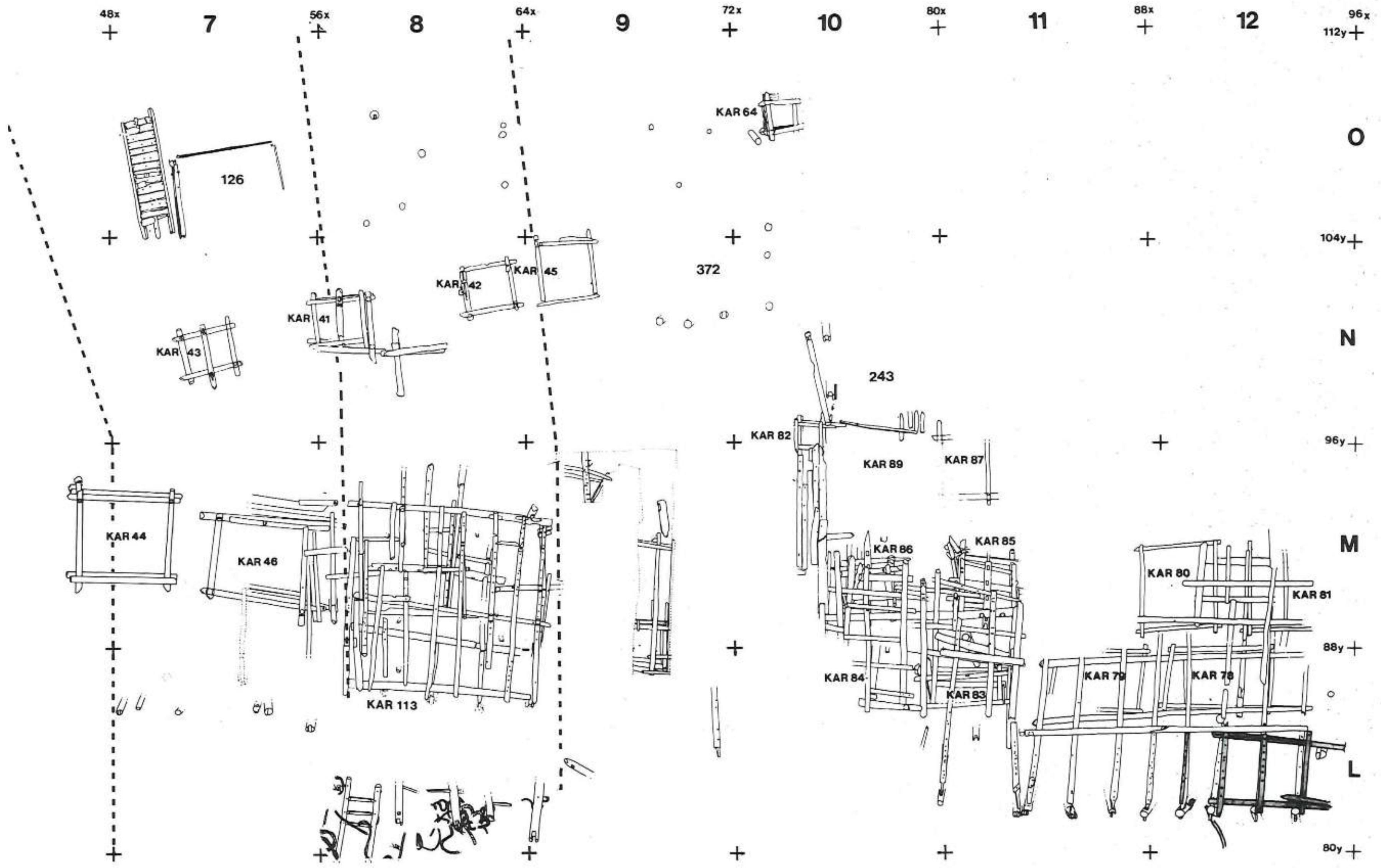

Fig 3. The Phase 3.1 waterfronts in Bugården, Engelgården and Søstergården.

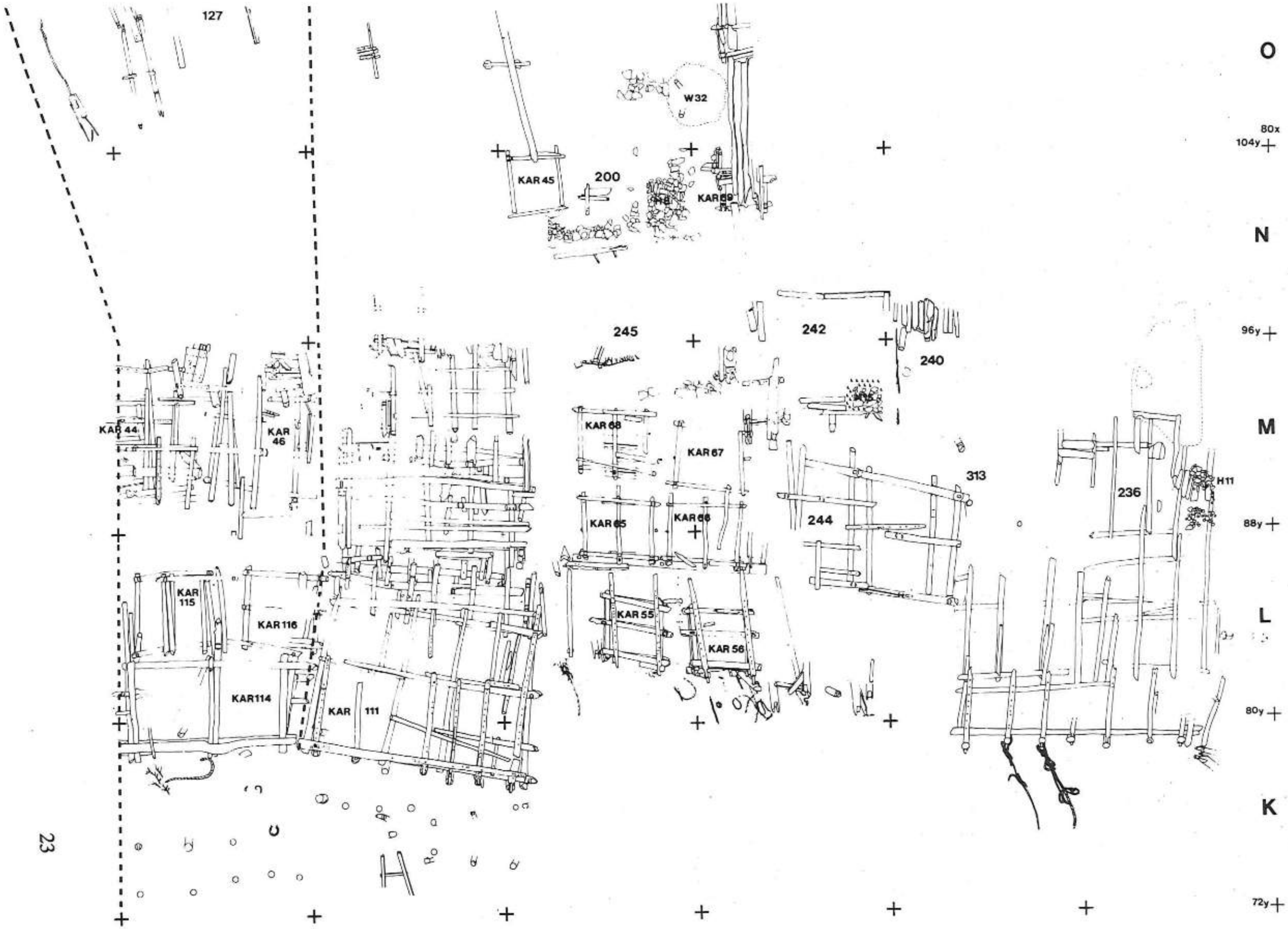

Fig 4 The Phase 3.2 waterfronts in Bugården, Engelgården and Søstergården.

The Bryggen excavation was expected to run for six months; in fact it lasted for thirteen years and covered an area of some 4,000 sq m, involving *c* 18,000 cu m (Herteig 1968, 74). As the first large-scale urban site in Norway, the problems faced at Bryggen had never been encountered before, and the project became a pioneering exercise in many ways (Herteig 1985a, 1985b), not least because here, for the first time, the accumulation of the strata and the objects contained within them were considered as important as the structures, if not more so.

2.3.2 The recording system

The excavation followed the traditional grid system, the layout of which was based on the southern part of the Bugården tenement. This resulted in a grid measuring 8x8m, which was oriented on the lines of the building rather than on the Norwegian Geodetic survey (Herteig 1969a, 18–25; 1985a, 13–15). The north-south axis was coded by letters, the east–west axis by numbers. Thus Gullskoen lies within Rows –1 to +6 (approximately half the excavated area); Søstergården lies within Rows 7 and 8; Engelgården lies within Rows 9 and 10, and Bugården lies within Rows 11 and 12. In the central eastern part of the site the upper layers were cleared by machine. The site was normally excavated in layers, but where these were more than 0.15m thick they were excavated in spits.

As the site was excavated, a complex sequence of buildings and waterfront structures was revealed, numerous fire layers were encountered, and thousands of objects were unearthed (Herteig 1985a; 1985b; 1990). A large number of samples were also taken for dendrochronological dating. Given the vast amount of data recovered, a system of codes was devised to indicate whether an object was found within, beside, over or under a particular type of feature, and how this stratigraphic location fitted with the sequence of fire layers (Herteig 1969a, 18–27; Herteig 1985a, 15–21; Lunde 1989, 45–6). Every find was recorded with an accession number, which links it to the grid square in which it was found and to the coded stratigraphic information (*ibid*, 33–46). Following the end of the excavation, this data was entered into the computer at the University of Bergen, so that it is theoretically possible to analyse the finds both chronologically and spatially.

Before we proceed to discuss the pottery from the excavation, the means by which the site chronology has been built up will be briefly reviewed.

2.3.3 Site Chronology

The relative chronology of Bryggen was determined during the excavation by tracing eight fire horizons across the site (Herteig 1969a, 28–33; 1985a, 21–33). The fires were numbered sequentially as they were encountered during the excavation, the latest fire being Fire I, the earliest Fire VIII. By using simple codes it was possible to denote the relationship of a find to a fire layer. Thus in the computer records:

U6 = under Fire VI
I6 = in Fire VI
O6 = over Fire VI
A6 = about Fire VI (possibly derived from above or below it)
K6 = found on the same level as Fire VI but not in it.

By this means the strata have been divided into nine periods, each separated by a fire layer (see Tables 1, 2, 3); each rebuilding is defined as a new phase within the appropriate period. Although there may be local problems, for example where the fire horizon had been removed, or was never present, this chronology has been demonstrated by master sections running both north–south and east–west across the site (see figs 6 & 7). The potential of the fire layers observed in Bergen was first recognized by Koren-Wiberg (1870–1945), who attempted to establish a 'fire chronology' for the town on the limited evidence available at the time (Herteig 1985a, 10–11; Lunde 1989, 43). The Bryggen excavation offered the ideal opportunity to correlate the archaeological and documentary evidence for a fire (Helle 1975; 1979; 1982a; Herteig 1985a, 22–26), and to compare the structural evidence on the site with other documentary evidence, such as the Town Laws, which detail specific building regulations.

The fire horizons form a good foundation for the relative chronology of the site, but there are many variables to be considered before absolute dates can be assigned to the different periods of occupation. Finding archaeological evidence for eight fires and documentary evidence for only seven major fires, the excavator presented three possible chronologies for the Bryggen sequence up to 1248 (Herteig 1985a, 29–33, fig 13). He concluded that the undocumented fire must have been the earliest one on the site, after which the fire horizons proceed through those recorded in the literature to the latest fire in 1955. As shown in Table 1, the documented intervals between the fire horizons for the twelfth to fourteenth centuries are 18 years, 50 years and 84 years respectively. It might be thought that by checking these dates with the pottery and other finds in the fire layers one could determine which fire horizon belonged to which documented fire, and thus date the activity in the intervals between the fires, but this is not necessarily the case.

Firstly, although these are the major fires, they are not the only fires recorded in Bergen, and the detail and accuracy of the documentary record may be inconsistent. It is not definite that all the main fires affected the Bryggen area, and if so, left archaeological traces of their presence. Conversely, there were other fires in the area, notably two undocumented fires confined to single properties in Bugården (Herteig 1985a, 26; 1990, 21, 25) and a more extensive fire observed in the western part of Bugården, in Engelgården and possibly in part of Sostergården (but not in Gullskoen), which has been interpreted as the historically documented fire of 1393 (Herteig 1985a, 26; 1990, 30, 73–4, 105). The chronology proposed in 1985 is supported by evidence for three twelfth-century fires at Kroken 3, just to the north of Bryggen (Dunlop 1985a, 51–2), but is at variance with the interpretation of the archaeological evidence from excavations to the south at Finnegården 6a and at Stallen. On both these sites (Finnegården phase 9, Stallen phase 9) evidence was found for an unrecorded fire which is thought to have occurred between the fires of 1198 (Fire 6) and 1248 (Fire 5); on the evidence of Scarborough pottery, this fire has been provisionally dated to *c* 1225–30 (Dunlop 1982a, 47, 51–2, 60–1; Dunlop *et al* 1982, 37–8, 45–8). To the east of Bryggen, excavations at Øvregaten 39 (phase 7) also revealed evidence for a fire which has been dated ceramically to the early/mid-thirteenth century, but no trace of the 1170/71 fire (Dunlop 1982b, 32, 36, 49; Dunlop *et al* 1982, 38).

Secondly, the fire chronology proposed above also conflicts with the radiocarbon and dendrochronological evidence, which suggests either that there was a 90–100% re-use of timbers, or that the fires should all be shifted one step back (Gulliksen and Thun 1990, 13). If the additional fourteenth-century fire of 1393 is taken as Fire IV and not as Fire IIIB, then Fire V would become that of 1248 and there would be a certain match between the scientific and archaeological evidence. To do this, however, creates other problems with the phasing and the ceramic evidence, and therefore in the most recent discussions of the site chronology, the excavator has elected to retain the established framework (Herteig 1990, 12–17; Herteig 1991, 96–8).

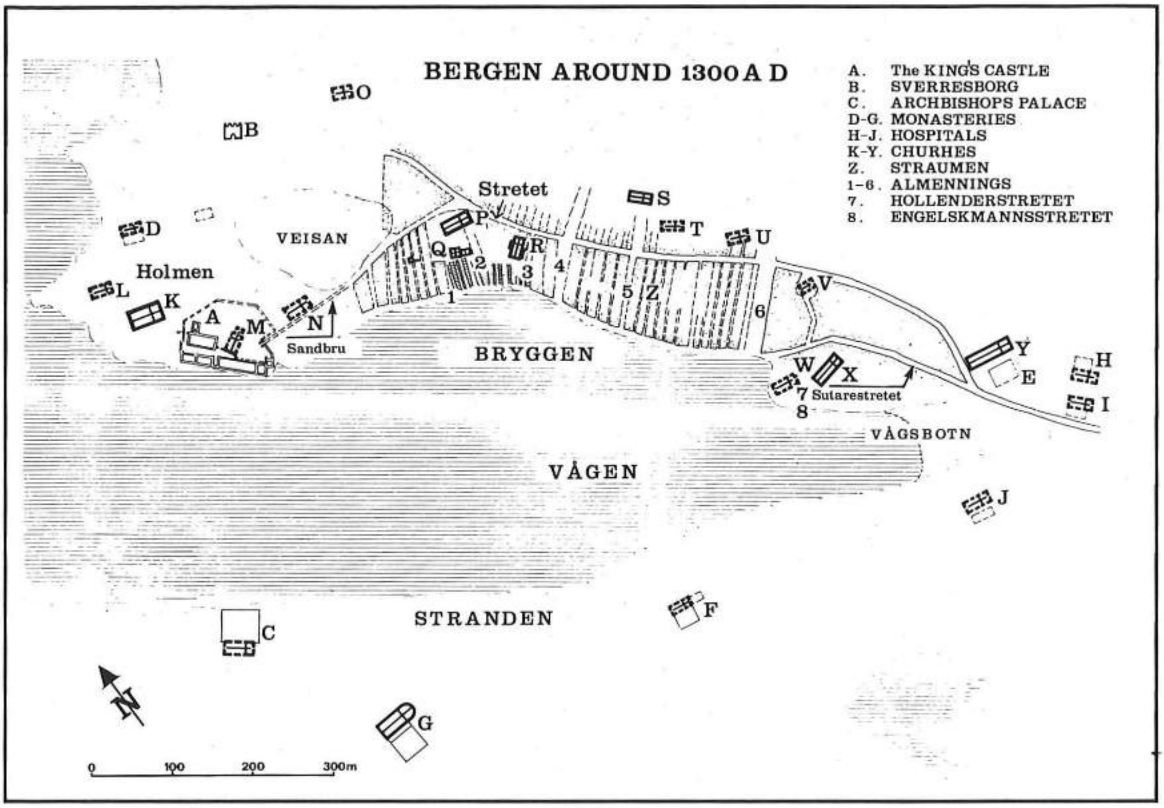

Fig 5 Plan of Bergen in the early fourteenth century.

2.3.4 The distribution of the finds

The finds fall into two categories: those which are from fire layers (the minority), and those which are from general deposits which were dumped or which accumulated in a number of episodes corresponding to the various building phases between fires (Herteig 1985a, 28). This activity was governed not only by building regulations, but by a number of other factors, notably:

a) Topography. This includes the slope of the ground surface on land or under water, and also the original coastline.

b) The degree of devastation and the number of fatalities. This could mean that building work in different tenements may have progressed at different speeds and at different times, so that the stratigraphy in each tenement may be independent, except where linked to adjacent tenements by structures or fire horizons.

c) The availability of material for use as infill for land reclamation, which would have been determined by the ability of the authorities to order or impose restrictions on the disposal of rubbish in the previous period (Helle 1982, 209; NgL III.12).

Viewing the site from north to south, the main structural features in Gullskoen are presented in Table 2, while the Bugården, Engelgården and Sostergården tenements are summarized in Table 3. The following summarizes the sequence of the ceramic groups found in the Bugården tenement up to Period 5 (Herteig 1990, 29–62).

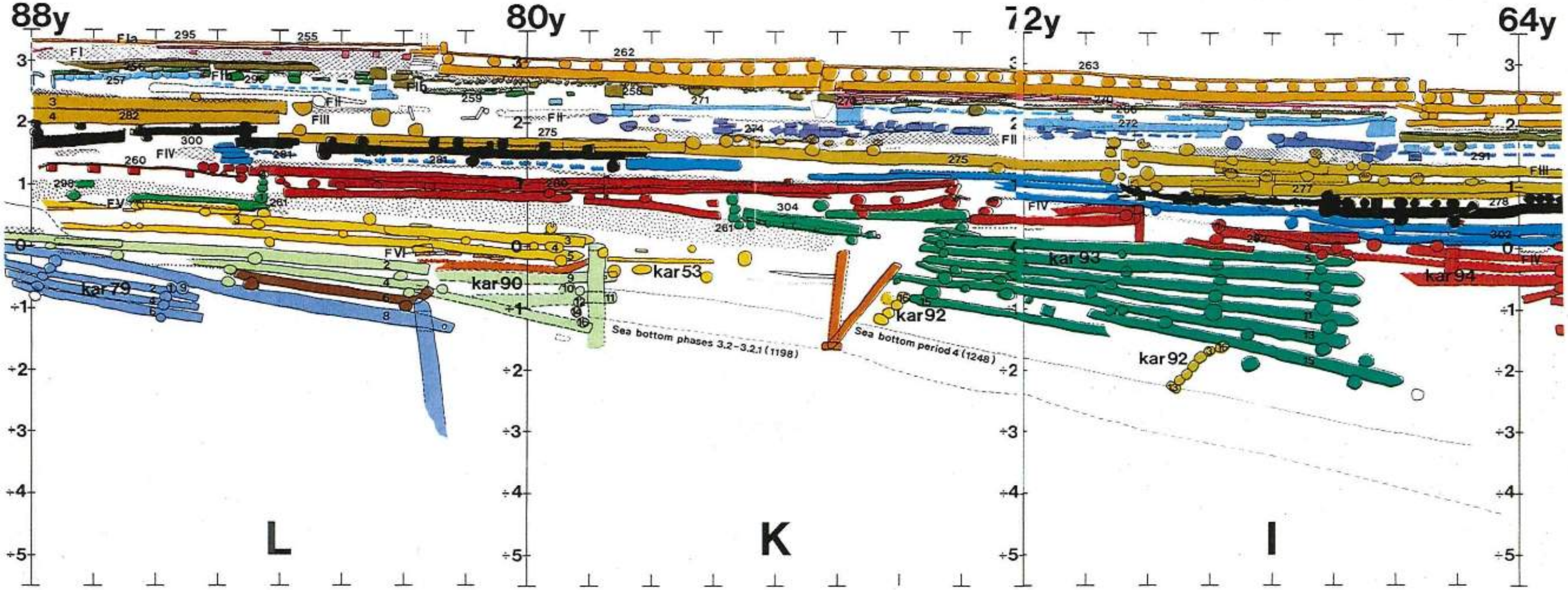

Fig 6 Detail of the main east-west section in Bugården, showing Kars 92 and 93.

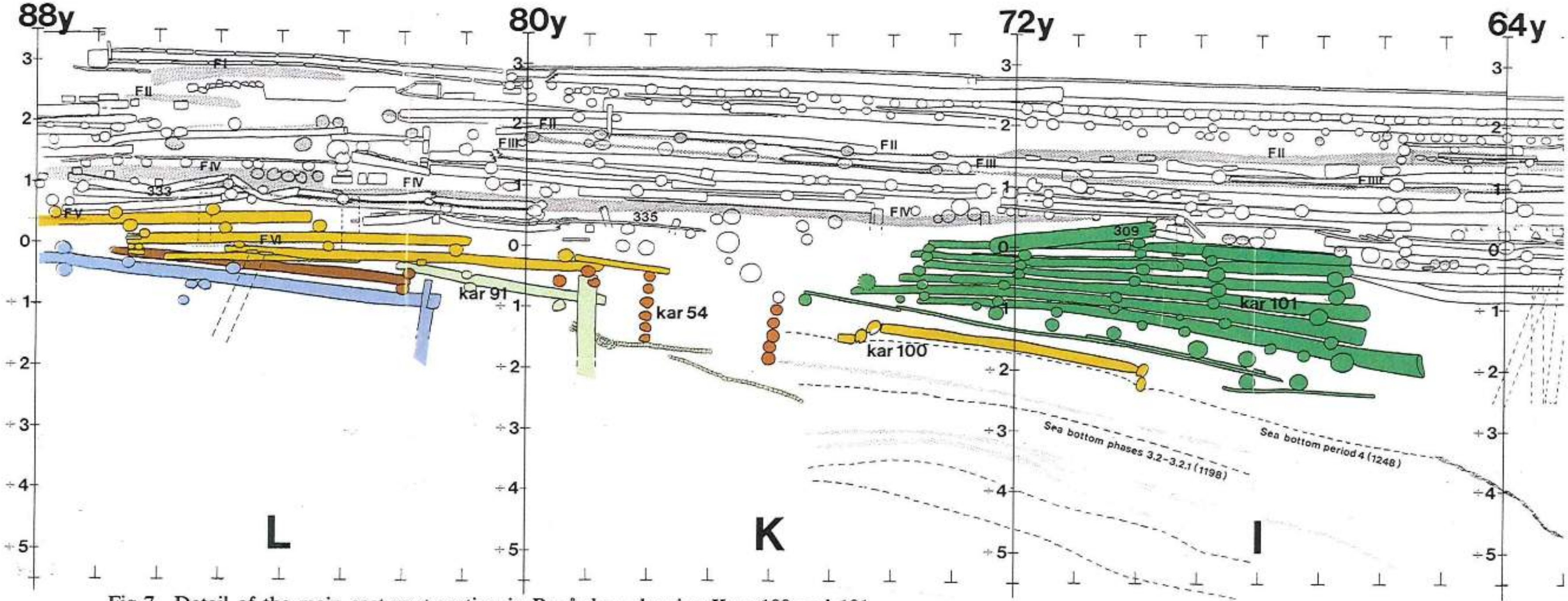

Fig 7 Detail of the main east-west section in Bugården, showing Kars 100 and 101.

Period 2: Relatively little pottery was found in the rubbish dumped on the earliest foreshore (the so-called beach phase), except for that associated with the Period 2 waterfront, which, on the chronology given above, was destroyed *c* 1170/1171. This may be because the warehouses yielded little in the way of domestic rubbish, but probably also reflects the small size of the settlement and/or the general lack of pottery in use at that time. Rubbish was purposely dumped in the harbour in Periods 3.1, 4, 5 and 6 as a part of the rebuilding process.

Period 3: This includes material incorporated into the Phase 3.1 waterfront (Kar 78–81) or other contemporary foundations, or dumped in front of it, or associated with the repairs to this structure in Phase 3.1.1 (fig 3). Some of this material may have been deposited before Fire VII (dated to 1170), but the group must have a *terminus ante quem* within a decade of that fire. This sub-phase was not terminated by a fire.

Subsequently material was incorporated in the foundations of the Phase 3.2 waterfront (Kar 90, 91), and to lesser extent dumped in front of these structures (fig 4). The latter may be associated with the repairs to the Phase 3.2 waterfront in Sub-phase 3.2.1 (Kar 54). This waterfront was destroyed by Fire VI, *c* 1198.

Period 3–4: A small amount of material from the Fire VI horizon.

Period 4: Material incorporated in the Period 4 waterfronts and building foundations, erected shortly after Fire VI, notably deposits in or adjacent to foundation substructures such as Kar 92 and Kar 100 (figs 6, 7).

Period 4–5: A small quantity of pottery from the Fire V horizon, dated to 1248.

Phase 5.1: Material associated with the initial reconstruction work after Fire V, when the former foundations (Kar 92 and Kar 100) were reduced in height and new foundations (Kar 93 and Kar 101) were constructed (figs 6, 7).

Phase 5.2: Loose deposits and rubbish dumped in front of the Phase 5.1 construction to raise the level of the sea-bed. New foundations were then laid for the Phase 5.2 waterfront (Kar 94, 95, 102, 103).

Period 5/6: Material found in or over the Fire IV horizon, dated to 1332.

As the above shows, the status of the two categories of ceramic evidence is not as clear-cut as it may appear. The phenomena of the fire layers was described by Lüdtke as the 'Pompeii effect', since it was thought that these deposits should contain the more or less complete contents of a house, and that the pottery should 'reflect with relative accuracy the ceramic assemblage of the household' (Lüdtke 1989, 11; 66). However, although this material should be well stratified, it comprises only a tiny fraction of the total ceramic assemblage, and for various reasons the pottery may be earlier or later than might be expected. Furthermore, the recording system includes not only definite but approximate locations such as 'about' or 'on the same level as' a fire horizon, which may include finds from before or after the fire as well as lost during it.

Some of the pottery and other finds from the deposits over a fire, or in the waterfront dumps, may be broadly contemporary with those deposits. For example, pottery broken in transit on board ship may have been dumped in the harbour immediately before or after the cargo was unloaded. Such finds offer important dating evidence both for the context in which they are found, and for the currency of the ware in Bergen, as they may appear at an earlier date and in a higher quantity than used pottery, which may not appear in the archaeological record until the following period.

The bulk of the pottery found between fires, however, will be residual, ie. derived from the previous Period, or possibly even the one before that. This material may derive from the site, or from elsewhere in the town. It is thus of uncertain status and date, and the 'residuality factor' must be taken into account. Lüdtke (1989, 30) observed that if one were to rely on the finds from the general layers on the landward side for dating the structures in the occupied area (as opposed to the waterfronts), then the resulting chronology would consistently be one period too old (this is exactly the same conclusion as that drawn from the dendrochronological data).

The absolute site chronology, therefore, can only be determined when the stratigraphic sequences have been correlated with the complete dating evidence on a tenement by tenement basis, and the results then compared across the site as a whole. At present this can only be done with a limited range of finds, but the following analysis of the London-area pottery demonstrates the potential of the ceramic finds to test and confirm the site sequence, and to understand the way in which the deposits were formed.

3 The background to the ceramic study

3.1 MEDIEVAL POTTERY FROM BRYGGEN

The Bryggen excavations yielded between 150,000–160,000 sherds of pottery ranging in date from the eleventh to the twentieth centuries. General notes on the pottery have appeared in the various publications by Herteig (1958a, 134–5; 1959, 181–184; 1968, 74–77; 1969a, 54–59, 154–156, 162–166; 1975, 80).

The initial sorting of the pottery was begun in the spring of 1980, and in October of the same year a preliminary assessment of the collection was carried out by Asbjørn Herteig, Ian Reed and John Hurst. The sorting of the pottery into broad ware categories continued during 1981, when the material was removed from its original context groups and stored by fabric type in open boxes on some 860 open trays 45x100cm within a storage system of rolling stacks. Each box on a tray contains a sherd or sherds with the same accession number. This means that it is difficult to obtain a quick impression of the original associations of different wares and vessel types, but the system has the considerable advantage of offering a speedy way to view a particular ware and to obtain a rough idea of the proportions of the different wares present (Lüdtke 1989, fig 4).

In October 1981, following an international meeting held between Asbjørn Herteig, members of the Bryggen project and specialists from Norway (B Magnus, P Molaug, and I Reed), Sweden (B Hulthen), England (J Hurst and R Hodges), Germany (H Georg Stefan) and Belgium (F Verhaege), it was decided to study the material by country of origin. The aims of the ceramic research were published the following year, when Herteig also described the collection at the Medieval Pottery Research Group conference on Ceramics and Trade in Hull (Hurst 1983, 258–9).

The composition of the Bryggen pottery assemblage has been outlined by broad ware classification (Herteig 1982, 200), and by approximate quantity according to the number of storage trays for each group (Lüdtke 1989, 17; fig 4). This shows that there are thirty-eight main ware groups, which include pottery deriving from over sixty production centres. The bulk of the identified material is from England and Germany, with smaller amounts from the Netherlands, Denmark, Belgium and France. It should be noted, however, that the second largest group in the collection is named 'diverse cooking pots', while the third largest is named 'uncertain'; once these have been identified the proportions of pottery from different countries may change considerably.

3.2 CHRONOLOGICAL TRENDS IN THE BRYGGEN POTTERY

Even in the first years of the excavation a ceramic sequence was recognized which has changed little despite the more detailed study of specific wares and of the site stratigraphy. As early as 1958 three ceramic phases were defined (Herteig 1958a, 135). Continental wares were seen to be predominant before *c* 1200; the English wares became more common until *c* 1400, but then disappeared completely, to be replaced by high quality continental pottery (Herteig 1959, 183). At the end of the excavation these ceramic phases were developed chronologically: *c* 1050–1250; 1250–1400; 1400–post-medieval (Herteig 1968, 74–75; 1969, 162–164), but apart from noting that in the first phase a minor proportion of the material was from south-east England, the general picture was unchanged. In 1975 the sequence was modified slightly: mid-twelfth to first half of the thirteenth century; thirteenth-fourteenth centuries; 1400 onwards.

The ceramic chronology was also considered by Lüdtke, who came to the same conclusions, but proposed three slightly different ceramic phases of *c* 1100–1250, *c* 1250–1400 and *c* 1400–1600 (Lüdtke 1989, 21–24, 31; figs.4–8). In the first ceramic phase, English wares form some 17% of the total, German wares some 60%, and also present are smaller amounts of pottery from Andenne and Denmark. In the second phase, this is completely reversed: English wares comprise *c* 65%, German wares only 17%; lesser amounts of pottery from France, Denmark and the Netherlands are also present. In the third phase, English wares are absent; German wares comprise *c* 78% of the total, with the remainder coming from the Netherlands. This is illustrated by distribution maps of selected wares (including Grimston ware, Scarborough ware, Shelly-Sandy ware (London Shelly) and London-type ware (London Brown) and bar charts showing the proportional distribution of these wares by period (*ibid*, Diags. 1–30).

The figures quoted by Lüdtke are based on a crude quantification of the material by storage trays, and on incomplete stratigraphic and ceramic data (*ibid*, 19–20). As a result they only include pottery with information on both location and period/fire (Lüdtke estimated that *c* 25% of the material was excluded from the diagrams because of this), while the figures refer to the total accession numbers for each ware, not to the actual number of sherds or different vessels (see also Section 4.1). Analysis of the London-area wares has shown that in several cases sherds deriving from more than one vessel share the same accession number, while others were mis-identified in the initial sorting. Lastly, although differentiating between the number of sherds found in and between fire layers, these general distribution analyses cannot distinguish between small or large groups, or contemporary and residual material, so that the chronological distributions of the pottery may be distorted. It is also difficult to appreciate the location of sherds inside or outside buildings or to understand the changing associations of different wares; these problems are considered further in Sections 4.3 and 7. Nonetheless, the diagrams presented by Lüdtke offer a reasonably accurate overview of the general trends and a good point of departure for further discussion and research.

3.3 ENGLISH POTTERY FROM BRYGGEN

Taken as a whole, identified English pottery occupies 241 trays, and is thus approximately equal to the total amount of German pottery (243 trays). By far the largest group of English pottery is Grimston ware (115 trays); Scarborough fills 48 trays, Humber-type 22 trays. Shelly-Sandy ware and London-type ware occupy sixteen and twelve trays respectively. As stated above (p 13), it was decided that the first study of the English wares should be devoted to the pottery from the London area since the pottery from a number of sites in the City of London had recently been examined in detail and a ceramic sequence formed which it was hoped would help refine the

Bryggen chronology (see below). All the pottery from the London area found at Bryggen was examined, and was found to comprise:

Shelly-Sandy ware:	Fabric code = SSW	(1150-1220)
London-type ware:	Fabric code = LOND	(1150-1350)
Coarse London-type ware:	Fabric code = LCOAR	(1150-1200)
Kingston-type ware:	Fabric code = KING	(1230-1350)
Mill Green ware:	Fabric code = MG	(1270-1350)

The pottery originally classified as 'London Shelly' was in addition found to contain sherds of an East Midlands shell-tempered ware, which are not discussed in this report. The pottery originally classified as West Kent, and subsequently renamed Mill Green was found to be largely London-type ware. Herteig (1975, 80) refers to pottery from the Dover area, but none was observed, nor were any South Hertfordshire grey wares found, although these were noted by Hurst (1983, 259). Using the ceramic evidence from London, it is possible to identify not only those wares which were produced in the London area and used in both London and in Bergen, but just as importantly, to isolate the London area wares which were not exported, such as other sandy or shell-tempered fabrics, or the South Hertfordshire grey wares.

3.4 THE LONDON MEDIEVAL POTTERY SEQUENCE

Before proceeding to the two London-area wares studied in detail, we will briefly outline the main trends in London pottery during the tenth–fourteenth centuries as observed on the waterfront sites in the City of London, which in many ways offer a good parallel for the situation in Bergen.

Since 1972 excavations have been carried out in advance of redevelopment on numerous sites along the north bank of the Thames, mainly between London Bridge and Blackfriars Bridge (fig 8), notably at Baynards Castle, Trig Lane, Swan Lane and at Billingsgate. These have revealed a complex sequence of waterfront structures dating from the Roman period onwards. The most important structures dating to pre-*c* 1180 are the Saxon bank, the first revetment at New Fresh Wharf (*c* 1020), and Seal House waterfronts I and II (c 1140 *c* 1170 respectively). Although work on the stratigraphic reports for some of these sites is still in progress, the dating of these Late Saxon and medieval waterfront structures and of the finds from the associated deposits has been established by using a combination of relative stratigraphy and the dates suggested by dendrochronology, radiocarbon measurements, coins, pottery and other finds such as pilgrim badges, and by then comparing the data from different excavations (Milne and Milne 1982, 50–53; Pearce *et al* 1985, 127–137; Pearce and Vince 1988, 13–19; Vince 1985; Vince 1987, 1–7; Vince 1991; Vince and Jenner 1991).

The foundation for the resulting chronological sequence is the Billingsgate Lorry Park site, excavated in 1982 (Brigham 1990; Brigham and Schofield in prep; Grew and de Neergard 1988, 135–136; Steedman *et al* in prep; Vince 1985, 85–90; Vince 1987, 3; Vince 1991; Vince and Jenner 1991, 23) of which a summary is presented here, using the prefix W for waterfront.

The first Late Saxon embankments (W2 and W4) were probably constructed in the early 11th century; they were divided by a revetted inlet which exploited a gap in the Roman quay, and thus have parallel, but not identical, stratigraphic sequences (Vince 1991, fig 1). These early structures produced very little pottery, but a coin of AD 959–973 was stratified in a gravel deposit contemporary with the construction of the bank, while timbers from the revetment of waterfront 2 have been dated by

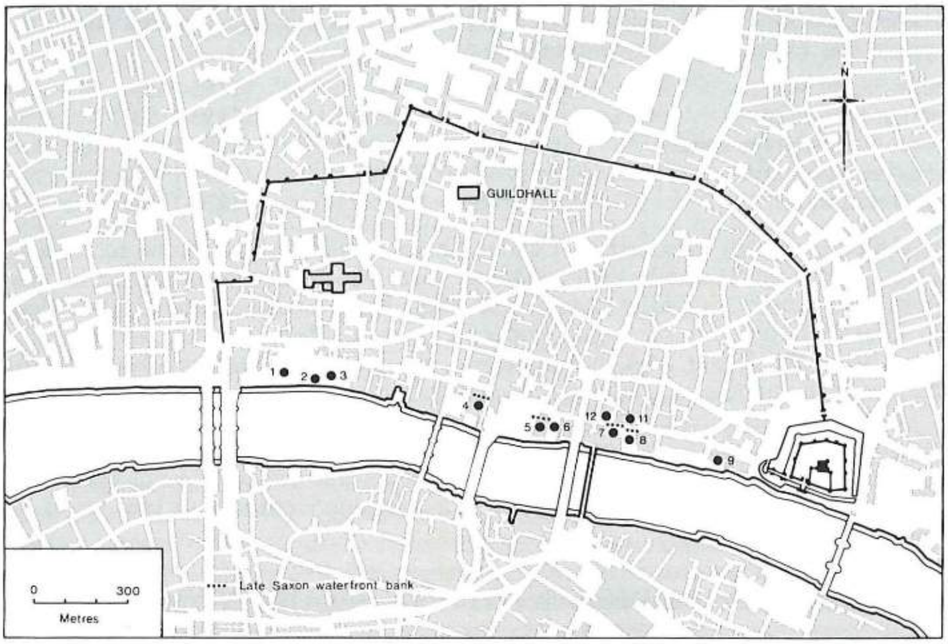

Fig 8 The City of London showing the location of recent excavations along the waterfront. Those mentioned here are: 1, 2 Baynards Castle; 3 Trig Lane; 5 Swan Lane; 6 Seal House; 7 New Fresh Wharf; 8 Billingsgate Lorry Park (from Pearce *et al* 1985).

dendrochronology to *c* AD 1039–1040. This construction was short-lived since timber from W3 (which replaced W2) has been dated by dendrochronology to *c* AD 1055. The waterfront on the east side of the inlet was probably replaced at about the same time, since the subsequent structure, W5 has been dated to *c* 1047–1070).

The pottery from the various construction deposits associated with W3 would normally be dated to *c* 1050–1100. The evidence from the subsequent phases, however, suggests that it probably dates to *c* 1050–1080, since the clay deposits which had built up in front of this revetment (and which contained a small amount of pottery) were sealed by a layer of gravel containing several lead 'coins' or trial pieces of William I made within the period 1080–83 (Vince 1985, 88–89). This gravel was sealed by the forward collapse of W3, which was succeeded by W6, a revetment with a dendrochronological date of AD 1080 or later. Waterfront 7, an inlet lining for the east bank which replaced W5, has a dendrochronological date of *c* AD 1056–1101; this was therefore probably contemporary with W6. The associated pottery includes some intrusive material but contains a wide range of local and imported wares dating to early twelfth century.

After this seven successive waterfronts were constructed, each placed further to the south and narrowing the River Thames. Waterfronts 6 and 7 were replaced by W8 and W9 respectively, and W9 was later replaced by W11; W8, however, probably continued in use for some time after the inlet was bridged by W10. Staves from W8 and W9 have been dated by dendrochronology to AD 1108+, while staves from W10 and W11 have been dated to AD 1144–1183 although the date of W11 has been modified to AD 1172–1216. Both the dendrochronological evidence and the pottery from the associated dumps suggest that W12 was in use for ten/fifteen years until *c* 1225 or later. A stake behind W12 has a suggested felling date range of *c* AD

1168–1205, a primary timber in W14 has a date range of *c* AD 1189–1234, while timbers from the apparently contemporary W15 are dated to *c* AD 1204–1235, *c* AD 1215/1216 and *c* AD 1194–1249. It would appear, therefore, that W14 and W15 were built between *c* 1225–1249. Following this the ground surface in the area of these two waterfronts was raised with a series of dumps which contain pottery dating from *c* 1150–1200. The date of the latest waterfront (W16) is unclear, since it appears to incorporate a large number of reused timbers, but the latest dendrochronological date is *c* AD 1243–1269. The finds from the revetment dumps include a group of late short-cross and early long-cross pennies, types which were used together for only a few years *c* 1250, and pottery with a possible date range of *c* 1225–1275. It is most probable, therefore, that the material within the latest dump was gathered soon after 1250.

The other waterfront sites in London may be dated more closely by dendrochronology in due course; at present their dating rests on their relative spatial order, coins and other datable artefacts associated with the later structures. There is little doubt about their approximate dates, for deposits on several other sites in London confirm and amplify the Billingsgate sequence; of these the Seal House excavation of 1974 is most relevant to the period during which London-area pottery was exported to Bergen (Grew and de Neergaard 1988, 135; Pearce *et al* 1985, 15; Vince 1985, 87–88; Vince 1987, 5).

Although the processes by which the finds arrived in the various waterfront deposits are unknown, the range of pottery found in the different phases on different sites is quite uniform, and it would appear that the bulk of the finds comprise contemporary rubbish dumped directly behind the waterfronts rather than spoil derived from other earth-moving operations (Vince 1985, 26). By considering the ceramic data together with other classes of evidence, as described above, it has thus been possible to construct a sequence of medieval pottery forms and fabrics found and to arrive at a number of 'ceramic phases' for London (Vince and Jenner 1991, 19–25; Vince forthcoming).

The coarsewares (see fig 9)

The bulk of the pottery found in tenth – to twelfth-century deposits in London comprises handmade coarsewares (Vince 1991, 266–7; Vince and Jenner 1991, 40–44). Of these the earliest is Late Saxon Shell-tempered ware (fabric code LSS; both handmade and wheel-thrown), possibly imported from the Oxford region, which was the dominant ware from the late ninth century. By *c* 1050, LSS was replaced by an inferior, handmade sand-and-shell-tempered ware made in the London area (fabric code EMSS), possibly at the same production centre as Early Medieval Sand-tempered ware (fabric code EMS), which appeared in the early eleventh century. Another shell-tempered ware found at this time is fabric EMSH, which has a clean clay matrix. This occurs in small quantities by *c* 1055, increases slowly up to *c* 1100, and then declines slowly throughout the twelfth century. By far the most common wares in the late eleventh-/early twelfth-century are Early Surrey ware (fabric code ESUR), and fabric EMSS, which account for up to 40% and 30% respectively of the handmade sherds in the Billingsgate assemblage of *c* 1060–1120. A number of minor handmade sand-tempered wares, probably from Essex, Middlesex or South Hertfordshire, also appear at this time; the most common is a local greyware (fabric code LOGR), which emerged in the later eleventh century and which is dominant in some late eleventh-/early twelfth-century groups. This would appear to be closely related to the glazed wheelthrown Coarse London-type ware (fabric code LCOAR), which appears in very small quantities at about the same time (see below).

During the late eleventh/early twelfth century there appears to have been a transitional period, with the handmade types (both cooking pots and table wares), continu-

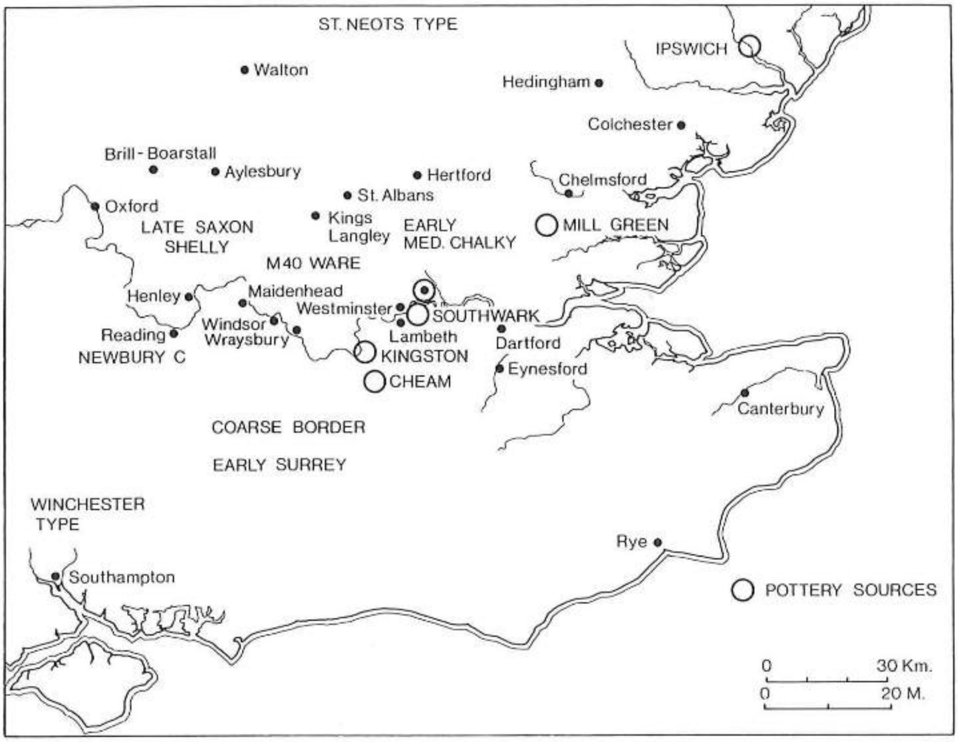

Fig 9 The sources of late Saxon and Medieval pottery found in London (from Vince 1985).

ing in use alongside wheel-thrown and glazed wares, with some glazed hand-made wares also being produced (Vince 1991, 267–8; Vince and Jenner 1991, 46–7). Thus occasional sherds from wheel-finished, if not wheel-thrown, cooking pots in Shelly-Sandy ware (fabric code SSW) first appear in late eleventh-century groups at Billingsgate, and again in a deposit dated to the mid-twelfth century at Seal House Waterfront I, which has been dated to *c* 1147 by dendrochronology (Vince 1985, 87). By *c* 1150, Shelly-Sandy ware was rapidly gaining in popularity, reaching a peak of 40% of the *c* 1170–1190 assemblage from Billingsgate. It is also common in Seal House Waterfront II (dated to *c* 1170 by dendrochronology), and at Swan Lane in deposits which have been dated to the late twelfth century (after AD 1180) by dendrochronology, associated coins which date to after AD 1180, and the absence of certain early thirteenth-century pottery types (*ibid*, 86–87).

By the early thirteenth century fabric SSW was already declining as the wheel-thrown sand-tempered wares such as London-type ware (fabric code LOND) and South Hertfordshire-type sandy ware (fabric code SHER) gained in popularity. Numerous deposits of this date have now been excavated, notably at Billingsgate (see above) and at Seal House, where Waterfront III has been dated to *c* 1210 by dendrochronology (*ibid*, 87–88). These groups usually contain small quantities of fabric SSW but later groups, dated to *c* 1230–1250 by the presence of Kingston whiteware and absence of Mill Green ware, contain very little SSW, showing that by the mid-thirteenth century it was no longer in use, and that any occurrences may be considered residual; the dating of these mid-thirteenth-century deposits is confirmed by coins, and by the relative stratigraphy of Seal House Waterfront IV.

The dates proposed for some of the above wares have been confirmed by finds from sites outside the City at Westminster Abbey, where deposits dated by documentary evidence to the late eleventh century were excavated in 1986 (Goffin in prep), and at the National Gallery extension site, where a pit containing mixed shell-tempered and other sand-tempered wares, but no SSW and little London-type ware, was dated archaeomagnetically to *c* AD 1150 (Blackmore forthcoming).

The table wares (see figs 9–11)
The earliest locally produced wheelthrown and glazed wares are Coarse London-type ware and London-type ware (fabric codes LCOAR and LOND); these were made in the same basic iron-rich clay, which was possibly obtained quite near to the City (Pearce *et al* 1985, 2–3; for fabric descriptions see Section 6.1). The dating for the introduction of both these wares has recently been revised following the study of the Billingsgate material, which showed that a small amount of glazed pottery was present in groups dated to as early as 1055–1085 and 1108 (Vince 1991, 268; Vince and Jenner 1991, 46–7; 83–5). The same range of forms was produced in both wares during the first half of the twelfth century, when LCOAR was the more common; after *c* 1140 the relative proportion of coarse to fine London-type wares moved heavily in favour of the fine ware (at the same time as wheel-thrown coarsewares were coming in), and the overall proportion of glazed London-type jugs with slip decoration in the 'Early Style' increased (see below, Section 6.4.2). LCOAR appears to have gone out of use by 1200, and possibly as early as 1170–90. As above, the sequence of the form types has been derived mainly from waterfront groups at Seal House, Billingsgate Lorry Park and Swan Lane (Pearce *et al* 1985, 13–21, 127–135; Vince 1985, 48–50; see Section 6.4 for form descriptions). At Seal House, Early Rounded jugs comprise 33% of the total wares in the assemblage associated with waterfront II (*c* 1170).

In the late twelfth century, that is, later than 1180 on the evidence of coins and a pilgrim badge found at Billingsgate Lorry Park (Pearce *et al* 1985, 132; Vince 1985, 89), London-type ware jugs in the Rouen style and North French style first appeared. These are the main jug types associated with Seal House waterfront III, dated to *c* 1210, by which time they had almost completely replaced the Early-style vessels. The Rouen-style vessels decline at an earlier date than the North French type jugs, which are common in deposits dated to *c* 1240 at Seal House, waterfront IV.

By *c* 1250 the proportion of Rouen-style and North-French-style London-type ware jugs had dwindled, and plain London-type Baluster jugs had first appeared (Pearce *et al* 1985, 132), together with a Surrey whiteware known as Kingston-type ware (Pearce and Vince 1988, 13–16), which forms a significant proportion of all ceramic assemblages from this time on. Soon after this (by *c* 1270), London-type redware gave way to Mill Green ware (Pearce *et al* 1982). Production of London-type ware ceased *c* 1350, and thereafter the London market was dominated by the later Surrey white-wares (Pearce and Vince 1988, 16–18).

The imported wares
Throughout the tenth–twelfth centuries the range of imports is remarkably consistent. The most common wares are Blue-Grey ware (Paffrath), Pingsdorf-type ware and Andenne-type ware, all of which appear in the later eleventh century and continue until the early thirteenth century. North French wares appear to arrive in the twelfth century, and to continue longer into the thirteenth century.

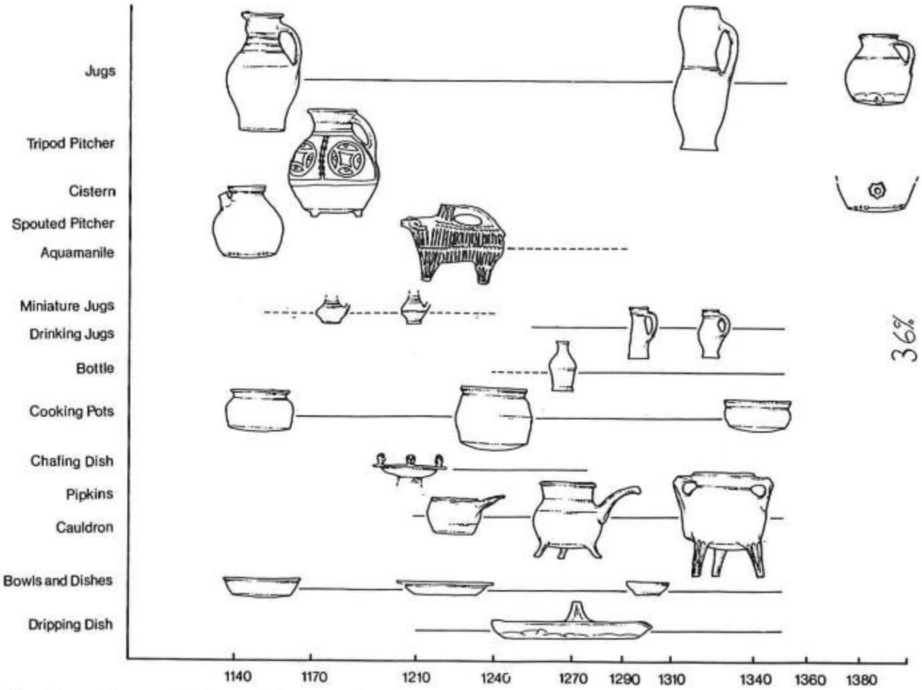

Fig 10 The evolution of the major London-type ware pottery forms, based on the Seal House/Trig Lane sequence (from Pearce *et al* 1985).

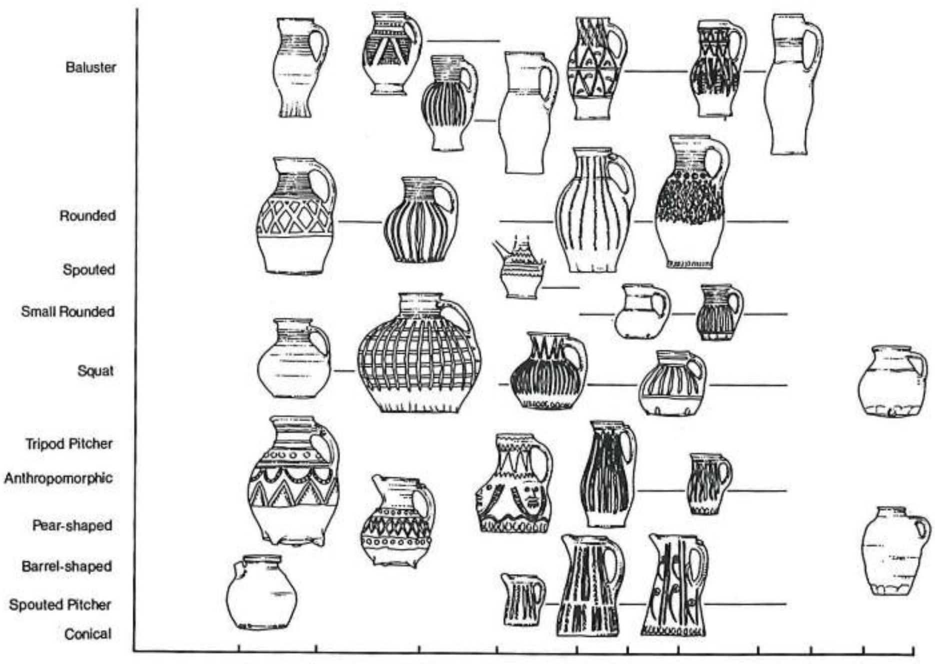

Fig 11 The typology of London-type ware jugs (based on the Seal House/Trig Lane sequence (from Pearce *et al* 1985).

Summary

During the eleventh–fourteenth centuries therefore, the pottery sequence in London is well-defined, with 'nodal points' which coincide with major events at Bryggen. For example, the fire of 1198 at Bryggen took place at the time of the transition in London from London-type Early-style jugs to Rouen-style and North French jugs. The Bryggen fire of 1248 took place just after the introduction of Kingston-type ware and the change from Rouen-style to more highly decorated North French-style jugs and plain baluster jugs, but before the introduction of Mill Green ware. By comparing the London sequence with the London-area pottery found at Bryggen (despite the high proportion of residual material present) it should thus be possible to confirm or question the early phases of the Bryggen chronology.

Table 2 The main structural features in Gullskoen (Rows 6-1).

Period	Row 6 N	Pass	Row 5 S	Row 4 N	Pass	Row 3 S	Row 2 N	Pass	Row 1 S
1				B45		B497			
2.1			B44	B498		B68			
			B496	B502		B69			
		K22				B495			
						B39			
2.2	B210		B499			B487	B42		B483
			B66			B43	B494		B484
			B46			B488			B486
			B41			B40			
		K23	B38			B489			
		K24			K29	B490			
		K25		K27	K30	K32	K37	K35	
	K49	K38	K26	K28	K31	K33	K34	K36	K40
3.1			B481	B33			B479		B478
			B493	B35			B480		
			K127					K128	
	K19	K19	K19					K129	
3.2	B116		B67	B62	B50	B64	B492		B471
	B115		B63	B34		B24	B472		
			B37	B35		B25	B475		
			B133	B135		B28	B138		
			B134			B137			
			B473			K132			
				K14	K130	K13			
				K12	K131	K10			
				K9	K5	K7	K111		
				K6		K4	K114		
			K1	K2		K3	K123		
4.1			B16	Grave-			K125		
			B58	yard			K121	K122	
			B217				K124	K74	
			B117				K120	K75	
4.1.1	B207/8								
4.1.2	B206								
4.2	B205		B60	B61?		B27	B99		B104
	B114		B31	B21			B98		
	B474		B29	B20			B466		
			B26	B223			B467		
			B36	B222			B149		
			B32	K117					
			B211	K118					
				K135			K119		
5.1	B204		B55	B48		B48	B464		B458
	B119		B22	B17		B476	B97		B459
			B30	B15		B218	B460		B457
			B112	B186		B220	B461		
			B216	B187		B221			
				B214		B219			
5.2			B54	B12		B56	B95		
			B14	B10		B463	B96		
			B19	B188		B13	B456		
			B183	B214		B212	B455		
			B113			B462			
						B220			
						B221			

Table 3 The main structural features, Søstergården to Bugården.

Sostergården			Engelgården			Bugården			Period
N	Pass	S	N	Pass	S	S	Pass	N	
Posts									1
B482			B196						2.1
B130			B373						
B402			B203						
			K45						
K43		K41	K70						
K40		K42	K71	K64	K88	Posts			2.2
B126			B243		B372				3.1
			K87/9						
K46		K47	K85/6			K80		K81	
K44		K48	K83/4	K82	K-	K79		K78	
		K113							3.1.1
B127		B171	B200		B242	B313		B236	3.2
			B245		B240				
		K76	B244	K69?	B244				
K116		K77	K67/8			K90		K91	
K115		K112	K65/6						
K114		K111	K55/6			K54		K53?	3.2.1
B121		B400	B195		B192	B306			4.1
B399		B401	B369		B202				
		B123	B370		B232				
		B125	B197		B233	B235		B231	4.2
		B122	B371		B241	B230			
					B234				
K72					B349				
K73			K60	K59	K58				
K119			K62	K61	K57	K100		K92	
B395		B376	B191		B201	B227		B298	5.1
B396		B377	B189			B229		B261	
B397		B378	B174			B334		B304	
		B379				B335			
						B336			
			K108	K108	K108	K101		K93	
		B89							5.1.1
		B90							
B393		B88	B175		B199	B228		B266	5.2
B394		B87	B198		B347	B333		B260	
		B86	B193		B348	B309		B280	
			B367					B292	
			B368			K101		K93	
						K102		K94	
						K103		K95	
								K97	

PART 2

THE ANALYSIS OF THE LONDON-AREA POTTERY

by

Lyn Blackmore and Alan Vince

4 Methodology

4.1 THE INITIAL DATA

As described above (see Section 2.3.2), a complex system of codes was devised on site to record the precise location of every find. Following the excavation, the stratigraphic and artefactual data were entered on to the computer, using the Computer Centre (EDB-Senter) of the University of Bergen (Herteig 1985a, 42–45). In addition to the main data sets, there are now subsidiary files which include the detailed analysis of the Pingsdorf-type wares (Lüdtke 1989, 18), and those presented in this volume. By using the Accession No. (Tilvekstnr) as a 'key', it is possible to combine the detail on a specific find with the relevant stratigraphic information, and to sort the finds data in many ways – by location or by specific attributes.

However, there are some problems with the recording system which should be noted. The accession number (usually four or five digits) was written directly on to the finds at the time of recording. As there is no prefix, many of these numbers can be read either way up, so that a number may be 8088, or 8808, while a hand-written seven can be mistaken for a one, and so on. The recording took place many years ago, and in some cases the numbers were found to be unreadable or were missing, having been written too close to the edge of a friable sherd, or over a deposit which has since flaked away. These problems are lessened when the accession number is repeated on a metal Dymo tag, or when a group of sherds share the same number; such groups are the most reliable to use for detailed stratigraphic analysis in a project such as this, although they do present other problems. For example, it is possible that sherds of different ware types may share the same accession number (Herteig 1985a, 42–43), while the basic computer record of the accession numbers does not distinguish between small, large or mixed groups of pottery. A further problem encountered was the allocation of a single accession number to finds of mixed type (see 4.3 below). As noted by Lüdtke (1989, 19–20) there are, therefore, potential problems if accession numbers are used as a basis for quantification without recourse to the material itself.

Errors in transcription, or misinterpretation of an accession number leads in turn to a faulty correlation with the stratigraphic information recorded on the computer. To guard against this, all the stratigraphic information relating to the London wares has been checked as far as possible by the excavator. Other aspects of the data have been noted above (Section 2.3.4).

4.2.1 Recording and terminology

All the London-area pottery was recorded on proforma sheets as described below, using the codes listed in Appendices 3 and 4; these codes are explained more fully in the discussions of the different wares. Care was taken to use as much information provided by a sherd as possible, including condition, wear and fragmentation. Where sherds from more than one vessel share the same accession number these were recorded as separate entries. The terminology used for the recording and discussion of the London-type wares is the same as that adopted for the analysis of this ware from excavations in London (Pearce *et al* 1985). The descriptive terms used for the shell-tempered wares are mainly the same as those applied to medieval coarse wares in general. The coded data were then entered on to the computer and this forms the basis of the statistics and discussion which follow.

4.2.2 Shelly-Sandy ware

Each record for the Shelly-Sandy ware includes the accession number, number of sherds, weight, rim diameter and percentage of rim present (EVE); bases were recorded by sherd count and weight only. As the pottery was sorted, archive illustrations were made of the profile of most rim sherds, so as to study standardisation or variations of vessel size and form. Following the computer system already in use, number or letter codes were used to describe rim type, vessel form, method of manufacture (hand-made, wheel-made, or both), and decoration.

4.2.3 London-type ware

The system used for the London-type ware was the same, although the details recorded vary slightly. The amount of Mill Green ware and Kingston ware was so small that this was not recorded in any detail.

4.2.4 Sherd links

By plotting the distribution of sherds from the same vessel and comparing this with the site stratigraphy, it may be possible to come to a better understanding of the activity on the site. This exercise was carried out by Lüdtke (1989, 15–16) with limited success for the Pingsdorf ware and Olive Proto-stoneware; the results for the Shelly-Sandy and London-type wares were more positive and are discussed below (Sections 7.1.2; 7.2.2; 10).

4.2.5 Condition

The condition of the two main ware types was recorded using a numbered scale to indicate the extent of use, as evidenced by sooting or other deposits, or by changes in the surface of the pot such as chipping, abrasion or erosion. For the London-type ware (mainly table wares) a single code was used to describe both traces of wear and condition, since on the whole these do not show such clear evidence of use as kitchen wares.

The wear and condition of the Shelly-Sandy cooking pots was recorded in two fields for two reasons. Firstly, vessels which have been used can be readily distinguished by sooting or other deposits, the type and position of which was recorded by one of six codes (see Sections 5.4, 7.1.3, 7.1.4). Secondly, this class of pottery has a valuable characteristic not shared by the London-type wares, in that the shell inclusions are readily affected (leached) by acid. Sherds with only internal leaching may once have contained an acidic liquid; those which are externally leached must have weathered after the sherd became buried. If all the shelly wares in a deposit are leached on both surfaces, this is good evidence that the leaching probably took place *in situ*. If leached and unleached sherds occur together, this shows that some of the leached sherds may have been redeposited. The results of this study are summarized below (Sections 5.5, 7.1.5).

4.3 CONSTRAINTS

Various limitations were placed on the study of the London area pottery. A major factor was the time actually spent working in Bergen. As a result some sherd links may have been missed, as it was not possible to conduct more than a cursory examination of the two large groups of 'diverse' and 'uncertain' pottery (total 170 trays). Lastly, the speed at which the initial recording was carried out did not allow for the classifications to be checked during the initial analysis, and only those sherds which have been illustrated have been double-checked.

The quantification and discussion of the London-area pottery in this report is also governed by various factors. In addition to the points noted in Sections 2.3.4, 3.2 and 4.1, some sherds of the two main ware types were found to have accession numbers which did not correspond to ceramic finds in the original finds catalogues, so that their original provenance is in doubt, while the stratigraphic data assigned to other sherds was found to be unreliable. Such sherds have been included in the general totals and some have been illustrated, but on the whole they have been omitted from the chronological analyses. In addition, a few sherds of London-type ware were identified after the initial recording of this material; these are not included in the pottery totals, although a few have been illustrated. Lastly, the stratigraphic analysis of Bryggen excavation is still in progress and many finds remain to be studied. The vertical distribution of the London-area pottery may therefore change if the stratigraphy is reinterpreted, while the dates assigned to deposits on the basis of sherds studied in isolation by fabric type may be revised when all the wares in a group are considered; these points are also considered in Section 7.

5 Shelly-Sandy wares from the London area

At present Bergen has the largest known collection of London-area Shelly-Sandy ware (fabric code SSW) outside South-east England, and this ware comprises the bulk of the shell-tempered pottery found on the Bryggen. The stratified material consists of 1780 sherds (785 Tilveksts), weighing 35.549 Kg. These represent *c* 307 vessels counting rims with the same Tilvekst number and from the same vessel as one; this figure is slightly less when sherd links are taken into account. The estimated vessel equivalent based on the total percentage of measurable rim circumference precent (EVE) is 43.86 vessels (nb three Type 1 rims could not be measured, one being too small, the others burnt and distorted. In addition there are fifty-three shreds (1.103 Kg, 0.14 EVEs), some of which has been illustrated, which cannot be assigned to a stratigraphic location; these are asterisked (*) in the following text.

5.1 FABRIC

All sherds identified as having shell inclusions were examined by eye, and if there was any doubt about their identity as Shelly-Sandy ware, they were further studied using a binocular microscope (up to x50). From this, four fabric groups were formed, together with a few miscellaneous sherds, as listed below.

Table 4 Shelly-Sandy ware: the distribution of the fabric types.

	No. of accessions	No. of sherds
1. Sparse shell temper	106	133
2. Moderate shell temper	451	964
3. Abundant shell temper	193	630
4. Shell and grit	32	48
5. Misc.	3	5
	785	1780

Sherds of each fabric type were scattered both horizontally and vertically across the site, so that given the probable period of manufacture (*c* 1150–1220) these variations do not appear to have any chronological significance. A sample of ten sherds was examined in thin-section (accession nos. 4810*, 4811*, 78998*, 79890*, 80458*, 81971, 82383*, 82883*, 84939*, 87080*), since the glauconite and fine angular flint inclusions which characterize the fine sand in SSW cannot be identified by eye, and these help to confirm that the inclusions originated in an area of Cretaceous or younger rocks. The results of this analysis are included in the following description of the inclusions.

The main characteristics of SSW are moderate to abundant fragments of shell, up to 4mm long, and abundant fine sand, up to 0.2mm across (pl 1, accession no. 20984*). The fine sand is mainly composed of quartz, although sparse white mica is also visible to the naked eye; iron, iron-rich pellets, glauconite and flint are identifiable in thin-section. In addition, very sparse flint up to 2mm across, very sparse to sparse red iron-rich compounds up to 4mm across, sparse rounded quartz up to 1mm across and moderate organic inclusions may be found.

Although there is usually little variation in fabric (a few vessels have more shell and less fine sand than normal, and a few have better sorted and coarser fine sand), there is a small but distinctive group which has abundant gritty inclusions in addition to the shell and sand (pl 2, accession no. 19058).

The shell. Fragments of shell are visible in all but one sample, and in one case are abundant. The shell fragments are angular, with no signs of abrasion on their edges, nor of any staining or patination of the fragments in their present state. There are no signs of cement adhering to the fragments, which cannot, therefore, have been derived from a shelly limestone. They must either have been recent shell which was deliberately crushed, or have been derived from a deposit containing naturally fragmented shell. The fragments are too small to be identified, but it can be seen that all were from bivalves, some with ornamented shells similar to *cardium*, but most with smooth surfaces. Under the binocular microscope it can be seen that the shells vary from 0.3mm to 1.3mm in thickness, and that they usually have a laminated structure, often varying from white to grey in colour between the laminae. A small proportion of the shells had been attacked by fungae or algae and are pierced by borings *c* 0.5mm in diameter. Shell fragments in samples of shelly-sandy ware from excavations in London were examined by Dr J Cooper of the Department of Palaeontology, Natural History Museum, who commented that they are probably all marine shell. Unspecified bivalve is the most common type, and includes several fragments bored by sponges. Oyster shell, also heavily attacked by sponge (of a different species) is also common. Rare specimens of gastropod are also present. The shells are often heavily abraded and stained light brown.

Algal limestone. Rounded fragments of calcareous algae are present in all but two samples. In one case these fragments ranged up to 2.0mm across and in others up to 1.0mm. One sherd not examined in thin section has a pellet of probable decayed algal limestone 7x4mm across (accession no. 18323).

Quartz. Sparse rounded ill-sorted, angular, sub-angular and rounded quartz grains up to 0.5mm across are present in all but one of the samples examined in thin-section, and are abundant in three. Sparse rounded quartz grains, maximum dimensions 2.0mm, are present in all but one sample. In a few cases these grains are milky, ie traversed by numerous bubble and other impurities, whilst in others they are either coated with haematite or have veins of haematite within them. Most grains are clear with a matt surface, although some are 'water-polished'.

Fine sand. The moderate to abundant fine subangular quartz sand is usually ill-sorted, and is mostly less than 0.1mm across; a few fragments up to 0.2mm are present. In a rare variant, noted both in London and in Bergen, the sand is better sorted, averaging between 0.1mm and 0.2mm across (eg accession no. 21408).

Flint and chert. Sparse fragments of angular white flint and chert are present in all the samples examined. The largest fragments of white flint are *c* 2.0mm long, although fragments up to 4mm across were noted in sherds which were not thin-sectioned, while one sherd (accession no. 31124) contains a flint pebble measuring

9x4x4mm across. Flakes of muscovite up to 0.2mm long are also moderately common in sherds examined in London.

Iron. Iron occurs in the form of sparse well-rounded grains up to 0.5mm across with a black shiny surface.

Iron-rich compounds. These include rounded fine grains of glauconite, usually altered to a red iron-rich compound (probably principally haematite). Sparse rounded red and black iron-rich compounds are present in six of the samples examined; in one instance these are 1.5mm across, but in most others the largest were up to 0.5mm. Among the sherds which were not thin-sectioned, iron-rich inclusions up to 4mm across were noted, with one example (accession no. 17696) measuring at least 7x5mm. In many sherds from Bergen the iron-rich inclusions have reacted after burial to cause eruption and spalling of the surface of the pot (pl 3, accession no. 21578). This is not found on examples from London, and must therefore be due to the local conditions in the ground. Clay pellets, which may be mistaken for iron-rich compounds, are sparse inclusions varying from a light brown colour to dark grey, usually less than 1mm across.

Organic inclusions. The clay from which SSW was made was originally rich in organic matter. This is best observed when the vessels have been low-fired or have a reduced core. In these conditions moderate to abundant organic inclusions may be seen. Otherwise only those with distinctive shapes may be recognized as voids, perhaps surrounded by a ring of reduced, carbon-rich clay. Some fragments were probably roots, between 0.6mm and 1mm, while others were fragments of wood. Sparse carbonized inclusions were noted in four of the samples examined, the largest being 1.5mm across. In sherds examined from London, fragments of stem, root, leaf, wood and possibly seeds have all been noted. These organic inclusions are often associated with minute crystals of iron pyrites, which also occur in lenses within the clay.

5.1.1 The relationship of Shelly-Sandy ware to other London-area fabrics

The basic clays used to make SSW are very similar to those used to make the finer London-type wares, which contain all the inclusions noted earlier apart from the shell. Thus some vessels with only sparse shell fragments are intermediate between Shelly-Sandy ware and London-type ware. It has long been suspected that these shell-tempered wares were probably produced by the addition of shell to the fine sandy clay used by potters making other vessels in London-type ware, since no naturally shelly brick-earths or sands have been found in the City of London or in the immediate hinterland, while the presence of glaze spots on several shell-tempered vessels indicates that they were being made alongside glazed wares. This is further supported by the discovery on a waterfront site at Vintry in the City of London (site code VRY89) of a base sherd from an Early Baluster jug in a calcareous London ware (LCALC, see below), which has a fragment of SSW, partly covered by a green glaze, fused to the underside of the base. A few vessels, described in London as shell-tempered Coarse London-type ware may also have been produced alongside London-type ware.

The similarities between SSW and London-type ware are not confined to fabric, but also extend to form, again reinforcing the suggestion that they were produced together. The London ware cooking pots are sometimes in the typical SSW form, while dishes in SSW are very similar to bowls in London-type ware. Decoration is also very similar on both wares: thumbing or incised wavy lines on the rim, applied strips on the body.

5.2 FIRING

Shelly-Sandy ware typically has a reduced light grey core and margins which are progressively redder towards the surface. The surfaces are almost always a slightly duller light brown; there is little variation in colour between the exterior and interior of the vessels. Completely oxidized sherds do occur (eg accession nos. 20675 and 21408), but these are rare. On more highly fired vessels, which are less common, the same basic firing pattern can be seen, but the junction between the oxidised margins and reduced core is sharper, while both the core and margins have a brighter colouring. Less highly fired vessels have a blackened core and margins, and either a reduced grey or oxidized light brown surface; there is a small, but significant group of these in the Bryggen assemblage, most of which do not appear to have been used. There are no shadows caused by the shielding of one vessel by another during the firing, and very few flame marks on the outside of the pots; when present the latter occur on the base. The low-fired sherds have a rough fracture, whereas that of the more highly fired vessels is laminated, although still breaking around the quartz inclusions rather than through them.

This evidence shows that the vessels were mainly fired at a moderate temperature, between 700 and 900 degrees C, and that they were stacked in such a way as to allow the air to circulate freely during firing. The surface colour was probably achieved through partial removal of the oxygen while the vessels were cooling. Despite the occasional presence of over-fired or under-fired vessels, the pots show that considerable control over their firing was achieved. Secondary firing caused by inclusion in a conflagration was rarely observed, and when found this was generally confined to small single sherds.

5.3 THE FORMS

In London the range of forms in Shelly-Sandy ware includes: cooking pot, pipkin(?), bowl, handled bowl, dish, pedestal base, strainer or perforated plate, cauldron, skillet(?), curfew and storage jar. Only two forms are represented in the Bryggen collection, the cooking pot and the pipkin, with only one example of the latter, but the cooking pots include a range of sizes with a number of complete vessel profiles, which form a better stratified sample for studying the manufacturing techniques than any available in the country of origin at the time of this project.

Table 5 Fabric SSW: the distribution of the rim and vessel forms.

Rim type	No. of accessions	Vessel profile	No. of accessions
1. Everted, rounded	115	1. Grooved neck	92
2. Everted, angular	73	2. Straight neck	100
3. Everted, inner bead	45	3. Long neck	62
4. Clubbed	2	4. Base	87
5. Flat, rounded	22	5. Body	260
6. Flat, angular	19	6. Base/body	130
7. Flat, inner bead	16	7. Pipkin	2
8. Down-turned bevel	8	8. Indeterminate neck	31
9. Other	7	9. No neck	20
	307		784

During the analysis nine types of rim form were defined, with three types of vessel profile and two types of base angle, as illustrated in Table 5. These figures give a reasonable guide to the most common forms, but it should be noted that the most common rim type does not coincide exclusively with the most common vessel profile (see Tables 6 and 7), while due to the small size and irregular nature of many of the sherds, some fragments could fall into more than one category (see below).

5.3.1 The cooking pots

The cooking pots range from 120mm to 320mm in diameter, and vary in width–height ratio. In some cases the surviving portion of a pot may give a false impression of the true vessel size; an apparently short neck, for example, was occasionally found to be an elongated form on a squat vessel, and vice versa. However, using the 'envelope' principle (Orton 1986), and matching vessel profiles, it was found that despite minor differences between pots, the basic vessel profiles mainly fall into a limited number of 'families.' These are remarkably uniform, both within pots of the same rim diameter and in pots of different sizes, showing that standard forms were produced in different capacities.

The distribution of the cooking pots by measurable rim diameter/rim type and vessel profile is illustrated in Tables 6 and 7. This shows that there is a small but significant group of vessels with a rim diameter of 140mm (29 accession nos), but few vessels are smaller than this, or have a diameter of 150mm or 160mm. The numbers rise at 180mm (48 accession nos), and the bulk of the collection measures between 200–220mm in diameter (131 accession nos). After this the numbers fall off sharply; there is a group at 240mm diameter (33 accession nos) which balances that at 140mm diameter, but very large pots are rare, and only two were found to be more than 260mm in diameter.

5.3.2 Rim form

The two main rims are: everted (Types 1–3) and flat (Types 5–7). The former (233 accession nos) is over four times as common as the latter. In addition there are a few small groups of other types (see Table 5). Most rims of all types were finished, if not made, on the wheel, although a few examples can only have been hand-made. Some of the more irregular vessels have rims which are both rounded and angular at different points of the circumference due to slight variations in the angle or pressure of the potter's hand, so that some 'differences' in form may be incidental rather than intentional. Some features, however, such as an internal bead, a particularly angular form, or thumbing on the rim may be characteristic of specific potters. On the whole the rims are remarkably consistent, regardless of their angle or the size of the vessel; the upper surface of most rims is between 15–20mm across, while the thickness is usually between 5–9mm.

Everted rims: Types 1–2 (figs 12–14)
Rim types 1 and 2 were defined according to the profile of the outer edge, which may be rounded (Type 1), or angular (Type 2). Of the former, simple everted rims such as nos 1 and 4 may reflect the Late Saxon antecedent of the industry. Some Type 1 rims, such as nos 8, 9, 11, 13, and 23, have a rounded edge but may appear to have an angular vessel profile due to their straight neck and angular inner rim edge; conversely some Type 2 rims, such as nos 24, 26, 34, have a flat outer edge

to the rim but may appear to have a rounded vessel profile due to a rounded inner rim edge and grooved neck.

The upper surface of the rim normally slopes downwards towards the inner edge of the neck at an angle of between 10–25 degrees; no. 7 is exceptional in that the angle is almost 45 degrees. On most Type 1 and Type 2 rims the junction of the underside of the rim and the neck is quite smooth, but some (eg nos 9, 11, 23, 35) have a distinctive undercutting, while no. 13 has a ridge of clay in the angle of the neck. Some examples (eg nos 2 and 12) have a grooved neck but an angular junction of the neck and rim.

'Developed' and internally beaded everted rims: Type 3 (figs 15 and 16)
This category includes both rounded and angular everted rims which are 'developed' to a greater or lesser extent. The latter comprises a group of vessels with a slight depression inside the neck which gives the rim the appearance of being internally thickened or expanded (eg nos 36, 39–41, 44, 48–51, 53–54). More developed rims with a 'hammer' profile include nos 37, 38, 52. The most characteristic rims in this group have a clearly defined ridge and groove at the inner junction of the rim and the neck (nos 42, 43, 45–47, 55–56). These internally beaded rims are generally more angular than the above.

Flat rims: Types 5 and 6 (fig 17)
In London this form appears to be more common than the everted type, but in the Bryggen assemblage the truly flat rim (such as nos 57, 58) is quite rare; some rims slope very slightly in to the mouth of the pot (eg nos 60, 65, 67–69), others have a slight depression or groove in the upper surface of the rim (eg nos 59, 61–65, 93). The outer rim edge is generally rounded, but a few angular examples are found (eg no. 69). No. 66 is of interest since some parts of the rim appear rounded, while others appear flat. Some examples of both types were clearly made by folding the thin outer edge of the rim under and back on itself (accession no. 89462: rounded; accession nos 41971 and 87737: angular).

Developed flat rims: Type 7 (fig 18)
This group contains a wide range of vessel sizes and rim profiles. As with the everted form, some rims (mainly the larger vessels) have a 'hammer' profile caused by a depression made in the inner wall of the neck as the vessel was being finished (probably on a wheel); a few rims have a triangular cross-section, of which no. 73 is the most pronounced. These and other smaller vessels in this group (eg nos 74, 76, 77) have a distinctive inner bead. Some rims in this group are flat (eg nos 72, 75, 78, 91), some have a slight depression in the upper surface (eg nos 70, 71), while others slope inwards slightly (eg nos 74, 76, 88).

Clubbed and down-turned rims: Types 4 and 8 (figs 17 and 18)
These forms are extremely rare. Rim type 8 includes a range of forms in which the upper surface of the rim slopes downwards away from the inner upper edge of the neck. The forms present include a small vessel with a simple rolled rim (no. 79), and another with a sub-rounded outer rim edge (no. 80). The remainder have either a simple bevel (nos 81, 83, 95), a simple bevel with an inner bead (no. 84) or a double bevel (no. 82).

5.3.3 Vessel profile

Three main rim/neck profiles are represented, which occur in any combination with the rim forms described above.

Form 1: Grooved neck. In cross-section the rim, neck and shoulder normally form a smoothly curving profile; the groove of the neck formed by the potter's forefinger is on average c.15–20mm across. This form is seen at its best with a simple rim such as nos 16 or 30, 34, 72 or 79. As noted above, in some cases the neck is grooved but the junction with the rim is abrupt.

Form 2: Straight neck. In cross-section the junction of the rim and the neck is usually abrupt, and the junction of the neck and shoulder may also be more angular. Classic examples are nos 11, 23, 45, 85. Vessels in this group often have a neck which slopes in towards the centre of the pot.

Form 3: Long neck. Type 1 rims in this group normally have an elegant 'S' profile where the curve of the neck flows evenly into a slack shoulder (eg nos 33, 77, 89, 94); elongated straight necks include nos 23, 67 and 71.

Form 8: Indeterminate. This code denotes rims where insufficient of the neck survives to determine the vessel profile.

Form 9: No neck; the shoulder of the pot develops from directly below the rim (eg nos 1, 4, 19, 88).

5.3.4 Base forms

The bases are all sagging (not flat); the thickness ranges *c* 2mm to 7mm (accession no. 4559). Two main types of base angle are found: those where the body of the pot is convex at the junction with the base, and those where the body is concave. A few rare vessels have almost straight-sided walls.

5.3.5 Manufacture

It was thought from the London evidence that Shelly-Sandy ware cooking pots were generally made on a wheel, but although a few vessels in the Bryggen assemblage are quite neatly wheel-thrown, it would appear that the normal method of manufacture was to form the base by hand; the body of the pot was built up to the shoulder by hand and/or on a turntable, while the neck and rim were finished on a turntable or wheel. This is well demonstrated by no. 29, where the entire base is covered with finger impressions and the walls have horizontal wiping marks both inside and out, but the rim appears even and well-formed. Other base sherds such as accession nos 10177* and 20112 also show thumbing inside the base angle.

As a result of this technique, many pots had an inherent weakness at the angle of the shoulder and neck, and/or at the base angle, which is reflected in the way they have broken. For example, one almost complete base sherd weighing 150gm (accession no. 18420) has broken away from the body of the pot due to an inadequate join at the base angle. Other vessels may have been weakened while the base was being pushed out to create a sagging form, as in the case of accession no. 19058, an apparently wheel-thrown pot. This base is only 2mm thick at the centre, and has a circular crack 30mm in from the base angle, which was probably aggravated by over-hasty drying and a very high temperature in the kiln.

Possibly in an attempt to counteract this problem, the bases of some pots have been strengthened with additional clay luted inside the base angle. Examples of this are accession no. 21578 (pl 3) and accession no. 19929, where the inner surface is smeared over the lowest of the irregular girth grooves inside the base, and accession no. 46097, where changes in the direction of the shell inclusions indicate a two-stage process of manufacture. This is occasionally observed on the underside of the vessel also, for example, accession no. 9732, which has been wiped smooth (see pl 5).

On the outer surface of the pot a slight ridge of excess clay is commonly found around the base angle. This generally occurs on the wall above the angle (eg accession nos 21726, 42881 and 22250; on the latter the ridge is 6mm deep) but occasionally it is found on the underside of the base (eg. accession no. 36259). In a few cases this area has also been knife-trimmed (eg accession no. 20189), or wiped, but such external surface treatment is rare.

