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Historical Context and Provenancing of Late Roman Hand-Made Pottery from Belgium, the Netherlands and Germany

First Report

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1 Introduction

The former village of Donk, since 1970 merged with the municipality of Herk-de-Stad (in the Belgian province of Limburg), is located on the southern slopes of the east-west Demer depression. In this locality, the valley of the Demer is about 2 km wide and receives several tributaries (the Gete, e.g.). The Demer is the natural border-line between the Campine *(Kem-*

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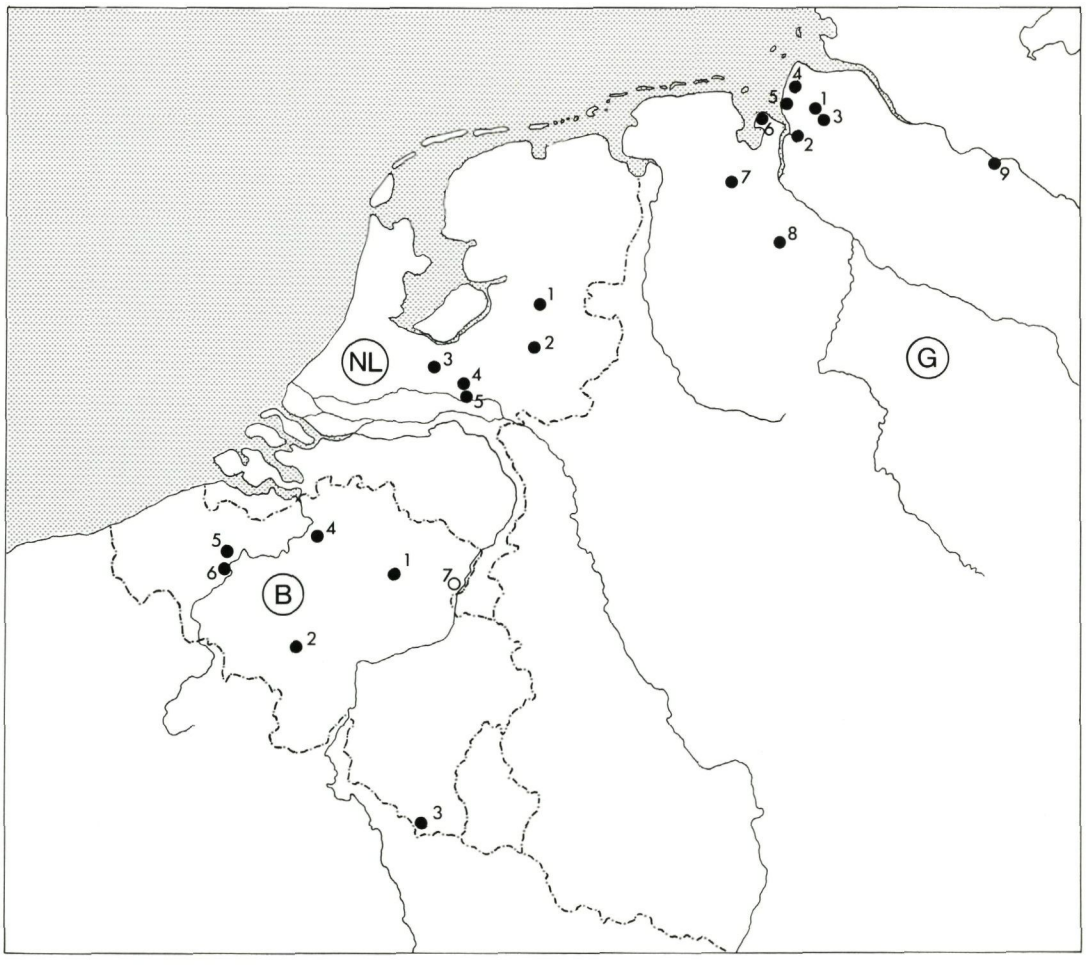


1 *Location of the sites from which 'Germanic' pottery has been analysed:*
Belgium:
1. Donk;
2. Liberchies;
3. Virton;
4. Kontich;
5. Asper;
6. Sint-Martens-Latem.

The Netherlands:
1. Dalfsen;
2. Colmschate;
3. Oud-Leusden;
4. Ede-Veldhuizen;
5. Bennekom.

Germany:
1. Flögeln;
2. Loxstedt;
3. Lintig;
4. Midlum-Northum;
5. Feddersen-Wierde;
6. Ruhwarden;
7. Gristede;
8. Mahlstedt;
9. Rullstorf.

pen), in the north, and the so-called *Hageland*, in the south. The latter is a transitional region between the Campine, with its sandy soils, and the loess plateaux of Middle Belgium (Hesbaye)[1].

Extensive excavations carried out in Donk since 1977 revealed a wide range of occupation periods, dating from the Mesolithic to the Late Bronze Age, the Early Iron Age, the Early La Tène period, the Roman period, and beyond into the Carolingian period.

The present paper deals exclusively with pottery from the last phase of the Roman occupation in the area, and more particularly with a set of hand-made pottery sherds recovered in connection with 4th-century AD settlement traces. Although this material recalls Iron Age wares in terms of form and technique -and for a while they were identified as such - their relatively high firing temperature and fine gravel grade temper are very distinctive and constitute surprisingly new elements. Comparison with Late Roman pottery from regions beyond the Rhine allowed us to assume a 'Germanic' origin for this material[2]. Using typological and chronological data provided by pottery found in close association with the wares described here, we placed the latter within the historical background of the arrival and settling of Salian Franks in *Toxandria*. According to Ammianus Marcellinus (XVII.8) these events go back to the mid-4th century AD[3].

The archaeological evidence for the occurrence at Donk of an intrusive 'Germanic' settlement opened new perspectives for the study of the Late Roman period. Hand-made pottery from the *castellum* at Liberchies-Brunehaut, previously considered to be prehistoric[4], now took on a new meaning (cf. *infra*). In the first half of the 1980's, excavations at Neerharen-Rekem, on the Belgian bank of the Meuse river, revealed a large 'Germanic' settlement[5]. At about the same time, excavations in the Dutch provinces of Limburg and North Brabant yielded similar discoveries[6].

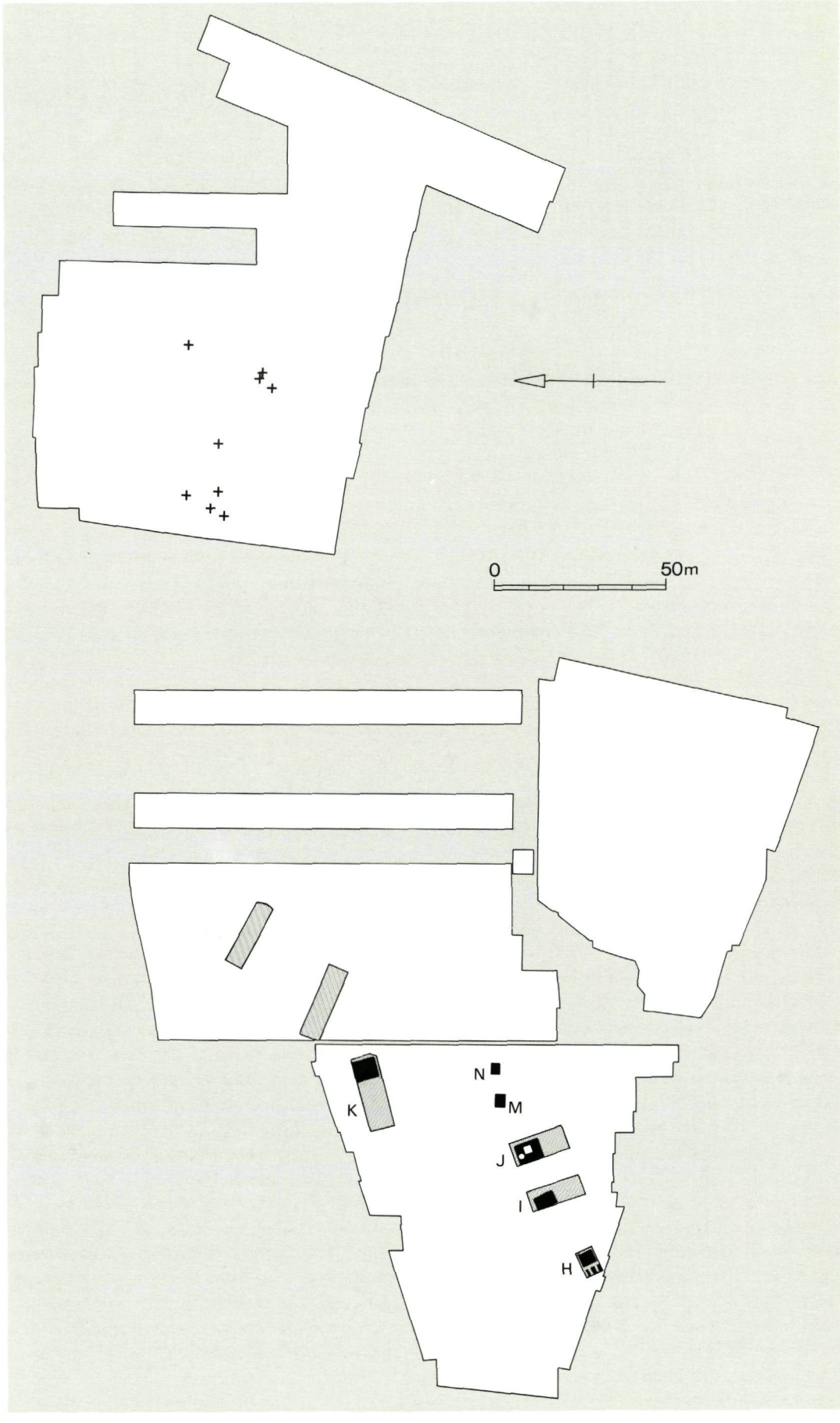
As the Late Roman pottery from Donk was subsequently used by other archaeologists as reference material, a complementary and more objective analysis of this material obviously was needed. Indeed, there was a growing danger that more and more sherds of hand-made pottery would be compared without the use of objective criteria and that possibly all hand-made Late Roman pottery might be classified as 'Germanic'.

It therefore seemed quite advisable to determine whether or not some generally recognizable criteria could be established for this 'Germanic' pottery by discovering characteristic elements in its clay composition. Along with the endeavour at defining more clearly the term 'Germanic' in terms of geographical origin, we also tried to date the Donk finds more accurately. But, due to the absence of coins and other objects, such as brooches, which are often very abundant on other sites, we were forced to rely on the earlier less precise dating based on comparison with the associated pottery. Although C-14 dating and dendrochronological analysis in connection with our 'Germanic' pottery have not always been successful, we still have some findings which made us reconsider our first interpretation about the Salian Franks in 358. Relying on the established conventional dating methods for several types of pottery and on the new C-14 dating, we believe these finds must be related to an earlier and more widespread immigration, i.e. to a phenomenon which occurred over a longer period of time and in which the already mentioned immigration of 358 represents only one phase.

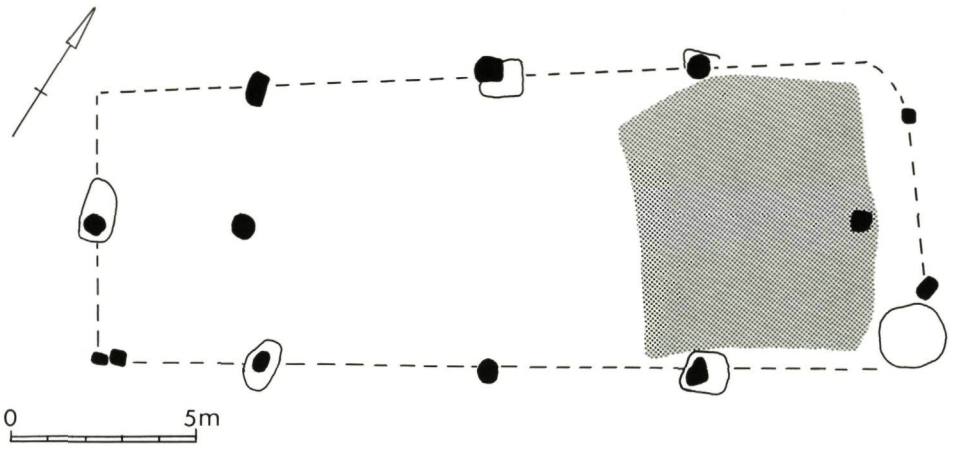
Microscopic analysis of the available pottery seemed worthwhile only when and if two conditions prevailed: (1) the use of test samples from other Belgian settlement sites in order to establish a sufficiently wide range of variation within the material studied; and (2) a comparison with a series of comparable excavated sites to the north, northeast and east of our country which might reveal (a) possible area(s) of geographic origin of the pottery.

A major problem was of course that only part of the discovered potsherds could be sacrificed for destructive scientific techniques. The choice of potsherds used was therefore arbitrarily based on their size and on a visual recognition as 'Germanic' pottery. The results of our research therefore have an indicative rather than an absolute value. We also acknowledge that the material from the Netherlands and from Germany was not selected by us but by our foreign colleagues. Their choice was not predetermined by us; and, although it was probably less arbitrary than our's, it was just as limited. We trust that their more extensive experience with native and hand-made pottery from the Roman period guarantees the objectivity of their selection.

1 Christians & Daels 1988.
2 Van Impe 1983.
3 De Boone 1954.
4 Mertens & Brulet 1974.
5 De Boe 1985 & 1986.
6 e.g. Willems 1986. Bazelmans 1990.



2 *Donk (B): survey of archaeological features, houses and burials, associated with 'Germanic' pottery.*



3 *Donk (B): plan of house K, with the sunken hut (stable ?) on its NE-side.*

2 Archaeological data

2.1 BELGIUM

2.1.1 Donk (fig. 1: B-1)

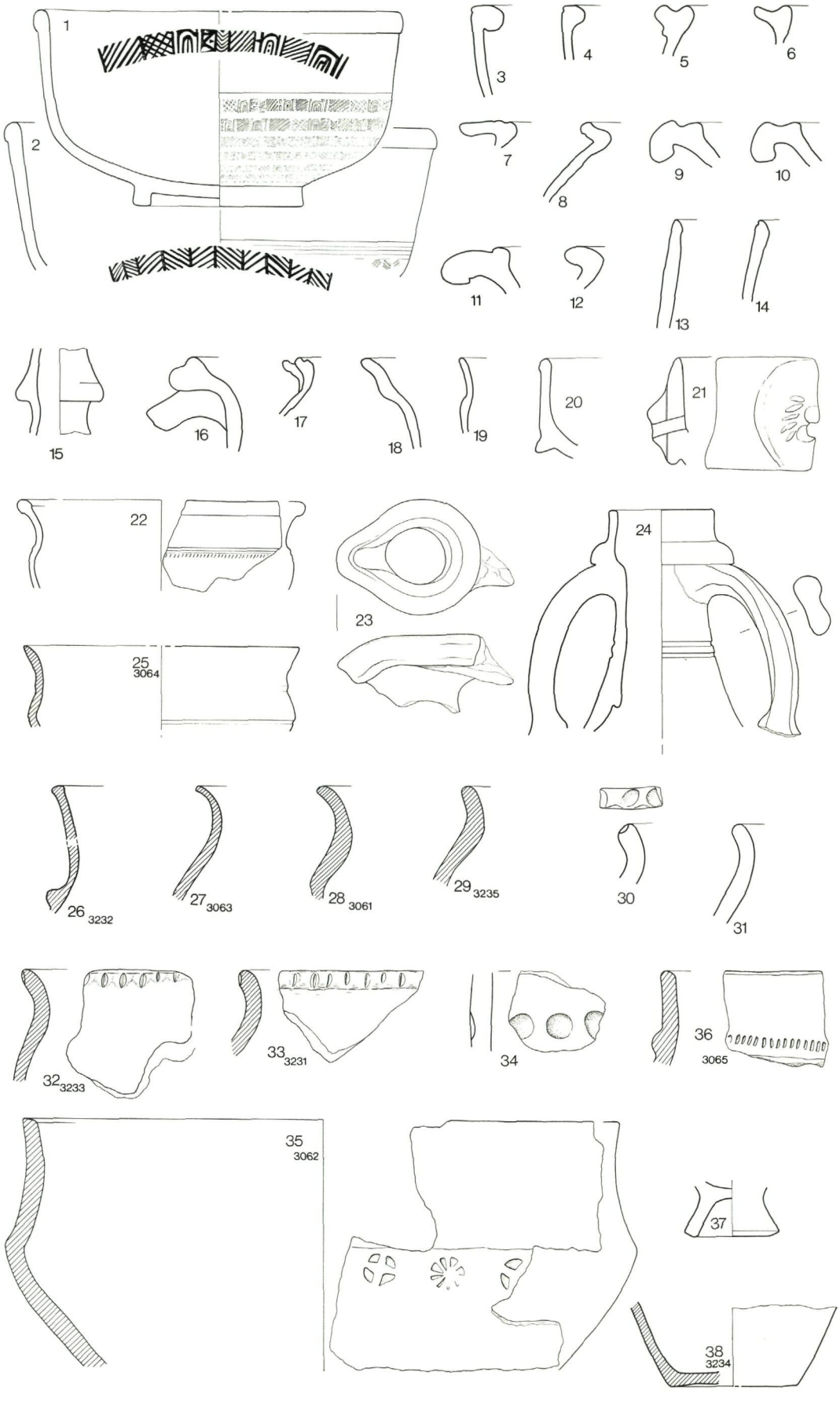
Archaeological evidence :
Among the settlement traces, a number of similarly constructed buildings can be distinguished, all of which have a large room dug into the earth (fig. 2-3). Regarding their function, these interior, sometimes 7 m by 7 m large, *Grubenhäuser* (sunken rooms) are usually accepted to have served as deep litter houses (in Dutch: *potstal*), a type of stable known in the Campine sandy region especially during the Middle Ages. For at least one of the buildings in Donk, this kind of use may clearly be assumed. For some of the other sunken rooms, however, the evidence points to a handicraft rather than to an agricultural function. The evidence does not allow us to make an ethnocultural statement regarding the interior arrangement linked to this type of house; nor does it allow us to establish the chronology of this type of house. Whether the 2nd- and 3th-century potsherds on the bottom or in the infilling of the sunken rooms or stables point to an actual residence or are to be considered as residual material from an earlier period could not be established due to the condition of the excavated objects. In any case, at least two of of the four houses of this group - or parts of them - were still occupied at the end of the 3th century or during the first half of the 4th century and underwent significant renovations.

