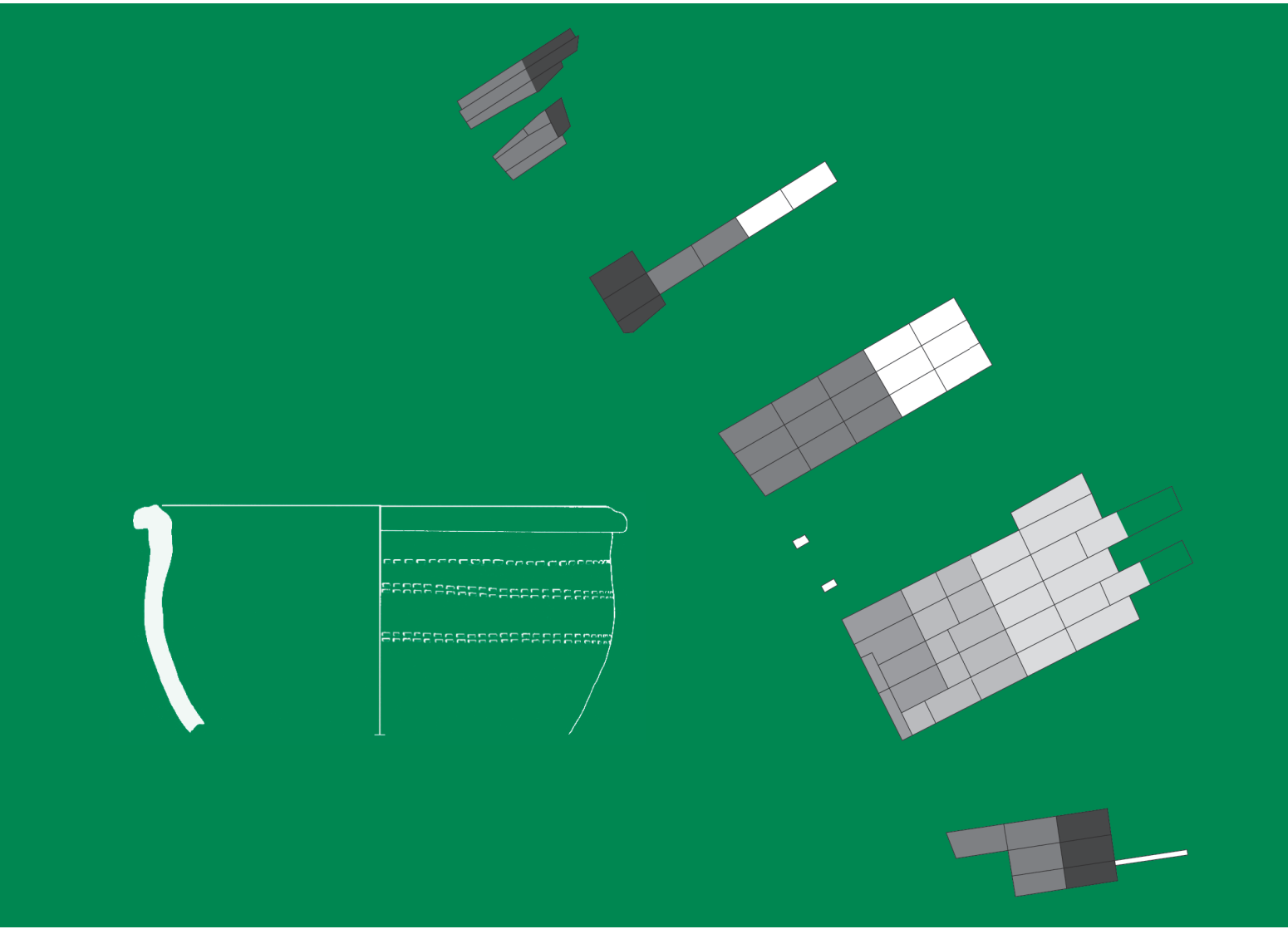
W.A. van Es
W.J.H. Verwers

EXCAVATIONS AT DORESTAD 3
Hoogstraat 0, II–IV



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W.A. van Es/W.J.H. Verwers

with contributions by J. van Doesburg, H. Enno van Gelder (†) and C. Isings

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ONDERZOEK CULTUURLANDSCHAP

Colofon

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Nederlandse Oudheden 16

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Contents

Voorwoord

Tussen dit tweede deel in de serie verslagen van onze opgravingen in Dorestad en het eerste (Van Es/Verwers 1980) gaapt een kloof van bijna dertig jaren. Daarvoor zijn verschillende oorzaken aan te voeren, maar dit is niet de plaats daar uitgebreid op in te gaan. Een van de belangrijkste was de enorme vloed van gegevens die moest worden verwerkt, en nog handmatig verwerkt bovendien, want ons onderzoek in Dorestad dateert van voor de elektronische revolutie. Niet bevorderlijk waren daarnaast de veranderingen die zich sinds de jaren negentig hebben voltrokken bij de dienst die de opgravingen had uitgevoerd. De Rijksdienst voor het Oudheidkundig Bodemonderzoek is inmiddels opgegaan in een bestuurlijk kenniscentrum waarin grootschalig opgraven geen prioriteit meer geniet. Gelukkig heeft de nieuwe Rijksdienst voor Archeologie, Cultuurlandschap en Monumenten de publicatie van de opgravingen in Dorestad nog wel als erfenis aanvaard.

Deel 1 behandelde de resultaten van de eerste grote opgraving in het zogenaamde havengebied, de Karolingische Kromme Rijnbedding ten oosten van de Hoogstraat. Na Hoogstraat I zijn nu de andere vier opgravingen in dat gebied aan de beurt: Hoogstraat 0, II-IV. In een derde en laatste deel zal het overgrote deel van de overige opgravingen die tussen 1967 en 1992 op het terrein van Dorestad hebben plaatsgevonden, aan de orde komen. Daar het manuscript al vergevorderd is, mogen wij hopen dat het verschijnen van dit boek niet nog eens een onderzoekersleven op zich zal laten wachten.