Vessels showing particularly good evidence of their manufacture include nos 20, 22, 40, 42, 45, 69, 78. Of these no. 20 has a row of fibre impressions over the outer edge of the rim, perhaps from the frayed sleeve of a careless potter or from a cloth used in the workshop. The rough surfaces inside the neck of this pot suggest that the rim was added on to the body in a separate operation; this is possibly also the case with nos 22 and 87. Nos 20 and 22 are of inferior quality in every way, with flaking surfaces which are probably caused by a combination of poorly prepared clay, over-hasty potting and/or drying, and a very low firing temperature, compounded by post-depositional damage.

The lower inner wall of no. 42 has a series of broad vertical grooves where the clay has been drawn up by hand, although the upper body and rim appear to be wheel-made. The lower body of no. 40, by contrast, has an unusually straight-sided wall with horizontal grooves indicating that this pot was almost certainly finished, if not made, on a wheel. Despite these differences, however, nos 40 and 42, like no. 78, were externally wiped and/or knife-trimmed above the base angle. The evidence from other unillustrated sherds indicates that while horizontal wiping as an integral part of the manufacturing technique (rather than a finishing process) may occur over the entire outer surface, knife-trimming rarely extends more than 35–40mm above the base. An exception is accession no. 21578, a pot with a splayed base angle which has a very obvious and uneven junction of the base and body (both inside and out) accentuated by knife-trimming over the lower 45mm of the outer surface.

Other features include slight finger impressions on the rim of no. 7, and inside the shoulder of nos 45, 69 and 91 (the latter partly obscured by a deposit of pitch). These could have been intended as a crude form of decoration, but may simply reflect the mood of the potter or show where these pots were held when moved from one place to another at the leather-hard stage.

5.3.6 Decoration

Only 26 rims are decorated, the majority with thumbings on the outer edge of the rim. One rim (no. 85) has a single thumbed impression; two (including no. 86), have a doubling thumbing, and eight (including nos 88, 90–92) have triple thumbing. A further fourteen sherds have broken in such a way that the number of thumbings is uncertain (eg nos 89, 94). Only one sherd is thumbed on the inner edge of the rim (no. 95).

Two rims are decorated with incised lines (nos 96, 97), while one body sherd has a vertically applied thumbed strip (no. 98); although decorative, these were usually applied at intervals around the pot to strengthen it. Both these traits are more common on Shelly-Sandy wares found in London.

5.3.7 The pipkin

Only one pipkin was positively identified (no. 99); this is a small squat vessel with a slightly closed form, an internally thickened rim designed to prevent spillage, a lip for pouring, and a horizontal handle, of which only the handle scar remains. It is possible that nos 24 and 61 also belong to this category, but neither show any evidence for a lip or handle. As only 21% of the rim of no. 61 survives it is not impossible that this was a pipkin, but no. 24 (60% present) is a less likely candidate.

5.4 SURFACE DEPOSITS

Approximately two thirds of the sherds recorded (528 accession nos in all) had traces of use in the form of sooting or other surface deposits (see Table 8). Some sherds were externally sooted only (Code 1: 84 accession nos), while a few had internal deposits only (Code 2: 6 accession nos, but the majority had deposits on both surfaces (Code 3: total 414 acession nos). The latter indicate clearly that vessels of all sizes were used time and again until they became so caked with soot and residues that they were discarded. External sooting usually extends from just above the base to the top of the rim. Internal deposits range from a thin stain to a thick encrusted layer of burnt food up to 5mm thick; analysis of similar deposits on vessels from English medieval settlements has shown that these contained vegetable and animal traces, probably derived from soups, stews or sauces. A selection of sherds with food deposits were submitted for analysis at the University of Bergen, but the results were inconclusive.

A number of sherds (mainly from the larger pots) have a thin yellow-brown deposit over the inner surface, which is probably a 'furring' produced by boiling the iron-rich water of the Bergen area. This deposit may be quite thin but can appear layered as if built up over a period of time. A few sherds have a combination of this brown staining and food deposits, showing that some, if not all, pots were multi-functional.

A third type of use, indicated by a pale pinkish-purple deposit on the inner surface of seven sherds (Code 4), probably relates to craft activities rather than food preparation (see section 7.1.5). Sherds with similar deposits found in London and submitted for chemical analysis at the University of York proved to have contained madder. The limited presence of such sherds at Bryggen is insufficient evidence for commercial production of dye in this part of the town, although it may have been prepared for personal use.

In addition to the above, two sherds (no. 91 and accession no. 82971*) have a thick yellow-brown deposit which is thought to be wood pitch (Code 6).

Approximately one third of the sherds recorded appear to be quite fresh (Code 0); some may have been used to contain dry goods, but others, especially fragile pots such as nos 7 and 22, could have broken in transit and been discarded unused on arrival in Bergen (see Section 7.1.4).

5.5 CONDITION

Very few sherds appear to have been subjected to the intense heat of a major fire, although more may be found in the category 'Secondarily Burnt'. A significant number, however (285 Tilveksts in all), have been altered through leaching of the shell (see Table 9 and pl 3). Of these, approximately one quarter are leached on the inner surface only (Code 2), showing that they come from vessels which had contained an acidic liquid. By contrast, leaching of the outer surface only is rare (Code 1), and most sherds are leached on both surfaces (196 accession nos). Some of these must come from vessels which had been used, but others must have weathered in the ground; it is impossible to distinguish pre- and post-depositional weathering in this group. Many of the unleached sherds have sooting or other deposits on one or both surfaces which may have protected them from weathering. The distribution of the leached/unleached sherds is discussed below (Section 7.1.5).

Table 6 The typology of the London–area Shelly-Sandy wares by rim diameter and rim form (accession no. count only).

Rim form	Rim Diameter in cms																
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	28	32
1	–	1	6	–	6	2	18	1	25	–	32	1	12	1	6	–	–
2	2	2	7	–	3	–	11	1	18	–	17	2	6	–	3	–	–
3	–	–	4	–	1	–	7	4	6	2	5	4	8	–	4	1	1
4	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–
5	–	–	6	–	2	–	2	–	3	2	4	1	2	–	–	–	–
6	3	2	–	–	2	–	2	1	4	–	4	–	1	–	–	–	–
7	1	–	2	2	1	–	4	–	3	2	1	–	–	–	–	–	–
8	1	–	1	–	–	1	1	–	1	–	1	–	2	–	–	–	–
9	–	–	1	–	–	–	3	–	–	–	1	–	2	–	–	–	–
	7	5	29	2	15	3	48	7	60	6	65	8	33	1	13	1	1

Table 7 The typology of the London–area Shelly-Sandy wares by rim diameter and vessel profile (accession no. count only).

Vessel Profile	Rim Diameter in cms																
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	28	32
1	3	4	16	2	7	–	15	3	12	3	15	1	7	1	4	–	–
2	1	–	4	–	5	1	19	2	25	–	28	2	10	–	2	–	–
3	1	–	4	–	–	2	7	1	13	1	11	2	13	–	3	1	1
7	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–
8	2	–	3	–	1	–	3	–	6	1	9	1	1	–	2	–	–
9	–	1	1	–	–	–	3	1	4	1	2	2	2	–	2	–	–
	7	5	29	2	13	3	48	7	60	6	65	8	33	1	13	1	1

Table 8 Surface deposits on Shelly-Sandy ware cooking pots in Periods 2, 3, 4 and 5 (accession no. count only).

Fire	Type of Deposit						
	0=None	1=Ext.	2=Int.	3=Both	4=Dye?	6=Pitch	Total
U VII	3	–	–	2	–	–	5
I VII	1	–	–	1	–	–	2
O VII	1	–	–	3	–	–	4
U VI	64	17	1	108	–	–	190
I VI	3	–	–	3	1	–	7
A VI	12	2	–	20	–	–	34
O VI	52	21	4	88	–	–	165
U V	89	34	1	134	2	1	261
I V	3	1	–	2	–	–	6
A V	7	3	–	8	–	–	18
O V	13	5	–	36	–	–	54
U IV	2	1	–	9	–	–	12
I IV	–	–	–	–	–	–	–
A IV	–	–	–	–	–	–	–
Total	250	84	6	414	3	1	758

Table 9 The distribution of leached and unleached Shelly-Sandy ware in Periods 3 and 4.

	Type of leaching				
Fire	0=None	1=Ext.	2=Int.	3=Both	Total
U VII	2	–	–	3	5
I VII	–	–	–	2	2
O VII	2	–	–	2	4
U VI	133	1	16	40	190
I VI	2	–	1	4	7
A VI	30	–	2	2	34
O VI	123	2	18	22	165
U V	134	10	26	91	261
I V	2	–	1	3	6
A V	6	–	2	10	18
O V	33	4	4	13	54
U IV	6	–	2	4	12
I IV	–	–	–	–	–
A IV	–	–	–	–	–
	473	17	72	196	758

6 London-type ware

Wheel-thrown, glazed wares made in or very close to London have recently been the subject of a comprehensive study (Pearce *et al* 1985). In this work, two major fabrics were identified, London-type ware (LOND) and Coarse London-type ware (LCO-AR). A third twelfth-century fabric is a calcareous variant of LOND (LCALC).

As with the Shelly-Sandy ware, Bryggen has the largest known collection of London-type ware from a single site outside South-east England. The present study of this material showed that the identifications made during the initial sorting of the pottery in 1981–82 were very accurate for the late twelfth-century Early Rounded jugs and Rouen-style vessels, but a rapid survey of some other fabric types which might be confused with London-type ware did reveal some further examples, particularly of the coarser variant, which was not originally recognized as a London-area product. A more extensive study of the other fabric types might increase the number of sherds and extend the range of forms slightly, but the overall picture would probably not change greatly from that outlined below.

The stratified fine London-type ware comprises a total of 1893 sherds (1274 accession nos, weight 40.128 Kg, EVE 23.84). Of these, fifty sherds (37 accession nos) associated with Building 197, and 56 sherds (43 accession nos) associated with other features, have not yet been assigned to a precise phase. In addition to this there are 72 sherds (59 accession nos, weight 1.601 Kg, 0.19 EVE), some illustrated, the stratigraphic location of which is uncertain. These are listed in Table 10, but are not included in the distribution analyses.

The stratified Coarse London-type ware comprises 158 sherds (88 accession nos, 4.335 Kg; EVE 1.12). Of these, only 6 sherds (4 accession nos) have not been assigned to a phase. The different London-type wares are described here as one group unless otherwise stated; their distributions are discussed in Section 7.2.

6.1 FABRIC

Fine London-type ware. This is a fine silty fabric containing abundant quartz silt up to 0.2mm across; moderate organic inclusions from 0.1mm to 3mm across; sparse to moderate rounded quartz up to 0.8mm across (including milky, clear and red-grained examples); sparse to moderate angular flint up to 0.5mm across (including black, white and brown-stained varieties) and sparse black iron-rich compounds up to 0.3mm across; sparse red iron ore and green glauconite up to 1.0mm may also be present (*ibid*, 2–3).

The white slip applied to the outer surface of many vessels can be up to 0.25mm thick, and contains sparse visible quartz up to 0.25mm across and sparse to moderate muscovite (white mica) up to 0.1mm across. The slip appears to be finer in texture than that used for coarse London-type ware.

Calcareous London-type ware. Some sherds have a distinctive light-coloured body (eg nos 102, 103, 107, 114, 116–118, 141, 150, 168, 173). Analysis of similar sherds from London has shown that the petrology is virtually identical to the above, except that the fabric has a calcareous content which probably causes the clay to 'bleach' on firing (*ibid*, 3). The Bryggen sherds were quantified together with the above.

Coarse London-type ware. This ware is characterised by a coarse sand temper, which consists of rounded grains of quartz, calcareous matter (probably algal limestone), red sandstone, flint, chert, iron ore and both red and black iron-rich compounds (*ibid*, 3). These inclusions typically range in size up to 1.0mm across, although larger grains may be sometimes present. Examples from Bryggen include nos 129, 131 and 160.

6.2 FIRING

Fine London-type ware. A study of the firing patterns of groups of Rouen-style and Baluster jugs showed that there was considerable variety and no apparent preferred firing pattern. A few sherds have a 'sandwich' firing possibly due to the addition of more fuel during a normal firing, which would cause the removal of oxygen late in the firing process (see below). The evidence from London suggests that pots were fired in an inverted position in the kiln, at temperatures between 600–900 degrees C (*ibid*, 4). Vessels of early/mid-thirteenth century date are generally more highly fired than twelfth-century examples, but those of later thirteenth- or fourteenth-century date are quite poorly and unevenly fired. The presence of 'shadows' on the surface of many vessels, together with the direction in which the glaze has run, indicates that most jugs were fired in an inverted position. Pipkins, on the other hand, were fired the right way up.

Calcareous London-type ware. This fabric is consistently fired to the same colour throughout; this may be due in part to a low iron content and a higher than average content of calcareous matter, but nonetheless suggests greater control of the kiln conditions than was used for the fine and coarse wares.

Coarse London-type ware. In general, sherds in this fabric found at Bryggen are well-fired, and few have dark grey or black carbon-rich cores. Most sherds are hard (ie they cannot be scratched with the fingernail), and a few vessels were fired at such a temperature that when they were broken the sherds fractured through the quartz inclusions rather than around them. Where the original firing patterns could be determined, five different groups were noted in the Bryggen collection. These are:

(1) Fired grey with reddish margins and a darker inner surface.
(2) Fired grey throughout with a brown inner surface.
(3) A 'sandwich' firing with a grey core surrounded by first oxidized and then reduced margins.
(4) Oxidized with a grey inner margin.
(5) Oxidized outer margin with grey core and inner margin.

The above suggests that LCOAR was fired to high temperatures, perhaps in the order of 900–1000 degrees C. The firing patterns suggest that the surface colours of the vessels were not important to the potters, since thirteen of those recorded had oxidized surfaces and eleven had reduced ones. Firing patterns (4) and (5) indicate that the mouths of these vessels were sealed during the firing process. This is probably accidental, due to firing the pots in an inverted position, either on the floor of the kiln or stacked on the base of another vessel. The distinctive sandwich effect (3) is noted above.

6.3 MANUFACTURE, SLIPS AND GLAZES

Fine London-type ware. All vessels in this fabric have abundant evidence for the use of the wheel, both for the initial manufacture and for decorative features such as cordons and corrugations on the neck, shoulders and bases of jugs. Knife-trimming is common on most vessels, and is particularly evident on the lower parts of the bodies of the Early-style jugs. In contrast to LCOAR, there is no evidence that vessels in LOND were ever made by coiling. Early-style vessels normally have wheel-thrown strap handles and sagging or flat bases; Rouen-style and North French-style vessels have rod handles, and the bases are usually flat or recessed, although some are thumbed. After this the rod handle remained the most popular type but the bases vary – the thumbed form is most common between *c* 1240 and 1300, the bases of the later Baluster jugs are flat or recessed. Throughout the industry the most common method of handle attachment was to insert it through holes made in the neck and body of the pot, the inner surface of the join being smoothed over with the fingers. For further comments see below.

Coarse London-type ware. Body sherds of vessels in this fabric have signs of a regular thumbing on the interior, while the walls are of irregular thickness, suggesting the use of the coil method of manufacture. The necks and rims, on the other hand, bear all the signs of having been thrown on a wheel, but it is not certain whether this is the result of the pots having been placed on a turntable and 'trued-up'. Other general techniques are as those described above or noted below.

Slips. Jugs in both LOND and LCOAR often have a white slip over most or all of the body (see 6.1 above), presumably to provide a better surface and foil for the glaze and any other decoration. This appears to have been smeared on by hand, rather than by painting or by dipping the pot into liquid slip, although one Baluster jug (accession no. 19410) has slip on the underside of the base, suggesting a possible combination of techniques. The red slips, however, were probably painted on.

Glazes. Many Early-style and Rouen-style jugs in both the main fabric types have a lead glaze which is pock-marked and which was probably applied in a relatively coarse state rather than as a fine powder (*ibid*, 4–5). The glaze is usually clear or yellowish, with occasional streaks due to impurities in the lead, but sometimes copper oxide was used as a colourant. When simply dusted onto the surface this gives a mottled yellow-green effect, but some examples, such as nos. 101 and 140 have a lustrous green glaze, possibly achieved by the even application of a ground glass powder or frit made by melting lead, copper, quartz sand and a flux (*ibid*, 5). The casual manner in which the glaze was normally applied is shown by vessels such nos. 105, 112, 114 and accession no. 9919 (LCOAR), where the glaze is absent from the surface of the pot facing the handle. Where the glaze has started to run during the firing, it can be seen that it was running from the base to the top of the vessel. Jugs in the North French-style have a good quality, evenly mixed glaze containing copper as well as lead, which was probably applied in a liquid suspension (eg nos 151, 157–160).

6.4 THE FORMS

In London the jug was the main form produced in all three fabrics, although other vessels such as cooking pots, pipkins, lids, 'drinking jugs', and bottles were also produced in LOND and LCOAR. The latter can only be broadly assigned to a phase within the total production period of London-type ware, but the fine ware jugs were produced in distinct phases. Coarse London-type ware is here found only in Forms 10–12 and should thus have an end date of *c* 1200.

Table 10. Fine London-type ware: the distribution of the form types.

Form: Jug forms	No. of accessions Strat	Unstrat
10 Early rounded	877	38
11 Early Baluster	15	–
12 Large squat	17	2
13 Very Large rounded	1	–
14 Squat	5	1
15 Reused rounded	5	–
16 Andenne-type	1	–
17 ?Spouted vessel	1	–
20 Rouen/North French	8	1
21 Rouen-style	48	2
22 North French-style	30	3
23 Zoomorphic	3	–
24 Large rounded (misc)	12	–
25 Small Pear-shaped	2	1
26 Squat North French	9	–
27 Large rounded (Rouen)	3	–
28 Plastic decoration	2	–
30 Small baluster (HD)	4	3
31 Large Rounded (HD)	3	–
32 Baluster (HD)	34	1
33 Pear-shaped (HD)	5	–
34 Squat	3	–
Total	1088	52

Form: Other forms	No. of accessions Strat	Unstrat
40 Cooking pot	7	1
41 Pipkin	7	–
43 Lid	4	1
44 ?Bottle	1	–
45 Chafing dish	3	1
46 Finial	1	–
47 Miniature jug	1	–
00 Indeterminate	78	–
01 Undiagnostic	84	4
Total	186	7

Each sherd or group of sherds was classified according to the form of the vessel from which it derived and where a precise identification could not be made it was usually possible to assign even featureless sherds to a general class of form (see Table 10). In most cases the London-type ware vessels found at Bryggen are very similar to those already published in London (Pearce *et al* 1985). That said, it is of some interest that a few forms which are rarely found in the excavated assemblages from the City of London have travelled so far afield as Bergen; the reasons for this can only be speculated on.

6.4.1 Jugs

The jugs were subdivided into three broad groups according to their known phase of use in London (see Section 3.4 and figs 10–11). The first major category consists of sherds of *Early-Style* vessels (codes 10–17), which date to the mid/late twelfth century. The second group comprises sherds decorated in the *Rouen-style* or *North French style* (Forms 20–28); these date from the late twelfth/early thirteenth century to *c* 1250. The third category includes *Baluster jugs* and *Highly Decorated vessels* (codes 30–34) which date from *c* 1250–1330.

6.4.2 Early-style jugs (figs 21–23)

This group is by far the most common within the Bryggen collection (1,051 accession nos in all). Methods of manufacture and surface treatment are remarkably consistent and are different from those in the two subsequent groups (*ibid*, 22–23; 25–28; 31). A few transitional sherds are present, but there was no difficulty in assigning sherds to this class.

Most sherds are from *Early Rounded jugs* with sagging bases (Form 10, figs 10–12), which account for 68.8% of the accession nos for stratified fine London-type ware and 96.5% (85 accession nos) of the coarse wares. As a rule the profile of these jugs rises almost vertically from the base, swells out slightly at the girth, and then gently curves in to the neck and shoulder, which are often decorated with a series of broad ridges and troughs giving a corrugated appearance. Some more rounded examples (eg nos 105 and 109) are also found. The necks usually have a carination or collar just below the rim, formed by being pushed out from the neck while the vessel was still rotating on the wheel (eg nos 102, 110, 111, 137, 140); the rims are generally flat or rounded with an external bead. Most handles are of strap form. On almost every example seen, the lower part of the body displays abundant near vertical knife-trimming on the outer wall (nos 105, 107, 112, 114); the inner wall may be wiped (no. 108).

Jugs of this type were occasionally decorated with applied slip (*ibid*, 31), often in a contrasting colour to the body of the pot. From this it is apparent that batches of clay were selected which would fire to different colours, since both applied white clay on a red body and applied red clay on a light-coloured body are found. The latter was either fired in an oxidizing atmosphere to give a light brown colour, or in a reducing atmosphere to give a light blue-grey colour. The decorative schemes used are generally very simple: a rectangular lattice (no. 105), interlocking arcs (no. 109), vertical or near-vertical lines (no. 110), diagonal and/or near-horizontal lines (nos 112, 114). The decorative zone is often banded by horizontal lines at the top and bottom. Most vessels have a thin pitted glaze which is often restricted to the top two-thirds of the jug.

Additions to the known corpus of ornamentation are rare but include variations in handle decoration and a few vessels with a more complex decorative scheme using incised horizontal or vertical wavy lines, either sgraffito (nos 115, 117) or combed (nos 116, 118); these may cut directly into the body of the pot, or through a band of slip (eg no. 117, a light-coloured pot with sgraffito on a red slip). Several handles also have a similar incised decoration (nos 124–127). A number of sherds are from jugs decorated with applied scales, usually on the body of the pot (nos 119, 121), but also on the neck (no. 120).

A few variations on the basic Early Rounded jug form were found. Some have a constriction of the lower part of the body like that used for the later Baluster jugs; these are thus known as *Early Baluster jugs* (Form 11, nos 133–134). Some examples are much larger and more globular than the Early Rounded form, and are termed *Large Squat jugs* (Form 12, including nos 135–140). The latter include a substantial part of the body of a jug decorated with a grid of lines painted in red slip, with applied pellets of white clay at the intersections (no. 136), and a jug with dimples at regular, closely spaced intervals over the body (no. 140); this also has applied thumbed decoration on the strap handle. Similar but smaller vessels termed *Squat jugs* were also distinguished (Form 14, not illustrated).

The above forms appear to have been regularly produced since they are represented by several complete examples from London as well as the Bergen fragments. A few sherds found in Bergen, however, appear to come from Early Style vessels which are much rarer, possibly one-off products. These include one sherd from a *Very Large Rounded jug* (Form 13, accession no. 21335) and a globular vessel with wide corrugations on the body, the interior of which has been scooped out with a knife in the manner normally associated with *Andenne-type* ware (Form 16: no. 141). The closest parallel for this form appears to be a spouted pitcher from London (*ibid*, fig 21, no. 40). Another vessel, possibly a form of *Ewer,* has a very narrow neck and a strap handle with incised cable decoration along the edges (Form 17: fig 16, no. 173); this probably had the body form which would have accompanied a type of tubular spout found in London (*ibid*, 25–26; fig 58, nos 233–240); no complete examples of this vessel type are known.

In addition to the above, five sherds are from one or more *Early Rounded jugs* reused for cooking (Form 15, Accession nos 63094, 63115, 63231, 63233, 63405); these were scattered in different deposits in the northern corner of the site, and may derive from the same vessel.

6.4.3 Rouen- and North French-style jugs (figs 23, 26, 27, 29)

In the late twelfth or early thirteenth century, the Early-Style jugs were replaced by a radically different range of forms, some of which appear to be linked to specific decorative techniques and which apparently follow Continental fashions.

It is uncertain whether these vessels were made by the same potters who were producing the Early-style jugs, or whether a completely new group of potters had taken over the London market. There is little doubt, however, that there was little overlap between the two types, since most assemblages in the City of London contain jug sherds of only one or other of these groups, with few mixed assemblages. Sherds in this category whose precise identity was uncertain were assigned to Form 20. One of these (no. 123) is decorated with applied scales which are more closely spaced than those found on the Early Rounded jugs (eg nos 120, 121), and which resemble those found on the contemporary Kingston-type ware (see below, Section 8.2).

Jugs with a decorative scheme in white and red applied slip or clay on a red body and under a clear glaze, ie. with no copper as a colourant, are termed *Rouen-style* (Form 21, nos 142–147) in recognition of the close parallel between these jugs and those found in Rouen (Barton 1966; Pearce *et al* 1985, 24; 28–29). The most common form is a small baluster jug with a cylindrical neck and angular base, often embellished with wheel-thrown cordons. The decoration generally consists of a central band divided into repeating geometric motifs, with a separate scheme for the neck; the lower part of the body is usually left plain. One very worn jug, no. 148, is unusual for London-type ware in that the decoration includes applied rosettes in white clay, but this style of decoration is known in Northern France (Nicourt 1986, 263, nos 4, 7). Spouted jugs with Rouen-style decoration, such as no. 147, are very rare.

Jugs decorated with applied red and white clays under a green glaze coloured with copper are termed *North French-style* (Form 22, nos 149, 150). A wider range of forms was produced than in the Rouen-style, but the small baluster form is the most common, either with the same angular profile as the Rouen-style jugs, or with a smoother profile. The decorative schemes normally consist of repeating geometric motifs such as alternating vertical and wavy lines or other similar patterns which cover the whole body from just below the rim to the base (Pearce *et al* 1985, 24; 29).

Other vessels in this group are *Large Rounded jugs,* usually with thumbed bases; one example has Rouen-style decoration (Form 27, no. 154), others have North French-style or simple geometric designs in white clay (both classed as Form 24). It is possible that nos 152, 153 and 159 all derive from the same vessel, a Large Rounded jug of Form 24 or 31.

Similar in shape to Forms 24 and 27, but with a quite different and highly original form of plastic decoration is fig 28, no. 175. The lower half of this zoomorphic jug is complete and the greater part of the handle survives intact; the neck and rim are missing. The applied decoration comprises a frieze showing a lion, two mythical creatures (griffins or wyverns) and two birds, which are arranged so that the head of the first 'griffin' is directly opposed to the handle (for a schematic representation of the frieze see Dunning 1968, 43, fig 17; Herteig 1969, 163). The modelling is in the same clay as that used for the body of the pot, with no trace of any slip surviving. The outer surface of the jug is very worn (see also Sections 6.6, 10.2, Period 5); much of the glaze has been lost and the definition of the figures, while sharp in some places, is poor in others, especially on the central 'griffin' and bird to the left of it. The strap handle, which is in relatively good condition, has an applied strip which has been slashed to give a plaited effect; below this are vertical rows of applied pellets of clay with one or more round impressions in them.

This jug was compared by Dunning to a devolved Rouen-style polychrome vessel with rod handle from the Surrey kilns, found in London and published by Rackham (1948, 26, pl B). However, a better parallel in the same volume (not quoted by Dunning) is a jug from Earlswood with applied decoration of a stag hunt (*ibid*, 27, pl 61). This has a plain base rather than a thumbed one, while the applied decoration is in a white clay, but the form and strap handle are otherwise very like the Bergen example. The best parallels from London itself are sherds from two jugs from the Billingsgate excavation, which are decorated with applied birds, again modelled in white clay (Pearce *et al* 1985, 31; fig 57, nos 227–229). Another close parallel is a large rounded jug found in 1987 in a thirteenth-century ditch at Carter Lane/Pilgrim Street in London. The decoration comprises an applied frieze of rampant lions within 'Rouen-style' triangular zones defined by diagonal strips, all modelled in the same clay as the pot itself. On this evidence, and the presence at St Denis, France, of some very highly decorated polychrome jugs with applied floral and zoormorphic decoration (Nicourt 1986, 263, no. 6) it seems likely that the various zoomorphic jugs from the London area, like the other forms described above, were inspired by similar jugs produced in the area of Rouen and Paris (Pearce *et al* 1985, 133).

Applied plastic decoration is also found on two other sherds (Form 28, nos 155, 156); of these no. 155 shows the right eye and eyebrow of a creature, while no. 156 has part of what appears to be an arm. These appear to be part of a distinctive sub-group, although the body form and other features may be the same as those on other types of jug.

Unillustrated types in this group include small *Pear-shaped jugs* (Form 25) where the maximum girth is significantly below the midpoint, and *Squat jugs* with North French style decoration (Form 26), where the maximum girth is as great as or greater than the height (*ibid*, 24). In London, the former type starts in the early thirteenth century, but seems to continue into the late thirteenth/early fourteenth century.

6.4.4 Later jug forms (fig 26)

A third phase of jug forms and decoration recognised in London is also present in Bergen, but in much smaller numbers. By this stage (in the second half of the thirteenth century) Rouen-style jugs had gone out of fashion, but green-glazed jugs continued to be made in forms similar to those used previously. Some new forms and techniques were introduced, such as the *Conical jug* (*ibid*, 24) and the use of copper to enhance the decoration on what was otherwise a plain lead-glazed vessel, but in the main it seems that there was merely a development of the earlier schemes, with a tendency to an increasing complexity of decoration (*ibid*, 29–31). Four forms found at Bryggen fall into this group. The first is the *Small Baluster jug* with complex decoration (Form 30, nos 157, 158). The second is the *Large Rounded jug* with complex decoration (Form 31), which possibly includes nos 152, 153 and 159 (see above, Form 24). The remaining types are *Squat jugs* with simple applied decoration under a plain lead glaze (Form 34) and *Pear-shaped jugs* with North French-style decoration (Form 33). The latter include no. 160, a spouted pear-shaped jug in a coarse sandy fabric with applied rouletted strips, stems and leaves on the body and thumbed dimples on the handle (cf Pearce *et al* 1985, figs 51, 53).

These highly decorated vessels usually form only a very small part of any London-type ware jug assemblage from London itself, and the majority of the later vessels are *Baluster jugs* (Form 32). The rims of these jugs develop typologically from a flaring rim on the earlier examples to an inturned 'tulip' rim on the later examples (*ibid*, 23–25, fig 37). Most such vessels are undecorated, but have a crudely applied slip and a splashed lead glaze which is usually clear, but which may have copper added as a colourant.

6.4.5 Other vessel types (fig 29)

Only a very few sherds of London-type ware are from vessels other than jugs. This is the same pattern as is found in London, and may or may not indicate the specific production of jugs for export. It is possible, however, that *Cooking pots* are under-represented in the Bryggen collection (Form 40, nos 161, 162), since they can be completely unglazed apart from accidental spots, and unglazed sherds would probably have originally been sorted as Diverse Sandy wares, which were not examined during the present study. Those cooking pots which were identified by the original researchers as London Brown are of similar size and form as those in the Shelly-Sandy ware.

Sherds from a maximum of seven *Pipkins* were found (Form 41, nos 163–166); these were normally more heavily glazed than cooking pots, and are thus more likely to have been recognized in the initial sorting. They have a variety of handle forms, including socketed (no. 164) and solid (no. 166). For further details of cooking vessels see Pearce *et al* (1985, 42–3).

Fragments of four *Lids* are present (Form 43, nos 167–170). These are probably contemporary with, and were probably used on, Early-style jugs; they are rare in London, and may have reached Bergen in a single consignment. All have a green glaze coloured with copper.

A single fragment of a *Bottle or Drinking Jug* was also found (Form 44: accession no. 89074). This class of vessel seems to have been more common during the third period of production (later thirteenth–fourteenth century), although examples have been found in London in earlier deposits (*ibid*, 40–41; figs 63–66).

No obvious bowls or dishes were recognised, but fragments of two *Chafing dishes* (Form 45, nos 171, 172), are of considerable interest since they include the first recognizable base to be published. This is very similar, both in terms of dimensions and in the applied anthropomorphic decoration to part of a chafing dish from the Billingsgate site in London (*ibid*, 44; 132; fig 73, no. 400). The latter, found in a context of apparently early thirteenth-century date, probably originally had three applied knobs in the form of human heads at regular intervals around the rim, linked by applied arms with clasped hands; the Bryggen example, which has a good green glaze, has arms and hands which stretch down the uprights between the cut-outs in the pedestal base. The rim sherd (no. 171) has a dark green glaze over an incised zig-zag line.

Another vessel with anthropomorphic decoration is represented by a single sherd from a *Miniature jug* (Form 47, no. 174). Such vessels range in date from twelfth to thirteenth century; they are often biconical in form (ibid 46; fig 77, nos 424–426).

Finally, there is a sherd which has tentatively been identified as part of a globular *Finial* (Form 46, accession no. 9571). These vessels are rare in London, but several types have been found (cf Pearce *et al* 1985, fig 78).

6.5 EVIDENCE OF USE

Only a very small proportion of the London-type wares show obvious evidence of use, or of reuse as cooking vessels, although since the bulk of the collection is contemporary with the Shelly-Sandy ware cooking pots this is perhaps not surprising. A few jugs, however, have traces of sooting or internal deposits which show that they were used for heating liquids in some way; the codes used for the different types of wear are noted below.

Jugs which were probably used to heat liquids when complete are represented by a sherds from a Rouen-style jug with internal sooting (no. 144) and one or two other wall sherds on which the sooting or deposit does not extend over the broken edges (Wear code 5, eg accession no. 9047). Sherds from the few cooking pots and pipkins found also fall into this group.

A less well-defined group contains sherds which derive from vessels which could have been used for heating liquids either while intact or after breakage. Most of these have a yellow-brown 'furring' of the inner surface similar to that seen inside the Shelly-Sandy wares and presumably caused by boiling water (Wear code 7, eg no. 108; this group also includes sherds from cooking pots and pipkins). Some such sherds are also fire-blackened externally, notably a base sherd in LCOAR, which is covered with soot (accession no. 63540). Occasionally, however, a brown deposit was noted inside a vessel with a good external glaze which showed no evidence for sooting (Wear code 8); examples include both Early Rounded jugs (accession nos 4159, 20435, 85738) and a squat jug (accession no. 24904). A few sherds have soot deposits around the base only, but no internal deposit (Wear code 9, eg accession no. 62684); this may be due to the mulling of ale or wine over a griddle.

A few jugs were reused as cooking pots after breakage (Wear codes 1 and 7); these include accession nos 22561, 31427, 85362, and 88541. Five sherds with internal furring from one or more Early Rounded jugs reused as cooking pots were found in Gullskoen (see above, Form code 15).

A further possible use to which broken jugs could be put is as containers. This was not noted in the Bryggen assemblage, but has been observed in Trondheim, where the lower part of a London-ware jug was adapted (?for use as a 'bucket') by trimming the broken upper edge and drilling holes through it, presumably for a thong of some kind (Reed 1990, 14).

No comparative figures for the frequency of traces of use or reuse are yet available from English medieval sites, but the impression is that there does not appear to be evidence for any higher amount of reuse in Bergen than on an English site. There is no reason to believe, therefore, that London vessels were more highly prized in Bergen than in London because of their scarcity. No vessels were seen which had been repaired, either with lead or wire. Both methods of repair are found on jugs of this period in England.

6.6 CONDITION

Most sherds are remarkably fresh in appearance, with a glossy glaze, sharp fractures and few traces of use. Because of this, and the suggestion that vessels might have been unused stock, or broken in transit, care was taken to record the slightest traces of wear which might help the interpretation of the material. Sherds which showed any sign of wear on the base or of chipping around the rim were noted (Wear code 2), together with any which appeared to be abraded (Wear code 3). The former include three of the lid fragments (eg nos 168, 169). The latter include some of the less highly fired jugs with applied decoration, where the glaze and surfaces may have been more susceptible (eg nos 119, 121, 148). One of the relatively few vessels which has indications of extensive use and/or post-depositional wear is the large zoomorphic jug no. 175. This vessel has lost most of the glaze on the side opposite the handle, possibly due to use, but perhaps because it had lain that way up in the ground. Various other sherds are also noticeably abraded, with battered or roughly rounded edges, although they would not merit comment on an excavation in London. None of the sherds examined, however, were waterworn; this suggests that they were buried soon after being discarded, although since the harbour area is not affected by tidal currents, movement under water would have been minimal.

Another feature of the glazed London-type wares, not recorded in this study, but worth noting here, is the particular metallic lustre which the glaze has often acquired. This was observed at the time of excavation, when a number of sherds appeared to be covered with a very thin blue powder. It was suggested by the excavator that this might result from a vivianite process caused by the high concentration of phosphorus in the soil (Herteig 1959, 182). This phenomenon has since been noted on finds from waterlogged deposits in Trondheim and in London, but not on dry sites, and may thus reflect a reaction of chemicals in the water with those in the glaze.

Finally, some sherds appeared to have been burnt after fracture (Wear code 4), but whether this was in a domestic hearth or in a conflagration cannot be ascertained. No heavily warped sherds were present, but these might not have been recognizable, and would thus be stored in the original fabric category of 'secondarily burnt sherds'. A cursory glance through this material confirmed that it would be impossible to reliably identify any sherd as a product from the London area.

7 The distribution of the London-area pottery

7.1 SHELLY-SANDY WARE

Since the Shelly-Sandy wares and the bulk of the London-type wares have similar periods of use, they should have comparable distributions across the site. Having introduced the two main London-area wares, we will now outline their chronological and geographical distribution on the Bryggen site. The overall trends, rubbish management and the redeposition of material are considered in Section 10.

Since the stratigraphic analysis of the site is still in progress, and also for the sake of conformity, it was decided to follow the method of presentation already established by Lüdtke for the early German pottery and other selected wares (including those from London) and to illustrate the distribution of the London-area pottery by means of the simple period plots based on the number of accession nos. per grid square (diags 1–8). Naturally, plots such as these do not show the configuration of the buildings and open spaces, but they are nonetheless a reasonable guide to the amount of refuse in a particular area or period.

However, the figures quoted by Lüdtke (1989, 32; diags 23, 24) for the London wares were provisional, and some differences have emerged. For example, a reassessment of the stratigraphy in the Bugården tenement has resulted in many finds first assigned to Period 5 being dated to Period 4 (Herteig 1990, 44–48). Since much of the pottery from these two periods comes from the Bugården tenement, this clearly has repercussions on the statistics used by Lüdtke. Other differences are caused by a reclassification of the material (eg some shell-tempered sherds were found to be from the East Midlands, not the London area), while the separate recording of sherds from different vessels which have the same accession number has led to an increase in the total accession numbers for each of the London wares. A further important point is that although the total number of ceramic accession nos quoted by Lüdtke for each period are now out of date, they have not been recalculated since they will certainly undergo further changes as work on the different wares progresses. The total accession nos and all percentages quoted below must therefore be treated as provisional, and until all the different wares have been studied and the real quantities of each type are known, the figures quoted by Lüdtke for the different periods remain valid as a guide to the overall proportions of the different wares in each period (see also Sections 2.3.4, 3.2 and 4.3).

7.1.1 The general distribution, by Period

The dating of Shelly-Sandy ware in London has been discussed above (Section 3.4). To recap briefly, until the mid-twelfth century this ware comprises a very small part of the London area pottery output. Between *c* 1150–1200 it represents a substantial proportion of all London pottery assemblages, but by the early thirteenth century it is less common, and by the mid-thirteenth century it is absent from the London assemblages, unless residual. The overall distribution of this ware between *c* 1170 and *c* 1332 is illustrated in Table 11, where the number of sherds is on the left, the number of accession nos. on the right in brackets.

Table 11 The main distribution of Shelly-Sandy ware (SSW).

Period 3 1170–1198				Period 4 1198–1248				Period 5 1248–1332			
O VII	=	5	(4)	O VI	=	342	(165)	O V	=	106	(54)
U VI	=	544	(190)	U V	=	522	(261)	U IV	=	16	(12)
I VI	=	9	(7)	I V	=	6	(6)	I IV	=	–	–
A VI	=	149	(34)	A V	=	36	(18)	A IV	=	–	–
Total		707	(235)			906	(450)			122	(66)
(Total accession nos after Lüdtke 1989:		3019				3508				6185	

Period 2 (diag 1)
Only seven sherds predate Fire VII (five accession nos). Four of these were found in the Gullskoen area: one to the east of the Phase 2.2 Kar 27 in Row 4 (Herteig 1991, 86) and three between two foundations. Another sherd was in the foundation of Kar 71 in Engelgården (Herteig 1990, 90–92), and the last two were found in the area of Kar 41 and 42 in Søstergården (*ibid*, 123–24; fig 90).

Four sherds (two accession nos.) were found in the Fire VII horizon (including no. 56). They are from grid squares N04 (three burnt sherds) and O02 in Gullskoen.

According to Lüdtke, Shelly-Sandy ware represented 5.43% of the pottery in Fire VII (seven out of 129 accession nos) and 3.48% of all the pottery in this Period (Lüdtke 1989, 29; fig 8; diag 23). These figures, however, are rather lower: 1.55% for the fire layer, and 0.69% for the Period as a whole. In itself this evidence is insufficient to prove that Shelly-Sandy ware was being exported to Bergen at this time. However, the proposed date of 1150–1170 for Phase 2.2, agrees well with the period when this ware was gaining in popularity in London, while the bulk of the pottery found over Fire VII or under Fire VI should derive from Period 2. The presence of a well-stratified sherd in Kar 71 is thus good dating evidence for this structure, and it seems likely that Shelly-Sandy ware was reaching Bergen in increasing amounts from *c* 1165–1170 onwards.

Period 3 (diag 2)
Only five sherds were found directly over Fire VII. Of these, four were found in Gullskoen: one to the south of the Period 2 Kar 30 in the passage between Rows 3 and 4 (Herteig 1991, 86) and the others in grid squares N06 and P04 (no precise location). The last sherd (no. 10) was found in Engelgården, on the same level as log course 5 in Kar 68 (Herteig 1990, 88).

After this, there is a dramatic increase in the amount of Shelly-ware, with 544 sherds found under Fire VI (dated to *c* 1198); sherds from 34 vessels have been illustrated. At present 6 sherds (6 accession nos) have been assigned to Phase 3.1 (including nos 51 and 54), while 445 sherds (90 accession nos), including nos 6, 14–15, 29, 44, 46, 48, 50, 66, 68, 74, 79, 80, 86 and 99, have been assigned to Phase 3.2. Most of the above were found in the dumped deposits behind the new quays, but a few were found under or in waterfront structures or buildings inland. The most informative sherds are listed below.

In Engelgården, two sherds were found in Kar 67 and one to the south of Kar 68 (Herteig 1990, 88). In Søstergården, nine sherds were found in Kar 111, another in Kar 77, and eight to the west of the Phase 3.1.1 Kar 113 (*ibid*, 116, 120). In Gullskoen, two sherds were found under Building 25 and another under Building 137 (both Row 3), while in Row 4 eight sherds were found under Building 35 and one in Building 135 (Herteig 1991, 72). In Row 5, five sherds were found in Building 37, one under Building 473 and one in it (*ibid*, 74–5). A further 25 sherds were found near these and other buildings in Gullskoen, while one sherd was found under Kar 1 in the quay fronting Row 6. In Bugården, 31 sherds were found in front of the Period 3 waterfronts under Kar 92 (which may belong to both Phases 4.2 and 5.1; see below). For a general plan of the waterfront area in Phases 3.1 and 3.2 see Herteig 1990, figs 91 and 92. All these sherds, and those found in the fire layer which ends this Period, are good confirmation of the late twelfth-century date of these structures.

Nine sherds (including nos 36 and 45) were found in the Fire VI horizon; these were all from contexts in Gullskoen or the area to the north of it. Usefully stratified material is limited to one sherd found in Building 135 in Row 4, and one over Building 63 in Row 5 (Herteig 1991, 72; 74: both assigned to Phase 3.2). One sherd was found in grid square P04, to the west of the much later structure Well 1 (Period 7), the remainder in grid squares MO5, NO4 and NO5 (no precise location).

Some 150 sherds (including nos. 11, 14, 26, 35, 60, 66, 73–74, 96 and part of no. 88) were found 'about' this fire horizon; of these three were in Kar 59 and six were under the later constructions of Kars 92, 100 and 101.

These figures are greater than those presented by Lüdtke (1989, 98), who calculated that Shelly-Sandy ware accounts for 6.16% of the total pottery in Period 3. This increase (7.78% of the total 3,019 accession nos.) is well in keeping with the London evidence, especially when it is remembered that most finds from Period 4 will be derived from Period 3, and it is possible that a large amount of London-area pottery was imported after Fire VII to supply the townspeople needing to restock their new homes. Some of the Period 3 sherds from along the waterfront may have been broken in transit (see Section 7.1.3).

Period 4 (diag 3)

Most of the 342 sherds found over Fire VI probably derive from vessels in use at the time of that fire. These include nos 5, 8, 18, part of 20, 25, 28, 32–33, 40–41, 43, 53, 55, 57, 70, 76–77, and 83. Further importation of this ware may account for some of the 522 sherds under Fire V (dated to *c* 1248), but again, the majority must derive from earlier deposits; sherds from 19 of these vessels have been illustrated. At present, 68 sherds (44 accession nos including nos 4–5, 17–18, 28, 40, 43 and 87) have been assigned to Phase 4.1; several of these were found under, or occasionally incorporated in, structures dated to Phase 4.2, but only two sherds (two accession nos.) have so far been assigned to that sub-phase. Almost all the Shelly-Sandy ware found 'over Fire VI' and approximately half that found under Fire V is from general excavated spits. A significant proportion of the latter, however, was found in or under structures, as listed below.

In Bugården, one sherd was found in the foundation of the Phase 4.2 Building 231 (Herteig 1990, 49–50), while in the waterfront area (grid squares I11, K11 and K12), five sherds were found under Kar 92, three in it and 27 adjacent to it, while seven were under Kar 101 and one in it. As noted above, the dating of Kars 92 and 100 is problematical; it is thought that these structures were first built in Phase 4.2, but that they were reduced in height and reused as the bases for Kars 93 and 101 in

Period 5 (Herteig 1990, 45–47; 58). Thirty-six sherds found under Kar 101 have been assigned to this Period.

In the North Row of Engelgården, four sherds were found under Building 371. In the South Row, five sherds were in Building 192, and 69 to the north of it, mainly in a passageway; two sherds were in Building 202, 25 in Building 232 and two under Building 349. By far the largest group is from the Phase 4.2 waterfront area, Kars 57–62 (grid squares I09, I10, K09 and K10) where some 40 sherds of Shelly-Sandy ware (including nos 19 and 82) were found in these structures, and 110 sherds (including no. 62) adjacent to them (*ibid*, 82–5). The contemporaneity of these deposits is confirmed by the presence of joining sherds found both inside and outside Kar 62 and in the area of Kar 57 (see 7.1.2, d and e). A considerable amount of other pottery from the London area was also found in this area (see below, 7.2.1). Two sherds were found under/in Kar 108, which overlay Kars 57–62.

Few sherds were associated with structures in Søstergården, but in Gullskoen a number of sherds were associated with Phase 4.2 structures: in Row 4, one or two sherds were found under each of Buildings 20, 21, and 61, and another in Building 222 (Herteig 1991, 59–62). In Row 5, one sherd was found under Building 31 and two in Building 32; further sherds were found around Buildings 32 and 211 (*ibid*, 62–64).

The debris of Fire V contained six sherds of Shelly-Sandy ware, including no. 93. One of these was found in Bugården (grid square L12, no precise provenance), the remainder in Gullskoen. The latter include one sherd found in the Phase 4.2 building 211 in Row 5 (Herteig 1991, 64), and one found under St Mary's Guildhall (Row 3, building 48) which has been assigned to Phase 5.1 (*ibid*, 49–50).

A further 36 sherds (including nos. 47, 97 and part of 87) were found 'about' the Fire V deposit in Bugården, Engelgården and Søstergården; the most usefully stratified comprise six sherds found under the Phase 5.1 Kar 101, three sherds found under the Phase 5.1 Kar 108, and two found in this construction (accession no. 18393).

While the number of accession nos. from the fire deposit is the same as that quoted by Lüdtke (1989, diag 23), the overall figures for this Period are now significantly higher (12.8%); according to Lüdtke, Shelly-Sandy ware accounted for only 5.9% of the total 3,508 accession nos for Period 4. This increase partly reflects an increase in the accession numbers for Shelly-Sandy ware, and partly a revision of the correlation of structures with the fire layers in Engelgården. It cannot be taken as a longer period of importation, but rather emphasizes the degree of residuality in this period. In England this ware should have been out of use for at least twenty years by the fire of *c* 1248, so that these sherds can only be used to give a *terminus post quem* for the contexts in which they were found. Nonetheless, the fact that so many sherds were incorporated in the rubbish used in the construction of Kars 57–62, confirms the London dating of Shelly-Sandy ware, while the presence of sherds under, in and around Kars 92 and 100 supports the hypothesis that these constructions span two periods.

Periods 5–8 (diag 4)

The small amount of Shelly-Sandy ware present after Fire V shows clearly that this ware had gone out of use in Bergen, and the cluster of sherds in/near the Phase 5.1 buildings 189, 191, 201 in Engelgården must be residual, as are the seven sherds found under Kar 101 (but see comments in 7.2.1); this group includes nos. 58, 59, 67 and part of 88,. The number of sherds over Fire V is almost one-fifth of that found under it, while only 16 sherds are listed as being under Fire IV, (*c* 1332). After this only 13 sherds (including no. 64) are from stratified deposits in the subsequent levels, the latest being found over the Fire 1 deposit (1702). The total SSW for

Period 5 represents 1.06% of the total 6,815 accession nos., rather less than the 3.95% calculated by Lüdtke (1989, 90).

7.1.2 The distribution of joining sherds of Shelly-Sandy ware

Several sherds were noted with different accession numbers which probably derive from the same vessel, but only stratified sherds which actually join are noted here. As far as possible these are listed chronologically according to the relationship with the fire layers. No cross-fits between tenements were found.

Periods 3 and 4
(a) In *Gullskoen*, three joining sherds from the same vessel were found in two different levels in grid square N04. Two sherds were found under Fire VI (ie deposited pre-1198): one (accession no. 54236) to the west of the Period 3.2 Kar 1, the other (accession no. 53783) under the north wall of the Phase 3.2 Building 137 (Herteig 1991, 72; 76). The third sherd (accession no. 54354) was found in the Fire V horizon (1248) to the south of the Phase 4.2 Building 31.

(b) In *Bugården*, sherds from a used cooking pot with thumbing on the rim (fig 19, no. 88) were found in two different levels in grid square I11: in a general fill 'about' Fire VI (accession no. 10305), and in a general fill below Fire V (accession no. 9944, 27 sherds).

Period 4
(c) In *Bugården*, 15 sherds from a cooking pot with thumbing on the rim (fig 19, no. 87) were found in excavated spit 166 under Fire V (accession no. 9474); these join with ten sherds found 'about' Fire V to the west of Kar 92 and on the same level as log course 8 (accession no. 4204).

(d) In *Engelgården* seven sherds from a cooking pot (fig 18, no. 72) found under Fire V to the west of the Period 4 Kar 62 join with six sherds found within the same foundation structure (accession nos 20394, 20165; Herteig 1990, 84–5); all are on the same level as log course 16.

(e) Also under Fire V in *Engelgården* (grid square I10), one sherd from spit 544, joins with two found to the west of the Period 4 Kar 57 (accession nos 20675, 21408; *ibid*, 84–5).

Other
(f) A group of twenty sherds from a large, possibly unused, cooking pot found under Fire V in spit 544 (grid square I10) joins with sixteen unstratified sherds.

7.1.3 The distribution of vessels showing no evidence of use

The distribution of potentially unused Shelly-Sandy ware in Periods 3 and 4 was examined in the hope of confirming the suggestion that cargoes of pottery broken in transit, or that stores of unused goods damaged in fires might have been discarded directly into the harbour.

The evidence for use (sooting and/or food or other deposits) has been summarized above (Section 5.4; Table 8). Using the accession numbers as a measure, approximately one in three shows no evidence of sooting or deposits (*c* 255 accession nos). Of the *c* 215 accession nos. which are from Periods 3 and 4, one is externally leached, 11 have internal leaching indicating probable use as containers, while approximately one-third (*c* 70 accession nos) have leaching of both surfaces, probably due to weathering. Examination of the larger fragments with no sooting or deposits shows that not only were many of these vessels never used for cooking, but they also have no signs of wear on the base, which they would certainly have gained if used for other purposes around the house. Ignoring single sherds (which are often too small to determine accurately whether they were used or not) the distribution of groups of two or more 'clean' sherds with no evidence of internal leaching is as summarized below.

Period 3. Only one group of unused sherds was found in a Period 3 foundation structure (Kar 111). However, 28 groups (including fig 17, no. 66 and nine other groups with over ten sherds) were found in general excavated spits, many of which are associated with Period 3.2 constructions along the quayside in Gullskoen (grid square K06), Søstergården (spits 683, 684, 688, 692, 721, 724, 726, 730) and Bugården (spits 272, 312 and 318, plus six groups from under each of the Phase 4.2 Kars 92, 100 and 101). The latter are in grid squares I11 and I12, quite some distance from the line of the quayside (for a plan of this area see Herteig 1990, fig 92).

Since the dumps preceding the Phase 3.2 waterfront do not follow a fire, and only three of the above groups of potentially unused sherds are weathered (ie 10.7%), the pottery from these deposits is more likely to be goods broken in transit rather than stock damaged by fire or redeposited material, a theory which is supported by the frequent occurrence of groups of twenty or more sherds, an example of a nearly complete apparently unused vessel (no. 66), and scattered sherds from the same vessels. As a proportion of all the accession numbers, unused Shelly-Sandy ware is more common in the northern part of the waterfront area (nine groups, 130 sherds) than in front of the Bugården tenement (eight groups, 63 sherds), where used and unused sherds were mixed together. The different extents of the Period 3.1 waterfront and those of Periods 3.2 and 4 may, however, be a confusing factor here.

Period 4. The picture here is rather different, for although the number of groups of 'unused' sherds is higher (45 in all) these are generally smaller than those in Period 3, and 13 are weathered (ie 28.8%). Most sherds from over Fire VI are from general excavated spits in the area of the waterfronts, notably in Engelgården, spit 544 (four groups, of which three, including fig 13, no. 20, have over twenty sherds), and spits 546, 547, 551, 562, 568, 572, 588 and 643 (a total of 15 groups from grid squares I09, I10 and K09, seven with over five sherds). In addition there are three weathered groups from spits 671, 676 and 681 in Søstergården (grid square K08). Six groups from under Fire V are from spits: five in Bugården (170, 196, 202, 228 and 231) and one in Søstergården (681), but fifteen groups (ie *c* 33%) were found under, in or adjacent to structures (eg Kars 57, 61, 62, 92, Building 211; see above 7.1.2, c and d); these include the largest group, a substantially complete unused vessel (no. 3), found under the Phase 5.1 Kar 101. These distributions suggest that most of these sherds derive from vessels deposited in Period 3.

7.1.4 The distribution of sherds with unusual deposits

Of the seven sherds with pink internal deposits (see Section 5.4), six were found in Gullskoen: two (leached) sherds in Fire VI, in/over the Phase 3.2 Building 63 in Gullskoen (accession no. 72959), and four (accession no. 53781) under Fire V to the south of the Phase 4.2 Building 211, where evidence was found for some specialized activity (Herteig 1991, 64). Another sherd was found under Fire V in a passageway to the north of the Phase 4.2 Building 232 in Engelgården (accession no. 89384, grid square N10).

Two sherds with a thick yellow-brown coating, probably wood pitch, were also found in Engelgården. One was found in grid square N09 (no. 91, no precise location), the other under Fire V to the north of the Phase 4.2 Building 192 (accession no. 82971).

7.1.5 The distribution of leached and unleached vessels

The evidence for leaching has been summarized above (Section 5.5 and Table 9). The most striking feature of this aspect of the pottery is the large number of single sherds leached on both surfaces; internal leaching only is rare, while only one group is externally leached. Few sherds with internal leaching show no other sign of use; most have sooting or other deposits on one or both surfaces. Unleached sherds are the most common, but a high proportion of these have sooting or other deposits. The distribution of the clean, unleached pottery is virtually identical to that of the 'unused' vessels described above; the distribution of groups of two or more leached sherds in Periods 3 and 4 is as summarized below.

Period 3. Only one group is internally leached only (grid square L06, no precise location). Nine groups have both internal and external leaching, of which four also have sooting/deposits. Of the seven leached groups found in or near constructions, three were in the Gullskoen tenement: south of building 25, south of building 28, in Building 35, and in Fire VI in/over Building 63 (these have a pink internal deposit: see above). One was in Engelgården (south of building 200, grid square N09), and two in Bugården, under Kars 92 and 101.

Period 4. Nine groups have internal leaching only. Of these, five were found near buildings or foundations and one in a passageway. Twenty-one groups with both internal and external leaching were recorded, most of which were found under/in or adjacent to foundations or Kars. When all the sherds (both singletons and groups) associated with Kars 57–62 are considered together, the numbers of leached and unleached fragments are approximately equal.

To conclude, the presence of leached and unleached vessels in the same deposits implies that the environment in which the sherds were weathered was not that in which they were found. In the two Periods described above, leached sherds are in the minority, but there are differences in the overall distribution of groups of sherds. In Period 3, *c* 25% of the twenty-five groups of unleached sherds with no other deposits were found in, under or near structures; these must therefore have been buried soon after breakage. The remaining nineteen groups from general levels cannot have been on the surface long enough for their surfaces to be altered, but a few leached sherds found in or near buildings could have weathered on the site. In Period 4, unleached sherds probably include vessels broken or damaged during the fire of *c* 1198, and rubbish dumped into the harbour in the preceding phase (see above). In Periods 4 and 5 only two groups of leached sherds were actually recorded as being inside houses; most groups were associated with the foundation structures. These sherds probably derive from middens elsewhere in the town, which would have provided a mixture of weathered and unweathered material.

7.2 LONDON-TYPE WARE

7.2.1 The general distribution, by Period

The development of London-type ware in London has been described above. In brief, the first main phase of production dates from *c* 1150 to *c* 1200 and is dominated by Early-style jugs in both fine and coarse fabrics. The second dates from *c* 1200 to *c* 1250 and is characterized by jugs in the Rouen and North French style (almost entirely fine wares). The third dates from *c* 1250 until *c* 1350; there is a brief trend to more highly decorated wares, but the simple baluster jug typifies this final phase of the industry.

The chronological distribution of the stratified London-type ware in Periods 3–6 is summarized in Tables 12 and 13 (sherd numbers on the left, accession nos on the right in brackets). The typological composition of the assemblage for the period *c* 1170–1476 is illustrated in Table 14.

Table 12 The main distribution of London-type ware (LOND).

Period 3 1170–1198					Period 4 1198–1248					Period 5 1248–1332				
O	VII	=	13	(9)	O	VI	=	201	(156)	O	V	=	492	(284)
U	VI	=	252	(151)	U	V	=	404	(299)	U	IV	=	165	(111)
I	VI	=	6	(4)	I	V	=	16	(15)	I	IV	=	9	(7)
K	VI	=	1	(1)	K	V	=	3	(3)	K	IV	=	–	–
A	VI	=	43	(30)	A	V	=	62	(41)	A	IV	=	21	(6)
Total			315	(195)				686	(514)				687	(408)
Total accession nos (after Lüdtke 1989)			3019					3508					6185	

Table 13 The main distribution of Coarse London-type ware (LCOAR).

Period 3					Period 4					Period 5				
O	VII	=	2	(2)	O	VI	=	9	(9)	O	V	=	6	(6)
U	VI	=	85	(26)	U	V	=	40	(32)	U	IV	=	–	–
I	VI	=	–	–	I	V	=	–	–	I	IV	=	–	–
A	VI	=	4	(3)	A	V	=	1	(1)	A	IV	=	–	–
Total			91	(31)				50	(42)				6	(6)

Period 2 (diag 5)

Only five sherds of LOND and three of LCOAR were stratified below Fire VII (five and three accession nos. respectively), and only two sherds of LOND were found 'about' that fire horizon (two accession nos). Five of these sherds are from Early Rounded jugs. One was found to the east of Kar 68 in Engelgården, (part of the Phase 3.2 quay; see Herteig 1990, 88), and four in Gullskoen: one to the south of Building 38 (Herteig 1991, 91), one to the north of a footbridge (grid square 005), the others in grid squares N06, O06, P05. Also from Gullskoen are two undiagnostic body sherds, and a sherd from a Rouen-style jug (no. 145, found to the north of a street in grid square N05). This is of particular interest as the form would normally be dated to no earlier than the last decade of the twelfth century, ie after Fire VII, and when London-type ware was certainly reaching Bergen in some quantity. If securely stratified, this sherd must be from one of the earliest vessels of its kind to reach Bergen (see below); since sherds of similar form were found in later deposits in the same area, however, it is not impossible that this sherd is intrusive. The two sherds found 'about' Fire VII (one of Form 10, one unclassified), were also found in the Gullskoen tenement (grid squares N05 and N06).

The combined accession nos for London-type ware give exactly the same percentage as that calculated for Period 2 by Lüdtke (1989, diag 24: 0.99% of an estimated 1,007 accession nos). This low amount would suggest that either this type of pottery was only just beginning to reach Bergen when these deposits were accumulating, or that rubbish was not disposed of on the site.

Period 3 (diag 6)

A total of 406 sherds (226 accession nos, LOND and LCOAR combined) was recovered from the Period 3 deposits; this is slightly more (7.48%) than the sum calculated by Lüdtke for this period (6.7% of 3,019 estimated accession nos). The most common type is the Early Rounded jug, which on a sherd count represents *c* 90.6% of the identifiable fine wares (see Table 14) and 93.5% of the coarse wares; other forms in LCOAR comprise one sherd from an Early Baluster jug (Form 11) and one from a Large Squat jug (Form 12, possibly intrusive; see comments in Period 4).

The deposits immediately over Fire VII contained thirteen sherds of LOND, nine of which were found between the Phase 3.2 structures Kar 67 and Kar 68 in Engelgården (Herteig 1990, 88); five of these are from Early Rounded jugs, and one from a Rouen-style jug (no. 142). Four sherds were found in Gullskoen, one of Form 10, and three miscellaneous, including one (assigned to Phase 3.1) found under Building 33 in Row 4 (Herteig 1991, 72; 80). Also present are two sherds of LCOAR (both Form 10), found in the area of Kars 43 and 45 in Engelgården and Søstergården.

Most sherds found under Fire VI are from Bugården and Engelgården, but smaller amounts were scattered across Søstergården and Gullskoen. At present six accession nos, including nos 103 and 107 have been assigned to Phase 3.1 (five LOND, one LCOAR) and 50, including no. 127, to Phase 3.2 (four LCOAR, the rest fine). For simplicity, all the pottery from this horizon is discussed as one group. Many sherds are from general spits (eg nos 103, 107; see also Section 7.2.2, g; h), but a significant proportion was found in, under or near structures associated with the waterfront. Unless stated otherwise, the following are all Early Rounded jugs in LOND).

In Bugården, 56 sherds, including no. 112, were found under Kar 92, while twelve sherds were in spits 208, 218, 219, 221, 242, and 253, which ran under Kar 100 (both Phase 4.2 constructions). Three sherds were also found in spits 220, 224 and 248, which ran under the Phase 5.1 Kar 101.

In the north row of Engelgården, one or two sherds were found in each of Kars 56, 65, 66, 67 and 68 (see Herteig 1990, 85–6), while *c* thirty sherds were found in close proximity to these structures; these include nos 117 (see Section 7.2.2, m) and 131, and one of Form 11 found to the north of Kar 67. In the south row of this tenement, one sherd was found under Building 242 and another in it (*ibid*, 85–86). A few sherds, including no. 129, were also found near structures assigned to Phase 4.1 or 5.1.

In Søstergården, ten sherds (including one LCOAR) were found to the west of the Phase 3.1.1 Kar 113; one sherd was found in Kar 76, twelve (including two LCOAR) in Kar 111, and one in Kar 114 (all Phase 3.2, *ibid*, 116–117, 120; see also Section 7.2.2, i). In Gullskoen a number of sherds were associated with Phase 3.2 buildings (Herteig 1991, 71–5). In Row 3, three sherds (including two LCOAR) were found under Building 25 and eleven in a passage to the north of Building 24 (see also Section 7.2.2, j). In Row 4, five sherds (four undiagnostic) were found in Building 135 and one in a passage to the south of Building 35. In Row 5, one sherd was found under Building 37, and another under Building 63.

Other forms found in Bugården comprise four sherds from Early Baluster jugs (including part of no. 134; see also Section 7.2.2, l) and one of Form 22, found in unnumbered foundation. Other sherds from Engelgården comprise part of a pitcher (Form 16, no. 141) found to the west of the Period 2 Kar 71, and part of a spouted vessel (Form 17); a sherd from a North French-style jug (Form 22) was also found to the east of a drain cover in Gullskoen.

Six sherds of London-type ware were found in the debris associated with Fire VI in Gullskoen: four, found in a passageway and under Building 135 (see above, Phase 3.2) are of Form 10; another is from a Rouen-style jug (Form 21), found in grid square P03 to the east of well 13 (assigned to Phase 5.1). The sixth sherd was of unidentifiable form and has no precise location.

A number of sherds were found 'about Fire VI', nine of which (including three LCOAR) have been assigned to Phase 3.2 (see above). As above, these are mainly of Form 10 (including nos 102, 106, 120, 132), but also present are sherds from two Early Baluster jugs (including no. 133: see also Period 4 and Section 7.2.2, k), and an interesting group of sherds found in an eavesdrip to the north of the Phase 3.2 Kar 55 in Engelgården (Herteig 1990, 88). These comprise part of a North French-style jug, part of a lid, and three sherds from a chafing dish with anthropomorphic decoration (no. 172).

Period 4 (diag 7).

The longer interval between Fires VI and V than between Fires VII and VI is reflected both in the volume of London-type pottery and in the range of forms represented (fifteen different types: see Table 12 and below), which include a number of sherds typical of the first half of the thirteenth century. Following a reassessment of the stratigraphy, the combined total accession nos. for LOND and LCOAR now accounts for considerably more (15.3%) than the sum calculated by Lüdtke (1989, diag 24: *c* 7% of an estimated 3,508 accession nos. in this period).

As before, the group is dominated by the Early Rounded jugs (including nos. 101, 105, 108, 110, 111, 114–116, 119, 121, 124–126, 130, and sherds from nos 113, 117, 118), which on a sherd count represent 85.5% of the identifiable fine wares and 100% of the coarse wares. Most of these must have been imported and discarded in Period 3, but their presence, together with Shelly-Sandy wares, in/near waterfront structures or buildings is nonetheless important evidence which may help us to understand the formation of certain deposits. The Coarse London-type wares are less informative, but include four sherds in Building 202 and two in Building 232 in the South Row of Engelgården (all of Form 10), and a few other sherds scattered in/under Kars 92 and 100 in Bugården. The following comments refer only to London-type ware.

The broad distribution of LOND in this period follows the pattern observed for the Shelly-Sandy wares. Most sherds found over Fire VI are from general excavated spits; 32 sherds were scattered near Period 3 contructions, but only 15 were found in Period 4 Buildings (202 and 232 in Engelgården, South Row). By contrast, approximately 67% of the pottery found under Fire V (*c* 270 sherds) was found in, under or near structures; sherds from the same vessels (eg no. 105) found in different Period 4 deposits indicate, however, that they were mostly laid within a short space of time. Almost all the identifiable pottery is of Form 10; the few other types are noted where appropriate in the following summary.

Taking these two groups together, a few sherds were found near the Phase 3.2 and 3.2.1 waterfront constructions Kars 90, 91, 53, 54 (Bugården), Kars 55–56 (Engelgården) and Kar 111 (Søstergården); these include one sherd of Form 27 and one from an Early Baluster jug (no. 133; see above and Section 7.2.2, k). A few sherds were also recorded as being found under the following Phase 5.1 constructions: Buildings 48, 192 and 261, Kar 101 and Kar 108; the latter (19 sherds) are not reliably stratified (Herteig pers comm).

The most useful sherds are those found beneath, in or adjacent to structures forming part of the Phase 4.2 waterfront: Kar 92 (9 sherds), Kar 100 (20 sherds, including no. 108 and three sherds of Form 11) and Kars 56–62 (over 100 sherds). The latter group includes nos. 121, 126 and 135 (Form 12), and other sherds of Forms 12, 22 and 40. Sherds from the same jugs, including no. 105, were also found in both tenements (see Section 7.2.2, p; q). Numerous sherds were also scattered beneath, in, or near other Phase 4.2 constructions: Buildings 230, 231, 235 in Bugården (9 sherds in all); Buildings 192, 202, 232, 233, 234 and 371 in Engelgården (72 sherds); Building 125 in Søstergården (1 sherd) and Buildings 20, 29, 31, 32 and 60 in Gullskoen (12 sherds). The sherds from Engelgården include part of an Early Baluster jug (no. 134, see above and Section 7.2.2, l).

While few of the other more diagnostic forms which could be used as dating evidence appear to be usefully stratified, there are nonetheless changes in the general composition of this group which deserve attention. Of significance is the first appearance of the Baluster jug (Form 32), and two types of Squat Jug (Forms 12 and 14: eg nos 135, 138, 140), of which the former accounts for 3.9% of the identifiable material. In London it has been suggested that forms such as the Squat Jug may have been produced by local potters in response to the Rouen-style vessels, since both have decorative elements in common (Pearce *et al* 1985, 131–132). It is to be expected, therefore, that Form 12 would appear soon after the first occurrence of Forms 21 and 22. The Rouen-style sherds include part of no. 148, a sherd found under Kar 108 in Engelgården and another under Building 261 in the South Row of Bugården (both Phase 5.1 structures; see Herteig 1990, 43 and 80–81). Form 22 includes no. 150 (found under a passageway in Bugården), two sherds found in the area of the Period 3 Kar 57, and three found under Kar 108.

The Baluster jug (Form 32) is represented by nine sherds recorded as found under Fire V, south of a passageway in Engelgården (grid square M10, no precise locations). The baluster form is long-lived, but this example (accession nos. 82024, 82133 and 84020) has a 'tulip' rim (cf Pearce *et al* 1985, fig 37, no. 126) and should date to the later thirteenth or fourteenth century: ie these sherds would not be out of place in Period 5, but are unexpectedly early in deposits dating to pre-1248. Other forms include part of a Zoomorphic jug (no. 155), one or two Squat Rouen-style jugs (including no. 154), two Pipkins (nos 163, 165), four Lid fragments (nos 167–170), part of Drinking Jug(?) and part of a miniature Anthropomorphic Jug (no. 174).

Sixteen sherds were found in the debris of Fire V, dated to *c* 1248. These include ten sherds of Form 10, one of Form 12, two of Form 21 and one of Form 22 (no. 151). Pottery found under/in Phase 5.1 structures includes: one sherd of Form 10 in St Mary's Guildhall (Building 48 in Gullskoen); two sherds of Form 10 and one of Form 12 in Building 189 (Engelgården); two sherds of Form 10 in Building 201 (Engelgården). The 63 sherds (including one of LCOAR) found 'about' this fire horizon are mainly of Form 10 (eg no. 101), but include five of Form 21 (including part of no. 144), two of Form 22, one of Form 24 and one of Form 40. Of these, four were found in Kar 100, three under and one in Kar 101, and nine in Kar 108 (both Phase 5.1 structures), while most of the others were scattered around different Kars dated to Phases 3.2 to 5.1.

Period 5 (diags 22–25).

The amount of Coarse London-type ware in this Period is so small that it will not be commented on further. Of the 687 sherds of London-type ware found in Period

5 deposits (*c* 1248–1332), some 430 were found under, in or near buildings or waterfront constructions. Of these *c* 365 sherds are from contexts described as 'over Fire V', while *c* 65 sherds were found 'under Fire IV'. At present, approximately 165 sherds from these two groups have been assigned to Phase 5.1 and 27 to Phase 5.2.

The most significant groups are all from the Engelgården tenement, where over 60 sherds were found in the area of the Period 4 Kars 57 and 61, *c* 30 sherds in or near the Phase 5.1 Kar 108 and numerous sherds in or near the following Phase 5.1 buildings: Building 189 (68 sherds), Building 191 (65 sherds) and Building 201 (15 sherds). In addition, 94 sherds were found in/near the Phase 5.2 Building 199, while several were found in a passageway (grid square P10). In Bugården, smaller groups were found under/in/near Kars 92 and 100 (Phase 4.2), Kars 93 and 101 (Phase 5.1) and Kars 102 and 103 (Phase 5.2), and also around Buildings 216, 229. In Søstergården and Gullskoen few groups were associated with buildings. Several sherd links were noted in this Period.

This group (see Table 12) differs from contemporary deposits in London, where Early-style vessels had long gone out of use: here they still account for *c* 68% of the identifiable sherds (including nos. 104, 122), while Large Squat Jugs, Rouen and North French-style jugs (which include nos 123, 136, 137, 143, 146, 149 and parts of 144, 147, 148) account for a further 11.6%. Given that most of this material is concentrated in quite distinct areas, it seems that a considerable amount of material was displaced and redeposited on the same area of the site after Fire V, with additional rubbish brought in from pre-existing middens elsewhere in the town (see also Section 7.2.2, r; s; t; u).

Other form types are limited, but the later thirteenth-century date of the group as a whole is supported by the first appearance of Squat North French-style jugs (Form 26), highly decorated wares (Forms 23, 30, 31, including nos 152, 157, 158, 159), Conical jugs (Form 33) and plainer Baluster jugs (Form 32). Other types include Large Rounded jugs (Form 24, eg no. 153), part of a pipkin (no. 166) and the rim of a chafing dish (no. 171).

Nine sherds were found in the debris of Fire IV (*c* 1332). With the possible exception of sherds from two Baluster jugs, it is very unlikely that these were in use at the time of the fire (three sherds are of Form 10, one is of Form 40). Four sherds of Form 33 found 'about' this fire horizon in an eavesdrip to the north of Building 333 and to the south of Building 199 (Bugården) probably date to *c* 1300–1325.

Period 6.

The Period 6 deposits contained very little London-type ware (see Table 14). This was scattered across the site, and the only concentration within a structure is that in Building 172 in Engelgården (10 sherds). Significantly, Forms 10–12 are represented by only 26 sherds (including part of no. 137). By contrast, 16 sherds (including no. 156 and part of no. 147) are from Forms 20–30, and 16 are from Baluster jugs (Form 32). This suggests that some of the Period 6 pottery derives from contemporary refuse which had accumulated between 1248 and 1332, but that the importation of London-type ware on any scale had ceased by this date.

Periods 7 and 8.

By the suggested time of Fire III (1413), London-type ware was no longer being produced or used in London. This is reflected at Bryggen, with less than thirty sherds of London-type ware definitely found in deposits later than Fire 3. (It should be noted that this figure does not include sherds which have no relationship with a fire horizon.) All are types found earlier in the Bryggen sequence.

Table 14. The chronological distribution of stratified London-type ware by form and sherd count.

Code	Form	Period						
		2	3	4	5	6	7	8
10	Early Rounded Jug	3	270	496	414	24	9	
11	Early Baluster		7	7	3	1		
12	Large Squat Jug			23	21	1		
13	Very Large Rounded			1				
14	Small Squat			2	6			
15	Reused type 10			2	3			
16	Pitcher		8					
17	Spouted vessel		1					
20	Rouen/North French				5	6		
21	Rouen-style	1	5	12	33	3	1	9
22	North French-style		3	11	17			
23	Highly Dec. Baluster				36			
24	Large Rounded			1	7	3		
25	Small Pear-shaped					2		
26	Squat North French				16			
27	Large Squat Rouen			4				
28	Zoomorphic			1		1		
30	Highly Decorated				3	1		
31	Polychrome type 30				3			
32	Baluster Jug			9	22	16	2	
33	Conical type 30				19			
34	Squat					6		
40	Cooking Pot			2	4	1		
41	Pipkin			4	4			
43	Lid		1	3				
44	Drinking Jug?			1				
45	Chafing Dish		3		1			
46	Finial?				1			
47	Miniature			1				
00/01	Unidentified	3	17	106	79	8	1	
Total		7	315	686	697	73	13	9

7.2.2 The distribution of joining sherds of London-type ware.

Some seventy cases of joining sherds with different accession numbers were noted. Most are from Engelgården or Bugården, but some from other parts of the site. Many are from the same context or from general fills, or the locations are uncertain, but others are more useful. The most informative examples are presented here in chronological order (the alphabetical notation follows on from the Shelly-Sandy wares (Section 7.2.1); they are discussed in Section 10.2.

Period 3.

(g) In *Bugården*, five sherds from an Early rounded jug (Form 10, accession nos. 10146, 10147) found under Fire VI in a general spit (219) under Kar 100 join with four sherds found 'about' Fire VI under Kar 101 (accession no. 10153).

(h) In the same area of *Bugården*, two joining sherds of Form 10 were found under Fire VI in spits 232 and 248 under Kar 101 (accession nos 10247 and 10352).

(i) In *Søstergården* (South Row), three joining sherds of Form 10 were found under Fire VI in grid squares L08 and K08: one to the west of the Phase 3.1.1 Kar 113 (accession no. 36041), one in the Phase 3.2 Kar 111 (accession no. 35578), the third with no precise location.

(j) Two joining sherds of Form 10 were also found under Fire VI in *Gullskoen* (Row 3), one under Building 25 (accession no. 62684), the other to the north of Building 24 (accession no. 63198), which was situated to the rear of Building 25 (see Herteig 1991, 71–72).

Periods 3 and 4.
(k) In *Bugården* (North Row), one sherd from an Early Baluster jug (no. 133, accession no. 18132) found over Fire VI to the west of the Phase 3.2 Kar 91 joins with two sherds found 'about' Fire VI under Kar 54 (Phase 3.2.1; accession no. 18145).

(l) Three sherds of Form 11 (no. 134, accession nos. 89441 and 89625) found under Fire VI in an unnumbered foundation in grid square M11, which spans both *Bugården* and *Engelgården,* join with five sherds (accession nos 88641, 88643 and 88644) found in the same grid square to the west of Privy 233 in the South Row of *Engelgården* (Herteig 1990, 81).

(m) In *Engelgården,* 16 sherds of Form 10 (no. 117) were found in three locations under Fire VI: to the west of Kar 68 (Phase 3.2, North Row; accession nos 85730, 85751), and to the east and west of Kar 58 (Period 4, South Row; accession nos 85683 and 84869). These join with a sherd found under Fire V in the Period 4.2 Building 232 (also in the South Row; accession no. 89607), and with five other sherds with no precise location.

Periods 3 and 5.
(n) In *Bugården* (North Row), 9 sherds of Form 10 found 'about' Fire VI under the Phase 4.2 Kar 100 (accession nos 9980, 10044) join with 6 sherds found over Fire V. Three of these (accession no. 9906) were found under the Phase 5.1 Kar 101, which was constructed on/over Kar 100; the others have no precise location).

(o) In *Engelgården, 38* sherds of Form 10 were found in three different constructions on both sides of the tenement. The earliest sherd (accession no. 84760) was found in the Phase 3.2 Kar 66 (North Row). The remainder were found in Period 5 deposits, 14 over Fire V in the Phase 5.1 Building 189 (North Row), and 23 over Fire V in the Phase 5.2 Building 199 in the South Row (accession nos. 84461, 84686 and 84710; and accession no. 84742 respectively).

Period 4.
(p) Ten sherds of Form 10 (no. 105) were found under Fire V in the Phase 4.2 waterfront structures of two tenements. In *Bugården* (North Row), one sherd was found under the Phase 4.2 Kar 100 (accession no. 9763); the remainder were some distance away in Kar 57 in *Engelgården* (South Row; accession nos. 19935 and 19993).

(q) In *Bugården* (South Row), one sherd of Form 21 (accession no. 9234) found over Fire VI to the west of Kar 91 joins with two sherds from *Engelgården*, found to the east of, and in, the Phase 5.1 Kar 108 which spanned the width of the tenement: accession no. 17895 (under Fire V) and accession no. 18673 ('about' Fire V) respectively.

Period 5.
(r) In *Bugården* (North Row), two sherds of Form 24 were found under Fire IV, one (accession no. 11230) in Kar 102, the other (accession no. 8924) to the east of Kar 103 (both Phase 5.1 constructions).

(s) Several sherds of Form 21 (no. 143) were found under Fire IV: in *Engelgården*, one sherd (accession no. 17433) was in a foundation to the east of Kar 108; in *Gullskoen*, 6 sherds (accession no. 37773) were under an unnumbered foundation (grid square I05) and 4 were in/over the Phase 4.2 Kar 135 (Row 4; accession no. 37855). Three other sherds from the same vessel are unstratified, but probably also come from the Gullskoen tenement.

(t) In *Gullskoen,* 15 sherds of Form 10 were scattered to the south of the Phase 4.2 Building 17 (Row 5, accession nos 72500, 72521 and 74620), under and to the east of the Phase 5.1 Building 31 (Row 4, accession nos 72015, 72020 and 72482), and to the west of a passageway (accession no. 74468).

Periods 5 and 6.

(u) Four sherds of Form 21 (no. 147) were found in four locations in *Bugården*. The earliest was found over Fire V in the eastern part of Building 261 (North Row; accession no. 3528). Two were found under Fire IV, one under a passageway to south of Kar 103 and one in a passageway to the north of Kar 95 (accession nos 9047 and 3233; both Phase 5.2, North Row and South Row respectively). The latest sherd (accession no. 2054) was found over Fire IV within the Phase 6.1 Kar 97 in the South Row (see Herteig 1990, 35–38).

8 Kingston-type ware

This medieval whiteware was not recognized during the original sorting of the Bryggen material, and does not figure in the quantitative analysis of the assemblage presented by Lüdtke (1989, fig 4). A fairly thorough search of all the categories of vessels with fabric descriptions similar to that of Kingston-type ware revealed only four sherds, thus confirming the true rarity of this ware in Bergen. Two sherds were found under Fire IV (1332), and should be broadly contemporary with the deposit in which they lay; one sherd found under Fire III (1413) should be residual.

8.1 FABRIC

The following is taken from the recently published analysis of the Surrey whitewares from excavations in the City of London (Pearce *et al* 1985). The clay used for this ware was imported to Kingston from quarries in the Reading Beds, a geological deposit which extends through Berkshire, Surrey and Hampshire. The fabric is generally off-white or buff throughout, but sometimes has a grey core; pinker examples are sometimes found. The inclusions comprise abundant well-sorted quartz (up to 0.5mm), which may be rounded or sub-angular, iron-stained, clear, milky, rose or grey; sparse to moderate black or red iron-rich compounds (up to 0.5mm); sparse angular white flint; sparse limestone; abundant flecks of mica (up to 0.1mm). Glazes may be clear, yellow or green; some jugs have a white slip under the glaze, while others have applied decoration in red (probably local) clay.

8.2 FORMS, DECORATION AND DATING

Kingston-type ware is the earliest of the Surrey whiteware industries, which started in the early-thirteenth century and which dominated the London market from the later thirteenth century until *c* 1500. It was produced at Kingston-upon-Thames, some 12 miles upstream from London (fig 9), where excavations have revealed the remains of mid-thirteenth-century kilns producing white earthenware jugs and kitchen wares. Production of similar vessels may have also been taking place in Southwark, on the south bank of the Thames opposite the City of London, although no kilns are known. For this reason, and also because of the close similarity of the fabric to that of other whitewares from the Surrey-Hampshire borders, the term Kingston-type ware is used by pottery specialists in England.

All Kingston-type wares were wheel-made; specific manufacturing techniques have been discussed elsewhere (*ibid*, 7–8). It is thought that the potters who first established the Kingston industry were from London, but the later generations were clearly inventive, and a wide range of vessels types was produced, some of which are unique to Kingston. Jugs appear in a number of forms, some similar to those produced by the London-area potters, some similar to those from Mill Green (see below), and some which have no parallels outside the industry. This ware first appears to reach London between *c* 1230 and *c* 1250, a time when Rouen-style and North French-style jugs were still being produced by the London potters, but when the more highly decorated wares and baluster jugs were becoming more popular. After *c* 1250 the highly decorated Kingston-type wares, which like their London counterparts were influenced by pottery styles in 'Northern France' (*ibid*, 38), filled a new gap in the market, and soon became the dominant ware in London; this situation continued until *c* 1350 when it was replaced by wares from the the Farnham area in south-west Surrey.

The evidence from London and Kingston suggests that the main jug forms and their broad date ranges are as follows. Pear-shaped jugs are present in the early assemblages of *c* 1240–1260, but then become a minor type. Conical jugs may span the entire production period, but are most common between *c* 1270 and 1360. Baluster jugs were produced from *c* 1240–1360, but different types peak at different times; metal copy baluster jugs, for example, are most common *c* 1300, and again *c* 1330–1360. Squat jugs appear around *c* 1270 and continue until *c* 1310, when they become less common. Rounded jugs are present as a minor type in early groups, but become more common after *c* 1280, and then continue through until *c* 1360. The miniature jugs probably date to *c* 1270, although they are found in assemblages up to *c* 1300; biconical jugs are a mid-fourteenth-century form.