Besides this series of houses we must also point out the presence of two small *Grubenhäuser*: one was well preserved (fig. 3: M) and had a tiled roof supported by two strong posts, one at each short gable; all that remained of the second one was the discoloration of the bottom layer and a single post (fig. 3: N).

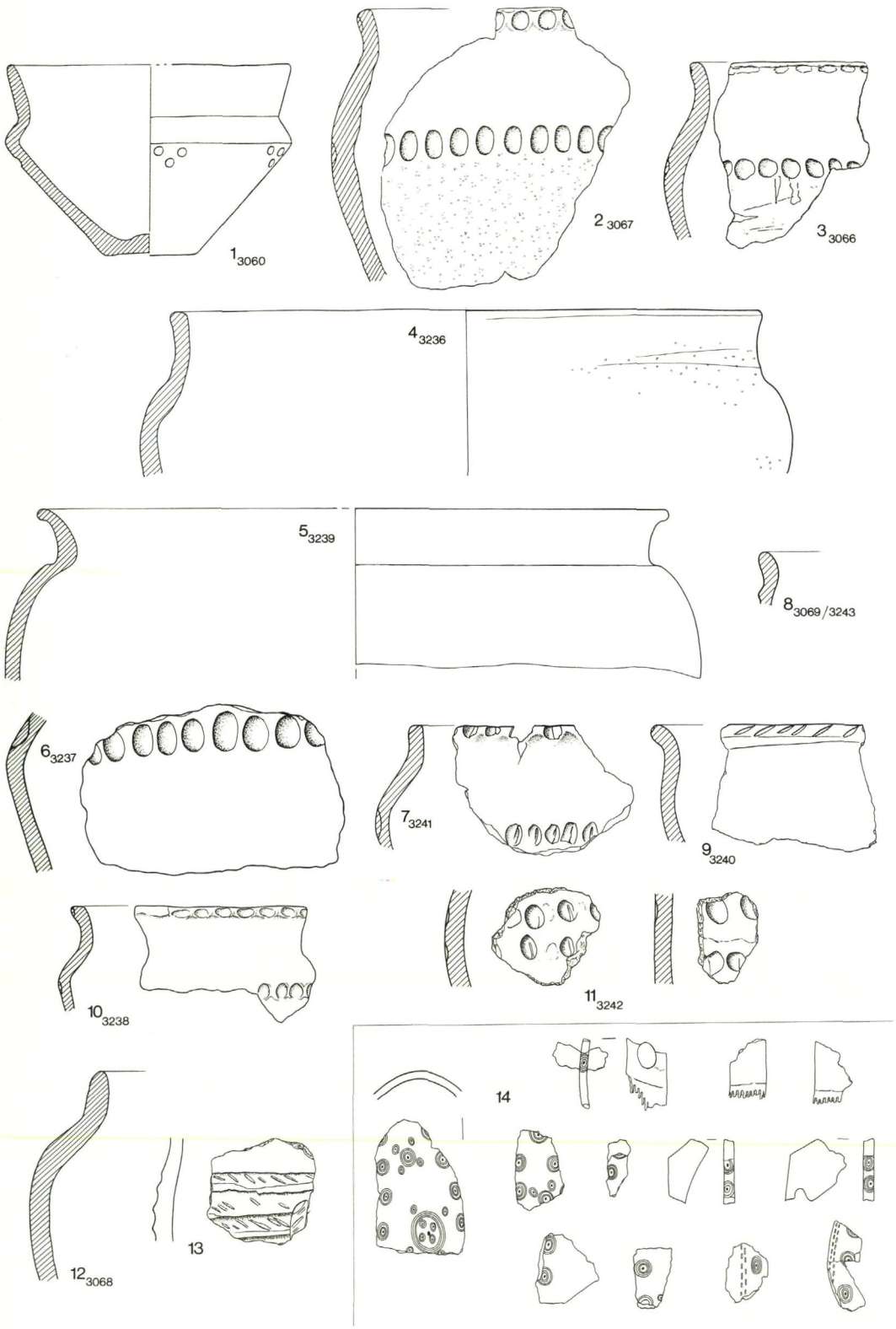
To the northeast of this group, remains of two long houses with 'Wijster' characteristics could be identified, one of them containing a few small cattle-boxes. Nine small, very simple and poor cremation graves were identified to the east of this group. Most likely these are the only remaining witnesses of an orginally larger cemetery.

Finds :
One of the above-mentioned sunken rooms or stables in particular yielded a lot of hand-made pottery along with some more usual 4th-century wares. Fragments of terra sigillata bowls (Chenet 320) with rouletted decoration (Hübener 1968: groups 1 and 3) occur frequently from the second third of the 4th century onwards (fig. 4: 1-2). Jugs with more or less developed trefoil spouts and orange-red painted amphoras[7] were also widespread during the 4th century (fig. 4: 24). Noteworthy is a fragment of a good quality white-grey cup (Chenet 342) imitating 'Germanic' pedestal cups known from the mid-4th century onwards (fig. 4: 22)[8]. A thin-walled and smoked bowl made of rather porous clay appears to be related to late biconical terra nigra forms. A series of sherds of hand-made pottery equally belong to the range of 4th-century finds; they include coarse as well as fine wares and also smoothened neck- and rim fragments, some of which bear fingernail notches on the outside of the thickened rim. Fingertip impressions occur occasionally between the somewhat smoothened neck and the slightly rougher body. A

7 Pirling 1966: Krefeld type 72.
8 Mildenberger 1972.



4 *Donk (B): Gallo-Roman (nrs. 1-24) and hand-made (nrs. 26-38) pottery of 'Germanic' origin, found in the sunken room (stable ?) within house K (scale 1:3).* A hatched section indicates that a thin section was available for analysis.



5 *Donk (B): hand-made 'Germanic' pottery from the sunken hut M (nos. 1, 6), the sunken hut N (nos. 2-3), from graves (nos. 8, 11, 13-14) and wells (nos. 5, 10, 12), and stray finds (nos. 4, 7, 9) (scale 1:3).*

rim fragment with a notched relief band and the foot of a pedestal cup are to be mentioned as well (fig. 4: 36-37). Finally, there are a few large potsherds from a large wide biconical bowl decorated with rosette and cross-shaped stamping (fig. 4: 35). Several sherds from this last group bear a striking resemblance to 4th-century and earlier hand-made pottery from the area northeast of the Rhine. Particularly conspicuous here are the similarities with ceramics

from the settlements Westick (Kr. Unna) and Erin (Castrop-Rauxel)[9]. Fragments of pedestal cups have a long tradition in 'Germanic' areas[10]. The biconical bowl on the other hand with its stamped motifs has a counterpart in a grave of the second half of the 4th century in Altendorf[11]. Several fragments of outward curved rims with concave necks are found in 3th-century and later contexts. Cooking-pots with fingernail notches and decorated with fingertip impressions also go back to forms which can be traced back to Iron Age traditions; they occur frequently in settlements outside the borders of the Roman Empire[12]. Finally, we should mention the rim and the foot of a pedestal cup belonging to von Uslar's group II dated from the middle of the 1st to the 3th century.

Grubenhaus M yielded a small black biconical cup with groups of three very small round impressions (in German: *Dellen*) on the shoulder (fig. 5: 1). Although a relationship with prehistoric Marne pottery is possible, it seems rather to be a less well-known form which may perhaps be linked to a major group of funnel cups from west 'Germanic' and more northern pottery production centers[13]. A C-14 date of the ash layer in this *Grubenhaus* gave a result of 1740 ± 45 BP (Irpa-509) which after a 2 sigma calibration gives a probable date between 110-440. There remains a 68% chance that the actual date is to be placed between 216 and 395[14].

Grubenhaus N yielded two fragments of globular urns with roughened wall and fingertip impressions similar to the type already mentioned (fig. 5: 2-3).

In the middle of the sunken room of building J (fig. 2) we discovered a well consisting of a rather sloppy construction with pile-driven birch trunks[15]. Hand-made pottery was found in the funnel-shaped construction pit of the well as well as in the secondary infilling within the funnel-shaped pit itself. A C-14 date of the wood gave a reading of 1840 ± 60 BP (Irpa-698) which after a 2 sigma calibration leaves a 95% probability for the period between 51 and 265[16]. The construction pit linked to a secondary tree-trunk well also contained a small hand-made potsherd and some 4th-century pottery. Two C-14 dates are available here, giving an average value of 1770 ± 35 BP (Irpa-696/7) which after a 2 sigma calibration leaves a 95% probability for the period between 134 and 348[17].

Among the ash and cremation remains of the small group of graves, a few hand-made pottery sherds were found. Among them, there is a potsherd with a so-called *Ahrenmuster*, a small burnt rim and wall and bottom fragments with fingernail imprints; and a single grave, yielded burnt fragments of a 4th-century triangular bone comb (fig. 5: 8-14)[18].

A few stray finds (fig. 5: 4, 7, 9) complete the series .

Finally, we should mention the post-383 AD dendrochronological date of a well - without any artifacts - which provides a clear indication that the area was occupied up to the end of the 4th century[19].

2.1.2 Liberchies-Brunehaut (fig. 1: B-2).
Bibl.: Mertens & Brulet 1974; Dewert et al. 1987; Severs & Dewert 1988.

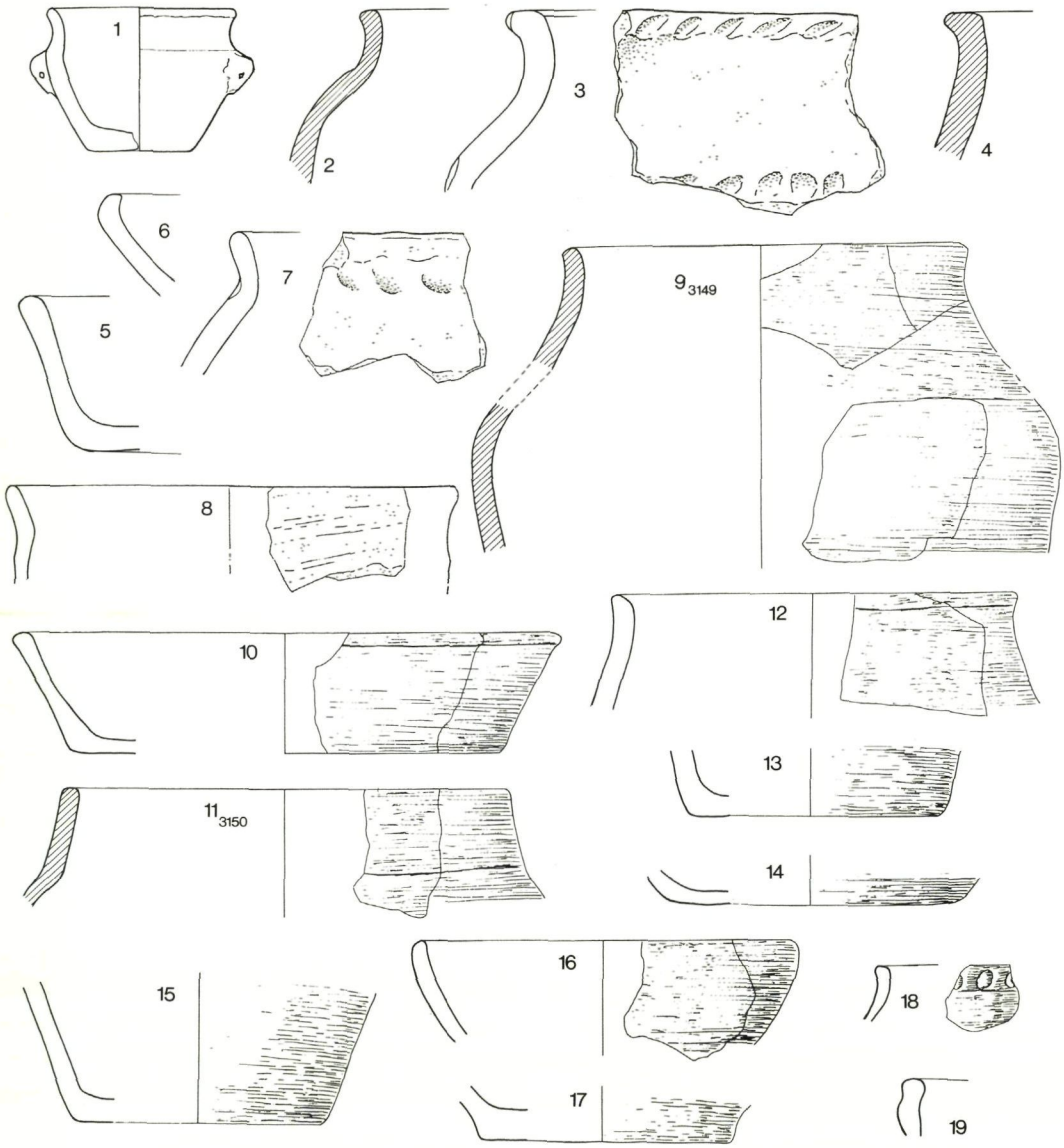
Hand-made pottery discovered in earlier excavations of a 4th-century *castellum* was not thought to be relevant and was not mentioned in the literature[20]. The finds from Donk led R. Brulet to reconsider this collection of artifacts: this group includes not only a small two-ear vessel[21], but also fragments of plates and urns with outward curving rims (with notches and fingernail imprints: fig. 6). New excavations along the southern edge of the oval fortification moat around the *castellum* yielded a new collection of hand-made pottery[22]. Although the authors still have some questions about the exact stratigraphic location of this pottery in the infilling of the moat, it seems that it is to be related to the most recent occupation of the area, i.e. sometimes during the 4th century. The coin finds suggest renewed activities in the last decade of the century, after a dense occupation in the second quarter of the 4th century. The 'Germanic' element is particularly well illustrated by the presence of a few *Armbrust* type brooches.

As far as technical matters such as the fabric composition and firing processes are concerned, the hand-made pottery from Liberchies cannot be distinghuished from that found at Donk. Particularly noteworthy is the slight number of potsherds with fingernail imprint decorations.

2.1.3 Virton-Château Renaud (fig. 1: B-3).
Bibl.: Cahen-Delhaye 1987 (with further bibl.).

A hilltop fortification located along a by-road off the Roman road from Reims to Trier was primarily occupied from the second quarter of

9 Schoppa 1970a &1970b.
10 von Uslar 1938: group II.
11 Pescheck 1978: Taf. 11: 6.
12 von Uslar 1938, 17-18, 68-72; Taf. 7: 6.
13 van Es 1967, 187-188, 293 (type IB1).
14 Dauchot-Dehon *et al.* 1984. Van Strydonck 1987 and personal comm.
15 Cf. van Es *et al.* 1985: Bennekom W 6-10-16.
16 Dauchot-Dehon & Van Strydonck 1987. Van Strydonck 1987 and personal comm.
17 Dauchot-Dehon & Van Strydonck 1987. Van Strydonck 1987 and personal comm.
18 Cf. Thomas 1960: probably type II with motif combination B or C, Gilles 1981: vgl. motif Taf. 69: 4.
19 Analysis: P. Hoffsummer, University of Liège.
20 Mertens & Brulet 1974.
21 Mertens & Brulet 1974, fig. 34: 20.
22 Dewert *et al.* 1987, Severs & Dewert 1988.