Het boek dat nu voor u ligt, draagt enigszins verwarrend de titel *Excavations at Dorestad 3*, terwijl het, zoals gezegd, het tweede deel is van de drie opgravingsverslagen die van meet af waren voorzien. Nummer 2 van de *Excavations* is de dissertatie van Prummel uit 1983. Eigenlijk was het de bedoeling geweest ook andere monografieën die op Dorestad betrekking hadden, in deze serie op te nemen, maar dat is niet gebeurd en daarom worden de Dorestad-publicaties nu afgerond met de nummers 3 en – hopelijk – binnen afzienbare tijd 4. Nummer 3 zou nooit verschenen zijn zonder de hulp van talloos velen. Onze dank gaat uit naar ieder van hen, ook al kunnen wij hier slechts enkelen noemen.

Van de veldtechnici die bij de opgravingen betrokken waren, gedenken wij met respect en dankbaarheid C. van Duijn, A. Buisman en R.E. Lutter. Van Duijn heeft lange jaren de opgraving geleid en Lutter heeft een hoofdrol gespeeld in de uitwerking van de veldgegevens. Zijn tekeningen zijn door S.J.A. Kuppens langs fotografische weg tot overzichtskaarten gemonteerd. Geen van hen heeft, helaas, de voltooiing van dit boek mogen beleven. Hetzelfde geldt voor G.H. Scheepstra, die een belangrijke bijdrage heeft geleverd aan de drukvoorbereiding van tekst en tekeningen.

Speciale dank gaat uit naar het Hoofd Sector Kennis Erfgoed van de RACM, professor J.G.A. Bazelmans, die ons fondsen en faciliteiten ter beschikking stelde. Op zijn initiatief werd het tekenwerk en het opmaken van de afbeeldingen uitbesteed aan het buro IO-Graphs te Utrecht, waar R. Elburg en P. van der Kroft zich met inzicht en voortvarendheid van deze taak hebben gekweten. Mevrouw C. Jefferis uit Zaandam vertaalde de Nederlandse tekst in het Engels en, zoals altijd, was het met haar weer prettig samenwerken. De opmaak van het boek was in handen van Studio Imago in Amersfoort.

Opende en Hoevelaken, februari 2008
W.A. van Es
W.J.H. Verwers

I Excavation Method

Fig. 1 Location of Dorestad.

The excavations in the area to the east of Hoogstraat took place between 1971 and 1975. They were carried out in five campaigns corresponding to five complexes of excavation trenches labelled Hoogstraat 0, I, II, III, and IV. The exact dates of the individual campaigns can be seen in table 1.