The most distinctive sherd from Bryggen is from a jug with an applied all-over decoration of pellets or scales under a green glaze, giving the impression of a fir cone (accession no. 14771). This style of decoration, also found on London-type ware (cf fig 23, no. 123) was used on a variety of forms, including metal copy jugs and cylindrical necked baluster jugs, but on the evidence of vessel size and profile, the Bryggen sherd must derive from a rounded or squat jug (cf Pearce *et al* 1985, fig 70, nos 101–103; fig 73, nos 118–120); the well-formed and closely-spaced scales suggest that the latter is most likely. This is in keeping with the regularly spaced thumbing on the base sherd (accession no. 12720*), which is more like that found on the squat jugs than on the rounded jugs, which tend to have widely spaced thumbing or none at all.

Two other sherds from a large strap handled jug (accession nos. 26710 and 46851) have a white slip under the green glaze. The handle has a longitudinal slashing of the outer face giving a cabled effect. Within the typological framework outlined above, the Bryggen sherds would appear to date to between *c* 1275 and 1300.

9 Mill Green-type ware

This was previously described as West Kent ware, both in the south-east England and in Bergen. Recent research, however, has shown conclusively that it was produced at kilns near Ingatestone in Essex (Pearce *et al* 1982, 266–7; see fig 9). In the analysis of the Bryggen pottery presented by Lüdtke (1989, fig 4), it would appear that West Kent ware fills a whole storage tray, but in fact this is not the case; even before this study there were less than twenty sherds, and some of those have since been reclassified as London-type ware, so that the final total is less than ten sherds (five accession nos.) from two or three vessels. Since four accession nos. are 'over Fire IV' (1332), and one is 'about Fire III' (1413), most sherds should be broadly contemporary with the deposits in which they lay.

9.1 FABRIC

This ware has a very distinctive fabric which is extremely fine and micaceous, with very smooth surfaces. The following description is taken from an analysis of sherds found in London and Essex (Pearce *et al* 1982, 277–9). The clay matrix contains very fine quartz (0.08mm) with sparse to moderate fine mica, sparse iron ore, with occasional plagioclase felspar and organic matter; other inclusions, probably added to the clay to strengthen it, comprise sub-angular and rounded quartz and metamorphic quartz (0.28–0.8mm), and sparse flint. The fabric is normally brick-red in colour, but may have a reduced inner margin and oxidized outer margin, a sandwich firing with a reduced core and oxidized margins, or be completely reduced. The wall thickness is generally about 2–3mm and quite even.

A coarse fabric was also produced (*ibid*, 289–92); this was primarily used for cooking pots and other utilitarian wares, but was sometimes used for the handles of the fineware jugs in order to provide extra strength.

9.2 FORMS, DECORATION AND DATING

Mill Green ware started to reach the City of London around 1270; it was clearly popular in the late thirteenth and early fourteenth centuries, but was never a serious threat to the London potters or those in Kingston. Thus, although Mill Green ware is found on most sites of this date in London, it rarely accounts for more than 20% of the medieval pottery assemblages. All the Mill Green wares are wheel-made. Four main jug types are known: the conical or pear-shaped jug, the baluster jug, the rounded jug and the squat jug; all have strap handles, and most have thumbed bases. Other types such as polychrome vessels and miniature jugs were also produced in the fine ware.

The original Mill Green forms are the conical (either plain or with horizontal cordons) and pear-shaped jugs; the former is the most common of all the Mill Green products (*ibid*, fig 3; fig 4). The decoration comprises a white slip applied by hand over most of the body, extending just inside the rim, and stopping just above the base angle, into which groups of vertical lines were often incised with a three- to five-toothed comb (*ibid*, 285). The glaze is generally smoother and glossier than that of the London-type wares, suggesting that it was dusted on as a fine lead oxide or sulphide, with or without copper. Some of the Bryggen sherds may derive from this form of jug, although they are too small to be certain.

The baluster jugs appear in both small and large sizes; the profile may be gently curving (often with a devolved Rouen-style decoration), or more exaggerated, in the manner of the metal copy jugs produced at Kingston. Another fourteenth-century type is the rounded jug, which also appears to copy the Kingston and London forms. Neither the baluster nor the rounded jugs were as common as the conical jugs, or the later squat jugs, which appeared in the late thirteenth century and became the dominant type in the fourteenth century.

Squat jugs have a bulbous body with a width/height ratio which is approximately equal. The neck/rim profile is usually carinated as described above; the bases may be either thumbed or plain. Some examples are decorated in the same style as the conical jugs; these usually have a mottled green glaze of lower quality than that used in the thirteenth century. Others have a free design painted in white slip; these are either unglazed or have a clear glaze. At least two of the Bryggen sherds (one with a strap handle) derive from a large jug of this type (accession no. 5748). Two rims (accession nos. 13150* and 38850) probably also derive from squat jugs, although they may be from conical jugs.

To conclude, the presence of Mill Green ware in Bergen, and also in Trondheim (although not on the Library site), is of interest in confirming the widespread distribution of this ware *c* 1270–1325, but these jugs must have reached Norway as 'one-offs' alongside some other cargo; there is insufficient evidence to prove that they were ever traded in their own right.

10 Discussion

10.1 RESIDUALITY

Pottery is one of the most durable and most common of archaeological finds. It is also highly mobile, as any multi-period urban site will demonstrate. Nonetheless, the residuality factor continues to be underestimated by researchers anxious to establish a ceramic chronology.

The importance of taphonomy (the study of post-depositional transformations, or more simply, how an archaeological deposit came to exist), has been recognized as an essential part of post-excavation analysis at least since the work of Schiffer (1972). In Norway, where the problem of redeposition is particularly real, the question of artefactual representativity has been debated by Molaug (1989, 230–231), and most recently by Reed (1990, 11–27) with regard to the pottery from the Library site in Trondheim, where it was estimated that some 14% of the medieval sherds were residual in one way or another.

Nowhere is the relevance of such a study clearer than at Bryggen, where two factors serve to highlight this problem. Firstly, there are very few undisturbed cut features such as pits and wells offering closed and well-dated groups of finds. Secondly, due to the need to extend the habitable area after every fire, there was greater displacement, redeposition and introduction of new material than would normally be found on a land site with unlimited room for redevelopment and expansion. Other factors have been noted above.

10.1.1 Pottery from fire deposits

The importance of the fire deposits for the study of the Bryggen pottery was emphasised by Lüdtke (1989, 11–12; 30), on the assumption that the pottery found in them derived from vessels which were actually in use at the time of the fire. This phenomenon was described by Lüdtke as 'the Pompei effect', a term also employed by Molaug (1989, 232). If this were the case, then such '*de facto*' material which has entered the archaeological record without being discarded would undoubtedly enhance the significance of the pottery from these horizons, but the study of the London-area pottery showed that this hypothesis cannot be taken at face value.

Firstly, it has been calculated that only 9.4% of the total pottery assemblage is from fire deposits (Lüdtke 1989, 28; fig 7), as compared with 22% of the loomweights and 14% of the spindlewhorls (Molaug 1989, 237). Secondly, few sherds, even from the fire layers, show any distortion caused by burning (fourteen trays in the storage system, or 1.6% of the total 857 trays). Very little of the pottery found in fire deposits is from the London area, so that our interpretation may be biased, but no complete or near-complete London area vessels were present in fire layers, and the sherds found would appear to be part of an artefactual residue. That is, those objects which could be salvaged had been rescued from the site either before, during or after the fire (*ibid*, 232, 237; Reed 1990, 74), or were subsequently displaced, either as a result of the fire or during the next building phase. For example, in the 1972 excavation, the evidence for the fire which had destroyed Building 38 was found both at passage level and in a cellar into which the burning floor timbers had fallen (Harris 1973, 67). Indeed, some of the pottery from a fire layer may equally derive from earlier or later deposits (sherds of twelfth-century Shelly-Sandy ware were even found in the 1702 fire layer). No definite examples of intrusive pottery from later Periods were identified in the fire horizons themselves, but two cases were noted of sherds appearing in earlier deposits than would normally be expected. The first is a piece of Rouen-style pottery found under Fire VII, which was possibly trampled down during the next building phase; the second comprises a few sherds from a Baluster jug of fourteenth-century type found 'under Fire V' (1248) over a foundation in Engelgården, which may have slipped down through crevices in/beside the Period 5 wooden structures.

Another point to remember is the life-span of different types of vessel; as noted by Molaug (1989, 236) and Reed (1990, 14), cooking pots are regularly used, and are thus regularly broken and discarded, whereas less frequently-used fine wares may have survived for decades; this is illustrated by no. 175, probably made *c* 1225 which was discarded in a near complete state some 100 years later, after the fire of 1332. For all these reasons the pottery from a fire layer may not be truly representative (either in terms of type or quantity) of that in use at the time of the fire, and we would agree with Lüdtke (1989, 26) that the small amount of pottery in each fire deposit does not permit any reliable conclusions to be drawn from the horizontal distribution of the different wares. We must therefore consider the other ceramic evidence if we are to understand the Bryggen chronology.

10.1.2 Pottery from deposits between fires

Lüdtke (1989, 30) has argued that finds from the deposits between fires are unreliable for dating purposes, being on average one period older than the deposit in which they were found. However, if this phenomena is taken positively, ie applied to each ceramic group as a 'calibration', then certain chronological trends may be detected. Thus a Phase 5.1 dumped deposit, for example, should consist almost entirely of pottery used and discarded in Period 4, with little or no material dating to Period 3. An exception is the Fire IV deposit, dated to 1332 by documentary evidence, which in some areas lay immediately over refuse dumped at the beginning of Period 5 (shortly after 1248), which in turn contained artefacts discarded during Period 4 (1198–1248). Thus early thirteenth century artefacts may be present in a mid-fourteenth-century fire layer, while fourteenth-century material may have been trampled into the underlying deposit.

In principle, there are two ways in which the deposits created in the construction phases between fires might have been formed. The first involves the direct disposal of rubbish in the harbour, either from on board ship, or from Bryggen, although a by-law of 1282 indicates that this was forbidden in the later thirteenth century at least (NgL III.1, Helle 1982a, 208–09). This mechanism is mainly casual, and governed by individual motivation; some material disposed of in this way might be considered as 'primary rubbish' even though the findspot may not be exactly the same as that of the last place of use.

The second comprises the deliberate displacement and creation of strata as the site was levelled and extended into the harbour. The mechanism in this case is collective effort and involves the deliberate gathering, removal and redeposition of large amounts of soil (Herteig 1990, 47). It has been calculated (Herteig pers comm) that the volume of rubbish needed to extend the waterfront after each fire was so great that all the available sources of refuse would have been exhausted, particularly since a yearly cleaning up of the town was required by law. Middens situated elsewhere must have therefore have been utilised to supplement the infill material; finds from such a source comprise 'secondary' or even 'tertiary' rubbish.

The general distribution of the different types of London-area pottery wares, the presence of joining sherds in different contexts (over seventy cases), and the condition of the material, were all considered in the attempt to ascertain whether it was possible to distinguish between these two types of rubbish and elucidate the sequence of events on the site. The combined results of this study are summarized below.

10.2 THE DISTRIBUTION OF THE LONDON-AREA POTTERY

The bulk of the London-area pottery was found in Bugården and Engelgården, with smaller concentrations in Gullskoen, Rows 3–5. However, if the figures are compared with those for the distribution of all the pottery assigned to Periods 3, 4, and 5 (see Lüdtke 1989, diags 1–30), this density becomes part of the general concentration of wares of all types in this area. Given the large amount of residual material, differential preservation of the strata (inland from the harbour the archaeological deposits are thinner and in some cases have been completely removed by later activity) and the way in which the site was excavated, this might suggest that the spatial distribution of the pottery cannot clarify patterns of site use. A general study of the distribution of the Pingsdorf-type wares failed to find any concentration of these wares in any of the tenements, and it was concluded that this was the same for other pottery types (Lüdtke 1989, 52). A more detailed distribution analysis of the London-type wares, however, revealed that there was a quite specific concentration in Engelgården and to a lesser extent in the Bugården/Engelgården waterfront.

Period 2: pre-1170

Very little pottery of any kind was deposited on the site before Fire VII. London-area pottery is present, but in no greater quantity than any other ware. On the current dating of this pottery in London it is highly unlikely that organised export to Norway started before *c* 1150, and since Shelly-Sandy ware and London-type ware arrive together it is most probable that trading started a few years before the fire of 1170.

Period 3: 1170–1198

No London area pottery was recorded as coming from under or in Phase 3.1 waterfront constructions, although some sherds of London-type ware (several joining) were found in an unnumbered foundation in grid square L12 (possibly Kar 79). Shelly-Sandy ware cooking pots and London-type ware Early-style jugs were clearly imported, used and broken in Phase 3.1, but it seems that little was deposited on the site, except in the harbour. Much of the Shelly-Sandy ware from these Period 3 deposits is very fresh; the shell inclusions survive well, and some vessels appear to have been smashed *in situ* (eg fig 19, no. 88; see Sections 7.1.2, b; 7.1.5). It is not clear whether these vessels were dumped over the side of ships which had newly arrived in the harbour, or whether they were discarded, perhaps as unwanted stock, from the adjacent tenements, but some at least of the cooking pots had been used.

Some twenty sherds of both shell-tempered and London-type ware were deposited to the west of the Phase 3.1.1 Kar 113 in Søstergården (see Section 7.2.2, i).

The Period 3 waterfront constructions and associated deposits are quite complex, especially in Bugården, where the analysis of the London area pottery in 1989 led to a revision of the stratigraphic sequence. Both the Phase 3.1 and Phase 3.2 quays in this tenement subsided to such an extent that they had to be levelled up, raised and strengthened; the Phase 3.2 waterfronts were moreover reused as foundations for later constructions in Periods 4 and 5 (Herteig 1990, 43–47; 51–57; pl 1). As a result, sherds from the same vessels, some joining, were found under, in, and around not only the Period 3.2 buildings and waterfront structures, but also under later foundations in this area. In Bugården, a study of the distribution of groups of two or more sherds recorded in the levels in front of the Phase 3.1 waterfront (ie in grid squares I11, K11, I12, K12) showed that the vessels were mainly found in the top metre of deposits beneath the level of Fire VI, but running underneath the Phase 3.2 and 3.2.1 waterfronts, or those built in Period 4 (see Section 7.2.2, g; h; k; n; see also below). These sherds must either represent rubbish dumped during the latest use of the Period 3.1 waterfront, or have been dumped as a part of the preparation of the foreshore for the new structure. Sherd links were also noted between the Period 3 waterfronts in Bugården and other tenements, between Period 3 and 4 waterfronts in Engelgården (Kars 55/56, 65–69), Søstergården (Kars 77, 111, 113) and Gullskoen (Kar 1) and between waterfront structures and other buildings (see Section 7.2.2, i; l; m). Interestingly, virtually no sherds were definitely recorded as found under/in Kars 90, 91, 53 or 54 in Bugården; an exception is sherd link (k) listed in Section 7.2.2. In Phase 3.2, the fact that the sea-bed in front of the waterfront in Bugården was covered in a fine sandy silt *c* 50–60mm thick suggests that no rubbish was dumped in the harbour here for some time prior to Fire VI (Herteig 1990, 44).

The general pattern for both the Shelly-Sandy ware and London-type ware is very similar, and when the finds from the Period 4 dumps are taken into consideration, it is clear that the bulk of the London-area pottery was imported during Period 3, by the end of which time Shelly-Sandy ware should have been going out of use. At present it is not possible to demonstrate whether London-type ware was more or less common by the end of Period 3 than in the earlier deposits, but the range of forms becomes slightly broader. In Phase 3.2 most used pottery was probably disposed of on middens elsewhere, but some was thrown into the harbour, while some of the more diagnostic London-type wares, such as the early baluster jugs, spouted vessel, Rouen-style and North French-type jugs, lid and chafing dish may have been discarded on the site. The presence of such sherds in contexts dated to pre-1200 shows that the latest pottery fashions were reaching Bergen quite promptly, although the small amount of such material suggests that this may have been as personal property rather than as merchandise. It is currently thought that these forms were introduced to London in the last two decades of the twelfth century, so that these sherds fit well with the date of 1198 for Fire VI. The Rouen-style sherd found in Period 2 is more problematical; if it is not intrusive it is the most important dating evidence for that Period and arguably for this style of pottery in general.

Period 4: 1198–1248

This is the largest group of London-area pottery (some 1,600 sherds in all). The analysis of the use and condition of the Shelly-Sandy ware (which should have gone out of use by *c* 1225 at the latest) shows that most of this material was not fresh, but had lain exposed to the atmosphere for an unknown period of time; it was therefore probably brought onto the site with general rubbish from middens created during Period 3. Most of the London-type ware derives from Early-style jugs (some at least discarded in Period 3), and although the range of other types appears to increase towards the end of the Period, it seems likely that the actual volume of pottery imported reached a plateau early in Period 4, if not in Period 3.

Almost all the pottery from deposits over Fire VI is from general spits. Most of that found under Fire V is associated with constructions, which on the evidence of sherds from the same vessels found in different contexts, must have been built within a short space of time (see 7.1.1, d and e). Certain amounts of pottery were found beneath, in or near Kars 92 and 100 in Bugården; some of these may have been discarded in Period 3, but others may be contemporary since they join with sherds in adjacent deposits in Bugården and elsewhere (see 7.1.1, c; 7.2.2, q). The most important sherd link (see 7.2.2, p) shows that, as is to be expected, the Phase 4.2 waterfronts in Bugården and Engelgården (Kars 100 and 57) were probably constructed at the same time (Herteig 1990, 45).

The amount and distribution of the London area pottery (all ware types) found in Engelgården (Periods 4 and 5), both in the area of the Phase 4.2 waterfront (especially Kars 57–58 and 61–62) and in the buildings of the tenement, especially in the South Row, is such that it is tempting to see a particular English interest in this property, or a very specific source for the rubbish used in the waterfront dumps, although since this area was excavated over a long period of time by three different people, differential finds recovery and recording cannot be ruled out. Nonetheless, the presence of joining sherds which link Kars in Engelgården with other Kars, with dumped deposits, or with buildings dated to Periods 3, 4 and Period 5 suggest that the evolution of structures and strata in this tenement would repay further analysis using different pottery types.

Period 5: 1248–1332

Most of the London-type ware from Periods 4 and 5 is from 'under' or 'over' Fire V' (see Tables 10, 11: some 940 sherds in all). Noticeably less material was found under Fire IV. The London-type wares are still dominated by Early-style jugs, but this Period sees the widest range and highest sherd counts for most of the other form types, notably a variety of jugs in the 'North French' style, and the Baluster jug. As in Period 4 there is a marked concentration in Engelgården, with distinct groups of pottery found in or near buildings 189, 191, 199, and 201 (some perhaps derived from Period 4; see above and 7.2.2, q). The most useful 'cross-fit' for this Period relates building work in the area of Kar 108 in Engelgården to activity in the area of Kar 135 in Gullskoen (see 7.2.2, s). Sherds from a Rouen-style jug were widely scattered across the Bugården tenement (see 7.2.2, u).

The most striking find from this Period is a near complete London-type ware jug (no. 175), which appears to have weathered *in situ* after deposition on the site, as the glaze is quite fresh on one side, but is almost completely worn away on the other. This suggests that when discarded (in a general level over Fire V in Bugården) the pot originally lay at an angle with one side exposed to the elements. Other sherds, notably the Rouen-style jugs, are much less well-preserved than those found in Periods 3 and 4: the glaze has flaked away and the sherds are abraded. This confirms that, like the shell-tempered cooking pots, much of the London-type ware deposited in Period 5 was originally discarded and subjected to weathering elsewhere in Bergen.

Period 6: 1332–1413

Almost all the London-area pottery from this Period is residual, and although the sixteen sherds of Baluster jug, and possibly the sherds of Kingston-type ware and Mill Green ware, could have been discarded shortly after Fire IV, it is more likely that they were thrown away before this.

10.3 SUMMARY

To conclude, shell-tempered cooking pots and a range of glazed table wares from the London area seem to have first reached Bergen *c* 1160–1170. These wares rapidly gained in popularity during Period 3, but Shelly-Sandy ware probably went out of fashion early in Period 4. The importation of London-type ware probably reached a plateau in the early thirteenth century, and although the range of forms increases, the number of thirteenth-century types found either before or after Fire V is quite limited in comparison to the Early-style vessels; it seems, therefore, that the volume of material imported decreased rapidly after *c* 1220 and that the organised importation of London-type ware had ceased by *c* 1250, if not earlier (see Herteig 1990, 15).

From Fire VII onwards, every building phase was preceded by the dumping of rubbish deposits in the harbour basin (Herteig 1990, 45). Rubbish was also deposited randomly at other times. The distribution analyses described in Section 7 and above have shown that no London-area pottery was found in the Period 2 Kars, and very little in those assigned to Period 3, although some pottery was present in the dumped deposits around these constructions. Different sources of material may therefore have been used as infill. In Phase 3.1 some pottery was discarded directly into the harbour, but from Phase 3.2 most refuse was firstly disposed of on dry land, probably elsewhere in Bergen, and was only dumped at Bryggen as part of land reclamation following Fire VI (1198).

From this it may be suggested that in Period 2, and for much of Period 3, most rubbish disposal was haphazard, but that during the latter part of Period 3 some form of rubbish management was probably organised, with material being disposed of in such a way that it was readily retrievable for use as infill when required, as has been suggested for Trondheim (Reed 1990, 80). However, since there are no pits, it is possible that, as also suggested for Trondheim (*ibid*, 18) there were small short-term middens at Bryggen as households accumulated enough waste material to warrant a trip to the quayside or to a rubbish dump away from the buildings. It seems unlikely that these would be allowed to grow to any size, but they would account for odd sherds found in or under passageways and for the odd case of joining sherds from beside buildings and in the dumped levels (perhaps dropped while being transported from one place to another).

The absence of early twelfth-century London-area pottery from the Period 1 and 2 deposits at Bryggen may reflect many factors other than the date of the excavated deposits. The demise of Shelly-Sandy wares in Bergen, however, directly reflects the changing fashions in London, as a result of which production of this ware ceased. The arrival of North French-style vessels in Bergen also reflects the changing pottery market in London, but the small amount of these wares and near absence of later thirteenth-century and fourteenth-century London forms is more likely to reflect the change in trade (ie the increasing dominance of Grimston ware, and subsequently of the German wares), or at least the changing role of pottery in trade with England. The validity of this conclusion for other sites in Bergen and elsewhere in Scandinavia is considered in Part 3. With regard to the Bergen chronology, it may be concluded that on the whole the evidence supplied by the London-area pottery found at Bryggen confirms the London chronology, agrees with the conclusions reached by Lüdtke (1989, 31, 34) and lends further support to the site chronology proposed by Herteig (1985a; 1990, 12–19).

PART 3

THE BRYGGEN POTTERY IN THE WIDER CONTEXT

by

Lyn Blackmore

11 The historical background

11.1 ANGLO-NORWEGIAN TRADE

Before discussing the ceramic finds from Bryggen in their wider context, the main developments in Anglo-Norwegian trade will be summarized, with particular reference to Bergen. It is not intended to duplicate here the studies by Helle (1968; 1982a; 1982b) and Nedkvitne (1976; 1978; 1983), to which the reader is referred for more specific information. Other studies include those by Bugge (1898; 1914), Carus-Wilson (1962–63), Gras (1918), Rafto (1958), Herteig (1969, 151–174), Postan (1973) and Clarke (1983).

The main sites mentioned here or elsewhere in this report are shown in figs 9, 29, 30.

According to the sagas, Oslo, Bergen and Trondheim were all founded by kings, but each developed differently (Lidén 1977, 86). Bergen, said to be founded by Olav Kyrre (1066–93), grew rapidly and in the thirteenth century became not only the first capital but also the leading trading centre of Norway. Trondheim is arguably the oldest town, founded in the reign of Olav Trygvason (995–1000). In 1152/1153 Trondheim was chosen as the spiritual capital of Norway when it became the seat of the newly established archbishopric. The origins of Oslo are disputed; it was formerly thought that the town was founded by Harold Hardråde *c* 1050, but the archaeological evidence supports the development of a settlement from late tenth/early eleventh century (Christie 1966; Schia 1989). Although it was a bishop's seat and king's residence, the town developed slowly for the first 200 years, but in the late thirteenth century the area of the Oslofjord became the 'centre of gravity' of Norway due to its proximity to Denmark and S Sweden. This accelerated the growth of both Oslo and Tønsberg, to the extent that during the reign of Håkon V Magnusson (1299–1319) there was a bipartition of the functions of a capital between Oslo and Bergen. After 1319, however, both cities lost their importance as administrative centres when Norway became dependent on Denmark and Sweden.

Although there is archaeological evidence for Anglo-Scandinavian contact in the Late Saxon and Viking period, little is known about the mechanisms of trade as such (Helle 1982a, 304). Following the Norman Conquest relations between England and Norway appear to have been strengthened and by the twelfth century trade was well established (Postan 1973, 203). From the late twelfth century onwards there are documentary references to trade between the two countries, although most information dates to the fourteenth and fifteenth centuries. The early information is mainly recorded in the English Exchequer and Chancery enrolments (Helle 1968, 102). These include the Pipe Rolls (from 1165), the Patent Rolls (from 1201), the Close Rolls (from 1204), and the Liberate Rolls (from 1226). In 1275, changes in the English system of charging customs dues resulted in the Collectors' and Controllers' Accounts for different sections of the English coast, which run until 1565. These are to be found in the King's Remembrancer Custom Accounts (Public Record Office), together with other accounts such as the Enrolled Customs Accounts of 1303–1605 (Clarke 1983, 18). The volume of trade between Bergen and the east English ports has been quantified by Nedkvitne (1976; 1978; 1983) on the basis of the customs accounts of King's Lynn, Boston and Ravensere.

Changes in the nature of Anglo-Scandinavian trade were prompted by two main factors: firstly, the growth of the population in northern Europe from the eleventh century onwards, and secondly, the influence of religion on the weekly diet (Helle 1968, 102; Helle 1982a, 308). Together these created a new market for dried fish, which Norway was in a prime position to exploit. Once recognized, the potential of this trade was fully developed. The fisheries in the Lofoten Islands grew into a major industry, while smaller fisheries developed along the length of the north and west coasts of Norway. The cod was mainly marketed through Bergen, the main focus of the new trade, which soon developed to include other products. In the first half of the fourteenth century it is estimated that in addition to other fish, some 3,000 tons of dried cod were exported through Bergen each year, of which over 50% was bound for England (*ibid*, 308).

One of the earliest references to Anglo-Norwegian trade is to be found in the Orkney sagas of *c* 1200, which record that when Kale Kolson visited Bergen in 1127, 'there were many people from both north and south in the land, and many from other lands, who had brought many good wares hence'.

Another early reference to trade with England is dated 1186, when King Sverri thanked the English merchants for bringing wheat and honey, flour and cloth, and others who had brought linen or flax, wax and cauldrons (Carus-Wilson 1962, 187; Indrebo 1920, 110). At the same time the king bemoaned the influence of the German merchants, who by importing large quantities of wine into Bergen had not only brought drunkenness and misery to the people of the town, but had also much impoverished the country by carrying away large quantities of dried fish and butter, which could be exchanged for more essential items.

A few years later, when Bergen was visited by Danish crusaders in 1191, it was described as 'the most famous town in the land', packed with ships and merchants from all over northern Europe, including Denmark, Sweden, Greenland, Germany, England and Ireland, and so much dried fish that it could not be counted. Also on sale were honey, grain, fine clothing, silver and other merchandise (Gertz 1922, 475–6; Herteig 1968, 73; Herteig 1975, 66; quoted *in extenso* by Helle 1982a, 169). In the thirteenth century, Matthew Paris wrote that as many as 200 ships could be seen at one time in the harbour at Bergen (Carus-Wilson 1962, 191).

In 1217 the ties which had already been established between England and Norway during the reigns of Henry II and John (Helle 1968, 101–2) were reinforced when the young Håkon Håkonsson came to the throne and agreed with Henry III that there should be free trade between the two countries. There followed a period of close Anglo-Norwegian trade, and in 1223, after visits from Norwegian ambassadors, the English obligations were formalized in a letter patent issued in the name of Henry III, who undertook to protect the men and merchants of his beloved and special friend the king of Norway so that they could visit England freely in the course of their business.

For the next forty years Norwegian ships, mainly from Bergen, regularly called at ports along the east coast of England such as Grimbsy, Hull, Boston, Ipswich, and Kings Lynn (Herteig 1969a, 159), while English ships frequently visited Norway. Kings Lynn, which became the English equivalent of Bergen, was the outlet for the large amount of grain produced in the fertile hinterland, and also for the by-products of malt and ale. The true scale of export is unknown, but in 1224 five ship-loads of grain were destined expressly for Bergen. On another occasion eleven Norwegian ships were docked at Kings Lynn to load up with English corn (Carus-Wilson 1962, 185). Other English exports included cloth, wool, pottery, flour, herbs, honey, wine, leatherwork, fancy goods, and salt. In return Norway exported fish, dried cod, fish oil, birds of prey such as falcons and hawks, furs, litmus for dying cloth, and wood, the latter becoming increasingly important in the thirteenth century (Helle 1968, 105–6; Helle 1982a, 310, 312–314, 318–23). Archaeology has shown that stone was also shipped to England for use as hones. In addition to the exchange of commodities, the alliance between England and Norway also promoted a cultural exchange of ideas in courtly and religious affairs, notably art, architecture and literature.

During the reign of Håkon Håkonsson, trade between England and Norway grew rapidly. In the mid-thirteenth century however, changes began to take place when the supply of English grain became insufficient for the growing population of Norway. In 1250 a treaty of peace and commerce was signed by Håkon Håkonsson and the city of Lübeck, through which the king intended to supplement the English corn with grain and malt from the Baltic (*ibid*, 314–16). Together with other political factors at the time, this contributed to the emphasis of Norwegian foreign interests gradually shifting from the British Isles to Denmark and the Baltic trade (Helle 1968, 112–3), which Håkon Håkonsson wished to control; as a result the German merchants began to establish a greater presence in Bergen and other Norwegian towns, and to take a hold on Norwegian trade. In the latter half of the thirteenth century the German expansion of the fish market led to a marked increase in trade between England and Norway, but by this time most trade was carried out by the Germans (Helle 1982a, 385, Helle 1982b). From 1260 onwards merchants from Germany were wintering in Bergen alongside smaller groups of Dutch and English traders (Herteig 1968, 73; 1975, 66), and by the 1280s they had obtained various privileges which exceeded those granted to other merchants, foreign or local (Helle 1982a, 378–88; 472–83; Helle 1982b, 14–7). In 1292 the German position was further strengthened by the breakdown of the alliance between England and Norway caused by the war between England and Scotland (Helle 1968, 114).

Following the death of Håkon V Magnusson in 1319, and the political and economic changes which ensued, Norway became dependant on Denmark and Sweden, and Oslo and Bergen where forced to rely for their survival on trade. For Oslo and Tønsberg this was mainly with Rostock; Bergen, as noted above, already had a strong relationship with Lübeck, a leading town in the Hanseatic League.

The Hanse began as an informal trading network of Baltic towns, which expanded in the thirteenth century to include a number of West German ports whose merchants had acquired special privileges and/or established unions in other European countries. Two of the earliest such unions of German merchants were at Visby and London, where the term Hanse was first used to describe the right of merchants to form trading associations (Postan 1973, 192). By the mid-fourteenth century, the League, headed by Lübeck, had grown into a formidable political association which dominated the North Sea trade until the mid-fifteenth century when there was a decline, mainly due to competition from the Dutch. The main outposts of the Hanse, known as *Kontore* or Offices, were in London, Bruges, Novgorod and Bergen. In England there were smaller outposts in Hull, Boston, Great Yarmouth and Kings Lynn.

The Hanse Office in Bergen was established at Bryggen, which came to be known later as the German Wharf (see Helle 1982a, 730–87; 1982b, 18–20). According to Postan (1973, 200, 234) they were 'a kingdom within a kingdom, with their own laws and jurisdiction', so powerful that they almost succeeded in expelling the local merchants from their native port. Even after the Dissolution of the League in 1630 there was a strong German presence in Bergen until the mid-eighteenth century, although most of those who stayed on gradually became Norwegian citizens (Herteig 1968, 73; Herteig 1975, 66).

To summarize, documentary sources indicate that there were strong trading links between England and Norway in the later twelfth and thirteenth centuries. The actual volume of Anglo-Norwegian trade increased as the German influence grew, and peaked in the first half of the fourteenth century. There was a decline after the Black Death, and Anglo-Norwegian trade virtually lapsed in the fifteenth century when the English began to import fish directly from Iceland (Helle 1982a, 790–91). The English presence in Bergen has been discussed by Helle (1982a, 374–76, 788–92; 1982b, 24).

With regard to the pattern of trade between England and Norway, there is no reliable means of quantifying and comparing the relative importance of the different English ports in the twelfth and thirteenth centuries, although this has been done successfully by Nedkvitne (1983) for the fourteenth century, working from customs accounts. Thus the real level of contact between London and Bergen during the period 1150–1250/1300 is unknown; by the fourteenth century, however, direct trade between Norway and London was minimal, and it seems that Boston was the main centre of German trade between Bergen and England.

11.2 THE USE OF POTTERY IN MEDIEVAL NORWAY

Although pottery was widely produced in Norway in the migration period, the industry had almost died out by the Viking age, and for almost 1000 years there was no (known) indigenous pottery industry. All the medieval pottery found on archaeological excavations in Norway was thus first imported by sea and it was not until the late seventeenth century that local production was reintroduced (for example, at Trondheim; Reed 1990, 43; Reed forthcoming). However, although there are many documentary references to the various goods imported into Bergen, none are known which refer specifically to pottery, possibly because most vessels found in any quantity probably entered the country as an adjunct to trade in another commodity, for example, as containers for dry goods or for liquids such as honey and wine. References to traded pottery are also rare in other parts of Norway.

Throughout the medieval period pottery was used together with kitchen utensils and table wares of other materials: firstly stone, wood and leather; later, metalwork and glass, although it is likely that most vessels were multi-functional. The relative proportions of cooking pots in stone and pottery vary according to region and period. In the Viking and early medieval periods, cooking pots were mainly made of soapstone. It has generally been accepted that these were gradually replaced by pottery cooking pots in the twelfth and thirteenth centuries. However, a survey of the evidence for ceramic (unglazed blackwares) and soapstone cooking pots from excavations in Olso, Bergen, Borgund and Skien (Myrvoll 1983) suggested that in Oslo, Bergen and Skien, pottery vessels were in fact more common than those of stone before 1200, and that although the amount of pottery as a whole increases in the thirteenth century, this reflects the increase of ceramic table wares and other forms, rather than an increase in cooking pots (see also Molaug 1982, 204). After *c* 1200, therefore, fragments of soapstone cooking pots are either more common on these sites than ceramic ones, or the numbers are approximately equal. From this it was very tentatively suggested (*ibid*, 23), that (at least in some parts of Norway) the development of internal trade may have resulted in soapstone cooking pots replacing those of pottery from the early thirteenth century until the late medieval period, when metal cauldrons and their ceramic copies (imported from the Low Countries) became the most popular cooking vessels. Myrvoll concluded that there was insufficient archaeological evidence to allow any statements to be made on the relationship between cooking pots of pottery and stone, but subsequent work on the finds from Mindet's Tomt and Søndre Felt in Oslo has shown that the ratio of soapstone vessel fragments to sherds of pottery remains constant throughout the medieval period; this has been taken to indicate that soapstone vessels were the more common of the two (Molaug 1982, 207ff; 1989, 237). On the Library Site in Trondheim, it was again found that fragments of soapstone cooking pots were much more common than those of pottery in the deposits up to *c* 1275 (Reed 1990, 53; the Nordregate site, however, supports the accepted theory, with soapstone fragments dominant in the early levels, but a clear increase in the amount of pottery cooking pots during the period *c* 1175–1350.

The relative proportions of tablewares of different materials have not been analysed, but the proportions of different form types imported from Germany, social customs (such as the number of jugs used and the sharing of beakers) and the possibility of tablewares being imported as 'drinking sets' have been discussed by Lüdtke (1989, 55–9).

11.3 POTTERY AS AN ELEMENT OF NORWEGIAN TRADE

The sources of the medieval pottery imported into Norway vary considerably with time and according to the location of the site in question, but are dominated by areas bordering onto the Baltic and the North Sea: eastern and south-eastern England, the Low Countries, the Rhineland and Northern Germany. In Sweden and Denmark, however, vessel-types imported into Norway were copied locally, and the originals appear to be less common in excavated assemblages (Herteig 1959, 183).

The potential of pottery as an indicator of trade has long been recognized; in Norway, and specifically in Bergen, this potential is arguably greater than anywhere else in Northern Europe (Dunning 1968; Herteig 1968, 75–77; Herteig 1969a, 161–165; Lüdtke 1989, 59–62). The importance of the Bryggen assemblage was recognized as early as 1959, when it was observed that 'the frequency of the English pottery as compared with Continental pottery during this period (11th–15th centuries).. may give an astonishingly good picture of the alternating emphasis of mercantile contacts between Norway and these areas' (Herteig 1959, 181–4; 186). In this article Herteig drew attention to the similarity of certain wares to those found at the market of Borgund (Sunnmøre), and noted that the predominance of East Anglian pottery in the English wares almost certainly reflected the frequent visits made by Norwegian vessels to the English east coast ports such as Boston and Kings Lynn. The presence or absence of different pottery types, however, may reflect social factors as much as economic ones. The large numbers of Rhenish storage jars, jugs and drinking vessels found on the Bryggen site from the twelfth century onwards were seen by Herteig as a consequence of the Rhenish wine trade, whereas the abundance of Trichterhalsbecher, a form of drinking vessel from Siegburg which is rarely found in Sweden and Denmark, was interpreted as a reflection of drinking habits rather than differences in trade connections, the Norwegians preferring wine, Denmark and Sweden preferring beer. Wine was also imported from France, and pottery from the Saintonge (near Bordeaux) has been found not only on coastal sites such as Bergen and Trondheim, but also inland, for example at Skien (Myrvoll 1982, 183, fig 6).

At the close of the excavation in 1968, the importance of the ceramic assemblage was again stressed by Dunning (1968, 51), who stated that 'when the vast quantity of pottery found at Bergen is subjected to statistical analysis, the results are certain to throw a flood of light not only on the various sources of pottery traded by sea, but also on the relative amounts of pottery from these sources, particularly those in England, and their incidence at particular periods during the 13th and 14th centuries'.

Since the above observations on pottery and trade, ceramic research has advanced in Norway and across Europe. The three ceramic phases defined at Bryggen have been discussed above (Section 3.2). The work on the pottery from other sites in Norway is summarized in Sections 12 and 13, while some views on the way forward are offered in Sections 14 and 15.

12 The Bryggen pottery in the local context

12.1 MEDIEVAL POTTERY FROM OTHER SITES IN BERGEN

In addition to the Bryggen site, pottery has been recovered from excavations carried out by the Medieval Section of the Historical Museum on the site of St Lawrence's Church, and sites in Sandbrugaten, Dreggsalmenning and Vestlandsbanken, but this has not yet been sorted and even approximate figures are unavailable. Since 1980 pottery has also been recovered by the Riksantikvarens Utgravningskontor for Bergen from a number of sites elsewhere in the city (fig 2; see Section 3.2).

Seven assemblages have been selected for comparison with the Bryggen site. Of these, *Dreggsalmenning* is adjacent to the 1955–68 excavation; *Kroken 3* and *Øvregaten 39* are inland but near the Bryggen site, while *Stallen* and *Finnegården 6a* lie within the surviving area of warehouses on Bryggen; *Korskirken* and *Domkirkegaten* are situated at the head of harbour. The cooking pots of stone and pottery (blackwares) from four of these sites have been discussed by Myrvoll (1983), but otherwise the material has so far only been considered on a site by site basis, primarily as a dating tool. The following summaries are derived from various archive reports, and from discussion with Rory Dunlop. They should be read with the following provisos: firstly, in some cases the identifications and dating of the fire layers and of the pottery in them, are provisional. Secondly, the shell-tempered wares include material which may not be from London. Thirdly, as at Bryggen, there is a substantial body of 'uncertain' material. The pottery from these sites was not re-examined prior to this report. In the following, the numbering of Periods/Phases is in reverse order, ie. from the most recent to the earliest.

The most striking feature of these assemblages is their small size; the amount of pottery recovered, and particularly the amount of stratified medieval pottery, is considerably less than that from the Bryggen site in proportion to the area excavated. For example, the site at Finnegården 6a, which most closely resembles the Bryggen sequence of dumping and waterfront construction, produced 1,784 sherds, ie less than the total no. of sherds of London Shelly-Sandy ware from Bryggen. The identified wares are the same as those found on Bryggen, mainly from England and Germany; French wares are uncommon on all sites.

Dreggsalmenning, the site of the entrance to the underground carpark of the SAS Royal Hotel (excavated in 1979) yielded *c* 4,200 sherds, of which 3,464 were well stratified. Unfortunately, the material cannot easily be compared either with that from the excavations on the adjacent Bryggen site or from those excavated by Riksantikvaren, as the initial pottery classification followed the system used in Oslo (Marstrander 1983, 29–35; see below), so that it is not easy to compare the two sites. Moreover, the excavation was less deep than that on the main site of Bryggen, while the notation of the fire layers is alphabetical not numerical. On the ceramic and documentary evidence available at the time, it was suggested that Fire A = 1248, Fire B = 1332, Fire C = 1413, Fire D = 1476, Fire E = 1527.

The pottery is divided into three groups, each with various subgroups: I unglazed; II glazed; III stonewares. Group I was divided into two main sub-groups, early and later, with further divisions according to provenance. The former (I 1–7) appears after Fire A; these include some sherds (group I 6) which are ascribed to 'Southern England, London', but no further detail is given; these wares were dated to 1225–1275. The later unglazed wares (I 8–17) comprise both medieval and post-medieval wares from Germany and Denmark from stratigraphically later contexts. The stone and ceramic cooking pots from levels pre-dating Fire A to *c* 1527 have been compared by Myrvoll (1983, 19, fig 3). On a sherd count, pottery was found to be over twice as common as stone; on a vessel count, however, the ratio of stone to ceramic pots actually increases from the thirteenth century onwards.

Of the three main glazed wares, Group IIA (found in most layers until Fire B) comprises white wares, mainly Stamford ware, with Scarborough, French, Dutch and south Scandinavian wares. Group IIB includes both oxidized and reduced wares, mainly from Grimston, with Yorkshire, Lincoln and Toynton wares with some Dutch and Scandinavian pottery. This group is most common in phases between Fires A and B, being dominant from Phase 7 and disappearing in Phase 13 after Fire C. Group IIC comprises glazed redwares from Aardenburg, Holland, Skåne, and England (IIC 11, not identified by source). This group, which only appears after Fire A, is dated to after 1250.

It was concluded (*ibid*, 33) that English wares are dominant between Fires A and B (1248–1332), and then disappear abruptly; after this German wares are dominant. This date is earlier than that proposed by Herteig (1969, 112) who suggested then that the change took place after the fire of 1413 (Dreggsalmenning Fire C).

Kroken 3, excavated in 1985 (Dunlop 1985a), lies inland, just to the north-east of Bryggen. A total of 3,028 sherds were recovered, of which 924 are from medieval deposits (Phases 14 to 5). English medieval wares (from all phases) comprise 470 sherds, of which 35 are shell- tempered, and 11 are London- area jug sherds. Grimston ware accounts for 46% of all the English sherds (7.1% of the total sherds), followed by Scarborough and Humber-type. The pattern appears to follow that on Bryggen: in the twelfth century 35% of the pottery is Blue-Grey ware, while very little is English. After this English wares gradually increase as German wares decline; in Phase 8 (after the fire of 1248) Grimston wares become more common and remain the dominant ware until Phase 5. In the transitional late medieval/post-medieval group (Phase 4), dated to *c* 1400–1600, Grimston and Rhenish wares are almost equally represented, but the former may be residual. From Phase 3 English wares are rare.

Øvregaten 39, excavated in 1981 (Dunlop 1982b), lies just to the east of the Bryggen excavation, and a short distance to the south-east of Kroken 3. This site produced only 302 sherds, of which *c* 255 are from medieval deposits. English medieval wares (all phases) comprise 103 sherds, 34.1% of the total number of sherds; of these *c* 70% are Grimston, with York only 5.6%; only one sherd of shell-tempered ware and two of London-type ware were found. Little pottery was found in the early deposits, and English wares, Andenne, Pingsdorf-type and Blue-Grey ware are each represented by a few sherds only. The proportion of English to Continental pottery increases after a fire dated to 1225/1230 (on the evidence of Scarborough ware), and Grimston ware is dominant after the fire of 1248 in Phases 5 and 4; German stonewares and later earthenwares are poorly represented. Analysis of the cooking pots from the late twelfth century to *c* 1527 showed that very few pieces were present in the thirteenth - to fifteenth-century deposits, and that pottery outnumbers stone at all times;

neither type was found in the layers post-dating the fire of 1413 (Myrvoll 1983, 19, fig 5).

Svensgården, Stallen, excavated in 1980–81, lies within the remaining part of the Bryggen warehouses, just to the south of the 1955–68 excavation (Dunlop *et al* 1982). The earliest timber structures may have been foundations for buildings or associated with a raised walkway behind the quayfront, but the excavation did not extend sufficiently far west to locate any later waterfront features. This site produced 2,115 sherds, of which *c* 1,232 are from medieval deposits. English medieval wares (all phases) comprise 402 sherds, of which Grimston accounts for 60%, shell-tempered ware 1.24% (five sherds), and London-type ware 4.9% (twenty sherds). As at Øvregaten 39, very little pottery was found in the early deposits. Grimston wares appear in the early/mid thirteenth century; after the fire of 1248 (Phase 6) this is the dominant ware until the early fifteenth century (Phase 5). German stonewares become more numerous in Phase 5, and outnumber the English wares from Phase 3 onwards (later fifteenth century). Analysis of the cooking pots from the late twelfth century to *c* 1527 showed the same pattern as at Dreggsalmenning (Myrvoll 1983, 19, fig 4).

Finnegården 6a, excavated in 1981, lies to the south of Nikolaikirke-almenning, at the southern end of the present Bryggen wharf (Dunlop 1982a). This site produced 1,784 sherds, of which *c* 1,320 were well-stratified in medieval deposits. English wares from all phases comprise 494 sherds (27% of the total). Of these Grimston acounts for 54.6% (270 sherds) with only four sherds of shell-tempered ware and eight of London-type ware. The early deposits are mainly associated with the in-filling of a bay between this site and the promontory on which Korskirken was constructed. Later phases produced evidence for further dumping and waterfront construction in this area. In the later twelfth century (Phases 11–10) English pottery (mainly Stamford ware) and Continental types (Andenne, Blue-Grey and Pingsdorf-type) are more or less equal; in Phase 7, after a fire dated to 1225/1230 by Scarborough ware, Grimston ware is the most common type, and remains so until the late fourteenth/early fifteenth century (Phase 5) when German stonewares appear. After this all English wares are residual. Analysis of the cooking pots produced the same results as above (Myrvoll 1983, 19, fig 1).

The sites at *Korskirken and Domkirkegaten 6* both lie at the head of the harbour. The former produced 2,278 sherds, of which only 45 are from medieval deposits, mainly within a graveyard (Dunlop 1985b). English wares comprise 25 sherds, of which 1 is shell-tempered and 11 are Grimston ware. At Domkirkegaten, a total of 735 sherds were recovered, of which 438 are from medieval deposits (Komber *et al* 1987). English wares (all phases) total 225 sherds (30% of the total sherds), of which 16 are shell-tempered and 11 are London-type ware. The amount of general rubbish, and the low quantity of medieval pottery found on both sites reflects the fact that this was an industrial area occupied by shoemakers.

12.2 DISCUSSION

This summary of the pottery from other sites in Bergen shows that in general these assemblages conform to the three broad ceramic phases defined for Bryggen (see Section 3.2), although any comparative study is beset by various problems.

Firstly, the area of subsequent excavations and the number of sherds recovered is too small for statistical comparison. Secondly, sites inland such as Kroken 3 do not have the same degree of dumped deposits, and may have had a different function from contemporary sites on the waterfront; this will be reflected in the ceramic record. From Bryggen Period 3, and especially in an extended period between fires, it would appear that domestic debris was not only disposed of in the harbour, but also on peripheral sites away from the water, where we might expect to find pottery which is not well represented on Bryggen itself.

Thirdly, there is the problem of correctly identifying and correlating the different fire layers which occur in different areas of Bergen. As noted in Section 2.2, excavations at Finnegården 6a, Svensgården, Øvregaten 39 and Kroken 3 have all produced evidence for an undocumented fire which has been dated to *c* 1225/30, before the major fire of 1248 (Dunlop 1982a, 47, 51–2, 60–1; Dunlop 1982b, 32, 36, 49; Dunlop *et al* 1982, 38; Dunlop 1985a, 51–2).

Fourthly, the pottery has not been studied to a common standard.

However, the general trend is the same on all sites: German wares dominate at first, with a few English wares: Stamford, Developed Stamford, York and the London area. Grimston appears as a few scattered sherds on most sites in the early thirteenth century; it becomes more common after a fire dated to 1225–1230 on the basis of Scarborough ware, and is the dominant ware from *c* 1248 to the early/mid fourteenth century, representing 70% of all the English wares at Øvregaten, 60% at Svensgården, and 55% at Finnegården 6a. After this German stonewares begin to take over and most English medieval wares should be residual.

If another large site becomes available between Bryggen and the head of the harbour, it might be possible to plot any differences in the dumping pattern and the point at which this changes to that found in the area of Korskirken. This however, seems unlikely due to better fire precautions, the probable disturbance of archaeological deposits by eighteenth- and ninteenth-century buildings, and the fact that much of the crucial strata probably lie beneath the present road surfaces.

13 Medieval pottery from other sites in Norway

Having considered the ceramic finds from Bergen, the English pottery from recent excavations in Trondheim, Borgund, Skien, Tønsberg and Oslo (fig 29) will now be summarized and compared with the Bryggen assemblage.

13.1 TRONDHEIM

The analysis of finds from numerous excavations over the last 16 years is nearing completion. So far the pottery has been studied on a site by site basis, but it is now becoming possible to use these local assemblages to identify broad chronological horizons across the town and to define the chronological trends more accurately; this will be especially valuable since the excavated sequence extends back into the eleventh century. The following draws on final, interim and draft reports and discussions with Ian Reed, who has kindly provided most of the figures quoted below. Pottery from the London-area is confined to shell-tempered ware and London fine wares, both calcareous and the more usual red-brown ware; no eleventh or early twelfth-century sherds are present, which confirms their absence in Bergen, and most date to the later twelfth/early thirteenth century. No Surrey white wares or Mill Green wares have been positively identified. In the following the phases are numbered sequentially from the earliest (1) through to the latest.

Analysis of the finds from *Nordregate 1977* (Telephone Exchange) showed three main periods: 1000–1250; 1250–1500; 1500–1800 (Reed 1983, 66–80; Reed in prep; Lüdtke 1989, 23). The pottery was quantified by vessel equivalents based on sherd groups rather than by sherd count or EVEs. A total of 6,987 sherds was recovered, of which 705 are medieval. In Period 1 (215 sherds), English and German wares are almost equally represented (29% and 25% respectively). The largest group comprises miscellaneous cooking pots (35%), while the remainder derives mainly from the Low Countries (10%). Of the English wares, those dated to the eleventh/early twelfth century are all from Stamford. By the mid-twelfth century, however, London-area wares are dominant, with Shelly-Sandy ware and London-type ware accounting for 36% and 30% of the English sherds respectively. In Period 2, English wares comprise *c* 55% of the pottery, but as in Bergen, London wares have disappeared and Grimston is the dominant fabric (35%), while the various Yorkshire wares account for a further 14%. In contrast to Bergen, German wares comprise only 8% of the total sherds from this period. In Period 3, only 2.5% of the post-medieval pottery is English, the group being dominated by pottery from the Low Countries.

At *Norges Bank 1980,* the phasing is more complex, but the general trend is the same (Reed 1986, 42–45). The 330 sherds were quantified using sherd counts. Of the 258 medieval sherds, 60% are English, mainly Grimston, with smaller amounts of pottery from Yorkshire and only very few sherds from the London area: one of fine ware, and six shell-tempered. Many of these are residual in fourteenth- and fifteenth-century contexts. Stonewares are present but not abundant; Langerwehe dominates over Siegburg. French wares are rare in all periods. This site is of interest in having a larger sample of late medieval and post-medieval wares, including seventeenth-/eighteenth-century English wares from Staffordshire.

The largest and most complex excavations at *Folkebibliotekstomt* (Library site) have produced the most important ceramic assemblage (Reed 1988, 163–67; Reed 1990), with 34,134 sherds (112.148 Kg) deriving from some 6,016 vessels; approximately 100 different fabric types are represented in this collection. The medieval pottery comprises 11,668 sherds. As above, three broad ceramic periods have been defined for the Library site, dated to *c* 1000–1250, *c* 1250–1500 and after 1500 (Reed 1990, 72–79). In Period 1, *c* 22% of the total sherds are of English origin; of these, 2% are of eleventh-century date (Stamford wares), while 20% date from *c* 1150. The composition of the Period 1 English wares is as follows: Stamford ware *c* 22%; shell-tempered wares *c* 24% (from both London and the East Midlands); London-type ware *c* 31%; Splash-glazed wares *c* 15% (*ibid*, 67). The shell-tempered wares first appear in Phase 3, but are more common from Phase 5 and peak in Phase 8 (43 sherds); London-type ware first appears in Phase 6 (seven sherds) and is also most common in Phase 8 (97 sherds). These two wares each account for *c* 6% of the imports for this period, which are dominated by pottery from the Rhineland and the Low Countries (*ibid*, 75; Table 3 and Appendix 1).

In Period 2, the pattern is reversed; 61% of the pottery is of English origin, while German wares account for only 12% of the total sherds. Small amounts of pottery from the Low Countries, France and Scandinavia are also present. Any pottery from the London-area is residual, and the dominant ware is Grimston, which accounts for *c* 57% of the English material and for 35% of the total sherds (*ibid*, 67; 77); a further 26.5% of the Period 2 assemblage is from Yorkshire (c 14%) and Lincolnshire (c 11.5%). It cannot be said, however, that these wares continue as late as 1500, and sherds from the latest Period 2 contexts must be residual. As at Bergen, English wares decline and German stonewares become more common in the fourteenth and fifteenth centuries, when Dutch red-wares and other imports also appear; this pattern continues in the sixteenth century.

The forms represented in London-type ware include cooking pots as well as jugs, although several jug sherds show evidence of having been placed over the fire, and some have heavy sooting internally and externally. The jugs are mainly of Early Rounded or Early Baluster type (*ibid*, 67). Vessels of note include a jug with horizontal rilling on the neck, red-painted swags across the shoulder and a patchy green glaze (N24149); another vessel in a calcareous fabric has alternating straight and wavy diagonal lines painted in red slip/iron oxide (N59907), similar to examples from Bryggen (fig 22, nos 112, 114, 117). The range of forms includes jugs with carinated necks (eg N88827B; cf this report, fig 22, no 110; Rouen-style or North French-style decoration (eg N58213, N89350), and a jug decorated with dimples (N88146, cf this report, fig 24, no. 140). The most unusual sherd is a jug rim with a bridge spout and sgraffito decoration on the neck (N96460). A lid fragment and part of a possible miniature jug are also present (cf this report fig 27, nos 168–170, 174).

13.2 BORGUND

The settlement at Borgund in Sunnmøre was excavated from 1954 into the 1960s (Herteig 1958, 138–42; 1969, 159–160; Sulebust 1984, 188–201). Warehouses and domestic buildings suggest that the site was occupied all year round and over a long period of time; in addition to fishing, evidence of local crafts such as smithing, leather-working and stone-working shows that trade was an integral part of the economy. The settlement functioned as a trading centre in its own right, and as an entrepot for goods imported to Norway via Bergen.

The pottery found at Borgund shows that there were trade connections with the Rhineland and with England from *c* 1200; the paucity of earlier material may reflect the nature/location of the excavations as much as trading patterns (Helle 1982a, 321; Lüdtke 1989, 61). Much of the pottery probably reached Borgund via Bergen, but direct trade with England is documented in the early fourteenth century (Sulebust 1984, 194), and was probably carried out in the thirteenth century also. In addition to pottery, soapstone was also imported into Borgund as a raw material and made into vessels there (*ibid*, 193). The pottery from the excavation has not been studied in detail, but a total of 343 sherds is quoted by Lossius, of which 149 (43%) were thought to be from England (Lossius 1977, 47, fig 22; Myrvoll 1983, 21). A cursory examination of this material in July 1977 showed German and English wares from Grimston and kilns in Yorkshire, but no obvious London-type wares; if present, pottery from South-east England is certainly not common at Borgund.

13.3 STAVANGER

Imported medieval pottery has been found during excavations in Stavanger, possibly imported via Bergen; the material has not been published, but a brief review appeared in 1971 (Stavanger Museums Årbok). One of the sites mentioned in that report produced *c* 4,000 sherds, the bulk of which appears to be Grimston ware; a photograph also indicates the presence of Scarborough ware, Rouen ware, and Pingsdorf-type ware. The sequence appears to start in the mid-to-late twelfth century, and to follow the same pattern as at Bergen, although the excavations are too small to permit any real conclusions (Helle 1982a, 321; Lüdtke 1989, 61).

13.4 SKIEN

The excavations at *Handelstorget* in 1979 produced 55 sherds of pottery, of which only seven sherds were thought to be of English origin (Myrvoll 1982, 179–190, 257). These comprise two shell-tempered sherds (not necessarily from London), five sherds of Grimston ware, and one of Scarborough. Other wares include Blue-Grey ware, Danish blackwares, Dutch and South Scandinavian glazed wares, German stonewares and three sherds of Saintonge polychrome. The trading connections of Skien, through which imported goods reached the Telemark, were clearly widespread; on the basis of such a small sample, however, contact with London can be neither demonstrated nor ruled out.

13.5 TØNSBERG

In Tønsberg, English wares are less common than in Bergen and Trondheim, but pottery from North-west Europe is well-represented by imports from Germany and the Low Countries (Holland and Belgium), although early Pingsdorf-type ware was deemed to be rare by Lüdtke (1989, 61). Recent excavations on four sites, *Storgate*

24–26, Nedre Langate (Lunde 1985, 124–5), *Nedre Langate 25–27* and *Baglergaten 2–4* have shown that the northern part of medieval Tønsberg comprised industrial sites, while the southern part was largely residential. This is reflected in the pottery (Reed 1992), with cooking pots being most common in the northern area (80%), and a wider range of forms in the southern area, although most pottery was disposed of on open land and thus cannot be associated with specific structures. The three sites in the southern part of the town together produced a total of 6,820 sherds, of which 3,394 were medieval. The largest assemblage is that from *Baglergaten 2–4* (3,413 sherds, 1,012 medieval), but *Storgate 24–26* produced more medieval material (total 2,593 sherds, 1,662 medieval). The English wares from all sites consist almost entirely of Grimston-type ware: 458 sherds, comprising 13.5% of the medieval sherds recovered. Some Scarborough, Yorkshire, Humber, Developed Stamford wares are also present, but London-area pottery is so far limited to six sherds. The present distribution of pottery types may, however, be biased. Firstly, the excavations at *Nedre Langate*, which produced only 814 sherds, were of limited depth, and did not fully investigate the medieval deposits; secondly, much pottery was dumped together with other rubbish in the attempt to extend the medieval waterfront out into the fjord. Further investigations may thus change this distribution, but the overall pattern will probably remain much the same.

13.6 OSLO

The situation in Oslo differs from that in Western Norway. The Baltic and East European influence dominates; West European imports are less common than in Tønsberg, and much less so than in Bergen and Trondheim.

The classification and quantification of the material from Oslo and sites in Sweden is primarily based on firing and the presence or absence of glaze. Products from different kilns may thus be counted in the same group, while pottery from the same kiln may be counted in different groups, so that it is difficult to make meaningful comparisons between these assemblages and those in western Norway. However, some specific wares have been identified and discussed so that it is possible to compare the trends on different sites in Oslo. The pottery is divided into the following groups, each of which has numerous sub-divisions:

I	Unglazed earthenware	
II	Lead-glazed earthenware:	A = whitish; B = greyish C = reddish; F = tin-glazed NT = post-medieval
III	Stoneware	
IV	Porcelain	

At *'Mindets Tomt'* (Molaug 1977, 72–115) pottery accounts for 3,808 of the total 9,495 accession nos. The glazed white wares include Stamford ware, Developed Stamford ware, Winchester, Andenne and other wares thought to derive from France. Other English wares from Scarborough, Yorkshire and Lincolnshire are also identified. There is no reference to London-type ware, but four sherds of shell-tempered pottery are noted in contexts dated to 1150–1250 (Group I6, 1342 sherds in all).

Excavations at *Oslogate 3* produced 133 sherds, of which 45 were medieval; the site at *Oslogate 7* produced 144 sherds, of which 40 were medieval (Molaug 1979, 33–46; English summary 44). The earliest material dates to the second half of the twelfth century, but the ceramic evidence suggests that most deposits are of thirteenth-fourteenth century date. Identified English wares are in the minority. Most are of thirteenth- to fourteenth-century Grimston-type, with only a few from Yorkshire. There is no reference to London ware.

The report on the pottery from *Sondrefelt* (Molaug 1987, 229–320; English summary 321–24) refers to 15 sherds of chalk-tempered ware (?=shell-tempered ware) in contexts dating to 1150–1250. Two sherds of probable London ware were identified (*ibid*, 250), with one sherd of possible Mill Green ware in Group IIC3 (*ibid*, 262). The impression is that English wares (London, Developed Stamford, Yorkshire) are rare in the twelfth century, increase slightly during the thirteenth century, and then disappear.

13.7 OTHER SITES

It has not been possible to consider here the pottery from other sites in Norway, Sweden, Denmark or on the Baltic coast, but it is worth noting that no London-area pottery has been recognized amongst the pottery found at Tromsø in the north of Norway, or at Visby on Gotland, although it is possible that some may be present at Kalmar in Southern Sweden, (see below). At Hollingstedt in Jutland, the situation is rather different. This was evidently an outport for Sleswig, whence goods were shipped overland rather than making the journey around the Jutland peninsula. However, although twelfth- and thirteenth-century pottery from the London area is common at Hollingstedt, much larger excavations on contemporary sites in Sleswig have produced only a few sherds. Finally, mention should be made of Clarke's observation that of all the ports in the Baltic, Gdansk (Danzig) is the most likely of all the one where English pottery might be found in contexts later than at Bergen or Trondheim, as an English merchant colony was founded there in the late fourteenth century and frequented by the English throughout the fifteenth century (Clarke 1983, 24).

14 Pottery as an indicator of trade

14.1 THE LONDON-AREA POTTERY FROM BERGEN

A consideration of ceramic evidence for trade between London and Bergen in the first half of the twelfth century is hindered by the general lack of excavated material, and the lack of independent dating evidence for the earliest strata in the town. Certainly there is very little London area pottery in the levels before Fire VII, but the material found in these levels was most probably deposited soon after Fire VIII, for which there is no exact dating evidence. The other early wares found in Bergen, (Andenne-type ware, Blue-Grey ware and Pingsdorf-type ware) are all present in London waterfront deposits dated by dendrochronology to the mid-eleventh century (see Section 3.4), and it must be said that there is no ceramic evidence which could disprove a date in the later eleventh century for Fire VIII. The amount of London-area pottery ware in the subsequent Period, however, supports the excavator's view that Fire VIII dates to *c* 1140–1150, and demonstrates an intensification of contact with London in the later twelfth century. In the early thirteenth century, however, there appears to be a sharp decline in the amount of London-area pottery coming to Bryggen. Rouen-style, North French-style, and Highly Decorated jugs are all present, but only in small quantities. This could be because little contemporary pottery was being deposited on the site between the beginning of the thirteenth century and immediately after the fire of 1248, but by *c* 1250 the peak of London-area pottery production had passed, and even in London new types were coming into use. The presence of a few sherds of Plain Baluster jugs, Polychrome jugs and very small amounts of Kingston and Mill Green ware demonstrate some importation of London-area pottery in the late thirteenth/fourteenth century, but these do not necessarily indicate trade with London. The London-type wares may have arrived on an ad hoc basis. The Kingston-type ware certainly came to Bergen via London, but the Mill Green ware may have arrived in Norway via a port in Essex. In both cases the amount is minimal, and merely emphasises the fact that by the later thirteenth-fourteenth century there was little contact with London, at least as demonstrated by the pottery finds.

14.1.1 The London-area pottery from Southern Norway

Thanks to extensive excavation and post-excavation work in London (see Section 3.4), elsewhere in England and on the Continent, the pottery chronologies of Northern Europe are much clearer now than in 1968, when Dunning reviewed the trade in medieval pottery around the North Sea and Barton considered the medieval glazed wares of Sweden. Much research remains to be carried out, but certain wares, including London-type wares, may now be more readily recognised in other countries. For example, a jug found at Kalmar, Southern Sweden (Barton 1968, 38; fig 7; Pl 4, no. 40) is a classic London-type ware form, very similar to no. 175 from Bryggen in profile, if not in decoration. Conversely, some vessels found in Northern Europe and thought by Dunning to be from London or Scarborough are in fact more likely to derive from Denmark (eg a jug from Lübeck, Dunning 1968, fig 18, no. 1). At the time of his survey, the only late twelfth-/early thirteenth-century English pottery known to have been exported was Developed Stamford ware (found at Bryggen). However, as demonstrated above, it is now clear that many of the London-type ware jugs and the Shelly-Sandy wares, dated by Dunning (1968, 43–44) to the thirteenth and late thirteenth-century respectively, are of twelfth-century manufacture.

The division of the pottery from Bergen and from Trondheim into three broadly contemporary ceramic phases has been discussed above (Sections 3.2, 12, 13.1). In both cases the London-area pottery plays a small but significant role in the first phase, which is generally agreed to have ended *c* 1250 (the start date is placed at 1000 in Trondheim, and 1100 in Bergen).

Wider studies are difficult, for the reasons outlined below. Lüdtke (1989, 31), compared the finds from Bryggen with those from Mindets Tomt in Oslo; although noting that the quantities involved were different from those in Oslo, he concluded that not only was the general pattern the same, but that this indicated that a steady stream of ceramic imports reached Norway during the Middle Ages with chronological consistency and without strong regional differences (in the sense of strongly progressive or conservative).

While it is agreed that certain wares occur together at certain periods on widely dispersed sites, and it may be true that German wares reached all parts of Norway with chronological consistency, it should be noted that the demise of these wares is governed not only by foreign trade but other factors such as the economic and social factors governing pottery production in the different countries. The survey presented in Sections 12 and 13 shows that real regional differences (largely influenced by the geographic location of the sites in question) are reflected in the quantity and nature of the pottery. On the Library site in Trondheim, for example, English wares appear to be more strongly represented in the early ceramic phase than at Bergen. Conversely, at Mindets Tomt in Oslo, Shelly-Sandy ware from the London area is represented by only four sherds, as compared with several hundred sherds in the early deposits at Bergen, while London-type ware is absent altogether. Both wares are equally rare on other sites in Oslo. Baltic pottery, on the other hand, is well-represented in the early deposits at Oslo, but at Bergen less than ten sherds were found (*ibid*, 25).

14.2 DISCUSSION

An assessment of the real role of pottery in medieval trade is hindered by several variables and gaps in our existing knowledge. Some of these have already been noted by Lüdtke (1989, 59–62) and Reed (1990, 74–5, 81). They include:

1. An imperfect knowledge of the means by which pottery reached Norway. References to shipments of pottery figure rarely in the documentary sources, and most pottery probably travelled overseas as an adjunct to trade in perishable goods, rather than as a commodity in its own right. Some pottery would have reached Norway as personal possessions or have been imported specifically for the use of foreign merchants rather than the local community.

2. An imperfect knowledge of the internal trading mechanisms. Pottery may have travelled further than perishable food-stuffs or exotic goods, but it seems that the distribution is mainly coastal. Borgund and Trondheim may have been supplied direct, but many commodities were probably trans-shipped through Bergen and Oslo, and possibly distributed again through markets inland.

3. Regional social customs. Pottery was not necessarily used as commonly in Norway as in Europe; in some parts of the country cooking pots of soapstone and table wares of wood and leather were equally, or more, important (see Sections 11.2 and 12). Allied to this is the differential curation of wares in daily use and 'luxury' items.

4. Residuality (see Sections 2.2, 2.3.4, 7, 10).

5. Methodology. The efficacy of pottery as a dating tool and indicator of economic trends depends not only on the quality of the excavation on which it was found, but also on accurate identification of the wares (which in turn largely depends on the level of research in the countries of origin), and a uniform system of quantification (see below and Sections 12 and 13.6).

This last point is most important. The study of trade connections 'is a topic which demands the use of material from as many excavations as possible within the town to provide a coherent view' (Reed 1990, 81); studying one site in isolation is liable to provide biased results. However, it will be seen from the above that the analysis and interpretation of medieval pottery in Norway is very much confined to the local level; it is not easy to compare assemblages at the national or international level, partly due to the lack of published material, and partly due to the inconsistency of recording techniques. Until such time as the ceramic products of different countries are correctly identified and uniformly quantified, this will continue to be the case, and it is to be hoped that the systems used at Bergen and Trondheim will set the standard for future pottery studies in Scandinavia.

Despite the above, pottery probably reflects more accurately than any other material in the archaeological record the general international trading pattern at any one time within the towns where it was first imported, such as Bergen and Oslo. The value of pottery as an indicator of internal trade within Norway needs further study. At present it is impossible to confirm or deny that any of the London-area pottery found at Bryggen was destined for trans-shipment, for although much appeared to be quite fresh, a significant proportion had been used and even reused. It is probable, however, that the latest London-type wares were brought in for personal use rather than for sale.

The relatively sudden appearance of pottery from the London area on a number of sites around the North Sea in about 1150, and an equally uniform decline in the mid thirteenth-century may reflect a number of factors such as changing political alliances, the quality of the pottery, the marketing techniques employed by English merchants, and contemporary fashion. The nature of trade between London (or England) and Bergen before *c* 1150 is unclear, but the decline from the later thirteenth century is reflected both artefactually and by the fact that there is no reference to Bergen in the fourteenth-century Customs Accounts for London (Helle pers comm).

Direct trade between London and towns such as Borgund and Trondheim, which are at an even greater distance than Bergen, is thus unlikely after *c* 1250, if not earlier. Nonetheless, there must have been some ongoing contact between London and Norway, via the ports of the Wash, since thirteenth/fourteenth-century rubbish deposits recently excavated by the Museum of London at Ludgate Hill were found to contain large quantities of unworked Norwegian ragstone, presumably representing the direct importation of raw material from Norway for hone manufacture in England.

Research into the dominant English wares of the later thirteenth and fourteenth century (Grimston and other east coast wares) should clarify the pattern of later Anglo-Scandinavian trade in ceramics.

Despite the problems encountered in conducting this brief survey of pottery from widely dispersed sites in Norway, it would appear that the ceramic sequence for Bergen closely matches the political and economical factors governing the development of the town and its trade, and that this applies to other sites in Southern Norway. Further study of the ceramic evidence may in turn help to understand the development of trade connections by the countries which were supplying Norway with pottery during the medieval period.

PART 4

CONCLUSIONS

by

Lyn Blackmore and Alan Vince

15 Conclusions

The London-area pottery from the Bryggen excavations is a small proportion of the total, yet its study has been useful for many reasons. In the introduction to this report, the aims of the research were outlined and a number of questions were asked of the pottery. The study will be concluded with a review of how successfully each of these objectives was met.

1. *Earliest date.* The pottery of the London area cannot be used to resolve the debate regarding the origins of medieval Bergen in the late tenth or early eleventh century, since Shelly-Sandy ware and London-type ware, the earliest English fabric types recognized at Bryggen and elsewhere in the city, were not used in London until *c* 1150. If there was a settlement in Bergen before this, it cannot be shown that pottery from the London-area reached it. On the Bryggen site, however, it may be demonstrated stratigraphically that both the main wares exported from London are present, albeit in small quantities, before *c* 1170, with a few sherds of Shelly-Sandy ware and London-type ware both under and over Fire VII. Both these wares were well established by 1198.

2. *Latest date.* Due to the residuality factor, the date when these wares ceased to be used in Bergen would be impossible to define confidently were it not that sufficient work has been done in London to establish an independent typology and chronology. The Bryggen stratigraphy confirms the London evidence that Shelly-Sandy wares had gone out of use by *c* 1225; to a lesser extent it also reflects the fact that production of London-type ware had ceased by *c* 1360, but it does not reflect the typological evolution of London-type ware. Indeed, from the Bryggen data it could be argued that the Early-style jugs continued in use alongside the other forms until the mid fourteenth century. From the London evidence, however, we can assume that all the Shelly-Sandy ware, and most of the London-type ware found in deposits post-dating Fire V, is residual.

3. *Quantification.* This is beset by many problems. The amounts of each type of London-area pottery, and the amounts in each Period or phase as it is currently understood and defined have been presented above (Sections 7 and 10). It is not possible to reliably compare these figures with those for other wares. For the purposes of comparing the proportions of different wares at different times, the data presented by Lüdtke should be used as a standard measure until all the wares have been examined and quantified. From these figures, and from the above, it may be concluded that the London area pottery was mainly in use between 1170 and 1248, when the stratified material accounts for approximately 22% of the total accession nos in both Periods 3 and 4.

4. *Form types present.* The range is more limited than in London, with only two Shelly-Sandy ware forms and twenty-eight of London-type ware. As in London the

latter are dominated by the Early-style jugs, which were undoubtedly produced for export, but the collection includes a few rare types such as Chafing Dishes and Miniature Vessels which may have arrived in Bergen as personal possessions.

5. *Distribution.* It is difficult to make meaningful comments on the general distribution of the London-area pottery, although there appears to be a concentration within the Engelgården tenement; a peak was also observed in the waterfront area in front of Bugården, but this is part of a general concentration of all wares in this area. The study of specific groups such as weathered, unused or joining sherds provided more useful information on the methods of rubbish management and could be used to study the processes of land reclamation in more detail.

Examination of the distribution of different forms of the London-type ware showed that this matches the stratigraphic sequence and known chronology quite closely, although as noted in Section 7 there were a few surprisingly early occurrences of certain types. From the ceramic evidence it was possible to produce a relative chronology which is independent of, but in agreement with, the site chronology based on documented dates for the fire deposits excavated at Bryggen and recorded elsewhere in the town from the late twelfth century onwards.

6. *Comparative studies.* Within both the local and the wider context the ceramic assemblage from Bryggen was found to comprise an unparalleled collection of exported medieval pottery from sites across Northern Europe and as far afield as the Mediterranean; while it obviously reflects the scale of the excavation, it is unlikely to be matched on any other site in Bergen, or indeed in Norway, should the opportunity arise to excavate on such a scale again.

7. *Trade.* During this study, it has been possible, in outline, to evaluate the role of the London-area pottery within the general pattern trade and the importation of English and other pottery to Norway. It was found that while general trends may be observed across Norway and in Sweden, there are also regional differences which reflect the social, economic and political factors of the times. Unfortunately the same factors prevail in pottery studies today, and it is regrettable that while important assemblages remain unstudied, the data which is available often cannot readily be compared at a local level, still less at national or international level. Used in conjunction with scientific dating techniques and dated artefacts such as coins, pottery is one of the best means available to the archaeologist of aiding the chronological and wider interpretation of a site. Until such time as the pottery from different sites within the same town/country is described and quantified to a common standard, its potential as an analytical tool will continue to be under-exploited.

To conclude, this paper has presented evidence which shows that the London-area pottery found in the Bryggen excavation is remarkably useful for elucidating the early development of the site and for testing the absolute dating of the sequence of this development. It has confirmed the chronology of the fire layers originally proposed for the site, and the conclusions reached by Lüdtke (1989, 67); it has also confirmed the theories already proposed regarding the pattern of traded ceramics, showing that from a peak in the late twelfth/early thirteenth century, the amount of pottery imported from the London area declined noticeably from the second quarter of the thirteenth century onwards.

With regard to future work on the Bryggen material, important areas for research have already been proposed by Lüdtke (1989, 67-8), but as he has pointed out, only when all the stratigraphic chronology has been finalized, all the finds studied and their distributions compared within and across tenements will it be possible to consider the many social, economic and functional questions posed by the site and the material from it.

Beyond the study of Bryggen itself, it is to be hoped that the data presented here, or available in the site archive, may be used in future studies of ceramics exported from London and sites along the east coast of England to Bergen and elsewhere in Norway, although such a study can only be carried out when an accurate assessment has been made both of the relative quantities of these other English wares and the proportion of all the English wares present in the different assemblages. Equally important is the need to obtain precise and compatible comparative data from other ports around the North Sea. Pottery from the London area is known from sites on the east coast of England, eastern Scotland, the north-west coast of Germany, and from other sites in Norway, notably Trondheim. Studies in any of these places could throw more light on the complex network of trade connections which bound the communities of north-west Europe at the start of the High Middle Ages.