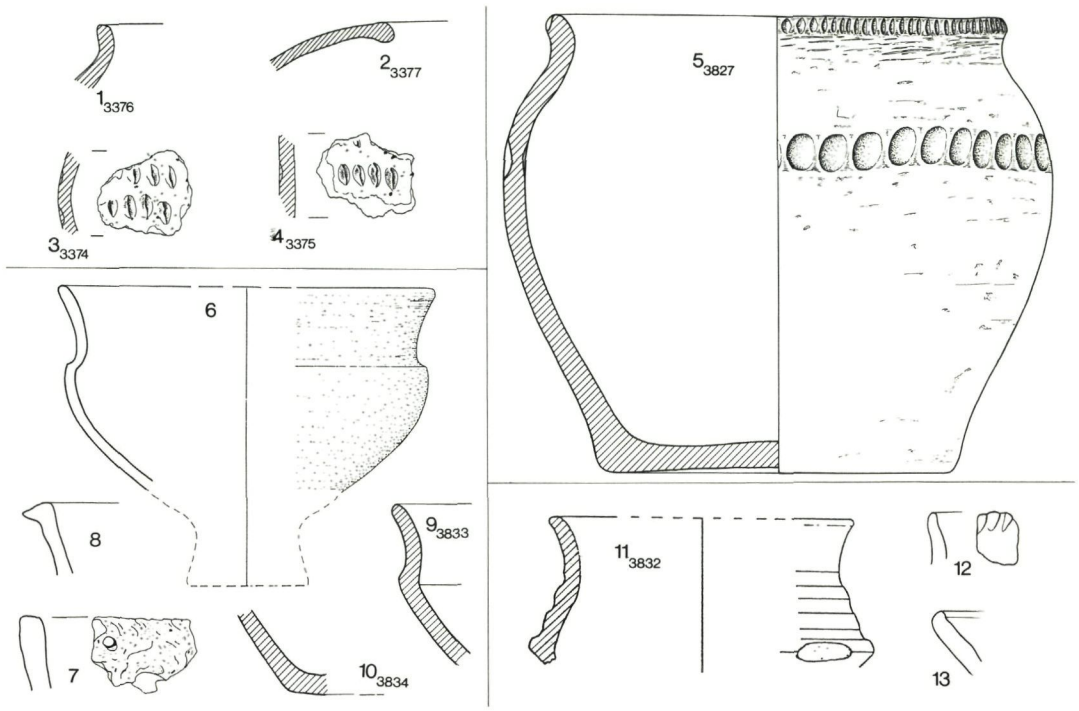


6 *Hand-made 'Germanic' pottery from Liberchies (excavations Mertens & Brulet: nos. 1-8; excavations Dewert: nos. 9-19) (scale 1:3).*

the 4th century up to the very beginning of the 5th century. Only four potsherds of hand-made pottery are known, all of them stray finds: two wall fragments decorated with rows of fine fingernail imprints, a fragment of an outward curving rim and a fragment of a concave rim. All these sherds show rough gravel as tempering material (fig. 7: 1-4).

2.1.4 Kontich (fig. 1: B-4).
Bibl.: Lauwers 1966; Biemans 1975; Cuyt 1988 (with further bibl.); Verbeeck *et al.* 1986; Verbeeck & Lauwers 1987.

A large Roman settlement (possibly a *vicus*), but up till now no evidence for an occupation in the Late Roman period. A globular cooking-pot is said to have been found on the bottom of a well. The pot is hand-made, light gray to black smoked and its wall seems to be better finished than the neck (fig. 7: 5). The clay is black and tempered with fine gravel. The outer surface of the rim is decorated with small vertical notches. Neck and body are separated by a row of wide fingertip impressions. According to the excavators, the find is to be dated through its association with 1st and 3th century pottery, particularly terra sigillata. Typolo-



7 Hand-made 'Germanic' pottery from Virton (nos. 1-4), Kontich (no. 5), Asper (nos. 6-10) and Sint-Martens-Latem (nos. 11-13) (scale 1:3).

gically, it belongs to von Uslar's form III[23], and therefore is to be dated in the 2nd to 3th century. The Westphalian examples - among them those from Castrop-Rauxel-Erin - which belong to a younger phase of form III, equally provide numerous comparable objects[24].

2.1.5 Asper (fig. 1: B-5).
Bibl.: Vermeulen 1986.

A Roman settlement and burial site on the left bank of the Schelde, inhabited from the 1st to the first half of the 3th century. Renewed occupation during the second half of the 4th century: a small square construction and some pits with roulette-stamped terra sigillata and hand-made pottery (among them terra nigra pedestal cups) (fig. 7: 6-10).

2.1.6 Sint-Martens-Latem (fig. 1: B-6).
Bibl.: Vermeulen, 1989.

In the neighbourhood of a Roman settlement: 2 successive sunken huts (*Grubenhäuser*) on the same spot. Late Roman terra sigillata, terra nigra, several Alzey-types and hand-made coarse ware found in both the sunken huts and as stray finds (fig. 7: 11-13).

23 von Uslar 1938, 17-19, 68-72 and Pl. 7: 6.
24 von Uslar 1970 a-b.

2.2 THE NETHERLANDS

47 potsherds were submitted for analysis by courtesy of Prof. Dr. W.A. van Es and his colleagues at the R.O.B. The pottery was found in Late Roman settlements, all located north of the Limes:

- Dalfsen-I (fig. 1: N-1).
  Bibl.: Van Beek & van Es 1964; Van Es 1973.
- Colmschate (fig. 1: N-2).
  Bibl.: Verlinde 1986a-b.
- Oud-Leusden (fig. 1: N-3).
  Bibl.: Van Tent 1985 and 1988.
- Ede-Veldhuizen (fig. 1: N-4).
  Bibl.: van Es 1969 and 1973.
- Bennekom (fig. 1: N-5)
  Bibl.: van Es *et al.* 1985.

2.3 GERMANY

80 potsherds were submitted for analysis by courtesy of our colleagues at the 'Niedersächsisches Institut für historische Küstenforschung' at Wilhelmshaven.

- Flögeln-Eekholtjen, Kr. Cuxhaven (fig. 1: G-1).
  Bibl.: Haarnagel & Schmid 1984; Schmid

& Zimmermann 1976.
Potsherds from excavations by H. Zimmermann 1983 (not published).
- Loxstedt, Kr. Cuxhaven (fig. 1: G-2). Potsherds from excavations by H. Zimmermann 1981 (not published).
- Lintig, Kr. Cuxhaven (fig. 1: G-3). Potsherds from excavations by H. Zimmermann 1971 (not published).
- Midlum-Northum, Kr. Wesermünde (fig. 1: G-4).
Bibl.: Zimmermann 1972.
- Feddersen Wierde, Kr. Wesermünde (fig. 1: G-5).
Bibl.: Schmid 1969 and 1977. Haarnagel & Schmid 1984 (with further exhaustive bibl.).
- Ruhwarden, Kr.Wesermarsch (fig. 1: G-6). Potsherds from excavations by Steinmetz 1985.
- Gristede, Kr. Ammerland (fig. 1: G-7).
Bibl.: Zoller 1963, 1969 and 1975.
- Mahlstedt, Kr. Oldenburg (fig. 1: G-8).
Bibl.: Wegner 1981.
- Rullstorf, Kr. Lüneburg (fig. 1: G-9).
Bibl.: Gebers & Luth 1984.

3 Analytical method

Nonplastic inclusions are disseminated in the paste of ancient ceramics and include a wide range of materials. There are three main categories: mineral and rock fragments, organic matter and anthropogene elements (e.g. 'grog')[25]. Examination of nonplastics is therefore employed currently for characterization and classification purposes. It is also a particularly valuable tool for provenance deduction and may provide sound clues to pottery-making techniques. Hence, it was decided to submit one hundred sixty-nine pieces of Late Roman pottery from Belgium, The Netherlands and northern Germany to a thorough study under the polarizing (=petrographic) microscope.

The application of polarizing microscopy in ceramic studies requires the manufacture of pottery slices (thin sections) of c. 30 µm thick and measuring ideally 2.5 x 2.0 cm. The most satisfactory method to prepare such slices is that widely used in geological and micromorphological research laboratories for making thin sections of unconsolidated rocks and soils[26]. However, due to weathering and friability, the great majority of sherds examined presented difficulties when preparing good-quality thin sections. To overcome this problem, the sherds were impregnated previously with a polyester resin. As many polyester resins are hydrophobic, it was of primary necessity to remove the water from the samples before thin-sectioning.

Sherds available for petrographic analysis were oven-dried at about 40°C before the impregnation mixture was added. The latter was obtained by mixing TRA (resin), interox (catalyst), NL49 (accelerator) and acetone (solvent). The impregnation apparatus was connected with a vacuum pump during the application of the medium to ensure an optimum penetration of the resin. At the very end of the impregnation procedure, all treated samples were transferred to a well-ventilated fume cupboard, where they gelled and cured to coherent material in about 5 to 6 weeks. Subsequently, small chips were cut from the resin-impregnated pottery using a diamond saw, and petrographic thin sections of standard thickness were made.

The microscopic investigation focused on the mineralogy, grain size, shape, roundness, degree of sorting, texture, parentage and relative frequency of all transparent nonplastics of the sand and gravel grade categories[27]. Furthermore attention was also paid to secondary constituents. They fill or line pores of the pottery and are built by minerals that precipitated from aqueous solutions percolating through the pottery during its burial in the soil or usage. Vegetable remains and bone fragments are present in several finds but identification of plant and animal species was beyond the scope of this work. Eventually, it appeared that neither the poor state of preservation of the plant matter[28] nor the commonplace histologic properties of the bone clasts are very promising to achieve this goal one day. In rare cases only morphologies of organic compounds could be studied to some extent. For that purpose a scanning electron microscope (SEM) equipment of the Laboratory for Electronmicroscopy (directed by Prof. dr. Ir. A. Vinckier) of the University of Gent was used.

Appendix 1 gives a description of all analysed archaeological specimens. Register numbers refer to the register of the Laboratory of Geology (presently directed by Prof. dr. W. De Breuck) of the University of Gent where thin sections made within the framework of the present project are presently stored and kept available for comparative analytical research. For the time being, a petrographic study of Late Roman hand-made wares discovered on an additional series of excavated sites in Belgium

25 The term 'grog' refers to materials heated to high temperature before use, such as fired clay and ground potsherds, tiles or bricks (Searle 1929-1930).
26 Hartshorne & Stuart, 1970. Murphy, 1986.
27 Sand particles have a diameter in the range of 0.05 - 2 mm. Gravels consist predominantly of mineral and rock particles larger than 2 mm.
28 Carbonaceous material is burned out from the clay in firing in an oxidizing atmosphere.

and Germany is in progress and will be the subject of a forthcoming paper[29].

4 Petrographic data

By far the greater part of the potsherds studied microscopically carries abundant sand-sized nonplastic inclusions. The aplastics consist most commonly of mineral and rock fragments and to a lesser extent of organic matter and grog. With the exception of wares containing relatively large quantities of bone and grog it is always difficult to say whether nonplastics occurred naturally in the raw materials or were added deliberately by the primitive potters during the preparation of the paste.

Judging from the composition, proportion and parentage of the tempering materials, it is suggested to classify the selected pottery in five major groups of paste compositions (A, B, C, D and E). The most striking petrographic features of the various groups are listed in Table 1 and rather detailed microscopic descriptions follow.

4.1 GROUP A

Pottery assigned to this first group contains many angular paste bodies which derive from siliceous plutonites and quartzo-feldspathic rocks of moderate or high metamorphic grade. Mineral grains and rock debris are generally unsorted and equally abundant. Material of sedimentary origin and organic compounds are much less common. The pottery either lacks grog or contains very little of it. Nonplastics occur in all sizes from disseminations of the silt grade category[30] up to about 7 mm across. Most particles, however, range in size from 0.1 to 1 mm.

Discrete mineral grains are randomly scattered through the paste. The mineral assemblage is composed essentially of quartz and alkali feldspars; the latter include orthoclase, microcline, orthoclase microperthite and microcline microperthite. Other common minerals are sodic plagioclase, green hornblende, brown biotite, muscovite, minerals of the epidote group (pistacite is always predominant) and iron ore. In addition, the pottery contains minor or accessory amounts of apatite, zircon, garnet, sphene, actinolite and chlorite. Tourmaline, allanite, rutile, hypersthene, clinopyroxene and glauconite were recorded in a very limited number of thin sections. The size of the minor and accessory constituents is of the order of 0.1-0.3 mm across. Except for glauconite all of the above minerals can be matched with constituents of the rock fragments embedded in the paste.

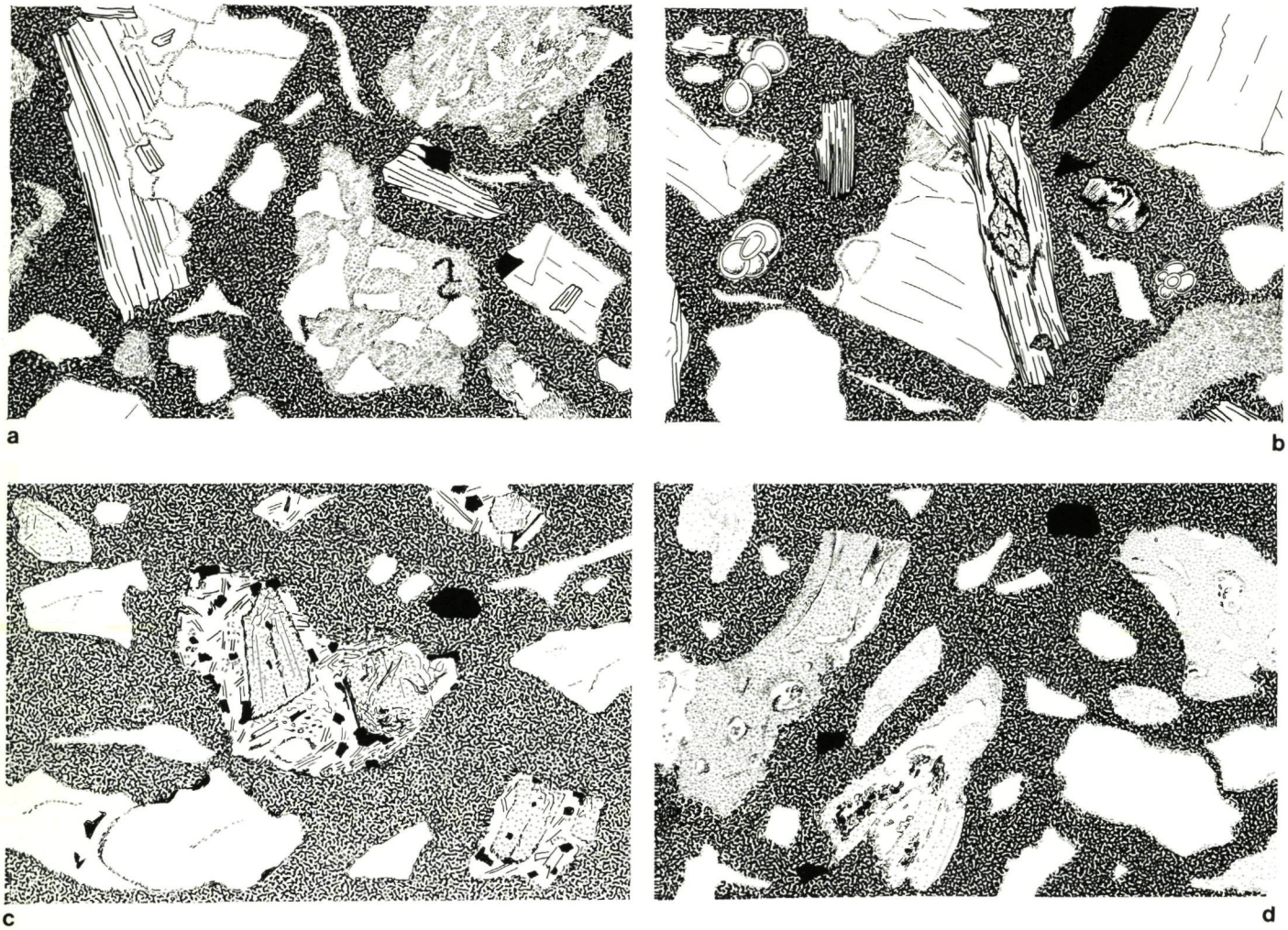
Plagioclase grains show lamellar twinning and their composition tends to be albitic ranging from perfectly fresh to thoroughly altered. Common alteration products of plagioclase include minutely crystalline muscovite (sericite), and fine-grained mixtures of zoisite, epidote and sericite (saussurite). Potash feldspars are fresher than plagioclases. Many grains of ferromagnesian minerals are strongly oxidized. This may explain why in certain finds nearly all fragments of hornblende and biotite are partially or wholly converted into red brown oxyhornblende and copper-red oxybiotite respectively. In rare cases these minerals are fringed with or completely replaced by granular magnetite. For the same reason, it appears that many glauconite pellets are altered to opaque (or nearly

Table 1
Petrographic grouping of 169 Late Roman pottery samples from Belgium, the Netherlands and Germany.

Group	Distinctive features
A	Nonplastics derive mainly from plutonic and metamorphic rocks.
B	Nonplastics derive mainly from volcanic rocks.
C	Bone is a major tempering constituent.
D	Nonplastics derive mainly from sedimentary terranes. Five types are distinguished taking into account the composition of the predominant tempering materials. Limits between different types are gradational.
E	Grog is a major tempering constituent.

29 De Paepe & Van Impe, in preparation.

30 The term silt is used here to describe rock or mineral particles in the range of 0.002-0.05 mm, while clay-sized particles are smaller than 0.002 mm.