Hoogstraat 0 was a trial excavation. It revealed the course of the river Rhine at the time of Dorestad, but it was too limited to provide a full understanding of the way in which the riverbed had been used. The subsequent Hoogstraat excavations supplied more comprehensive information. They contained cross-sections through the traces of early-medieval occupation in the bed of the Rhine, starting on the left bank in the west and running to where the traces ended in the east. The results of Hoogstraat I were published in 1980.[1] The remaining excavations in the Dorestad area to the east of Hoogstraat are the subject of this book.

The site was described in some detail in chapter I of the above-mentioned publication, so this need not be repeated here. The layout of the excavations along Hoogstraat is shown in figure 2. Since there was not enough time to uncover the whole Hoogstraat area of the early-medieval Rhine bed, we had to be content with trial trenching. The individual excavations were spaced out more or less evenly. The intermediate spaces, which were roughly 100 m wide, had to be left unexcavated, and these have now been built on. Most of the archaeological data they contained must have been destroyed in the process and anything left is now inaccessibly buried below modern houses and streets.
The excavation methods used in Hoogstraat 0, II, III, and IV did not differ fundamentally from those of Hoogstraat I. They were explained in chapter II of the book on that excavation, and since much of what was said there applies to the excavations discussed here, we may restrict ourselves to a few additional remarks. The trenches of Hoogstraat 0 fall into two groups. The space between both groups could not be excavated as this area had been ear-marked as a road-bed. The sequence of trench numbers in this excavation (260–268; number 265 was given to a trench in another part of the Dorestad excavations) indicates the order in which the trenches were excavated. Hoogstraat 0 was our first acquaintance with the Carolingian Rhine bed. This is immediately evident from the divergent shapes and

TABLE 1 Dorestad, Hoogstraat 0–IV
Dates of excavation campaigns to the east of Hoogstraat.

Campaign		from	to
Hoogstraat	0	29.I.1971	6.V.1971
	I	31.I.1972	3.XI.1972
	II	27.III.1973	29.XI.1973
		18.II.1974	10.VII.1974
	III	30.VII.1973	30.XI.1973
		31.VII.1974	3.X.1974
	IV	17.IV.1975	28.X.1975