Appendices

Appendix 1. Catalogue of the illustrated Shelly-Sandy wares.
(* denotes sherd excluded from computerized data)

No.	Accession	Grid	Fire	Period	Sherds	Form	Rim	Comments
Fig 12. Rim type 1								
1	17672	L09	U5	4	1	9	1	
2	35236	L07	U6	3	1	1	1	
3	09777	I11	U5	4	35	2	1	
4	04143	I12	U5	4.1	1	9	1	
5	25254	K08	O6	4.1	1	1	1	Heavy ext. soot
6	31834	K07	U6	3.2	2	1	1	
7	11522	I11	U6	3	1	1	1	Finger nail impressions
8	04455	K12	O6	4	2	2	1	Heavy soot
9	62767	O03	U6	3	1	2	1	
10	85669	M09	O7	3	1	1	1	
11	22185	K09	A6	3	1	2	1	
12	23293	L10	U6	3	1	1	1	
13	11764*	–	–	–	1	3	1	
14	21278	K10	A6	3.2	1	1	1	
15	10757	I11	6	3.2	1	2	1	
Fig 13. Rim type 1 (large)								
16	11599	K11	U5	4	2	1	1	Heavy soot
17	04196	I12	U5	4.1	1	1	1	
18	24979	K08	O6	4.1	1	1	1	
19	19105	I10	U5	4	2	9	1	Textile impression
20	21291	I10	O6	4	20	1	1	
	21543*	–	–		16	6	–	
21	85846	M09	U6	3	1	3	1	
22	10236	I11	U5	4	2	1	1	Internally laminated
23	88350	M10	U5	4	1	3	1	

No.	Acces-sion	Grid	Fire	Period	Sherds	Form	Rim	Comments
Fig 14. Rim type 2								
24	32914	K06	U6	3	16	1	2	
25	22174	K09	O6	4	1	1	2	
26	10320	I11	A6	3	1	3	2	
27	63184	O04	U6	3	6	3	2	
28	04400	K12	O6	4.1	1	2	2	External sooting
29	26087	K08	U6	3.2	43	1	2	
30	32912	K06	U6	3	11	1	2	External sooting
31	43745	O04	U6	3	1	1	2	
32	22748	K10	O6	4	2	1	2	Sooting
33	25272	K09	O6	4	1	3	2	
34	61882	P03	U5	4	8	1	2	Internal sooting
35	21261	L10	A6	3	1	1	2	
Fig 15. Rim type 3 (developed, with inner bead; small)								
36	42333	M05	I6	3	1	8	3	
37	17672	L09	U5	4	3	1	3	
38	43196	P05	U5	4	9	3	3	
39	89831	N10	U6	3	1	3	3	
40	25809	K08	06	4.1	2	1	3	
41	31574	K07	O6	4	19	3	3	
42	09577	I11	U5	4	3	1	3	
43	21073	K10	O6	4.1	1	3	3	
44	04929	I12	U6	3.2	1	1	3	
45	42466	N05	I6	3	1	3	3	
46	10366	I11	U6	3.2	1	3	3	
47	24421	L08	A5	4	1	1	3	Glaze spots on rim
Fig 16. Rim type 3 (developed, with inner bead; large)								
48	22814	K11	U6	3.2	1	3	3	
49	84827	M10	U6	3	1	1	3	
50	04929	I12	U6	3.2	1	1	3	
51	11011	K11	U6	3.1	1	1	3	
52	89458	M10	U5	4	1	3	3	
53	45429	M05	O6	4	1	8	3	
54	23051	K10	U6	3.1	1	3	3	Heavy soot
55	20179	K12	O6	4	1	3	3	
56	43232	O06	I7	2	1	3	3	

No.	Accession	Grid	Fire	Period	Sherds	Form	Rim	Comments
Fig 17. Clubbed rim (type 4) and flat rims (types 5 and 6)								
57	32302	L06	O6	4	1	3	6	
58	09880	I11	O5	5	8	1	5	
59	63406	O03	O5	5	1	2	5	
60	20860	L10	A6	3	1	1	6	
61	09463*	–	–	–	1	1	5	
62	19543	I10	U5	4	1	8	5	
63	20324	I10	U5	4	1	9	5	
64	33108	O05	O2	8	1	1	5	
65	09991*	–	–	–	1	1	5	
66	31962	K07	A6	3.2	54	1	6	
67	87737	N11	O5	5.1	1	3	6	
68	22863	K09	U6	3.2	1	3	6	
69	42920	M06	U6	3	1	3	6	
Fig 18. Flat rims (type 7), and down-turned rims (type 8).								
70	21640	I09	O6	4	1	8	7	
71	80383	M08	U5	4	1	3	7	
72	20165	I09	U5	4	7	1	7	
	20394	K09	U5	4	6	1	7	
73	21512	L09	A6	3	1	3	7	
74	31921	K07	A6	3.2	1	1	7	
75	63628	O02	U5	4	2	1	7	
76	21855	K10	O6	4	1	1	7	
77	20174	K12	O6	4	1	3	7	
78	32914	K06	U6	3	18	1	7	
79	26088	K08	U6	3.2	1	1	8	
80	88742	L12	U6	3.2	1	3	8	Burnt
81	52771	N04	U6	3	1	1	8	
82	19791	I09	U5	4	2	1	8	
83	22250	K09	O6	4	1	2	8	
84	78812	K02	U5	3	1	1	8	
Fig 19. Cooking pots with thumbing on the rim.								
85	32912	K06	U6	3	24	2	2	
86	32059	K07	U6	3.2	1	1	1	
87	04204	I12	A5	4.1	10	1	5	
	09474	I11	U5	4	15	1	5	
88	09944	I11	O5	5	27	9	3	
	10305	I11	A6	3	1	9	3	
89	53044	M04	U6	3	1	3	3	
90	36430	L08	U6	3	4	1	3	
91	85084	N09	–	–	1	3	7	Pitch deposit
92	25401	L09	U6	3	1	3	2	
93	61419	P03	I5	4	1	1	5	

No.	Accession	Grid	Fire	Period	Sherds	Form	Rim	Comments
Fig 20. Decorated cooking pots and the pipkin.								
94	74768	R02	U5	4	1	3	9	
	75614	Q02	U5	4	9	3	9	
95	44810	M05	U6	3	2	3	8	
96	21459	K10	A6	3	1	3	2	
97	18393	K09	A5	4	1	9	1	
98	86970	N11	U5	4	1	5	–	
99	10187	I11	U6	3.2	25	7	4	

Appendix 2. Catalogue of the illustrated London-type wares.
(* denotes sherd excluded from computerized data)

No.	Accession	Grid	Fire	Period	Sherds	Form	Comments
Fig 21. Early-style jugs							
100	18608	K12	–	–	1	10	Green glaze
101	09611	H11	A5	4	2	10	Uneven lustrous green glaze
102	10092	I11	A6	3	1	10	LCALC; cordon, green glaze
	10098	I11	A6	3	1		
103	23101	K10	U6	3.1	1	10	LCALC; clear/yellow glaze
104	18943	I10	O5	5	1	10	Applied pellets in cream slip
105	09673	K11	U5	4	1	10	Grid in white slip, splashed green glaze
	19993	I10	U5	4	8		
	19935	I10	U5	4	1		
106	19410	K10	A6	3	1	10	Splashed glaze, knife-trimmed
	84271*	–	–	–	1		
107	23101	K10	U6	3.1	1	10	LCALC; knife-trimmed base angle; pale
	84923	M09	–	–	1		green glaze
108	09486	I12	U5	4	1	10	Reused as cooking pot
109	Unnumbered			–	1	10	Lop-sided; interlocking arcs in white slip; thin green glaze
Fig 22. Early-style jugs.							
110	88827	M11	U5	4	1	10	Vertical red stripes, patchy olive glaze
	88828	M11	U5	4	1		
111	32922	L06	O6	4	1	10	Olive glaze
112	04959	I12	U6	3	20	10	Bands of red and cream slip
113	17649*	–	–	–	1	10	Stripes of iron and copper oxide, clear glaze
	18031	L11	O6	4	1		
114	20558	K10	O6	4	1	10	LCALC; incised wavy line, band of cream slip, patchy green glaze
115	30502	K06	O6	4	1	10	Diagonal bands of red and cream slip
	30637	K06	O6	4	1		
	32053	L05	U5	4	1		
116	22123	L10	U5	4	1	10	LCALC; combed horizontal and wavy lines, patchy green glaze
117	84869	M09	U6	3	3	10	?LCALC; incised vertical zig-zag lines over bands, iron oxide; clear glaze
	85683	M09	U6	3	3		
	85730	M09	U6	3	5		
	85751	M09	U6	3	5		
	89607	M10	U5	4	1		
	84889	M09	–	–	3		
	85161	N09	–	–	1		
	85561	N09	–	–	1		
118	21126	K10	O6	4	1	10	LCALC; knife-trimmed on lower body;
	21173	K10	O6	4	3		bands of combed wavy lines; patchy clear and
	84923	M09	–	–	1		green glaze

No.	Accession	Grid	Fire	Period	Sherds	Form	Comments
Fig 23. Early-style and Rouen/North French style (No.123) jugs.							
119	21033	K09	O6	4	1	10	Cordons on neck; applied scales in cream
	21628	I10	O6	4	1		slip, thin green glaze; very worn
	21658	I10	O6	4	4		
	21852	K10	O6	4	1		
	21458*	–	–	1			
120	18810	L09	A6	3	1	10	Applied scales below cordon; green glaze
121	20071	I10	U5	4	15	10	Rilled neck, applied scales; green glaze
122	32156	L07	O5	5	1	10	Applied thumbed strip; green glaze
123	10219	H11	O5	5	1	20	Applied scales; green glaze
124	21742	I10	U5	4	1	10	Incised lines, thin green glaze
125	24954	K08	O6	4	1	10	Incised zig-zag; green glaze
126	20239	I09	U5	4	2	10	Incised zig-zag; thin green glaze
127	22816	K11	U6	3.2	1	10	Incised zig-zag; mottled clear/green glaze
128	20900*	–	–	–	1	10	Stabbed all over; unglazed
129	89770	M10	U6	3	1	10	LCOAR; horizontal stripe of slip, stamped decoration, olive glaze
130	83620	N10	U5	4	1	10	Impressed decoration, green glaze
131	85754	M09	U6	3	1	10	LCOAR; lightly finger-tipped decoration, thin green glaze
132	31885	K07	A6	3	1	10	Thumbing/incised zig-zag line, olive green glaze
Fig 24. Early Baluster and Large Squat jugs.							
133	18132	K11	O6	4	1	11	Finger marks underneath
	18145	K11	A6	3	2		
134	89441	M11	U6	3	2	11	Knife-trimmed
	89625	M11	U6	3	1		
	88641	M11	U5	4	3		
	88643	M11	U5	4	1		
	88644	M11	U5	4	1		
135	19862	I09	U5	4	1	12	Diagonal stabbing around base, splashed glaze, sooted
136	11844	H11	U4	5	12	12	Grid in red slip with pellets in cream slip
	12004	H11	–	–	4		
137	08569	H11	U4	5	1	12	Horizontal bands of cream
	10946	G11	U4	5	1		
	08239	F11	O4	6.3	1		
138	17757	L10	U5	4	2	12	Horizontal bands and pellets in cream slip
139	87892*	–	–	–	1	12	Horizontal bands and pellets in cream slip
140	21335	N10	O6	4	1	12	Cordons and dimples on body, applied
	21410	I10	O6	4	12		thumbed band on handle; good green glaze
	21542*	–	–	–	7		

No.	Accession	Grid	Fire	Period	Sherds	Form	Comments
Fig 26. Andenne-type and Rouen-style jugs.							
141	86467	N09	U6	3	8	16	LCALC; corrugated surface, pale green glaze; internal trimming
142	84828	M10	07	3	4	21	Rouen-style; red wash, applied strips and pellets in cream slip, green glaze
143	17433	L10	U4	5	1	21	Rouen-style; chevron and roundels in red and cream slip
	37773	I05	U4	5	6		
	37855	I05	U4	5	1		
	16960*	–	–	–	1		
	18384	–	–	–	1		
	41050	O04	–	–	1		
144	17771	L10	O5	5.1	1	21	?Slip, clear glaze
	18350	I10	A5	4	1		
	17998	L10	A5	4			
145	44573	N05	U7	2	1	21	
146	04411	K12	O5	4	1	21	Splashed green glaze
147	03258	L12	O5	5	1	21	Spouted Rouen-style jug, sooting inside body
	03233	H12	U4	5	1		
	09047	H11	U4	5	1		
	02054	G12	O4	6	1		
148	16750	L10	U5	4	2	21	Applied rosettes in cream slip, green glaze; very worn
	17187	L10	O5	5	1		
	16757	I06	I1	8	9		
Fig 27. Assorted French-style, Rounded, Baluster, Pear-shaped, and Zoomorphic jugs.							
149	12449	G11	O5	5.1	1	21	Applied vertical strips in cream slip, green glaze
	12490	G11	U4	5.2	1		
150	08970	L11	U5	4	1	22	LCALC; cream slip over neck, vertical ribs; green glaze
151	31075	L06	I5	4	1	22	Rilled neck, lustrous green glaze
152	10979	G11	U4	5	1	31	Thumbed base; green glaze
153	08924	H11	U4	5	1	24	Spouted jug; cream slip, applied decoration
	11230	H11	U4	5	1	24	
	87096	–	–	–	1	24	
154	08975	L11	U5	4	1	27	Cream slip over and inside rim, patchy green glaze
	09062	L11	U5	4	1		
155	21479	K10	O6	4	1	28	Zoomorphic; applied face, green glaze
156	08772	G11	O4	6	1	28	Zoomorphic; patchy green glaze
157	07412	I11	U4	5	1	30	Applied strips and pellets in cream slip, green glaze
	11005*	–	–	–	1		
158	60351	O03	O5	5	1	30	Rouletted strips in cream slip, green glaze
159	10942	G11	U4	5	1	31	Rouletted strips and rosette stamp; lustrous green glaze
	10979	G11	U4	5	1		
160	08220	L11	A4	5	1	33	Spouted North French-type jug; applied decoration, thumbing on handle, green glaze
	87087	M11	–	–	15		
	87096	M11	–	–	1		
	87108	M11	–	–	1		

No.	Accession	Grid	Fire	Period	Sherds	Form	Comments
Fig 27. Cooking pots, pipkins, lids, chafing dishes and bottle.							
161	09334*	–	–	–	1	40	Cooking pot; splashed glaze
162	71001	Q02	U4	5	2	40	Cooking pot; sooted
	71180	Q02	U3	6	1		
163	41088	M05	U5	4	1	41	From near handle joint; patchy clear/green glaze in and out
164	17479	K09	O5	5	1	41	Pipkin? with handle socket
165	32053	L05	U5	4	2	41	Pipkin; splashed glaze
166	18585	I09	O5	5.1	1	41	Pipkin handle; green glaze
167	42824	O05	O6	4	1	43	Knob from a lid; green glaze
168	22385	L10	U5	4	1	43	Lid, LCALC; chipped edge, pale green glaze
169	79716	M08	U5	4	1	43	Lid, chipped edge; green glaze
170	43006	P05	U5	4	1	43	Lid, green glaze
171	17925	K09	U4	5	1	45	Chafing dish rim; incised wavy line; green glaze
172	19225	L09	A6	3	2	45	Anthropomorphic chafing dish base; good green glaze
	19253	L09	A6	3	1		
	24648*	–	–	–	1		
173	22741	K10	U6	3	1	17	Bottle, incised cable decoration on edges of strap handle, patchy green glaze
174	09571	I11	U5	4	1	47	Miniature anthropomorphic jug; green glaze
Fig 28. Highly decorated rounded jug.							
175	09621	H11	O5	5	3	23	Near complete jug with plastic decoration; worn
	09622	H11	O5	5	23		
	09895	H11	O5	5	33		

Appendix 3. Key to the computerized data: Shelly-Sandy ware.

The computer records comprise pottery-specific data which can be merged with varying amounts of stratigraphic data. The standard entry comprises:

Accession no. (Tilvekstnr.); fabric; form; weight in grammes; number of sherds; rim type; rim diameter;% of rim present; manufacture, use (group a = sooting and deposits), use (group b = condition and leaching), decoration; comments and sherd links (code = shl).

These are abbreviated as follows in the computer lists:

Tilv	:	f	:	fo	:	weig	:	sh	:	r	:	ri	:	ri	:	m	:	u	:	u	:	d	:	comm
nr	:	a	:	rm	:	ht	:	er	:	t	:	di	:	ev	:	a	:	a	:	b	:	e	:	ents

The criteria for classification and the numeric codes used are as follows:

Fabric

Sparse shell	1
Moderate shell	2
Abundant shell	3
Shell and grit	4

Form

Cooking pot:	
grooved neck	1
straight neck	2
long neck	3
base	4
body	5
base/body	6
indeterminate neck	8
no neck	9
Pipkin	7

Rim type

Bevelled: rounded	1
angular	2
inner bead	3
Triangular/clubbed	4
Flat: rounded	5
angular	6
inner bead	7
Down-turned bevel	8
Other	9

Manufacture

Indeterminate	0
Handmade	1
Hand/wheel-made	2
Wheel-made	3

Use

Clean	0
External sooting	1
Internal deposits	2
Deposits and sooting	3
Unusual deposits inside	4
Ditto and sooting	5
Unusual deposits on both surfaces	6

Leaching

No leaching	0
External leaching	1
Internal leaching	2
Leaching of both surfaces	3

Decoration

None	0
Single thumb impression	1
Double thumb impression	2
Triple thumb impression	3
Multiple thumbing	4
Thumbing, unknown number	5
Incised zig-zag on rim	6
Applied thumbed strip	7
Thumbing on inner edge of rim	8

Appendix 4. Key to the computerized data: London-type ware.

The computer records comprise pottery-specific data, as above, but with fewer fields. These follow the same sequence and headings as above:

Accesssion number (Tilvekstnr); form; weight; sherd; rim diameter;% of rim present; use (all types); comments and sherd links (code = shl).

The criteria for classification and the numeric codes used are as follows:

Form

00/01	Unidentified
10	Early Rounded jug
11	Early Baluster jug
12	Large Squat jug
13	Very Large Rounded jug
14	Small Squat jug
15	Reused type 10
16	Pitcher
17	Spouted vessel
20	Rouen/North French jug
21	Rouen-style jug
22	North French-style jug
23	Highly Decorated Baluster jug
24	Large Rounded jug
25	Small Pear-shaped jug
26	Squat North French jug
27	Large Squat Rouen jug
28	Zoomorphic jug
30	Highly Decorated jug
31	Polychrome type 30
32	Baluster jug
33	Conical type 30
34	Squat jug
40	Cooking Pot
41	Pipkin
43	Lid
44	Drinking jug?
45	Chafing Dish
46	Finial?
47	Miniature

Use/Wear

Reused as cooking pot after breakage	1
Chipping on rim/base	2
Abrasion	3
Burnt after breakage	4
Extensive external sooting	5
Internal furring	7
Internal deposits, no external sooting	8
Sooting on base only	9

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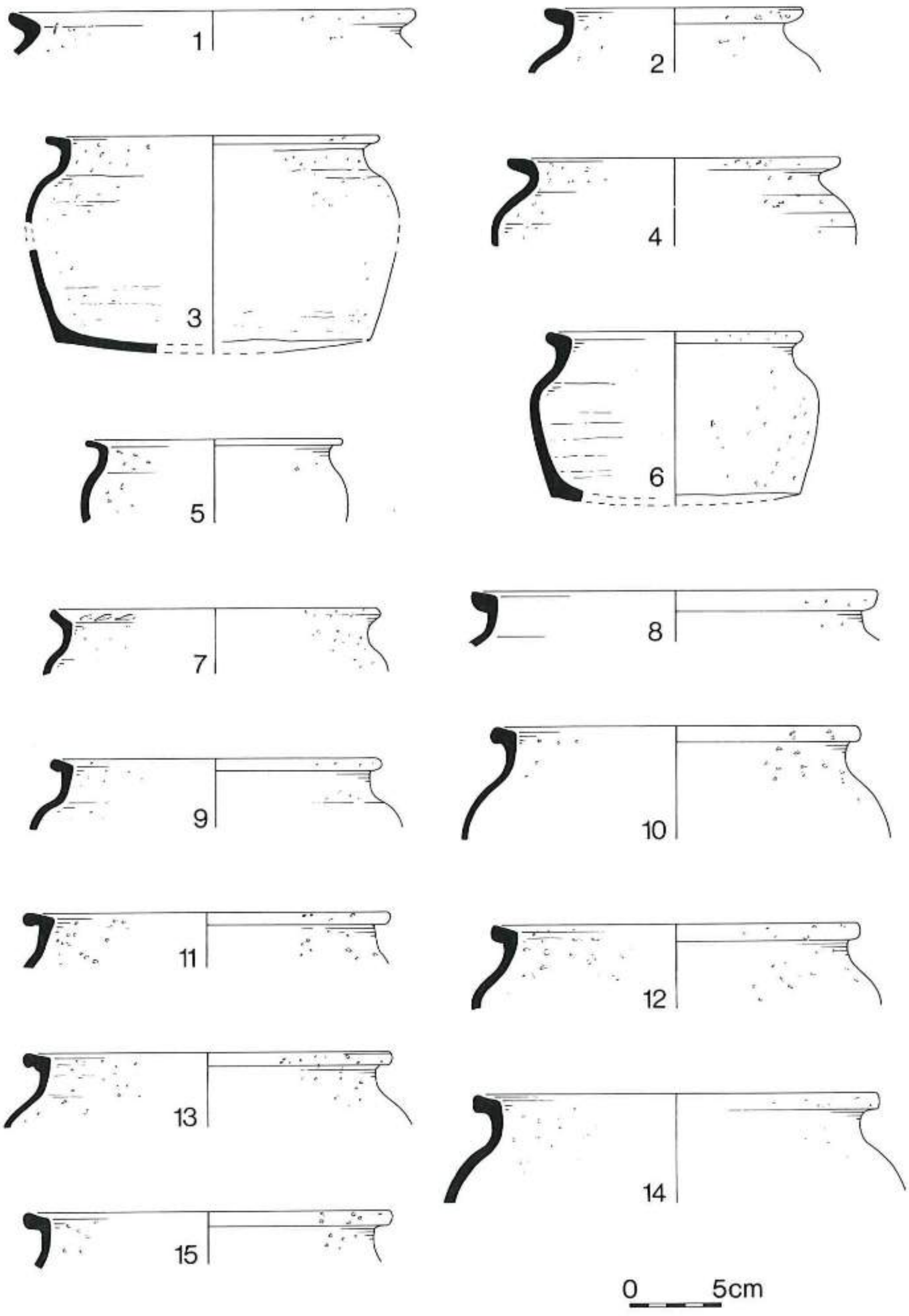


Fig 12 Shelly-Sandy ware. Rim type 1.

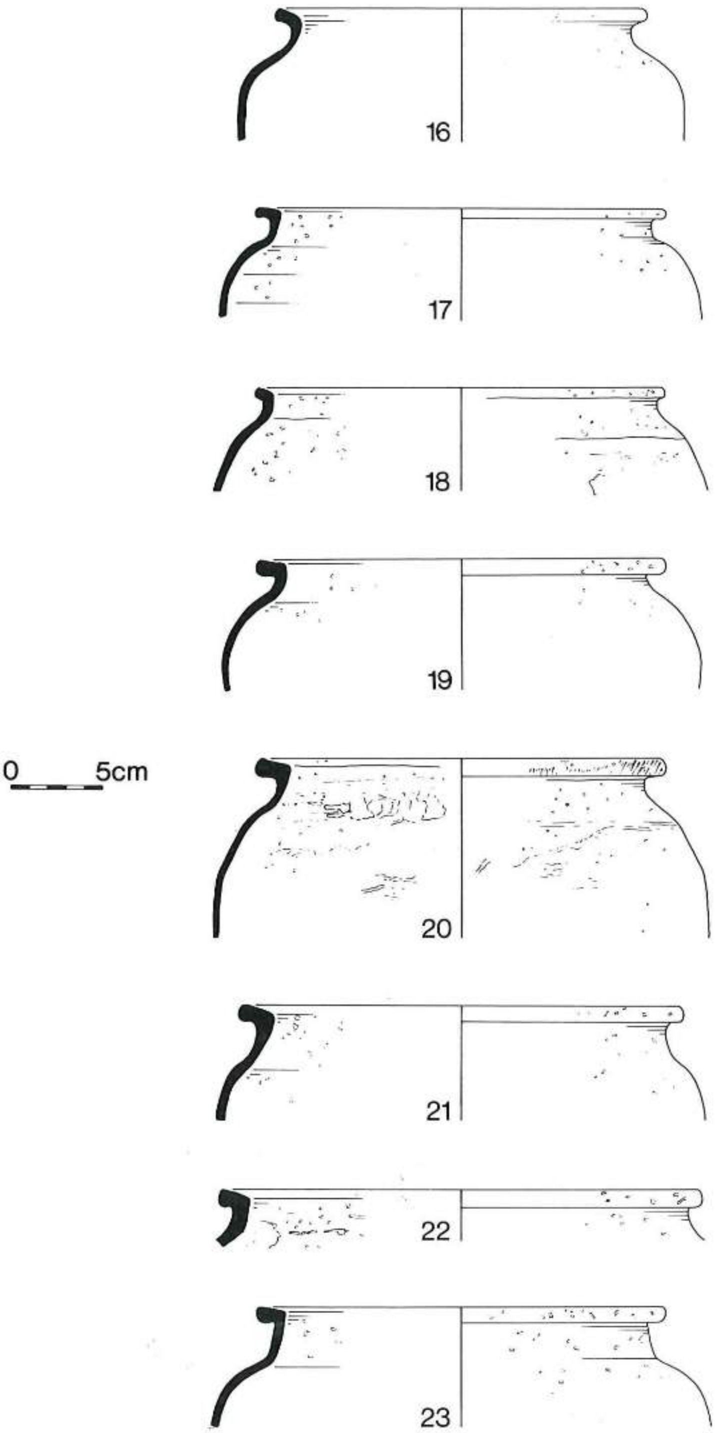


Fig 13 Shelly-Sandy ware. Rim type 1 (large vessels).

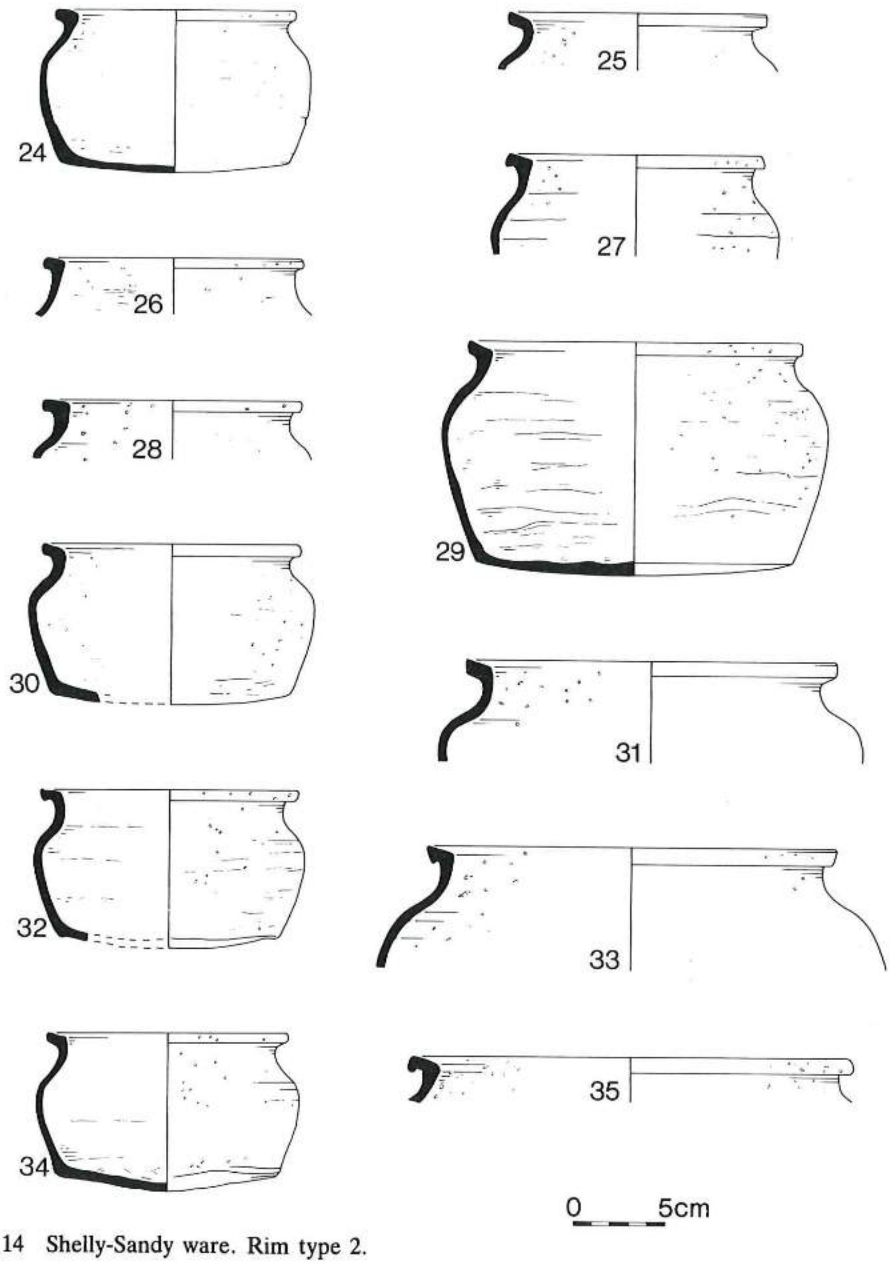


Fig 14 Shelly-Sandy ware. Rim type 2.

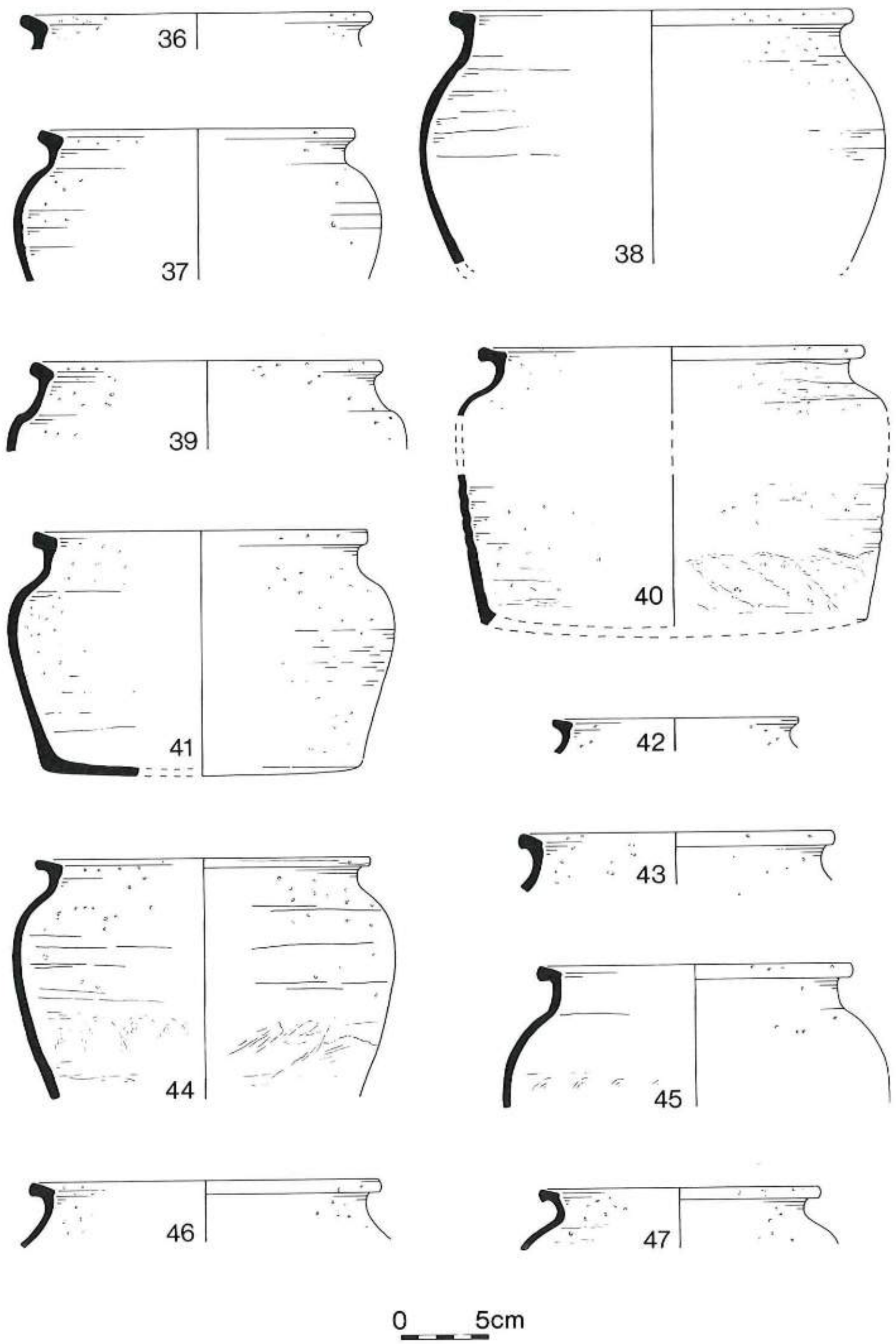


Fig 15 Shelly-sandy ware. Rim type 3.

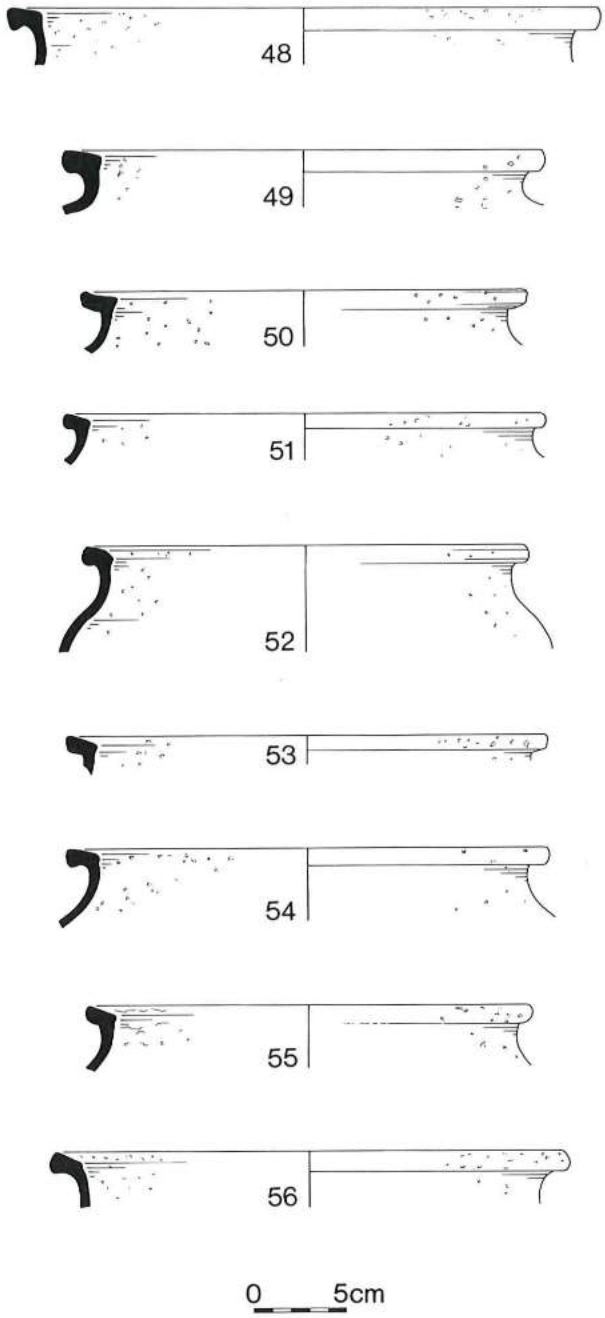


Fig 16 Shelly-Sandy ware. Rim type 3 (large vessels).

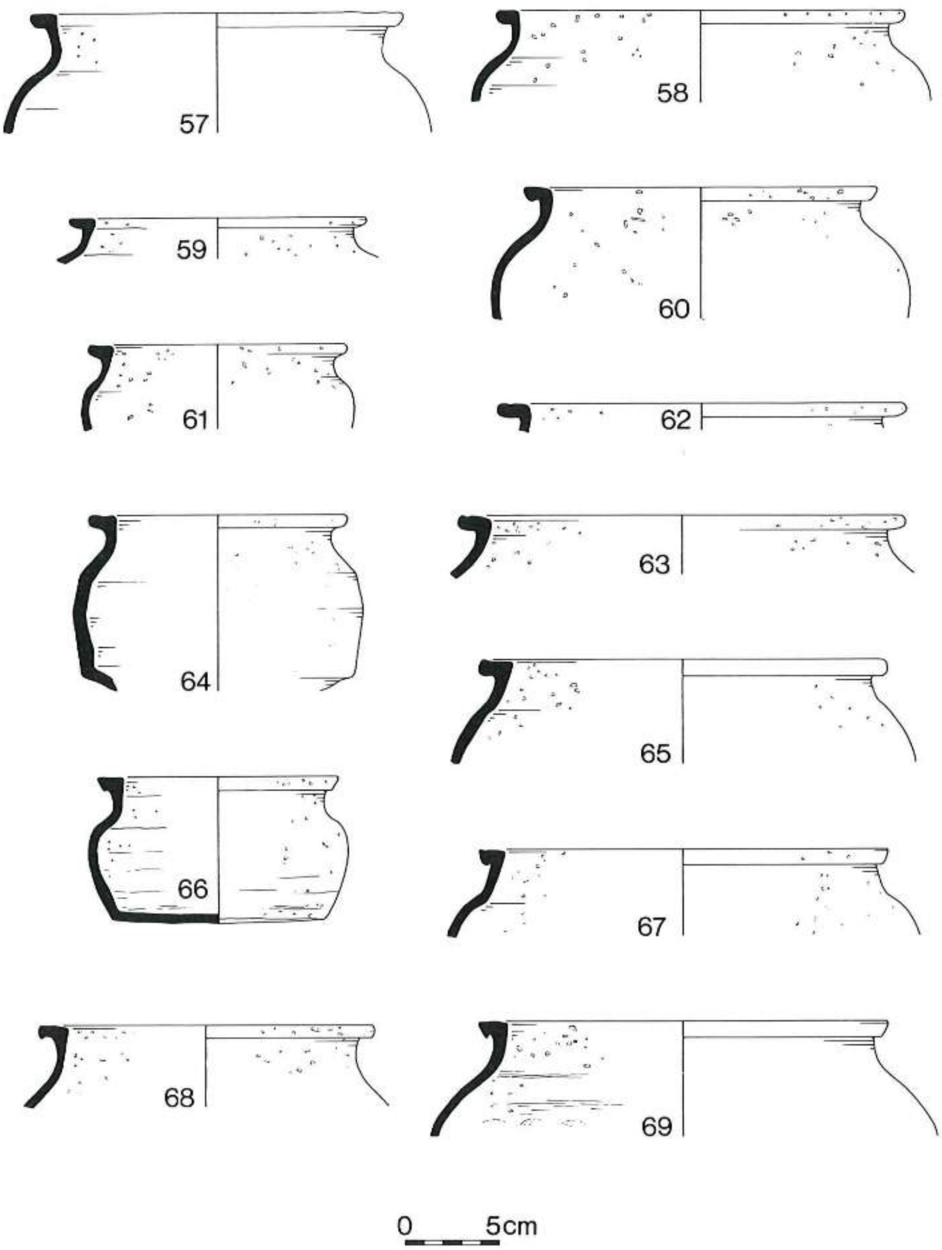


Fig 17 Shelly-Sandy ware. Rim types 4, 5 and 6.

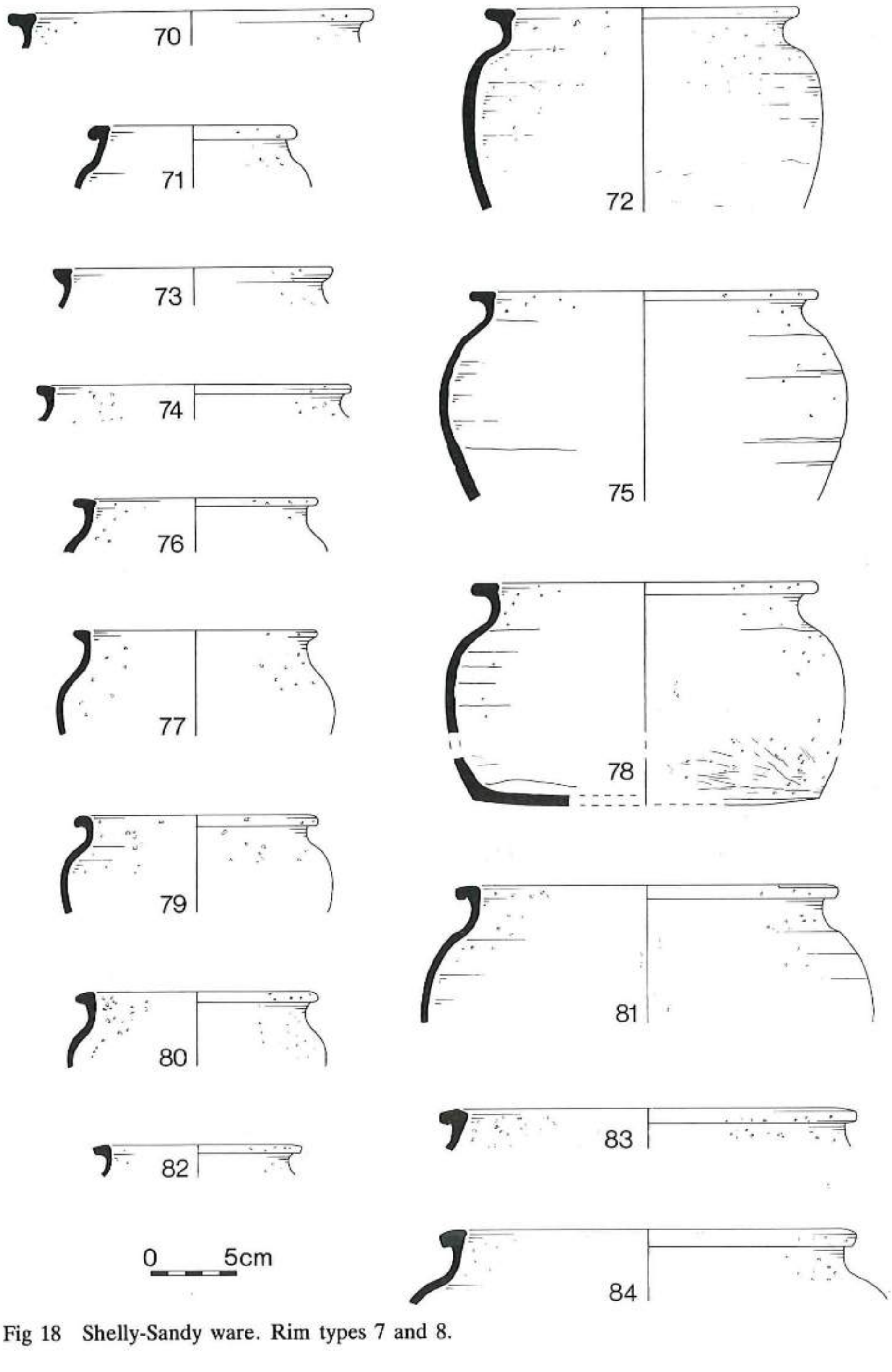


Fig 18 Shelly-Sandy ware. Rim types 7 and 8.

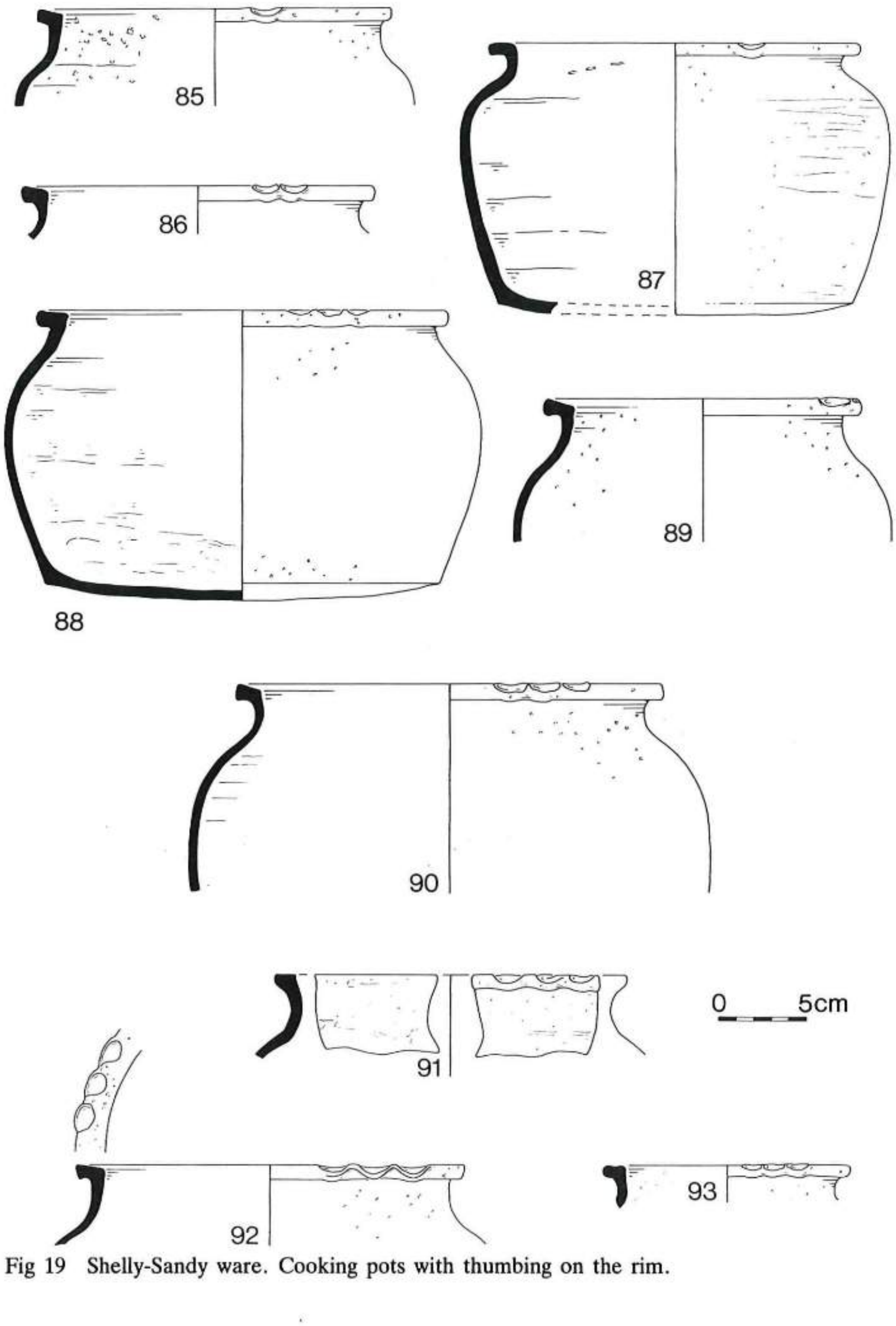


Fig 19 Shelly-Sandy ware. Cooking pots with thumbing on the rim.

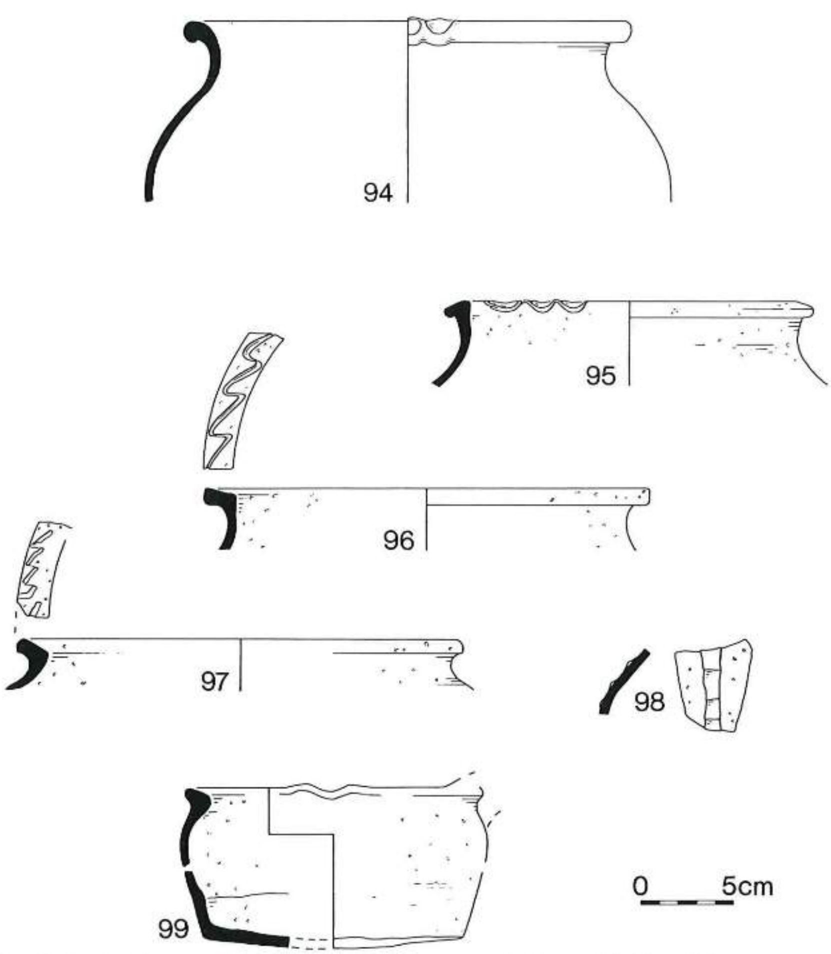


Fig 20 Shelly-Sandy ware. Decorated cooking pots and the pipkin (no. 99).

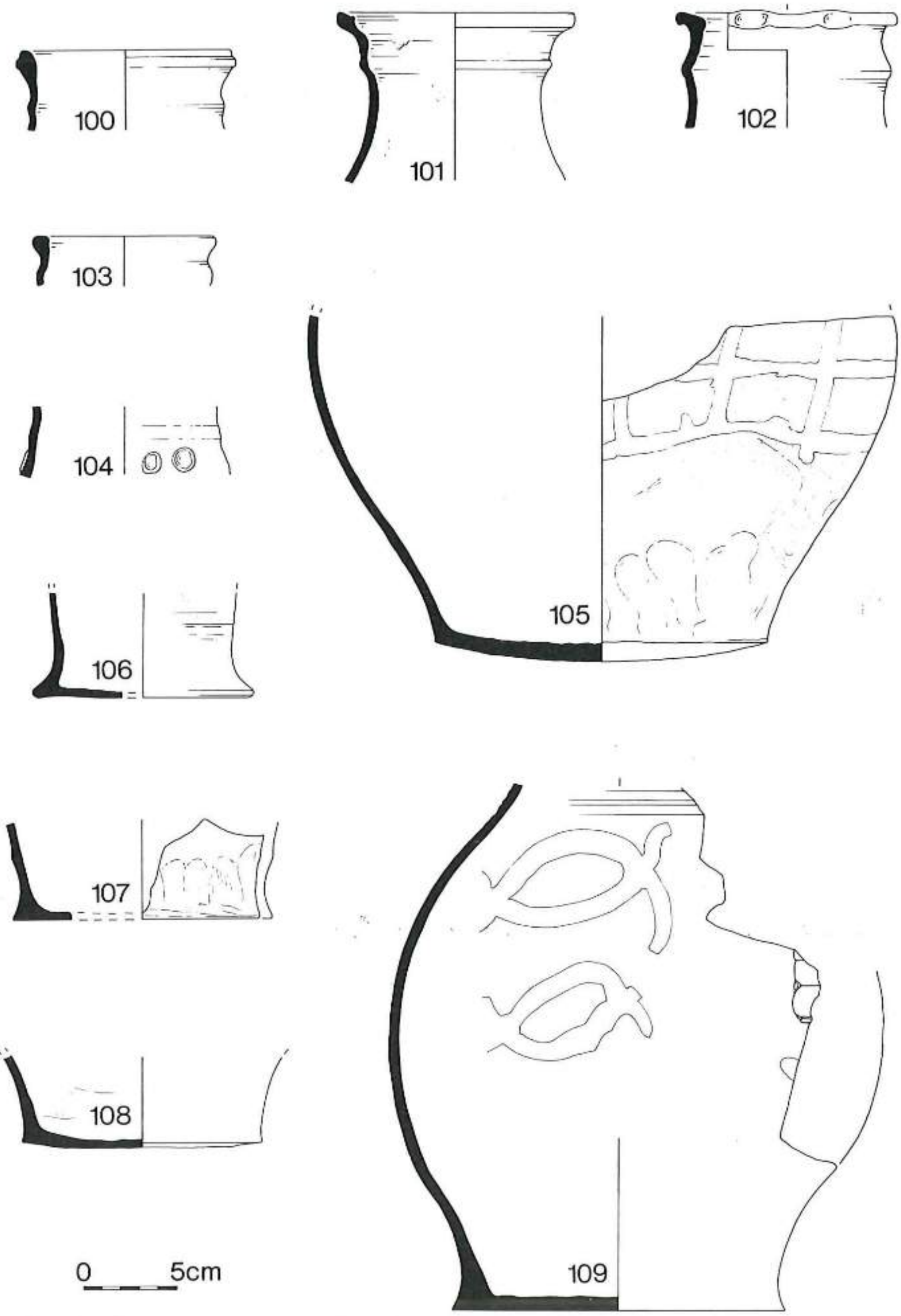


Fig 21 London-type ware. Early Rounded jugs.

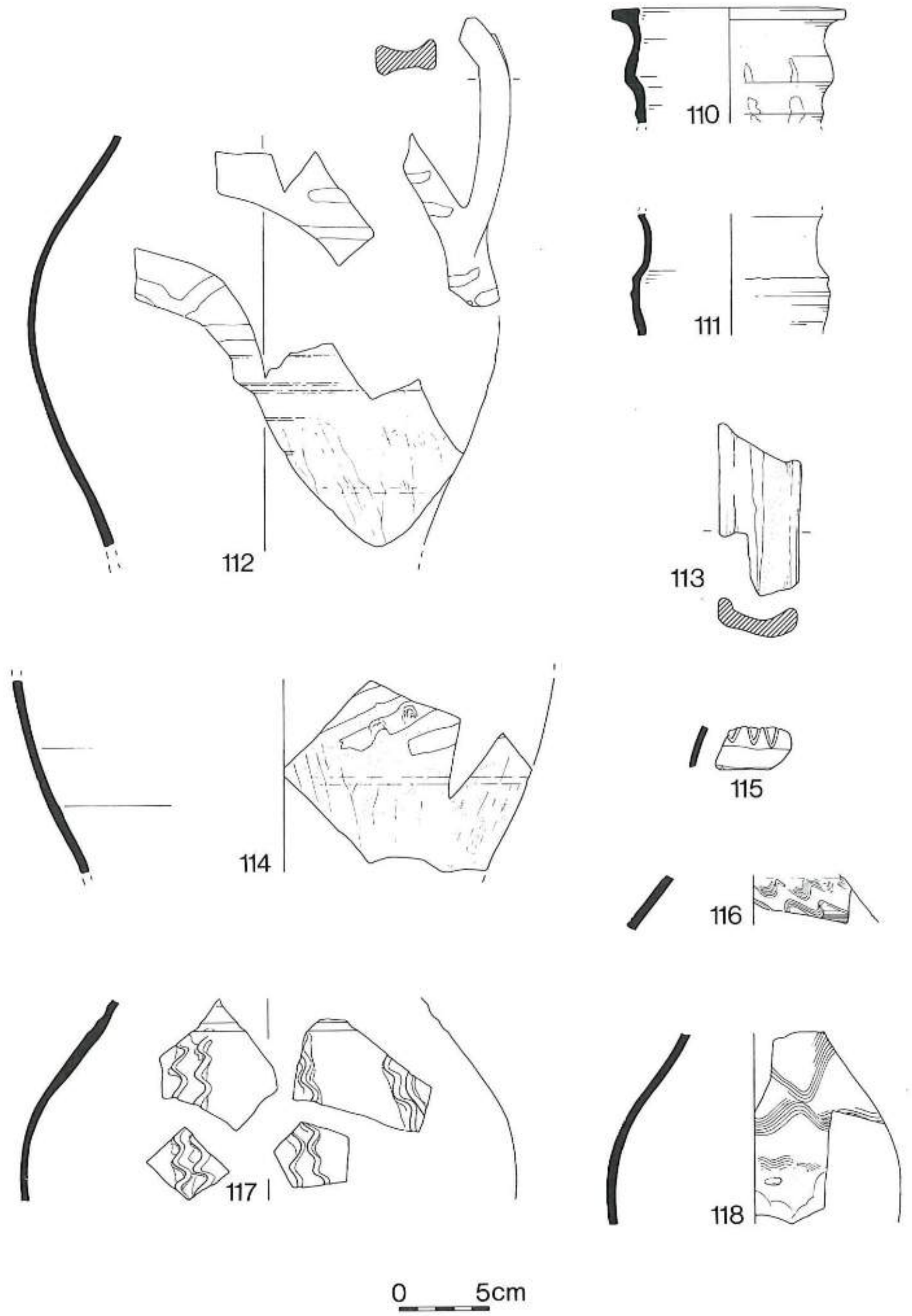


Fig 22 London-type ware. Early Rounded jugs.

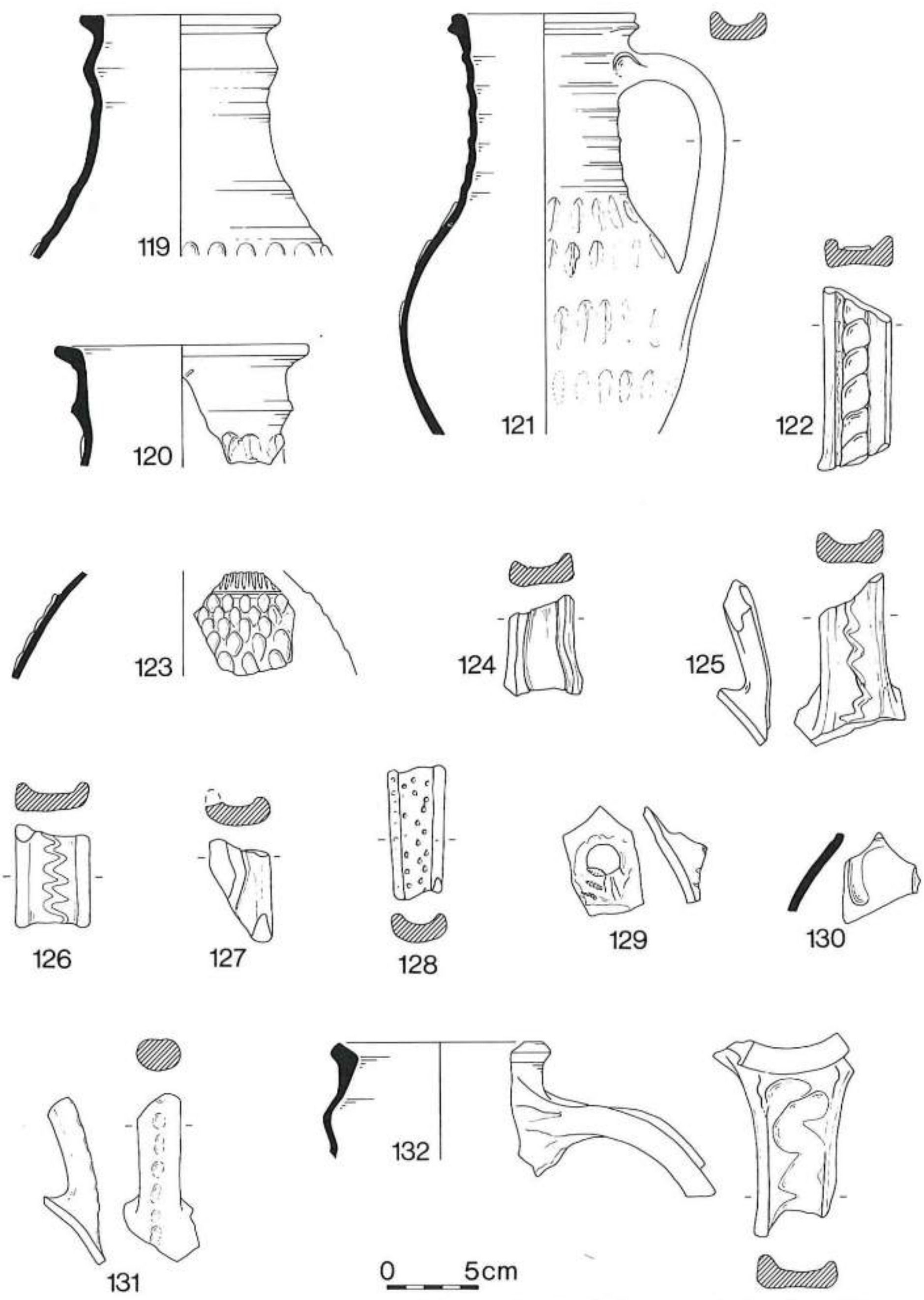


Fig 23 London-type ware. Early Rounded jugs and a North French-style jug (no. 123).

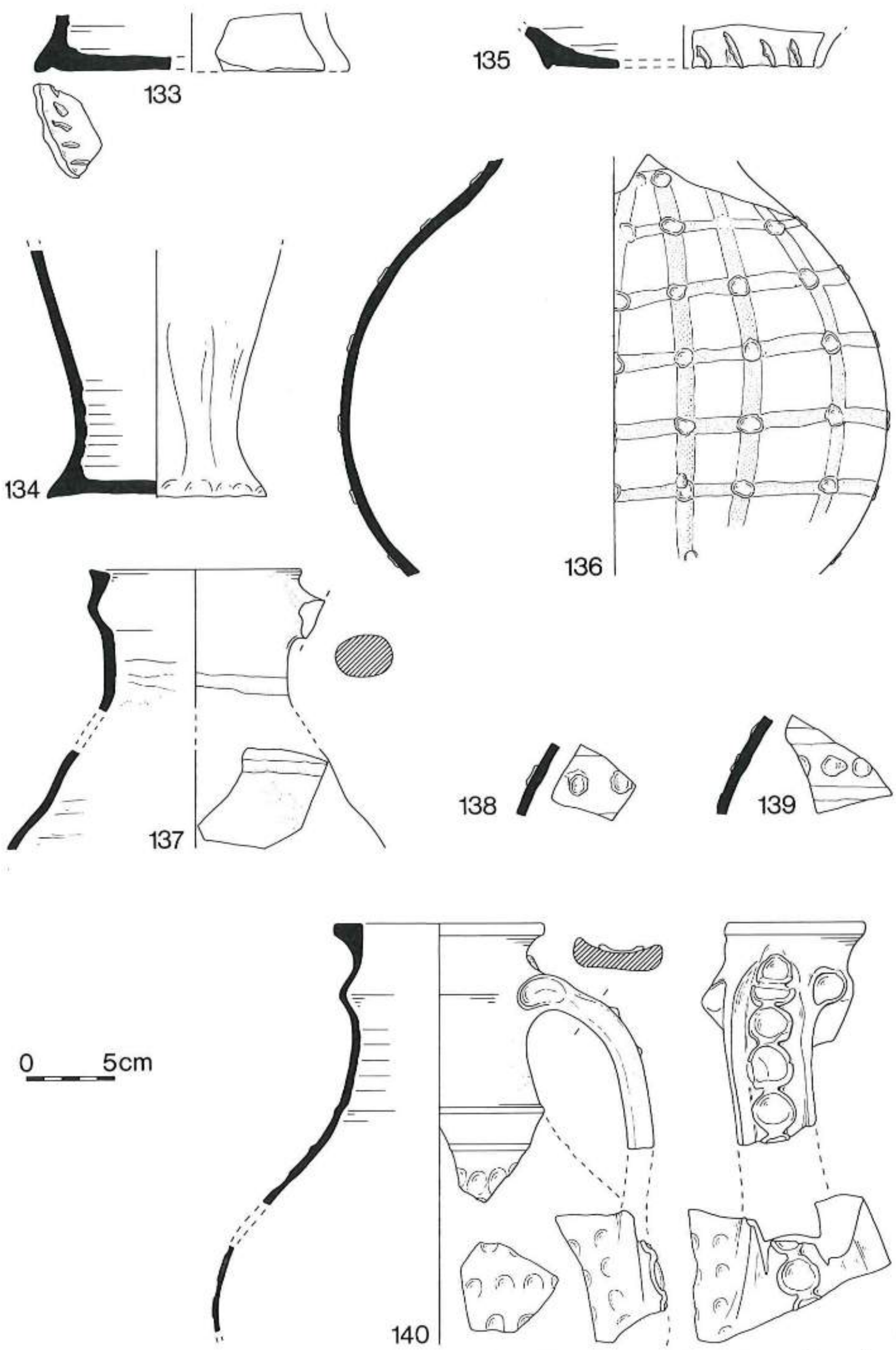


Fig 24 London-type ware. Early Baluster jugs (nos 133–134) and Large Squat jugs (nos 135–140).

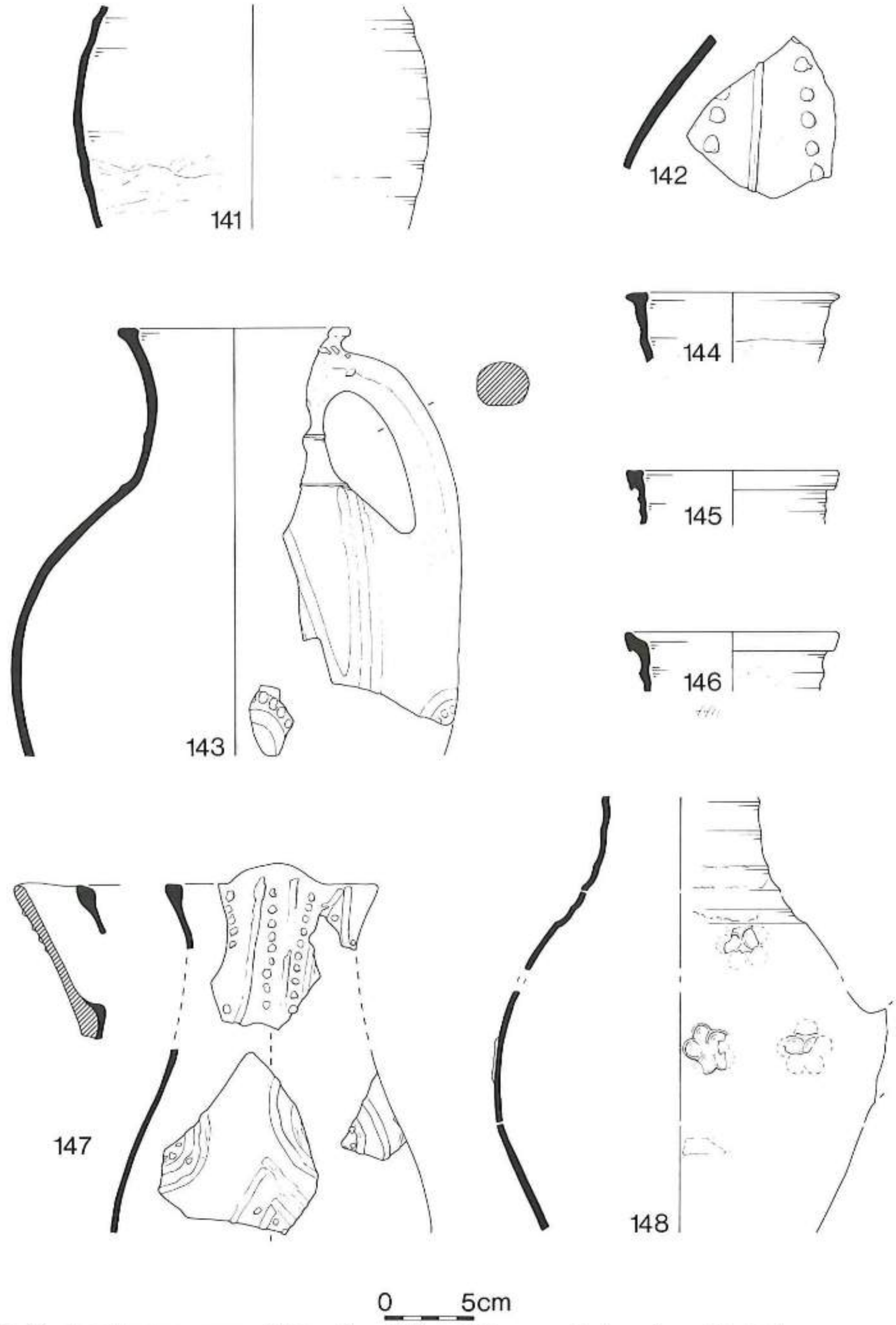


Fig 25 London-type ware. Pitcher (no. 141) and Rouen-style jugs (nos 142–148).

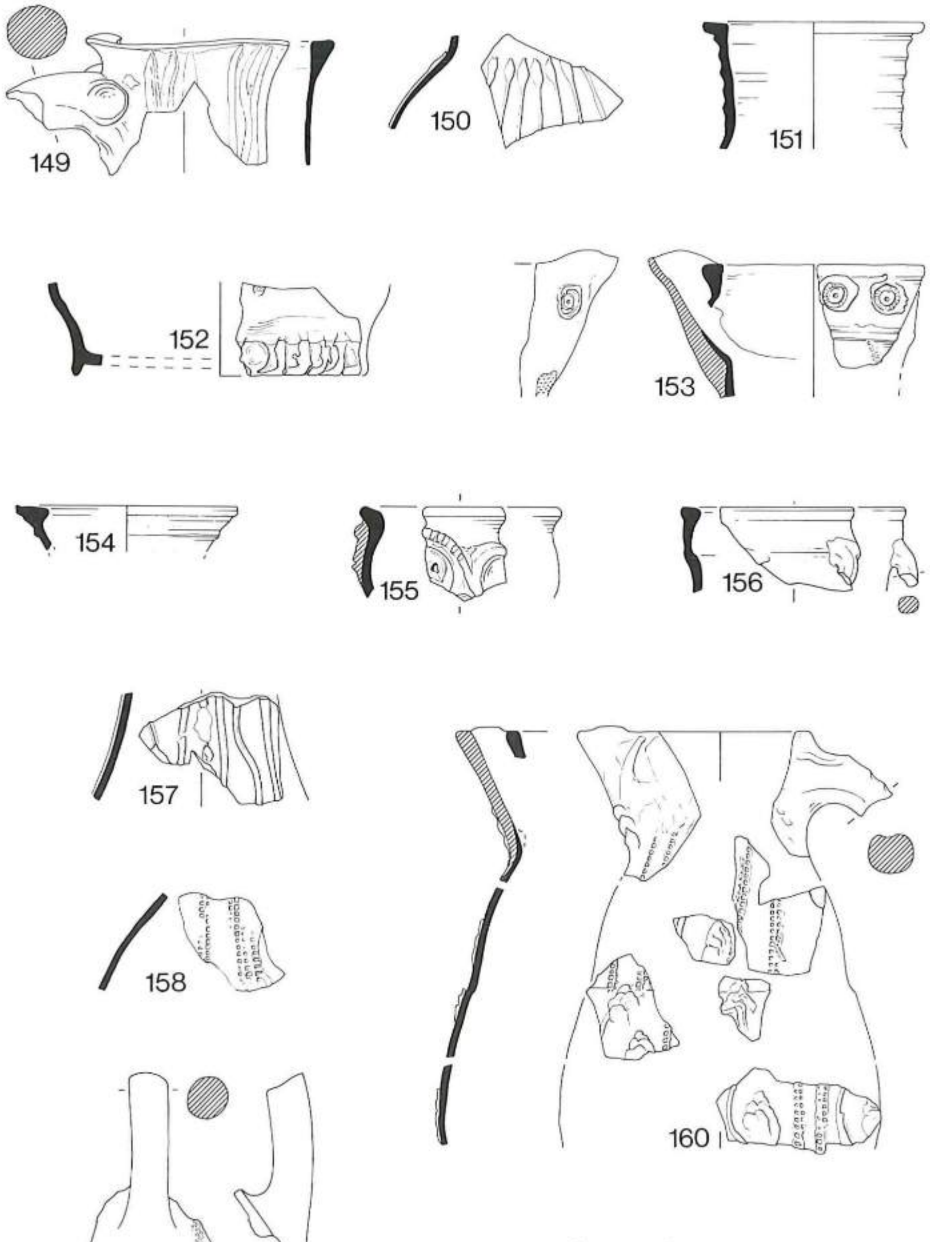


Fig 26 London-type ware jugs. Rouen-style (no. 149) and North French-style (nos 150, 151), Large Rounded (nos 152, 157, 159), Large Rounded/Pear-shaped (no. 153), Zoomorphic (nos 155, 156), Small baluster (nos 157, 158), Pear-shaped (no. 160).

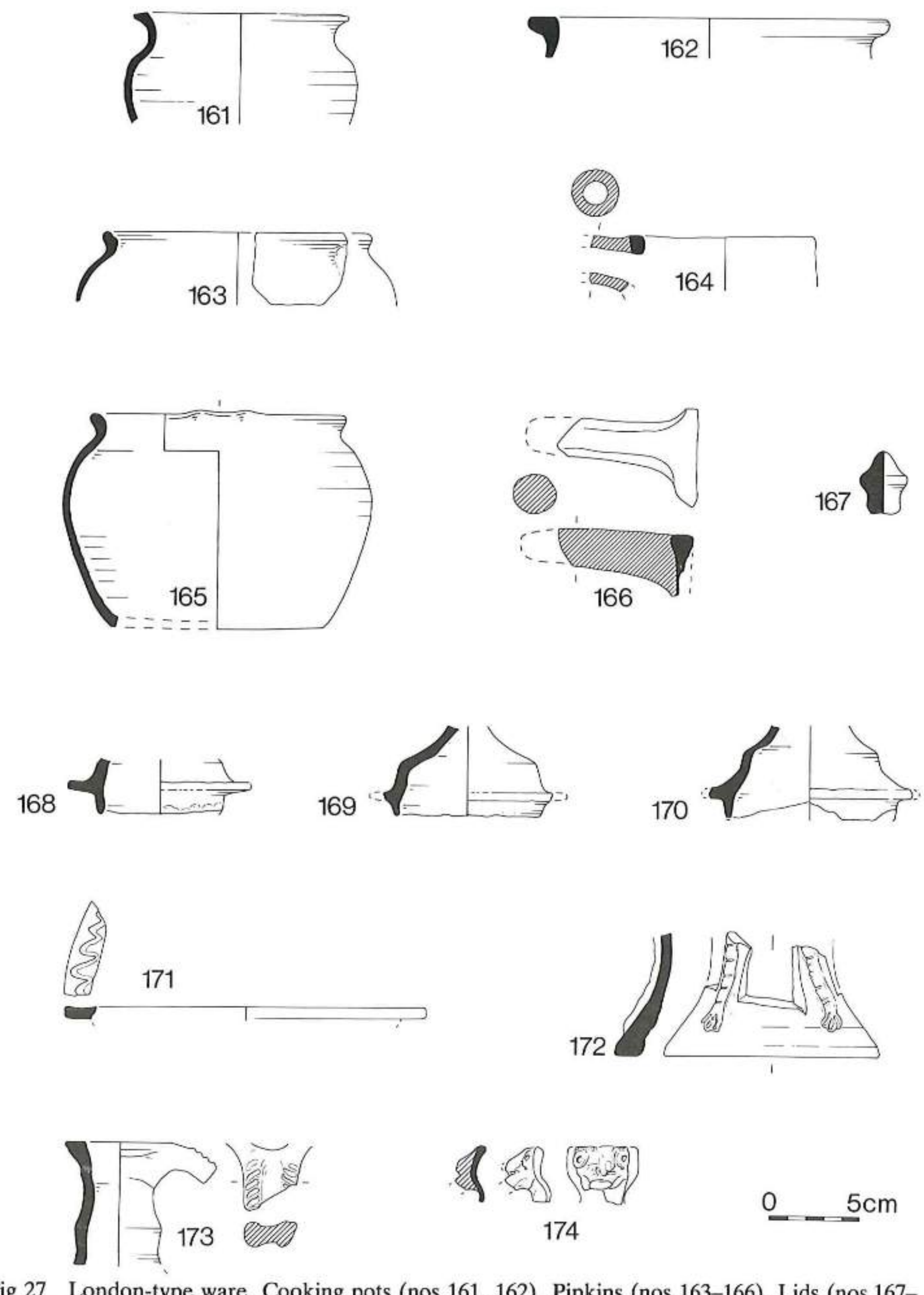


Fig 27 London-type ware. Cooking pots (nos 161, 162), Pipkins (nos 163–166), Lids (nos 167–170), Chafing dishes (nos 171, 172), Tubular-spouted jug (no. 173) and Miniature jug (no. 174).

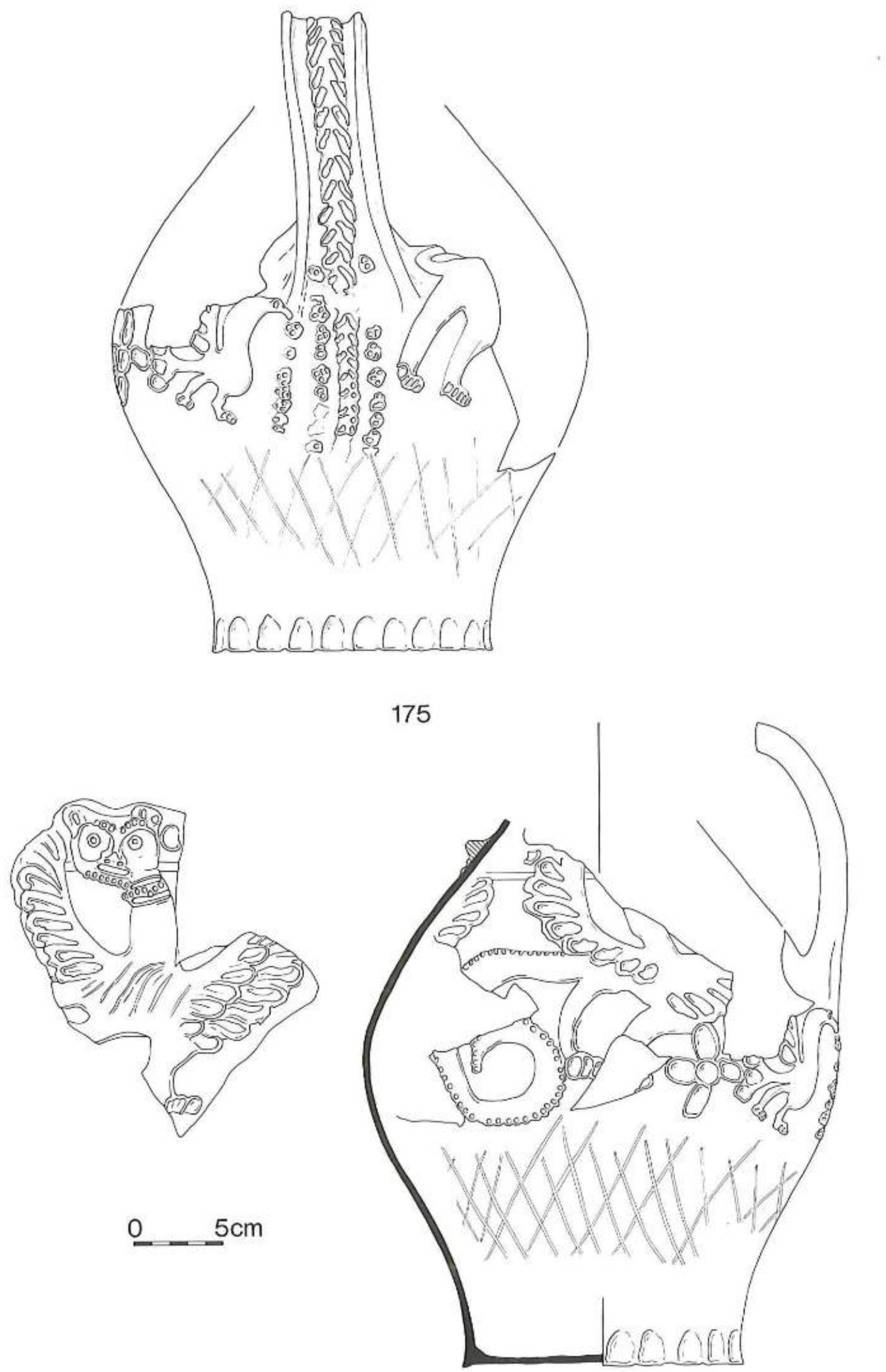


Fig 28 London-type ware. Large Rounded jug with applied zoomorphic decoration.

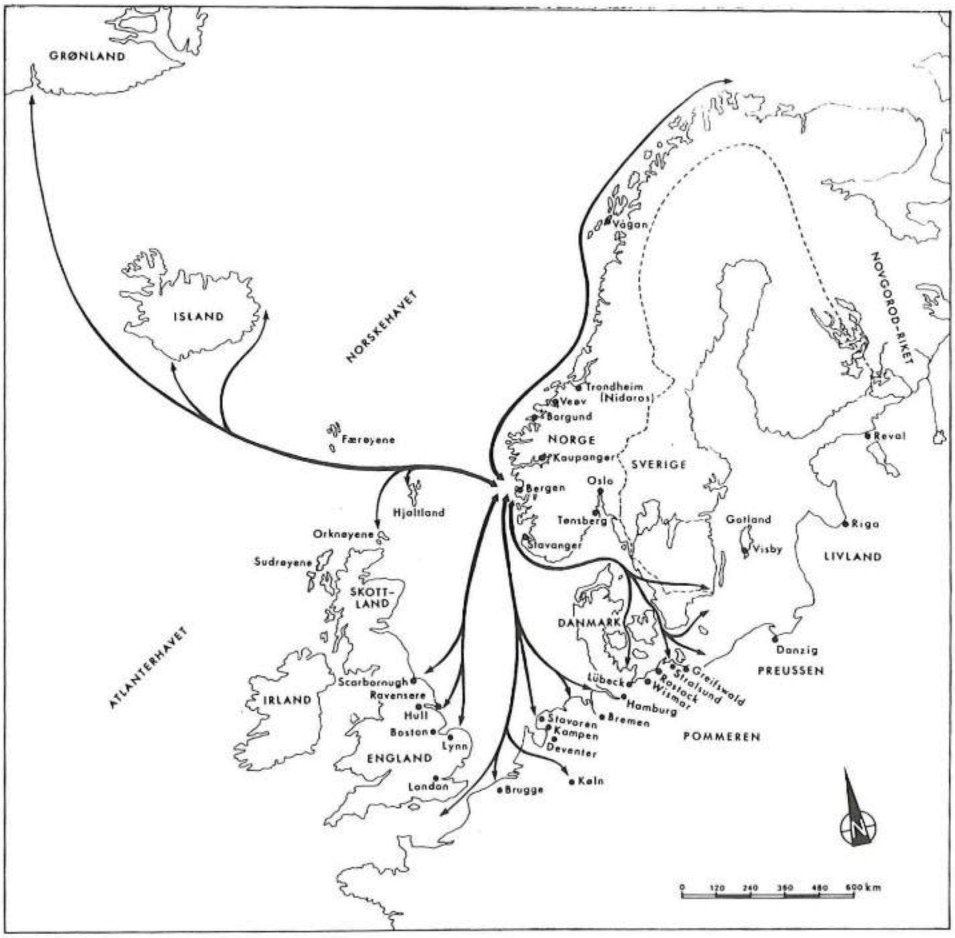


Fig 29 Trade routes in the thirteenth century, showing the sites mentioned in the text (from Helle 1982a).

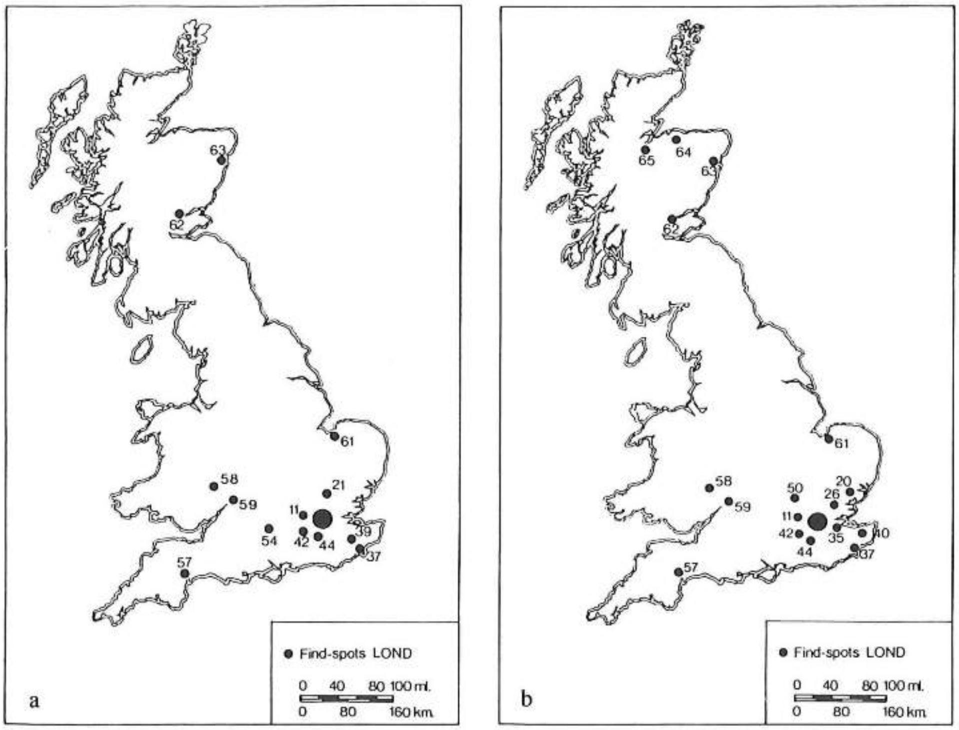
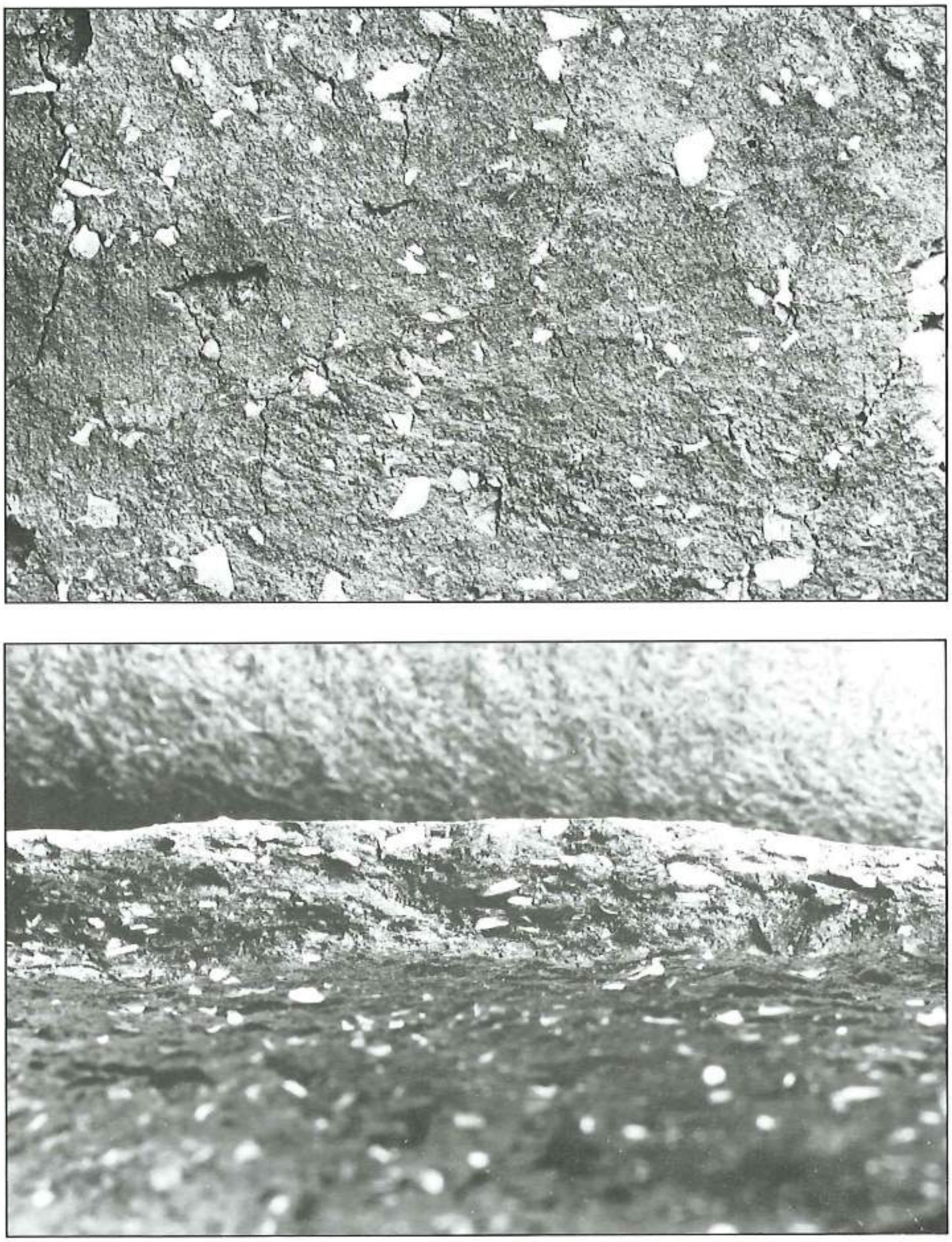
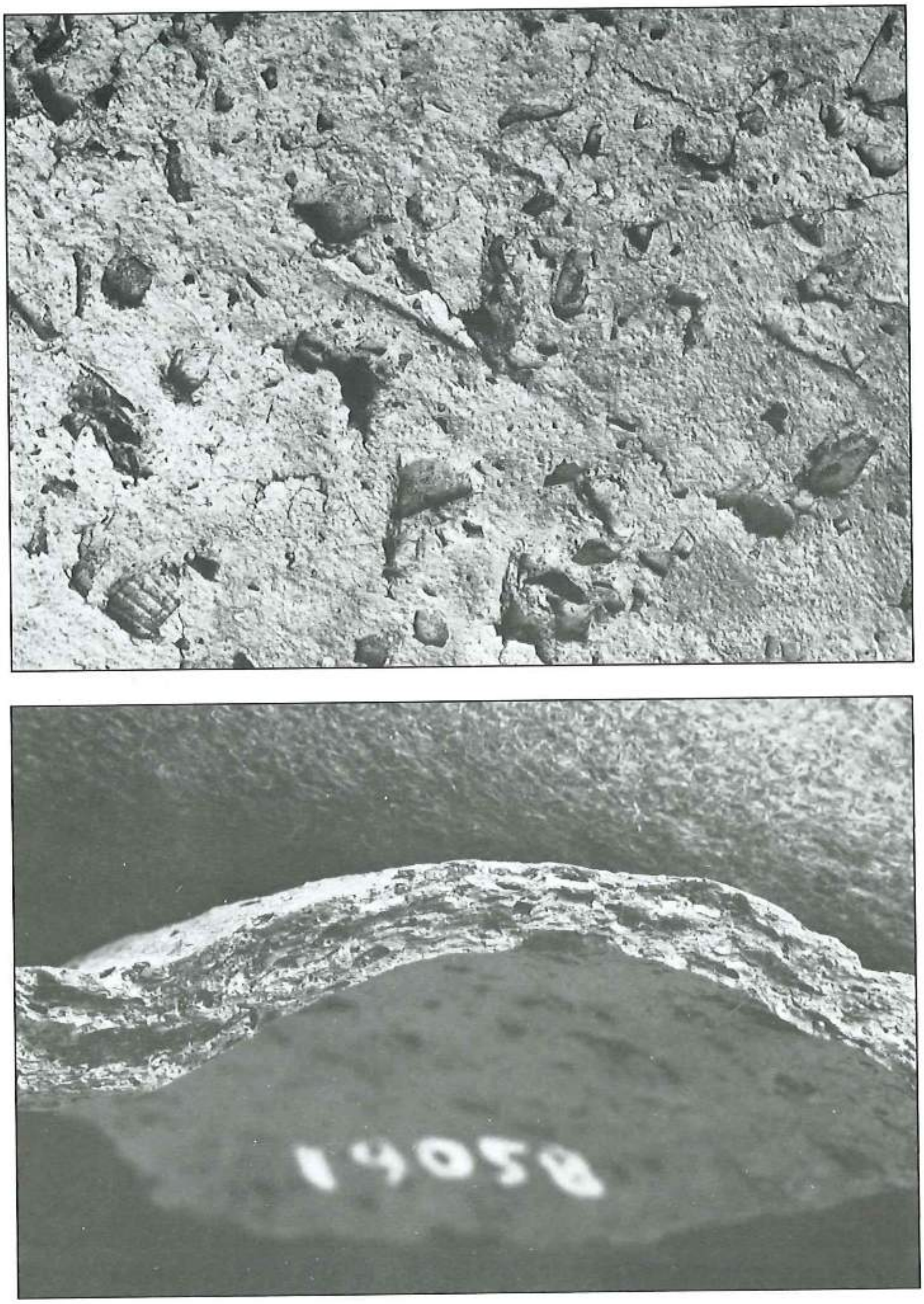


Fig 30 Mainland Britain showing the distribution of London-type ware (a) in the twelfth and (b) in the thirteenth century. Only the furthest extent of the distribution in the south-east is shown, not every site at which the ware is found. From Pearce *et al* 1985.