8 *Microdrawings of Late Roman pottery samples from Belgium, the Netherlands and northern Germany.*

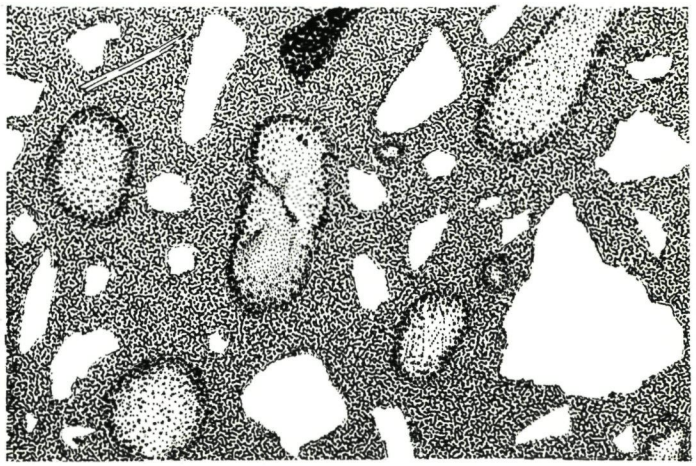
a *Pottery of Group A (AR3219, Mahlstedt, Germany).*
Poorly sorted granitic detritus consisting of cuneiform intergrowths of quartz and turbid orthoclase (middle and upper right of section), quartz, alkali feldspars and biotite in baked clay matrix. Plane polarized light. X 75.

b *Pottery of Group A (AR3202, Feddersen Wierde, Germany).*
Granitic detritus, foraminiferal tests, rutile (middle right), organic matter (black) and microcrystalline limestone (lower right) in baked clay matrix. Plane polarized light. X 75.

c *Pottery of Group B (AR3413, Ede-Veldhuizen, the Netherlands).*
Quartz grains and microporphyritic-textured lava debris with microphenocrysts of pale brown augite, laths of plagioclase and granules of iron ore (black) in baked clay matrix. Plane polarized light. X 75.

d *Pottery of Group C (AR3242, Donk, Belgium).*
Quartz grains and bone fragments (shown stippled) with coarse perforations of the Haversian canals in baked clay matrix. Plane polarized light. X 75.

e



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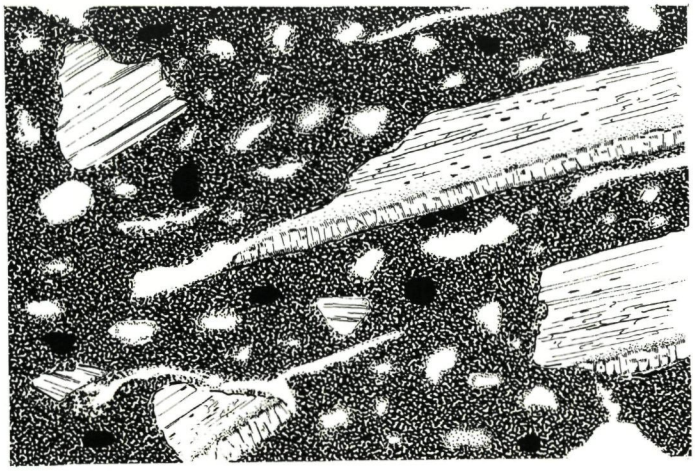

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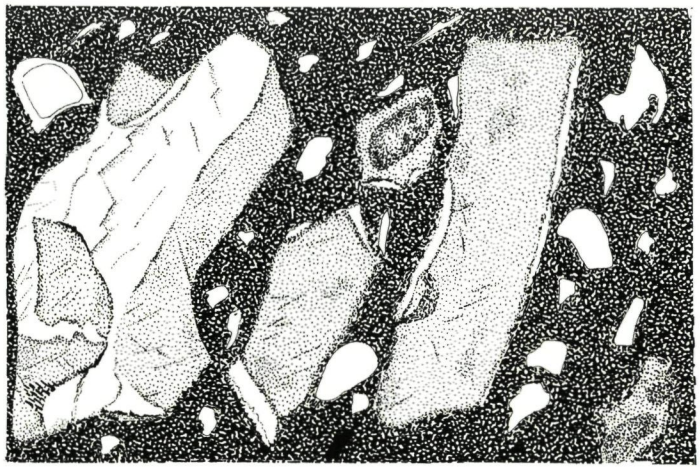


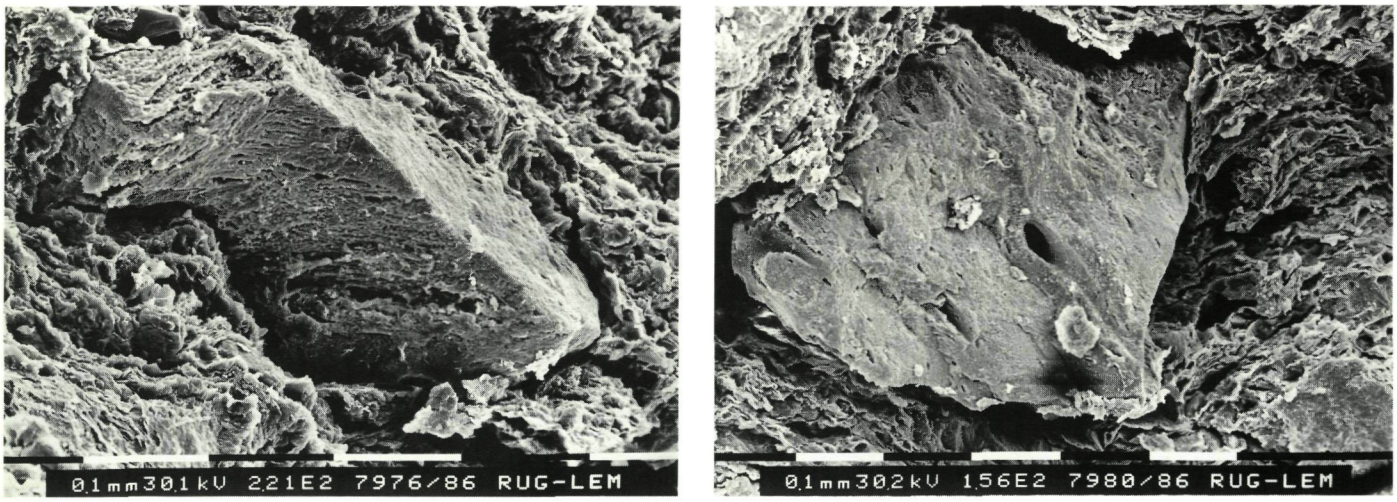
h

e *Pottery of Group C (AR3236, Donk, Belgium).*
Quartz grains and bone fragments, showing a patchy colour and distinctive organic structures, in baked clay matrix. Plane polarized light. X 75.

f *Pottery of Group D Type 2 (AR3832, Sint-Martens-Latem, Belgium).*
Angular quartz grains and glauconite in the form of microcrystalline pellets (heavy stippling) in baked clay matrix. Plane polarized light. X 75.

g *Pottery of Group D Type 3 (AR3147, Liberchies, Belgium).*
Strongly oxidized glauconite pellets and shell fragments, wholly composed of carbonates and showing two distinct layers, in baked clay matrix. Plane polarized light. X 25.

h *Pottery of Group D Type 3 (AR3148, Liberchies, Belgium).*
Fragments of crinoidal limestone and small quartz grains in baked clay matrix. Plane polarized light. X 20.



9 *Scanning electron photomicrographs of bone fragments embedded in a Late Roman potsherd from Donk (AR3242). The bars are 0.1 mm long.*

opaque) ferric oxides and hydroxides (limonite, haematite, a.o.). As the outlines of the glauconite pellets remain more or less ovoid during the course of the oxidation process the primary composition of this marine mica-type constituent can still be ascertained in fully oxidized wares.

Widespread rock fragments enclosed in sherds typical of Group A comprise the following types of plutonites: alkali granite, granite, granodiorite and their fine-grained hypabyssal equivalents. Most of these rocks appear to be highly micaceous and plates and flakes both of biotite and muscovite are noted. Green hornblende is a less common constituent. In thin section several grains of granitic rock show a micrographic texture resulting from the abundance of well-developed, cuneiform intergrowns of quartz and orthoclase (fig. 8: a). Hornblende-bearing fragments of dolerite or gabbro are distinctive for a single find from Feddersen Wierde (no. 91 of Appendix 1).

Lithic debris of metamorphic origin, deformed in varying extents and in varying ways, occur in intimate association with the granitic rock suite. They are composed of granitic gneiss, gneiss, amphibolite, quartzite and high-grade metamorphic rocks, the latter consisting principally of plagioclase, hypersthene, diopside and garnet. A sherd recovered from Lintig (no. 122 of Appendix 1) is very rich in garnet-bearing high-grade metamorphic rock fragments. It is probable or at least possible that they originate from granulitic outcrops.

Sedimentary inclusions, unlike those of igneous and metamorphic origin are of occasional occurrence. They are represented by chert, quartzose sandstone, feldspathic sandstone, ferruginous sandstone and microcrystalline limestone. Chert fragments may be extremely large-sized (no. 122 of Appendix 1) and enclose quite frequently radiolarian tests, elongate sponge spicules and haematite dust. Sandstone fragments are cemented by authigenic quartz outgrowths which are easily distinguished from detrital quartz grains by opaque lines of impurities. On present evidence, limestone is incorporated in one potsherd only (no. 97 of Appendix 1).

Charred plant remains displaying a great variety of morphological forms are recognizable in many tens of sherds. Other materials of organic origin include pieces of (molluscan?) shells, multichambered either thick- or thin-walled tests of Foraminifera, crushed bone, sponge spicules and phytoliths. These ingredients are really rare but may be abundant in some finds (fig. 8: b). Bone is a major constituent of a specimen from Dalfsen (no. 88 of Appendix 1) and in thin section it shows coarse perforations of the Haversian canals. In plane polarized light, the colour of the bone clasts is often patchy and ranges from colourless, pale yellow or pale brown to very dark reddish brown. Sponge spicules and phytoliths are variously shaped but invariably very small. These opaline organic substances may contain finely dispersed carbonaceous matter.

In a very limited number of pottery fragments, we suspect the presence of grog. Vitrification of the paste is restricted to two burned rims discovered in cremation graves at Donk (nos 12 and 25 of Appendix 1). In both finds, the abundant grains of quartz and feldspars are either strongly cracked and resorbed, or show an incipient stage of melting. The glass phase

is mostly concentrated in the matrix. In general it is highly vesiculated and colourless or yellowish brown in transmitted light.

The only sample of Group A which suffered considerable mineralogical change during its burial in the soil comes from Kontich (no. 26 of Appendix 1). Indeed, many pores of this find are filled in with blue lath-shaped crystals and microcrystalline masses of vivianite, an iron phosphate mineral. Occasionally, vivianite crystals are arranged in a crude radial pattern. Vivianite formation is characteristic for a wet peaty soil environment[31].

4.2 GROUP B

The paste composition of Group B is typified by abundant angular nonplastic inclusions (discrete mineral grains and rock fragments) of volcanic origin. The latter are closely associated with quartz grains showing undulose extinction and all gradations of roundness. Both the mineral and rock fragments are very ill-sorted. Particles of the coarse and very coarse sand grades dominate, though some may be up to about 4.5 mm across.

Quartz is associated with numerous grains of pale brown to purplish brown diopsidic or titaniferous augite, opaque iron ore, and subordinate quantities of orthoclase, muscovite, albite-twinned plagioclase, tourmaline, green hornblende, zircon and zeolites with a pronounced fibrous habit. All these ingredients are rather small (usually less than 0.1 mm across), the only exceptions being grains of quartz and augite.

The lithic material is made up predominantly of basic volcanic detritus. Rocks of non-volcanic parentage consist of chert, sandstone and tourmalinite. Grains of volcanic rock are microporphyritic with an intergranular or intersertal matrix (fig. 8: c). They carry pale brown titaniferous augite, albite-twinned zoned plagioclase laths, opaque iron ores, brown hornblende and a little leucite. Pseudomorphs after hornblende are built of granular mixtures of augite and magnetite. The core of several augite microphenocrysts is pale green in plane polarized light and shows a faint to moderate pleochroism. A lava fragment incorporated in a specimen from Ede-Veldhuizen (no. 73 of Appendix 1) contains a corroded quartz xenocryst. It is surrounded by a jacket of needle-shaped pyroxene crystals set in a brown glassy matrix.

Pottery assigned to Group B is rather poor in organic remains. They look very different morphologically but correspond invariably with carbonized plant material.

4.3 GROUP C

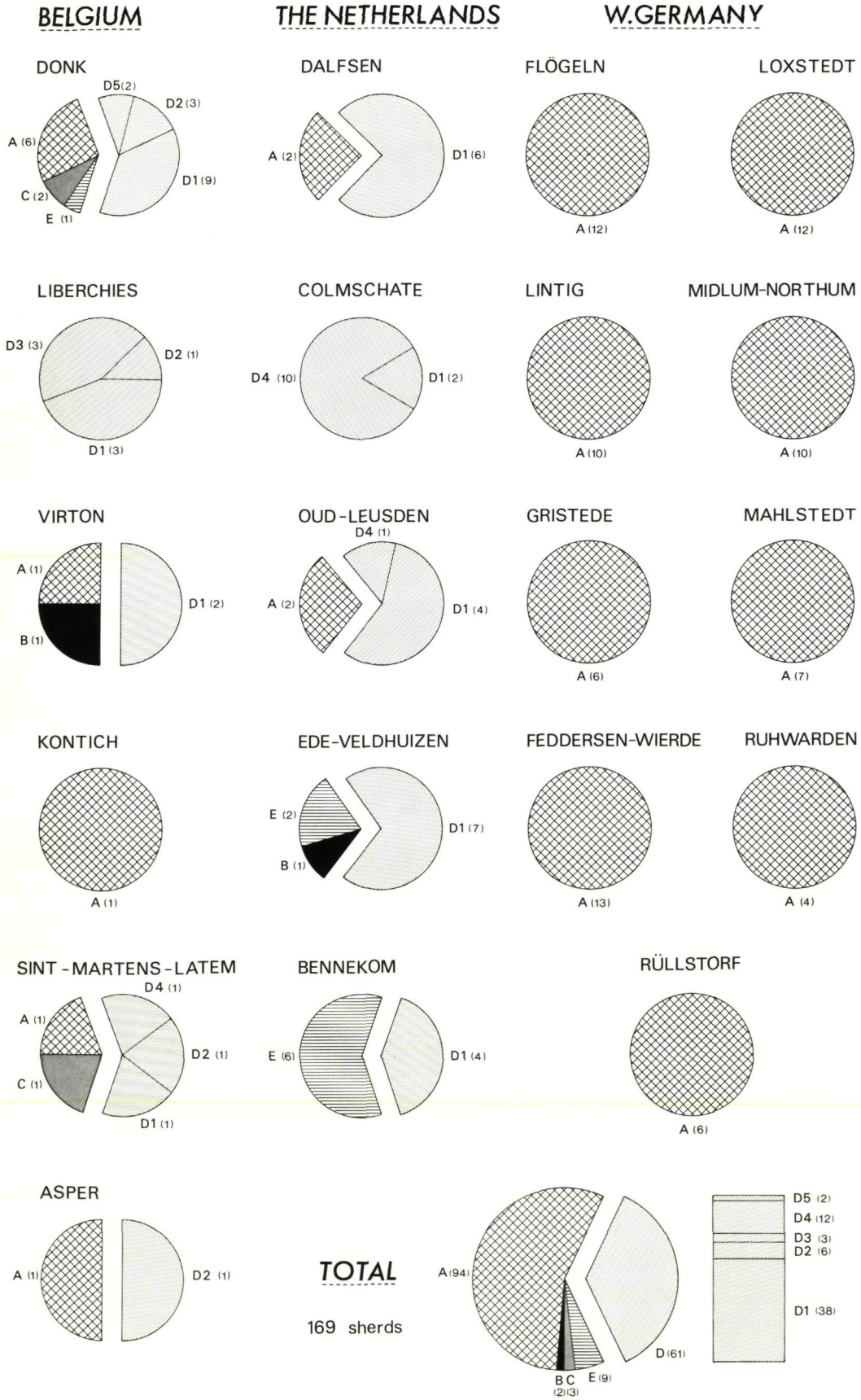
As shown in Table 1, bone fragments are considered to be the most distinctive feature of this paste composition (fig. 8: d and e; fig. 9: a and b). They form very irregular clasts of all sizes up to about 1.7 mm and consist almost exclusively of collophane, an amorphous to cryptocrystalline hydrous calcium carbonate-phosphate. Microscopic investigation learns that the colour of collophane differs widely, not only from one fragment to another but also from spot to spot within a single bone fragment. It is usually some tint or shade of yellow or brown. Less frequent is colourless, dark brown or deep reddish brown collophane. Histologic structures, including Haversian canals, *lacunae* and *canaliculi*, can be identified easily in most sections.

Collophane is generally isotropic though a very weak birefringence due to strain is not uncommon. A pseudospherulitic structure pointing to a concentrical arrangement of lamellae around Haversian canals and large cavities or parallel to the surface is a rather unusual feature. In a small number of clasts the walls of the canals are outlined by iron oxides. In others, iron oxides (being coloured in different shades of dark red and brown) constitute minute spherical or ovoid bodies which invade the collophane matrix and change its colour drastically.