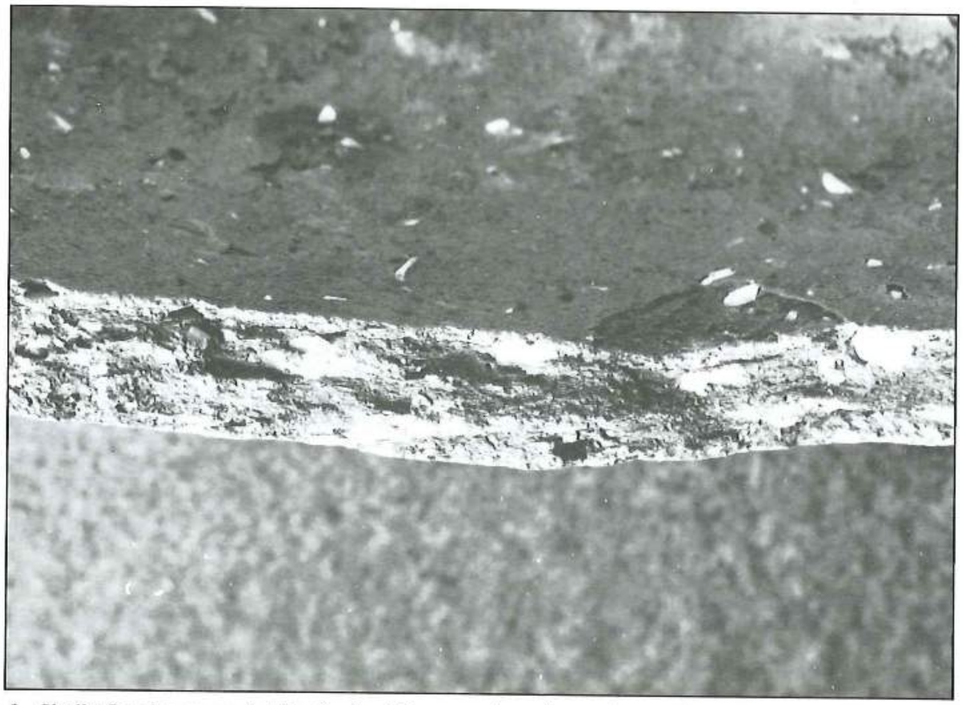
Plates



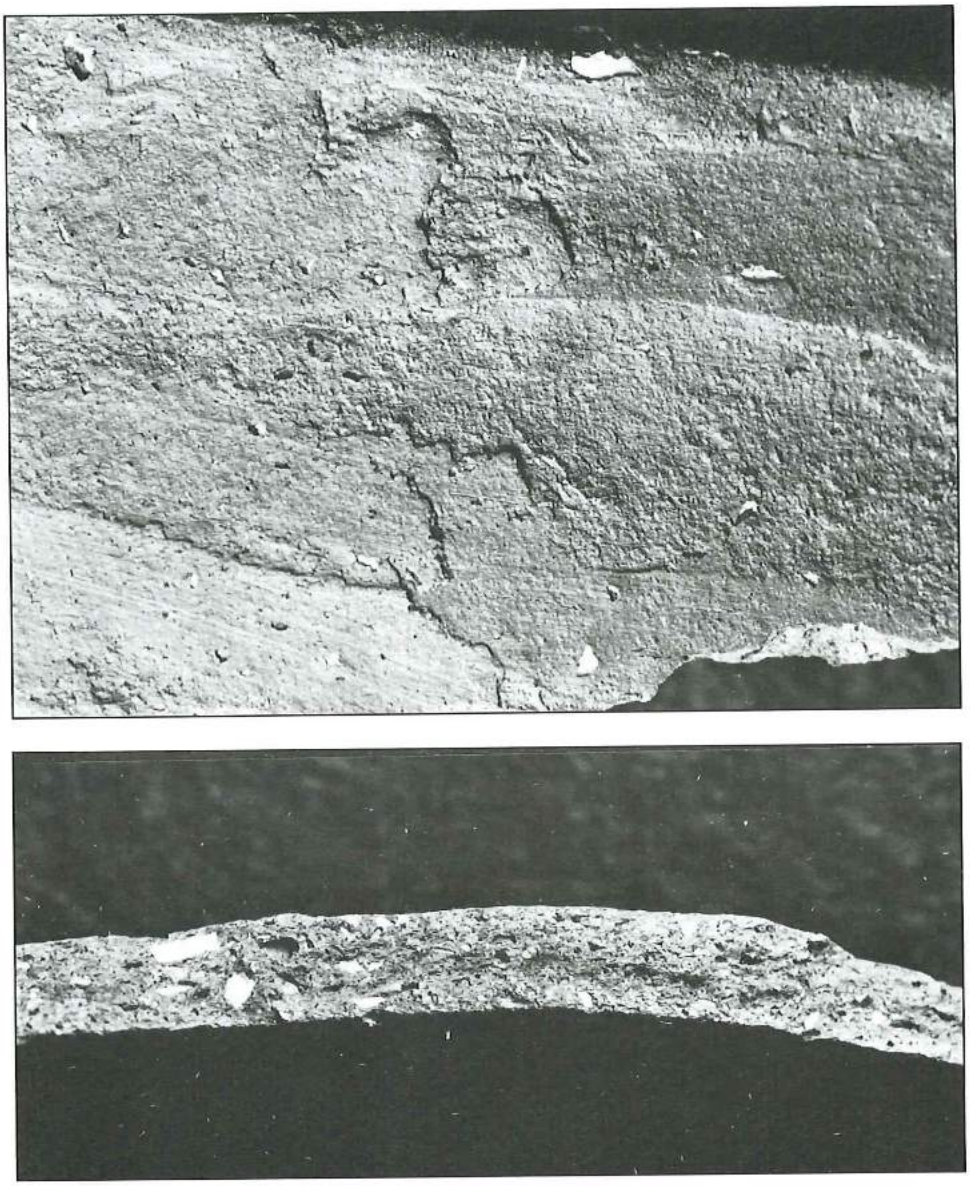
1. Shelly-Sandy ware: detail of Fabric 3 (accession no. 20984).



2. Shelly-Sandy ware: detail of Fabric 2, showing leached shell inclusions (accession no. 19058).

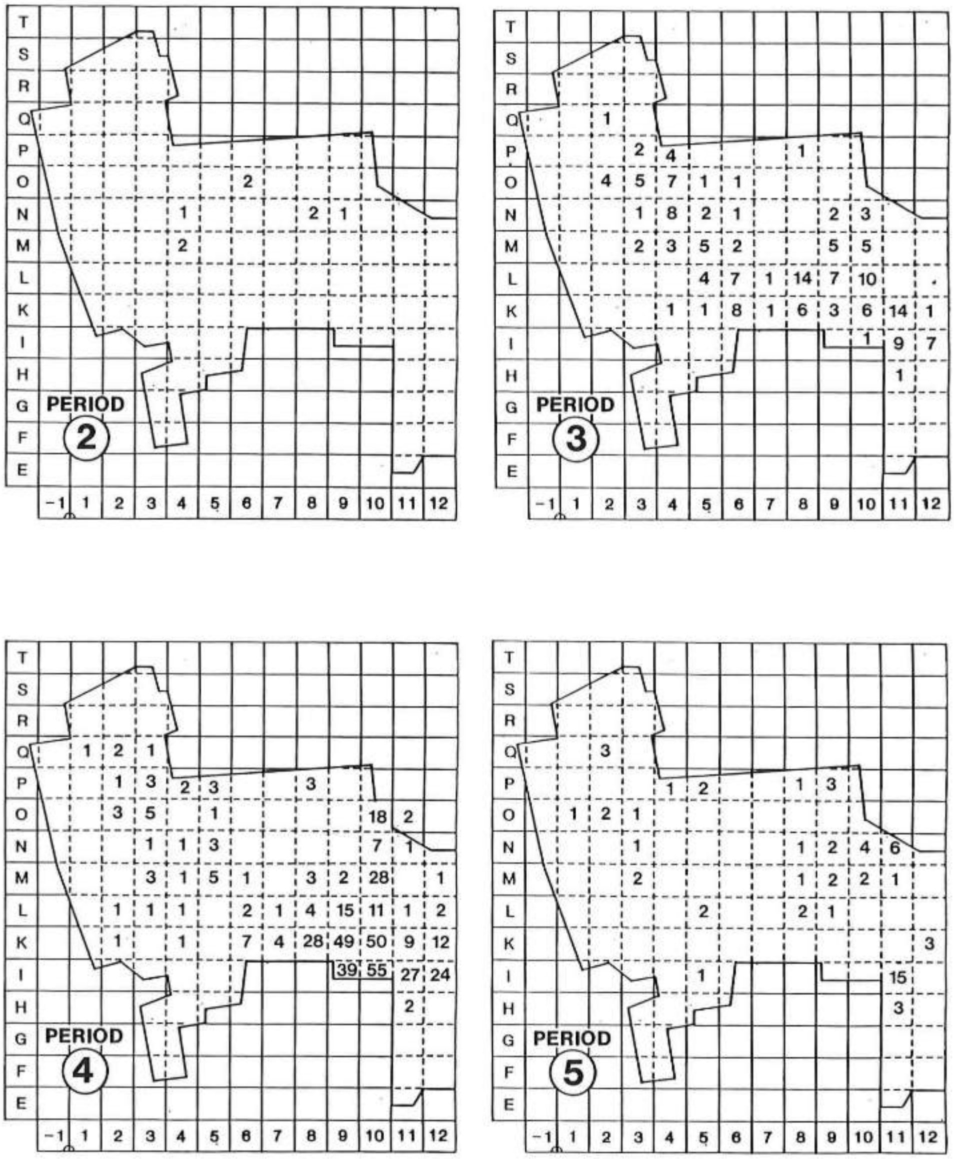


3. Shelly-Sandy ware: detail of wiped inner surface (accession no. 21578).

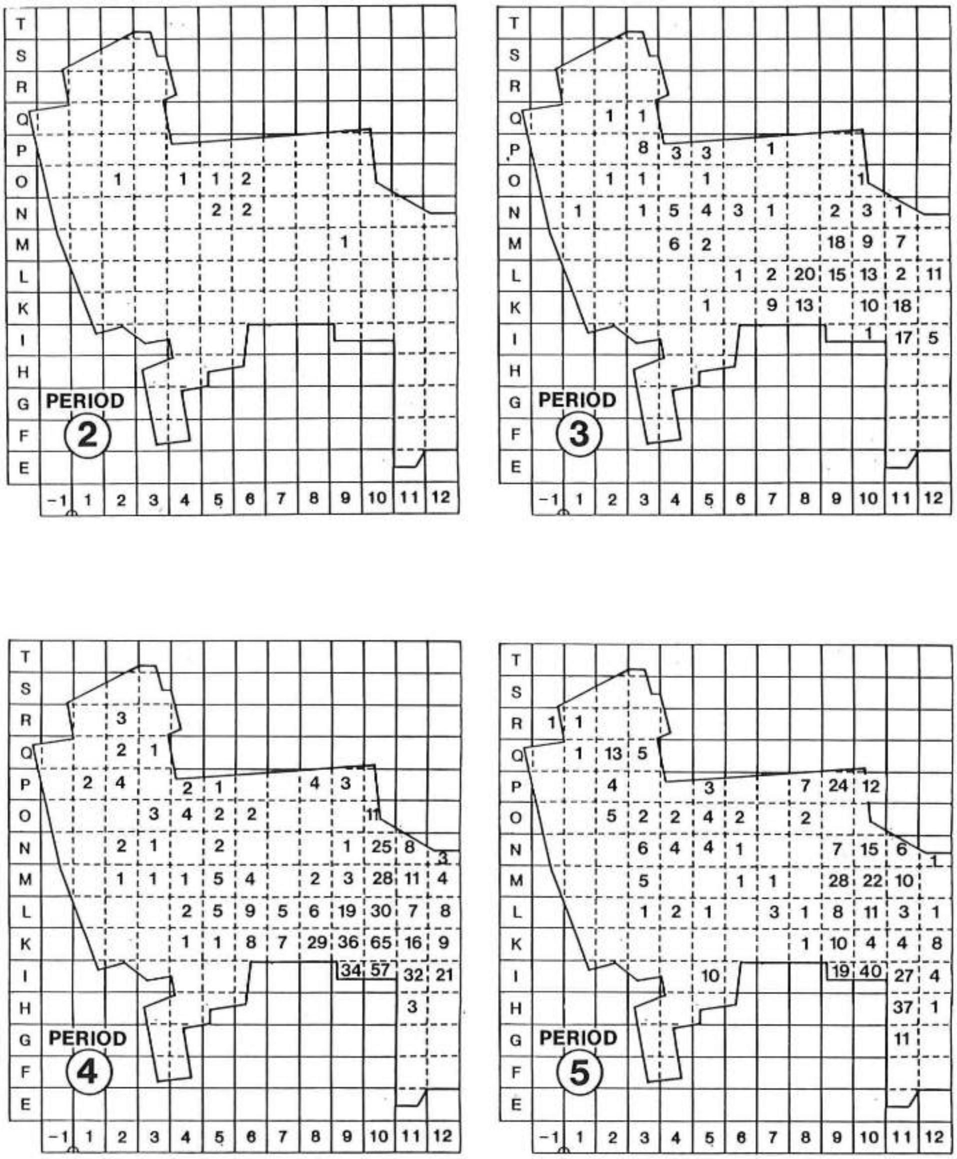


4. Shelly-Sandy ware: detail of wiping on underside of base (accession no. 9732).

Diagrams



1 The distribution of Shelly-Sandy ware on the Bryggen, Periods 2–5.



2 The distribution of London-type ware, Periods 2–5.

FRENCH MEDIEVAL CERAMICS FROM THE BRYGGEN EXCAVATIONS IN BERGEN, NORWAY

by

Didier Deroeux, Daniel Dufournier &
Asbjørn E Herteig

Contents

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1 Context of the study

Thanks to its situation, the port of Bergen (Fig 1) assumed at an early date a significant role in Norway's trade with Europe and became one of the main Hanseatic trading stations, or *Kontore*, abroad, similar to Bruges, London and Novgorod (Dollinger 1964; Herteig 1969). The Hanse merchants occupied the wooden buildings and wharfs of Bryggen on the northern side of the harbour, where the plots of land lying at right angles to the sea shore were progressively extended over backfilled deposits into the harbour basin (Herteig 1985, 11).

In 1955, a great fire destroyed a large area of Bryggen, thus providing the opportunity for an exceptionally extensive archaeological excavation, which went on continuously until 1969. The stratigraphic sequence showed eight successive fire levels, precisely determining the chronology of the site. Herteig has been able to establish a correlation between the archaeological data and the historical sources which refer to the various fires affecting Bryggen in medieval and post-medieval times. The precise dates attributed by the archaeologist to the fires (Fig 2) are based on a deductive hypothesis; they do not, however, completely agree with the dates suggested by the dendrochronological analysis (Thun 1984; Herteig 1990, 12–17).

As the particularly complex post-excavation analysis of the structures and the associated finds was still in progress at the time of writing, we refer to Herteig's earlier synthesis (Herteig 1985) and have followed the system adopted by Lüdtke (1989, 11–20) of examining the chronological distribution of the sherds period by period, a period being defined as the interval between two fires (cf Fig 2). The geographical distribution of the finds is based on the 8m × 8m squares of the excavation grid (Fig 8), which was laid out on approximately the same alignment as the modern properties of Bugården, Engelgården, Søstergården and Gullskogården (Herteig 1985).

The excavation produced a significant amount of information about the occupation of the site and the arrangement of the buildings associated with the port trade, as well as the material culture and daily life of the inhabitants in this quarter of the city in the medieval and post-medieval period.

There was no ceramic production in Norway during the Middle Ages, and so the origin of the sherds recovered from the excavations must be looked for elsewhere in Europe (1). During excavation, an initial visual classification of pottery was made according to traditional typological criteria. This allowed 'national sets' of pottery to be identified, the detailed study of which has subsequently been entrusted to a number of specialists (eg Lüdtke 1989; Vince & Blackmore, report in this volume).

Although they are very fragmentary, the sherds presumed to be of French origin could be divided into six groups: 'Beauvais', 'Rouen', 'Saintonge', 'North French', 'French type', and 'French monochrome'. In 1988 we undertook at Herteig's request a closer study of this pottery.

Reconstruction has provided a few complete profiles, but only of pottery presumed to be from Beauvais. Moreover, we noticed that the number of vessels identified from handles was unusually high compared with the number of vessels identified from rim sherds, at a ratio of 2:1. Consequently, any attempt at a quantification of sherds is unreliable and destined to produce somewhat absurd results. These circumstances have therefore dissuaded us from giving an exhaustive list of sherds, which would not really be useful in this case, and have led us to devote more space to a synthesizing approach, based on the major qualitative features of the finds.

Our reconsideration of the sherds during the work and further vessel reconstructions convinced us of the need to correct some of the attributions, basing our conclusions at first on visual observation and subsequently on the physico-chemical analysis.

2 Chemical definition of groups

A chemical analysis was carried out on 135 sherds whose place of origin had been tentatively identified as follows:

12 sherds presumed to be from Beauvais,
50 sherds presumed to be from Saintes,
34 sherds presumed to be from Rouen,
17 sherds classified as 'North French',
19 sherds classified as 'French type',
3 sherds classified as 'French monochrome'.

The analysis focused on the following ten oxides: SiO_2, Al_2O_3, Fe_2O_3, TiO_2, CaO, MgO, Na_2O, K_2O, MnO and P_2O_5.

A simple visual observation of the results allowed us immediately to distinguish a few sherds (nos 131–135) by their particular content of Fe_2O_3 and/or CaO, MgO and Na_2O (table I a–e). These could thus be excluded from the mathematically-based classification, which consisted of a cluster analysis based on the results of a Principal Components Analysis (first four principal components) of the normalized chemical data (mean = 0, standard deviation = 1) (2).

Only six of the chemical compounds were used in this classification process (SiO_2, Al_2O_3, Fe_2O_3, TiO_2, MgO and K_2O), because certain phenomena greatly altered the ratio of the other oxides in many samples, in particular the ratio of CaO, P_2O_5 and MnO (for example, in nos 8, 47, 66, 83, etc) (3).

For the same reason and before carrying out the calculations, it was essential to reduce the influence of the most disruptive constituents, especially P_2O_5 and CaO, on the rest of the chemical composition. This was corrected by supposing that all the samples had a constant P_2O_5 + CaO content, and a value equal to 1% was chosen (4). Without this precaution, it would have been pointless to attempt a classification that would have placed samples in different groups distinguished only by the degree of alteration.

The classification highlighted eleven groups of distinctive chemical composition (G1–11), of which the first four alone (G1–G4a/b) cover 108 of the 130 sherds, in other words almost 85% of the total (5). The other seven groups (G5–G11) covered therefore the remaining 22 sherds!

In order not to spoil the synthetisizing significance of this study, let us first deal with the problem of these disparate 22 sherds. Of these, 11 belong to the set of 12 sherds presumed to be of Beauvais origin (nos 112, 117–126) (6) and they are spread over the four chemical groups G6–G9. None of the samples in this *'Beauvaisin'* set can be related to any known products from Beauvais (7) and we must therefore search elsewhere for the origin of this ware, probably outside French territory. Attention is drawn to the fact that these sherds are from the later periods, in particular Periods 8 and 9 (cf Fig 2).

The other 11 'disparate' sherds are spread among the following groups: G5 (nos 109–111), G6 (nos 113–116), G9 (nos 127–128), G10 (no. 129), and G11 (no. 130). Their limited number makes any further study useless, and the same can be said for nos 131–135, which had been excluded from the mathematically-based classification. Nos 134 and 135, however, which are of a particularly unusual type, are dealt with briefly in an appendix to this paper. It should be noted that the chemical composition of no. 130 (G11) is very close to that which characterizes the G1 group.

Table IIa shows the distribution of all 27 sherds in the disparate set according to their presumed origin and chemical group.

We shall now turn our attention to the first 4 groups, G1–G4, which are easily distinguishable and must represent four different production centres. Group G4 is divided into two subsets, referred to as G4a and G4b, on the basis of very slight differentiations in the proportions of Fe_2O_3 and MgO. However, the similarity of two very characteristic handles, one from G4a (no. 87, Fig 6) and the other from G4b (no. 108, Fig 6), encourages us to believe that, in spite of the very slight chemical dissimilarity, it is very likely that the two subsets share a common origin.

Table IIb shows the distribution by presumed origin of the sherds in groups G1–G4. The following observations must be made:

– the majority of the sherds presumed to be of Rouen origin are found in groups G1 and G2 (31 out of a total of 34), while most of the pottery presumed to be of Saintonge origin belongs to groups G3 and G4 (39 out of a total of 50);

– the set of sherds presumed to be from Rouen and those thought to be from Saintonge are therefore separated into two distinct wares.

– The distribution of the sherds within the various chemical composition groups allowed us to identify without any doubt the morphological features of these four sets.

3 Morphological definition of groups G1–G4

We shall first summarize the principal morphological features of the Bergen samples. Then, before going on to the study of the origins of the wares, we shall present some parallels of similar ceramic specimens from some French sites and areas where their occurrence is not incidental.

Groups G1 and G2 (Figs 3 & 4)

All the sherds making up group G1 (Fig 3) come from highly decorated jugs, made from a light clay, pale grey to white in colour, with a fine texture. This homogeneous type is characterized by

- a fluted, slightly widened, neck,
- a cordon in relief between the belly and the base (eg no. 25, Fig 3),
- a flat bottom,
- a rod handle more or less cylindrical or occasionally polygonal in section (eg no. 14, Fig 3), attached beneath the rim with noticeable lugs.

These jugs present different combinations of a varied repertoire of decoration. Whether or not they have been slipped with red-firing clay (8), all the pieces have an applied decoration formed from the same clay as the vessel and consisting of strips and plain or conical pellets. The strips and/or the top of the handle are occasionally decorated with a roulette. All the pieces are covered with a lead glaze, sometimes coloured green with copper oxide.

Group G2 (Fig 4) is composed of jugs made from a fine white clay, brighter than G1, and is distinguishable from that group by a greater variation (9), especially among the rim forms. All the handles are hollow, oval in section, and in most cases with a more or less pronounced rib on the top. The only piece where the upper fixing point of the handle could be studied shows no sign of a lug, but this cannot be regarded as a diagnostic feature.

Some sherds reveal types of decoration identical with those of group G1; others, however, are different, with applied strips of red-firing clay and engraved patterns. The lead glaze is often coloured green with copper oxide.

All the descriptive parameters of groups G1 and G2 correspond to what we know of pottery from Rouen and Paris found on French sites. The classic studies of K J Barton (1965; 1966) and J Nicourt (1986) are still useful. The large number of sherds found by Nicole and Olivier Meyer on the pottery production sites at Saint-Denis, near Paris, provide further invaluable references (Meyer *et al* 1979; 1981; 1983).

Group G3 (Fig 5)

Group G3 is represented by thin-walled pitchers made from a light clay of very fine texture, pale grey to pink in colour. The fragility and lightness of the ware explains the extremely fragmented state of the sherds, and only the type of decoration allows us to join different pieces together. We have been able to distinguish two types of jugs with the following characteristics:

- bridge spout with a bright, green, even glaze (eg no. 73, Fig 5)
- collar rim, bridge spout, baluster-shaped body, polychrome decoration, and clear glaze. The patterns consist of flat elements in yellow and green, outlined in brown.

These two types of jugs (10) fit in well with our knowledge of the medieval products from Saintonge found in France, especially with J Chapelot's types 120–121 and 124–125 (Chapelot 1983, 50). Earlier studies by David and Gabet (1972) and Barton (1963) have been renewed with the research carried out in Saintonge by Chapelot (1972; 1975, 57–62) and with recent discoveries in Saintonge (Henriet 1986; idem 1988) and Toulouse (de Filippo 1990).

Group G4 (Fig 6)

Group G4 consists of sherds from jugs or pitchers with very varied shapes. The beige clay is thin with a few large inclusions. The rim profiles vary but have no pronounced characteristics. The handles are flattened and vary in size, and the two largest have an incised pattern on the outer surface (nos 87 and 108, Fig 6) (11).

Conical pellets and vertical thumbed strips adorn some vases, and a few jugs are covered with a green mottled lead glaze.

Compared with the previous groups, group G4 with its particular chemical composition presents a remarkable morphological heterogeneity and there are no reasonable comparisons, given the present state of discoveries. The general characteristics of the group, however, call to mind ceramics from the south-west of France.

4 The origins of the wares

We have compared the chemical composition of the four main Bergen groups with that of some sherds from Rouen and Saintonge, which were collected in the area of their origin.

For Rouen we used the results from an analysis of sherds that were absolutely typical of the 'highly decorated' type, like those found in Bergen. Moreover, as we know how difficult it is, even for a specialist, to distinguish between pottery 'from Rouen' and that 'from Paris', we analysed sherds from the medieval workshops at Saint-Denis north of Paris, which were kindly supplied by Nicole and Olivier Meyer.

For the Saintonge, Marianne Thaurè, curator of the museum of Saintes, provided us with over forty samples of characteristic types: vases with green glaze or polychrome decoration with birds, cocks, shields, etc. The 41 sherds which were analysed fall into two groups of 37 and 4 sherds respectively. The second of these two groups has been omitted from this study since the sherds are unlike any of the Bergen pottery (12).

Table III gives a summary of the results of the analysis of the Bergen groups G1–G4 and of the French wares used for reference. Because of the contamination problem mentioned earlier, we have assumed a constant proportion of 1% of CaO + P_2O_5 and we give the adjusted results in Table III. Three points dominate the table:

- the obvious geological relationship between the composition of the pottery from group G1 and the reference wares from Rouen
- the closeness in the chemical composition of the products from Rouen and from Saint-Denis, singularly strengthening the impression already given by their morphological relationship (13)
- the remarkable chemical likeness of the pottery from group G3 and the reference sherds from Saintonge.

The confrontation of the morphological and the chemical data shows a perfect correspondence of the results for G1 and the Rouen products on the one hand, and G3 and the Saintonge products on the other. The origin of the wares for these two groups is thus clearly established.

The morphological data do not allow us to establish with any certainty an Upper Normandy origin for group G2, but the existence of a chemically morphological relationship between this group and G1 (except SiO_2) reinforces this regional hypothesis.

Determining the origin of the wares of group G4 is more difficult, even though its chemical composition does not differ very widely from that of G3 (14). Ceramics with a similar typology from British sites such as Southampton and Exeter are traditionally ascribed to the Saintonge. In our opinion, the data available at the moment permit only a broad attribution to the south-west of France.

This part of the study proved that the origins of the French pottery from the excavations at Bryggen are exclusively limited to the Seine valley in the widest sense of the term and to the south-west of France, the two areas being represented by two types of products with differing chemical composition. Two of the four distinct groups of wares can be placed within more precise geographical limits: group G1 in Rouen, and group G3 in the area around Saintes, probably in 'La Chapelle des Pots' (Chapelot *et al* 1972; 1975). For the other two groups, G2 and G4, the present state of research means that we must be satisfied with a less precise regional origin while we wait for the workshops to be located.

5 Dating

The bar charts (Fig 7) show the distribution of the analysed samples by period as recorded during excavation on the basis of historically dated fires.

The results show a surprisingly wide scatter, indeed not less than three centuries for each group. In extreme circumstances, such a chronological range could be explained in the case of morphologically very heterogeneous groups, because there is nothing exceptional in the fact that the same raw material could have been used in the same production area for several centuries. But such a wide time range becomes almost absurd when it concerns a group as morphologically typical and homogeneous as group G1, and even more so group G3.

This phenomenon can probably be explained simply by the residual nature of a great number of the sherds from the Bryggen site. Such a hypothesis is not surprising when we bear in mind the development of the site, which inevitably involved the moving and accumulation of significant amounts of back-fill. It is obvious that these observations in no way undermine the data gathered during excavation, although they might have done so if the chronological margins had been much narrower but with the same mean value.

The histograms in Figure 7 are therefore biased, and it would be both illusory and dangerous to attempt to attach any specific significance to their average or modal values.

However, this bias does not necessarily bring into question the earliest datings, in other words those which safely correspond to the first appearance of our various products in Bergen. Nor does it challenge the relative chronology of the arrival of these products at Bryggen, which is satisfactorily demonstrated by the differences in the average values of the groups. In Bergen, as almost everywhere else, the pottery from Rouen (group G1) and the Seine valley generally (G1 and G2 are in fact contemporary) were the first to appear. The maximum expansion of the Saintonge painted polychrome ware (group G3) occurred about fifty years later, followed soon after by the other types from the south-west of France which make up group G4.

For the reasons already mentioned, it would be unreasonable to attempt to define the exact period of arrival of these different products in the Bergen harbour area or the periods of their possible co-existence. Nevertheless, it is possible, as we have already suggested, to tie their successive appearances to the earliest datings provided by the bar charts. Thus, in Bergen, the first pottery from the Seine valley would have arrived about 1200, the first Saintonge painted polychrome ware around 1250, and finally the other products from the south-west of France around 1250–1300.

Without any possibility of being more precise, we can say that these dates compare with those usually proposed on most other settlement sites (15). The dating of Saintonge painted ware seems to meet with unanimous approval within the chronological margin of 1250–1350. Refuse dumps recently excavated in Toulouse have moreover provided results perfectly comparable to this date range: a lot of Saintonge painted pottery together with a local type of pottery and fragments of glass dating from the end of the thirteenth and the fourteenth centuries were discovered on the site. Eighteen coins were found in the same context, 17 of which had been issued between 1270 and 1355 (de Filippo 1989; 1990).

The Rouen pottery offers the widest range of dating, which is difficult for us to analyse, but it may possibly be explained by the combination of two phenomena: the durability of the highly decorated products which originated during the first part of the twelfth century (16), and the co-existence and/or succession of workshops in Paris and Rouen with outstandingly similar products. The reasons behind the similarity of at least some of the wares from Rouen and Paris are discussed in the next section, as well as the reasons why London potters produced 'Rouen-type ware'.

To avoid any confusion we shall refrain from giving an account of the several dates already proposed for this ware, especially on English sites, not because we consider them to be unacceptable, but because the exact place of manufacture for the pottery cannot be definitely established. On this subject, we will only cite the following piece of information, as yet unpublished, from Jacques le Maho, director of the excavations in Rouen cathedral (17): the discovery of half a decorated jug inside a bell furnace sealed in 1286 and the discovery of pottery of the same type in a refuse layer associated directly with the building of the cloister in 1300.

Taking into consideration the very wide range of dating at Bryggen, combined with the residual nature of some of the artefacts and, at the time of writing, the still unfinished state of the very complicated post-excavation analysis for some parts of the site, and considering also the limited number of sherds, it is scarcely possible to use the spatial distribution of our pottery to undertake a study of the social and material context of their use.

Nevertheless, we present the distribution charts of the analysed sherds (Figs 8c & d) (18), but we restrict our comments to a simple description of the relative positions of the four groups, G1–G4. We note, for example, that the spatial distribution of group G2 is very close to that of group G1. It is more difficult to say anything about the relative position of groups G3 and G4, where the difference is not pronounced enough for us to offer any hypothesis. It should also be noted that the pottery from groups G3 and G4 is missing from zone A of the site (cf Fig 8d) where the G1 and G2 groups on the contrary are well represented (19).

Because of our imprecise knowledge concerning the origins of most of the products (ie the precise location of the workshops) and because of the difficulty of defining the period of distribution (20), we are unable to go beyond a conjectural level in the presentation of these chronological data.

6 Discussion and socio-economic interpretation

The medieval ceramics of French origin from the excavations in Bryggen point to two regions of production, one facing the Channel, the other the Atlantic seaboard. We know that these ceramic groups are almost entirely composed of vessels associated with the consumption of drink, dating back to the thirteenth and fourteenth centuries.

Recent developments in urban archaeology in France have led to the discovery of several workshops producing highly decorated pottery from this period (21). Indeed, at the beginning of the thirteenth century the development of pottery of this kind is a European phenomenon. The distribution of such high quality tableware seems to reflect both a social and an economic situation. On the one hand, wine was no longer the privilege of scholars or the nobility. The urban and demographic developments, the general improvement in the way of life, and the associated expansion of the wine trade created in fact a rising demand for wine from a new category of consumers: the burgesses, or town citizens (22). On the other hand, in the general context of social differentiation which led the urban elite to ape the nobility (‘*singer la noblesse*’, Fossier 1982, vol 2, 286), these high quality vessels demonstrate a broadening of the social basis of wine consumption, as well as the progressive dissemination of the cultural and aesthetic values of the nobility into the daily life of the bourgeoisie (23). High quality ceramics would have been cheaper than gold, silver or glass vessels, but were often inspired by objects of metal (le Patourel 1976, 176–78) or glass (Dufournier & Flambard 1987, 145; *A travers le verre...*, 1989, 178).

In addition to the utilitarian aspects, the decorative qualities responded to the need to relate the aesthetic value of the container – jugs or pitchers – to the gustatory quality of the contents, in this case the wine.

Moreover, the delicate nature of medieval wine influenced to some extent the pottery products. Medieval wines made for common consumption kept badly and acidified very quickly (Renouard 1959, 282; 1961, 1019; 1964, 253). They were best consumed immediately and this favoured the development of a wine retail trade (ie ‘*vente à broke*’) centred on the innkeeper, since even the richest citizens did not have a household large enough to empty a 900-litre barrel, or even a 450-litre one, before it turned sour (Derville 1985, 50). The wine retail trade, which was an important source of taxation for the towns (Renouard 1959, 293; Craeybeckx 1958, 4–6, 9), favoured the near standardization of jugs and pitchers (24). As A M Cocula remarks (1989, 269–70), taxation and retail demand led without doubt to the birth of and definition of ‘small’ liquid measures. The potter responded to the demands of the trade by producing appropriate forms – jugs and pitchers – which were almost similar in all countries, either for ostentatious use in the private home or for serving in the tavern.

In the current state of research, the available archaeological information concerning the dating and origin of products is very uneven. French products are incompletely identified and dated, since they are seldom available from the excavation of the pottery workshops. Each study of the spread of French medieval pottery cultivates a paradox: in the absence of definite data about the sites where the pottery was manufactured, the study is based exclusively on the interpretation of data from the excavations of sites where it was used – mainly in Britain, Flanders or Scandinavia – and a certain empiricism may sometimes bias the identification of the presumed French origins of the pottery.

Moreover, as long as the discoveries in France remain so unspecific, the dating of such 'imported' pottery will remain approximate. For example, we do not know the period of time during which Saintonge painted ware was made, although the building and occupying of the Welsh castles under Edward I allow us to define its period of use to between c 1280 and c 1310 (Dunning 1968, 45; Chapelot *et al* 1975, 122; Davey 1977) (25). The lack of precise quantitative data is an endemic problem in European ceramic studies, which once again are restricted to the empirical, if not the intuitive, interpretation of trends (Verhaeghe 1989, 54). As we have not been able to analyse the sherds presumed to be of French origin from every site in northern Europe, we have been obliged to gather our information from archaeological publications where the identification is often unreliable. Therefore we have had to favour a qualitative, synthetisizing, approach.

Among the various highly decorated French products, where jugs always represent the most common type, it seems that only those from 'the Seine valley' and 'the south-west' of France have made the long journey to the north. The combination in these areas of commercial wine-production and the manufacture of vessels with particular types of decoration is not a coincidence. Gerald Dunning has linked the French ware from Rouen and the Saintonge found on both sides of the Channel with the great trade of French wines in the Middle Ages (Dunning 1933, 1968).

The economic and historic significance of these French 'imports' is still under discussion (26). Although the pottery of French origin from the Bergen excavations does not completely renew the discussion, it has seemed interesting to us to set out some new hypotheses on the nature of the connection between the distribution of this pottery, for which the evidence is solely archaeological, and the French wine trade, which is historically well known (27).

As a result of the approximations and doubts which we have just mentioned, the analysis and the interpretation of the distribution in terms of trade remain a challenge which is worth considering in the present state of research, if only for the stimulus it can provide.

By augmenting the number of finds from north-west Europe, the recent expansion in urban archaeology has confirmed the specific character of the spread of French ceramics by sea (28). The sherds which are assumed to be 'from Rouen' or 'from the Saintonge' are negligible in quantity within the groups of pottery, but they are almost systematically found in or near towns and harbours along the Channel and North Sea coasts: in western and southern England, in Wales, Scotland and Ireland, in Scandinavia, and in Flanders and the Netherlands (29). Besides the harbours located along the shipping routes for these products, several monastic or manorial sites in the British Isles have furnished one or more French jugs. This distribution brings to the fore the main destination of this high quality pottery – the lords' or burgesses' table.

The spread of this pottery cannot be interpreted as an indication of a ceramic trade: the small amount which has actually been found on the various sites refutes this idea. We can assume that any production for trade would have resulted in a larger proportion of these finds in the assemblages and a more even distribution between coastal and inland sites. Local products of 'highly decorated' ceramic would often have been sufficient to supply the local market. In Bergen, as on other sites, the presence of French ceramics is totally incidental and cannot represent real trade in itself (30).

On the contrary, the pottery was taking advantage of the international shipping routes already created by the trade between the fisheries, the salt-producers, the manufacturing towns, the grain areas, the wine-growing countries, and so on. The north of Europe was the main market for French wines: the poor quality and uncertain nature of any locally produced wines soon led the British and Flemish in particular to the French vineyards, which enjoy a privileged climate.

Furthered by the political context and the monopolies and privileges granted to the merchants, the development of the vineyards was stimulated by their close proximity to the river and maritime outlets: Rouen for the 'wines of France', la Rochelle for wine from Poitou, Aunis, or the Saintonge, and Bordeaux for the wines from Gascony. These were the great harbours for the export of the products of the vineyards.

During the twelfth and thirteenth centuries, the 'wines of France' going down the Seine and exported through Rouen were the subject of a very active trade, competing with that of Rhenish wines. The merchants from Rouen enjoyed the exclusive privilege of the trade in wines shipped to Britain through their town, with London as the main market in the British Isles (31), but they also supplied other important harbour-towns, particularly Lynn after 1180–90 (Musset 1979, 70). After 1204, the new political situation created by the French conquest did not completely close the English market to the merchants from Rouen, who were still numerous during the thirteenth century in England (Sadourny 1979, 81) (32).

It was probably due to these political circumstances that the cheap and strong wines of Poitou, Aunis, Saintonge and Gascony took over the British consumers' table. The first of these wine-producing areas to assume a commercial role was Poitou at the end of the twelfth century, centred on Saint-Jean-d'Angèly and La Rochelle. The 'wine of La Rochelle' as it was called after the harbour through which it was shipped (Renouard 1959, 270) supplied the countries around the North Sea, especially England after Henry Plantagenet ascended the throne. According to the author of 'La Bataille des Vins', composed some time around 1230–60, it was supposed to bring '*tous les esterlins*' and nourish '*trestoute Engleterre, Bretons, Normands, Flamens, Galois / Et les Escos et les Irois / Norois et cels de Danemarche*' (Dion 1959, 362). During the thirteenth century, this great trade relied on La Rochelle, Saint-Jean-d'Angèly, Niort, and several other less important centres (Favreau 1988).

The different retail prices seem to confirm that the wines were of a specific quality: in Ypres (Ieper) in 1288 the wine from La Rochelle was sold for 12 deniers for a measure (like that from the Rhine) and the wine from Saint-Jean-d'Angèly for 10 deniers (like the 'wine of France') (Craeybeckx 1958, 54). The 'Poitou wine' seems to have been a large appellation covering the Niort area and no doubt included wine from Saintonge too (Favreau 1988, 56).

Prior to the region's unification with France, La Rochelle was greatly dependent on English consumers, but after that event the wine trade between La Rochelle and England was subjected to all the hazards of political vicissitudes, however not without making certain compromises (Favreau 1988, 50, 57). After 1224, the only outlet left to the vineyards of Aunis was through the countries along the Channel and North Sea coast that paid homage to France. Flanders became the dominant market for Poitou wines (Craeybeckx 1958, 98).

In England, between 1225 and 1243, the banning of French wines seems to have been strictly enforced as the systematic seizures testify (Favreau 1988, 56). However, even during times of hositilities, wine from La Rochelle reached England with the help of letters of safe conduct: even the king's house was partly supplied (James 1971d, 172–73; Favreau 1988, 57). During periods of tension, the Flemish were important mediators, re-selling wines from Aunis to England (Renouard 1952, 239; Craeybeckx 1958, 97–101) (33).

With the incorporation of La Rochelle into the French kingdom and the subsequent closing of the English market, Bordeaux remained the only large harbour in French territory still held by the English. The privileges accorded by the kings of England to the merchants from Bordeaux created the conditions for a great expansion of the Gascony vineyards. A real Anglo-Gascon monopoly was constituted during the thirteenth and fourteenth centuries, making Bordeaux the 'wine-cellar' of England (Renouard 1959, 272-75; James 1971b; Favreau 1988, 57). After the Treaty of Paris in 1259, Saintes became a frontier town, separated from the Poitou vineyards, resulting in the permanent loss of its administrative and commercial significance in favour of Bordeaux, which became the sole centre of a reduced Aquitaine duchy (Favreau 1988,53) (34).

In Bergen, the chronological interval between the pottery groups (cf above), composed essentially of jugs, seems to reflect what we otherwise know about the fluctuations in the wine market. However, the coincidence between the sea routes followed by the wines and the distribution of the archaeological finds confirms that the pottery was following the same path taken by the wine-casks ('*suit le cheminement des tonneaux*' Chapelot *et al* 1975, 120). The close proximity of the area where the pottery was manufactured to the port through which the wine was shipped helped to establish an association between a kind of ware and the wine it accompanied. However, if we admit that the pottery was accompanying the wine, we have to explain the apparent paradox that pottery from Rouen and Saintonge is found on sites under English rule at a time when England was progressively closing its market to the wine from these areas. Flemish traders could be playing an important role as intermediaries in the transport of French ceramic products to Flanders, England, Scotland and even Scandinavia (Chapelot 1987, 174).

The immediate correlation established between the origin of the wines on the one hand and the origin of the ware and typology of the sherds on the other accounts neither for the distribution pattern nor the way in which these objects spread.

The social conventions associated with the consumption of wine, an expensive imported product reserved for certain categories of society or for particular dining customs, do not alone justify the transport of low value products over such long distances. It is unlikely that the pottery was accompanying the wine from their common area of production just in order to adorn the lords' or burgesses' tables, when local pottery with equivalent aesthetic qualities could have done so equally well (35).

It would seem that the container was recognized as having an identifying function with regard to the contents. Can we in fact assume that the role of the pottery was to authenticate the origin and quality of the wine, just as the shape of a bottle today helps us to distinguish the wines from Bordeaux, Burgundy, Alsace and Champagne? Even if we do admit that the jug had this descriptive function, we are not able to determine exactly what the ceramic said to the consumer – was it the original locality, or an appellation, or a particular vintage? (36)

The more than close morphological relationship between the jugs from Paris and Rouen (Nicourt 1986) does not allow us to distinguish visually the products with any certainty. In this respect, 'London-type ware' (Vince 1985) is similar to the jugs from Rouen and Paris and is thought to be imitating Rouen ware. Vince has put forward the hypothesis that Norman potters emigrating to England were the pioneers of the insular production.

We, however, are tempted to see the wine as the source of this relationship, because London was the great market for French wines where the Rouen merchants enjoyed important privileges. Perhaps the almost identical nature of the products from Rouen and Paris should be explained by the probably concurrent promotion by Norman and Parisian merchants of the same product, the 'Seine wines' (Craeybeckx 1958, 54) or 'wines of France'. The similarity of the pottery from Rouen and Paris could be explained by the geographical proximity which allowed the consumer to compare and distinguish the pitchers with his own eyes. On the other hand, in the more distant market of London a less strict copy could probably constitute a credible enough approximation for the British consumer.

The origin and nature of the wines associated with the vessels from the Saintonge and the south-west whose sherds have been excavated in Bergen and in the area around the North Sea (37) have yet to be identified – Saintonge, Poitou, Gascony? Moreover, within such a typologically limited group as the Saintonge, G3, we can legitimately question the significance of the decoration as a means of identifying different qualities (white or red), appellations, or even vintners.

To admit that for the consumer the pitcher indicated or even authenticated the origin of the wine is an implicit acceptance not only of a deliberate commercial intention on the part of the wine producer(s) and/or the merchant(s), but also of the possibility of their interfering in the choice of patterns and models developed by the potter.

Although we cannot precisely establish the nature of the link between the wholesale wine trade and the associated ceramic, we can imagine that the jug was used as an 'advertisement' by the merchant staking his reputation on the quality and origin of this perishable and expensive product, promoting his entrance into the market, helping him subsequently to conquer it, and contributing to the development of customer loyalty.

The characteristic features of the distribution pattern of jugs from Rouen and Saintonge outside their area of origin and their absence from the redistribution markets seem to signify that the pottery travelled not just with the wine, but above all with the merchant. Were the pitchers used, for example, when the wine was being tasted before buying (cf Hartmeyer 1904, 32)? Was some wine sent in vessels by the merchant to potential buyers in order to promote sales? (38) Did the ceramics 'advertise' the wine? Can some jugs be regarded as the accessories of a sales technique? This would place certain aspects in a new light, such as their presence on monastic, manorial, urban and port sites, their limited numbers in the finds assemblages, and their transport over long distances.

The information provided by urban regulations about retail trading allows some significant comparisons to be drawn and illustrates the descriptive function – or even 'advertising' aspect – of the containers (39). The constant concern of the medieval consumer for protection from fraud and adulterated goods was answered through the tight watch which was kept on the retail trade by the urban administration (40). Innkeepers were often obliged to indicate the origin and quality of the wines on sale: in Ghent, for example, the symbol of an unfurled banner was displayed on the front of the tavern or on the barrels, varying according to the sort of wine being sold. This system allowed the buyers to identify immediately the wines on offer, as well as showing them where they were on sale, and it also simplified the work of the urban authorities controlling the wine. Sellers ('*crieurs de vins*') had to display a small flag whose colour corresponded to the sort of wine their employer was selling (Craeybeckx 1958, 190), and with a pitcher in one hand and a goblet in the other they offered a sample to passers-by (de Lespinasse & Bonnardot 1879, XXVIII) (41).

In admitting that the pitchers could have formed part of the set-up of a sales technique, we can at the very most recognize from finds reports the possible existence of a mode of distribution. The methods of trade are complex and numerous, and there are many middle-men: the common origin of the pitchers and the wine is not sufficient to allow us to determine either the nationality of the merchant or that of the ship (42). The presence of French pottery on one site does not imply the presence of French traders, but indicates the particular connection of a merchant with the trade of French wines. It would be illusory and dangerous to attempt to infer from the ceramic finds the marketing patterns or the route taken by the wine and/or by the pottery.

We cannot determine whether the wines and the pottery that was manufactured near the port of exit and used as an authenticator of the contents were transported directly or indirectly. The wine trade was provided with a varied fleet of boats from Spain, Bayonne, Brittany, Normandy, Flanders, England, Germany, and elsewhere (43). There is nothing which enables us to infer the number of shipments of either item of merchandise, or to suppose a direct route from France to Norway (44) calling in at the Zwin estuary in Flanders or at any particular English harbour.

7 Conclusion

The medieval pottery of French origin from the excavations at Bryggen can be divided into two large groups, one from the Channel area, the other from the Atlantic seaboard. Each group can be further divided into two sub-groups, giving us groups G1–4. The pottery consists almost exclusively of vessels for holding wine or of drinking vessels, again for wine, dating from the thirteenth and fourteenth centuries.

The chemico-physical analysis, which has helped to determine objectively the types of ware, allows us to avoid the attribution of an origin by successive approximations or by default. The reconsideration of the 'French' origin of some of the Bergen groups (G5–11), the combination of sherds – previously differentiated – into the same group and, more significantly, the differentiation of G1 and G2 on the one hand and G3 and G4 on the other have set the limits of the 'classic' attributions.

In order to carry out this study successfully, we identified groups of fabric by means of the chemical analysis of sherds according to the areas of production. These groups will serve henceforth for reference in the study of sherds discovered in France as well as abroad.

As the economic and historic significance of 'imported' French ceramics is still under discussion, it was necessary to place the Bergen archaeological discoveries in their north-west European context in order to try to understand the motives and mechanics of their distribution.

After having recalled that this French pottery was probably not the object of trade in itself, we have been able to observe that it reflected the fluctuations of the wine trade and that it followed the shipping route taken by the wine-casks. It then seemed interesting to us to set out a few hypotheses on the nature of the connection between the distribution of the pottery, attested only archaeologically, and the French wine trade.

With regard to the jugs, a series of suppositions has led us to consider the hypothesis that their role was to authenticate the origin and quality of the contents or even to promote the wine.

The significance of the French pottery from Bergen, as on the other sites around the North Sea, has not been to identify a trade route, which was complicated and moreover well documented. Even if the distribution of the finds enables us to state that some potters could have introduced their products into the shipping traffic and trading activities (Chapelot 1987, 174), we are still lacking the archaeological data, especially that obtained through the excavation of workshops, which might throw light on the organization of the production, the degree of specialization of the workshops, and the part of the production which was destined to go with the international wine traffic. A comparison of the archaeological finds and the historical data would enable us to understand better the mechanics of trade, and the type and degree of intervention by the urban traders in the transfer of the pottery from the workshop to the consumer's table.

Notes

1 The use of vessels made from wood or steatite (Molaug 1989, 237) partly explains why no pottery industry developed in these countries. About 70 presumed places of origin have been noted for the pottery from the Bryggen excavations.

2 To retain such sherds in a mathematical analysis of this type would have made it more difficult to distinguish the other groups.

3 The simultaneous enrichment of phosphorus, calcium and manganese has long been observed in some pottery. The changes in the proportion of the chemical constituents have been studied for a great part by G Duma (1968; 1972), C Lemoine & M Picon (1982), I C Freestone *et al* (1985), and V Walter & Y Besnus (1989). New research has recently formed the subject of a thesis at the Laboratoire de cèramologie, University of Caen (Bearat 1990).

4 We checked beforehand that all the sherds which were not debased contained the same ratio of CaO and P_2O_5, whatever their presumed origin. The chosen value of 1% for the CaO + P_2O_5 content corresponds approximately to the average amount in the unaltered samples.

5 It should be remembered that the five samples 131–135 are excluded from this mathematical analysis.

6 The twelfth sherd presumed to be from Beauvais is no. 132, which was excluded from the mathematical analysis.

7 Jean Cartier, who is one of the leading specialists in these wares and founder of the *Groupe de Recherches et d'Ètudes de la Cèramique du Beauvaisis*, which has produced several studies on the ceramics of this area, did not recognize any Beauvais products among the samples shown to him. We express our profound gratitude to him for his help in this study.

8 If too thin a coat of barbotine is applied, the reaction during firing between the developing glaze and the underlying coating will result in the complete dissolution of the slip. It is then impossible to detect its presence.

9 Of the two base sherds, one is scalloped, while the other has no cordon between the body and the base. The presence of a bridge spout was also noted.

10 A fragment of a green glazed jug with applied scale decoration departs from the known types and is here considered to be a stray find (Fig 5, no. 77). Chemical proximity cannot, of course, constitute a sole criterion for the attribution of origin.

11 Some pottery found in Britain and attributed to Saintonge bears similar marks, especially under the base and on a few handles (Platt & Coleman-Smith 1975, vol 2, Figs 181, 182, etc). One handle in particular from Southampton shows a pattern very close to ours (idem, Fig 187, no. 1036). Some pottery of English origin displays similar markings, but unlike the others they have been made before firing and are engraved on the belly of the vessels (Pearce *et al* 1985, 27, Fig 38). It is interesting to note that they only concern baluster jugs, which are morphologically very close to the Saintonge jugs. Unfortunately, we have no information which could enlighten us about the meaning of these particular marks.

12 For the same reason the results from an analysis of about 20 sherds from Haute-Saintonge (Daniou 1986) have been similarly omitted.

13 These two wares are very much worth the detailed studies which will be devoted to them in the coming months.

14 The parallels between the results of the analysis of the groups was suggested, of course, by the context of the study and certain morphological relationships. Unfortunately, we have not been

able to verify these hypotheses by means of samples from these places of origin showing all the morphological features of the G2 and G4 groups.

15 Most of these sites are in the British Isles. For further details concerning the corresponding dates, the reader is referred to the following published material for the different sites.
Wales and North-West England: Davey 1977, 5–7; *ibid*, 1983, 213; Hurst 1977, 122.
Bristol: Ponsford 1983, 222.

16 This is according to the first results of the Saint-Denis excavations, exhibited in the town museum.

17 We are extremely grateful to Jacques le Maho for supplying us with these recent chronological data, which at the time of writing had not been published.

18 In view of the small number of samples and the residual quality of some of the sherds, it seemed more sensible to combine in our diagrams the G1 and G2 groups on the one hand and the G3 and G4 groups on the other, and not to separate the periods.

19 On this point, our observations should be compared with those of H Lüdtke (1989), who undertook the difficult task of gathering the data for 25,000 sherds from Bryggen. This comparison poses a problem for the G3 and G4 groups, which Lüdtke linked together under the label 'Saintonge'. We believe that the results produced by Lüdtke which do not correspond to the actual situation must be corrected. It is probably due to a data confusion. The graph showing all the presumed Saintonge sherds as it ought to have been presented on p 101 of Lüdtke's report forms the subject of Fig 8b. It should be noted that this distribution fits well with that of the analysed ceramics (cf Fig 8d).

20 It is obviously more important to know the period of production (or distribution) of a particular fabric than the lapse of time separating its production and its use, which on the whole is insignificant compared with the former. The period of life of an object worth taking into account can be approximately defined on the basis of ethnographical and statistical data (Arnold 1985, 152–155).

21 The presence of highly decorated ceramics with applied decoration is attested on a large number of sites north of a line running approximately through Lyon and Bordeaux. The production sites are not all known, but it seems that most of them are not really far from the sites where the pottery was used and they should be looked for within or in the immediate vicinity of the nearest urban groups. This is probably the case with the origins of the decorated jugs found at the following places: Caen (Fauverge 1968; Dufournier & Leenhardt 1982; Burnouf *et al* 1983), Gravenchon in the Rouen area (excavations by J le Maho, publication forthcoming), Vienne-en-Val in the Orlèans area (Nicourt 1973), Anse in the Lyon area (CAHMGI 1981, pl VIII B, p 210), Chälons-sur-Marne and Troyes in Champagne (Lenoble 1982; Lenoble *et al* 1987, chap 1), and so on. The recent discovery of urban workshops producing this type of ware in Douai in the North (excavations by P Demolon, publication forthcoming) and in Metz in Lorraine (Bourger & Dautremont 1988) also belong to this pattern.

22 The guilds of the urban merchants sealed the business at their meetings by an almost ritual *compotatio vini*, like the one mentioned in 1083 at Saint-Omer (Pirenne 1933, 230; Doehaerd 1950, 155). A century later, in Bergen, King Sverrir shouts down the German merchants who had introduced not only the wine, but also the problems that went with it (Hartmeyer 1904, 31).

23 The presence of pseudo-heraldic decorative motifs (shields, knights, etc) on some pottery seems to reflect the same phenomenon (Le Patourel 1984; Verhaeghe 1989, 51–52).

24 Even if typological variations and regional families become apparent.

25 Easily recognizable 'imported' pottery is often used as a means of dating in archaeological publications, frequently giving rise to fallacious reasoning.

26 It is advisable to exercise reservation on another point: the term 'import', *stricto sensu*, is not neutral; its use supposes a regular exchange of some economic significance, established on purpose. Is it rational that some archaeologists persist in qualifying a few sherds as imports?

27 The trade in French wines in the Middle Ages has formed the subject of detailed studies, to which the reader is referred: Frèville 1857; Pirenne 1933; Mollat 1952; Craeybeckx 1958; Dion 1959; Renouard 1968; Sadourny 1968, 1978; James 1971a, b, c, d. With regard to Bergen, see Hartmeyer 1904, 30–32, and Delavaud 1929, 27.

28 Gerald Dunning has noticed (1968, 44) that these products have not been attested in France other than in the area of their production. For the Saintonge ceramics, Jean Chapelot (1974, 144) indicates a few French finds on the Atlantic and Channel coasts. The recent excavations in Toulouse have already been mentioned (de Filippo 1990). It should be noted that up to the present time, the urban excavations which began on large areas several years ago, eg at Arras

(A Jacques) and Douai (P Demolon), have produced hardly any sherds coming from the areas of production under consideration.

29 Dunning's distribution maps (1968, 38–47, Figs 20, 21 & 24) have an indicative value (Davey 1989). In addition to the recent publications dealing with pottery of presumed French origin found in the British Isles given in Note 15, see also Bencard 1972, 13–19; Lüdtke 1989, 124, Fig 62; Vince 1985; Laing 1973; Hillewaert 1988; and Thompson 1980, 678.

30 Various non-commercial activities can explain the incidental presence of pottery at a great distance from the production sites (Moorhouse 1981; Chapelot 1987), for example, obtained as souvenirs, vessels used by seamen on board ship, pottery belonging personally to foreign merchants, or even casual trading by seamen (Bernard 1978, 168). None of the hypotheses can be rejected *a priori*, but none throws any light on the selective nature of the simultaneous distribution from outside port sites.

31 The London tax lists attest the presence of merchants from Rouen at the beginning of the eleventh century (Pirenne 1933, 230; Doehaerd 1947, 279).

32 Moreover, it opened up the Norman market for the wines of France and Burgundy (Sadourny 1979, 81).

33 With regard to the links between Bruges and Bergen, see Gilliodts van Severen 1904, I, no. 14; Gade 1951, 21; Haepke 1908, 124).

34 The French occupied Bordeaux from 1294 to 1303.

35 The painted Saintonge decoration has no contemporary equivalent except in the Mediterranean countries (Chapelot 1975; Whitehouse 1978; Barton 1980a).

36 As regards young wines in general, they would have been of common production and their quality would vary according to the area and according to the producer within the area, so that there would be no particular vintage (Renouard 1958).

37 The recent discoveries at Toulouse (de Filippo 1990) also present this problem.

38 In the Middle Ages the gift of wine in pots is a common practice regularly attested (Derville 1974).

39 There is nothing to prevent the local products from having the same advertising function in the tavern.

40 Retail sale was strictly controlled and reserved to the town burgesses; it was most often forbidden to foreign merchants. In Bergen in the first part of the thirteenth century the presence of foreign merchants was limited to the summer months from May to September, but from 1260 onwards it is noted that Germans, Flemings and Englishmen remained during the winter (Herteig 1968, 73–79).

41 In Paris the pot and the ewer had to carry a distinctive mark as a guarantee of understanding between the seller (the *'crieur de vins'*) and the innkeeper (de Lespinasse & Bonnardot 1879, 21).

42 The sea-faring merchants (*'marchands frèquentans la mer'* Bernard 1978, 171) were sometimes also wine-producers themselves and either travelled with their wines to sell them, or else had middlemen in the towns (Renouard 1959, 291). The traders from Rouen often travelled with the cargo (Musset 1979, 69). Renouard (1961, 1026 n.9) has studied La Rochelle's sphere of influence from the places associated with the burgesses who took the oath of allegiance to Louis VIII in 1224 and notes the following: Ireland, Cornwall, Wales, Southampton, London, Flanders, Artois, Hainault and probably Norway (eg 'Henri le Norrois').

43 Beaurepaire 1856, 22; Leroux, 1888, 41; Agats 1904, 52–56; Hartmeyer 1904, 30–32; Haepke 1908, 128, 133, 142; Boissonade 1924; Delavaud 1929, 14, 25; Johnsen 1936; Gade 1951, 4, 7, 94; Renouard 1952, 239; Darsel 1957; Craeybeckx 1958, 90–97; Carus-Wilson 1962–63, 185, 196; Helle 1968, 103, 112–113; James 1971d, 173 n.2; Nedkvitne 1977; Le Patourel 1983; Favreau 1988, 64. The study of the Saintonge pottery recently discovered at the harbour of Saint Peter Port on Guernsey could give some explanation of the manner of distribution of this ceramic. We thank K Barton, B Burns and R Keen for indicating this unpublished find and for providing documentation.

44 The material proof of the presence of boats from the North Sea and the Baltic on the Aunis and Saintonge coasts is provided by the stone from Brittany and the British Isles as well as from Scandinavia which was brought as ballast by the ships coming to load wine and which was left behind on the coast or along the rivers of the Charente (Favreau 1988). Did the decorated floor-tiles made at Artois around 1260–80 which were found at La Rochelle similarly serve as ballast? (Carette & Deroeux 1985; Deroeux & Dufournier 1986).

Appendix

The glazed polychrome sherds illustrated in Fig 9 (a, b and c), whose chemical analysis caused some doubt as to the Saintonge origin attributed to them, are worth a special mention on account of their unusual appearance and the identical nature of the decoration.

Their peculiarity is the find itself which has provided us with three identical pieces of a moulded design. Whether they formed the original ceramic object itself, such as a statuette, or whether they constituted the decorative element of some other more important ceramic piece of which there were one or more examples, we are unable to say.

The modest size of the three sherds, their identical appearance and the erotic nature of the design* are intriguing, almost as though someone wanted to remove this part from the rest of the object.

In any case, the 'Gallic' character of the pattern is not sufficient in itself to ascribe a French origin to these sherds.

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* The precise motif of the scene became apparent from a photomontage of the negatives produced by photographing the ceramic pieces after they had been covered with a thin coat of white gouache. This eliminates most of the flaws of the surface (marks, chips, etc) and so gives prominence to any relief. The idea of the photomontage and its execution are entirely due to Monique Louis-Philippe (CRNS, CRAM, University of Caen), who also made all the drawings.

Table Ia First results of the chemical analysis of group G1, calculated with a nil ignition loss and a total of 100.

Identif. number	Chemical group	Analytical number	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	MnO	P_2O_5	Period	Sherd number
1	G1	19A	74,27	20,98	2,02	1,28	0,46	0,16	0,23	0,44	0,02	0,14	3	73143
2	G1	41A	66,55	22,72	1,70	1,70	1,54	0,22	0,66	0,69	0,01	4,20	5	10995
3	G1	59A	74,76	20,31	1,65	1,16	0,64	0,23	0,27	0,49	0,02	0,47	3	33650
4	G1	61A	68,53	26,58	1,46	1,64	0,52	0,19	0,20	0,37	0,01	0,51	4	85251
5	G1	68A	76,09	19,59	1,30	1,74	0,45	0,11	0,17	0,33	0,01	0,21	5	61402
6	G1	71A	71,60	18,18	1,31	1,54	2,28	0,14	0,16	0,76	0,06	3,96	5	74530
7	G1	73A	70,15	24,15	1,87	1,93	0,51	0,18	0,19	0,51	0,01	0,51	6	76650
8	G1	76A	68,04	21,40	1,46	1,29	2,01	0,31	0,30	0,48	0,07	4,65	5	89903
9	G1	78A	71,75	22,10	1,63	1,49	0,52	0,22	0,44	0,90	0,01	0,95	5	89139
10	G1	80A	72,47	17,48	1,58	1,91	1,97	0,12	0,17	0,54	0,07	3,69	5	71720
11	G1	82A	68,77	21,25	1,47	1,38	1,62	0,29	0,43	0,60	0,03	4,17	3	24727
12	G1	83A	74,23	20,66	1,80	1,82	0,51	0,19	0,14	0,44	0,02	0,17	4	41654
13	G1	84A	71,22	22,40	1,89	1,81	0,84	0,26	0,22	0,53	0,03	0,80	4	76875
14	G1	88A	72,82	18,04	1,09	1,63	1,83	0,21	0,34	0,52	0,02	3,50	5	37945
15	G1	93A	70,21	25,17	1,74	1,48	0,47	0,18	0,21	0,39	0,01	0,12	5	40995
16	G1	95A	74,64	20,64	2,01	1,22	0,43	0,16	0,23	0,47	0,01	0,18	5	4263
17	G1	98A	74,71	20,82	1,52	1,61	0,52	0,15	0,19	0,38	0,01	0,07	5	71763
18	G1	100A	76,00	19,63	1,34	1,78	0,35	0,17	0,18	0,50	0,01	0,04	5	89896
19	G1	101A	72,84	22,65	1,58	1,43	0,56	0,14	0,26	0,42	0,01	0,12	5	12392
20	G1	102A	72,24	22,54	1,66	1,49	0,66	0,19	0,21	0,53	0,02	0,48	4	31189
21	G1	105A	73,19	21,80	1,49	2,31	0,45	0,13	0,20	0,30	0,01	0,11	5	3844
22	G1	106A	67,58	22,75	1,18	1,48	1,81	0,11	0,29	0,51	0,01	4,29	5	12309
23	G1	108A	68,76	19,56	1,36	1,62	2,71	0,13	0,16	0,92	0,09	4,69	5	74529
24	G1	110A	70,96	22,10	1,38	1,50	1,22	0,18	0,31	0,53	0,02	1,80	5	23571
25	G1	111A	75,92	19,65	1,31	1,62	0,51	0,27	0,15	0,46	0,02	0,08	8	49066
26	G1	112A	72,67	23,17	1,29	1,84	0,32	0,16	0,16	0,34	0,01	0,04	5	40419
27	G1	113A	70,67	23,91	1,83	2,15	0,50	0,19	0,31	0,37	0,03	0,05	4	24505
28	G1	114A	72,03	23,25	1,74	1,33	0,54	0,25	0,25	0,54	0,01	0,06	4	29956
29	G1	121A	71,67	22,73	1,54	1,97	0,40	0,14	0,19	0,42	0,01	0,92	5	37298
30	G1	122A	64,66	29,63	1,61	1,66	0,70	0,20	0,31	0,34	0,02	0,87	–	17149

Table Ib First results of the chemical analysis of group G2, calculated with a nil ignition loss and a total of 100.

Identif. number	Chemical group	Analytical number	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	MnO	P_2O_5	Period	Sherd number
31	G2	54A	79,63	16,95	0,88	1,16	0,31	0,17	0,17	0,65	0,01	0,06	3	35961
32	G2	55A	78,56	17,20	1,22	1,09	0,34	0,29	0,18	0,91	0,01	0,18	6	81684
33	G2	56A	78,71	16,95	1,27	1,09	0,41	0,24	0,23	0,89	0,01	0,20	4	20336
34	G2	57A	79,66	16,90	0,93	1,15	0,31	0,17	0,15	0,65	0,01	0,06	4	31551
35	G2	58A	78,62	17,23	1,23	1,12	0,31	0,18	0,19	0,91	0,01	0,18	4	84139
36	G2	60A	76,41	17,66	1,19	1,15	0,77	0,21	0,16	0,96	0,02	1,49	3	31720
37	G2	63A	78,88	15,97	1,18	1,04	0,80	0,25	0,22	0,96	0,03	0,66	4	88627
38	G2	64A	77,14	18,11	1,37	1,10	0,45	0,32	0,20	1,03	0,01	0,26	–	87860
39	G2	65A	78,15	17,82	1,27	1,24	0,44	0,19	0,12	0,55	0,01	0,20	6	65923
40	G2	66A	78,27	17,72	1,29	1,20	0,32	0,25	0,18	0,70	0,01	0,06	5	71496
41	G2	67A	77,57	18,15	1,48	1,21	0,31	0,26	0,16	0,73	0,01	0,13	5	71740
42	G2	69A	75,50	19,78	1,50	1,07	0,66	0,18	0,15	0,66	0,01	0,48	5	87859
43	G2	70A	79,43	17,00	0,91	1,12	0,36	0,16	0,19	0,65	0,01	0,17	5	38016
44	G2	75A	74,15	17,25	0,87	1,13	1,11	0,20	0,20	0,80	0,01	4,27	5	4102
45	G2	77A	82,12	13,73	1,26	1,11	0,28	0,26	0,15	0,97	0,01	0,11	5	39756
46	G2	79A	78,44	17,44	1,21	1,24	0,32	0,21	0,27	0,71	0,01	0,15	5	71182
47	G2	85A	73,33	17,64	1,42	1,26	1,44	0,15	0,14	0,54	0,01	4,07	7	33598
48	G2	89A	74,40	17,83	0,89	1,14	1,13	0,16	0,19	0,79	0,02	3,46	3	19225
49	G2	90A	76,80	18,26	1,89	1,21	0,27	0,24	0,25	1,00	0,01	0,06	4	29940
50	G2	91A	77,16	18,63	1,08	1,38	0,48	0,16	0,20	0,52	0,01	0,37	4	16640
51	G2	92A	79,18	16,84	1,12	1,09	0,35	0,24	0,18	0,89	0,01	0,10	5	4234
52	G2	94A	76,84	18,11	1,94	1,22	0,27	0,31	0,23	0,99	0,01	0,08	5	31058
53	G2	96A	73,52	18,42	1,28	1,26	1,07	0,24	0,43	0,57	0,01	3,21	4	18394
54	G2	97A	77,40	18,74	1,09	1,40	0,43	0,13	0,17	0,49	0,01	0,13	4	9588
55	G2	99A	77,11	18,82	1,09	1,37	0,54	0,09	0,17	0,54	0,01	0,24	5	12309
56	G2	103A	80,03	16,03	1,09	0,99	0,41	0,24	0,20	0,80	0,01	0,20	5	81681
57	G2	107A	79,94	15,70	1,77	1,44	0,26	0,19	0,18	0,46	0,01	0,04	5	9693
58	G2	109A	77,43	18,71	1,09	1,38	0,43	0,16	0,17	0,51	0,01	0,09	5	12551
59	G2	115A	78,96	16,37	1,47	1,11	0,33	0,34	0,18	1,06	0,01	0,16	6	60416
60	G2	117A	78,37	16,72	1,90	1,12	0,87	0,22	0,17	0,26	0,01	0,34	6	37710
61	G2	120A	79,67	16,76	0,94	1,19	0,33	0,13	0,19	0,65	0,01	0,12	4	30170
62	G2	123A	79,50	16,56	1,13	1,22	0,26	0,20	0,17	0,79	0,01	0,15	6	81814
63	G2	135A	81,34	13,85	1,57	1,19	0,28	0,28	0,21	1,03	0,01	0,23	5	16280

Table Ic First results of the chemical analysis of group G3, calculated with a nil ignition loss and a total of 100.

Identif. number	Chemical group	Analytical number	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	MnO	P_2O_5	Period	Sherd number
64	G3	14A	70,07	21,27	2,69	1,32	0,74	0,36	0,24	1,47	0,05	1,78	8	57384
65	G3	18A	69,66	23,96	2,08	1,38	0,39	0,39	0,46	1,59	0,01	0,08	5	7889a
66	G3	20A	67,11	22,51	2,42	1,15	0,96	0,33	0,62	1,52	0,03	3,34	5	28583
67	G3	21A	69,63	23,45	2,56	1,32	0,38	0,39	0,47	1,67	0,01	0,13	6	7889b
68	G3	24A	72,81	21,10	1,85	1,26	0,49	0,34	0,45	1,37	0,03	0,30	6	1602
69	G3	31A	71,09	21,52	2,14	1,31	0,66	0,36	0,45	1,67	0,03	0,76	6	15163
70	G3	36A	69,03	24,42	2,26	1,36	0,35	0,42	0,46	1,64	0,01	0,06	6	8193
71	G3	38A	70,02	23,75	1,96	1,40	0,41	0,40	0,44	1,43	0,01	0,18	6	7166
72	G3	40A	69,34	24,09	2,17	1,37	0,39	0,39	0,45	1,67	0,01	0,11	6	7688
73	G3	47A	70,06	23,08	2,61	1,34	0,40	0,39	0,43	1,56	0,01	0,12	6	2158
74	G3	48A	70,41	22,93	2,06	1,37	0,35	0,38	0,80	1,55	0,03	0,12	7	13670
75	G3	81A	71,59	21,88	2,26	1,26	0,42	0,61	0,22	1,55	0,02	0,19	7	76697
76	G3	104A	72,27	22,09	1,62	1,39	0,46	0,40	0,26	1,39	0,01	0,10	4	31453
77	G3	124A	66,60	26,44	1,84	1,71	0,67	0,48	0,41	1,68	0,01	0,15	5	2800
78	G3	126A	72,26	22,23	1,55	1,57	0,52	0,33	0,27	1,13	0,01	0,12	5	40551
79	G3	128A	72,99	21,20	1,46	1,64	0,55	0,39	0,27	1,36	0,01	0,13	3	26637
80	G3	129A	72,53	21,26	1,86	1,61	0,52	0,45	0,23	1,36	0,01	0,16	3	26347
81	G3	131A	71,48	21,92	2,09	1,32	0,39	0,37	0,43	1,72	0,01	0,26	6	7784
82	G3	132A	70,01	23,64	1,96	1,39	0,37	0,37	0,46	1,43	0,01	0,36	6	6085

Table Id First results of the chemical analysis of group G4, calculated with a nil ignition loss and a total of 100.

Identif. number	Chemical group	Analytical number	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	MnO	P_2O_5	Period	Sherd number
83	G4a	23A	66,43	20,87	2,28	1,15	1,40	0,46	0,28	2,94	0,06	4,12	5	35999
84	G4a	25A	69,97	20,88	1,98	1,10	0,78	0,56	0,38	2,94	0,04	1,38	5	27963
85	G4a	26A	68,99	19,95	1,97	1,00	1,31	0,51	0,40	2,87	0,06	2,94	5	89948
86	G4a	27A	72,86	19,66	2,10	1,04	0,31	0,59	0,36	2,93	0,02	0,13	5	16954
87	G4a	28A	72,69	19,68	2,10	1,10	0,40	0,59	0,42	2,83	0,02	0,16	7	13101
88	G4a	29A	70,50	21,48	2,53	1,19	0,43	0,60	0,43	2,66	0,01	0,16	7	5843
89	G4a	33A	70,70	21,31	2,06	1,12	0,45	0,60	0,32	2,97	0,04	0,42	6	34944
90	G4a	35A	67,76	23,50	1,93	1,24	0,66	0,61	0,48	3,18	0,01	0,63	6	7467
91	G4a	37A	70,69	21,51	2,23	1,15	0,34	0,66	0,36	2,94	0,02	0,11	6	36629
92	G4a	39A	69,91	21,97	1,61	1,15	0,74	0,52	0,37	3,10	0,03	0,60	6	81734
93	G4a	42A	69,44	22,31	1,73	1,16	0,67	0,49	0,32	2,95	0,03	0,90	5	79552
94	G4a	43A	72,99	19,84	1,95	1,17	0,28	0,54	0,30	2,57	0,02	0,34	7	25775
95	G4a	44A	70,66	21,38	2,28	1,15	0,40	0,59	0,39	2,85	0,01	0,29	7	24664
96	G4a	49A	70,00	21,71	2,52	1,13	0,46	0,64	0,46	2,93	0,02	0,12	9	68
97	G4a	50A	73,02	19,61	1,95	1,10	0,47	0,50	0,37	2,48	0,03	0,46	7	23859
98	G4a	51A	73,44	19,21	2,03	1,07	0,45	0,48	0,44	2,50	0,02	0,36	9	24576
99	G4a	53A	71,70	20,63	2,49	1,18	0,35	0,55	0,36	2,63	0,01	0,09	8	26382
100	G4a	119A	70,66	21,26	2,16	1,15	0,35	0,63	0,37	3,12	0,02	0,28	7	26274
101	G4a	130A	69,81	21,17	2,01	1,13	0,58	0,57	0,38	3,06	0,02	1,27	6	27906
102	G4a	133A	72,86	20,15	1,77	1,23	0,36	0,48	0,42	2,26	0,03	0,43	6	6704
103	G4a	136A	71,37	20,64	2,48	1,13	0,37	0,57	0,38	2,63	0,02	0,41	5	26095
104	G4b	15A	68,45	21,01	3,31	1,15	0,84	0,79	0,33	2,92	0,03	1,17	8	33906
105	G4b	16A	66,51	20,76	3,42	1,09	1,12	0,81	0,34	3,05	0,04	2,86	8	4003
106	G4b	17A	67,78	21,21	3,18	1,15	0,62	0,77	0,27	2,90	0,05	2,06	8	34396
107	G4b	30A	68,07	20,72	3,64	1,08	1,00	0,71	0,28	3,01	0,03	1,45	7	33986
108	G4b	34A	68,20	21,74	2,81	1,13	0,68	0,76	0,31	2,96	0,02	1,38	6	33974

Table Ie First results of the chemical analysis of groups G5–11, calculated with a nil ignition loss and a total of 100.

Identif. number	Chemical group	Analytical number	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	MnO	P_2O_5	Period	Sherd number
109	G5	32A	76,55	16,77	2,04	2,19	0,67	0,38	0,35	0,74	0,02	0,29	6	78965
110	G5	45A	74,74	16,20	2,01	2,13	1,22	0,25	0,45	0,72	0,03	2,25	4	24568
111	G5	46A	78,10	15,41	2,15	2,18	0,72	0,37	0,26	0,71	0,01	0,10	4	25092
112	G6	8A	78,67	15,44	1,34	1,47	0,34	0,44	0,30	1,72	0,01	0,26	9	830
113	G6	72A	79,19	15,43	1,67	1,24	0,36	0,30	0,26	1,21	0,01	0,33	5	29280
114	G6	74A	78,39	16,58	1,55	1,27	0,29	0,32	0,22	1,29	0,01	0,07	6	22010
115	G6	87A	75,36	16,69	1,89	1,19	0,86	0,33	0,62	1,26	0,03	1,77	5	15997
116	G6	125A	76,33	18,54	1,92	1,28	0,25	0,31	0,25	0,97	0,01	0,13	–	38016
117	G7	1A	70,76	20,75	2,84	1,47	0,33	1,10	0,27	2,41	0,02	0,06	7	150
118	G7	2A	67,90	22,15	3,62	1,64	0,96	0,48	0,47	2,37	0,03	0,38	8	178
119	G7	4A	72,22	19,19	3,01	1,37	0,31	1,11	0,20	2,49	0,01	0,08	9	5143
120	G7	5A	72,60	18,03	3,36	1,48	0,23	1,29	0,30	2,64	0,01	0,06	9	2119
121	G7	10A	71,58	20,02	2,95	1,40	0,36	0,89	0,27	2,24	0,01	0,27	9	482
122	G8	6A	76,84	15,39	2,54	1,35	0,24	0,88	0,21	2,24	0,02	0,30	8	93a
123	G8	7A	77,18	15,00	2,31	1,23	0,21	0,99	0,21	2,57	0,01	0,28	8	93b
124	G8	9A	74,40	17,84	2,48	1,68	0,30	0,80	0,23	2,06	0,02	0,19	9	808
125	G9	3A	76,84	16,87	1,96	0,99	0,54	0,80	0,45	1,50	0,01	0,04	8	603
126	G9	11A	76,92	16,07	2,03	1,12	0,56	0,68	0,36	1,60	0,01	0,64	8	699
127	G9	62A	74,05	19,51	2,23	0,92	0,36	0,72	0,25	1,86	0,01	0,08	4	38427
128	G9	86A	70,52	22,52	2,49	1,02	0,34	0,77	0,16	1,96	0,01	0,19	7	67919
129	G10	118A	76,35	16,47	3,12	0,77	0,51	0,42	0,19	1,27	0,03	0,86	7	68459
130	G11	127A	67,84	23,28	0,82	1,89	1,34	0,13	0,20	0,31	0,04	4,13	5	3953
131	(12)	22A	70,38	18,90	5,31	0,98	0,61	0,60	0,32	1,80	0,03	1,07	5	2033
132	(13)	12A	60,43	15,50	6,57	0,87	5,72	1,95	1,49	3,20	0,08	4,17	8	504
133	(13)	116A	70,06	13,45	5,03	0,86	3,04	1,50	0,87	2,73	0,07	2,38	7	25869
134	(14)	13A	51,33	16,60	6,81	0,86	13,58	2,84	2,48	1,68	0,10	3,72	8	4885
135	(14)	134A	52,27	16,21	6,99	0,88	12,77	3,06	1,91	1,67	0,09	4,14	8	5216

Table II Distribution of the analysed sherds according to the chemical groups and presumed area of origin.

Chemical group \ Presumed origin	«Beauvais»	«Rouen»	«Saintonge»	«North French»	«French Monochrome»	«French Type»	Total

Table IIa

Chemical group	«Beauvais»	«Rouen»	«Saintonge»	«North French»	«French Monochrome»	«French Type»	Total
G5			3				3
G6	1	1		1	1	1	5
G7	5						5
G8	3						3
G9	2	1				1	4
G10						1	1
G11				1			1
(12)			1				1
(13)	1					1	2
(14)			2				2
Total	12	2	6	2	1	4	27

Table IIb

Chemical group	«Beauvais»	«Rouen»	«Saintonge»	«North French»	«French Monochrome»	«French Type»	Total
G1		21	3			6	30
G2		10	2	12	1	8	33
G3		1	14	3		1	19
G4			25		1		26
Total	0	32	44	15	2	15	108

Total	12	34	50	17	3	19	135

Table III Average chemical composition of groups G1–G4 from Bergen and of the reference groups from Rouen, Saint-Denis and Saintonge. The results were calculated by supposing that P_2O_5 + CaO = constant = 1%.

Chemical group		SiO_2	Al_2O_3	Fe_2O_3	TiO^2	MgO	K_2O
G1							
(n = 30)	m	**72,65**	**22,15**	**1,58**	**1,65**	**0,19**	**0,51**
	s	2,5	2,4	0,23	0,27	0,06	0,16
Rouen							
(n = 4)	m	71,65	23,30	1,65	1,98	0,15	0,42
	s	1,4	1,45	0,22	0,20	0,05	0,03
Saint-Denis							
(n = 7)	m	71,95	21,90	2,55	1,62	0,44	0,53
	s	1,6	1,05	0,30	0,23	0,08	0,14
G2							
(n = 33)	m	**78,10**	**17,30**	**1,27**	**1,19**	**0,21**	**0,75**
	s	1,35	1,35	0,30	0,11	0,06	0,20
G3							
(n = 19)	m	**70,45**	**22,75**	**2,07**	**1,39**	**0,40**	**1,52**
	s	1,6	1,35	0,35	0,14	0,06	0,15
Saintonge							
(n = 37)	m	70,35	22,70	2,38	1,34	0,37	1,55
	s	1,7	1,6	0,42	0,07	0,05	0,16
G4 (a+b)							
(n = 26)	m	**70,60**	**21,05**	**2,32**	**1,14**	**0,60**	**2,85**
	s	1,45	1,00	0,57	0,05	0,10	0,24

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Fig 1 Major places mentioned in the text.