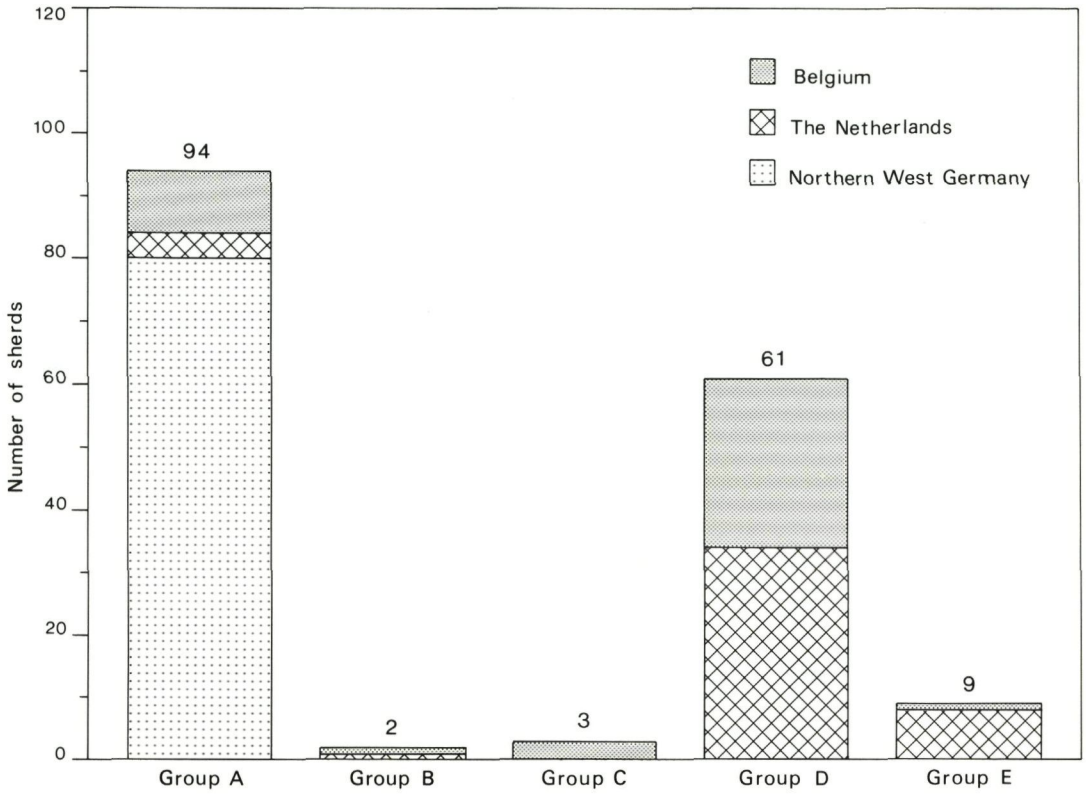
Quartz is another main aplastic constituent. Quartz grains are generally very poorly sorted and either angular, subangular, subrounded or rounded. In addition, discrete mineral grains comprise glauconite, opaque iron ore, plagioclase, microcline, muscovite, tourmaline and zircon. Except for glauconite, all these minerals are accessory constituents. Some sherds of Group C have a really high glauconite content. In other samples of the group, this mineral is hardly recognizable under the polarizing microscope or even not present at all. The brown or reddish brown colour of the glauconite pellets suggests a highly oxidized state and the average size of this tempering element ranges from 0.1 to 0.2 mm.

Lithic grains are scanty. They are composed of chert, sandstone and micrographic-textured granitic detritus. The majority of the sandstone fragments has a very fine-grained micaceous matrix. Minor amounts of carbonized plant mat-

31 Vochten *et al.*, 1979. Stoops & Eswaran, 1985. Visser *et al.*, 1986.



10 *Pie charts showing in terms of percentage the presence of each paste group pro site.*



11 *Bar chart illustrating the regional distribution and frequency of the main paste compositions recognized petrologically in 169 Late Roman sherds from Belgium, the Netherlands and northern Germany.*

erial have been detected in almost all samples attributed to Group C.

4.4 GROUP D

The chief tempering constituents of this paste composition are thought to originate in a sedimentary environment. Among the discrete mineral fragments, monocrystalline quartz grains dominate over other grain types. In some pastes the latter are even practically absent. Rock fragments have a limited distribution and can be classified in two large groups: sandstones and limestones, the former being by far the commoner. Variations in quantity and composition of the different kinds of nonplastic inclusions make it possible to discriminate adequately five paste types (D1, D2, D3, D4 and D5, respectively).

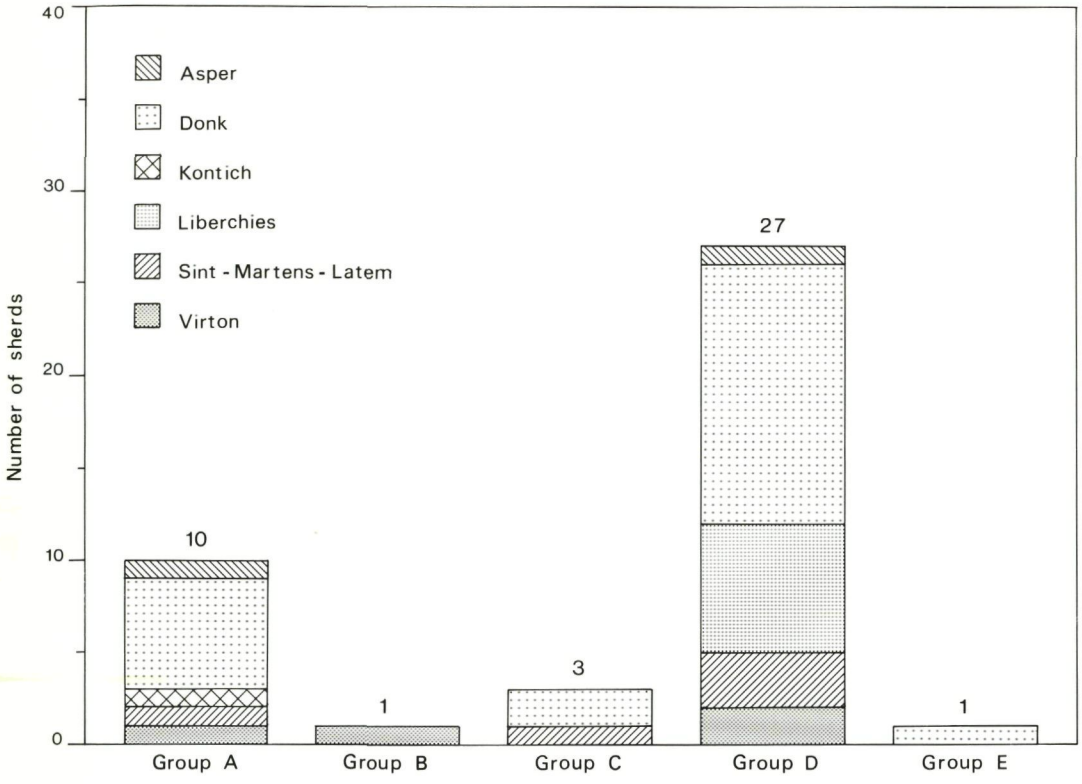
4.4.1 Type D1

Aplastics typical of the Type D1 paste consist primarily of loose mineral fragments. Monocrystalline quartz is the dominant grain type. In several of the thin sections studied, this detrital component is associated with relatively coarse grains of alkali feldspars (orthoclase, microcline) and polycrystalline quartz. The paste furthermore contains accessory amounts of one or several of the following minerals: plagioclase, muscovite, biotite, tourmaline, glauconite, epidote, opaque iron ore and garnet. The lithic grain assemblage includes principally coarse-grained sandstone and less frequently chert and alkali granite. The shape of the mineral grains and rock fragments is highly variable. Their average grain size exceeds rarely 0.1 mm.

Organic substances comprise both vegetable matter and bone. Plant remains are quite common, whereas bone clasts occur in a single specimen from Donk (no. 20 of Appendix 1). The colour of the bone fragments goes from yellow and pale brown to reddish brown in plane polarized light.

4.4.2 Type D2

Besides quartz grains, ceramics assigned to Type D2 paste also contain glauconite as a major nonplastic constituent. Glauconite builds structureless ovoid pellets which are systematically less abundant than the quartz grains (fig. 8: f). The poorly sorted quartz grains are up to 1.5 mm across whilst the strongly oxidized, finely crystalline glauconite aggregates range in size from 0.1 to 0.4 mm. Minor aplastic inclusions include orthoclase, microcline, plagioclase, muscovite, biotite, opaque iron



12 *Bar chart showing the distribution and frequency of the main paste compositions in finds from Belgium.*

ore, minerals of the epidote group (especially pistacite), tourmaline, zircon, lithic debris and organic matter.

The quantity of rock fragments varies considerably from one sherd to another. Lithic grains are up to 3.2 mm across and correspond with chert, sandstone and holocrystalline lava of basic composition. The groundmass of the sandstone particles is either quartzitic, micaceous or ferruginous. Inclusions of volcanic origin are diagnostic of a single potsherd from Donk (no. 16 of Appendix 1).

In some of the thin sections examined the organic substances are in excess over quartz and glauconite. In others the organic matter is absent or present in small amounts only.

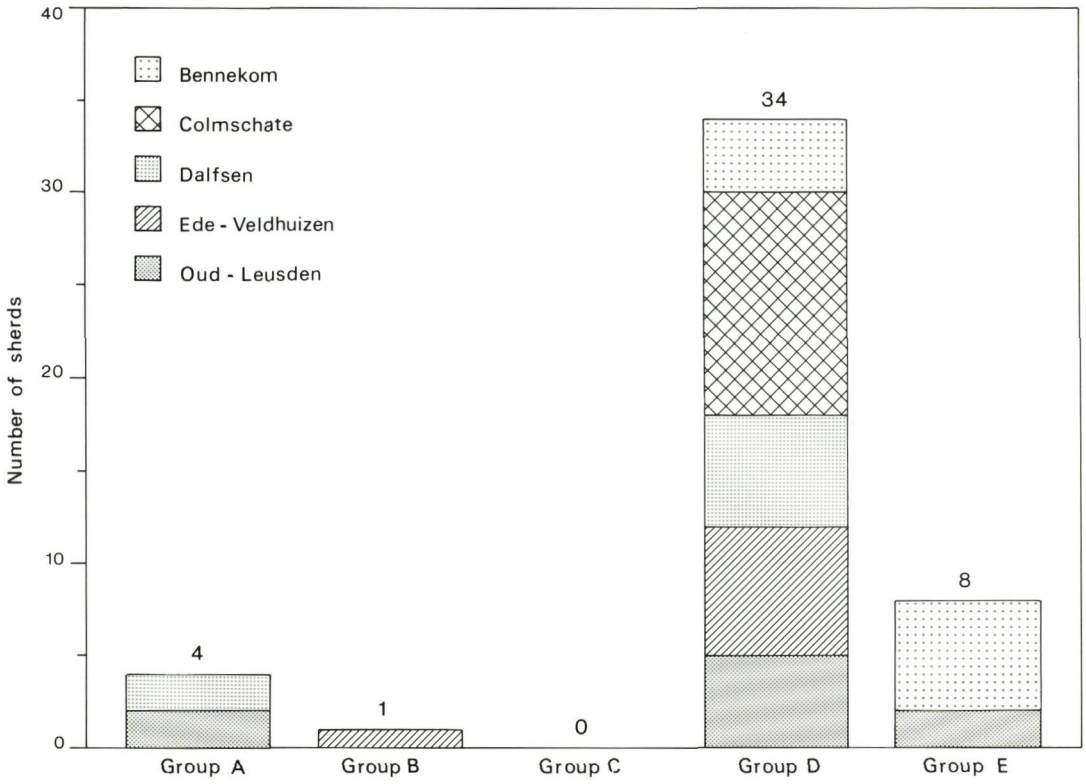
4.4.3 Type D3

In thin section, the Type D3 paste is characterized by the occurrence of abundant debris of calcareous rocks and biogenic skeletal matter composed wholly of carbonates. Amongst the commonest non-carbonate nonplastic constituents one should mention quartz grains and glauconite pellets. Glauconite pellets have a relatively uniform size and belong almost exclusively to the very fine sand and fine sand grade categories. Muscovite, biotite, opaque ores, plagioclase and microcline are minor or accessory constituents.

Shell fragments and limestone particles of all sizes up to about 5 mm are freely scattered through the paste. Shell remains showing very weakly curved sections are very conspicuous in a sample from Liberchies (no. 28 of Appendix 1). In general, they consist of two distinct layers: a thin outer layer, with crudely columnar crystals arranged perpendicular to the shell surface, and a finely fibrous inner layer with carbonates oriented nearly parallel to the shell margin (fig 8: g). Some shells are marked by a multi-layered structure. On the basis of curvature, size and thickness, a derivation of the shells from mollusks is very likely[32], though brachiopod shells may have a similar microstructure.

The vast majority of limestone pieces recorded in the paste of two specimens coming from Liberchies (nos 27 and 29 of Appendix 1) is angular-shaped and fossiliferous (fig. 8: h). Stem segments and calyx plates of echinoderms (crinoids) predominate but a variety of other forms are recognized under the polarizing microscope. Associated with crinoidal limestone one also notes rare pieces of fine crystalline limestone. The latter apparently does not contain fossils and looks usually turbid in transmitted light.

32 De Coninck J., personal communication, 1990.



13 *Bar chart showing the distribution and frequency of the main paste compositions in finds from the Netherlands.*

4.4.4 Type D4

Typical samples with a Type D4 paste enclose first of all abundant angular quartz grains of the silt grade and very fine sand grade categories, carbonized plant material and a variable proportion of spherical or irregularly shaped iron-rich bodies. The latter are either sharp-bounded or diffuse, and red, rusty brown, dark brown or nearly opaque in thin section. They fall significantly within a range covered by the sand grade category. There is clear microscopic evidence that at least a part of the iron-rich nodules developed around or in root channels. The nonplastics listed above are joined by minor amounts of plagioclase, microcline, orthoclase, muscovite, epidote, green hornblende and chalcedony.

Iron-rich nodules occur specifically in gley horizons of soils characterized by an excess of soil moisture (so-called hydromorphic soils). Poor drainage is typical of soils developed on clayey parent materials though topographic factors can also prevent normal water infiltration. Irregular colorations and nodules appearing in gley horizons result from iron (and sometimes also manganese) mobilization followed by reprecipitation in pores and as coatings. It is well known that they reflect the action of alternate periods of dry and moist conditions[33].

4.4.5 Type D5

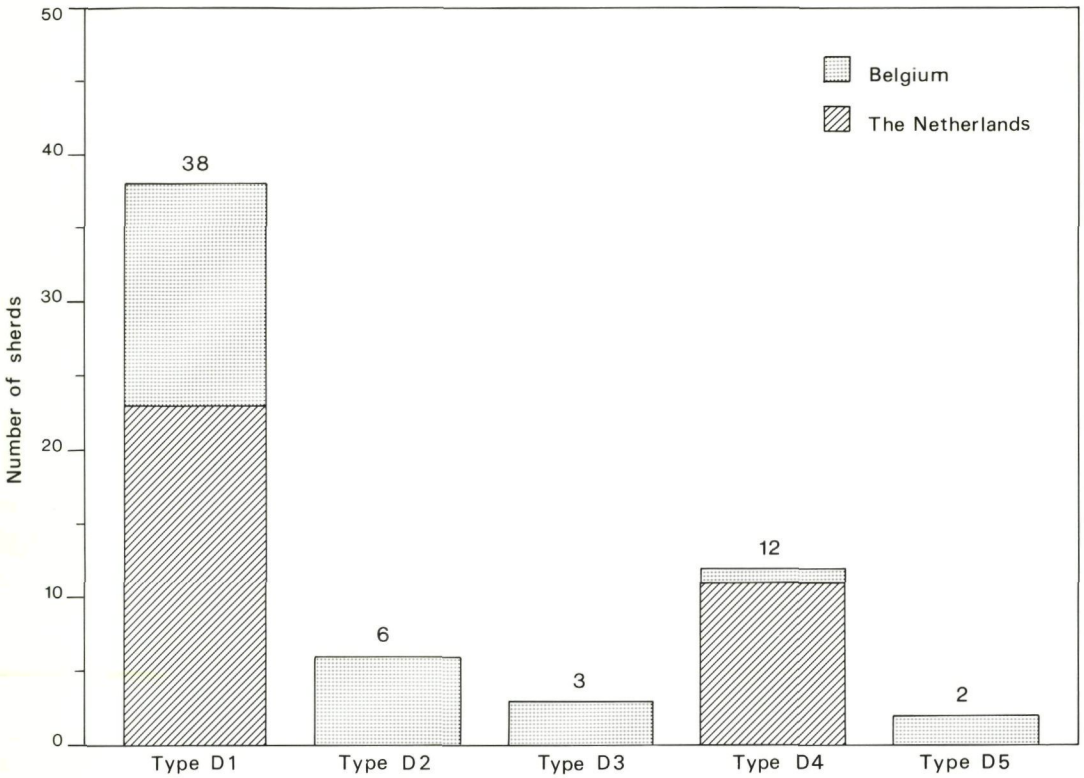
In pottery with a Type D5 paste quartz grains and particles of ferruginous sandstone are the prevalent nonplastic inclusions.

Quartz grains are poorly sorted, sand-sized, angular to subangular and usually monocrystalline. They are accompanied by the following accessory minerals: muscovite, biotite, green hornblende, iron ore, alkali feldspars, plagioclase feldspars, oxidized glauconite, zircon, garnet, rutile, kyanite, chalcedony and tourmaline.