Fire	Date	Fire Interval Period	Building phase
0	1955		
Ia	Prev. unknown	9	9.2 9.1 (9.1.2 / 9.1.1)
I	1702		
Ib	Prev. unknown	8	8.2 8.1 (8.1.1)
II	1476		
		7	7
III	1413		
IIIb	1393	6	6.3 6.2 (6.2.2 / 6.2.1) 6.1 (6.1.2 / 6.1.1)
IV	1332		
		5	5.2 5.1
V	1248		
		4	4.2 4.1 (4.1.2 / 4.1.1)
VI	1198		
		3	3.2 (3.2.1) 3.1 (3.1.1)
VII	1170/71		
		2	2.2 2.1
VIII	Prev. unknown		
		1	1.2 1.1

Fig 2 Chronological table for the Bryggen excavations (after A E Herteig).

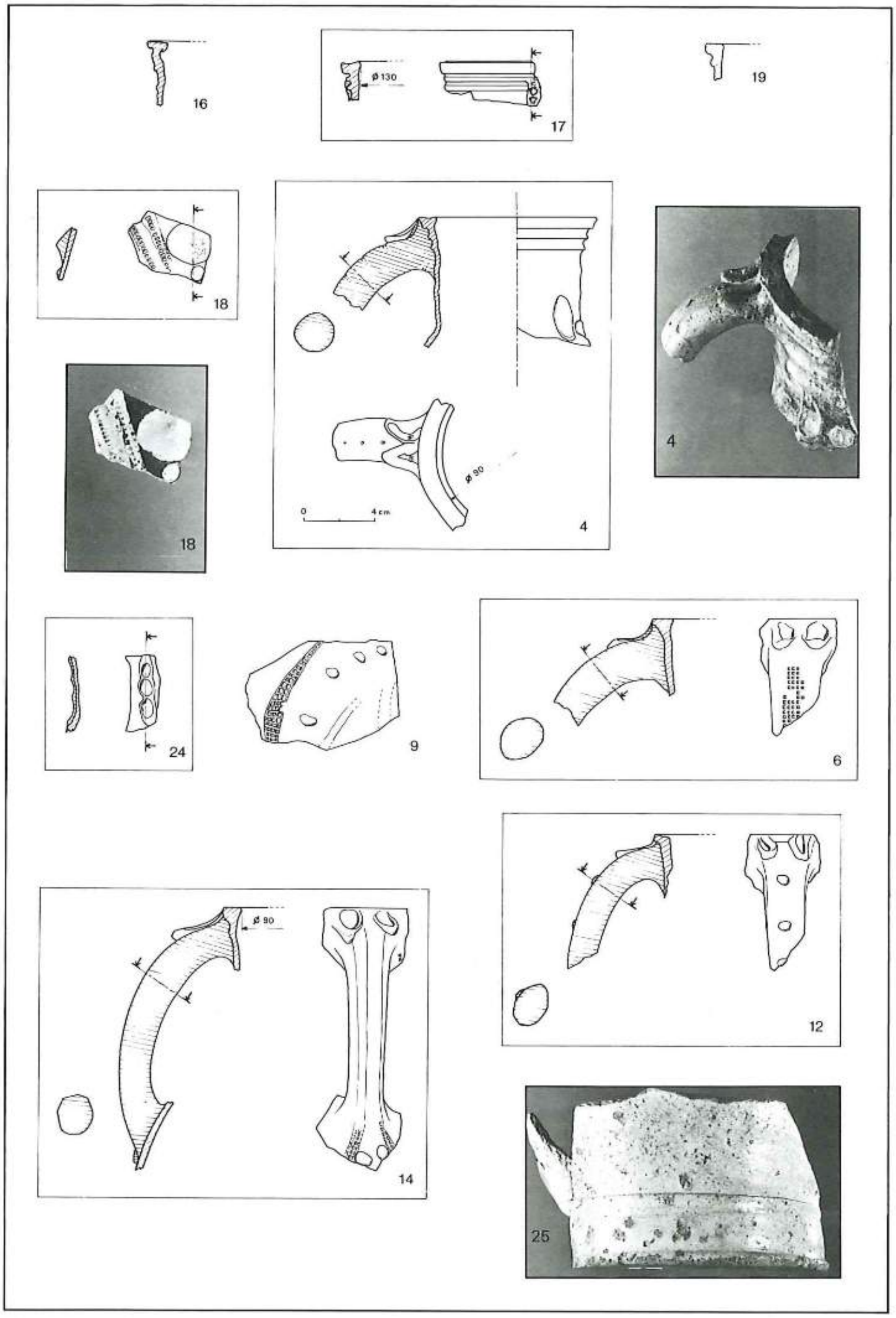

Fig 3 Ceramic samples representative of the Bergen group G1 (Rouen area). All drawings are at the same scale as no.4.

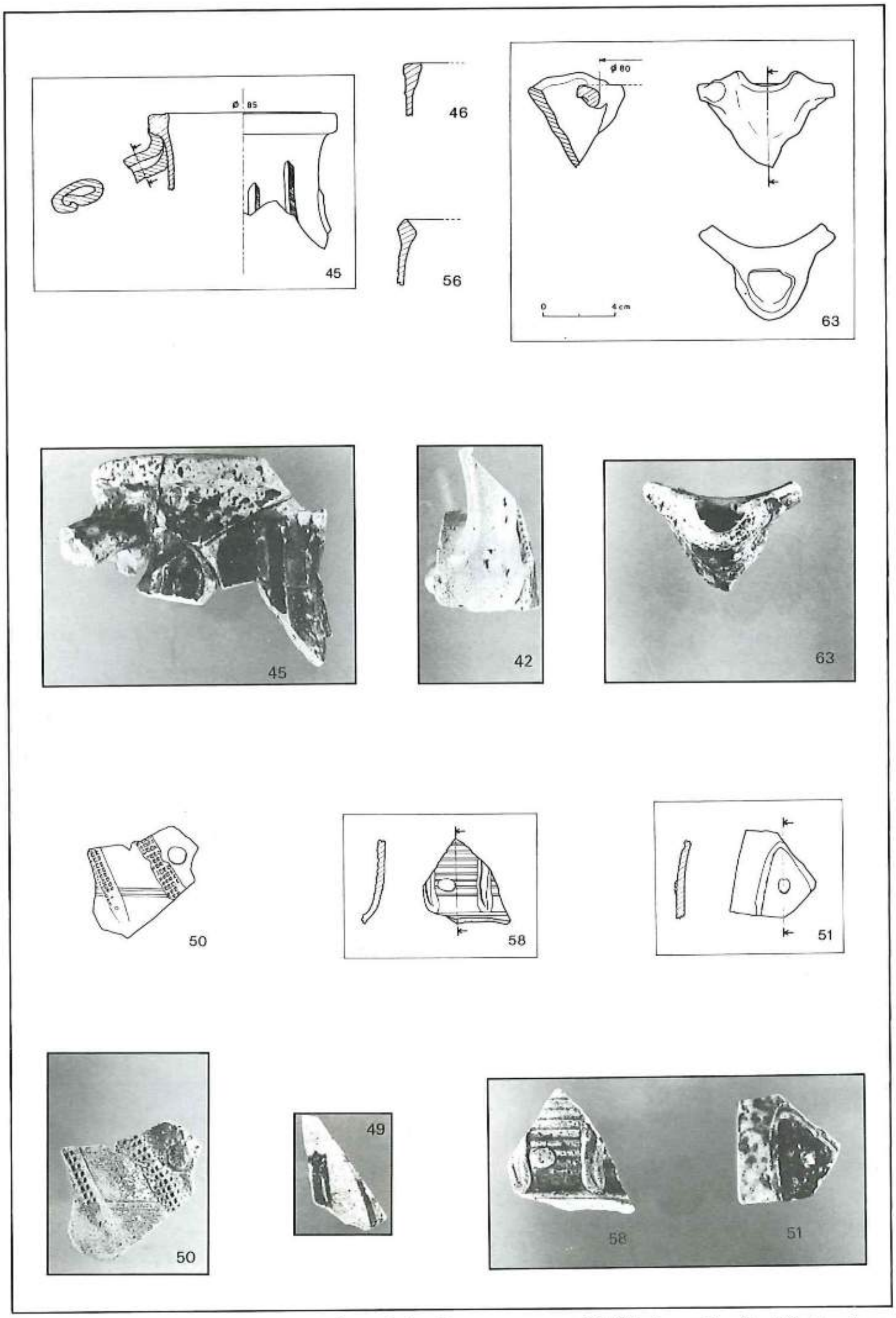

Fig 4 Ceramic samples representative of the Bergen group G2 ('Seine valley'). All drawings are at the same scale as no.63.

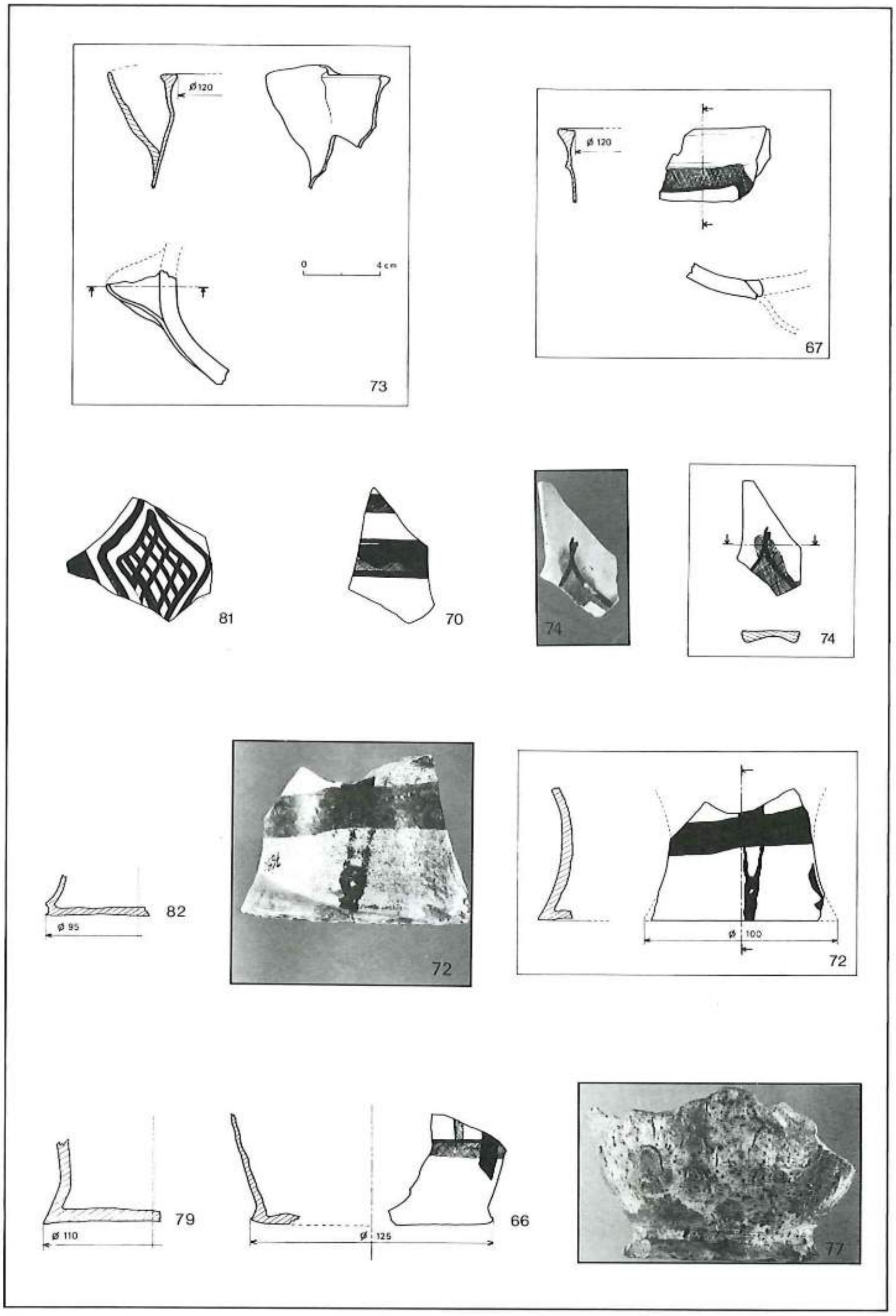

Fig 5 Ceramic samples representative of the Bergen group G3 (Saintonge). All drawings are at the same scale as no.73.

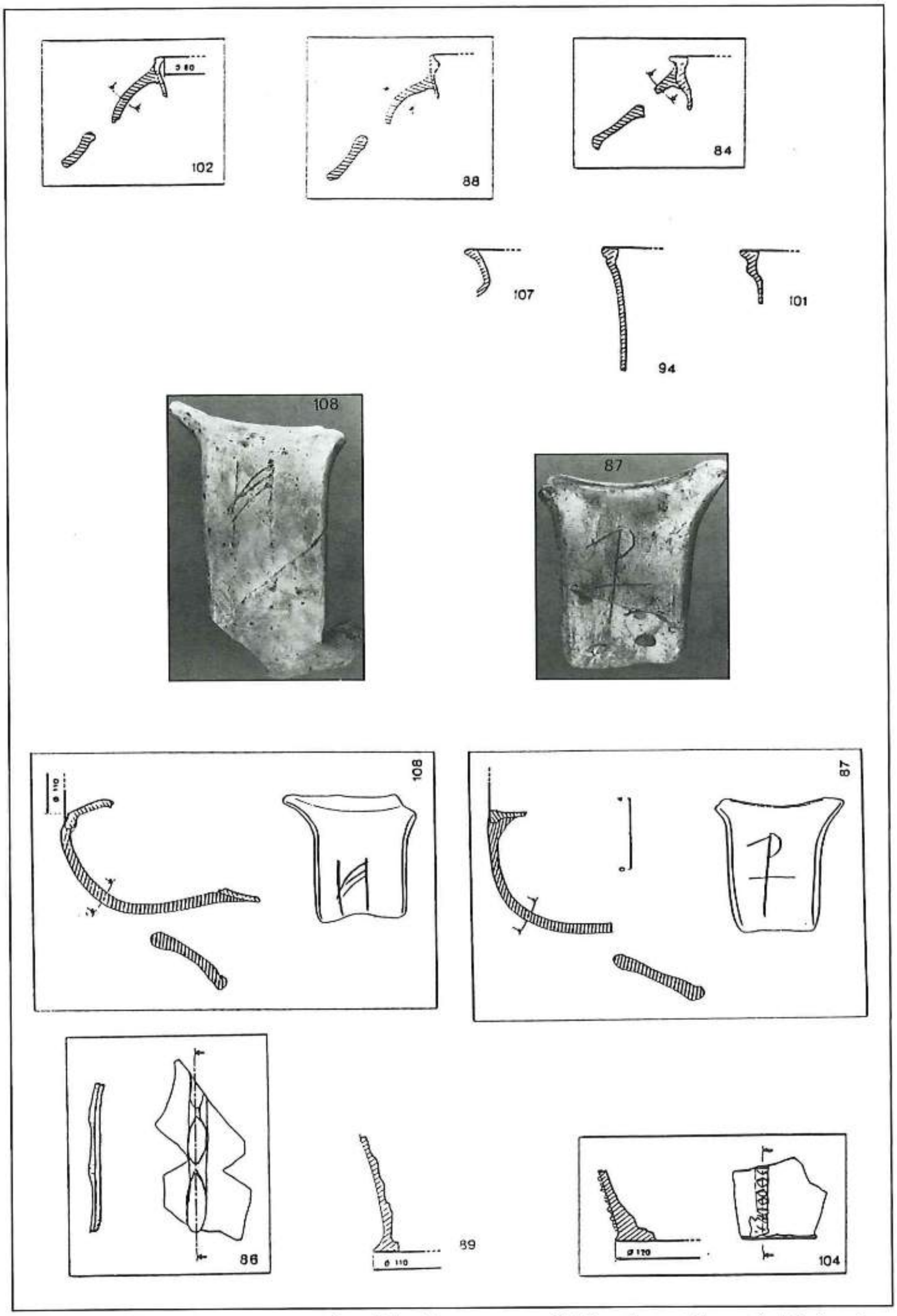

Fig 6 Ceramic samples representative of the Bergen group G4 (south-west France). All drawings are at the same scale as no.87.

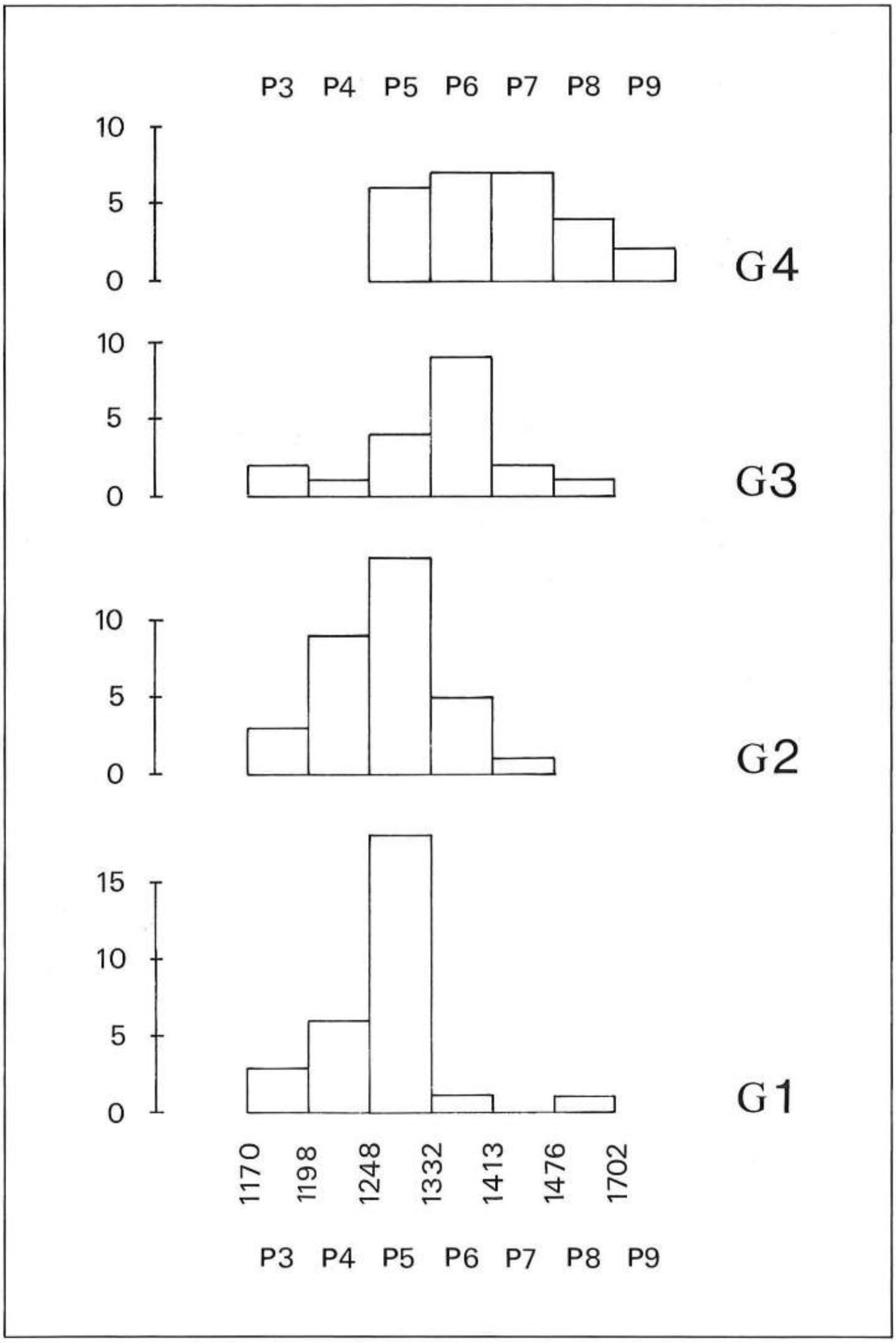

Fig 7 Distribution of the analysed ceramic samples according to the periods shown in Fig 2.

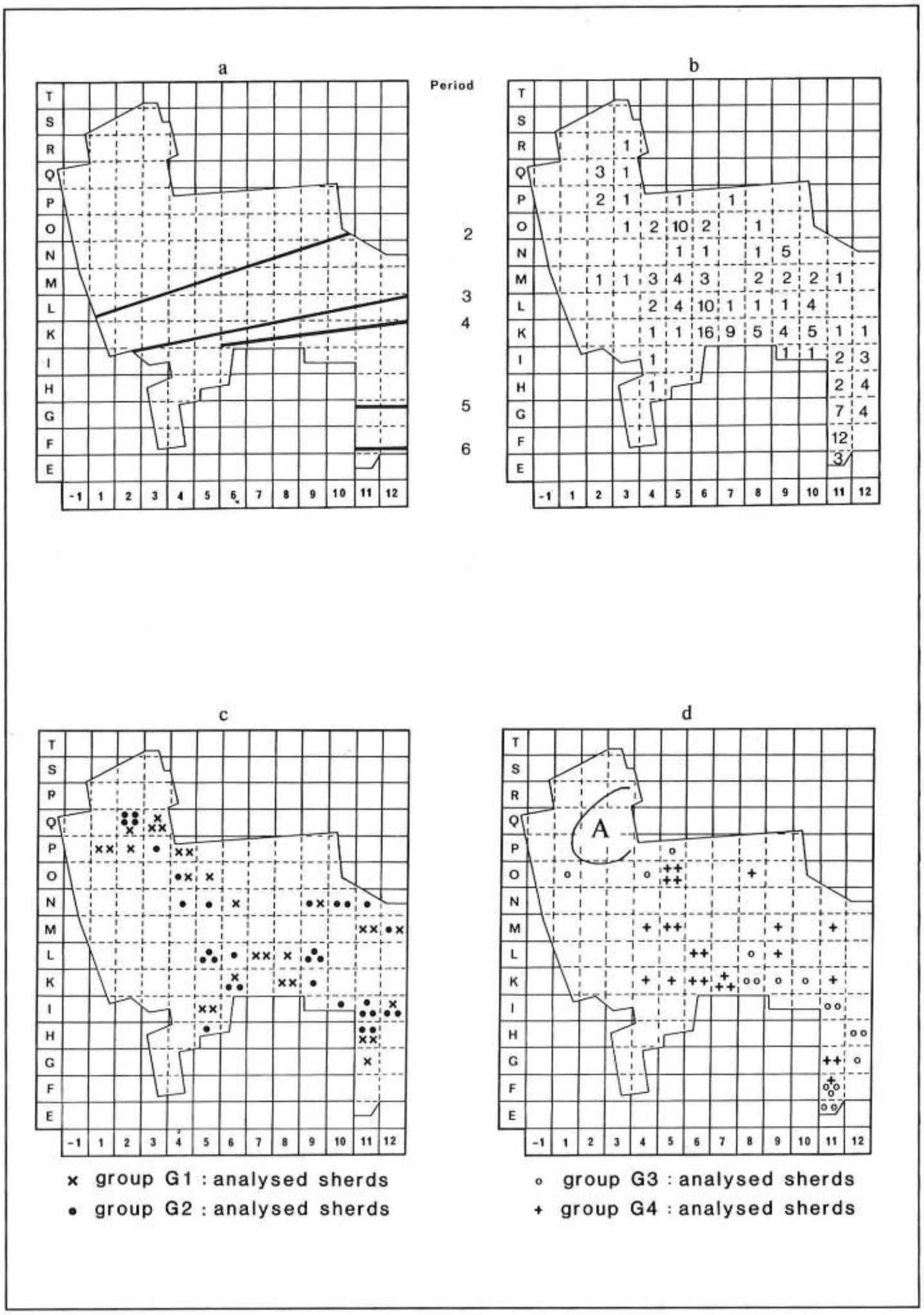

Fig 8 a. The advance of the waterfront in Periods 2–6 (simplified) (after Lüdtke 1989, 15).
b. Distribution of all the sherds presumed to come from Saintonge.
c. Distribution of the analysed sherds from groups G1 and G2.
d. Distribution of the analysed sherds from groups G3 and G4.

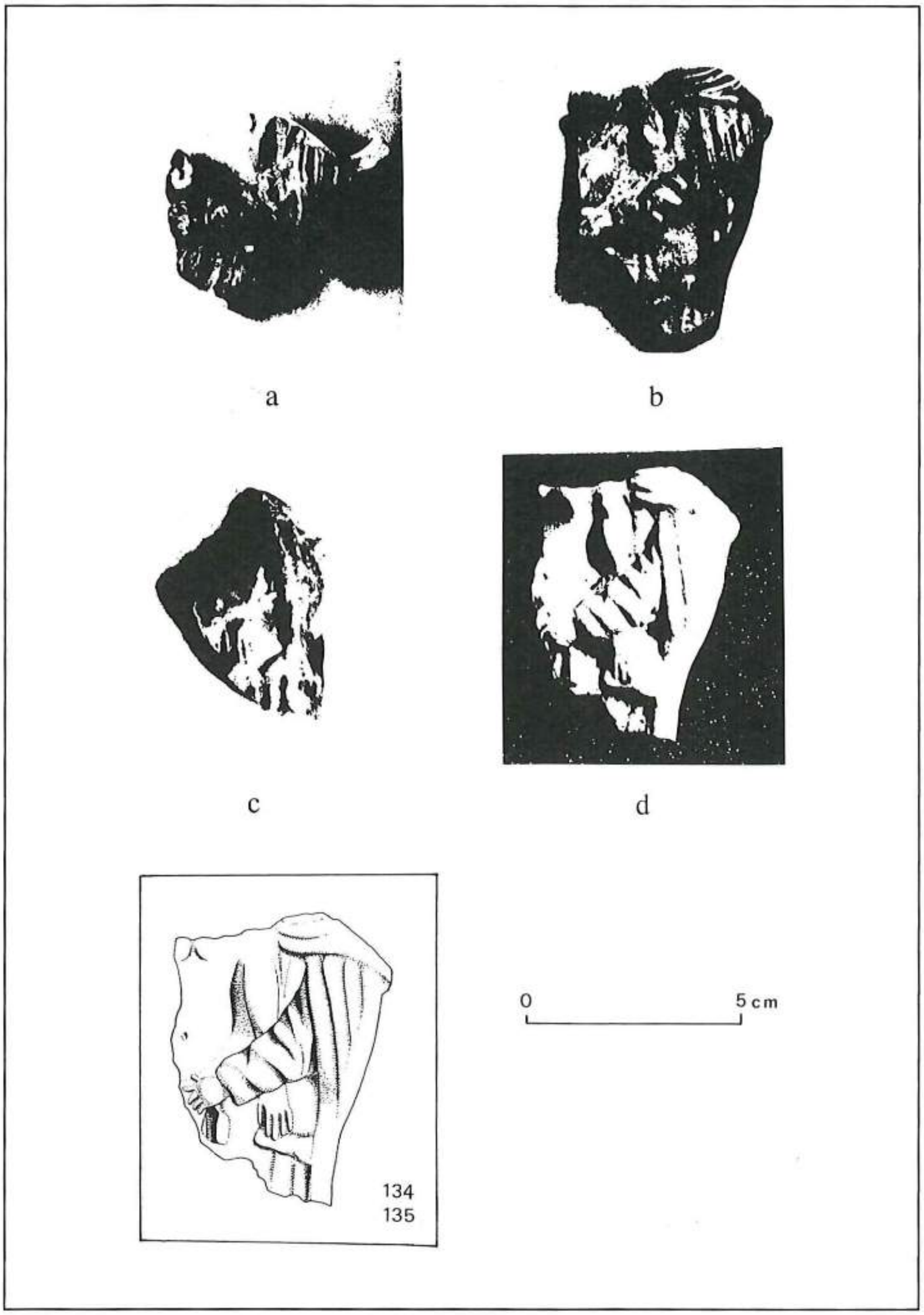

Fig 9 Three glazed polychrome samples (nos 134 and 135).
a, b, c. The original pieces
d. Photomontage from negatives made when photographing the sherds under a thin coat of white gouache.

THE DOG BONES FROM BRYGGEN

by

Anne Karin Hufthammer

Contents

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1 Introduction

In the course of the archaeological excavations at Bryggen in Bergen several hundred thousand bones were collected. This paper deals with the analysis of the bones derived from dogs (*Canis familiaris*). The purpose of the study was to investigate the keeping of dogs in medieval Bergen and in particular to determine how much this varied in the course of time and what changes, if any, took place with regard to the types of dogs, body size, age distribution and slaughter pattern.

The osteological material was collected over a long period of time, from 1955 to the 1970s, in the course of which significant changes took place both in the method of collection and in the value placed upon this material. A proper comparative study of the finds from the various stages of the excavation is therefore often difficult. This has great consequences on the value of what the material can tell us with regard to feeding, acquisition and use of domestic animals, hunting, fishing and fauna.

In the early excavations, starting with the site of Bugården in 1955, it was mainly the crania of cats and dogs that were collected. Very few post-cranial bones from these species were saved, and not very much at all from other species. Only from 1959 onwards, in connection with the excavation in Engelgården, were large amounts of other osteological material collected.

The presentation of the bone material from Bryggen is divided into three sections, one paper dealing with dogs, another with cats, and a third taking the osteological material in general. In the first two studies all the bones from the species which were found at Bryggen before 1973 have been used in the analysis; in the third study the analysis has been mainly based on the material from Engelgården, which provided the largest and best assemblage of finds of this type from Bryggen.

2 The bone material

The osteological material which is dealt with here is one of the largest archaeological assemblages of dog bones from the Nordic countries. It comes from 10 excavation seasons carried out between 1956 and 1972 and consists of 897 whole or fragmentary bones, 871 of which can be assigned to definite periods in the Bryggen chronology (fig 1). The remaining 26 could not be assigned to any specific period.

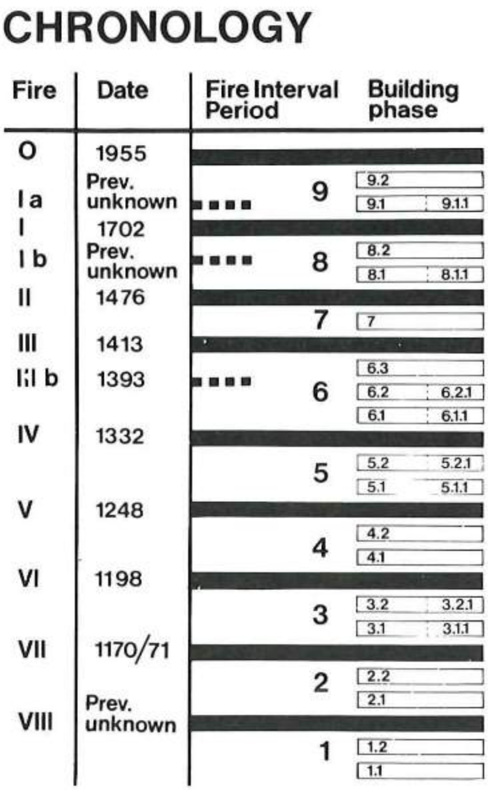


Fig 1 The fire levels and the intervening building phases and subphases related to the known historical fires in the Bryggen area (after A. E. Herteig).

Table 1 Total number of dog bones from different periods. The bones are divided into two groups: 1– without knife or axe marks; 2 – with knife or axe marks.

	Period 2 1170/71–1198		Period 4 1198–1248		Period 5 1248–1332		Period 6 1332–1413		Period 7 1413–1476		
Groups	1	2	1	2	1	2	1	2	1	2	
Bones											Sum
Cranium	7	1	24	47	7	1	9	1			97
Manibula	5	1	47	38	5	1	2				99
Dentes			4								4
Atlas	1										1
Vertebrae	3		27	4	2						36
Costae			35								35
Scapula	7	1	20	19	3		2	1			53
Humerus	7	2	43	37	3	1	2	3			98
Radius	3	2	37	27	1	3	2	1			76
Ulna	5	1	35	20	1	1	1				64
Radius/Ulna			5	2		1					8
Metacarpus			16				1				17
Os sacrum				4							4
Pelvis	3		15	34	1	4		3			60
Femur	9		20	26		4	3	5	1		68
Tibia	5	2	59	48	1	6	2	3			126
Fibula			7	2		1					10
Calcaneus	1										1
Metatarsus	1		10				2		1		14
Sum	57	10	404	308	24	23	26	17	2	0	
	67		712		47		43		2		871

The dog bones came mainly from the make-up deposits and cannot be directly associated with buildings except in a few cases. It is therefore uncertain whether they came from individuals slaughtered on the site or were introduced to the area as dead animals or individual bones.

Cat and dog crania were found in all samples of bones from Bryggen. It is most likely that they are over-represented in relation to other types of bones or species, possibly because they were often complete and easily recognizable. The dog and cat bones can be regarded as the most representative we have among the animal species at Bryggen.

It was essential to determine the stratigraphic and chronological position of the individual bones. This has been a time-consuming exercise, which has also been dependent on the general progress of the work in correlating the whole excavation. The material has been dated according to the revised chronology which was presented in the spring of 1988. Figure 1 shows the different levels and the fire chronology of Bryggen compared with known historic fires in the area (Herteig 1991, fig 5).

The osteological material bears all the signs of having been collected arbitrarily; in other words, it is a selective sampling by the archaeologists. The material was not collected by sieving nor by any other technique in which small bones and small fragments would have been retained. The collection methods have therefore given a strong over-representation of large and easily recognizable bones. For example, there is not a single canine phalange in the material.

The skeletal material covers three centuries. It comes from the layers deposited between the great fires of 1170/71 and 1476 (cf fig 1), with 82% of the material coming from the period between 1198 and 1248 (table 1).

The number of individuals seems to have increased greatly from the pre-1198 period to the period 1198-1248 (Period 4), from which there are 85 mandibles. This merely confirms, however, that there were at least 85 dogs in Bergen in Period 4. The actual number of individuals is naturally much higher than this – a large number of the dogs from this period will certainly not be represented in the collected material. In an osteological sample each individual will usually be represented with a few bones (Perkins 1973) and this means that there would have been several hundred dogs in Bergen during the period in question. Statistically it is likely that each individual is represented by only one bone (Lie 1981). On the basis of this model the osteological material from Period 4 with its 712 finds contains the bones of more than 700 dogs.

3 Methods

The bones were measured with a sliding rule or cranium calipers to the nearest 0.1mm at the points defined by von den Driesch (1976) and Duerst (1930). The following bones of adult individuals were measured: cranium, mandible, scapula, humerus, radius, ulna, pelvis, femur and tibia (see tables 1–35 in the Appendix). A large number of the long bones are fragmentary, but even the most fragmentary bones where no 'good' measuring points are intact may contain important information with regard to size and shape. In order to make use of this information measurements were taken at points which von den Driesch (1976) considers to be less suitable. Measurements not previously defined have also been used.

The total length of the long bones formed the basis for calculating the shoulder height. Cranial indices (Harcourt 1974) were used in order to identify any morphological groups which may be present.

Individual ages were determined on the basis of tooth eruption, state of the cranial sutures, and degree of ossification of the diaphysis and epiphyses in the long bones (Habermehl 1975).

All the bones were examined visually for pathological and mechanical traits, such as traces of disease, fracture, and knife or axe marks.

For statistical computation the G-test (Sokal & Rohlf 1969), F-test (idem), and the Coefficient of Variation (Simpson, Roe & Lewontin 1960) have been used. With the help of Probability Paper (Harding 1949), a percentage distribution of the various groups present can be shown graphically.

Considerable efforts have been made to examine the dog bones from Bryggen with the help of a Multiple Group Principal Analysis, which is described *inter alia* in the computer program package BMDP (Dixon 1983). This was unsuccessful mainly due to the fragmentary state of the bones and the paucity of intact specimens. Measurements which are lacking cannot be estimated for dogs on account of the extreme morphological variations in the skeleton, for example, the unpredictability of the proportions for the different bones.

4 Types of dogs in the Middle Ages

4.1 MORPHOTYPES

A great many attempts have been made to associate prehistoric canine skeletons with modern races (Studer 1901; Brinkmann 1923-24, 1925; Wagner 1930). More recent investigations of prehistoric dog skeletons have shown that there is probably no basis for any association (Harcourt 1974). Modern races are referred to in this study solely in order to provide an approximate indication of the shape and size of the dogs in medieval Bergen.

Even though there were already different types of dogs around 5000 BC, the Romans were apparently the first to breed dogs systematically and they probably had knowledge of most of the main groups (Clutton-Brock 1984). However, the majority of the *c* 400 modern races of dog have developed during the present century. Modern races are a result of the artificial selection of features which may have an economic, aesthetic or ritual significance. We can assume that such criteria also governed breeding in the past, even though we have no definite information. In addition to controlled breeding, free cross-breeding between some types of dog has almost certainly occurred. In theory there could have been 600–700 generations of selective dog-breeding from the Middle Ages to the present day, and it is therefore quite unlikely that any races have remained unchanged from medieval to modern times.

In most studies of medieval dog skeletons the individuals are grouped into types according to size and shape. The medieval urban excavations in Lund, Sweden, yielded dog bones dating to the period 1020–1400. The crania in this assemblage show little variation and suggest that it was a relatively well-defined medium-sized type of animal, the only exception being a small spaniel-like individual (Bergqvist 1957). A contemporary assemblage from Gdansk, Poland, on the other hand showed great variation, with the shoulder-height ranging from 35cm to 66cm (Kubasiewicz 1977).

Documentary sources show that already in the Middle Ages dogs were classified into various types, apparently by function and size. This is demonstrated by the scales of fines imposed for killing dogs, which are found in the medieval laws of Norway and Sweden (table 2).

According to the Frostating Laws, the *knähund* (or *skjødehund* in modern Norwegian) (ie 'lap-dog') was so small that a man's fingers could meet around its neck. *Mjøhund* may have been a general term for slender, fast, long-legged hunting dogs, corresponding perhaps to a kind of greyhound, whereas *jakthund* would seem to be a general term for more heavily built hunting dogs. *Vallhund* was used to describe a watchdog for flocks or herds, while *gårdvar* was used for larger guard-dogs. In

Table 2 Grading of dog types according to the size of the fine imposed for killing a dog, as stipulated in various medieval laws in Norway and Sweden. Fines are given in *ort* (= 1/5 *spesiedaler*).
FtL = Frostatingsloven; SkL = Skånelagen; Ögl = Östgötalagen; Sdml = Södermannalagen; KrL = Kristoffers landslag. (After Bernstrøm 1981).

	Ftl pre–1260	SkL c 1210	ÖgL 1290	SdmL 1327	KrL 1442
Knähund	12	6	6	24	–
Mjøhund	6	4	–	12	–
Jakthund	4	–	–	12	12
Vallhund	4	–	2	12	12
Gårdvar	4	2	–	3	–

addition to these there was most likely a miscellaneous group of dogs which did not have any economic value (Bernstrøm 1981).

The bone assemblage from Bryggen may have included all these and perhaps also other types, but the chances of being able to distinguish the types referred to in the medieval laws are slim. However, we can establish a probable classification of types by considering size (shoulder height). Wijngaarden-Bakker & IJzereef (1977) divided dogs from the late medieval period in the Netherlands into dwarf-dogs, small dogs, or large dogs on the basis of shoulder height.

4.2 SHOULDER HEIGHT

A changing pattern in the distribution of dogs according to shoulder height in the various periods may indicate that the keeping of dogs changed in character in the course of the Middle Ages.

The factors for calculating shoulder height have been estimated by examining dogs of 'normal' shape and limb length. Dogs with extremely small or bowed limbs have been omitted from the calculations (Harcourt 1974). Many of the dog bones from Bryggen are of such 'abnormal' shape that it is impossible to say how good the calculation of shoulder height is for these bones.

The ratio between the different parts of the limb can vary from race to race, a source of error which Harcourt (1974) did not take into account. The uncertainty will be particularly great when calculating the shoulder height of races with 'extreme' racial features associated with the long bones.

Harcourt (1974) gives the following figures for calculating the shoulder height (tl = total length of bone):

Humerus	$(3.43 \times tl) - 26.54$	Femur	$(3.14 \times tl) - 12.96$
Radius	$(3.18 \times tl) + 19.51$	Tibia	$(2.92 \times tl) + 9.41$
Ulna	$(2.78 \times tl) + 6.21$		

Several races of dog may have the same shoulder height. Many modern races – perhaps the majority – fall within the interval 35–55cm. It is likely that this was also the usual shoulder height in the Middle Ages and that there were several types of dog in this size group. Size as an expression of the shoulder height will therefore best be suited to distinguishing the extreme types, in other words the very small and the very large animals. Among these there will probably be relatively few types, possibly even only one type.

Table 3 Shoulder height (cm) of dogs from the different periods. Calculated from total length of long bones according to Harcourt (1974).

PERIOD 3 (1170/71–1198)												
Humerus	39	41	41	73								
Ulna	(no whole bones present)											
Radius	48	48										
Femur	29	30	35	35	40	41	70					
Tibia	31	31	38	51								
PERIOD 4 (1198–1248)												
Humerus	29	33	34	35	36	36	37	37	38	38	39	41
	42	42	43	46	47	49	49	52	53			
Ulna	27	33	38	38	38	38	39	40	40	40	40	41
	42	42	43	43	43	45	46	46	47	47	48	48
	48	48	48	49	52	52	59					
Radius	34	35	36	38	39	39	39	39	40	40	42	42
	43	43	43	43	43	44	44	47	47	47	48	49
	50	50	52	52	60							
Femur	28	34	34	35	36	43	48	53	57			
Tibia	27	28	31	32	33	33	33	35	35	36	36	36
	36	38	38	38	38	38	38	38	39	39	40	40
	40	41	42	42	42	43	43	43	44	44	46	47
	47	48	48	48	53	57	62					
PERIOD 5 (1248–1332)												
Humerus	(no whole bones present)											
Ulna	35											
Radius	47											
Femur	50	59										
Tibia	43	44	51	55								
PERIOD 6 (1332–1413)												
Humerus	29	61										
Ulna	34	57										
Radius	29											
Femur	32	43	61									
Tibia	36	62										
PERIOD 7 (1413–1476)												
(No whole long bones present)												

The calculated shoulder height for the dogs in the Bryggen bone assemblage (table 3) is hardly exact, but it does provide a sufficiently clear picture of the variation in size within the species.

The distribution of shoulder height is significantly different between Periods 3 and 4 ($F = 3.47$, $p < 0.001$) and between Periods 4 and 6 ($F = 4.00$, $p < 0.001$). Period 3 contains a relatively larger number of small and very large individuals than Period

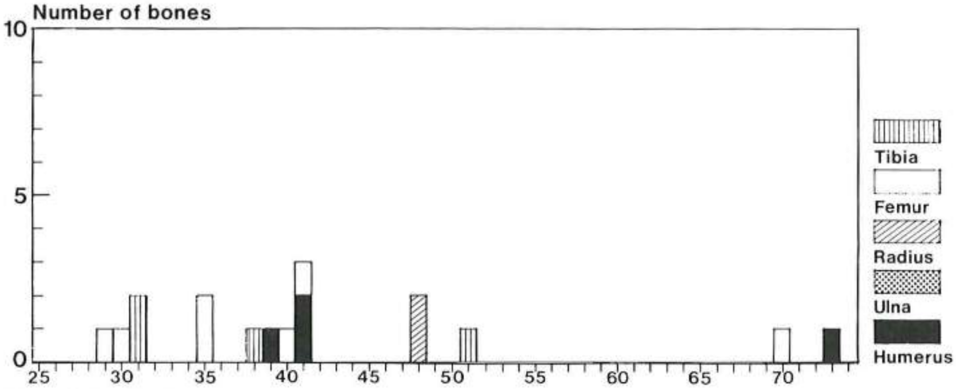


Fig 2 The distribution in shoulder height: Period 3.

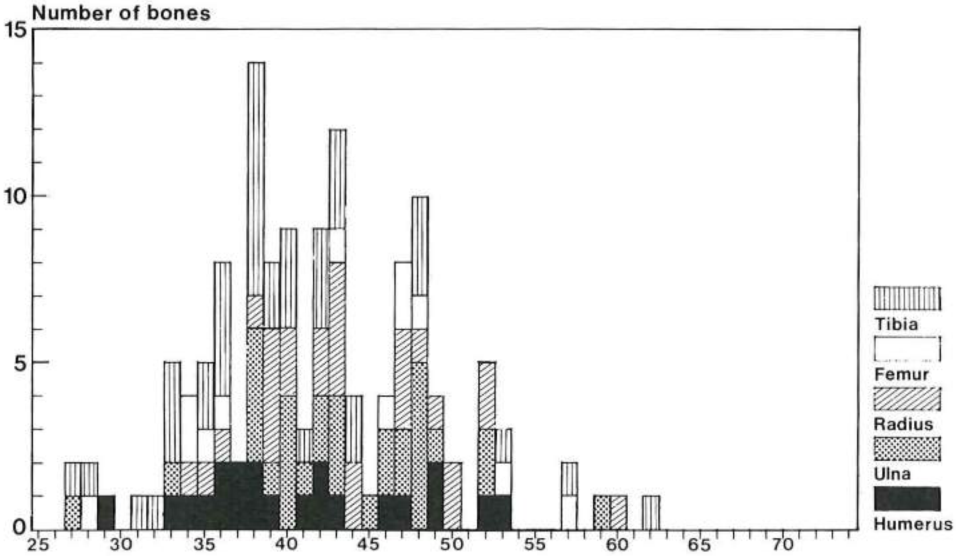


Fig 3 The distribution in shoulder height: Period 4.

4, where most of the animals lie within the normal range of 35–55cm. Although the sample from Period 5 is small, it does appear to give the same picture as Period 4. In Period 6 very small and very large individuals again dominate.

The great variation and uneven distribution of the shoulder height in Period 3 (fig 2) may suggest that certain types of dogs were definitely selected in the period before 1198. The large variation may also indicate that the breeding stock was limited or that there was little free cross-breeding.

Assuming that the bone assemblage is equally representative for the various periods, the increase from 67 long bones of dog in Period 3 to 713 in Period 4 suggests that there was an increase in the dog population in Bergen in the period from 1198 to 1248.

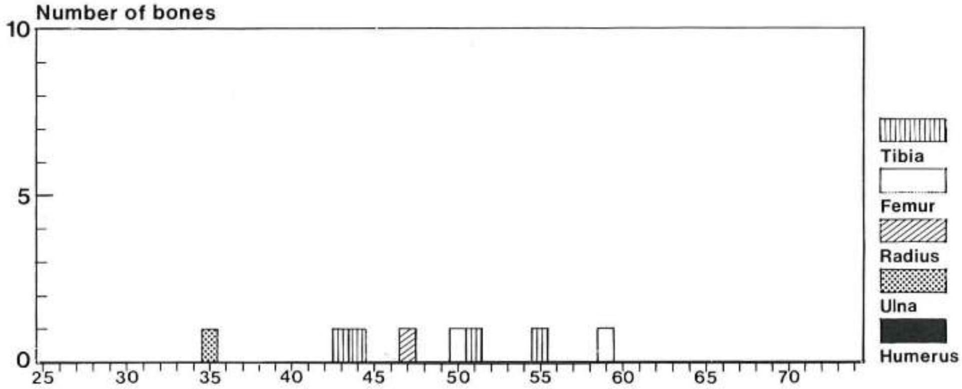


Fig 4 The distribution in shoulder height: Period 5.

The shoulder height for Period 4 (fig 3) shows less variation than in the earlier period and the extremely large individuals are few in number. The distribution is normal, suggesting a tendency towards homogeneity as a result of relatively free cross-breeding within the species. The decline in selective breeding may be related to the fact that the dog was used for meat, a point which will be discussed later. After 1332 selective breeding of extreme types with regard to size apparently became more dominant again (fig 5).

A great many of the long bones from Period 4 are fragmentary and therefore lack the total length which forms the basis for calculating the shoulder height. This could be one of the reasons why very large individuals in particular are not recorded in this period. For example, a fragment from a humerus was found in Period 4 where the proximal depth is 54.1mm, the proximal breadth 38.6mm, and the minumum breadth of the diaphysis 17.8mm (Appendix, table 14, no. 37). By comparison, the largest humerus in Period 3 where the total length could be measured (shoulder height of 73cm) was much more slender with a proximal depth of 43.0mm and a proximal breadth of 28.8mm. Even though the very large individuals were apparently few in number, Period 4 produced one of the largest individuals in the whole assemblage (fig 6).

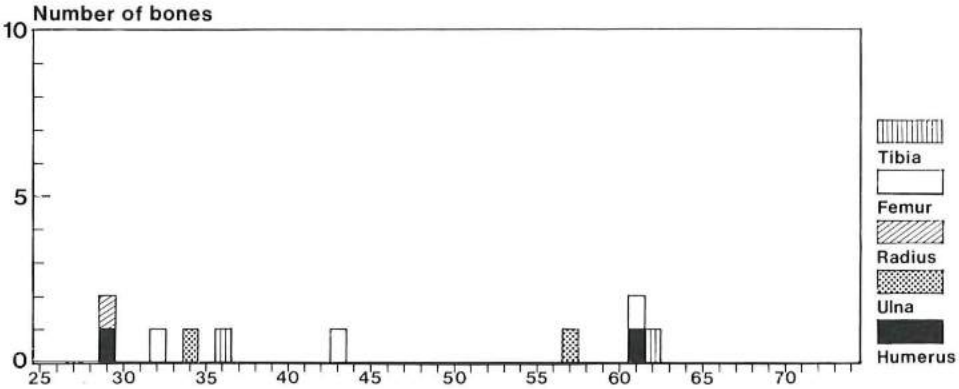


Fig 5 The distribution in shoulder height: Period 6.

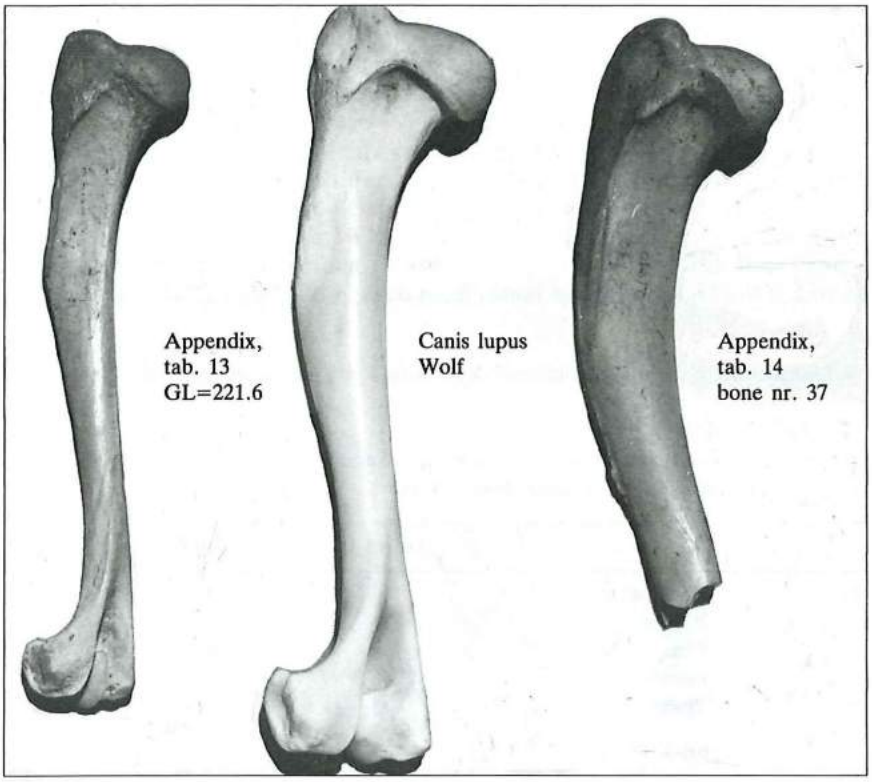


Fig 6 Comparison of humeri: left, from a dog with an estimated shoulder height of 73cm; centre, from a wolf; right, fragment of a humerus from the largest individual represented among the dog bones from Bryggen.

An association between subfossil skeletons and modern races has only been possible in exceptional cases. Clutton-Brock & Burleigh have described the skeleton of a large hunting dog from *c* AD 1200 from Canterbury which has many features in common with a modern bloodhound. Comparing the measurements of the humerus with individual no. 37 from Bryggen (Appendix, table 14) can indicate that such dogs also lived in Bergen in the thirteenth century.

4.3 SHAPE

Characteristic racial features are found in the skeleton, external appearance and behaviour, but they are seldom apparent to the same degree in the three groups. Even though the outward appearance can vary among different races, the skeletal anatomy may be the same or very similar and the racial difference will not therefore show up in the osteological assemblage. In some races it may be the cranium rather than the long bones which display the racial characteristics.

In the assemblage of dog long bones from Bryggen there are, however, two groups which are clearly distinguishable as special types (table 4, groups 2 and 3). Group 2 has thick, relatively short and very bowed legs. A comparison with the skeletons of modern races shows a great similarity to the dachshund, but the Bryggen individuals are somewhat larger than a modern dachshund. Group 3 has very slender, short, straight legs, and among modern races the dwarf pincher bears the closest resemblance. The remaining long bones consist of relatively straight bones of somewhat varying length and thickness, and it has only been possible in a very few cases to find features which could perhaps be associated with known races (table 4, group 1).

On applying the G-test, the distribution of the three groups of dogs between Period 6 and the earlier periods is found to be statistically significant ($p < 0.05$): between Periods 3 and 6, $G = 7.88$, and between Periods 4 and 6, $G = 7.27$, d.f. = 4. There is no significant difference between Periods 3, 4 and 5. The most noticeable feature in Period 6 is the high content of bones from dogs of the dwarf pincher type. Figure 5,

Table 4 Distribution of different varieties of dogs, judged visually according to the shape of the long bones
Group 1 = straight limbs
Group 2 = bowed limbs, comparable to modern dachshund
Group 3 = types comparable to modern dwarf pincher

		Group 1	Group 2	Group 3
Period 3	Humerus	8	0	0
	Radius	4	0	0
	Ulna	6	0	0
	Femur	10	0	0
	Tibia	5	1	0
	total	33	1	0
Period 4	Humerus	45	3	0
	Radius	48	2	0
	Ulna	46	7	0
	Femur	27	3	4
	Tibia	58	8	3
	total	224	23	7
Period 5	Humerus	0	0	0
	Radius	5	0	0
	Ulna	3	0	0
	Femur	3	0	0
	Tibia	5	2	0
	total	16	2	0
Period 6	Humerus	2	0	1
	Radius	0	0	1
	Ulna	2	1	0
	Femur	5	0	3
	Tibia	4	1	1
	total	13	2	6
Period 7	Femur	0	0	1
	total	0	0	1

which gives the shoulder height, shows a similar picture for Period 6. As much as 50% of the measured bones are from animals with a shoulder height of under 37cm.

The bones which are assigned on the basis of visual criteria to special types also clearly differ from the remainder of the material with regard to their measurements. The differences are most obvious when comparing maximum length with minimum breadth of diaphysis in the humerus, ulna, radius, femur and tibia. As the tibia is

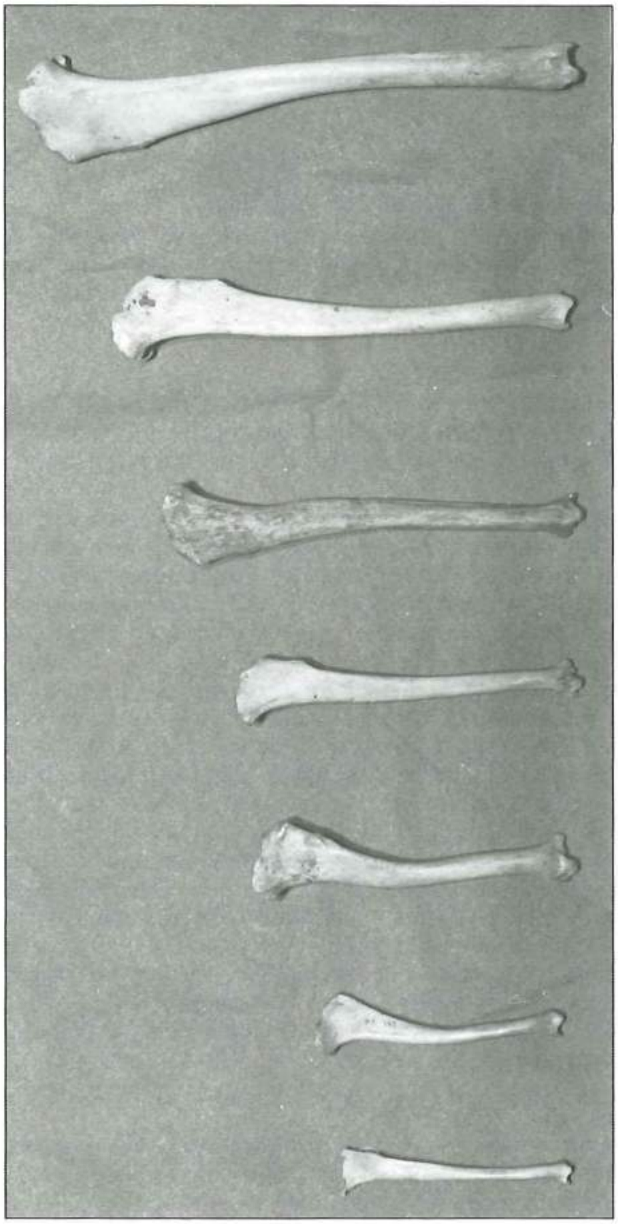


Fig 7 Variation in size and shape illustrated by 7 dog tibiae.

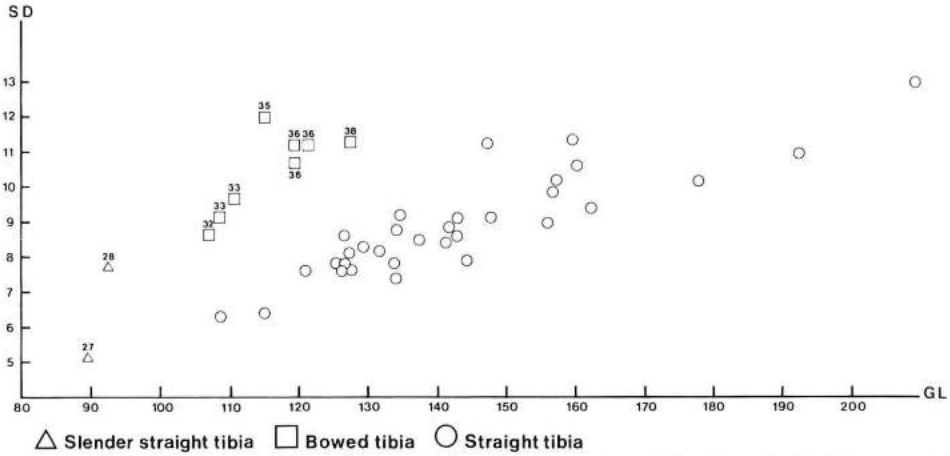


Fig 8 Variation in shape and size illustrated by all the complete tibiae from Period 4: comparison of maximum length and minimum breadth of diaphysis. Bones from dogs resembling the dachshund are indicated with a square; bones from dogs resembling the Dwarf pincher are indicated with a triangle.

the best represented, it has been chosen to illustrate this point (figs 7 and 8). Figure 8 shows that there are at least three types of dogs in the material from Period 4. The total length of the tibia of the smallest type shows no overlapping with the remaining material.

For two tibiae, a femur and an ulna in the 'dwarf pincher' classification, the shoulder height was estimated to 27cm, 27cm, 28cm and 28cm respectively (table 3). The very slender bones and the low shoulder height both indicate a type of largish lap-dog. The group classified as resembling the dachshund is also quite distinct, particularly with regard to the breadth of the diaphysis. In fifteen cases the shoulder height can be calculated and this ranges from 29cm to 38cm, with an arithmetic mean of 34.7cm. The shoulder height for this type greatly overlaps the group of smallest dogs in the non-classifiable material, whose mean height is 41.9cm.

As already mentioned, the calculation of the shoulder height for this type is very insecure and a comparison with the shoulder height of modern dachshund types is therefore of little value. Nevertheless, a direct comparison of the bones from Bryggen with bones of modern dachshund races shows that the medieval dogs resembling dachshunds are somewhat larger than the modern counterparts. Several studies have confirmed that the medieval dachshund-like dogs were essentially larger than modern dachshund races. A relatively large 'brachymele' dog was found, for example, during excavations at the medieval castle of Hitzaker (Kocks 1978). The limited variation in the shape and the size of the dachshund-like dogs from Bryggen indicates that this was a relatively clearly defined type. In Bernstrøm's survey of medieval types of dogs this group might be classified as a hunting dog. In Periods 4, 5 and 6 the bones of dachshund-like individuals make up between 9% and 11% of the long bones, whereas in Period 3 only a single bone (corresponding to 3% of the total) was found of this type.

Also from Period 4 are seven slightly bowed long bones from animals whose shoulder height varies from 38cm to 45cm. The bones do not form a special group with regard to the ratio total length/minumum breadth of diaphysis, and it is possible that they represent a cross between the dachshund type and a slightly larger animal.

The remaining long bones consist of straight bones of varying length and breadth and it has not been possible metrically to relate them to any distinct types. However, some of them have anatomical features which cannot be expressed in figures but which can be recognized visually. There are five fragmentary femurs and two complete humeri which are very similar to the corresponding bones from the Norwegian *lundehund* race in our comparative material. The humeri give shoulder heights of 36cm and 38cm respectively, which together with the form of the bones correspond to the modern variant of the *lundehund* race. No crania or mandibles in the subfossil material showing the same similarity with this race are found, and it is therefore uncertain whether the *lundehund* actually is represented in the Bryggen material. It is also uncertain whether this race existed in the Middle Ages.

To conclude, therefore, two types of dog can be identified among the long bones: dachshund-like dogs and lap-dogs. However, it is difficult to establish a basis for relating the crania and mandibles to the long bones.

In this study, twenty-two of the dog crania measurements have been used which von der Driesch (1976), partly on the basis of earlier studies, defines as 'good' (tables 1–4 in the Appendix). In most of the earlier osteological work where canid types are discussed, the most important basic data is the size and shape of the cranium. Ekman (1973) grouped the dogs from the early medieval assemblage from Lund into three types on the basis of cranial measurements independent of size. Using studies based on measurements both dependent and independent of size (Wagner 1930; Stockhaus 1965), Wendt (1978) found that the dogs at Haithabu in the Viking and early medieval periods had relatively long muzzles and narrow skulls. Harcourt (1974) found less variation in the shape of the skull of dogs from the Anglo-Saxon period (AD 500-1100) than in earlier material from Great Britain.

Harcourt (1974) uses three different indices to denote the shape of the skull:

(1) Cephalic index: zygomatic breadth × 100/total length. This index gives the relationship between width and length of skull.
(2) Snout or muzzle index: basal length × 100/total length. This index gives the relationship between length of muzzle and length of skull.
(3) Snout-width index: breadth at the canine alveoli × 100/vicerocranium length. This index gives the relationship between the breadth and length of the muzzle.

In the material from Period 4 at Bryggen there are eighteen crania where all the measurements used in Harcourt's indices are intact (fig 9). Figure 9 shows that on the basis of these indices it is apparently possible to identify different cranium shapes. For example, it can be seen that crania 2, 11, 13, 14 and 16 with their relatively long muzzles differ from the rest of the material. However, the group is very heterogeneous with regard to the length of the cranium in that the basal length ranges from 126.8mm to 187.9mm. If an attempt is made to group the material on the basis of all three indices, the picture becomes even more complex with apparently as many types as there are crania. The large variation can be illustrated by cranium 1 which is small and broad with a short broad muzzle, cranium 17 which is large and narrow, and cranium 16 which is large and broad with a relatively long and narrow muzzle.

The co-efficients of variation for the total cranial length (measurement 1, tables 1–4 in the Appendix) are V=18.8 for Period 3, V=13.2 for Period 4, V=17.1 for Period 5, and V=11.6 for Period 6. A coefficient of variation greater than 10 indicates that the sample is heterogeneous (Simpson, Roe & Lewontin 1960). The range in size also suggests that the cranial material contains representatives from several types/groups. The grouping of crania on the basis of these indices does not therefore seem suitable for determining races. Figure 10 shows some of the variations in the dog crania from Bryggen.

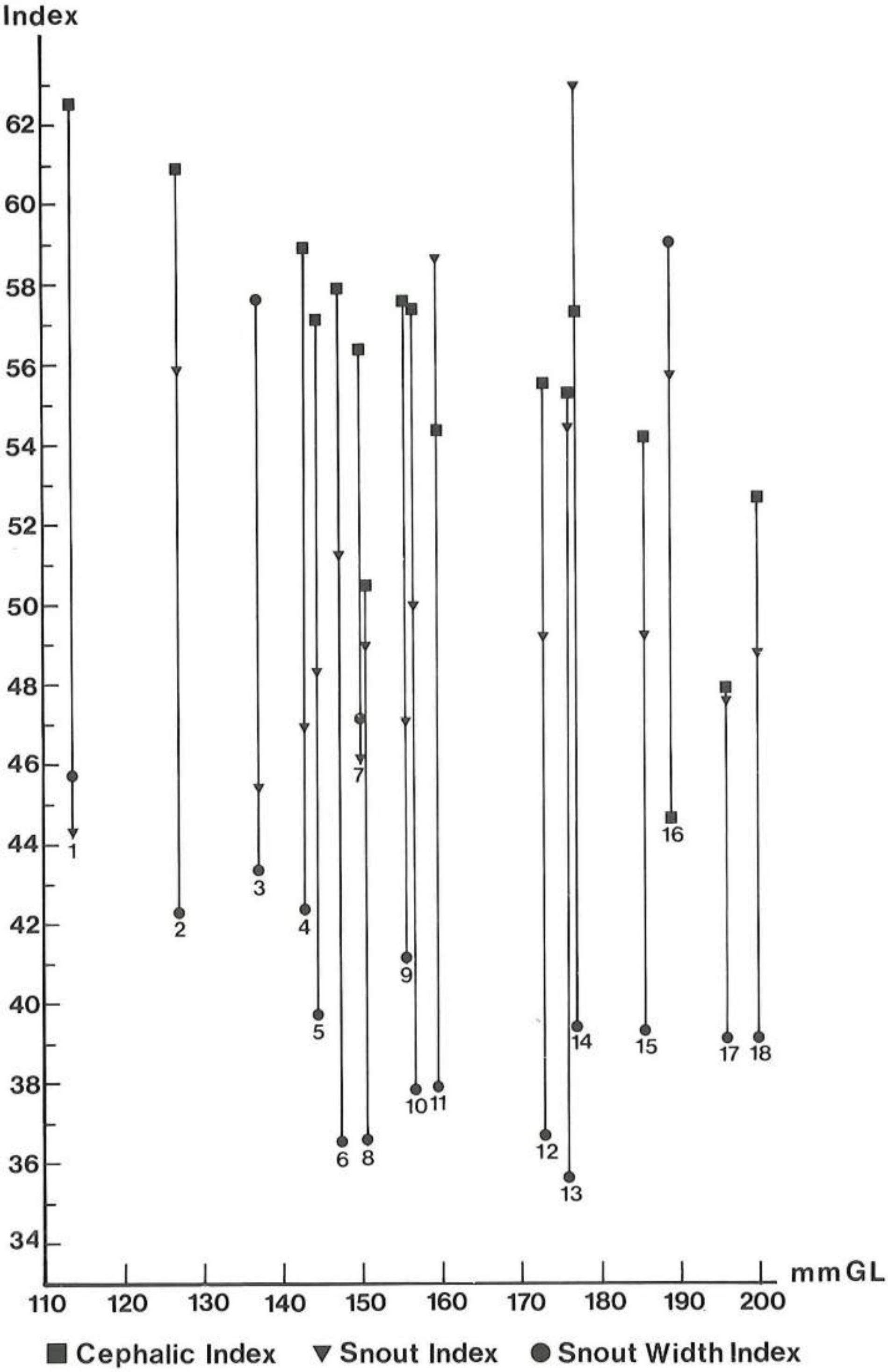
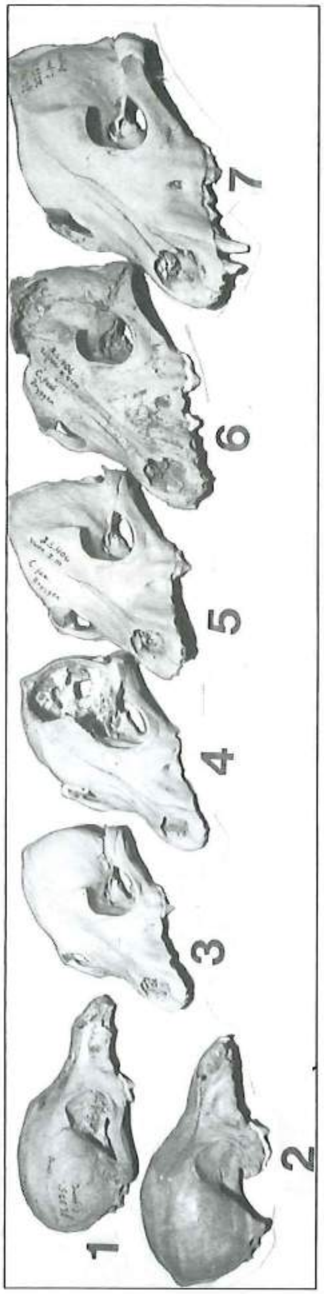


Fig 9 The cephalic, snout (muzzle length), and snout width indices for 18 crania from Period 4.



1. Appendix, tab. 1, ind. 4
2. Appendix, tab. 3, ind. 4
3. Appendix 2, ind. 9
4. Appendix 2, ind. 11
5. Appendix 2, ind. 13
6. Appendix 2, ind. 23

Fig 10 Some dog crania from Bryggen.

It is fairly unlikely that the same individuals are represented in all three groups of material: crania, mandibles and long bones. From the way in which the material was collected, however, it is likely that the same individual is represented by both mandible and cranium.

In figure 11 there is a clear break in the line for shoulder height in *c* 96%. In a non-adjusted scale of measurements the break will come between 53cm and 56cm. It has been shown previously, on the basis of shape, that several types of dogs are represented with a shoulder height ranging from 29cm to 38cm (fig 9). The apparently normal distribution of the population with a shoulder height less than 53cm which is graphically produced by using Probability Paper, thus consists of several populations with a large degree of overlapping.

There is an apparent similarity in the distribution with regard to the lengths of the lower jaw, canine teeth and cranium. A clear break in the probability for all three

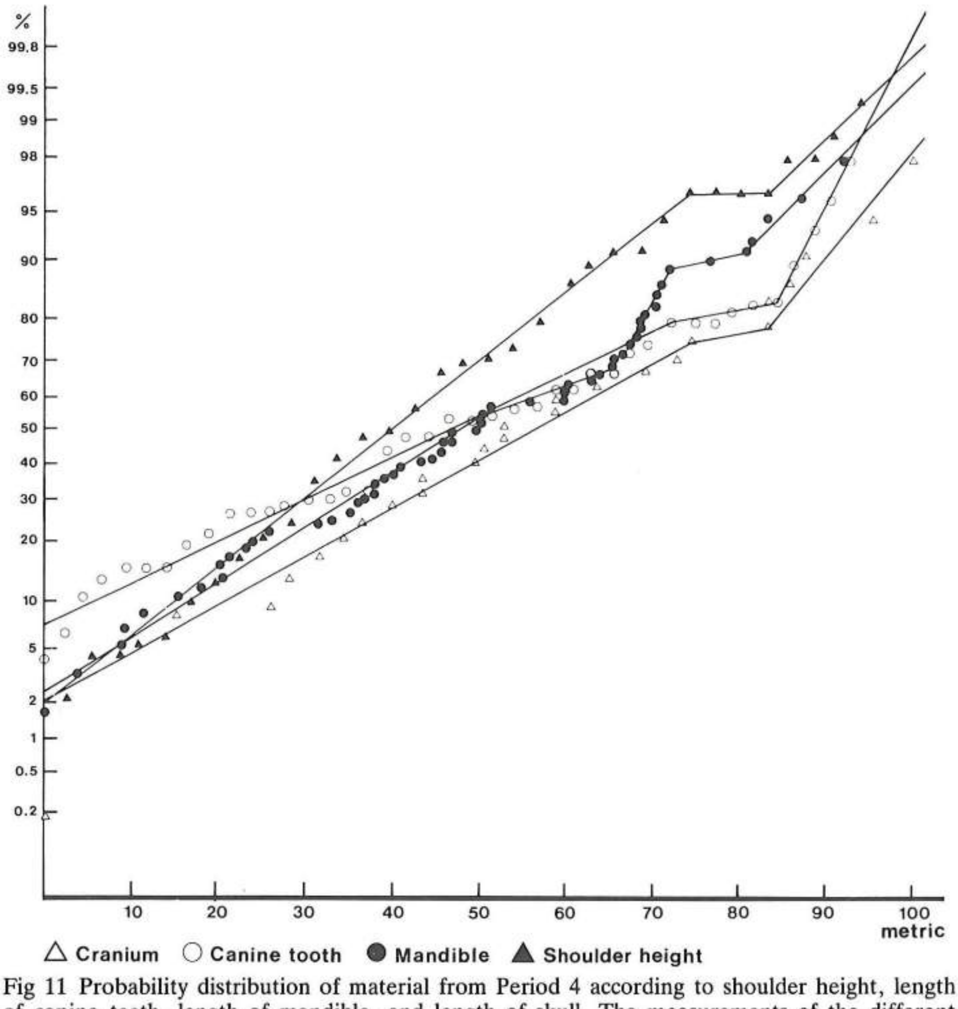


Fig 11 Probability distribution of material from Period 4 according to shoulder height, length of canine teeth, length of mandible, and length of skull. The measurements of the different types of bones have been re-calculated to a scale from 0 to 100.

bone types occurs somewhere between *c* 65% and *c* 80%, indicating that between 35% and 10% of the largest dogs belong to a clearly defined group or several groups, which can be distinguished from the remaining individuals, which are smaller.

The most marked break occurs in the distribution pattern for the mandible length. The straight line which is drawn for the length of mandible at a probability distribution of between *c* 68% and *c* 90% shows that *c* 22%, corresponding to 13 mandibles, possibly belong to a distinct type of dog. The total lengths (not recalculated on the scale 0–100) for the group range from 128.3mm to 133.0mm, with a mean of 130.6 and a standard deviation of 1.47. However, the coefficient of variation for the group is very low (1.12) and it is therefore unlikely that the entire variation in size for this group is shown. Perhaps there are several more mandibles, both large and small, which really belong to this possible dog type/size group.

With a distribution of probability between *c* 90% and 100% there is again an apparent normal distribution of mandibles. The given values correspond to a total length ranging from 139.6mm to 154.0mm.

The distribution pattern regarding the length of the dog teeth shows a clear break at *c* 80%, which means that there are apparently two distinct groups represented in the material. However, the coefficient of variation is 8.1 and the variation is not greater than would be expected in a natural population. On account of the conflicting results there is no basis for using the length of the canine teeth as a criterion for identifying different groups according to size. The results indicate nevertheless that changes in the size of the cranium and the mandible are not synchronous with the changes in the length of the canine teeth.

5 Breeding

Poplin (1976) shows that an irregularity in the molars of dogs is an expression of the increased variation resulting from domestication. The degree of abnormality is emphasized by two factors: the breeding of races which cannot exist in the wild, and selective breeding, such as inbreeding. Increased inbreeding in the dogs from Bryggen might therefore result in an increase of abnormal dentition (table 5).

The difference in the distribution pattern of normal and abnormal dentition in the various periods is not statistically significant, but as the samples in Periods 3, 5 and 6 are small, they provide a poor basis for maintaining that the distribution pattern is the same in all periods. There is therefore much uncertainty attached to the results showing that the frequency of inbreeding remained unchanged.

The degree of inbreeding can also be expressed as the frequency of inherited diseases such as dysplasia of the hip joint and arthrosis in the elbow joint (Grøndalen 1981), but owing to a lack of experience in interpreting the cause of abnormality in bone tissue and also to the paucity of material from diseased animals, this has not been examined further in the present study.

Table 5 Distribution by period of normal and abnormal dentition in the upper and lower jaws of dogs. Abnormality is indicated by having fewer teeth than normal (oligodontie) and/or teeth so large that they grow for example at right angles to the line of the jaw.

	MAXILLARY	
Period	Normal dentition	Abnormal dentition
3	6	1
4	47	4
5	7	1
6	7	2
	MANDIBLE	
Period	Normal dentition	Abnormal dentition
3	5	0
4	53	21
5	3	3
6	2	0

6 Pathological and mechanical changes in the bones

A number of anomalies due to disease, fracture or blows were found among both the long bones and the crania (see list below), some of which must have caused great suffering and restricted the animal's freedom of movement. That a dog was allowed to remain alive in spite of its handicap could be an indication that it was extra valuable to its owner. Siegel (1976) stated that 'dental disorders, arthropathy and fractures' account for most palaeopathological lesions. Veterinary surgeons Aursjø, Binde and Schjønheit have examinated the dog bones from Bryggen and evaluated the reduction in functionality caused by abnormal bone formation (*exostosis*). According to Baker & Brothwell (1980), 'disease is the result of a complex interplay of causal agents, hosts and environment'. The malformed bones from Bryggen are therefore a great potential for information and veterinary surgeon Dr Jorunn Grøndalen and the present author are planning a paper on the causes of malformation.

The following pathological and mechanical changes have been recorded on the dog bones from Bryggen:

Period 3 Ulna with broken diaphysis causing great malformation at the point of fracture. Serious exostosis in the proximal joint, probably brought about by abnormal weight distribution following the fracture. The malformation probably restricted functionality. The total length cannot be measured. Shoulder height estimated at 40–45cm.

Femur with serious exostosis under the proximal epiphyses. Movement of the thigh probably greatly reduced. Greatest length 98.3mm gives a shoulder height of 30cm.

Period 4 Cranium with a *c* 0.6cm circular hole in the left frontal bone; new bone tissue around the edge of the wound. Adult individual, but not old. Total length of skull 158.9mm.

Cranium with sequestrum, *c* 0.5cm in diameter, on the left maxilla; exostosis in the jugular/maxillary suture. The abnormalities may be the result of a bite. Total length of skull 150.9mm.

Humerus with a little exostosis on the junction between the proximal diaphysis and the head. The malformation is unlikely to have affected functionality. Greatest length 132.3mm gives a shoulder height of 43cm.

Humerus with a little exostosis at the junction of the proximal diaphysis and the head. The malformation is unlikely to have affected functionality. Total length of 113.6mm gives a shoulder height of 36cm.

Humerus with slight distal exostosis in the joint. Functionality most probably not affected. Greatest length unmeasurable. Smallest breadth of diaphysis 8.9mm. Estimated shoulder height 40–45cm.

Radius with slight exostosis at the junction of the epiphysis and proximal diaphysis. Function of the joint probably not affected. Total length 128.6mm giving a shoulder height of 43cm.

Radius with slight proximal exostosis, probably not affecting movement. Total length 125.2mm giving a shoulder height of 42cm.

Radius with well-healed fracture of the diaphysis. Slight exostosis in the proximal epiphysis probably due to uneven weight distribution. Greatest length not measurable. Smallest breadth of diaphysis 13.6mm. Estimated shoulder height *c* 60cm.

Femur with a growth on the diaphysis. Probably due to damage of the periosteum. Young individual. Not measurable.

Tibia with a *c* 0.5cm large proximal/ medial hole through the corpus. New growth of bone tissue around the wound. Malformation probably caused by some kind of a 'projectile' penetrating the bone. Total length not measurable. Greatest breadth of the proximal end 26.3mm. Estimated shoulder height 40–45cm.

Tibia with some exostosis in the distal epiphysis. Very old individual. Malformation probably due to age. Greatest length 159.8mm giving a shoulder height of 48cm.

Tibia with exostosis in the distal epiphysis. Very old individual. Malformation probably due to age. Greatest length 120.9mm giving a shoulder height of 36cm.

Period 5 Cranium with a *c* 1cm large hole in the right maxilla probably from a bite. New growth of bone tissue around the wound. Total length of skull 110.2mm.

This survey shows that there were two individuals which were kept alive despite a serious reduction in functionality. They were both from Period 3. From its size and form, one is thought to belong to the commonest category of dog from Bryggen. The other, which lived to a great age, was of a slender type, of which only a few individuals were found.

From Period 4 there were the bones of two individuals whose malformation was due to advanced age. From the size and form they belonged to the commonest type of dog at Bryggen.

In very many prehistoric finds of dogs, traces of partitioning have been recorded, which have been interpreted as evidence that the animals were used for food (Aaris-Sørensen 1988; Bökönyi 1974; Harcourt 1974; Wing 1978). There is no archaeological evidence that dog meat was eaten in Northern Europe as late as the Middle Ages. Wendt (1978) found 'relatively numerous' traces of tool marks on bones, especially on the skull, in dogs from the ninth-to-twelfth centuries in Haithabu. He does not exclude the possibility that dog meat was occasionally eaten. There are also a number of written references in Norway showing that dog meat was eaten under special circumstances. According to the Borgarting church law dating to the same time as the dog bones from Bryggen, a person who had not eaten for seven days could eat dog meat without incurring punishment (Bernstrøm 1981). According to the Older Gulating Law 'man should eat dog rather than dog eat man' (Storm & Hertzberg 1895).

The medieval dog bones from Bryggen contain clear evidence for skinning and partition. Marks caused by skinning are quite different from those caused by partition and are usually only present on the skull and jaw and around the extremities of the long bones (Binford 1981). A list of the crania from Bryggen with marks caused by skinning, by partition, or by both is given in table 4 in the Appendix.

Definite traces of skinning were only found on crania and mandibles. The marks on the crania were caused by a narrow-bladed cutting tool and were found on the frontal bone around the eye socket, cranially on the premaxilla and nasal bones (on the top of the muzzle) and ventrally on the maxilla (at the junction with the mandible). The marks on the lower jaw appear along the entire ventral surface.

Marks from skinning were recorded on one of the eight crania and one of the six mandibles from Period 3, and on 21 of the 71 crania and 15 of the 85 mandibles from Period 4. None of the bones from Periods 5 and 6 had any marks caused by skinning.

Together with research technician T Fredriksen I have skinned both dog and fox without leaving any clear knife marks on the bones. Contact with bone blunts the knife-blade and one therefore tries to avoid cutting deeply and penetrating the periosteum when skinning an animal. This, plus the fact that a large number of the recorded skull fragments are not from those parts of the head which would have marks from skinning, makes it likely that the proportion of skinned animals was higher than that indicated by the recorded crania and mandible samples.

The cranial and jaw measurements (tables 1–8 in the Appendix) show that dogs in every size category were skinned.

From Periods 5 and 6 there are 14 and 9 crania and lower jaws respectively, none of which had marks from skinning. The sample is too small to allow for a statistical comparison with the earlier material, but it may indicate that dog skins were of less importance after 1248.

Marks from partitioning are defined as marks which have been caused by a broad-bladed chopping tool. They can appear as deep incisions in the bone, or the bone may be cut right through.

On applying the G-test (Sokal & Rohlf), it was found that the proportion of bones with chopping marks compared with the total number is significantly different in Period 3 than in the other periods. There is no difference in the frequency of the partitioned animals in Periods 4, 5 and 6. The proportion of partitioned animals seems therefore to increase from Period 3 to Period 4 and then remains stable throughout Periods 4–6.

Marks from partitioning can be found on any part of the skeleton (cf group 2 in table 1). Since few bones from the outer limbs were recorded, it is difficult to judge whether the distal parts of the fore and hind limbs were also partitioned, but a comparison of the partitioning pattern found at Bryggen (fig 12) with modern known

Table 6 Relationship between total number of dog bones and dog bones with partition marks for each period

	Total number of bones	Bones with partition marks
Period 3	67	8
Period 4	712	282
Period 5	47	23
Period 6	45	19
Period 7	2	0

methods of partitioning show a great similarity. The non-fleshy distal parts of the limbs stretch from the middle of the upper part of the limb. If we exclude those bones which are not likely to have partition marks – dentes, metacarpus, calcaneum and metatarsus – we find that partitioned animals in Period 3 make up *c* 12%, while the proportion in Periods 4–6 is 41%, 49% and 45% respectively.

When partitioning a slaughtered animal, the pelvis and/or the sacrum will always be divided in two parts. The bones in the pelvic region are therefore very suitable for identifying partition. In Period 4 there were chopping marks on 34 of the 49 pelvic bones, indicating that the proportion of partitioned animals in this period is even higher than suggested by the other bones. Only three pelvic bones were found in Period 3, none of which has chopping marks. Even though the sample is small it reinforces the impression that dog meat was not consumed to any great extent at Bryggen prior to 1198.

In Period 4 there were four lower jaws and ten crania with both skinning and partition marks, suggesting that in these cases both the skin and the meat were used. Tables 1–37 in the Appendix, which list the measured long bones and crania, show that all size categories and all 'types' of dog were skinned and partitioned.