Sandstone fragments range from 0.1 to several millimetres across. They consist of angular quartz grains of the fine or medium sand grade categories set in a bright-red limonitic or haematitic cement. Other detrital compounds noted in this type of sedimentary material comprise thin flakes of muscovite and rare fully oxidized glauconite pellets. Organic matter of vegetable origin is present in highly variable amounts. In exceptional instances some plant debris are more than 1 cm across. Bone clasts have been observed in a few sherds only.

It is not always possible to differentiate finds of the types D4 and D5, the main mineralogical constituents of the iron-rich nodules (D4) and the ironstone debris (D5) being almost identical.

33 Stoops & Eswaran, 1985.



14 *Bar chart showing the distribution and frequency of the five types of Group D pottery recognized petrologically in finds from Belgium and The Netherlands.*

4.5 GROUP E

The paste composition of Group E differs from the foregoing pastes by containing an appreciable but most variable quantity of grog. Grog is generally mixed with abundant quartz grains of the silt grade category.

Discrete quartz grains are associated with accessory quantities of muscovite, biotite, plagioclase, orthoclase, microcline, epidote, opaque minerals, vegetable matter and bone. Rock debris are virtually absent though a single sherd from Bennekom (no. 51 of Appendix 1) carries an unusual high amount of micaceous arkosic sandstone fragments. These sandstone particles may have a diameter exceeding 6 mm across.

Grog particles range up to about 5 mm across but their average size is hardly 1 to 1.5 mm. They contain exclusively undiagnostic detrital minerals, especially quartz grains and rare muscovite flakes.

A decreasing grog content progressively grades samples of Group E into material with a Type D1 paste composition.

5 Distribution and frequency of the paste compositions

We see clearly from the present analysis that Group A is by far the commonest amongst the five groups of paste compositions defined above (fig. 10-11). Indeed, all pottery pieces coming from localities in northern Germany (80 in total) match this group. In addition, pottery of Group A is also represented on sites in Belgium and the Netherlands, where it accounts for 25 % (10 sherds) and 9 % (4 sherds) respectively of the specimens selected for analysis. Basically, the composition and relative frequency of the mineral and rock fragments of plutonic and metamorphic origin scattered throughout this paste do not show significant variations from one locality, region or country to another. Hence, from the present state of knowledge identification of wares from individual sites cannot be attempted.

As shown in fig. 10-11, paste compositions of Group B and Group C are nowhere numerically important. They have been defined on the basis of at most three samples per group. Pottery carrying predominantly nonplastics of volcanic parentage (Group B) has been discovered at Virton-Château Renaud (1 sherd) and Ede-Veldhuizen (1 sherd). Group C pottery, with its highly distinctive bone temper, was provided exclusively by excavations conducted at Donk (2 sherds) and Sint-Martens-Latem (1 sherd).

Though ceramics marked by a high percentage of nonplastics of obvious sedimentary origin are lacking at sites in northern Germany,

they still account for 36 % of all wares available for the present analysis. 27 Belgian and 34 Dutch finds (figs. 10-12) - that corresponds with 64 % and 72 % of all thin-sectioned specimens from Belgium and The Netherlands respectively - have a paste composition of Group D. The relative frequency and regional distribution of the five types of Group D pottery distinguished petrologically are presented in fig. 14.

The type D1 paste, which is characterized by an overwhelming amount of quartz sand grains, was used to manufacture a little less than 62 % of all samples assigned to Group D. It occurs at almost every site in Belgium and the Netherlands, the only exceptions being Asper and Kontich. The next in order of decreasing abundance is the type D4 paste: about 83 % of the material from Colmschate is of this kind. At any other locality, however, it is either absent or at best very poorly represented. Pottery enclosing large quantities of glauconite (type D2), and fragments of limestone (type D3) or ferruginous sandstone (type D5), is known from Belgium only. Vessels with a type D3 paste are diagnostic of Liberchies, whereas examples of sherds of type D5 occur exclusively at Donk. In contrast, pottery of type D2 has a more widespread regional distribution as finds were collected at Donk, Liberchies, Asper and Sint-Martens-Latem.

Grog-tempered wares (group E) finally, comprise hardly 10 % of all analysed sherds from Belgium and the Netherlands. Their occurrence is confined to the following sites: Donk, Ede-Veldhuizen and Bennekom. A very limited number of finds of Group E has been excavated at Donk and Ede-Veldhuizen. On the other hand, this paste appears to be quite common at Bennekom, where it constitutes 60 % of the thin-sectioned material.

From the foregoing discussion may be concluded that marked differences in paste compositions exist among wares from individual countries. The most relevant features are, of course, the homogeneity of the pottery collection from northern Germany and the great diversity of tempering materials recorded in samples recovered from excavation sites in Belgium and the Netherlands.

6 Broad geological outline of the sites

Source discrimination by petrographic analysis requires a basic knowledge of the geological setting of the sites where the analysed pottery was excavated. In view of the preliminary character of the present paper and the large number of sites examined, only very general geological and lithological data will be reported here.

At all archaeological sites studied in northern Germany and the Netherlands Quaternary deposits are present in considerable thickness (fig. 15-16). They are composed chiefly of beds of clay and sand with strongly varying thickness, lateral extension, grain-size composition and origin. Some of these deposits point to sedimentation in marine, lacustrine or fluvial environment. Others result unquestionably from processes acting under aeolian, periglacial or glacial conditions.

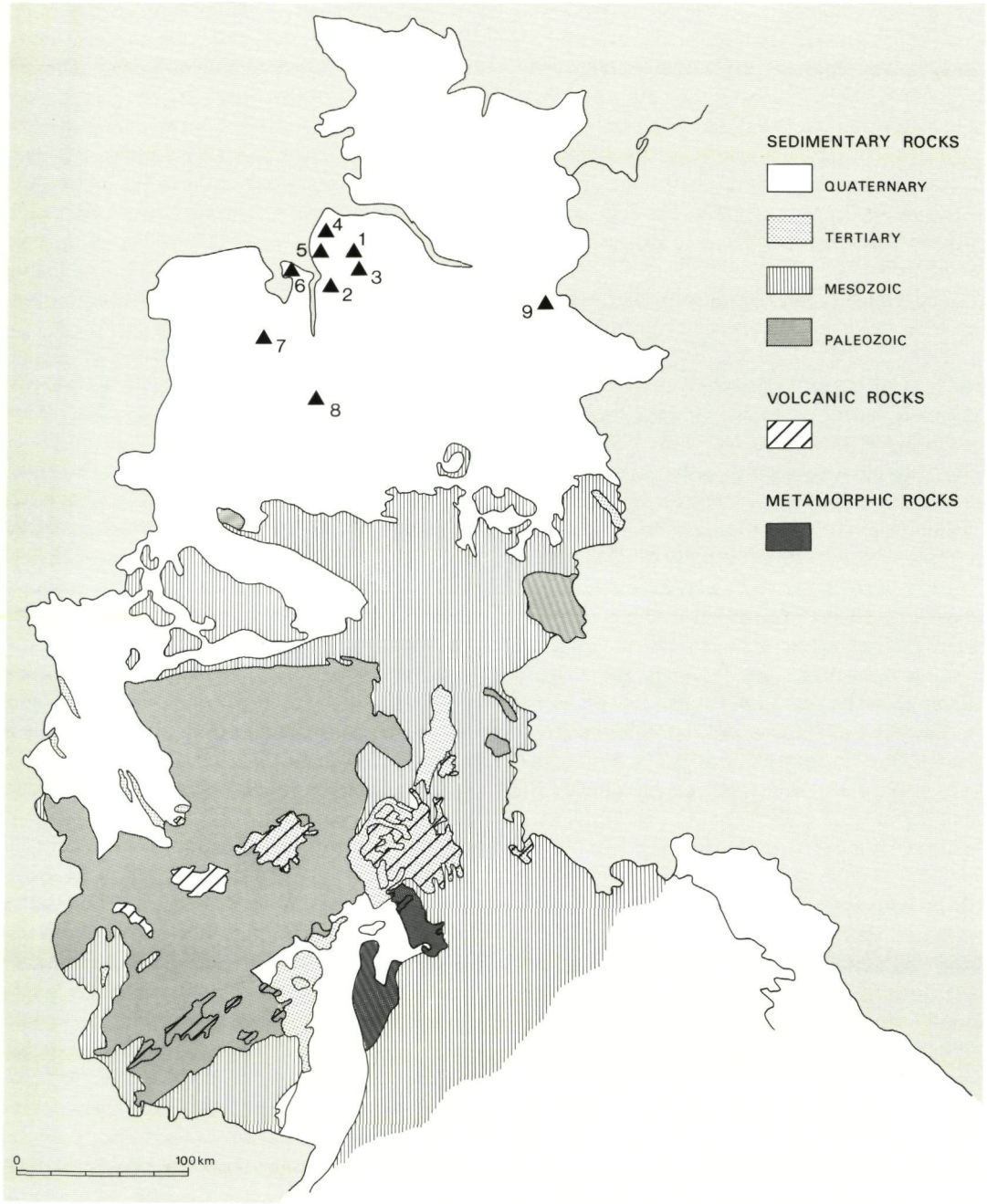
It is generally accepted that the bulk of the Quaternary glacial and periglacial sediments of Germany and the Netherlands has to be brought into relation with the Saale glaciation[34]. During this Late Pleistocene glacial stage, extensive areas of these countries were temporarily covered by part of the Fennoscandinavian ice sheet. Sediments related to the Saale glaciation are locally known as *Drente Formation* and they include both glacigenic till and glaciofluvial materials[35]. The Drente till is often designated as 'boulder clay' and it contains a high percentage of rock fragments ranging from gravels to boulder-sized erratics.

Different varieties of granite, granitic gneiss, diabase, quartzite, sandstone and chert are amongst the most common rock types incorporated in the Drente till[36]. Many are indicative for a Scandinavian provenance. The sources of the greater part of these rocks are known for many decades (Uppsala granite, Stockholm granite, Smaland granite, Revsund granite, Emarp porphyry, Dala sandstone, Kinne diabase, Schonen basalt, a.o.). They belong essentially to the Precambrian and are related either to the Svecokarelian cycle (2100-1750 Ma) or the Southwest Orogen (1750-1550 Ma)[37]. In some cases only the composition of the rock fragments is consistent with an eastern or southeastern provenance (e.g. the Eifel region).

According to petrographic data, erratics found in certain regions of the Netherlands derive almost exclusively from the Central-Baltic region, whilst in adjacent districts South-Baltic indicator boulders predominate. This proves that the Drente till was transported southward by ice sheets which followed very different flow trajects from the Scandinavian hinterland.

Pre-Quaternary rock formations are outcropping over extensive areas in Belgium.

34 Zagwijn & van Staalduinen, 1975; Geological map of Middle Europe, scale: 1/2.000.000, 1971.
35 Doppert *et al.*, 1975.
36 van der Heide & Hellinga, 1974; Korn, 1927; Hesemann, 1931; Hesemann, 1936; Hesemann, 1939; Hesemann, 1975.
37 Gaál, 1986.



15 *Outline geological map of the northern and the western part of Germany and location of the sites mentioned*

Depending on the geographic position of the site studied, the exposed rocks belong either to the subhorizontally bedded cover deposits of Tertiary and Mesozoic age or to the folded Palaeozoic basement (fig. 17). Rocks building cover and basement offer a great diversity of sedimentary rock types. Metamorphic and magmatic rocks are of very limited occurrence.

In the surroundings of Donk, Tertiary formations are widely distributed. They date from the Pliocene, Miocene and Oligocene, and are composed principally of glauconite-bearing sands, ferruginous sandstones and clays[38]. Miocene glauconitic sands and Oligocene clays are the main components of the subsoil at Kontich[39], whilst at Asper, a village located along the Scheldt river, glauconitic clays and sands of Lower Eocene age are exposed outside of the alluvial plain[40].

Sediments of very divergent ages and lithology built the subsoil of Liberchies. Along the main brooks and brooklets of the region, Middle and Lower Carboniferous rocks are exposed. They form part of the Namur Basin and consist

38 Van den Broeck, 1895.
39 Mourlon, 1894.
40 Delvaux & Mourlon, 1893.
41 Briart, 1899.

chiefly of limestones, sandstones and schists[41]. Elsewhere around the site, the coherent, tilted rocks of the Palaeozoic basement are overlain by Lower and Middle Eocene glauconitic sands and clays.

The site of Virton-Château Renaud, finally, is situated in the southernmost part of Belgium. In this part of our country rocks of Lower and Middle Jurassic age, including sands, marls, sandstones and schists, have a wide distribution[42]. Some of the sandstone varieties outcropping in this area are highly calcareous.

7 Source of the paste compositions

The petrographic characterization of the tempering materials demonstrates that boulder clay glacial deposits were used to manufacture the pottery of Group A. Finds on archaeological sites in the Netherlands and northern Germany may therefore have been made of local natural resources. In view of the spatial distribution of the raw materials employed in their production, a provenance in adjacent or more distant regions, however, cannot be excluded. Anyway, specimens with a paste composition of Group A discovered in Belgium have an exotic provenance as in this country boulder clay deposits do not occur at all. Either the Netherlands or northern Germany are likely to have provided the sources of these finds though trade connections with production centers in the Baltic area cannot be ruled out definitively on petrographic grounds only.

A recent study of medieval pottery from Schortens (Kr. Friesland, D), a locality situated west of Wilhemshaven, distinguishes two main types of vessels on the basis of their nonplastic inclusions[43]. Characteristic of the most widespread paste composition at this site is the occurrence of great quantities of mineral and rock fragments deriving from granitic, granodioritic, granito-gneissic and aplitic sources. To a smaller extent, this type of pottery also includes debris of gabbro, basalt, siliceous volcanic material, quartzite, sandstone and limestone. As this rock suite is typical for till deposits of the Drente Formation, it was concluded that in Early Medieval times boulder clay was widely used in northern Germany for making pottery. Our thin section results indicate that this tradition already existed in the Late Roman period.

The most possible provenance of the fresh and very distinctive leucite-bearing tephritic (?) lava debris freely scattered through pottery of Group B is the Quaternary Eifel volcanic field of Germany. Lava flows outpoured in this region comprise essentially basanites, tephrites, nephelinites, leucitites, melilitites and phonolites[44], and there are close mineralogical and textural parallels between the leucite tephrites of the Eifel and the lava fragments incorporated in Group B pottery. Leucite is after all a good discriminant for provenancing as it appears rarely in Tertiary and Quaternary volcanic products of Western Europe.

It should be emphasized, however, that these features do not necessarily imply that pottery of Group B was manufactured somewhere in the Eifel. Volcanic materials originating from this area occur also naturally in Quaternary fluvial deposits in The Netherlands and pyroclastic deposits correlated with Laacher See fallout tephra have been reported since the middle of this century in peat beds, soils and caves in eastern and southern Belgium[45]. Although more research is needed to solve the problem of provenance of this volcanic-tempered wares, we believe that the scarceness of the finds of Group B (2 sherds on a total of 169 pieces analysed) and the great quantity of volcanic debris occurring in this paste are forceful arguments in favour of a non-indigenous source.

The bone-tempered pottery of Group C is another example of paste composition with a very limited regional distribution. As bone is closely associated with abundant glauconite pellets, it is probable that it also represents a local production. As related above, glauconite is a main constituent of the greater part of the Tertiary clays and sands in Low and Middle Belgium. It is further worth mentioning that, on microscopic grounds only, pottery of Group C cannot be differentiated from bone-tempered Neolithic wares from the Hainaut province and eastern Belgium[46].

The parentage of the nonplastics embedded in different types of Group D pottery is obviously a sedimentary one. The value of the various tempering materials as indicators of provenance is very low since the mineral and rock suite is usually far too generalized to predict a particular source of origin. Without exception, all samples assigned to paste types D1, D2, D3, D4 and D5 may originate from production centres located within the area where the archaeological material was excavated. As far as pottery of paste type D3 is concerned, it seems likely that the source-to-site distance should be very small or practically nil.