What would the dog meat have been used for? I can envisage only three possibilities: human consumption, feeding to birds of prey (falcons and hawks), and dog food.

No traces of gnawing or biting as shown by marks from dogs' teeth have been recorded and the pattern of slaughtering (fig 12) indicates that the animals were

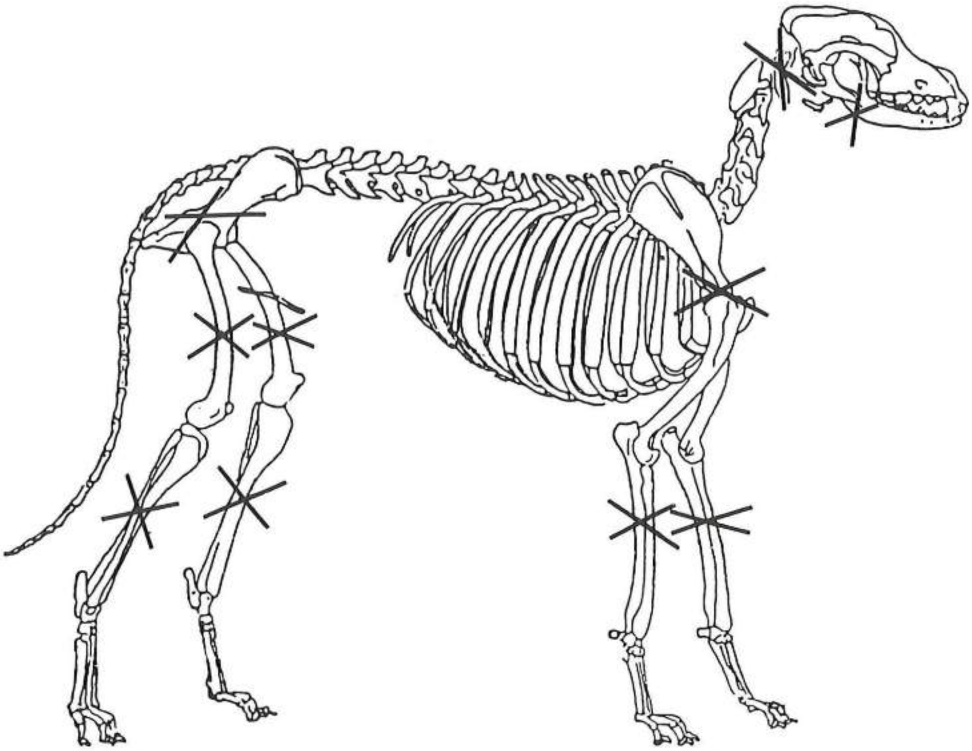


Fig 12 Dog skeleton showing the points at which the animals from Bryggen were partitioned.

divided into pieces too large for feeding to birds of prey. Consequently, there are strong indications that the dog meat was used for human consumption. The high frequency of slaughter in Periods 4, 5 and 6 (1198–1413) compared with the strict rules concerning the eating of dog meat at this time (Bernstrøm 1981) indicates that the written evidence does not fully reflect the practices of society.

7 Age distribution

The individual age of a dog can be determined from the epiphyses and the teeth. The fusion of the epiphyses with the diaphysis occurs at different ages in the different long bones, but takes place in modern races within the first 18 months of the animal's life (Habermehl 1975). The age at which ossification occurs can also vary somewhat within the same race. Both nutrition and hereditary factors probably affect the process (Noddle 1984). Dogs in the Middle Ages with poorer nutrition may therefore have needed longer time to reach adulthood, but the sequence of fusion will most likely have been the same.

Applying the G-test to the relationship between fused and unfused epiphyses (table 7) gives the following results (1 degree of freedom):

Periods 3 and 4	$G = 20.90$
Periods 4 and 5	$G = 0.17$
Periods 4 and 6	$G = 3.16$
Periods 3 and 5	$G = 7.28$
Periods 3 and 6	$G = 3.45$

The results show a highly significant difference between Periods 3 and 4 ($p<0.005$) and a significant difference between Periods 3 and 5 ($p<0.01$) in age distribution. Only a small number of the animals in Period 3 died before the fusion of the long bones was complete. In Periods 4 and 5 the number of younger animals represented in the bone samples is far higher. In Period 6 there is a slight tendency towards an increase in the relative frequency of fully-grown animals, but the sample is so limited here that the chances of drawing false conclusions are great.

The graph showing the rate of survival of dogs in Periods 3 and 4 (fig 13) is based on the results given in tables 7 and 8. The samples from Periods 5 and 6 are too small to show graphically.

The graph for Period 3 shows a very low and probably 'normal' mortality rate for the first 10 months. In Period 4 on the other hand there is a strong increase in the mortality rate at 7 months or so. Only half of the animals lived beyond 10 months; approximately 30% died during the first few months, probably after they had reached full size, but before they had reached adulthood. This may be an indication of a regular slaughtering of half-grown dogs.

The determination of age from the cranium and mandible is based on the eruption of permanent teeth. In modern races of dogs all the permanent teeth have erupted at the age of 7 months (Habermehl 1975). Some scholars recommend also using the degree of tooth wear as a criterion for age determination in older animals. Since the wear on teeth depends on the type of nutrition, I do not find this method suitable.

Table 7 Fused and unfused epiphyses in the different long bones. Single unattached epihyses have not been included. For complete bones, the state of the fusion at the two ends is given separately.

			Epiphysis fused	Epiphysis not fused
Period 3	Scapula	proximal	8	0
	Humerus	proximal	5	1
		distal	8	0
	Radius	proximal	5	0
		distal	2	0
	Ulna	proximal	6	0
		distal	2	1
	Femur	proximal	8	0
		distal	7	0
	Tibia	proximal	7	0
		distal	5	0
	Total		63	2
Period 4	Scapula	proximal	29	9
	Humerus	proximal	28	29
		distal	63	9
	Radius	proximal	51	11
		distal	39	11
	Ulna	proximal	53	5
		distal	35	8
	Femur	proximal	20	4
		distal	33	7
	Tibia	proximal	58	31
		distal	53	22
	Total		462	146
Period 5	Scapula	proximal	0	2
	Humerus	proximal	0	2
		distal	2	2
	Radius	proximal	4	0
		distal	2	0
	Ulna	proximal	3	1
		distal	1	0
	Femur	proximal	2	0
		distal	3	0
	Tibia	proximal	2	0
		distal	4	0
	Total		23	7
Period 6	Scapula	proximal	0	4
	Humerus	proximal	2	1
		distal	4	0
	Radius	proximal	3	0
		distal	2	0
	Ulna	proximal	3	0
		distal	1	0
	Femur	proximal	5	0
		distal	8	0
	Tibia	proximal	5	0
		distal	2	0
	Total		35	5

Table 8 Age of fusion of the epiphysis in the limbs of dogs determined by X-ray. After Sumner-Smith (1966) and Gorr (1967) in Habermehl 1975.

Age of epiphyseal fusion	Limb	Average age* in months
5–8 months	Humerus and tibia distal; radius and ulna proximal	6.5
6–8 months	Ulna and femur distal	7.0
6–9 months	Radius distal	7.5
6–11 months	Tibia proximal	8.5
10 months	Humerus proximal	10.0

* Average age is the mean between the highest and lowest age of the epiphyseal fusion.

As only a few upper and lower jaws of young dogs were recovered, I see no point in dividing the age group 0–7 months any further. In Period 3 there are no upper or lower jaws of animals younger than 7 months, while in Period 4 thirteen of the 156 jaws are from animals younger than 7 months (fig 13).

There is little correspondence between the graphs showing the degree of survival based on dentition and those based on fusion of the epiphyses. One of the most important reasons for this may be the way in which the bone material was recovered. During excavation the bone was collected by hand – the stratigraphic deposits were not sieved at all, and small bones were collected only to a limited extent. The crania of young animals where the sutures have not yet fused will occur as several small

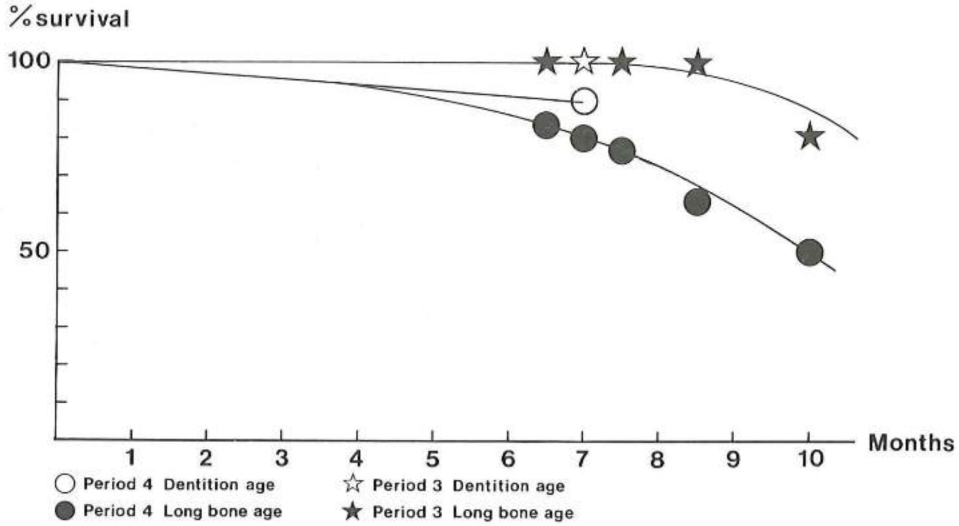


Fig 13 Survival of dogs in Period 3 (stars) and Period 4 (circles) based on dentition (white symbol) and epiphyseal fusion (black symbol).

bones and may therefore have escaped collection. A remarkably large number of complete crania of both cat and dog were found, which strengthens the assumption that mainly easily recognized bones were collected. In this context, the degree of survival of dogs based on dentition will probably give a distorted picture of the distribution of age at death.

Bones of individuals which had not reached adulthood are less resistant to decay than the bones of adults. For all types of bones young animals are therefore probably under-represented in comparison with the bones which were originally deposited at Bryggen. Consequently, there is reason to believe that the number of young individuals would have been even higher than the recorded long bones indicate.

8 Discussion and conclusions

The keeping of dogs at Bryggen in Bergen between 1170 and 1413 underwent changes which are expressed in the osteological material by means of size, form, frequency of partition and of age at death.

The greatest differences are found between Periods 3 and 4. The shoulder height of dogs in Period 3 (table 3 and fig 2) shows a wide and uneven distribution, from 29cm to 73cm in height. Only one of the 33 individuals has long bones of a form which can be clearly differentiated from the remainder (table 4). In Period 3 relatively few young animals were killed (fig 13). There are two cases where the animal was allowed to remain alive despite being seriously crippled. Approximately 12% of the bones show signs of partition (table 6).

While the dogs in Period 3 were generally either very small or very large with straight 'normal' limbs, medium-sized dogs with a shoulder height of *c* 35–55cm dominated in Periods 4 and 5. Between Period 3 and Period 4 the proportion of dog types with unusual limb formation increased from 3% to 13%. In Period 4 *c* 50% of the dogs were killed before the skeleton was fully developed (fig 13) and there is also a very high mortality rate among young dogs in Period 5. Probably far more than 41% of the dogs in Period 4 and 49% in Period 5 were partitioned, and traces of partitioning are recognized on the bones of all dog types.

After 1332 the dog population apparently changed character once more. More than 61% of the dogs in Period 6 had limb forms which connect them to types resembling the dachshund and the dwarf pincher. Very small and very large animals again become the most common, but in contrast to Period 3 where dogs had 'normal' limbs, the small dogs in Period 6 had slender limbs similar to modern dwarf pinchers. Also in Period 6 the proportion of partitioned animals is very high, *c* 42%, with all 'types' represented.

From sites in the Netherlands, at Haithabu in N Germany, and at Lund in S Sweden, it has been shown that the size and form of dogs changed in the course of time. A number of very large and several very small animals characterized the dog population in the 9th–11th centuries. In the 12th–15th centuries the largest dogs are lacking and the population is dominated by medium and small individuals (Wijngaarden-Bakker & IJezereef 1977). In two small samples, however, one from Oslo covering the period 1025–1624 (Lie 1988) and one from Bergen from the period 1170–1527 (Undheim 1985), no significant change in size was recorded over time. The shoulder height for the two groups (N = 11 and N = 8) ranged from 45cm to 58cm and from 32cm to 46cm respectively.

Very small dogs (miniature dogs) with a shoulder height between 23cm and 27cm have been recorded in England from the 1st century AD (Maltby 1983). Most of them had straight slender limbs, but small dogs with a heavier skeletal structure have also been recorded. Dogs with bowed legs were also common in the Roman period in England. The small dogs from Period 3 at Bryggen had relatively solid limbs. Small dogs with very slender limbs (resembling the dwarf pincher) do not appear until Period 4 and the type dominates in Period 6. Only one of the 33 limb bones in Period 3 is bowed (resembling the dachshund); in the later periods the type becomes more common, comprising between 10% and 15% of the dogs in the material (table 4).

The wide and uneven distribution in the size of animals (fig 2) suggests that in Period 3 special types of dogs were selected and also that there was not much free cross-breeding between the types. With a great degree of speculation, the dogs can be associated with the types which we have described from the Middle Ages (see p 218–19 & table 2): the smallest dogs may have been *knähund* (lap-dogs), the medium-sized animals could be *jakthund*, *vallhund* and *gårdvar* (more heavily-built hunting dogs, watchdogs and guard-dogs) or belong to some unspecified group, while the largest dogs usually with slender limbs can be associated with the *mjøhund* group (greyhound-type).

There is a low mortality rate among young dogs in Period 3 and several very old individuals were recorded in this period, suggesting that dogs in all size categories were especially valuable up to *c* 1200. This impression is strengthened by the fact that this period produced bones from crippled dogs which had been kept alive.

The size of the dogs changes significantly between Period 3 and Period 4. The distribution in the shoulder height in Period 4 gives the same picture as that which would be presented by a free cross-breeding within a population. Such distribution patterns have been discussed by Hedrick (1984). The almost normal distribution of shoulder height (fig 3) suggests that there was little or no selective breeding in any of the size categories in Period 4. Little selection with regard to special sizes (types), a high mortality rate among young animals (figure 13) and a high frequency of partition (table 6) suggest that the dogs in Period 4 were used to produce meat, probably in addition to being pets, hunting dogs or guard-dogs.

The large sample deposited between 1198 and 1248 (712 fragments) indicates that there was a large population of dogs in Bergen. Since there apparently existed some kind of breeding of dogs for meat production, there must have been a good supply of food waste rich in protein, for example, fish waste, on which the numerous dog population could feed. Strict rules concerning meat consumption indicate that dog meat was considered to be inferior. The osteological material indicates that from 1198 to 1413 a number of people consumed dog meat, probably out of necessity. The results from Bryggen are very different from those produced by bone assemblages from contemporary towns in northern Europe, eg England (Maltby 1979), the Netherlands (Wijngaarden-Bakker & IJzereff 1977), and Lund in Sweden (Bergquist 1957 and Ekman 1973), where the partitioning of dogs has not been recognized. Wendt (1978) did not exclude the possibility that the inhabitants of medieval Haithabu may have eaten dog meat on occasions. Boessneck and von den Driesch (1979) also suggested that dog meat may have been used to some extent for human consumption at Eketorp in Sweden in the period AD 300–1300. This assemblage, which includes the largest sample of canid bones from Scandinavia, produced a number of bones from partitioned dogs.

The keeping of dogs in Period 5 (1248–1332) is not significantly different from Period 4, even though the sample is much smaller. Both the site at Dreggen in Bergen (Undheim 1985) and medieval Oslo (Lie 1988) produced fewer canid bones in the late medieval period than in the High Middle Ages. Far fewer bones of all groups/species were collected in Periods 5, 6 and 7 at Bryggen than in Period 4. It has not been possible so far in the examination of the osteological material from Bryggen to determine whether this decline is due to the way in which the bones were collected, to taphonomic processes, or to the fact that less bones were deposited. Consequently, it cannot be assumed that there were fewer dogs in Bergen in Period 5 and again in Period 6 than in Period 4.

In Period 6 (1332–1413) the bimodal distribution of shoulder height (fig 5) suggests that small and large dogs were once more selected. The shape of the bones also indicates that different small types were chosen compared with Period 3 (table 4) and that in this period the dwarf pincher type is the commonest dog in the material. Wijngaarden-Bakker and IJzereef (1977) found a negative correlation in the Dutch material between the shoulder height of dogs and the prosperity of the towns. I do not feel able to offer the same explanation for the results from Period 6 at Bryggen, since here the small dogs were partitioned and possibly used for human consumption, which does not suggest an improvement in the prosperity of the town in the period 1332–1413.

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THE OSTEOLOGICAL MATERIAL OF DOGS FROM BRYGGEN

APPENDIX

The following abbreviations are used in the tables:

H = with marks made by an axe or some other broad–bladed tool
S = with marks made by a knife or some other narrow–bladed tool, such as during skinning
M = with marks made by a knife or axe
A = abnormal dentition (teeth not erupted / large teeth close together)
– = measurement could not be taken

1 MEASUREMENTS OF THE CRANIA (after von den Driesch, 1976)

1 Total length: acrocranion – prosthion
2 Condylobasal length: aboral border of the occipital condyles – prosthion
3 Basal length: basion – prosthion
4 Basicranial axis: basion – synsphenion
5 Basifacial axis: synsphenion – prosthion
7 Upper neurocranial length: acrocranion – frontal midpoint
8 Viscerocranial length: nasion – prosthion
9 Facial length: frontal midpoint – prosthion
12 Snout or muzzle length: oral border of the orbits – prosthion
13 Median palatal length: staphylion – prosthion
14 Length of the horizontal part of the palatine: staphylion – palatino–orale
18 Length of the carnassial
24 Breadth dorsal to the external auditory meatus
25 Greatest breadth of the occipital condyles
26 Greatest breadth of the bases of the paraoccipital processes
30 Zygomatic breadth: zygion – zygion
31 Least breadth of the skull: at the postorbital constriction
32 Frontal breadth: ectorbitale – ectorbitale
33 Least breadth between the orbits: entorbitale – entorbitale
36 Breadth at the canine alveoli
37 Greatest inner height of the orbit
38 Skull height: basioccipital – sagittal crest

Table 1
Crania, Period 3

Individuals Point of measurement	1	2	3	4	5	6	7	8 S
1	161.0	213.3	–	117.2	189.6	186.6	–	173.2
2	146.2	196.4	–	107.4	–	177.6	–	160.8
3	140.7	186.9	–	102.6	–	167.3	–	152.5
4	38.9	49.8	–	31.9	–	47.8	–	42.6
5	102.6	138.4	–	71.4	121.0	120.7	–	110.2
7	79.3	103.4	–	69.8	90.1	87.0	–	87.0
8	79.8	101.8	–	56.0	98.3	91.8	–	85.1
9	91.9	123.8	–	67.2	109.6	108.8	–	104.2
12	65.1	88.4	–	46.5	77.3	79.9	–	75.5
13	78.0	106.9	–	57.9	92.5	97.1	–	85.2
14	27.7	33.7	–	17.8	31.8	36.3	–	28.8
18	17.2	22.0	16.2	14.4	19.2	17.4	–	–
23	53.6	71.4	–	40.3	63.5	61.0	–	60.7
24	52.6	69.4	–	40.3	62.8	59.9	–	60.9
25	29.2	40.6	–	23.5	–	34.9	–	34.6
26	43.5	54.5	–	32.0	–	49.2	–	47.0
30	88.0	117.6	–	72.4	98.2	101.0	–	91.8
31	41.0	39.1	–	29.9	37.0	34.1	–	48.5
32	45.2	52.8	–	33.3	50.7	51.3	–	40.7
33	30.4	41.0	–	22.8	36.1	36.0	–	36.0
36	28.6	42.2	–	22.4	36.1	34.1	–	33.4
37	26.7	30.9	–	23.0	29.6	29.4	28.6	27.5
38	51.7	60.6	–	49.6	57.4	56.3	–	–

All the crania from Period 3 have been measured

Table 2
Crania, Period 4

Individuals / Point of measurement	1 S	2 S	3 H	4 H	5 H	6	7	8	9 HS	10 HS
1	150.9	143.4	172.9	159.4	187.9	–	176.9	–	126.8	158.9
2	–	131.4	163.0	–	176.1	147.8	168.9	–	–	–
3	–	125.2	159.0	–	168.0	140.1	159.9	–	–	–
4	–	36.1	40.7	–	45.7	38.6	43.3	44.2	–	–
5	95.2	89.1	115.0	105.0	122.1	100.2	116.5	–	82.3	104.4
7	71.4	73.4	83.2	72.8	93.0	–	83.0	83.0	63.8	75.7
8	73.9	67.2	85.0	79.2	83.9	77.0	87.0	–	61.2	77.8
9	85.4	79.5	98.6	93.4	104.5	–	111.2	–	70.7	91.7
12	61.3	55.2	71.6	68.5	77.8	61.4	71.3	–	50.6	64.4
13	73.6	71.2	87.9	79.6	91.8	78.4	88.2	–	66.2	79.2
14	25.0	22.9	28.2	27.4	33.8	26.2	29.3	–	20.6	26.9
18	17.0	15.4	15.6	15.9	19.0	16.5	17.4	–	14.9	17.8
23	–	50.3	57.8	–	62.7	57.5	58.9	63.7	–	–
24	–	50.4	55.9	–	62.1	55.9	58.6	61.0	–	–
25	–	30.4	32.7	–	37.0	32.7	35.5	36.4	–	–
26	–	39.0	46.1	–	51.2	42.0	45.7	46.6	–	–
30	76.3	85.3	95.9	86.4	110.7	93.6	101.2	–	77.2	–
31	34.0	–	33.9	33.4	41.4	–	32.1	37.4	32.9	37.4
32	48.0	54.1	54.4	–	60.4	–	57.4	55.1	53.0	52.5
33	25.7	25.1	30.2	28.2	36.7	32.1	30.1	34.1	24.5	28.8
36	27.1	28.4	31.2	30.0	37.4	33.4	34.2	–	25.8	31.0
37	23.7	26.5	27.2	25.5	29.3	27.8	29.6	–	24.6	–
38	–	46.3	49.0	–	57.0	–	49.7	53.4	–	–

(table 2, contd)

Individuals Point of measurement	11 HS	12 HS	13 H	14 S	15 H	16 H	17 H	18 S	19	20 HS
1	137.0	150.6	155.8	–	187.2	–	–	–	–	138.4
2	126.2	142.4	147.7	–	–	–	–	–	–	127.3
3	120.0	135.4	140.0	–	162.0	–	–	–	–	121.3
4	33.3	38.6	37.7	–	41.9	–	–	–	–	34.8
5	87.2	96.1	101.4	–	121.8	–	–	–	–	86.4
7	–	73.4	73.3	–	89.4	–	–	–	–	69.7
8	62.1	69.4	73.2	–	98.1	–	–	–	–	67.6
9	–	86.2	88.0	64.6	116.4	–	–	–	–	78.1
12	51.5	61.6	62.3	56.4	80.0	–	–	–	–	56.0
13	70.9	73.2	79.5	73.0	91.2	85.3	–	–	–	67.2
14	24.1	25.4	27.6	25.8	31.0	27.9	–	–	–	22.9
18	–	–	18.6	16.5	16.4	18.4	18.5	18.1	16.4	15.5
23	49.7	54.5	54.5	–	58.2	–	–	–	–	48.7
24	47.6	53.7	54.4	–	57.3	–	–	–	–	48.2
25	27.8	32.4	32.1	–	–	–	–	–	–	24.7
26	37.5	43.2	44.6	–	44.9	–	–	–	–	38.0
30	78.8	84.7	89.7	–	–	–	–	–	–	–
31	–	33.3	34.4	–	38.6	–	–	–	–	49.2
32	–	52.3	51.3	–	57.9	–	–	–	–	32.9
33	25.8	28.8	29.4	–	35.5	–	–	–	–	26.1
36	26.9	32.7	30.6	27.7	33.7	34.0	–	–	–	27.2
37	25.4	26.1	26.3	–	28.7	–	27.2	–	–	25.3
38	41.8	44.4	47.2	–	57.6	–	–	–	–	44.4

(table 2, contd)

Individuals Point of measurement	21 S	22 S	23	24 S	25 HS	26 S	27 H	28	29 H	30 H
1	185.1	184.9	199.3	147.5	176.0	–	–	–	195.4	–
2	176.3	167.3	186.4	134.9	–	–	–	–	182.3	–
3	167.0	157.8	177.9	126.9	156.4	–	–	–	174.7	–
4	45.7	39.8	50.3	35.7	41.7	–	–	–	44.0	–
5	122.0	117.6	127.3	91.6	114.5	–	–	–	129.8	–
7	88.1	–	93.3	70.1	84.3	60.0	–	–	90.4	–
8	91.0	–	97.0	75.6	95.6	–	–	–	93.3	–
9	106.6	90.6	116.2	88.1	101.8	–	–	–	120.6	–
12	78.5	78.8	81.8	62.0	75.5	–	–	–	86.2	–
13	90.7	88.1	98.6	67.5	88.6	–	–	–	95.0	–
14	28.1	30.5	34.2	20.2	31.0	–	–	–	30.3	–
18	18.9	17.4	18.2	14.8	17.2	14.9	17.6	18.4	17.6	16.2
23	63.7	62.0	69.8	54.5	59.1	–	–	–	63.4	–
24	63.0	62.0	66.8	53.2	59.4	–	–	–	60.9	–
25	35.5	33.8	36.0	30.7	–	–	–	–	36.2	–
26	48.5	47.4	50.8	41.8	42.5	–	–	–	54.4	–
30	100.0	99.3	105.0	85.4	97.2	–	–	–	93.7	–
31	33.0	30.0	38.9	29.0	36.3	–	–	–	–	–
32	56.9	58.0	61.0	51.5	57.4	–	–	–	–	–
33	30.4	37.0	37.0	27.6	35.4	–	–	–	–	–
36	35.8	36.8	38.0	27.6	33.7	–	–	–	36.4	–
37	28.6	–	29.9	26.0	26.9	24.4	25.8	–	26.6	–
38	48.1	55.0	56.7	45.8	48.8	–	–	–	50.0	–

(table 2, contd)

Individuals	31	32	33	34	35	36	37	38	39	40
	H	H	H	HS	S	HS	H		H	
Point of measurement										
1	–	–	156.6	–	–	–	–	–	–	144.9
2	–	–	144.1	–	–	–	–	–	–	137.6
3	–	–	136.1	–	–	–	–	–	–	131.5
4	–	–	33.5	–	–	–	–	–	–	35.6
5	–	–	103.5	–	–	–	–	–	–	95.4
7	–	–	71.8	–	–	–	–	–	–	71.9
8	90.6	77.9	78.0	64.4	–	77.8	–	–	–	69.9
9	–	90.0	91.8	77.4	–	89.8	–	–	–	79.0
12	76.4	62.8	63.4	49.8	–	64.4	–	–	–	55.5
13	–	76.5	80.2	66.0	–	78.4	–	–	–	74.6
14	–	26.1	27.4	23.0	–	26.4	–	–	–	27.4
18	18.3	18.4	16.4	14.7	14.7	16.4	–	16.0	–	16.9
23	–	–	52.7	–	–	–	48.3	–	–	48.1
24	–	–	53.5	–	–	–	48.0	–	–	48.1
25	–	–	30.2	–	–	–	26.8	–	–	30.7
26	–	–	41.7	–	–	–	37.5	–	–	39.6
30	–	–	89.9	–	–	–	78.6	–	–	82.7
31	–	–	–	–	–	28.6	–	–	–	34.0
32	–	–	–	–	–	–	–	–	–	–
33	–	28.6	28.0	27.9	–	–	–	–	–	26.1
36	–	33.4	29.4	25.3	–	31.7	–	–	–	27.7
37	28.4	–	27.7	24.0	–	26.7	–	–	26.5	26.2
38	–	–	48.0	–	–	–	–	–	–	47.5

(table 2, contd)

Individuals	41	42 S	43 HS	44 H	45	46 H	47	48	49 H	50 H
Point of measurement										
1	141.8	–	169.0	–	–	–	–	–	–	–
2	133.3	–	–	–	–	–	–	–	–	–
3	126.6	–	–	–	–	–	–	–	–	–
4	37.0	–	–	–	–	–	–	31.9	–	–
5	90.2	–	–	–	–	109.8	81.4	–	–	99.8
7	69.5	–	78.3	–	84.6	–	–	58.5	67.0	–
8	–	–	85.9	–	–	84.0	64.9	–	–	72.9
9	84.2	–	102.2	–	–	98.1	72.1	–	–	78.2
12	–	–	71.6	–	–	72.0	49.8	–	–	–
13	71.0	–	85.2	–	–	84.3	–	–	–	–
14	25.0	–	27.6	–	29.4	29.7	–	–	24.0	–
18	16.4	17.7	17.8	–	17.2	17.6	15.4	–	15.0	15.1
23	50.3	–	–	–	54.7	–	–	46.1	–	–
24	49.9	–	–	–	54.6	–	–	45.2	–	–
25	27.5	–	–	34.0	–	–	–	25.2	–	–
26	37.7	–	–	–	48.7	–	–	–	–	–
30	80.9	–	–	–	92.0	91.0	–	–	–	–
31	35.1	–	37.6	–	30.9	29.6	–	31.5	–	–
32	38.7	–	49.5	–	–	38.0	–	33.5	–	–
33	26.3	–	32.1	–	29.7	26.8	–	22.5	–	–
36	28.3	–	–	–	–	32.2	–	–	–	–
37	23.3	27.0	27.5	–	27.1	29.3	23.7	–	26.5	26.9
38	45.2	–	–	–	–	–	–	43.8	43.8	–

(table 2, contd)

Individuals Point of measurement	51	52 H	53 HS	54 H	55
1	113.9	164.2	–	164.2	–
2	–	–	–	153.6	–
3	–	142.4	–	147.0	–
4	–	40.9	–	40.6	–
5	74.0	105.8	–	107.0	–
7	–	93.0	–	76.8	–
8	50.4	78.5	–	81.9	–
9	63.4	93.4	–	98.7	–
12	40.5	62.2	–	70.2	–
13	58.7	78.5	–	81.4	–
14	29.5	25.7	–	26.6	–
18	–	15.6	16.7	16.7	–
23	43.4	53.8	–	52.4	–
24	43.8	54.3	–	52.8	–
25	–	31.8	–	32.3	–
26	33.4	–	–	42.3	–
30	71.2	–	–	–	–
31	37.8	31.3	–	35.4	35.7
32	51.0	52.7	–	49.9	39.1
33	24.3	28.9	–	27.7	26.4
36	23.0	–	–	32.9	–
37	22.8	28.9	25.4	27.4	–
38	–	46.2	–	48.4	–

In addition to the crania or cranium fragments from Period 4 which have been measured, the following also belong to this period:

3 cranium fragments of subadult/adult individuals. No marks from skinning or partition
4 crania from juveniles. No marks from skinning or partition
1 juvenile cranium fragment. No marks from skinning or partition
2 adult cranium fragments. No marks from skinning or partition
1 adult cranium fragment with marks consistent with skinning
2 subadult cranium fragments with axe-marks
3 adult cranium fragments with axe-marks

Table 3
Crania, period 5

Individuals / Point of measurement	1	2	3	4	5	6	7	8 H
1	151.4	159.8	151.2	110.2	181.4	–	–	–
2	143.7	150.1	–	105.4	171.4	–	–	–
3	135.7	141.7	–	97.2	163.1	–	–	–
4	37.1	36.6	–	25.4	45.9	43.5	–	–
5	98.8	105.3	97.0	71.7	116.7	–	–	–
7	71.7	73.5	77.1	57.6	84.2	–	82.9	–
8	72.1	77.2	73.4	50.9	91.9	–	69.7	–
9	87.4	94.2	81.4	63.0	117.8	–	–	–
12	63.5	65.6	59.4	39.0	75.6	–	55.5	–
13	76.7	80.8	72.6	54.8	89.0	–	–	–
14	25.5	27.2	24.4	16.6	29.4	32.4	–	–
18	16.0	15.7	16.9	14.5	18.0	18.4	15.4	16.6
23	47.7	55.0	52.4	40.1	62.9	60.9	–	–
24	46.7	53.6	54.1	43.3	63.5	61.0	–	–
25	28.8	30.3	–	22.2	34.5	34.0	–	–
26	40.1	41.5	–	30.3	51.6	48.8	–	–
30	83.5	85.5	93.6	–	–	97.4	–	–
31	34.0	33.5	34.4	33.8	–	35.9	30.0	–
32	52.3	54.9	42.9	35.4	54.7	58.2	–	–
33	28.4	27.6	29.8	23.0	35.1	32.4	23.7	–
36	28.7	29.4	31,5	22.4	32.7	33.9	–	–
37	25.6	26.1	27.5	22.3	30.0	29.1	23.9	–
38	41.8	43.7	–	33.8	55.4	53.0	–	–

All the crania from Period 5 have been measured

Table 4
Crania, Period 6

Individuals Point of measurement	1	2	3	4	5	6	7 H
1	148.7	124.0	134.3	–	173.2	156.0	147.2
2	135.4	133.2	126.3	–	152.8	148.6	134.6
3	129.1	107.8	119.6	–	144.3	140.7	128.2
4	35.9	33.0	32.7	29.5	37.1	40.0	35.4
5	93.5	74.8	87.5	–	108.6	99.7	93.6
7	72.8	64.4	65.5	72.9	84.5	–	–
8	70.8	58.4	65.0	–	89.1	76.8	70.2
9	85.8	67.2	76.7	–	101.2	–	–
12	61.9	45.9	55.0	–	71.1	63.9	57.6
13	75.3	59.7	65.4	–	82.8	77.2	73.3
14	26.2	18.5	19.0	22.2	30.8	27.0	25.0
18	16.4	–	15.6	16.9	17.6	17.9	15.6
23	52.7	46.2	46.4	51.2	56.7	53.9	52.9
24	52.4	45.8	–	51.2	56.0	52.4	52.9
25	28.7	24.6	27.1	29.4	29.3	32.3	30.5
26	40.0	36.6	37.0	40.0	42.3	40.5	42.2
30	86.9	78.5	–	83.4	93.5	–	–
31	33.5	32.6	26.1	36.5	38.3	33.4	–
32	53.8	39.4	33.0	41.0	56.2	50.7	53.5
33	27.3	25.5	23.9	30.0	–	28.9	29.5
36	27.5	25.8	26.6	–	32.9	30.2	28.6
37	25.7	24.8	25.1	24.5	26.6	–	26.1
38	47.3	43.4	42.4	48.6	54.4	49.8	41.4

In addition to the crania from Period 6 which have been measured, the following belong to this period:
2 juvenile crania with no knife or axe marks
1 subadult cranium with no knife or axe marks

The following crania and cranium fragments from the excavations at Bryggen cannot be assigned to a specific period:
2 crania with axe marks. Measured
1 juvenile cranium with knife marks
2 adult cranium fragments with no axe or knife marks
1 adult cranium fragment with axe marks

2 MEASUREMENTS OF THE MANDIBULA (after von den Driesch, 1976)

1 Total length: condyl process – infradentale
2 Length: angular process – infradentale
3 Length: on the identation between the condyle process and the angular process – infradentale
4 Length: condyle process – aboral border of the canine alveolus
5 Length: identation between the condyle process and the angular process – aboral border of the canine alveolus
6 Length: angular process – aboral border of the canine alveolus
7 Length: aboral border of the alveolus of M3 – aboral border of the canine alveolus
8 Length of the cheektooth row, M3–P1, measured along the alveoli
9 Length of the cheektooth row, M3–P2, measured along the alveoli
10 Length of the molar row, measured along the alveoli
17 Greatest thickness of the body of jaw (below M1)
18 Height of the vertical ramus: basal point of the angular process – coronion

Table 5
Mandibles, Period 3

Individuals Point of measurement	1	2	3 A	4 M	5	6
1	118.3	–	110.3	112.3	121.3	140.3
2	117.5	–	110.8	112.8	123.6	139.8
3	113.1	–	105.6	107.9	117.1	133.0
4	103.0	91.9	97.7	96.1	104.7	122.5
5	97.7	86.7	92.2	92.3	100.8	115.7
6	102.3	88.4	97.6	96.9	107.6	122.0
7	67.0	61.5	–	63.9	70.0	78.0
8	63.8	59.6	–	60.6	65.8	71.2
9	59.5	54.5	–	57.2	61.5	66.7
10	29.2	27.0	–	30.8	32.2	35.5
17	19.1	16.5	16.9	18.0	18.5	23.7
18	43.4	39.3	41.0	42.0	47.0	54.5

Table 6.
Mandibles, Period 4

Individuals Point of measurement	1	2	3 M	4 M	5 MA	6 A	7 A	8 A	9
1	116.5	116.9	94.8	86.3	113.6	121.0	97.6	107.5	132.3
2	115.7	116.3	95.7	85.8	115.6	121.6	97.2	108.3	132.3
3	110.8	110.6	90.6	82.8	111.3	115.2	92.8	103.4	127.3
4	102.4	101.2	80.9	72.5	98.3	104.7	83.8	91.5	113.8
5	96.5	95.2	77.0	69.3	95.3	99.8	80.1	87.8	109.8
6	101.7	101.1	82.0	72.3	99.9	105.6	83.9	92.4	114.8
7	68.0	67.9	53.7	48.6	64.9	–	–	61.6	76.3
8	63.4	63.0	51.8	48.2	61.8	–	–	57.3	71.7
9	59.4	58.8	48.1	45.0	–	–	–	53.5	66.2
10	32.0	29.2	24.5	22.7	30.8	–	–	27.2	33.2
17	19.5	18.3	14.0	14.5	19.1	19.1	16.1	18.9	21.5
18	45.4	43.0	37.4	32.0	–	47.2	37.7	42.4	48.4

(table 6, contd)

Individuals Point of measurement	10	11	12	13	14 M	15 M	16 M	17 M	18 M
1	130.5	103.2	140.2	95.6	–	–	136.9	–	–
2	131.0	102.7	135.1	95.5	–	–	137.3	–	–
3	125.7	99.0	140.5	91.2	–	–	131.8	–	–
4	113.1	88.1	123.1	80.8	79.2	–	118.2	–	–
5	108.6	84.1	118.8	76.7	75.6	–	113.5	–	–
6	113.8	87.7	124.4	81.8	79.5	–	119.2	–	–
7	73.8	60.0	78.9	57.3	53.8	–	78.2	–	–
8	65.0	57.9	71.0	54.3	52.7	–	74.2	63.8	–
9	60.5	53.3	66.0	51.1	49.4	–	70.9	60.6	–
10	33.5	28.1	33.9	26.7	25.6	–	34.8	31.9	–
17	20.5	15.7	22.1	15.1	14.4	–	22.0	18.5	–
18	49.1	39.5	51.7	36.5	33.9	58.5	54.7	–	46.4

(table 6, contd)

Individuals Point of measurement	19 M	20 M	21 M	22	23 M	24 M	25 M	26 M	27 MA
1	–	123.9	107.8	124.6	148.5	112.2	124.0	126.9	–
2	–	124.0	109.4	125.6	140.0	112.3	124.8	128.9	–
3	–	118.9	104.3	120.7	147.0	109.1	119.7	121.4	–
4	–	106.7	92.3	107.2	130.3	95.4	107.7	110.6	51.6
5	–	102.2	89.1	103.6	122.6	92.6	103.4	105.8	48.6
6	–	106.4	93.7	108.6	129.1	96.1	108.5	113.1	49.4
7	–	71.0	61.9	72.4	83.4	66.7	70.3	71.9	38.0
8	–	67.9	58.5	68.8	77.6	64.9	65.5	66.8	–
9	–	63.5	54.5	64.0	72.6	61.5	62.4	62.1	–
10	–	31.5	28.1	32.4	36.9	31.8	33.5	32.3	–
17	16.6	19.7	16.5	20.5	26.7	18.2	21.5	21.5	9.4
18	40.6	45.6	39.0	46.7	55.0	42.1	47.8	50.4	–

(table 6, contd)

Individuals Point of measurement	28 MA	29	30	31	32 A	33 A	34	35	36 M
1	108.6	127.2	128.3	105.8	91.1	133.0	141.5	128.5	–
2	107.8	129.1	128.3	103.8	90.5	127.5	139.8	128.1	–
3	103.7	121.5	124.2	101.4	87.6	132.2	135.4	124.6	–
4	93.8	111.9	110.4	89.1	78.2	115.1	123.2	110.8	–
5	88.9	106.2	106.6	85.0	75.4	109.3	118.4	106.0	–
6	93.4	114.0	111.2	87.9	77.8	114.6	122.4	110.9	–
7	65.0	74.4	74.0	64.0	54.3	77.2	82.0	74.4	–
8	61.6	70.0	70.7	62.9	51.0	72.2	76.9	70.1	–
9	–	66.2	66.2	58.6	46.6	–	71.3	65.6	–
10	31.4	33.9	35.5	33.0	25.3	33.4	36.2	33.4	32.0
17	17.2	19.5	20.4	17.0	12.8	21.7	24.2	21.2	19.5
18	41.7	48.0	–	38.4	31.5	49.0	53.7	47.1	–

(table 6, contd)

Individuals / Point of measurement	37 M	38	39	40	41 M	42 A	43	44	45 M
1	139.6	132.1	113.7	131.9	–	117.2	114.5	94.8	114.5
2	137.6	130.3	114.0	–	–	118.4	115.2	89.0	111.0
3	134.1	127.1	109.0	126.0	–	113.9	109.8	92.8	118.2
4	123.9	113.9	99.6	114.4	–	99.2	98.9	80.7	97.3
5	118.5	109.0	95.4	109.3	–	95.5	95.0	75.0	94.5
6	122.2	112.8	100.6	–	–	100.6	100.4	78.5	101.5
7	81.8	71.7	67.4	71.5	–	69.5	76.2	54.8	67.8
8	76.8	66.4	62.2	68.3	–	68.8	62.5	53.1	65.0
9	71.6	62.4	58.0	63.5	–	65.3	58.5	49.2	60.9
10	36.8	31.9	29.9	33.9	30.1	34.8	30.2	26.0	32.5
17	24.2	22.7	19.1	22.2	–	18.4	18.9	15.0	18.6
18	54.0	52.0	44.4	50.0	44.4	43.9	44.7	34.9	–

(table 6, contd)

Individuals / Point of measurement	46 M	47 MA	48 M	49 MA	50 MA	51	52	53 A	54
1	–	107.2	–	–	129.8	144.6	129.6	129.3	154.0
2	–	102.0	111.9	–	133.6	144.6	128.1	129.0	153.5
3	132.1	107.4	117.1	–	126.2	139.4	124.5	123.2	145.0
4	–	91.3	–	–	108.7	125.9	111.2	113.2	135.2
5	–	86.9	95.1	–	104.0	121.4	106.7	108.0	127.0
6	114.6	92.3	100.1	–	110.7	126.5	110.9	113.6	135.0
7	76.3	60.8	66.7	–	72.0	79.5	71.8	75.7	85.8
8	70.9	58.4	64.0	–	–	72.3	66.6	70.4	79.2
9	66.5	–	60.2	–	65.6	67.4	62.9	65.3	72.9
10	32.6	28.5	32.1	–	33.9	35.7	32.6	33.8	36.6
17	22.2	19.5	21.4	15.1	23.4	24.0	21.3	22.3	25.7
18	–	43.4	–	35.6	50.4	56.8	52.1	49.6	57.4

(table 6, contd)

Individuals Point of measurement	55 A	56 MA	57	58 M	59	60	61 A	62 A	63 M
1	97.3	99.4	106.4	109.9	113.0	–	–	88.5	130.9
2	98.8	104.4	101.5	103.2	113.1	–	–	87.4	127.1
3	94.6	95.3	106.6	–	107.9	–	–	83.0	131.2
4	82.9	85.8	90.7	97.1	95.5	–	95.0	75.4	112.9
5	80.4	81.3	86.7	91.1	90.2	–	90.0	70.3	109.3
6	84.6	87.0	92.0	–	95.8	–	93.6	74.7	113.2
7	57.4	57.9	61.6	65.0	64.8	–	–	–	75.1
8	55.2	54.0	57.9	60.9	61 7	–	–	–	71.4
9	50.8	49.6	54.0	56.5	51.1	63.4	–	–	66.2
10	27.5	26.3	29.5	29.5	30.8	44.0	–	22.3	33.0
17	15.9	15.1	17.8	18.7	18.4	22.4	17.7	14.4	20.1
18	37.4	38.8	41.2	–	44.1	–	37.9	32.8	45.6

(table 6, contd)

Individuals Point of measurement	64	65	66 A	67 M	68 M	69 M	70 M	71 A	72
1	79.7	131.0	86.1	104.3	–	–	109.8	82.4	117.8
2	76.8	126.1	81.6	102.8	–	–	110.3	83.6	–
3	80.6	131.0	86.5	100.6	–	114.2	105.8	79.7	112.7
4	66.8	112.8	71.8	91.1	–	–	94.5	69.7	104.9
5	64.3	108.0	67.9	87.1	–	100.2	90.8	67.0	–
6	68.0	113.1	73.3	90.1	–	–	96.2	71.1	99.9
7	45.8	76.0	–	61.7	–	70.4	62.6	50.5	66.2
8	42.5	71.6	–	58.5	–	61.1	59.1	48.5	61.3
9	38.1	67.1	–	55.1	–	50.8	55.6	45.5	48.6
10	21.8	32.4	–	28.7	33.6	30.0	29.6	24.4	28.3
17	12.2	22.9	14.7	15.4	24.1	18.4	18.0	12.0	20.7
18	29.9	49.8	34.2	39.6	–	–	43.9	29.5	–

(table 6, contd)

Individuals Point of measurement	63 A	64 A
1	130.9	93.3
2	132.0	93.3
3	126.3	82.6
4	113.3	79.0
5	109.4	72.5
6	115.1	79.0
7	71.2	–
8	67.2	–
9	62.4	–
10	–	–
17	20.0	14.4
18	51.2	36.4

In addition to the mandibles from Period 4 which have been measured, the following belong to this period:

1	age according to dentition	3 1/2 – 5	months	
2	« « « «	c 5 – 6	«	
3	« « « «	c 5 – 6	«	M
4	« « « «	c 5 – 6	«	
5	« « « «	3 1/2 – 5	«	
6	« « « «	c 5 – 6	«	M
7	« « « «	under 3 1/2	«	
8	« « « «	3 1/2 – 5	«	
9	« « « «	3 1/2 – 5	«	M
10	adult mandible, not measurable			M
11	« « « «			M

An adult is defined as having all the permanent teeth erupted, age 6–7 months (Habermehl 1975)

Table 7
Mandibles, Period 5

Individuals Point of measurement	1	2 A	3 MA	4	5 A	6
1	116.2	–	114.6	116.2	133.8	–
2	116.3	–	110.0	117.5	134.7	168.2
3	111.1	–	114.7	111.6	127.5	159.9
4	100.0	84.5	98.5	99.5	116.7	–
5	95.5	81.4	93.7	95.0	110.6	140.0
6	100.4	84.1	98.9	111.2	118.3	147.8
7	66.6	59.9	–	66.7	75.5	94.0
8	63.2	58.4	–	63.0	70.6	86.0
9	59.9	55.9	–	58.7	66.8	80.3
10	29.2	30.2	–	30.0	35.0	40.5
17	17.8	14.6	17.6	18.0	23.6	28.1
18	43.2	32.0	41.7	43.0	51.3	62.1

Table 8
Mandibules, Period 6

Individuals Point of measurement	1	2
1	118.9	–
2	119.4	–
3	114.9	–
4	112.1	–
5	98.2	–
6	113.1	–
7	68.8	81.9
8	66.0	79.7
9	62.0	73.6
10	31.6	38.5
17	17.5	21.4
18	42.3	–

The following mandibles from the excavations at Bryggen have not been related to a specific period:
1 Juvenile, not measured. Age 5–6 months
2 Juvenile, not measured. Age c 1/2 year
3 Adult, measured
4 Adult, measured

3 MEASUREMENTS OF THE SCAPULA (after von den Driesch, 1976)

1 HS – height
2 SLC – smallest length of the collum scapulae
3 BG – breadth of the glenoid cavity
4 GLP – greatest length of the processus articularis

Table 9
Scapulae, Period 3

Individuals Point of measurement	1 H	2	3	4
1	101.0	–	108.1	121.6
2	16.3	17.4	16.7	18.6
3	13.5	13.0	13.3	13.9
4	–	21.9	20.9	23.9

Table 10
Scapulae, Period 4

Individuals Point of measurement	1	2	3 H	4 H	5 S	6	7	8 H	9 H
1	–	–	125.3	–	112.3	116.3	–	93.2	–
2	16.2	19.1	–	14.7	18.5	19.4	29.1	17.9	35.2
3	13.0	14.8	14.9	12.0	14.4	13.6	18.6	12.8	–
4	21.4	24.5	24.2	19.4	24.3	23.8	30.3	21.5	–

(table 10, contd)

Individuals Point of measurement	10	11	12	13	14	15	16 S	17 S	18
1	89.8	81.0	126.7	107.0	103.8	89.9	110.2	90.7	94.5
2	13.8	15.8	22.6	16.9	19.6	15.2	21.4	12.7	14.7
3	11.2	10.1	16.7	13.3	15.1	12.0	16.2	13.3	11.9
4	17.6	18.2	27.3	21.8	25.0	19.8	27.2	17.7	19.4

Table 11
Scapulae, Period 5

Individual	1
Point of measurement	
1	136.4
2	21.4
3	16.6
4	27.7

Table 12
Scapulae, Period 6

Individuals	1	2
Point of measurement		
1	146.6	114.5
2	27.3	16.1
3	17.6	12.2
4	30.9	20.3

3 scapulae from the excavations at Bryggen, which cannot be assigned to a specific period, have also been measured

4 MEASUREMENTS OF THE HUMERUS (after von den Driesch, 1976, and Duerst, 1930)

1 GL – greatest length
2 Bp – greatest breadth of the proximal end
3 Dp – depth of the proximal end
4 SD – smallest breadth of diaphysis
5 Bd – greatest breadth of the distal end
6 Smallest diameter of the trochlea (Duerst 1930, 414, measurement no. 21).

Table 13
Humeri, Period 3

Individuals Point of measurement	1	2	3 H	4	5	6 H	7	8
1	127.8	–	–	122.4	126.3	–	–	221.6
2	30.5	–	–	28.1	29.5	–	–	43.0
3	22.0	–	–	19.4	20.3	–	–	29.8
4	18.5	–	11.7	9.9	8.8	9.5	8.9	13.1
5	24.2	29.2	29.2	22.8	23.0	24.4	26.7	34.8
6	9.8	11.2	11.1	9.7	9.4	10.2	10.0	14.1

Table 14.
Humeri, Period 4

Individuals Point of measurement	1 H	2 H	3 H	4	5	6	7	8 H
1	162.0	–	–	106.4	119.4	–	118.1	–
2	–	–	–	26.2	36.8	–	28.5	–
3	–	–	–	18.2	29.3	–	19.5	–
4	11.2	13.7	8.9	7.3	11.4	13.3	7.9	12.4
5	29.3	34.3	23.3	20.4	28.1	34.0	22.0	29.6
6	11.5	13.3	9.4	7.7	11.8	13.9	8.8	11.2

(table 14, contd)

Individuals	9 H	10	11	12 H	13 H	14 S	15 H	16 S	17 S
Point of measurement									
1	–	–	113.6	167.0	151.7	159.0	–	92.4	129.5
2	–	–	26.8	–	32.9	35.8	–	27.7	30.6
3	–	–	20.3	–	25.7	29.0	–	20.8	23.1
4	11.1	9.5	7.8	13.6	10.2	11.7	–	8.9	8.6
5	29.4	25.7	21.3	34.0	25.9	28.4	34.8	21.3	24.0
6	12.0	9.8	8.1	12.8	9.5	11.5	14.3	8.7	9.6

(table 14, contd)

Individuals	18	19 H	20	21 H	22	23 H	24 H	25 HS	26 H
Point of measurement									
1	–	–	130.1	–	132.3	–	–	–	–
2	32.2	–	30.6	36.6	30.1	–	–	–	–
3	24.3	–	23.2	27.4	23.5	–	–	–	–
4	10.6	–	8.6	9.7	8.9	10.9	8.7	12.4	–
5	–	31.4	24.3	–	25.3	32.1	24.0	29.3	24.1
6	–	12.9	9.6	–	9.1	11.4	9.4	11.8	9.7

(table 14, contd)

Individuals	27	28 H	29	30 H	31 S	32 H	33 H	34 H
Point of measurement								
1	116.3	116.3	120.8	–	142.7	–	–	–
2	26.9	26.4	27.2	–	34.0	–	–	–
3	19.6	18.3	17.8	–	24.2	–	–	–
4	7.4	7.2	7.5	–	11.0	7.2	7.4	–
5	21.7	21.8	21.2	34.4	27.9	19.2	20.3	34.5
6	8.4	8.4	8.4	13.3	10.7	7.2	8.2	13.4

(table 14, contd)

Individuals Point of measurement	·35 H	36	37 HS	38 H	39 H	40 H	41 HS	42
1	–	105.0	–	–	–	–	149.4	–
2	–	30.4	54.1	32.4	–	–	33.3	–
3	–	21.0	38.6	24.0	–	–	25.3	–
4	9.0	9.1	17.8	–	10.2	–	10.0	–
5	23.2	26.0	–	–	26.2	30.9	27.6	27.3
6	9.3	9.9	–	–	10.4	12.3	10.4	9.9

(table 14, contd)

Individuals Point of measurement	43 S	44 H	45	46	47	48 H
1	109.2	–	145.0	142.3	–	–
2	26.3	–	31.6	34.1	–	–
3	18.8	–	26.6	23.4	–	–
4	7.8	10.1	11.5	11.0	–	–
5	20.8	25.6	28.6	27.7	23.7	19.6
6	7.3	10.5	10.9	10.8	9.4	8.3

No measurable humeri were found in Period 5

Table 15
Humeri, Period 6

Individuals Point of measurement	1 H	2	3
1	–	187.0	91.8
2	40.1	–	25.8
3	31.1	–	20.0
4	–	13.2	7.9
5	–	33.8	21.1
6	–	12.8	8.7

A canine humerus which could not be assigned to a specific period has also been measured

5 MEASUREMENTS OF RADIUS (after von den Driesch 1976 and Duerst 1926)

1 GL – greatest length
2 BP – greatest breadth of the proximal end
3 Diameter of proximal epiphysis (diameter of the capitulum, Duerst 1926, measurement 12)
4 SD – smallest breadth of diaphysis
5 Bd – greatest breadth of the distal end
6 Diameter of distal epiphysis (Duerst 1926, measurement 15)

Table 16
Radii, Period 3

Individuals Point of measurement	1	2	3 H	4 H
1	146.0	143.5	–	–
2	14.2	14.1	15.5	14.8
3	9.0	9.3	10.0	9.5
4	9.5	9.5	10.4	9.9
5	18.5	18.8	–	–
6	12.1	10.6	–	–

Table 17
Radii, Period 4

Individuals Point of measurement	1	2	3 H	4	5 S	6	7 H	8 S
1	158.9	143.5	–	147.6	131.8	150.2	–	140.9
2	16.4	13.6	15.8	15.6	12.8	16.1	15.4	14.9
3	10.6	9.5	10.3	10.5	8.7	10.2	10.4	–
4	10.4	9.3	–	10.7	9.2	11.9	–	10.4
5	21.2	18.8	–	19.7	16.4	21.0	–	19.1
6	11.7	9.3	–	10.7	10.6	11.8	–	–

(table 17, contd)

Individuals Point of measurement	9	10	11	12	13	14	15 H	16
1	116.0	142.4	–	132.2	149.9	128.6	130.4	103.4
2	12.4	14.1	–	13.2	14.8	14.1	12.6	9.9
3	7.8	9.3	–	–	9.5	8.9	8.6	6.7
4	6.5	9.6	–	–	9.8	8.1	9.6	6.9
5	15.5	18.9	18.3	17.1	17.4	16.9	17.8	13.2
6	8.4	10.4	10.5	–	9.8	9.1	9.8	7.1

(table 17, contd)

Individuals Point of measurement	17	18 H	19	20 H	21 H	22 S	23	24 H
1	106.8	–	116.9	–	–	129.1	100.0	–
2	15.9	14.4	12.4	–	13.3	13.9	13.9	19.2
3	10.6	9.4	7.8	–	9.4	8.8	8.3	12.8
4	13.6	8.6	8.1	8.9	8.7	8.7	10.1	14.7
5	21.8	–	16.0	13.4	–	16.3	17.8	–
6	12.4	–	8.4	8.6	–	9.7	9.1	–

(table 17, contd)

Individuals Point of measurement	25 S	26 S	27	28	29	30 H	31 H	32
1	142.0	–	–	93.8	125.2	–	–	124.6
2	18.6	18.9	19.5	11.8	12.3	20.6	–	13.9
3	9.4	12.2	13.1	7.1	8.4	14.2	–	8.6
4	10.3	12.5	13.6	8.0	8.1	16.8	–	9.4
5	14.9	–	–	15.2	14.6	–	20.8	17.5
6	10.9	–	–	8.5	8.6	–	11.4	9.9

(table 17, contd)

Individuals Point of measurement	33	34	35	36 S	37	38 H	39 H	40
1	118.6	128.8	129.4	120.6	115.4	–	–	118.0
2	13.2	13.8	13.7	16.8	12.1	–	–	12.4
3	8.9	8.6	8.6	11.1	–	–	–	8.1
4	7.7	9.0	8.4	13.1	8.2	–	–	8.4
5	16.8	18.6	18.3	22.0	16.0	18.4	14.6	16.3
6	9.5	10.2	9.8	12.7	–	10.4	8.3	8.8

(table 17, contd)

Individuals Point of measurement	41	42 H	43 H	44 H	45	46 H	47 H	48	49 H	50 H
1	–	–	–	181.6	157.9	–	–	–	–	–
2	18.4	18.1	13.4	19.3	15.3	–	–	–	–	14.8
3	12.8	11.5	9.1	12.6	10.1	–	–	–	–	10.0
4	12.7	11.4	8.4	13.3	–	–	–	–	10.0	10.3
5	–	–	–	–	21.6	17.8	21.3	19.5	15.4	–
6	–	–	–	–	12.4	10.4	12.2	10.5	10.4	–

Table 18
Radii, Period 5

Individuals Point of measurement	1 H	2 H	3	4 H	5 H
1	–	–	141.0	–	–
2	–	23.3	14.6	12.6	18.3
3	–	16.1	9.6	8.0	11.2
4	–	–	10.0	–	11.2
5	22.9	–	17.3	–	–
6	13.3	–	–	–	–

Table 19
Radii, Period 6

Individuals	1	2
Point of measurement		
1	85.5	–
2	11.6	19.4
3	7.8	12.6
4	9.2	13.0
5	15.2	–
6	8.6	–

One canine radius which cannot be assigned to a specific period has also been measured.

6 MEASUREMENTS OF THE ULNA (after von den Driesch, 1976).

1 Greatest length.

2 Smallest diameter costalt/lateralt of the olecranon (not defined by von den Driesch or Durst).

Table 20
Ulnae, Period 3

Individuals Point of measurement	1 H	2	3	4	5	6
1	–	–	–	–	–	–
2	7.5	5.1	8.3	5.7	6.5	5.4

Table 21
Ulnae, Period 4

Individuals Point of measurement	1	2	3 S	4 S	5 S	6	7	8 H
1	141.3	165.5	149.8	165.3	133.7	134.2	–	139.4
2	–	6.3	7.2	7.5	5.4	–	6.4	5.2

(table 21, contd)

Individuals Point of measurement	9 S	10 H	11 H	12 H	13	14 H	15 H	16
1	135.9	172.0	–	–	170.5	186.5	–	–
2	6.6	8.1	7.0	6.9	5.7	6.7	9.7	6.9

(table 21, contd)

Individuals Point of measurement	17	18	19 H	20 H	21 S	22	23 H	24 S
1	164.5	169.7	–	–	172.2	174.0	–	163.9
2	5.4	5.1	5.9	7.6	5.9	8.4	7.2	8.1

(table 21, contd)

Individuals	25	26 S	27 H	28	29 H	30	31	32 H	33
Point of measurement									
1	134.6	–	–	152.0	–	–	171.2	–	–
2	4.6	12.3	9.4	6.8	6.3	4.9	6.4	4.8	4.9

(table 21, contd)

Individuals	34	35	36 H	37 H	38 H	39 H	40	41	42
Point of measurement									
1	–	186.0	–	116.0	–	208.9	95.0	145.4	141.2
2	6.8	7.6	5.9	7.2	7.6	9.3	4.4	6.6	5.8

(table 21, contd)

Individuals	43	44	45	46	47	48	49	50	51 H
Point of measurement									
1	143.3	150.8	139.9	–	150.3	–	157.9	151.1	–
2	5.8	7.1	6.4	5.6	7.8	5.7	7.1	7.1	5.3

Table 22
Ulnae, Period 5

Individuals	1	2
Point of measurement		
1	–	122.2
2	7.4	5.5

Table 23
Ulnae, Period 6

Individuals Point of measurement	1 H	2 H	3
1	203.7	–	119.0
2	9.4	7.0	5.2

7 MEASUREMENT OF THE PELVIS (after von den Driesch, 1976, and Lie, 1973)

1 GL – greatest length of one half
2 SB – smallest breadth of the shaft of ilium
3 SH – smallest height of the shaft of ilium
4 LFo – inner length of the foramen obturatum
5 LS – length of the symphysis
6 LA – length of the acetabulum including the lip
7 Minimum breadth of pubis (Lie, 1973)
8 Minimum thickness of pubis (Lie, 1973)
9 Minimum thickness of the ilium – ischium symphysis, measured with curved calipers (this measurement is not defined by von den Driesch)

Table 24
Pelvis, Period 3

Individuals / Point of measurement	1	2
1	–	–
2	–	6.2
3	–	14.2
4	27.5	–
5	40.0	–
6	19.2	–
7	3.1	–
8	5.7	–
9	–	–

Table 25
Pelvis, Period 4

Individuals / Point of measurement	1 H	2 H	3 H	4 H	5 H	6 H	7	8
1	125.9	–	–	–	–	–	–	97.7
2	7.7	–	5.4	4.0	7.5	–	5.0	4.9
3	14.6	–	11.8	11.0	15.9	–	13.4	9.8
4	24.5	24.0	–	–	–	–	–	18.7
5	35.6	–	–	–	–	–	–	25.2
6	17.7	16.9	12.7	13.9	15.9	15.0	–	13.8
7	6.1	5.0	–	–	–	–	–	3.1
8	3.1	2.3	–	–	–	–	–	2.1
9	7.8	6.5	7.5	5.0	–	–	–	1.9

(table 25, contd)

Individuals Point of measurement	9 H	10 H	11	12 H	13 H	14 H	15 H	16 H	17 H
1	–	–	95.2	–	–	–	–	–	125.5
2	–	8.1	4.2	6.1	5.7	8.8	8.8	4.5	7.1
3	–	17.3	10.0	11.9	12.6	19.0	18.0	11.7	16.4
4	–	27.5	17.6	–	22.8	26.8	–	–	25.1
5	–	–	27.9	–	33.4	–	–	–	37.8
6	13.0	20.0	13.5	–	15.7	21.5	22.4	–	18.9
7	3.0	8.4	3.0	–	–	–	–	–	–
8	3.9	3.8	1.4	–	–	–	–	–	–
9	5.5	8.5	4.5	6.0	–	–	–	–	–

(table 25, contd)

Individuals Point of measurement	18 H	19 H	20 H	21 H	22 H	23 H	24 H	25 H	26 H
1	9.3	–	–	107.5	–	111.2	102.9	122.9	–
2	18.6	6.8	6.3	4.9	5.4	5.3	5.1	6.6	7.4
3	29.0	14.3	15.9	11.8	13.9	11.2	12.0	14.5	15.6
4	48.1	–	–	10.5	–	–	22.0	23.8	–
5	22.6	–	–	30.6	–	–	30.4	36.2	–
6	–	16.6	18.7	16.1	–	13.4	14.3	18.1	–
7	–	–	–	–	–	–	3.0	–	–
8	–	–	–	–	–	–	2.2	–	–
9	–	–	–	–	–	–	4.0	–	–

(table 25, contd)

Individuals Point of measurement	27 H	28 H	29 H	30
1	125.4	93.5	–	95.0
2	5.9	4.9	7.0	4.3
3	13.9	11.0	14.8	10.0
4	24.8	19.5	–	17.5
5	–	–	–	27.7
6	17.2	15.9	18.3	14.0
7	–	–	–	2.9
8	–	–	–	1.4
9	–	–	–	4.9

Table 26
Pelvis, Period 5

Individuals Point of measurement	1 H	2 H	3
1	–	–	110.6
2	–	7.7	5.0
3	–	15.7	12.3
4	28.4	–	22.4
5	–	–	29.6
6	20.8	18.6	14.6
7	–	–	–
8	–	–	–
9	–	–	–

Table 27
Pelvis, Period 6

Individuals Point of measurement	1 H	2 H	3 H
1	155.5	–	–
2	10.4	9.6	5.6
3	20.3	19.6	12.3
4	–	–	–
5	–	–	–
6	24.4	–	15.4
7	–	–	–
8	–	–	–
9	–	–	–

8 MEASUREMENTS OF THE FEMUR (after von den Driesch, 1976)

1 GL – greatest length
2 Middle length of femur (Duerst 1926, measurement 8) – this measurement is used because the trochanter and caput femoris are often missing
3 Bp – greatest breadth of the proximal end
4 DC – greatest depth of the caput femoris
5 Greatest height of caput femoris (not defined by von den Driesch or Duerst)
6 SD – smallest breadth of diaphysis
7 Bd – greatest breadth of the distal end

Table 28
Femurs, Period 3

Individuals Point of measurement	1	2	3	4	5	6	7	8	9	10
1	135.1	97.0	–	116.5	116.0	–	132.0	98.3	–	227.6
2	129.0	92.5	–	111.0	110.0	–	127.1	93.4	–	226.9
3	28.6	19.8	34.8	–	–	27.3	27.2	19.8	–	43.6
4	14.4	9.6	15.4	11.2	12.1	12.7	13.2	9.8	–	20.0
5	14.2	9.4	15.2	10.9	12.2	12.3	13.1	9.4	–	19.3
6	9.7	6.5	–	8.2	7.2	9.5	9.4	6.5	11.0	13.4
7	24.4	18.5	–	20.6	20.3	–	22.3	18.5	28.0	35.9

Table 29
Femurs, Period 4

Individuals Point of measurement	1	2 H	3	4 H	5 S	6 H	7 H	8 H
1	116.7	–	–	–	94.2	118.0	–	–
2	109.2	–	–	–	86.2	–	–	110.0
3	24.9	–	–	–	23.7	–	–	–
4	11.6	–	–	–	11.1	–	–	–
5	11.0	–	–	–	11.5	–	–	–
6	9.4	8.0	–	11.2	7.8	7.6	–	8.2
7	20.4	19.5	22.0	29.4	20.9	20.8	26.2	19.3

(table 29, contd)

Individuals Point of measurement	9 H	10 H	11	12 H	13 H	14 H	15 H	16 S	17 S
1	–	–	–	–	–	–	–	113.4	141.2
2	–	–	–	–	–	–	–	107.6	133.7
3	–	–	–	–	–	26.8	24.3	24.4	27.3
4	–	–	–	–	–	12.3	12.0	11.1	13.7
5	–	–	–	–	–	12.2	11.4	11.1	13.3
6	10.7	12.6	7.6	14.8	8.8	–	–	7.6	9.8
7	21.4	26.5	19.6	29.5	24.2	–	–	19.7	24.0

(table 29, contd)

Individuals Point of measurement	18 HS	19 H	20 H	21 H	22 H	23 H	24 S	25	26 H
1	–	–	–	–	–	–	158.0	171.4	–
2	–	–	–	–	–	–	148.8	163.0	–
3	–	–	–	–	–	27.2	32.4	34.9	–
4	–	–	–	–	–	12.9	16.5	17.1	–
5	–	–	–	–	–	12.8	–	16.9	–
6	10.3	–	–	–	–	8.6	9.8	10.7	11.3
7	24.0	22.0	21.9	21.2	24.9	–	27.5	27.3	27.3

(table 29, contd)

Individuals Point of measurement	27 H	28	29 H	30	31 H	32 H	33 H	34 H	35 S
1	–	–	–	111.3	–	–	–	–	186.3
2	–	–	–	104.7	–	–	–	–	180.7
3	–	–	–	23.6	–	–	31.0	24.2	37.6
4	–	–	–	11.3	–	–	14.5	12.5	18.2
5	–	–	–	11.5	–	–	–	12.1	17.5
6	9.8	–	–	7.0	–	8.6	–	8.9	13.1
7	25.0	25.1	26.3	19.3	31.9	23.8	–	–	31.1

Table 30
Femurs, Period 5

Individuals Point of measurement	1 H	2 H	3 S
1	191.7	–	163.7
2	180.0	–	157.5
3	39.5	–	35.5
4	18.1	–	17.5
5	18.1	–	17.1
6	12.0	–	12.0
7	33.0	22.2	29.0

Table 31
Femurs, Period 6

Individuals Point of measurement	1 H	2 H	3	4 H	5 H	6 H	7	8
1	–	–	104.7	–	–	–	142.0	196.9
2	148.0	–	96.0	–	–	–	136.2	187.2
3	–	–	19.6	31.3	–	–	29.8	42.5
4	–	–	9.9	15.2	–	–	15.7	21.0
5	–	–	9.4	15.3	–	–	14.0	20.2
6	9.6	8.2	6.4	10.0	–	7.8	9.6	14.2
7	23.9	23.0	16.8	–	32.4	21.4	25.3	36.0

One femur from Period 7 (greatest length, ie measurement 1, = 92.6) and two femurs which cannot be related to a specific period have also been measured

9 MEASUREMENTS OF THE TIBIA (after von den Driesch, 1976)

1 GL – greatest length
2 Bp – greatest breadth of the proximal end
3 Greatest depth of the proximal end (the calipers of the slide gauge rest on points 29 and 30 and on point 19 (Duerst, 1926)
4 SD – smallest breadth of the diaphysis
5 Bd – greatest breadth of the distal end
6 Dd – greatest depth of the distal end

Table 32
Tibiae, Period 3

Individuals Point of measurement	1	2	3	4	5	6 H
1	103.5	128.1	–	171.2	104.5	–
2	19.6	28.4	26.4	29.2	18.3	24.9
3	17.9	31.8	29.5	31.8	9.3	23.7
4	6.0	10.8	–	11.9	6.1	8.1
5	12.7	18.6	–	19.1	12.8	–
6	9.0	13.3	–	13.7	8.8	–

Table 33
Tibiae, Period 4

Individuals Point of measurement	1	2	3 S	4	5	6	7	8 H	9 H
1	110.6	147.1	160.0	–	119.6	93.0	127.5	–	–
2	23.6	29.5	28.3	–	27.3	21.9	31.4	–	22.9
3	28.5	28.2	31.2	–	27.9	22.6	31.4	–	24.0
4	9.7	11.2	10.6	9.5	10.8	7.7	11.3	9.8	7.2
5	17.4	18.7	19.1	19.1	18.7	13.6	20.6	17.9	–
6	13.2	13.4	12.9	13.2	14.0	9.7	14.8	14.6	–

(table 33, contd)

Individuals Point of measurement	10 S	11 H	12	13 H	14 H	15 H	16 H	17	18
1	162.2	–	126.8	–	–	159.8	–	–	115.0
2	28.9	22.0	23.3	35.5	29.0	29.8	–	22.1	25.8
3	30.0	23.8	24.4	39.1	27.5	31.4	–	23.3	28.7
4	9.4	8.1	8.6	13.1	9.2	11.4	–	8.4	12.0
5	19.4	–	15.2	–	–	–	13.6	14.5	19.3
6	13.4	–	10.9	–	–	15.9	9.9	9.9	14.8

(table 33, contd)

Individuals Point of measurement	19	20	21 H	22	23 H	24 S	25 H	26 H	27
1	121.0	89.1	–	107.2	127.0	209.0	–	–	137.4
2	27.5	17.8	25.6	24.0	21.6	35.3	20.4	20.6	24.1
3	28.8	–	27.6	25.8	23.0	39.6	21.0	19.6	25.9
4	11.3	5.1	–	8.7	7.7	12.5	6.2	6.7	8.5
5	19.8	12.1	–	16.2	–	23.9	–	–	15.6
6	14.8	8.1	–	11.5	–	15.9	–	–	10.9

(table 33, contd)

Individuals Point of measurement	28 H	29	30 S	31	32 S	33 S	34	35	36 H
1	–	134.2	134.3	141.2	127.4	126.7	108.3	108.5	–
2	31.6	23.7	25.4	25.6	21.4	21.6	19.8	24.8	–
3	33.3	24.9	25.2	25.7	22.9	22.6	19.7	25.4	–
4	10.3	8.8	9.2	8.4	8.1	7.8	6.3	9.1	–
5	–	15.3	16.3	16.5	14.2	14.1	12.8	16.4	24.2
6	–	11.3	12.1	11.9	9.9	9.9	8.9	11.2	17.6

(table 33, contd)

Individuals	37	38	39	40	41	42	43	44	45
		H	H	H	H		H	H	
Point of measurement									
1	129.2	–	–	–	–	192.4	141.6	–	–
2	22.7	37.6	23.6	27.0	–	33.7	25.6	27.0	–
3	23.8	41.5	25.2	29.2	–	37.3	26.6	27.6	–
4	8.3	13.9	8.7	–	8.2	11.0	8.9	10.3	–
5	15.2	–	–	–	15.7	21.5	–	–	15.7
6	10.4	–	–	–	11.4	15.5	–	–	10.8

(table 33, contd)

Individuals	46	47	48	49	50	51	52	53	54
	H				S				H
Point of measurement									
1	120.9	133.7	147.7	142.8	125.6	–	131.7	142.7	–
2	21.2	22.3	27.6	25.7	22.9	34.9	23.5	24.0	27.9
3	22.4	20.8	29.0	25.6	22.1	37.6	25.4	27.0	27.6
4	7.6	7.9	9.2	8.7	7.8	13.3	8.2	9.1	8.8
5	15.4	14.7	17.9	17.4	15.3	–	15.2	15.7	–
6	10.2	10.8	12.9	13.1	10.8	–	11.0	11.8	–

(table 33, contd)

Individuals	55	56	57	58	59	60	61	62	63
		H			S				
Point of measurement									
1	156.5	–	134.2	–	115.0	156.0	144.5	127.3	–
2	29.7	25.4	23.3	26.3	19.8	29.0	24.9	25.9	–
3	31.0	28.8	23.6	28.5	18.9	30.0	27.4	24.4	–
4	9.9	9.2	7.4	9.3	6.4	10.0	7.9	7.7	9.0
5	20.1	–	15.4	–	13.1	18.3	15.5	16.5	17.0
6	14.0	–	10.6	–	9.1	12.9	11.0	21.6	12.4

(table 33, contd)

Individuals / Point of measurement	64	65 H	66	67 H	68 H	69
1	117.5	–	119.1	–	–	157.0
2	30.0	29.3	29.8	–	28.3	28.0
3	31.4	31.2	29.3	–	31.6	31.5
4	10.2	–	11.2	9.3	9.3	10.2
5	19.8	–	19.5	17.6	–	18.1
6	14.9	–	14.5	14.0	–	13.4

Table 34
Tibiae, Period 5

Individuals / Point of measurement	1 H	2 H	3	4 S	5	6 S	7 H
1	144.0	–	145.8	184.0	–	172.4	–
2	–	25.5	–	31.4	25.1	36.9	29.6
3	–	26.6	–	35.9	25.2	37.0	31.8
4	9.4	8.8	8.4	10.9	–	11.7	–
5	17.6	–	16.5	22.1	–	24.5	–
6	13.2	–	12.1	15.2	–	17.1	–

Table 35
Tibiae, Period 6

Individuals / Point of measurement	1	2	3 H	4 H	5 H
1	118.8	209.4	–	–	–
2	22.0	35.8	34.8	22.9	23.2
3	24.8	39.6	34.8	24.8	23.9
4	8.9	12.4	12.2	8.1	6.8
5	14.5	23.1	–	–	–
6	10.4	16.8	–	–	–

Two tibiae which cannot be related to a specific period have also been measured.

The 'cellar buildings' and privies at Bryggen

by

Asbjørn E. Herteig

The fire which swept through Bryggen in July 1955 affected nine Rows – the two rows in each of the properties of Bugården, Engelgården and Søstergården, plus the three rows of Gullskoen. In all, more than forty wooden buildings were destroyed. Within the area which could be excavated archaeologically it was possible to trace the layout of the properties back through sixteen or seventeen building phases to the period immediately after 1100. In spite of several catastrophic fires, a clear and informative picture has been obtained of the central area of an exceedingly well-planned medieval urban settlement of wooden buildings.

Throughout the whole of this period, the general layout consisted of parallel rows of buildings running back from the waterfront to the street of Øvregaten. The rows were arranged in pairs, forming so-called 'double tenements'.

The remains of about 500 buildings were recorded altogether. During this long period of time they had certain features in common but, as might be reasonably expected, they had been adapted to the changing demands of a dynamic urban society. Unfortunately, we only really established contact with the buildings nearest the waterfront and this is naturally reflected in the types of structures and the patterns of use which we recorded. On the whole, of course, we only have information about the lower storeys of these buildings, which were generally devoted to storage or to various kinds of manufacturing processes such as the production of slaked lime or the dressing of building-stone.

In a few cases we found the remains of interior features such as fireplaces or fixed benches running along the walls. These indicated various specialized functions, but only occasionally were we dealing with living accommodation.

During the twelfth century, basically simple timber-framed structures were used. The earliest example of a log-built structure, using horizontal logs notched together at the corners, was Building 60, which lay within the part of site that was built up in the mid-twelfth century. From this time onwards the number of log-built structures increased at the expense of post-and-beam buildings. This mixture of structural types continued right up to our own day, but there were admittedly only one or two post-built structures in each property.

Within the category of post-built structures there are two types from the earliest times which form the subject of this article: the house with 'open corners', and the so-called 'cellar-building', an elevated building where the space under the floor was enclosed within a vertical plank wall.

The building-type with 'open corners' has been discussed previously by Egill Reimers (1976) and its actual construction will not be analysed in further detail here. It is characterized by the fact that instead of adjacent walls meeting at a common corner post, each wall is terminated individually by a post, with the result that the four corners are each marked by a pair of posts standing slightly apart, the distance varying from 20–30cm to 40–48cm (figs 1 & 2). As there was no evidence that boards or anything else had been fixed to the posts for at least the lower 73cm, which was the maximum surviving height, it can only be concluded that the corners were left open. Figure 3, which shows the south-eastern corner of Building 41, illustrates how the adjacent floorboards continued for their full length between the posts.

This type of construction does not indicate an inhospitable or poorly developed building tradition, since good, unmistakable examples of ordinary post-built structures exist. It would therefore seem that these structures have been deliberately planned and erected with open corners in order to satisfy a specific need.

Only two examples were recorded and they are both from a mid-twelfth-century level, which also produced the remains of twenty-two other buildings. In the preceding phase, dated to the first half of the twelfth century, the remains of at least seven buildings were recorded within the excavated area. That no more than two buildings of this type were recognized from the whole of the twelfth century may be due to the fact that the two which were recorded lay within the rear part of the site, further east than the general eastern limit of the excavations. It is therefore possible that the available evidence is misleading in that this part of the excavation is not necessarily representative. It would indeed be rather remarkable if such a specialized and deliberately planned type of structure had really occurred so seldom.

The two structures which were recorded measured 5.70m × 4.30m and 5.40m × 5.40m and so they fit in well with the contemporary buildings with regard to size. As with the other buildings, it is reasonable to regard them as single-storey structures.

Most of the corner posts stood on flat pad-stones with their bases only 8–10cm below the level of the floor. In other words, they were practically standing on the contemporary ground surface. In his examination of the structural details, Egill Reimers considers the possibility that the buildings had an upper storey, but I have difficulty in accepting his argument. The slender corner posts with their poor foundations would not have provided the stability needed to support an upper floor in such small buildings and I therefore choose to regard them as single-storey storage buildings like the other structures. Regardless of whether they had one or two storeys, however, the problem of the open corners remains.

As it has not been possible to find any evidence for buildings of a similar construction either in Scandinavia or elsewhere, it is tempting to interpret them as a means of satisfying quite specialized local needs. It is natural therefore to look at these buildings in the light of Bergen's special medieval history. In the twelfth century Bryggen was already a centre for an extensive trade in fish and fish products from the far north, which were exchanged for the various goods brought to Bergen by merchants from many foreign countries. The fish was essentially dried fish, which had made the long and often stormy journey by open boat with only scant protection against the wind and the waves. At Bryggen it was unloaded and stored to await further dispatch, but in the damp Bergen climate this could be quite a risky business. Some of the cargo could have become soaked during the journey southwards and storing it damp in an enclosed building could make matters worse. It was therefore imperative to ensure that the fish was stored in well-aired premises and it is this requirement which seems to have been satisfied by our buildings with their open corners. Another fact to be reckoned with is that these low storage buildings, like most of the other structures, would have been roofed with turf and this would have helped to retain the damp indoor climate. I can see no other reasonable explanation for this special type of post-built structure: it fulfilled a particular local need and was perfectly adapted to the special local pattern of commerce.

In the second type of building discussed here, the so-called 'cellar-buildings', the sole-plates were raised on posts and the space below the floor was enclosed by a simple wall of vertical planks, split logs or round timbers standing side by side. The wall ran inside the line of the posts. The height of the floor above ground level varied, and in a couple of cases the enclosed area was also cut down below the ground surface. In addition to these features which the 'cellar buildings' had in common, there were a number of features which varied, such as the orientation of the building, its size, shape, probable function and structural details.

There were 18 buildings in all which have been placed in this category and they span a century from about 1150 to around 1250 (1). They were recorded in Periods 2–4 with six in Period 2 (*c* 1150–1170/71), five in Period 3 (1170/71–1198) and six in Period 4 (1198–1248). At least three of them, and possibly two more, have been interpreted as latrines.

The degree of preservation on the whole was good but the amount that had survived varied greatly, ranging from the ends of a few vertical wall planks and posts to practically the entire framework. The remains of vertical elements, which may have been as much as 1.5 m in height, would naturally have been subject to a greater degree of disturbance or removal than structures consisting of horizontal elements. It is therefore likely that there may have been an even greater number of these elevated structures with sub-floor enclosures among the medieval buildings at Bryggen.

In contrast to the 'open-corner structures' which were found in the rear part of the site, the 'cellar buildings' without exception were found at the front, in the area overlying the original beach. This may have some connection with the way in which these structures were used, a point which we shall be returning to in due course. But firstly we shall look more closely at the buildings from the earliest phase, Period 2, since these were both the best preserved and also contained the most important features.

Building 38 at the northern end of the site lay in Row 5 in the Gullskoen area on the south side of the tenement passage (figs 4 & 5). In contrast to practically all the other buildings in Period 2 it lay with its long axis across the tenement. Only the sub-floor 'cellar' had survived, the walls of which consisted mainly of flat boards up to 20cm wide standing side by side. The whole ground plan was intact, except for the north-west corner – which had been removed during the construction of a later well – and a gap of about 50cm on the east side, probably representing two or three missing wall planks. All the foundation posts had survived: one at each corner except at the disturbed north-western corner, plus one in the middle of each gable wall and two spaced out along each side wall. The posts seem to have had the same height when standing vertically but the wall planks were broken off irregularly at the top. A piece of timber lying over two of the posts in the wall on the east side may have been part of the sill-beam. The wall planks enclosing the cellar were in alignment with the inner face of the wall of the building.

The building measured approximately 4.60m × 5.90m. On the basis of the tallest surviving foundation post and an assumed thickness of *c* 20cm for the sill-beam, it is calculated that the floor lay *c* 85–90cm above the contemporary ground surface on the east side of the building and was *c* 20cm higher than the surface of the tenement passage in this period. The depth of the cellar below the floor level is estimated at *c* 80–85cm.

In this relatively well-preserved cellar there was apparently no way in from any side apart from the gap in the east wall mentioned above. This could have indicated an entrance since there was an open space outside the cellar on that side, but it seems more likely to be accidental and was probably due to the loss of two or three wall planks. An entrance at the north-west corner, which was disturbed by a later well-shaft, would have been a most inconvenient place for an entrance.

It is also an open question whether such a structure needed a permanent doorway. In most of the recorded examples, the existence of adjacent buildings would have prevented access from the side and it is therefore reasonable to assume that access, both in this case and elsewhere, would have been from above.