For evident reasons, the source of the

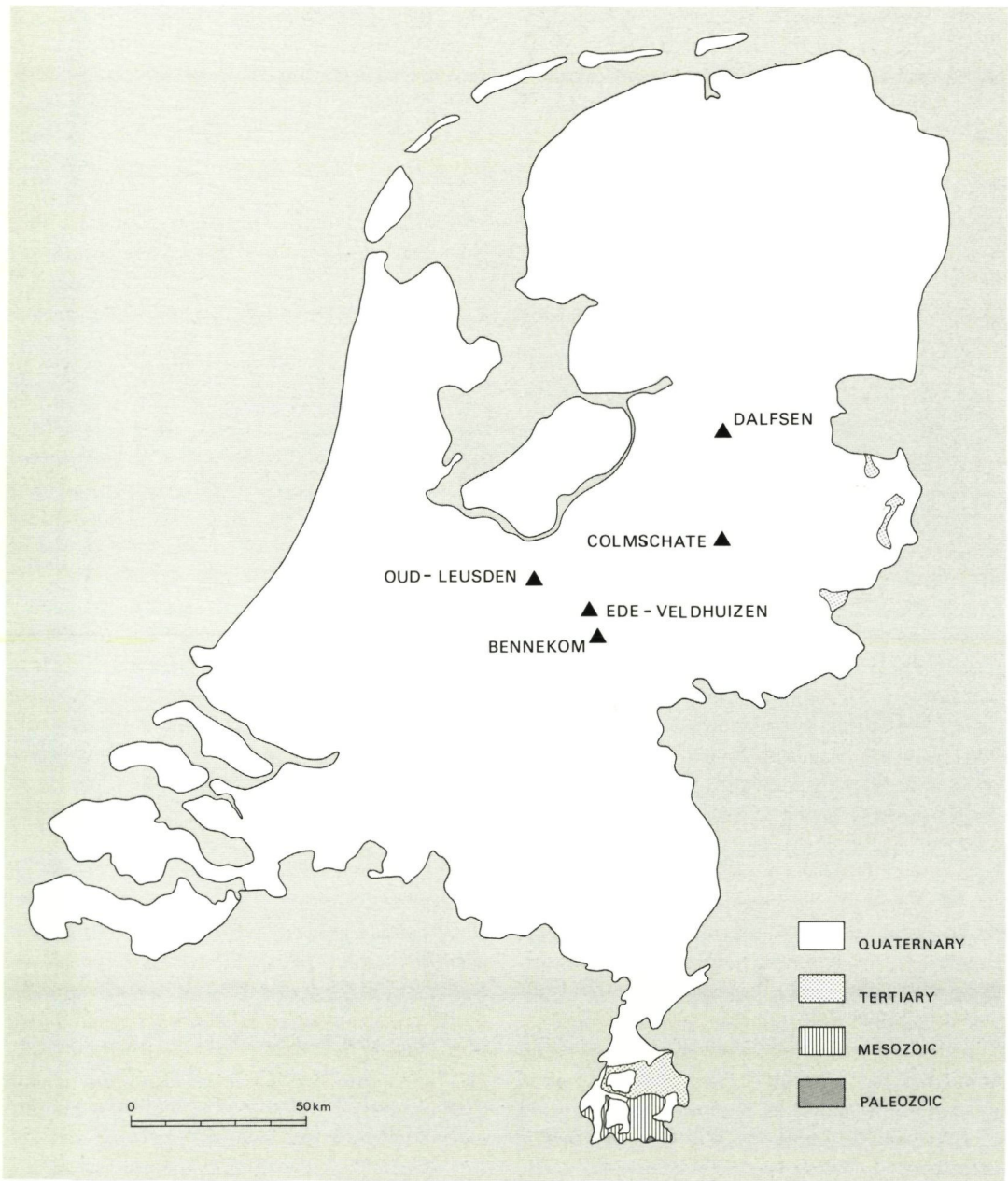
42 Dormal, 1896; Dormal, 1897.

43 Okrusch *et al.*, 1986.

44 Mertes & Schmincke, 1985; Duda & Schmincke, 1978.

45 Tavernier & Laruelle, 1952; Gullentops, 1952; Juvigné, 1983; Juvigné, 1984; Juvigné, 1988; a.o.

46 Constantin, 1986; De Paepe & Van Berg, in preparation.



16 *Outline geological map of the Netherlands and location of the sites mentioned.*

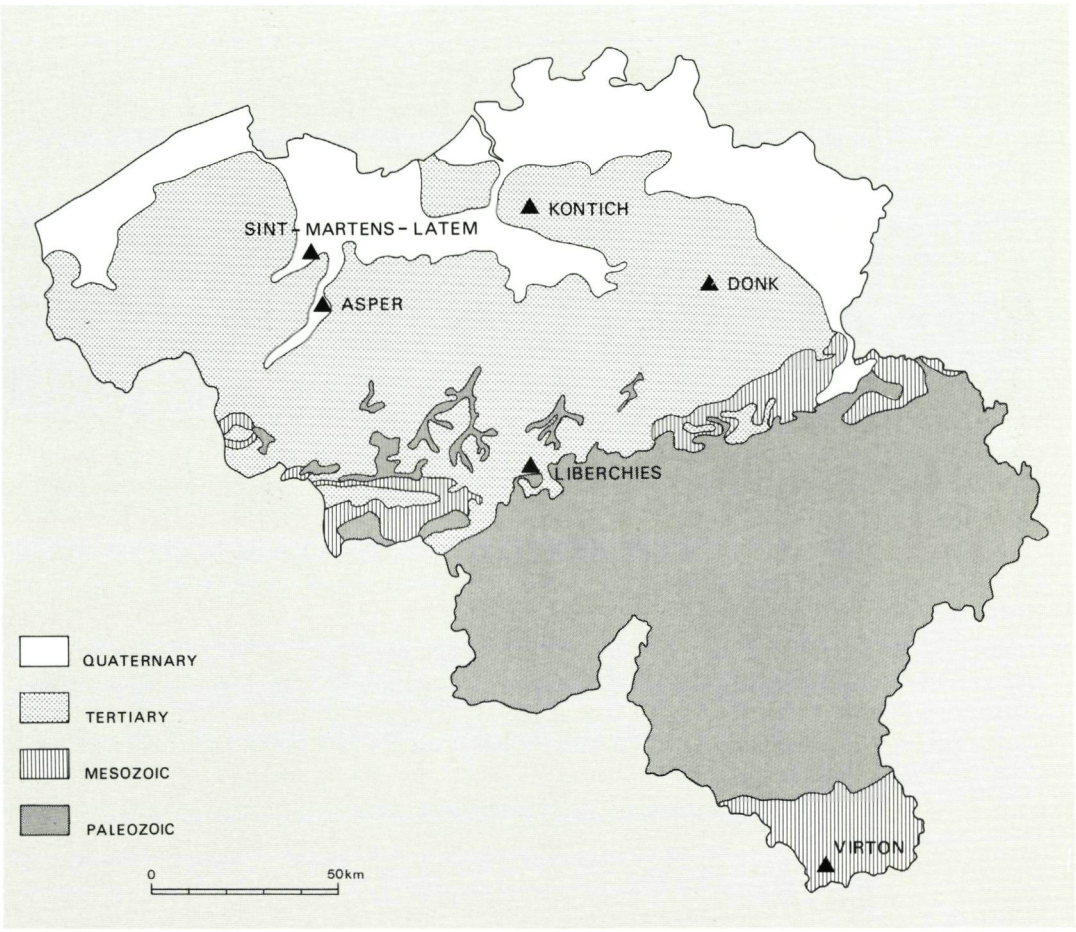
pottery of Group E is another problem which the present study cannot at this stage answer satisfactorily.

8 Some reflections on the archaeological and historical implications

It is our intention to focus primarily on finds from Belgian sites, hence the following reflections will be devoted to a more detailed discussion of these rather than of the two other groups of finds used as reference. The basis of comparison established between the Belgian finds as opposed to those from Niedersachsen and central Holland is yet too narrow to allow for final or far-reaching conclusions. Consequently, we shall confine ourselves to a few general comments on this first series of results which deserve due attention and which we consider significant enough to pursue.

The identification of nonplastic constituents of pottery from northern Germany reveals a remarkable homogeneity. Our own investigations as well as those of Okrusch[47], (on Dark Age pottery from the same area) allow us to assume that the supply of raw materials for pottery production was organized locally or at most regionally. Only boulder clay was used which is suggested by the exclusive presence

47 Okrusch *et al.* 1986.



17 *Outline geological map of Belgium and location of the sites mentioned.*

of tempering of type A. The presence of foreign matter which might point to the clay or other tempering materials being imported over long distances could not be demonstrated. It would indeed be surprising considering that sufficiently large deposits of good quality clay are available locally.

The number and distribution of settlements from which sherds for comparative study were available remain for the time being limited. We may assume that the use of boulder clay in the southern area was less common as only scattered and smaller outcrops of this particular kind of clay are available and then only in comparatively small numbers. The analysis of hand-made pottery from southern Niedersachsen and adjacent Westphalia should provide more telling evidence for the provenance of the clay.

However, the raw materials used for pottery production in the more southern area reveals less uniform nonplastic constituents and allows for more than one interpretation, as the first results obtained for material from Middle Holland already indicate. There the scarceness of type A material is striking. Though one must bear in mind that the number of analysed sherds from the Netherlands is hardly representative of the totality of the traditional pottery produced over the period under consideration, the petrographical results do conflict with expectations. The predominance of tempering of types D1 and D4 points to a preference for the use of clay varieties of sedimentary origin, which are widespread in the area. The preponderance of D1/D4 types (a percentage ratio against type A of 72:9) may indicate the existence of a rather stable population structure within which the influence of immigration factors remained negligible. In the present state of investigation, it is impossible to determine whether the sherds with a A-mineral spectrum represent a local or an imported pottery production, i.e. pottery brought along by immigrants from the north or north-west. Together with the extension of petrographic analysis work to the Westphalian hand-made products, more detailed investigation of Dutch material is to be recommended.

Unlike the finds from Niedersachsen and the Netherlands, the analysed material from Belgium is characterized by a wide range of the tempering types. The composition of the

Belgian group exhibits a number of differences from the Dutch examples, which is already obvious when considering the frequency of occurrence of type A on all sites except at Liberchies-Brunehaut. Since the Belgian soils do not contain the mineral spectrum of type A, the pottery sherds examined or even the raw material must have been imported. It seems fairly unlikely that coarse clay has been imported. Analysis could not detect whether the pottery examined arrived in Belgium by way of normal trading or as part of the luggage of some migrant's family. Fortunately, when dealing with this historical period, reliable written sources are available to provide a detailed picture of the manner, circumstances and exact juncture at which Germanic immigrants or invaders drifted into Belgium; and this may throw some light on the presence of this foreign pottery[48], as we already mentioned in our introduction.

It is striking that among the pottery of group A, a considerable proportion comes from Donk. It was found both in the infill of house K (fig. 4: 27, 23-33; see also Appendix nos 6/3036, 13/3231, 15/3233) and in one of the cremation graves (fig. 5: 8; see Appendix nos 12/24/3069/3243). The discovery of imported pottery of 'Germanic' origin in a grave is of the utmost importance. The presence of a number of burnt sherds from the same pot among cremated remains in a small pit can hardly be accidental. The pot must have stood near the body on the pyre: therefore, the presence of sherds in the tomb adds a personal dimension which sheds light on the origin of the deceased.

It seems odd that of the Donk pottery examined precisely those sherds which typological analysis catalogued as being of genuine 'Germanic' origin were not manufactured from type A clay but from D1, D2, or D5 clay varieties. The D1 type, found frequently on the excavated Belgian and Dutch sites (see p. 165), is characterised by abundant quartz tempering and can thus hardly offer a reliable guide to determine its provenance in these areas where sand-cover deposits are so widely distributed. On the other hand, D2 and D5 types occur solely in Belgian settlements and may point to local manufacturing using raw materials of an identical mineral spectrum, which are present in the vicinity. Types D2, with its preponderance of glauconite, and D5, with clearly recognizable ferruginous sandstone grains, possibly originate from local production in Donk. Glauconite-bearing clays and ferruginous sandstone banks are found everywhere on the Tertiary hill ridges in the immediate surroundings of the settlement. Moreover, ferruginous sandstone was employed as building material for the first time in the 4th century.

The explanation for this divergence would seem to be obvious. When their original household goods needed replacing, it was perfectly usual for immigrants to manufacture new pottery and at the same time to stick to the familiar ancestral forms and decorative techniques. It may cause some surprise that in the process of preparing and firing of the local paste, they managed to keep to their own pottery tradition so faithfully that the new objects could not be distinguished from the imported items, the original 'Germanic' wares. This shows that the 'Germanic' immigrants thoroughly explored their new surroundings, staying long enough to become familiar with the specific characteristics of the soil. Their striving for a perfect imitation of the homeland pottery may perhaps be explained by their yearning for the reassurance of objects reminding them of home, when they found themselves, either individually or as a group, socially and politically isolated within hostile territory.

The same conclusion may be drawn to explain the existence of type D3 tempering present only in the pottery excavated in the *castellum* of Liberchies. Here, also, we may assume a local production: the geological formations containing a D3 mineral spectrum can be found a mere 100 m. distant from the entrance gate to the *castellum*. Visually, this pottery can scarcely be distinguished from type A sherds (a.o. from Donk).

Whereas in the Donk collection there is a logical association of A-, D2- and D5-types of 'Germanic' pottery, the absence of type A sherds at Liberchies seems strange. It is the only site examined in Belgium where there is no trace at all of type A, even taking into account the limited number of sherds considered. In the absence of richer metal finds and of military equipment, one must assume that the 'Germanic' presence at Donk was of a purely civilian nature. The range of finds representative of the 4th century is totally different from that at the sites where, according to written sources, groups of Germans were brought in to defend the Roman Empire and where the scale of finds attests to a far wealthier and more explicitly military presence. At Liberchies the discovery of 'Germanic' pottery in the ditch of the *castellum* also must be viewed against the background of a military defence

48 De Boone 1954. Stolte 1961. Gysseling 1962.

of the hinterland[49].The absence of type A may be an indication that the troop contingent was composed mainly of Germans who already had been living or quartered in the area for quite some time.

This supposition applies equally to the fortification at Virton-Château Renaud where the presence of type A can undoubtedly be linked to the stationing of a 'Germanic' contingent. The presence on this site of type B containing volcanic ashes must not necessarily be explained by migration movements, since Virton lies in the proximity of the Eifel region.

The diversity of tempering types at Asper and Sint-Martens-Latem, both situated in the Scheldt valley, is comparable to the scale of types found at Donk. When compared with the imported pottery of group A the majority of the hand-made pottery examined appears to be local in origin.

The Kontich pot made from type A clay is significant not only as proof of a 'Germanic' presence, but in particular also from the point of view of chronology. It was discovered in a well and associated with some 3th-century pottery. The combination gives a clear warning: the presence of 'Germanic' pottery cannot always be explained by historical events of the middle or second half of the 4th century; their presence may in fact be related to Frankish and Saxon invasions in the third quarter of the 3th century. Recently, this connection was confirmed by a rescue excavation in the *vicus* at Elewijt (municipality Zemst). Hand-made, decorated pottery of 'Germanic' origin got into a well when part of the *vicus* was ravaged and eventually abandoned[50]. More indications at Donk, such as an early C-14 date for one of the wells of house J, lead one to suspect a connection with the migrations of the second half of the 3th rather than of the 4th century.

The only possible conclusion is that all finds of 'Germanic' pottery should first and most carefully be evaluated within their own archaeological context before they are in any way linked to one of the many historically documented migrations. The experience gained from this investigation together with our knowledge of 4th-century hand-made pottery should provide a sound basis for future archaeological identification of older migration movements. In the case of the Campine area, for instance, we may think of the sudden appearance of *Toxandri/Texuandri* who should have occupied from the 1st century onwards a vast part of the area previously inhabited by the Eburons.

Finally we would like to comment on the similarities and differences between the Belgian and Dutch sherds examined. Bearing in mind the differences between the tempering type A percentages in Dutch and Belgian settlements and the differences in distribution of the D1/D4 groups (present in the Netherlands and in Sint-Martens-Latem) and the D2/D3/D5 groups (present only in Belgian settlements), it seems quite unlikely that the Netherlands can be seen as a probable point of departure for the 4th-century migrations. This hypothesis is, of course subject to corroboration by further investigations. If at sites such as Donk a.o., we are - as we suggested in the introduction - dealing with Salian Franks who written sources report to have been chased south by the *Chamavi,* then we might have expected to find imported pottery of the D1/D4 groups in Belgium. Therefore, our future comparative investigations regarding the Donk finds should focus on the northeast, and particularly on parts of Dutch Limburg and North Brabant and later on, Westphalia. At this stage of our work, neither the C nor the E group can be discussed satisfactorily. We shall try and come back to them at a later stage.

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49 Mertens & Brulet 1974. Severs & Dewert 1988.
50 Van Impe & De Buyser 1990.

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Appendix
List of sherds examined

	a	b	c	d	e	f	g
1	B	Asper	3833	AJ85-7-K7-5	A	pit	sherd from shoulder, carinated bowl, greyish black, outer wall roughly smoothed.
2	B	Asper	3834	AJ85-7-K8	D2	pit	wall sherd, smoothed.
3	B	Donk	3060	80.DO.428	D1	sunken hut surface.	rim of biconical cup, dark grey to black, smoothed
4	B	Donk	3061	80.DO.340	D1	sunken room (stable?) in house	rim, brownish red paint, smoothed surface
5	B	Donk	3062	80.DO.340	D1	sunken room (stable?) in house	rim of biconical bowl, greyish, stamped impressions
6	B	Donk	3063	80.DO.340	A	sunken room (stable?) in house	rim, black, smoothed.
7	B	Donk	3064	80.DO.340	D2	sunken room (stable?) in house	sherd from biconical (wheel-made?) bowl, black, polished surface, porous.
8	B	Donk	3065	80.DO.427	D1	sunken room (stable?) in house	rim, notched rib, dark greyish brown, smoothed surface.
9	B	Donk	3066	80.DO.339	D1	sunken hut	rim with fingernail impressions, fingertip impressions on shoulder, grey/black, polished neck surface.
10	B	Donk	3067	80.DO.339	D5	sunken hut	rim, fingertip impressions on rim and shoulder, brown, roughened surface.
11	B	Donk	3068	80.DO.414	D1	well in sunken room in house	rim, dark grey, smoothed surface.
12	B	Donk	3069	80.DO.917a	A	cremation grave	burned rim, yellow.
13	B	Donk	3231	80.DO.427 /340	A	sunken room (stable?) in house	rim with fingertip impressions, dark grey, smoothed neck.
14	B	Donk	3232	80.DO.340	D2	sunken room (stable?) in house	sherd with ridge on neck, dark grey, smoothed surface.
15	B	Donk	3233	80.DO.340	A	sunken room (stable?) in house	rim with fingertip impressions, dark grey, porous.
16	B	Donk	3234	80.DO.340	D2	sunken room (stable?) in house	bottom, brownish red, rough surface.
17	B	Donk	3235	80.DO.340	D5	sunken room (stable?) in house	rim, dark grey, smoothed surface, porous.

a : country (B: Belgium; N: The Netherlands; D: Germany);
b : find site;
c : register number of the Laboratory of Geology of the Universiteit Gent (AR3833, AR3834, etc.);
d : number of the excavation-inventory list as indicated on the sherds or provided by the archaeologists;
e : petrographic group or type (this paper);
f : archaeological context (?: unknown);
g : vessel shape, colour, surface finish, decoration, and other macroscopic features.