The upper deposits in the filling of the cellar were secondary and consisted of a *c* 20cm thick layer of shavings and wood chips covered by a thin layer of soot and a 15–20cm thick layer of gravel. Over this was a layer of similar thickness derived from an adjacent lime slaking activity. The bottom layer of the filling consisted of a matted deposit of conifer branches and bits of logs and beams and it looked as if it had been an original deposit laid down for drainage purposes. A similar layer was found at the bottom of two other 'cellar buildings' (nos 44 and 203).

It is uncertain whether the piece of timber found overlying the posts in the east wall was actually from a sill-beam, but even if it had been, it could provide no information about the overlying structure, such as whether it had been a log-built or a post-frame construction.

That the posts were purely foundation posts could be seen from several other examples. In Building 343 in Phase 3.1 in Engelgården South two of the posts on the north side had a hefty notch cut in the top to receive a horizontal sill-beam. At the south end of the west wall of Building 196 in Phase 2.1 in Engelgården North a *c* 2m long sill-beam had survived *in situ* (fig 6), lying in the post at the south-west corner. A seating had been cut in the top of this post for the sill-beam on the south side and a fragment of the beam itself, which the excavator regarded as lying *in situ*, can suggest that the overlying structure had been log-built. As there were no traces of a groove in the beam for the ends of vertical wall planks, this interpretation seems reasonable. This is the only example where the construction of this type of building was directly indicated. It had not burnt and as the tops of the posts formed a more or less horizontal plane, they would appear to have supported sill-beams. The height of the floor above the contemporary ground surface seems to have been 120cm, the distance between the assumed floor level and the surface of the passage in this phase was *c* 25–30cm, and the internal height of the cellar was *c* 120cm. The building was at least 8.3m long and *c* 4.7m wide.

Building 44 just to the east of Building 38 in Row 5 on the Gullskoen site was clearly defined by a continuous row of wall planks along the south and west sides and at the western end of the north side (fig 7). Most of the foundation posts had also survived. The walls here were made up partly of flat planks of various widths and partly of split logs. Like Building 38 the bottom was filled with a deposit of tangled branches but a wide band of 20–30cm large stones running along the inside of the west wall was a new feature. Over the bottom layer was a greasy deposit *c* 20cm thick, covered by a relatively dense layer of stones measuring *c* 10cm across (fig 8). This stone layer was up to 30cm thick. On top were burnt deposits containing remains of lime. These upper two layers were secondary to the feature.

The floor level was estimated to be *c* 95cm above the contemporary ground surface and the depth of the cellar at the western end was *c* 100–105cm. This could suggest that the area had been cut into the ground and that the internal edging of stones had been laid to counteract pressure from outside, even though the difference between the bottom of the cellar and the external ground surface was not great, at any rate not to start with, and even though the uprights forming the wall were pointed at their base. In two other cases (Buildings 39 and 69) there was possibly an attempt to stabilize the walls with the help of horizontal beams along the base, but it is difficult to say whether these beams were primary or secondary. In Building 243 the west wall was braced by a slender horizontal bar fixed to the wall planks about 80cm up from the base and *c* 55cm below their burnt tops.

Building 39 in Gullskoen's Row 3 was in some ways a special case in that the form and extent of the ground plan was clear in spite of the fact that only the uprights from the west wall and a little of the adjacent north wall had survived. Its form and the position of the foundation posts could be identified by means of a dense layer of moss *c* 35cm thick, which clearly formed the actual primary deposit of the cellar (fig 9). Beneath the moss was a layer of wood chips with lenses of sand 0.5–2cm thick, while above it were the usual mixed deposits, clearly secondary. The height of the floor level was estimated to be at least 100–110cm above the contemporary ground surface and the depth of the cellar was estimated at *c* 80–100cm. The building measured 4.20m × 4.80m. A similar layer of moss was also recorded in Buildings 137, 245 and 400.

Building 130 in Søstergården North must be included among the better-preserved examples of these structures (figs 10 & 11). It was practically square, measuring *c* 5m × 5.2m with the slightly longer axis running across the tenement. The walls were more or less intact on the north and west sides and along part of the east side, and as far as could be ascertained, all the supporting posts had survived. Unfortunately, the excavation record contains no detailed description of the wall uprights or the filling. The height of the cellar was over 100cm with the assumed floor level *c* 20–30cm higher than the adjacent passage surface. The height of the contemporary ground surface could not be established.

In addition to these buildings with their representative features with regard to construction, height and alignment, there were three in Period 2 (Buildings 40, 69 and 203), four in Period 3 (137, 477, 500 and 245), five in Phase 4.1 (117, 121, 122, 400 and 401), and one in Phase 4.2 (114) which all fall within the same general pattern as far as their construction, external and internal levels, dimensions and alignment are concerned. In most cases only parts had survived and some continued outside the excavated area.

Building 400 and probably also Building 401 from Phase 4.1 had certain features which deviated from the others. They both occupied the northern half of the South Row in Søstergården, standing one behind the other and sharing the dividing wall (fig 12). They were small structures, measuring 3.7m × 2.8m and 4.5m × 1.9m respectively, and were orientated with their long axis parallel with the long axis of the tenement. There were no traces of any buildings on the wider southern half of the South Row, but it is natural to assume that both 400 and 401 had been annexes to two larger buildings standing to the south. The deposits, which included concentrations of moss in the case of 400, strengthen this assumption to a certain extent. Under the circumstances it is reasonable to interpret Building 400 as a latrine, despite the lack of any greasy deposit in the moss layer, since this need not be interpreted negatively. The investigation in this particular part of the site was undertaken as an emergency excavation with obvious consequences concerning the degree of documentation. Regardless of whether it was a privy or not, the layer of moss clearly indicated the function of this 'cellar'. In order to explain this in greater depth, it is first necessary to look at the other three situations where the main building adjacent to a 'cellar' structure was intact. These had all functioned as latrines.

'Cellar' 137 in Period 3 was situated at the west end of the foreshortened Row 3 on the Gullskoen site (cf fig 15). It ran the full width of the row and was physically integrated with a larger structure, Building 28, but on account of its size and location it may have been intended for common use.

Contemporary with 137 was Building 240 in Engelgården South. It was connected with Building 242, which had a fireplace, and was built in basically the same way as the other 'cellars'. It stood alongside the eaves-drip gap against the neighbouring property on the south side, with the main structure, Building 242, between it and the tenement passage.

In the next period the arrangement was repeated. The new main building 232 had a succession of two privies on the south side, 233 subsequently replacing 241.

These four latrines, 137, 240, 241 and 233, are commented on below.

The annexe structures 240, 241 and 233 were all privies associated with a main building and they were located as far away as possible from the tenement passage, close to the eaves-drip gap along the boundary to the neighbouring property. The excellent preservation conditions have demonstrated this in an instructive way. It must therefore be reckoned that several of the cellars commented on as annexes to another building could have had the same function, even though the evidence for an adjacent building could not always be found, as in the case of Buildings 400 and 401, and perhaps also with Buildings 122 and 245.

THE FUNCTION OF THE CELLAR BUILDINGS

As there were no finds and the filling was often secondary, it has been difficult to establish any pattern of use, if indeed there was a homogeneous pattern. Where the function can be identified, it is from the contents of the cellar, and partly also from the orientation of the building. We have seen that to a great extent the filling consisted of secondary deposits, especially in the upper layers. Within the lower – and what we consider to be the primary – deposits, the contents can vary from pure layers of excrement, at times mixed with moss, to concentrations of pure moss and layers of matted twigs, branches and logs, and sometimes layers of small stones. In the structures containing excrement layers the interpretation is self-evident. Buildings of this type were 137, 240, 241 and 233 from Periods 3 and 4, the last three being directly associated with adjacent buildings used as living accommodation. Apart from the earliest structure, Building 240, with a practically pure excrement layer at the bottom, the moss content increased in the upper layers. Buildings 400 and 401 can be interpreted in this way, and possibly also 122 and 245.

From what has been said above and from all the later privies recorded at Bryggen, it can be seen that moss was always present in the layers of excrement, a phenomenon which has long been observed in excavations in most of the early medieval towns in Norway and abroad. It has therefore been clear for a long time that moss is a reasonable, common and effective sanitary agent. In those instances where layers of pure moss were found in cellars where the deposits were still intact, the interpretation is clear: there must have been a need for large quantities of moss and our cellar buildings would have made ideal storage premises for this material. Stored in buildings located along the waterfront, the moss could be kept relatively damp for a long time. Moreover, the bottom layers of branches and twigs which were recorded in some of the cellars provided suitable drainage. These rooms must have been so suitable for storing this material that it is reasonable to believe that several of the 'cellar' buildings must have had this function, even though some of them were found empty.

PRIVIES

Some privies described above are closely related in construction to the cellar buildings apart from the fact that they stood on the contemporary ground surface. However, as the construction and the function overlap each other, we have found it right to include the privies in this survey.

One usually associates the word privy with some kind of physical arrangement, but quite understandably this has not always been the case. The references in the sparse documentary material on the subject also demonstrate a use of language which reflects the arrangements at different times. Translated literally, these range from «to find oneself a place», «to go out in the yard», «to sit on wood», and so on, to our own various modern euphemisms. References to the subject can be found in particular in Valtyr Guðmundsson (1889), Hjalmar Falk (1910), Troels-Lund (1929–31) and Sigurd Grieg (1957).

Altogether 18 definite privies were found at Bryggen, as well as four probable ones (14, 400, 401 and an unnumbered structure from Period 5 in grid-square L10 in Engelgården South), plus two possible ones (122 and 245) (2). In addition, the remains of six latrine seats were found (3).

In their construction the earlier ones at least seem to reflect the contemporary method of satisfying the structural demands. For practical reasons we have found it appropriate to divide them into three main types based on the location of the privy, with two variations in Type 2:

1 Structures supported on posts with a floor raised above the contemporary ground surface and with the pit lined with vertical or horizontal boards

2 Structures supported on posts with a floor at the same height as the contemporary ground surface and with the pit also usually lined with upright boards. Of this type, which became the usual type after 1200, there are two variants:

2a Privies attached to buildings definitely identified as living accommodation and situated between these and the eaves-drip gap, and running the full length of the house

2b Privies also situated beside the eaves-drip gap, but located in the space between two buildings in the Row. This variant seems to be the only type after about 1250.

3 A privy built in an external upper gallery or projection from the building and with the area below built up with cladding to form a shaft.

LOCATION AND EXTENT

Privies were recorded in every row, except Engelgården North and the truncated Row 1 and Rows 6 and 7 in Gullskoen, and parts of six latrine seats were also found at various points across the site. This distribution, however, hardly gives a correct picture of the real distribution pattern of the privies as it was not possible to investigate all the rows to the same extent. For example, only limited areas could be excavated in Søstergården and Engelgården. This is also the case with the 'truncated' or foreshortened rows and, for that matter, with Rows 6 and 7 in Gullskoen, especially the latter (Herteig 1991). Any apparent gaps in the distribution pattern are therefore probably due to these circumstances.

Four privies were recorded in Bugården, all from Period 6 (1332–1413), and on the Gullskoen site six were recorded in Row 2, one in Row 3, and two or possibly three in Row 4. The concentration in Row 2 is remarkable with two privies in Period 3, one in Period 4, two in Period 5 and one in the first phase of Period 6.

One of the reasons for the continuous location of privies in this row in particular may be its close vicinity to The Old Church Road which ran along the south side of the row from the waterfront up to St Mary's Church.

Whereas the privies in Row 2 were associated with different buildings at different times and those elsewhere were located randomly in most of the properties, in the two Rows in Bugården a particular location was used in two or possibly three consecutive phases in Period 6 with latrines situated immediately opposite each other on either side of the central passage. In some cases we see that they were erected beside buildings which did not bear the obvious marks of being storage buildings, but rather were living accommodation. It is also not clear whether they were open to the sky, although this is improbable. In the gap between two houses, which was the usual location for a latrine, it would have been a simple matter to erect a roof. It is also possible that the space between two buildings was occupied by a projecting external gallery at the upper floor level. In Gullskoen's Row 2 the layout in Phase 6.1 with Privy 10 located between two buildings was followed in the next phase by two buildings with a similar gap between them, but the remains of stairs showed that the space had been roofed over by a projecting gallery at the upper level. The privy had apparently been eliminated in this instance, but the possibility cannot be ruled out that gaps between buildings and privies located in them could have been roofed over in this way.

Type 1 includes Privy 15 in Period 3 (1170/71–98), since its floor level must have been higher than the contemporary ground surface. It differs from the others in size as well as in construction and location (fig 13). It was a timber frame structure but unlike most of the privies built in this way the vertical wall planks were set on sill-beams. Only three of these had survived but each one had a relatively well-defined groove along the top. On the west side, the groove contained the broken lower part of a wall plank still *in situ* as far as one could see. The lower part of the filling consisted of moss and the greasy light brown substance which was usual in these excrement deposits. This privy was placed right next to the passage at the front of the gap separating Buildings 475 and 480. Apart from Privies 5 and 6, which lay outside the area of double tenements, Building 137 and this example, all the privies were situated adjacent to the eaves-drip gap at the boundary with the neighbouring property and furthest away from the tenement passage. Privy 15 was the smallest measuring only 70cm by 65cm internally, and also one of the earliest, dating to the closing 10–15 years of the twelfth century.

The location of this little privy and access to it is difficult to understand. Access from the passage must at all events be eliminated. There is also nothing to suggest that it could have been approached from the other side, ie from the north. Alternatively, there could have been access through a door in the end wall of one of the adjacent buildings, preferably Building 480, since Building 475 seems to have had its own indoor privy, no. 14. This possibility cannot be excluded, but it still seems puzzling that it was located by the passage and not up against the eaves-drip gap. Another solution cannot therefore be excluded - that it was associated with an external gallery or room projecting from the upper floor of Building 480, for example. The cladding up to the upper floor must in this case have formed a relatively narrow shaft. This is suggested both by the well-defined groove for the upright planks in the sill-beam and by the location, but to interpret it in this way would probably be to anticipate the typological and cultural-historical development, since privies of the shaft type were hardly known in Norway at the time in question – the end of the twelfth century. As far as is known, the situation regarding privies in European towns generally was not good, nor indeed were the sanitary conditions as a whole. Most people performed such necessary functions more or less anywhere, outdoors or indoors, in the courtyard, and so on. To '*leita ser staðar*' – 'to find oneself a place' – and similar expressions are found in the Edda, the sagas and the old laws. Troels Lund (1929–31, 118) maintains that separate privies became necessary in connection with the development in castle building, but the tenth and eleventh century arrangements, which were placed within the walls, soon afflicted the whole place. Nevertheless it seems that a catastrophe had to occur before there was any improvement. At a ceremony in 1183 to pay homage to the emperor Barbarossa in the castle hall at Erfurt, the floor collapsed under the weight of the throng and a great number of people including eight princes, several noblemen, hundreds of knights and others died in the latrine pit beneath the building. According to Troels Lund, the lesson seems to have been learnt from this tragedy and in due course privies were moved to separate towers or externally projecting constructions. This solution seems to have been attractive to northerners at quite an early date (Troels Lund, op cit), but we do not know of any such arrangement in any vernacular buildings in our early towns. Even privies of the type which we have found at Bryggen do not seem to have been common in the Middle Ages, or for that matter before well into the nineteenth century in rural areas. In spite of this, the possibility cannot be ruled out that the access to Privy 15 could have been via an external gallery or a projecting structure on the upper floor and that the drop was enclosed in a shaft.

Beside Privy 15 stood Building 475. In the adjacent south-east corner of this building were the remains of three sides of a highly unconventional construction surrounding a pit which measured 1.95m × 1.40m and was at least 100cm deep. With some hesitation we have chosen to interpret it as a privy in spite of the fact that there were no clear indications of moss or excrement in the filling (cf figs 13 & 14). The north and east walls, which were partly intact, were of different construction and what was left of the west wall – a grooved sill beam – shows that this was different again. The east wall consisted of upright boards and split logs apparently driven into the ground, the north wall of horizontal boards fixed between two uprights, and the west wall of planks set into a sill-beam. The pit contained normal deposits resulting from a fire – in this case from 1198.

Building 137 was a free-standing building placed at the west end of Building 28 in the foreshortened Row 3 on the Gullskoen site, but it was also physically integrated with Building 28 in that it shared the corner posts and presumably also the dividing wall (fig 15). It was limited by four relatively solid corner posts marking a cellar area whose east wall consisted of split logs standing side by side and whose north wall was of upright planks standing edge-to-edge. This was more obviously than ever a 'cellar' in our sense of the term, since the surrounding area was enclosed by buildings. The contemporary passage ran c 15–20cm lower than the presumed floor level, while the cellar was c 130cm deep. The lower part of the room, which covered 8 sq m, was filled with a 15–20cm thick layer of compressed moss, mixed in places with a greasy substance usually interpreted as excrement. It measured *c* 2.6m × 3.4m with its long axis running across the tenement.

In the adjacent Building 28 the surviving sill-beams on the north and south sides rested in grooves cut in the two corner posts which this building shared with Building 137. As both sill-beams had a slot along the top edge to receive the bottom ends of upright wall planks, this was clearly not a log-built structure, and the shared corner posts at the west end must have been roof bearing. Since the north-west corner post also had a hole for the north sill-beam of Building 137 it is reasonable to assume that this building was of the same construction. They had burnt down in 1198 and all traces of the other corner posts disappeared, but the interpretation of Building 137 as a post-frame structure with a shared wall to Building 28 seems to be the only rational explanation.

In Building 306 in Bugården North we have a variation which recalls Building 137 in that it lay at right angles to the line of the tenement. It would appear that it had been a free-standing building, erected very soon after Fire VI (1198). The surviving remains consisted of three slender supporting posts and fragments of slender floor-joists mortised into two of the posts about 50cm above their bases which were pointed.

The contents comprised a layer of moss and excrement up to 40cm thick. The depth of the pit below the floor level must have been at least 50cm. The building was c 4m wide, the maximum surviving length was 2.40m, and the tallest surviving post was 90cm.

The earliest variation of Type 2 that was recorded was based on a more developed concept connected with houses which were clearly used as living accommodation. Like these, the floor was level with the contemporary ground surface and there was a pit underneath. These are the privies which have been described above: Building 240 from Period 3, and Buildings 241 and 233 from Period 4 (see also Herteig 1991a, figs 46, 48 and 52). They were larger structures and can almost be described as annexes running the full length of the building to which they were attached, standing between this and the eaves-drip gap. Each of these three structures had a main building acting as a buffer between it and the tenement passage, but they all had a separate entrance opening on to a cross passage running along the east side of the main building. Privy 240 was associated with Building 242 with its fireplace. Apart from the fact that the floor, as already mentioned, must have been level with the contemporary ground surface, it was built as a 'cellar building'. Admittedly, the corner posts were missing, as well as the wall planks on three sides – only the planks of the east wall had survived. The pit underneath was 4.4–4.5m in length, about 2.5m wide, and would have been nearly 1.5m deep. It contained a mixture of moss and excrement with some lime.

In the following period the arrangement was repeated on the very same spot. The ground plan of the main construction, Building 232, had survived with an almost intact ground frame, floorboards and fireplace. It must also have had earth-filled benches along the south, west and north walls. On the south side it had a succession of two privies, 241 followed by 233. The first one had wattle sides to the west and north and edge-to-edge planking on the other two sides; its replacement had a wattle wall only on the west side. Access was from the east, just like the main building. The side building contained the same mixture of moss and excrement as Building 240 and was practically sealed with a layer of lime several centimetres thick.

Variant 2b was really a smaller version of 2a, but with a different location. It also stood beside the eaves-drip gap marking the neighbouring boundary, but unlike Type 2a which ran alongside the main building, Type 2b was placed between two buildings in the row.

Access was from the tenement passage and this always had some form of planked surface (figs 16 & 17), but it is not clear whether or in what way this access was screened off from the passage. On the other hand, the view from the neighbouring property on the other side of the eaves-drip gap was apparently blocked, for in Privy 10 in Gullskoen's Row 2 in Phase 6.1 the opening between the two buildings was closed off at the eaves-drip gap.

Privy 10, which was erected at the north end of the gap between Buildings 428 and 430 in Phase 6.1, was one of the best preserved (fig 16). It consisted of a rectangular framework of boards set on edge and held in place by square, slender posts standing outside the corners. The bottom was covered with loose planks laid transversely. The passageway leading from The Old Church Road to the privy was paved with generally wide boards laid longitudinally over thin cross-joists. On the north side of the privy the gap between the buildings was closed with horizontal boards placed on edge and held in place with thin posts. The privy measured *c* 1.5m × 1.1m. The surviving height of the corner posts above the floor of the privy was 70–110cm. The two front posts to the south stood *c* 40–50cm above the boards in the passageway and the height of the seat is estimated at 45–55cm.

Privy 10 was not the earliest, but in its construction and on the basis of its good state of preservation it provided the best impression of the type of privy which was in use in the later part of the thirteenth century. The construction of the framework was done with some care, but some variation in detail or alternatively slovenly execution would rather seem to be the result of secondary maintenance or repair.

Our two privies of Type 3 (nos 5 and 6) form a special category in that they really fall outside Bryggen both topographically and socially. Privy 5 may have been built in Period 7 (1413–1476) in association with the hall of the St Mary's Guild. This was a two-storey building with the lower part built in stone and with a west-facing external gallery on the upper floor. It is first mentioned in 1276 as a moot hall (NgL III, 135), and after the fire in 1476 it was used as a priest's lodging. The documentary references to a gallery on the west side (DN II, no. 295) were confirmed during excavation by the discovery of a latrine pit 1.85m out from the north-west corner (figs 18 & 19). The privy must therefore have been located in the gallery. The shaft was lined with adzed boards 35–45cm wide standing in the pit and held in place by an internal, loosely-jointed, horizontal frame, which was prevented from collapsing inwards by a long stake at each corner. Externally the shaft measured 1.80m by 1.00m.

Privy 6 (1476–1702) was associated in a similar manner with St Lawrence's Church, which was apparently erected in Phase 3.2 in the 1180s or 1190s (fig 20) and may have continued to serve as a church or chapel right up to the fire in 1476. In 1565 it passed into the hands of the district governor Erik Rosenkrantz, who rented it out to Hanse merchants from Bryggen. At that time it was an impressive two-storey building. A well-built latrine outside the south-west corner may suggest that this building also had a west-facing external gallery, but as the latrine lay only 1.0m–1.3m out from the wall, the privy may simply have been in a projecting structure on the upper floor.

Whereas Privy 5 had a shaft of vertical boards, that of Privy 6 was constructed with solid horizontal timbers up to 50cm × 20cm in cross-section which were dovetailed at the corners. It measured 2.00m × 1.80m externally and the bottom was about 100cm below the upper edge of the plinth course on the west side of the stone building.

These two unusual privies also fell into a special category with regard to the nature of the contents. Whereas the others produced few ordinary finds, these revealed their social connection through the more unusual finds of pottery and stoneware, a great amount of broken glass from drinking vessels, including *römere*, *krautstrunk* and *passglass*, and from bottles and window-glass, as well as pieces of textile, fragments of floor tiles, roofing tiles and glazed oven tiles, a gold ring with a Latin inscription, the remains of eggs, the bones of wild fowl and various animals, berries, and so on.

LATRINE SEATS

Latrine seats have already been mentioned. In all, the remains of six were recorded, coming from Bugården South, Engelgården South, Søstergården South, and Rows 3 and 4 in Gullskoen.

Seat 90021 was the only one which had survived for its full length (fig 21). It was found lying among beams and planks, ship's timbers, etc, just inside the north door of Building 261 in Bugården's South Row and it must have belonged to the first phase after the 1248 fire (Fire 5). It measured 1.20m × 52cm and had two holes 25cm in diameter. Along the front edge was a shallow groove 2cm wide and 2mm deep like that recorded on the cross beams of the great ship from Bryggen and on some internal construction beams.

As only fragments of the other seats had survived it is difficult to calculate their original size and capacity. 90666 from Period 3 was a fragment measuring 105cm × 30cm with the remains of three holes, 93020 and 93330 from Period 4 both belonged to one seat which had four holes (fig 22), and 93496 from Phase 6.1, which measured 47cm × 38cm, was a fragment of a seat with one hole. Apart from the complete seat from Bugården South, the others may have had more holes than were recorded. The three-seater 93450 was found close to Building 232 with the *c* 5.8m long privy, Building 233, from which it could have come. This could have been an eight- or nine-seater. One of the holes was 27cm in diameter, the others were 25cm, and they were on average 60cm apart measured centre to centre.

SUMMARY

This article deals with a number of buildings which on account of their construction or their function fall outside the usual pattern of twelfth and thirteenth century structures at Bryggen. They comprise some 40 or so structures in all and come under the general category of post-built constructions.

Falling into a group on their own and with no known parallels either in Norway or abroad are two buildings with open corners (figs 2 & 3). Instead of a single post at each corner, there was a pair of posts standing slightly apart. There was no trace of any kind of wall filling in the gap, which varied from *c* 20cm to *c* 48cm.

The two buildings have been discussed previously by E Reimers (1976) and in the present context attention is drawn only to their function. They seem to have been built for the definite purpose of storing goods which needed a good supply of fresh air in an otherwise damp climate, and one automatically thinks of the dried fish which was transported to Bergen in large quantities during the summer months and piled up there awaiting export.

Another kind of post-built structure is the so-called «cellar-building». It belongs to a type of structure which is now known from excavations in most of the early medieval towns in Scandinavia as well as in other countries. Although the recorded examples have certain basic features in common, they vary in structure, degree of preservation, and probably also in function.

In the majority of cases the walls consisted of neatly adzed planks or split logs placed vertically side by side, often with their tops irregularly cut or burnt. The foundation posts which supported some overlying structure were always placed outside the line of the wall. In two or three cases fragments of an apparent sill-beam had survived. In one example there were details which clearly indicated that the building above had been log-built, while in another example the overlying structure was definitely a timber-frame construction.

In most cases the existence of adjacent buildings would have prevented access to the cellar from the side and it is therefore reasonable to assume that access was gained from above.

Except for a few cases which only produced deposits of a secondary nature, the structures contained moss or excrement or a mixture of both. Some cellars in fact seem to have been more or less filled with moss.

As is documented by the privies which were excavated, moss was an almost constant element in the sanitary arrangements. There must therefore have been a continual demand for this material and the damp cellars would have provided most favourable storage facilities.

Of the approximately 500 buildings recorded in the excavated area at Bryggen eighteen were privies, possibly with a further six. The recorded number is hardly representative for the whole of the excavated area, as some of the structures serving

this purpose could have been very simple arrangements and therefore difficult to recognize. Moreover, parts of the Bugården, Engelgården and Søstergården tenements were not excavated any deeper than the mid-thirteenth century (*c* Period 5) (Herteig 1991, 63, 75). It is reasonable to assume that privies would have been a relatively common phenomena in the Bryggen tenements throughout the Middle Ages, even though they may have been irregularly located and of relatively simple construction.

The large privies which were recorded were clearly intended for common use. There could have been room for six or seven persons at the same time, or even as many as nine as in Building 233.

After the fire in 1476, simple multipurpose sheds were built on the edge of the wharf (fig 23), and in the middle of these structures there was a partitioned area to which the Bryggen inhabitants were directed for the purpose of relieving themselves. They were forbidden to perform their bodily functions in the rows, but like most bans this would have been difficult to enforce.

The privies show that sanitary conditions at Bryggen were already relatively well-developed in the twelfth century compared with what we know of the situation in rural districts and from other excavated sites in Scandinavia. Sigurd Grieg (1957) refers to reports showing that privies were not common in rural settlements until well into the nineteenth century. According to Falk (1910, 13) the situation was no better in Iceland and he expressed some doubt as to whether conditions had been any better during the saga period, as Guðmundsson had maintained (1889, 446).

In the large privies in Bryggen lime was used to reduce the smell and perhaps also to reduce the risk of disease from flies, evidence for which was found in great concentrations inside the structures. How – or even whether – the latrines were emptied is not known.

The sanitary conditions in Bergen were also greatly helped by Nature. A fresh climate with high rainfall, together with the public regulations, helped to keep the town clean, even though foul smells from a great variety of sources could not be avoided.

This glimpse into the development of the sanitary arrangements at Bryggen is only a minor part of the complex civilisation process in Norway, but it is a part which we share with the rest of Europe, and which has hitherto been much neglected by modern historians.

NOTES

1 The following structures are recorded as 'cellar buildings':
Buildings 38, 39, 40, 44, 69, 114, 117, 121, 122, 130, 137, 196, 203, 245, 400, 401, 477 and 500. Of these the following are interpreted as privies or latrines: Buildings 137, 400, 401, and possibly also Buildings 122 and 245.

2 Definite latrines:
Buildings 2, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16, 17, 18, 137, 233, 240, 241 and 306.

3 BRM Accession Nos 90021, 90666, 92880, 93020 + 93330, 93450 and 93496.

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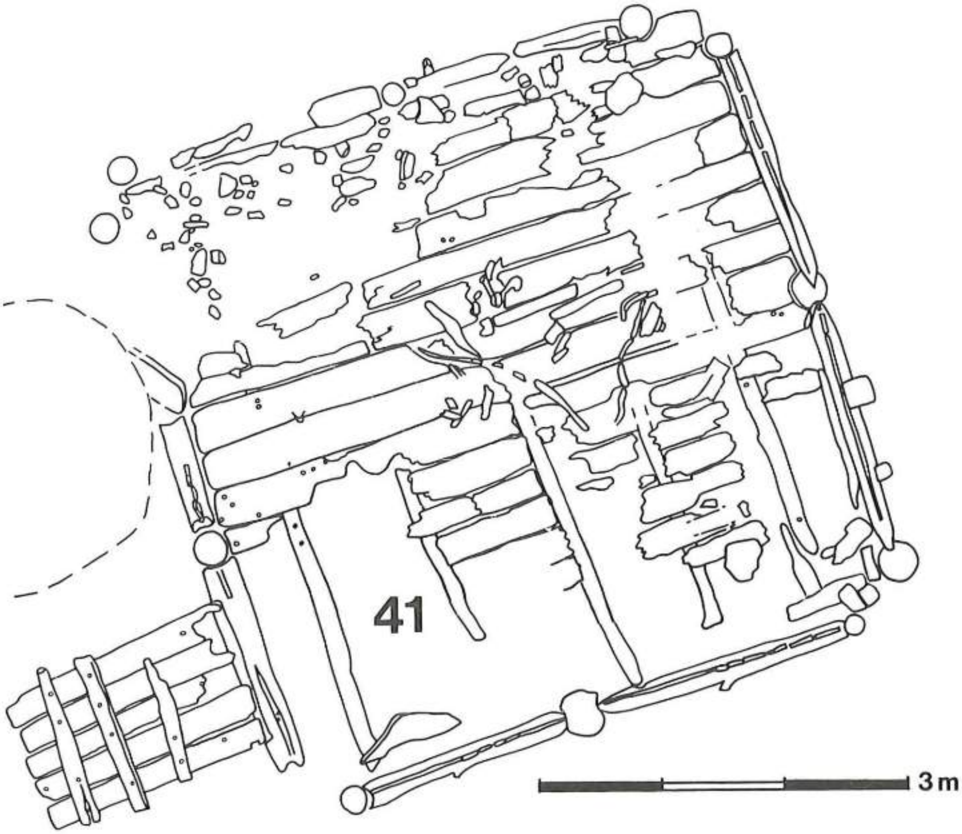
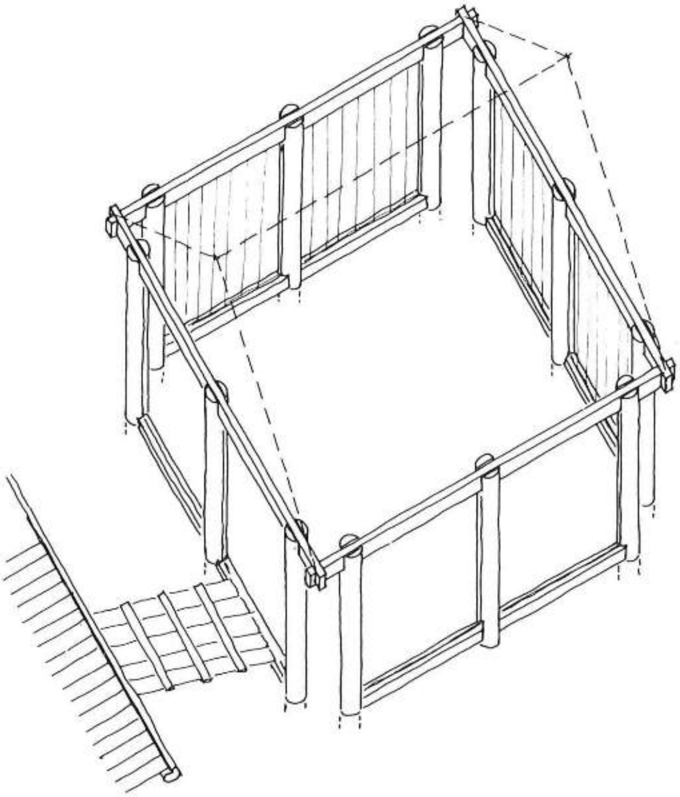
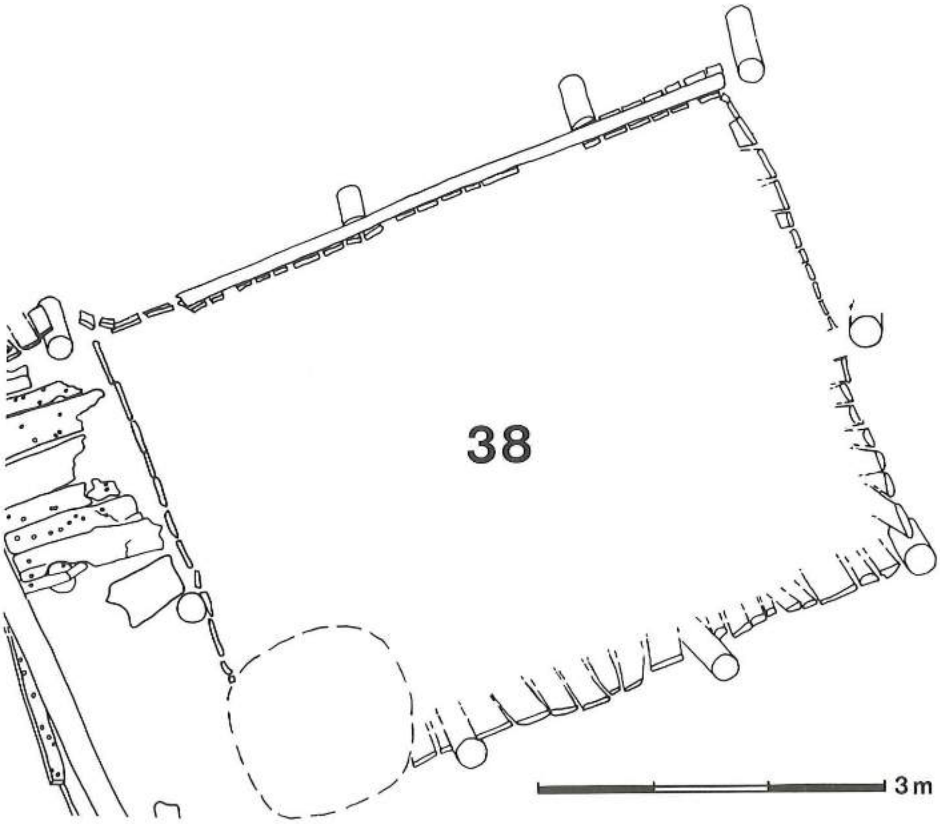


1 Building 41 with 'open corners'.



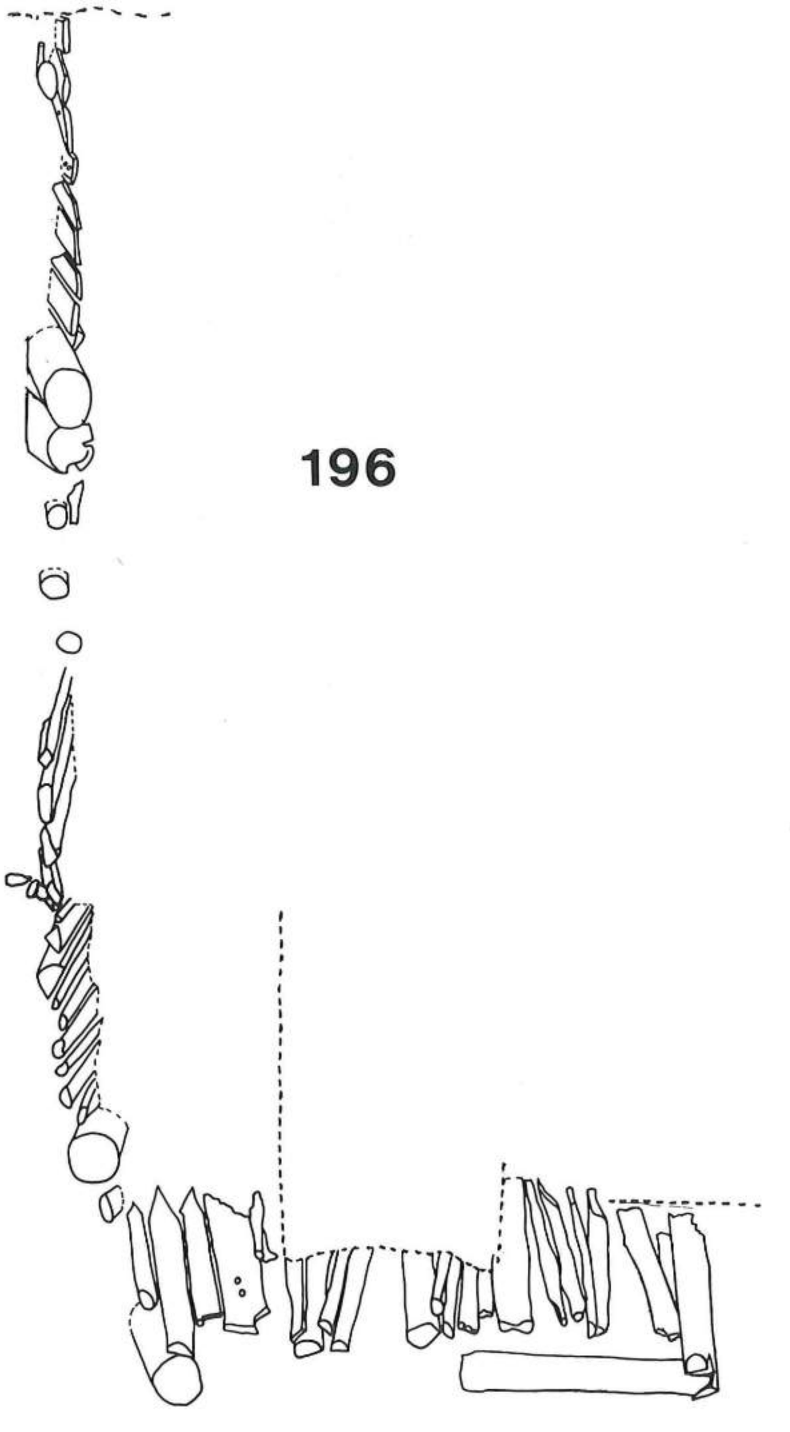
2 Suggested reconstruction of Building 41 by Egill Reimers.

3 Detail of the south-east corner of Building 44.

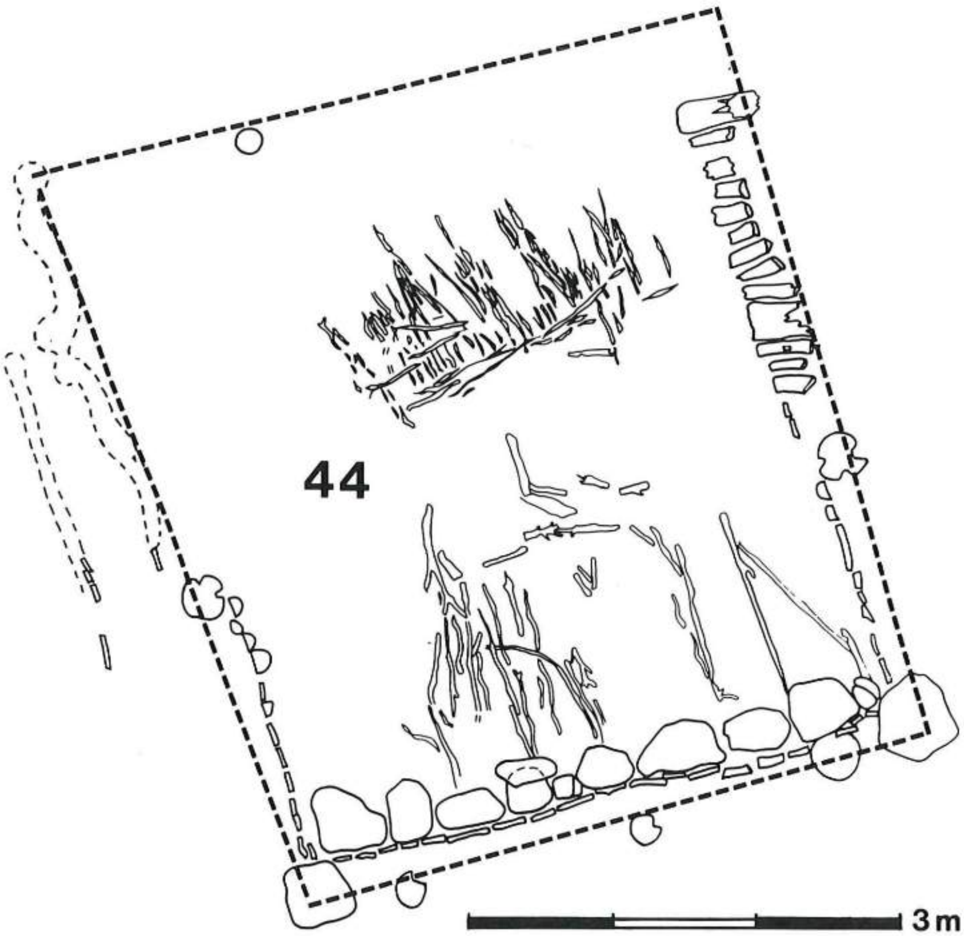


4 Building 38 with the remains of a possible sill-beam lying on the supporting posts of the east wall.

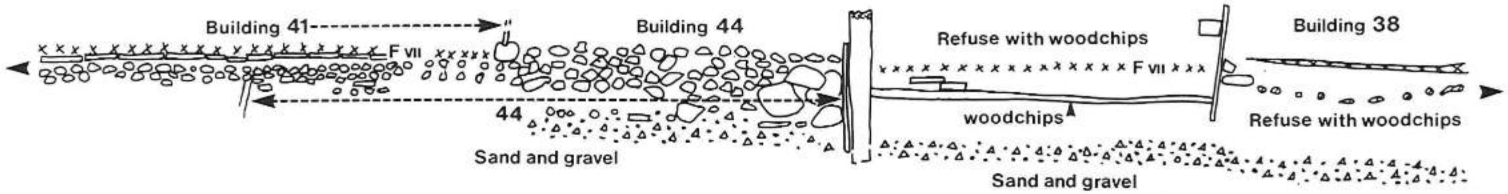
5 Building 38 from the north during excavation, showing the layer of tangled branches and bits of timber.



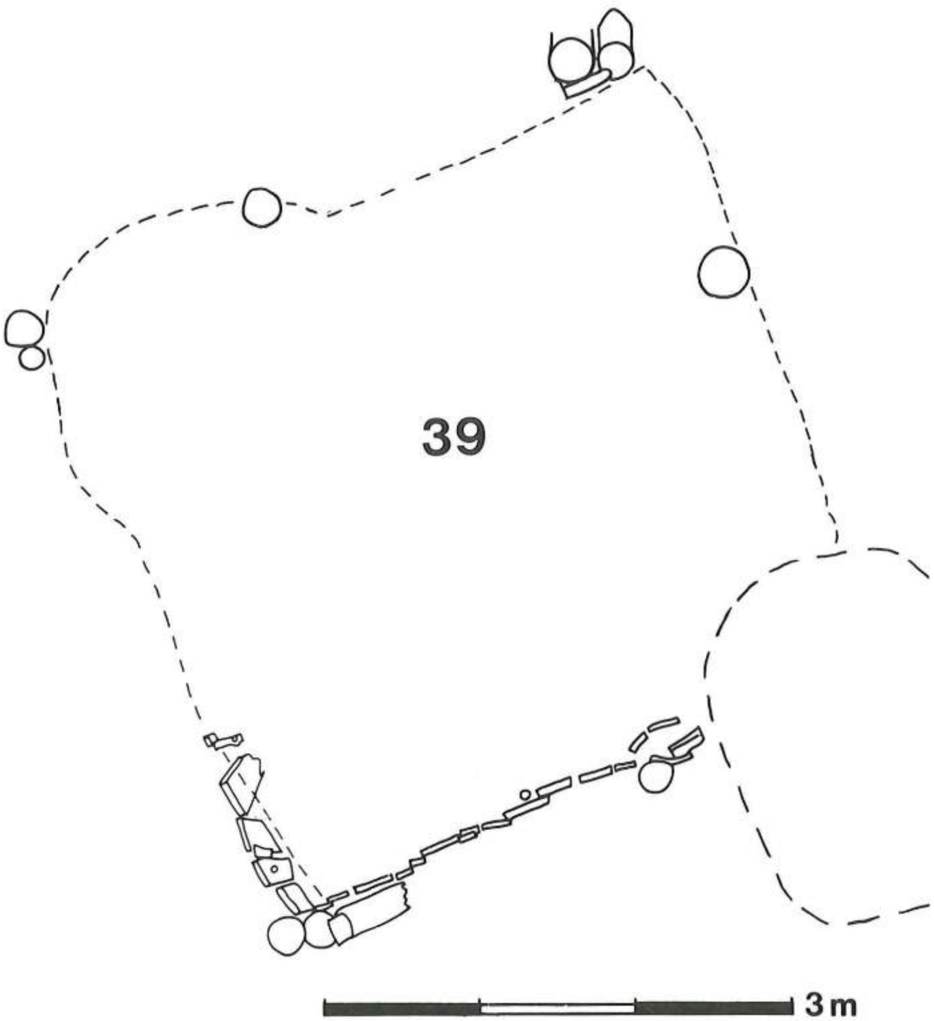
6 Building 196 with a fragment of the sill-beam *in situ* in the south-west corner.



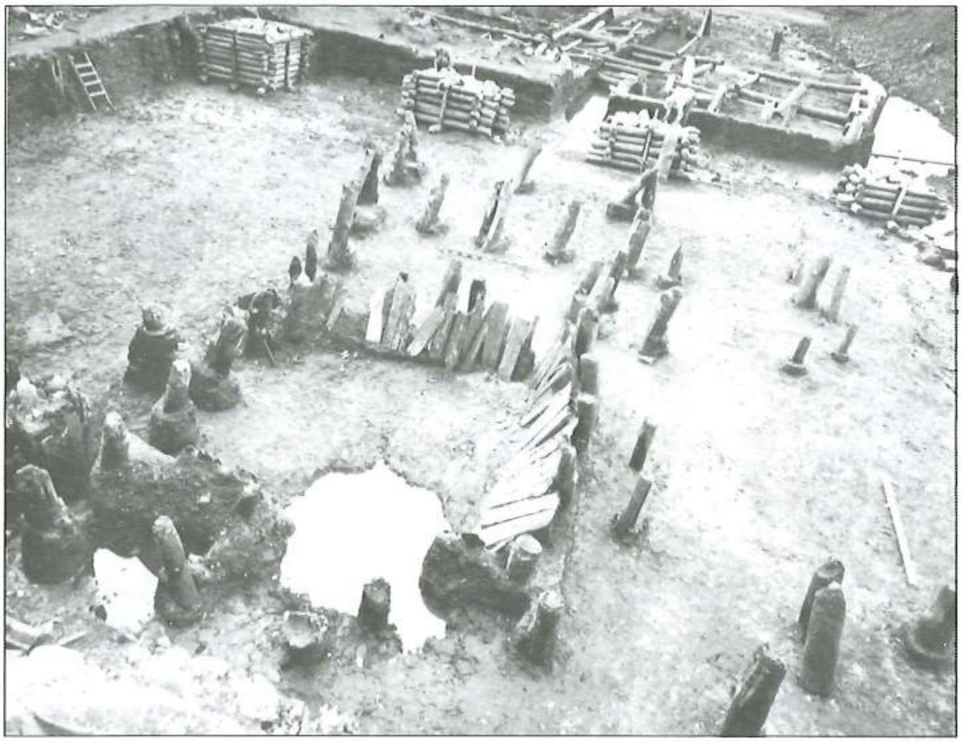
7 Building 44 with the band of stones at the foot of the west wall and the deposit of matted branches over the floor of the 'cellar'.



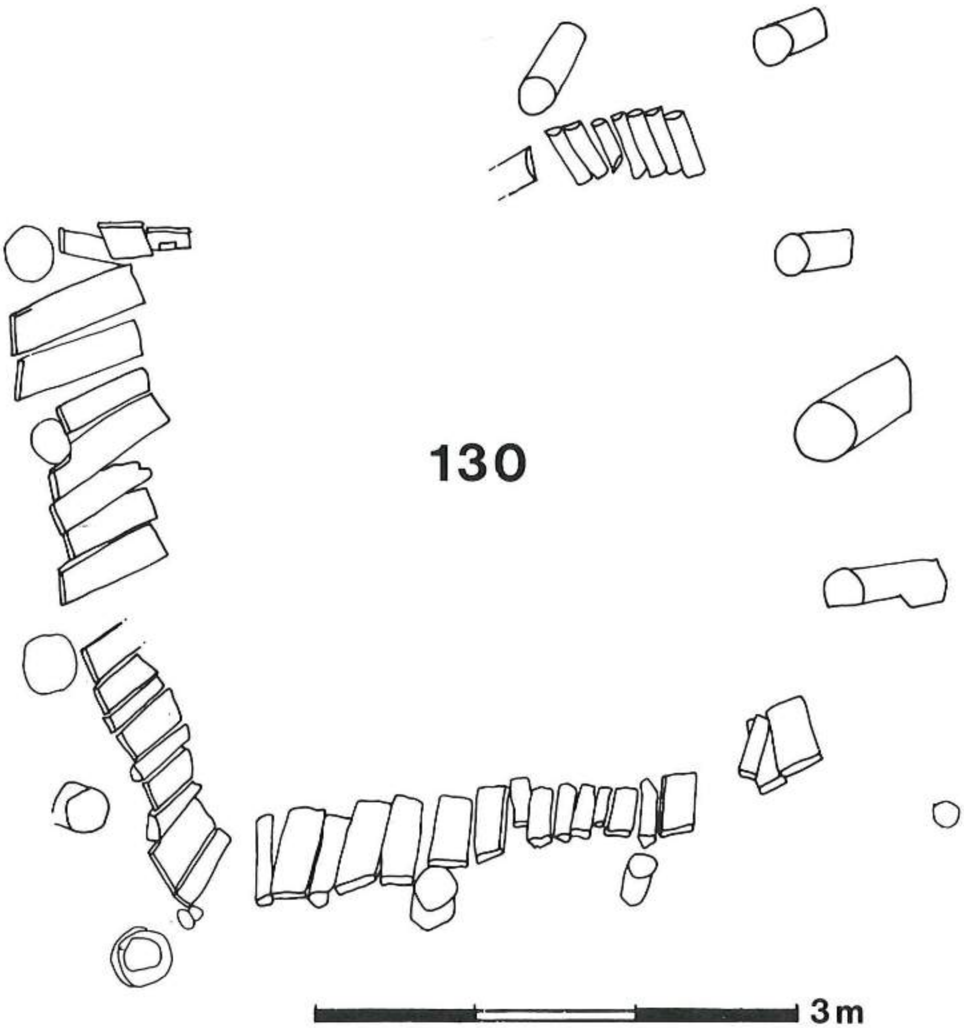
8 Part of long section no. 34 through Buildings 41 and 44.



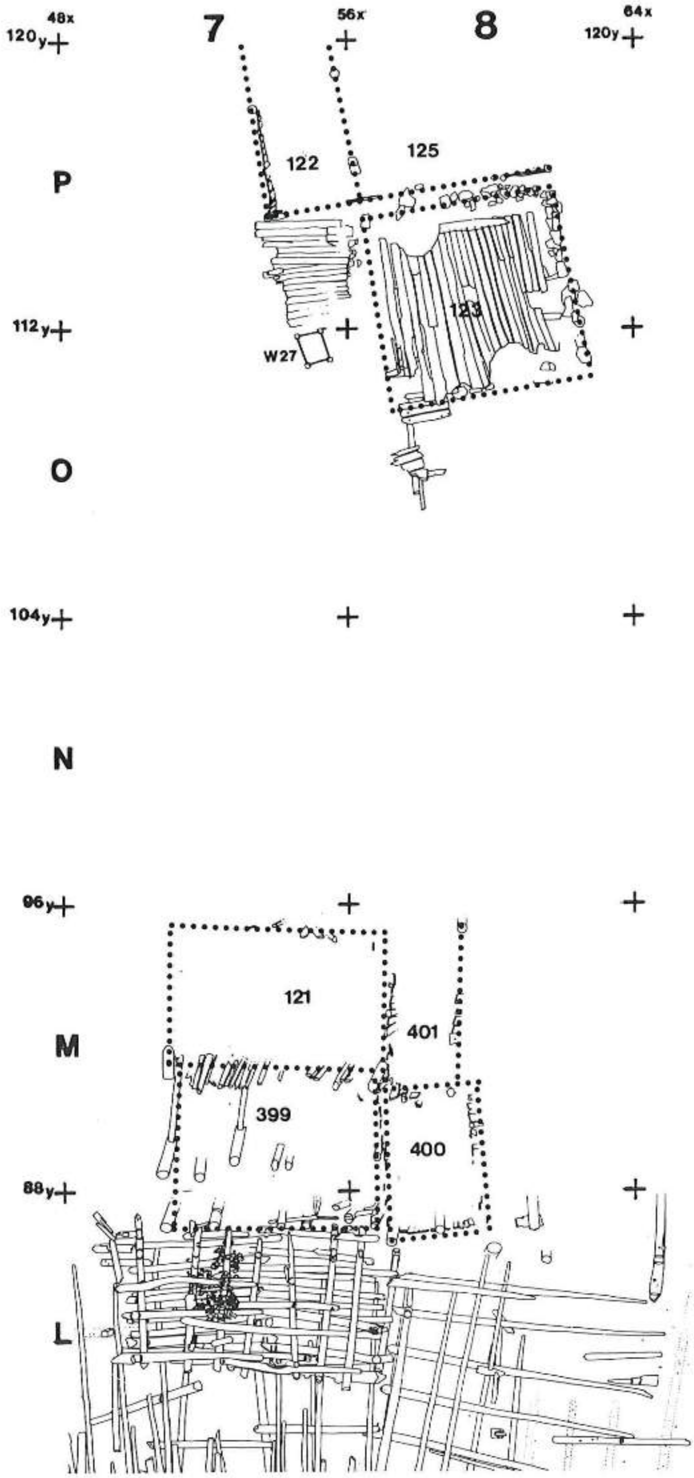
9 Ground plan of Building 39. The dotted line indicates the extent of the moss layer in the lower part of the filling of the 'cellar'.



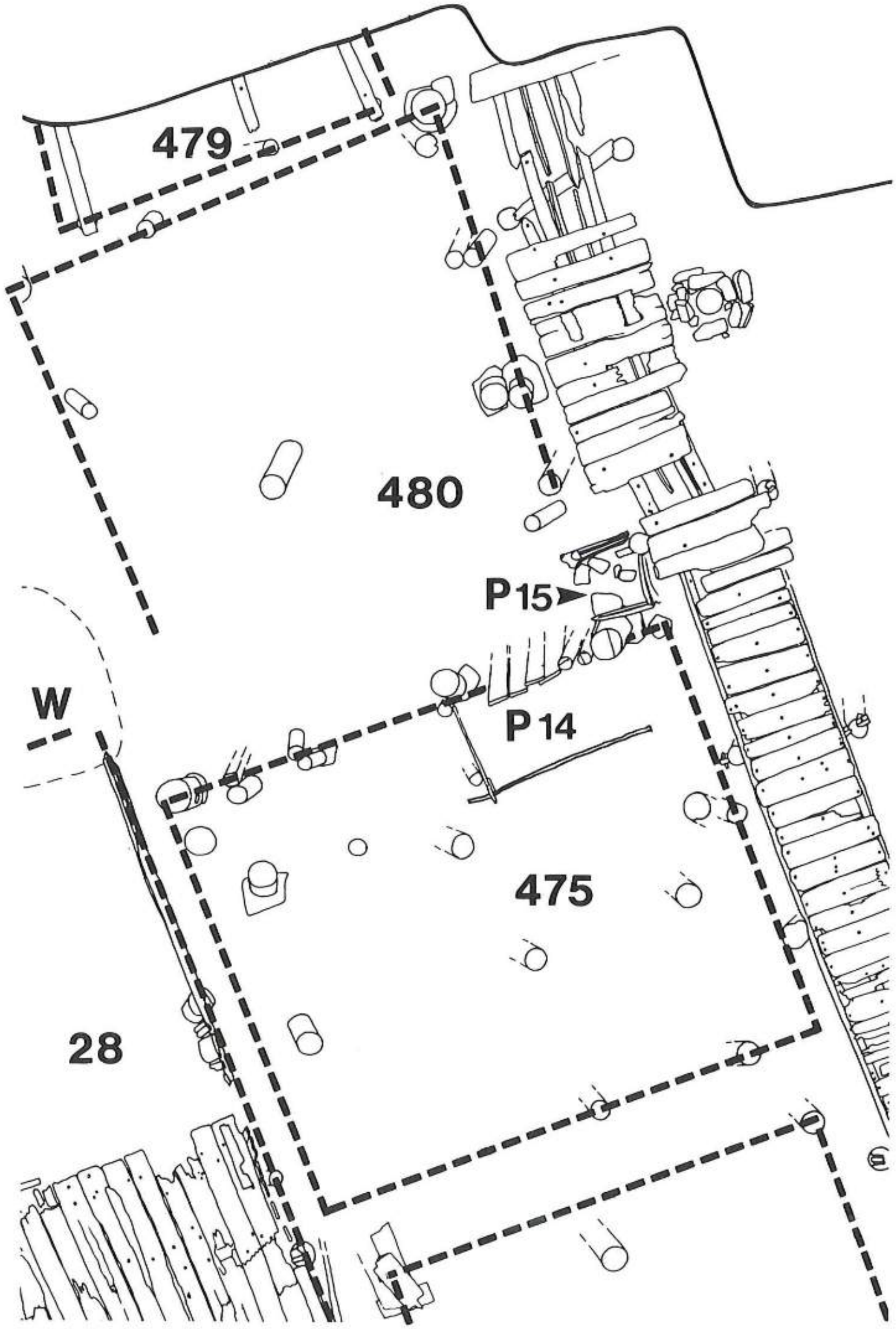
10 Building 130 from the west with vertical plank walls and supporting posts.



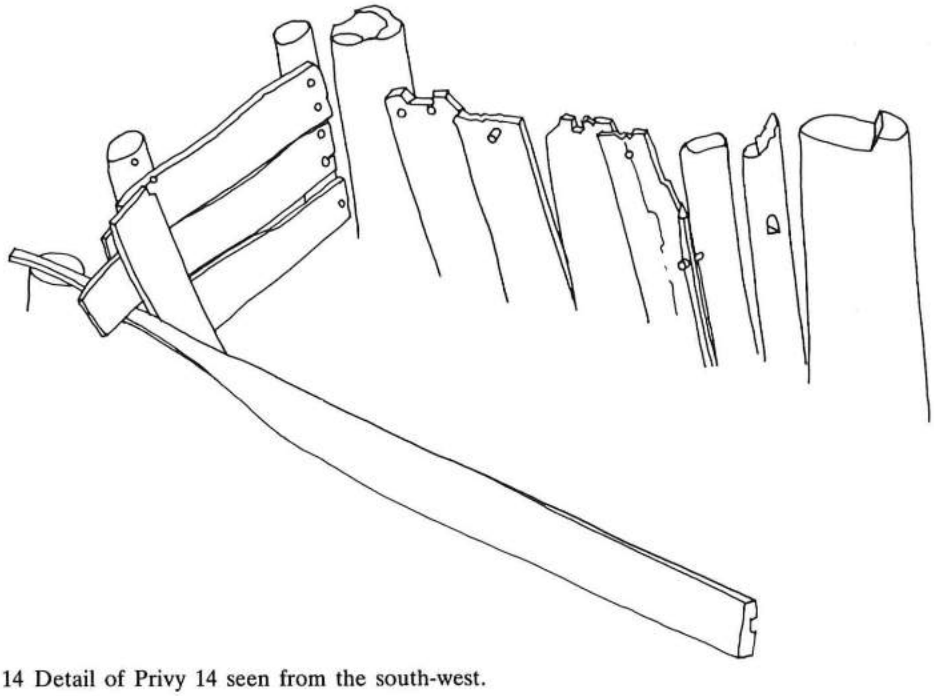
11 Sketch plan of Building 130.



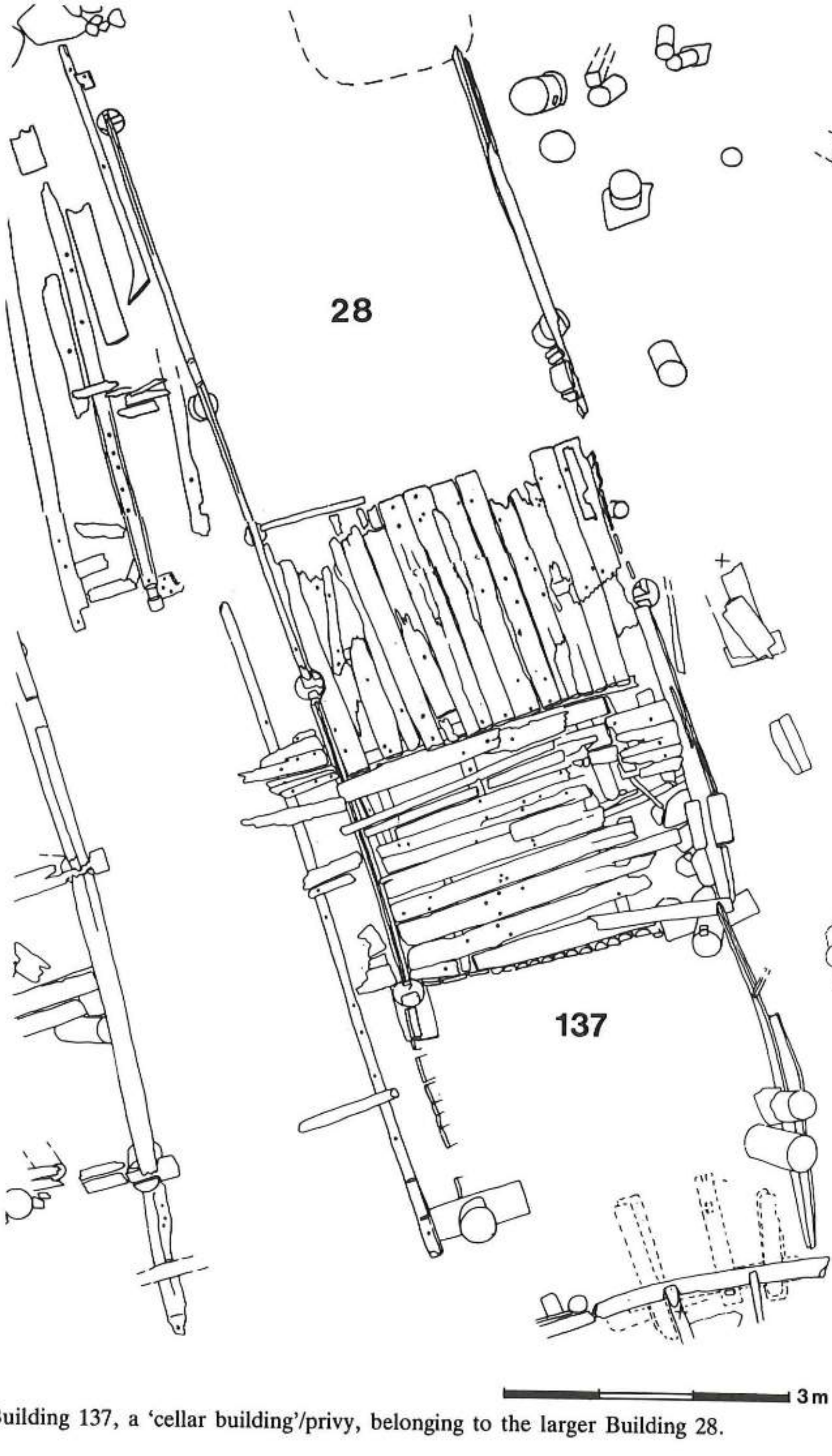
12 Sketch plan showing the location of the 'cellar buildings' 400 and 401 on the north side of Søstergården South. Building 122 in the background may be a side-annexe to Building 125.



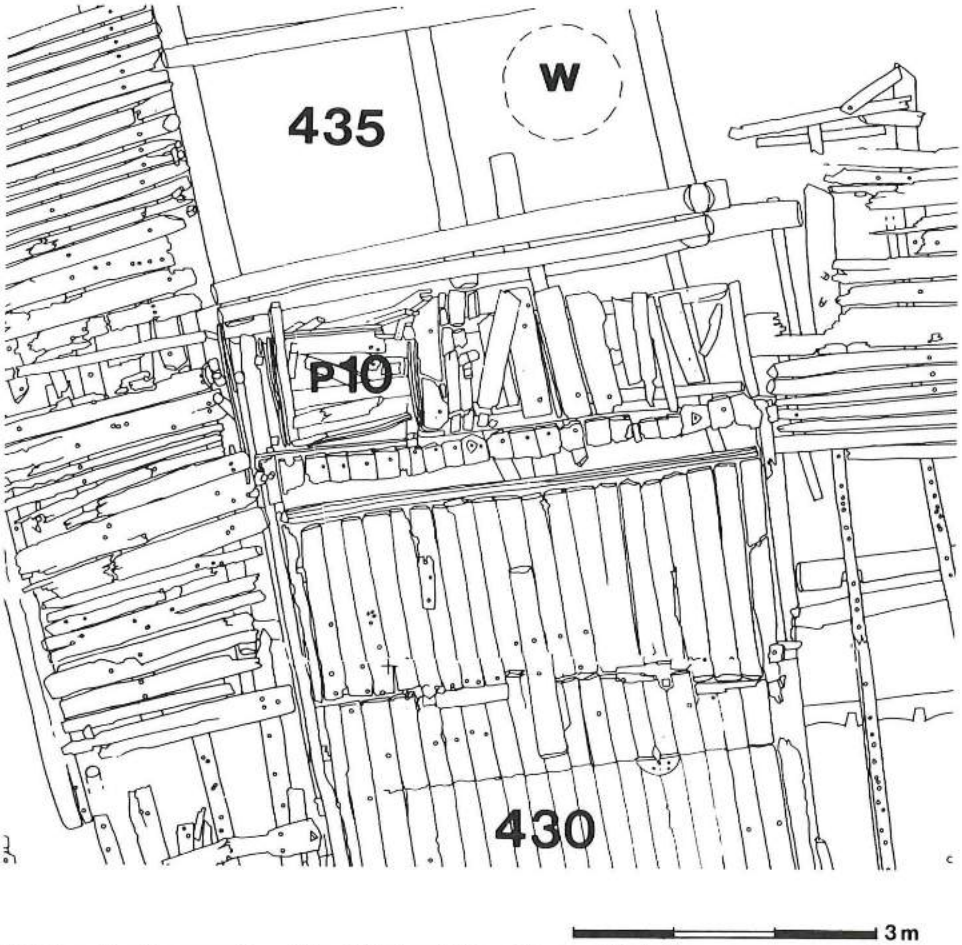
13 Privy 15 between Buildings 475 and 480, and Privy 14 in the south-east corner of Building 475.



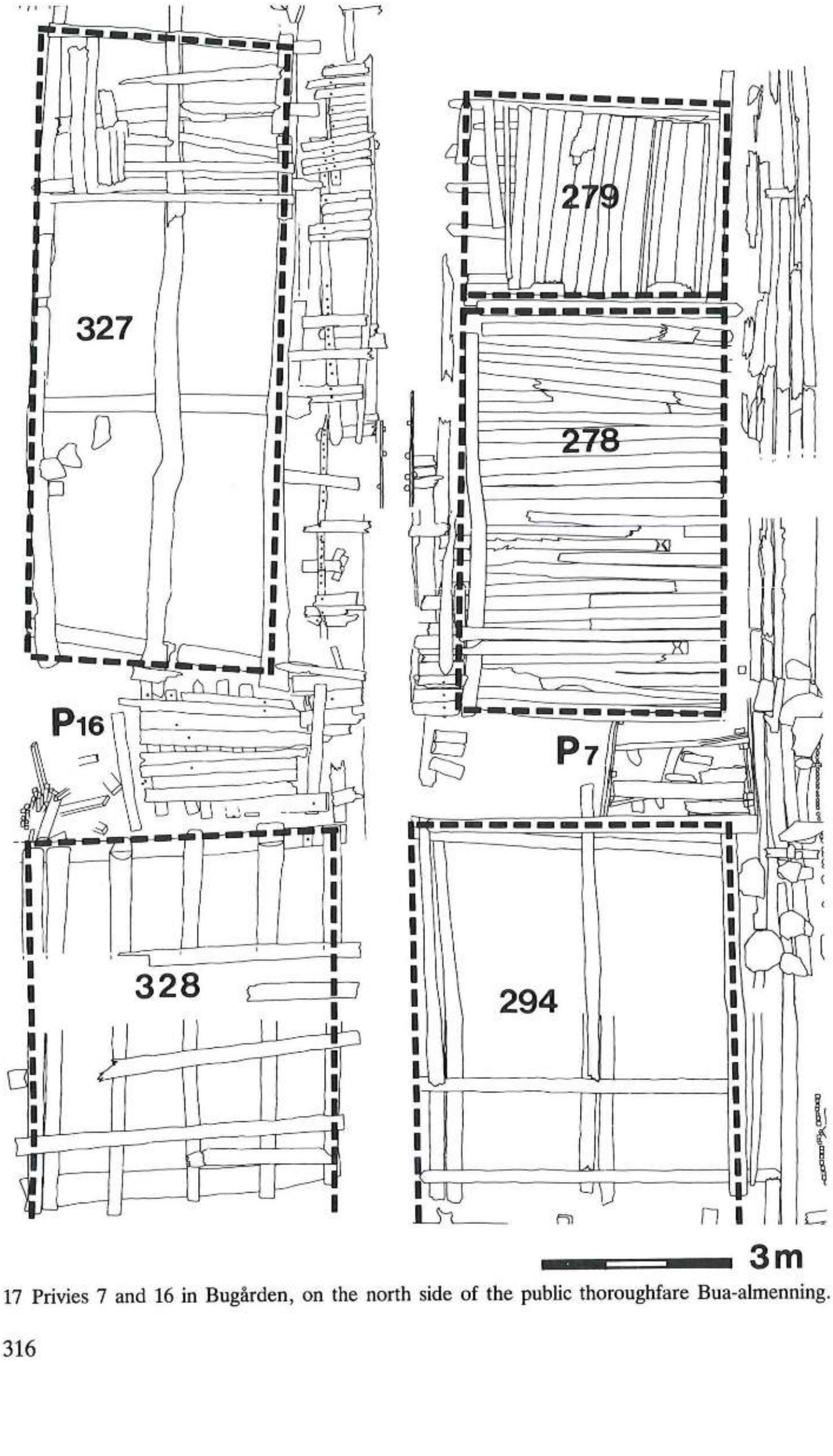
14 Detail of Privy 14 seen from the south-west.



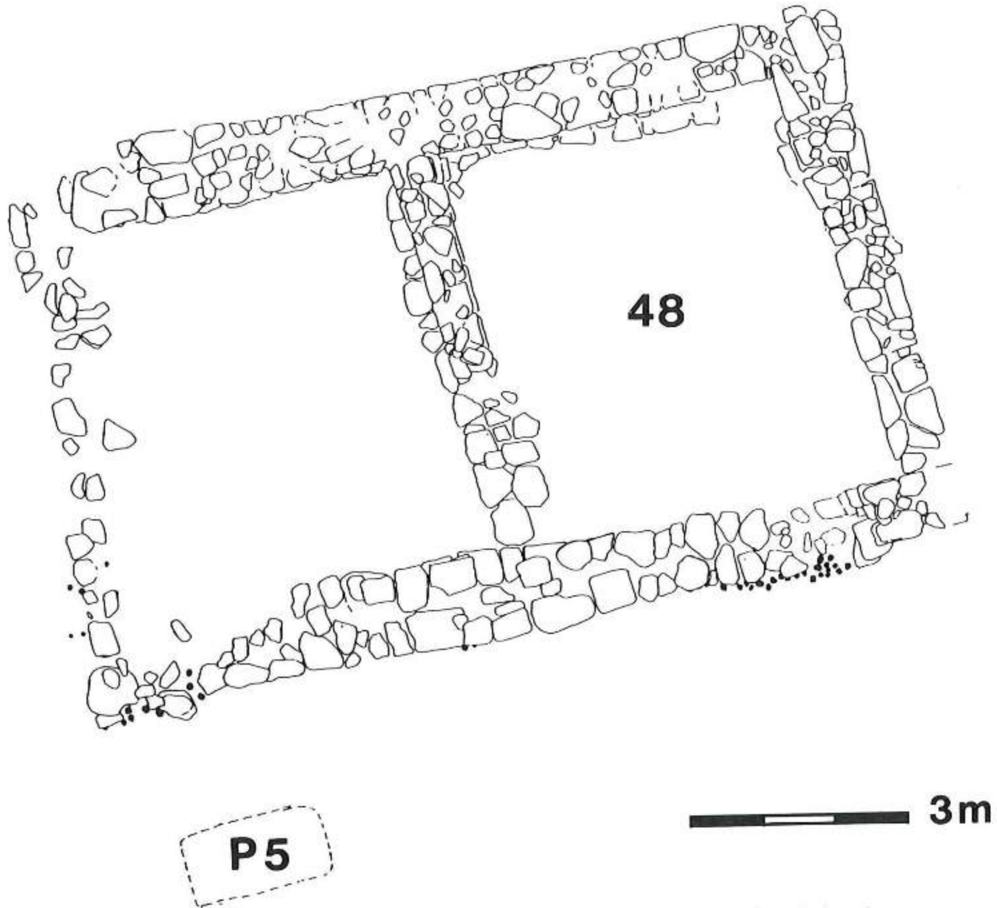
15 Building 137, a 'cellar building'/privy, belonging to the larger Building 28.



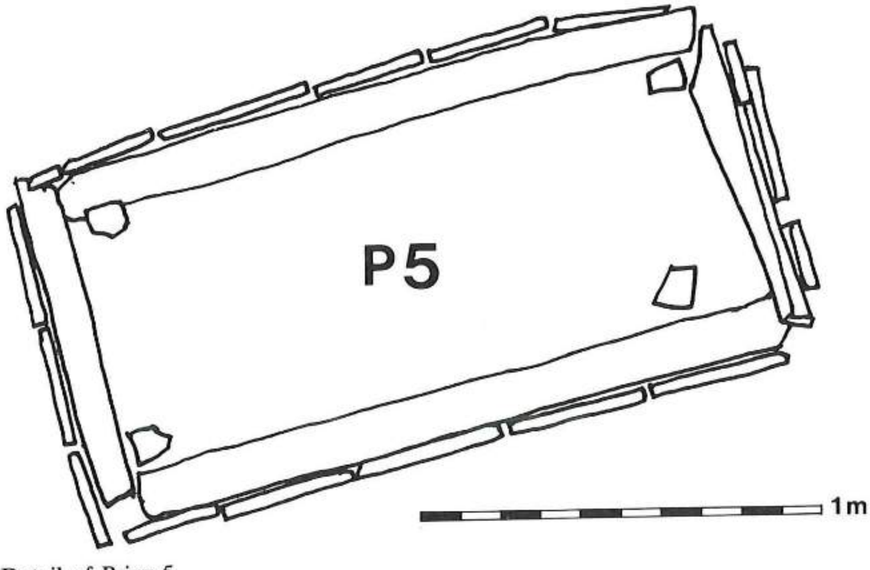
16 Privy 10 with access from The Old Church Road (to the right) via a narrow passage between Buildings 435 and 430.



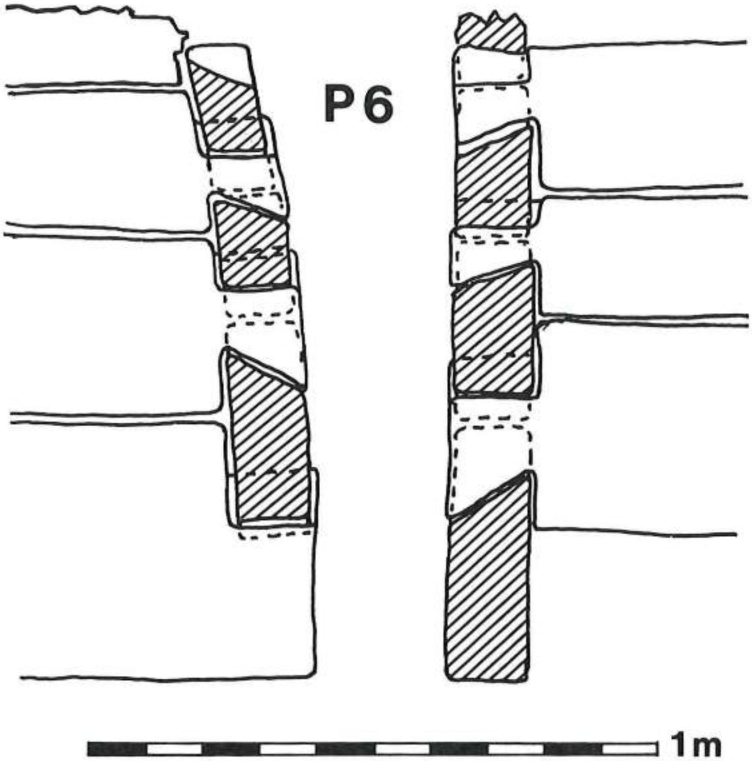
17 Privies 7 and 16 in Bugården, on the north side of the public thoroughfare Bua-almenning.



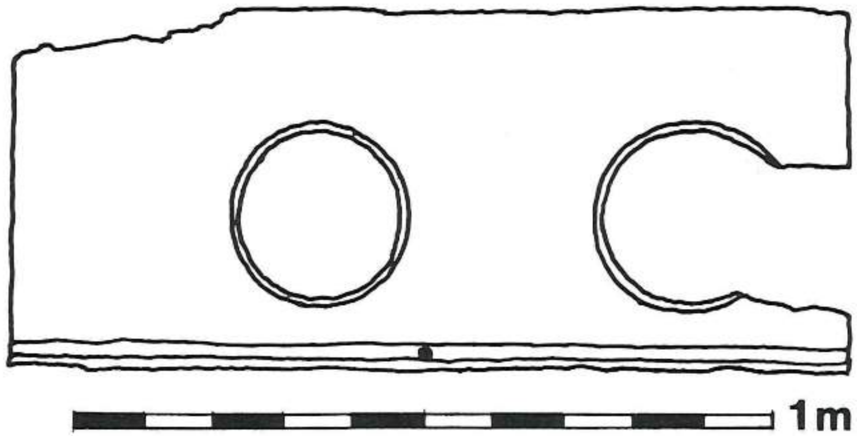
18 Sketch plan of the St Mary's Guildhall with the latrine pit of its privy, Privy 5.



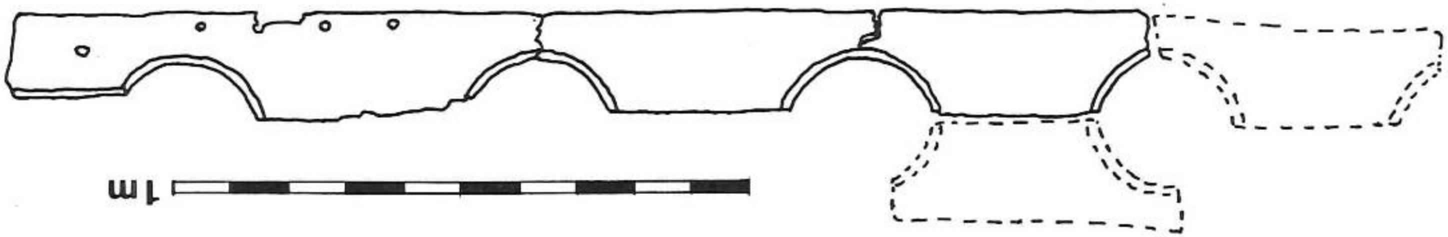
19 Detail of Privy 5.



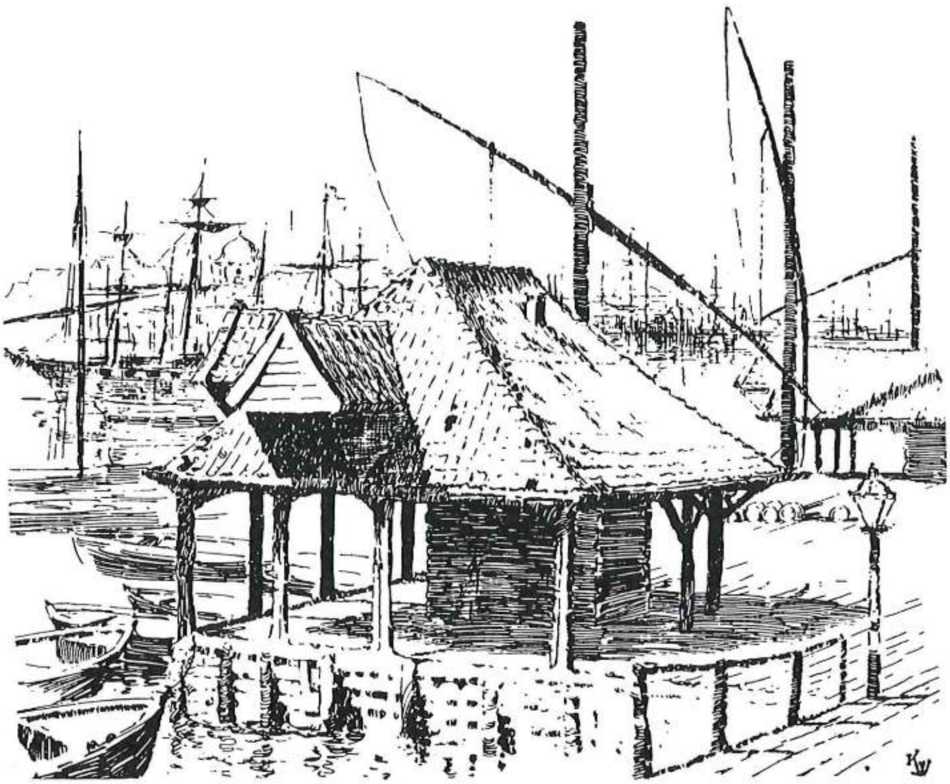
20 Details of Privy 6 belonging to the post-medieval, secular phase of the former St Lawrence's Church.



21 Latrine seat, no. 90021.



22 Latrine seat, no. 93020 and 93330, with four or possibly five holes.



23 An example of the sheds which were erected on the wharf after the 1476 fire with a central, log-built privy.

THE BRYGGEN PAPERS is a series of publications giving a scholarly presentation of the archaeological finds from the excavations at Bryggen – The German Wharf – in Bergen, which took place between 1955 and 1968. Bryggen was the economic centre of the old Norwegian capital. Later – in Hanseatic times – Bergen became one of the largest and most important seaports and commercial centres in Northern Europe. The excavations at Bryggen have revealed extensive material which gives valuable information about the development of the city as well as European cultural history in general.

In this volume Lyn Blackmore and Alan Vince present an exhaustive analysis of the medieval pottery from South-East England found at Bryggen. The study is an important contribution to the dating of the Bryggen finds in general. The physico-chemical analysis by Didier Deroeux and Daniel Dufournier of the French pottery from Bryggen has led to new ideas concerning the origins and uses of these wares.

On the basis of the canine bones from the Bryggen excavations Anne Karin Hufthammer shows the main trends in the physical development of the commonest dog types and proves that dogs were also a significant source of meat at times.

Herteig's article on «cellar buildings» and privies describes the development and use of proper sanitary arrangements at Bryggen through the Middle Ages and up to the eighteenth century.

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