18	B	Donk	3236	80.DO.666	C	stray find	rim, black, smoothed surface, neck polished.
19	B	Donk	3237	80.DO.433	D1	posthole sunken hut	sherd, fingertip impressions, reddish brown, smoothed surface.
20	B	Donk	3238	80.DO.413	D1	well in sunken room in house	rim, fingertip impressions on rim and shoulder, black smoothed neck, roughened surface.
21	B	Donk	3239	80.DO.406	E	well in sunken room in house	rim, dark grey, smoothed surface, wheel-made?
22	B	Donk	3240	80.DO.732	A	stray find	rim with notches, beige, smoothed surface.
23	B	Donk	3241	80.DO.666	D1	stray find	rim, fingertip impressions on rim and shoulder, black, polished neck, wall surface rougher.
24	B	Donk	3242	80.DO.765	C	cremation grave	sherd, fingernail impressions on smoothed surface, brown.
25	B	Donk	3243	80.DO.917a	A	cremation grave	burned rim, yellow.
26	B	Kontich	3827	XVI.A2	A	well	sherd from urn with notched rim, fingertips on smoothed shoulder, grey/black, roughened neck surface, smoothed surface.
27	B	Liberchies	3146	83B528	D3	infilling ditch	bottom.
28	B	Liberchies	3147	83B	D3	stray find	sherd, black.
29	B	Liberchies	3148	83B531	D3	infilling ditch	sherd from biconical bowl, brownish.
30	B	Liberchies	3149	83B520-522	D2	infilling ditch	sherd, brownish grey, smoothed surface.
31	B	Liberchies	3150	83A378	D1	infilling ditch	rim, dark brown.
32	B	Liberchies	-	70.LIB.11	D1	stray find (trench 39c)	rim.
33	B	Liberchies	-	70.LIB.36?	D1	stray find (trench 45c)	rim.
34	B	Sint-Martens-Latem	3828	LS.88.90	A	sunken hut	sherd, greyish brown, roughened surface.
35	B	Sint-Martens-Latem	3829	LS.88.90	C	sunken hut	sherd, brown.
36	B	Sint-Martens-Latem	3830	LS.88.90	D1	sunken hut	sherd, grey, roughened.
37	B	Sint-Martens-Latem	3831	LS.88.90	D4	sunken hut	sherd, brownish grey, smoothed surface.
38	B	Sint-Martens-Latem	3832	LS.88.90	D2	sunken hut	rim and bottom, biconical bowl, black.
39	B	Virton/Château Renaud	3374	79.VIR.263	D1	stray find (trench LXXXIII)	sherd, double range of fingernail impressions, brown, roughened.
40	B	Virton/Château Renaud	3375		D1	stray find	sherd, fingernail impressions, roughened, brown.
41	B	Virton/Château Renaud	3376	79.VIR.131	A	stray find (trench LXXIV)	rim, dark grey/black, smoothed surface.
42	B	Virton/Château Renaud	3377	79.VIR.262	B	stray find (trench LXXXII)	rim, dark grey/black, smoothed surface.
43	N	Bennekom	3415	BE.70-38a	D1	well	sherd, brown, roughened.
44	N	Bennekom	3416	BE.70-38b	D1	well	sherd from shoulder, brownish, smoothed
45	N	Bennekom	3417	BE.70-42a	D1	well	sherd, brown, slightly roughened.
46	N	Bennekom	3418	BE.70-42b	E	well	sherd, dark grey, polished.
47	N	Bennekom	3419	BE.70-43	E	pit	sherd, brown, porous.
48	N	Bennekom	3420	BE.71-99	E	pit	sherd, dark grey, polished.
49	N	Bennekom	3421	BE.71-121a	E	pit	sherd, dark brown/brownish grey, polished.
50	N	Bennekom	3422	BE.71-121b	D1	pit	sherd, beige, porous.
51	N	Bennekom	3423	BE.71-125a	E	well	sherd from shoulder, brown, smoothed.

52	N	Bennekom	3424	BE.71-125b	E	well	sherd, black, polished.
53	N	Colmschate	3386	22-1-3	D4	?	sherd, brownish red/brownish grey, smoothed, slightly roughened.
54	N	Colmschate	3387	22-2-12a	D4	?	sherd, reddish brown, smoothed surface.
55	N	Colmschate	3388	22-2-12b	D4	?	sherd, grey, smoothed surface.
56	N	Colmschate	3389	22-2-12c	D1	?	rim, dark grey/brownish grey, polished surface.
57	N	Colmschate	3390	22-2-12d	D1	?	rim, fingernail impressions, dark brownish red, roughened surface.
58	N	Colmschate	3391	111-1-5	D4	?	sherd, brown.
59	N	Colmschate	3392	111-1-8a	D4	?	rim, dark brown, smoothed surface.
60	N	Colmschate	3393	111-1-8b	D4	?	sherd, grey, smoothed surface.
61	N	Colmschate	3394	111-1-8c	D4	?	sherd, greyish brown, smoothed surface.
62	N	Colmschate	3395	111-1-8d	D4	?	sherd, brown, smoothed surface.
63	N	Colmschate	3396	111-1-8e	D4	?	sherd, pale brown, roughened.
64	N	Colmschate	3397		D4	?	sherd, brown, smoothed surface.
65	N	Ede-Veldhuizen	3405	EV.68-158	D1	?	sherd, dark grey, polished.
66	N	Ede-Veldhuizen	3406	EV.71-869	D1	?	sherd, beige, smoothed, polished?
67	N	Ede-Veldhuizen	3407	EV.71-1109	D1	?	small sherd.
68	N	Ede-Veldhuizen	3408	EV.71-991	E	?	sherd, dark grey, polished.
69	N	Ede-Veldhuizen	3409	EV.68-462	E	?	small sherd.
70	N	Ede-Veldhuizen	3410	EV.71-765	D1	?	small sherd.
71	N	Ede-Veldhuizen	3411	EV.68-510	D1	?	sherd, beige.
72	N	Ede-Veldhuizen	3412	EV.68-402	D1	?	sherd, relief decoration, brownish grey, roughened.
73	N	Ede-Veldhuizen	3413	EV.71-520A	B	?	sherd with fingernail impressions, beige,roughened.
74	N	Ede-Veldhuizen	3414	EV.71-739	D1	?	small sherd.
75	N	Oud-Leusden	3398	6-4-34	D4	square ditch	sherd, dark brown, polished surface.
76	N	Oud-Leusden	3399	6-4-46	A	square ditch	sherd, brown, smoothed.
77	N	Oud-Leusden	3400	9-3-8a	D1	square ditch	rim, grey (blewish), polished surface.
78	N	Oud-Leusden	3401	9-3-8b	A	square ditch	sherd, decoration with 'Warzen', grey.
79	N	Oud-Leusden	3402	9-3-16	D1	square ditch	sherd, grey, smoothed.
80	N	Oud-Leusden	3403	39-1-1	D1	settlement	sherd, dark grey, smoothed (polished?).
81	N	Oud-Leusden	3404	39-3-46	D1	settlement	sherd, beige, smoothed, slightly roughened.
82	N	Dalfsen	3378	116	D1	?	sherd, dark brown, smoothed.
83	N	Dalfsen	3379	114 (or 144?)	D1	?	sherd, pale brownish grey, slightly roughened.
84	N	Dalfsen	3380	368	D1	?	rim, dark brown/black, smoothed.
85	N	Dalfsen	3381	368	D1	?	sherd, brown, smoothed.
86	N	Dalfsen	3382	372	D1	?	rim, fingernail impressions, dark brown/black.
87	N	Dalfsen	3383	379	A	?	rim, black.
88	N	Dalfsen	3384	381	A	?	sherd, beige, smoothed.
89	N	Dalfsen	3385	489	D1	?	sherd, dark brown, smoothed (polished?).
90	D	Feddersen Wierde	3195	F.1022 Ba	A	?	sherd, brown, smoothed outer but with facetted ribs.
91	D	Feddersen Wierde	3196	F.1023 Ba	A	?	sherd with horizontal grooves, black, smoothed.
92	D	Feddersen Wierde	3197	F.865 Aa I	A	?	rim, black, smoothed.
93	D	Feddersen Wierde	3198	F.1040 Ba	A	?	rim, brownish grey, smoothed.
94	D	Feddersen Wierde	3199	F.1040 Ba	A	?	rim, brown, smoothed.
95	D	Feddersen Wierde	3200	F.1039 Ba	A	?	rim, black, smoothed.
96	D	Feddersen Wierde	3201	F.1033 Ba	A	?	3 very small sherds, 'Saxon' pottery, with decoration.
97	D	Feddersen Wierde	3202		A	stray find	rim, brownish grey, roughened.
98	D	Feddersen Wierde	3203		A	stray find	rim, dark grey, roughened.

99	D	Feddersen Wierde	3204			A	stray find	rim, black, smoothed.
100	D	Feddersen Wierde	3205			A	stray find	rim, black, smoothed.
101	D	Feddersen Wierde	3206			A	stray find	rim, dark grey, smoothed.
102	D	Feddersen Wierde	3207			A	stray find	rim, dark grey, roughened (with slip?).
103	D	Flögeln-Eckhöltjen	3151	1983		A	sunken hut 3082	sherd, brown, polished.
104	D	Flögeln-Eckhöltjen	3152	1983		A	sunken hut 3082	sherd, dark grey, smoothed.
105	D	Flögeln-Eckhöltjen	3153	1983		A	sunken hut 3082	sherd, pale brown, smoothed.
106	D	Flögeln-Eckhöltjen	3154	1983		A	sunken hut 3082	sherd, brown, smoothed.
107	D	Flögeln-Eckhöltjen	3155	1983		A	sunken hut 3082	sherd, dark grey.
108	D	Flögeln-Eckhöltjen	3156	1983		A	sunken hut 3082	sherd, dark brownish grey, smoothed.
109	D	Flögeln-Eckhöltjen	3157	1983		A	sunken hut 3082	sherd, dark grey/black, smoothed, polished.
110	D	Flögeln-Eckhöltjen	3158	1983		A	sunken hut 3082	sherd, dark grey/black, smoothed.
111	D	Flögeln-Eckhöltjen	3159	1983		A	sunken hut 3082	sherd, beige, smoothed.
112	D	Flögeln-Eckhöltjen	3160	1983		A	sunken hut 3082	sherd, dark grey, polished.
113	D	Flögeln-Eckhöltjen	3161	1983		A	sunken hut 3082	sherd, beige, slightly roughened with slip.
114	D	Flögeln-Eckhöltjen	3162	1983		A	sunken hut 3082	sherd, dark grey, roughened.
115	D	Gristede	3212	1966		A	pit 62A 3/5	sherd, pale greyish brown, smoothed.
116	D	Gristede	3213	1966		A	pit 62A 3/5	rim, dark grey, smoothed.
117	D	Gristede	3214	1971		A	pit 89/1	rim, black, smoothed
118	D	Gristede	3215	1971		A	pit 89/1	sherd with wide horizontal groove, dark grey smoothed (polished?).
119	D	Gristede	3216	1966		A	pit 150	rim, black, smoothed.
120	D	Gristede	3217	1966		A	pit 150	rim, black, smoothed (polished?).
121	D	Lintig	3175	1971		A	pit 20,1 N 2,0 E	sherd, grey, slightly roughened.
122	D	Lintig	3176	1971		A	pit 20,1 N 2,0 E	sherd, pale grey, smoothed.
123	D	Lintig	3177	1971		A	pit 20,1 N 2,0 E	sherd, grey, smoothed.
124	D	Lintig	3178	1971		A	pit 20,1 N 2,0 E	sherd, pale brown, slightly roughened.
125	D	Lintig	3179	1971		A	pit 20,1 N 2,0 E	sherd, grey, slightly roughened.
126	D	Lintig	3180	1971		A	pit 20,1 N 2,0 E	small sherd.
127	D	Lintig	3181	1971		A	pit 20,1 N 2,0 E	sherd, grey, roughened.
128	D	Lintig	3182	1971		A	pit 20,1 N 2,0 E	small sherd.
129	D	Lintig	3183	1971		A	pit 20,1 N 2,0 E	sherd, pale grey, roughened.
130	D	Lintig	3184	1971		A	pit 20,1 N 2,0 E	small sherd.
131	D	Loxstedt	3163	1981		A	sunken hut 93	sherd, brown, slip-roughening.
132	D	Loxstedt	3164	1981		A	sunken hut 93	sherd, brown, roughened.
133	D	Loxstedt	3165	1981		A	sunken hut 93	sherd, brown, slip-roughening.
134	D	Loxstedt	3166	1981		A	sunken hut 93	sherd, brown, smoothed.
135	D	Loxstedt	3167	1981		A	sunken hut 93	sherd, brownish grey, smoothed, slightly roughened.
136	D	Loxstedt	3168	1981		A	sunken hut 93	sherd, dark grey/black, polished.
137	D	Loxstedt	3169	1981		A	sunken hut 93	sherd, dark grey/black, polished.
138	D	Loxstedt	3170	1981		A	sunken hut 93	sherd, brown, smoothed.
139	D	Loxstedt	3171	1981		A	sunken hut 93	sherd, dark grey/black, smoothed.
140	D	Loxstedt	3172	1981		A	sunken hut 93	sherd, pale brown, smoothed.
141	D	Loxstedt	3173	1981		A	sunken hut 93	sherd, dark grey, smoothed.
142	D	Loxstedt	3174	1981		A	sunken hut 93	sherd, dark grey/black, polished.
143	D	Mahlstedt	3218	N-1,1	W28,3	A	?	rim, dark grey, smoothed (polished?).
144	D	Mahlstedt	3219	N-1,1	W28-29	A	?	sherd, dark grey/black, smoothed.
145	D	Mahlstedt	3220	N3,0	W35,0	A	?	rim, dark grey, smoothed.
146	D	Mahlstedt	3221	N3,0	W35,0	A	?	sherd with grooves, dark greyish brown, smoothed.

147	D	Mahlstedt	3222	N3,0	W35,0	A	?	sherd with traces of decoration, dark grey, smoothed.
148	D	Mahlstedt	3223	N7,5	W25,6	A	?	sherd decorated with ribs and grooves, black, polished.
149	D	Mahlstedt	3224	N7,5	W27,0	A	?	sherd with ribs, black, polished.
150	D	Midlum-Northum	3185	1971		A	stray find	sherd, black, smoothed.
151	D	Midlum-Northum	3186	1971		A	stray find	sherd, pale brownish grey, smoothed.
152	D	Midlum-Northum	3187	1971		A	stray find	rim, dark grey, smoothed.
153	D	Midlum-Northum	3188	1971		A	stray find	sherd, dark grey, smoothed.
154	D	Midlum-Northum	3189	1971		A	stray find	small sherd.
155	D	Midlum-Northum	3190	1971		A	stray find	sherd, dark brownish grey, smoothed, polished.
156	D	Midlum-Northum	3191	1971		A	stray find	sherd, dark grey, smoothed.
157	D	Midlum-Northum	3192	1971		A	stray find	small sherd.
158	D	Midlum-Northum	3193	1971		A	stray find	rim, dark brownish grey, smoothed, slightly roughened.
159	D	Midlum-Northum	3194	1971		A	stray find	rim, dark grey, smoothed.
160	D	Ruhwarden	3208	Ruh.II	1G/Pl3	A	?	small sherd.
161	D	Ruhwarden	3209	Ruh.II	1G/Pl4	A	?	small sherd.
162	D	Ruhwarden	3210	Ruh.II	1G/Pl5	A	?	small sherd.
163	D	Ruhwarden	3211	Ruh.II	1G/Pl4	A	?	small sherd.
164	D	Rullstorf	3225	Rul.5/1		A	sunken hut	bottom, black, smoothed (slightly polished).
165	D	Rullstorf	3226	Rul.5/1		A	sunken hut	rim, pale brown, smoothed, slightly roughened.
166	D	Rullstorf	3227	Rul.5/1		A	sunken hut	rim, black, roughened.
167	D	Rullstorf	3228	Rul.5/1		A	sunken hut	rim, dark brown, smoothed.
168	D	Rullstorf	3229	Rul.5/1		A	sunken hut	bottom, beige, roughened.
169	D	Rullstorf	3230	Rul.5/1		A	sunken hut	bottom, pale reddish brown, smoothed.