1 Van Es & Verwers 1980.

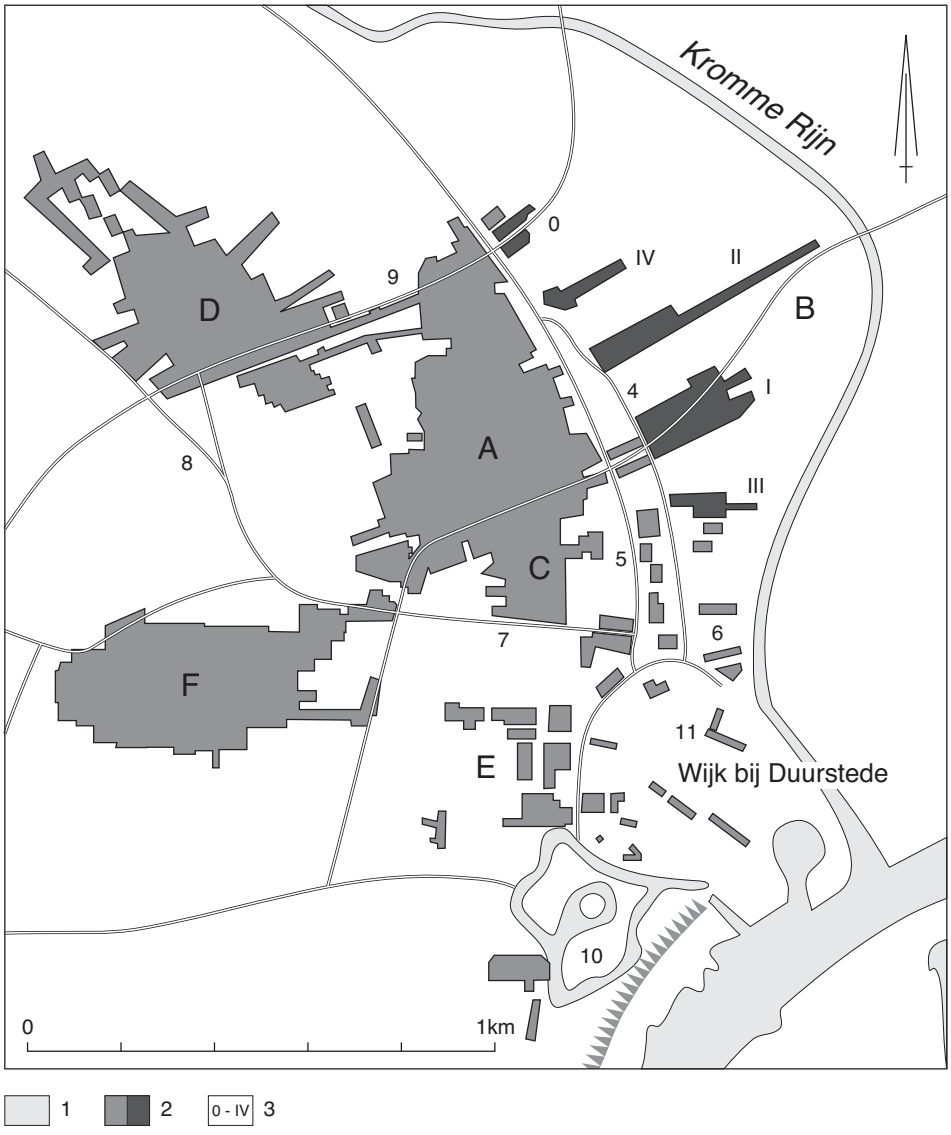


Fig. 2 Wijk bij Duurstede: excavated areas, situation 1.1.1999.
Legend:
1 rivers and moats;
2 excavated areas (black: Hoogstraat 0, II, III, IV);
3 sites Hoogstraat 0-IV;
4 Hoogstraat;
5 Zandweg;
6 Langs de Rijn;
7 Steenstraat;
8 Trekweg;
9 Romeinenbaan;
10 castle;
11 church, dedicated to St. John the Baptist;
A De Heul;
B Noorderwaard;
C Frankenhof;
D De Geer;
E De Engk;
F De Horden.

widely varying sizes of the trenches. At the start of this campaign, we were not yet aware of the kind of occupation evidence we were going to find in the riverbed and so we had to continue excavating in an exploratory way, and therefore the shapes of the trenches could not be adapted to previous results. It soon appeared preferable to use wider trenches, also in the river area. In the subsequent Hoogstraat excavations we therefore adopted the standard-size trench (20 x 40 m), which had been used to our satisfaction in the actual settlement part of the Dorestad site. Only in a few cases was it necessary to deviate from the accepted norm. Trench 454 in Hoogstraat IV was made slightly smaller, trenches 380–382 and 401 in Hoogstraat II and III did not contain any evidence of Carolingian occupation. They are located outside the Dorestad river area and were cut to obtain a section through the – upper part of the – sediments deposited after the occupation of Dorestad had ended. The exact sizes of the Hoogstraat trenches are given in tables 1–6.
The order in which the individual trenches of each excavation were dug was determined by the desire to be able to study complete longitudinal sections through the riverbed at one and the same moment. In Hoogstraat II, this aim was achieved by

cutting trenches 380, 382, 384, 386, 388, 390, 392, and 394 in one operation. They remained open until all of them had been completely excavated and only then were they filled in and the remaining trenches opened. In a similar way, the first phase of the Hoogstraat III campaign comprised the excavation of trenches 401, 402, 405, 404, 407, and of section 408 (indicated by an arrow in fig. 5), while 403 and 406 followed in a second operation. In Hoogstraat IV, the row of trenches between 448 and 452 was kept open at the same time. After these trenches had been filled in, 453 and 454 were dug.

Each trench was excavated in two or more levels. The maximum number of levels in one trench is nine. The range of excavation levels per trench is indicated in figures 3–6, which also show the locations of the sections illustrated in this book. The sections were drawn in the same way as those of Hoogstraat I: horizontal scale 1:400, vertical scale 1:80. The combination plans on a scale of 1:400 of figures 15–8 may be compared to the corresponding plan of Hoogstraat I. All were based upon the same principles, and are, unfortunately, liable to the same inaccuracies and uncertainties.[2]

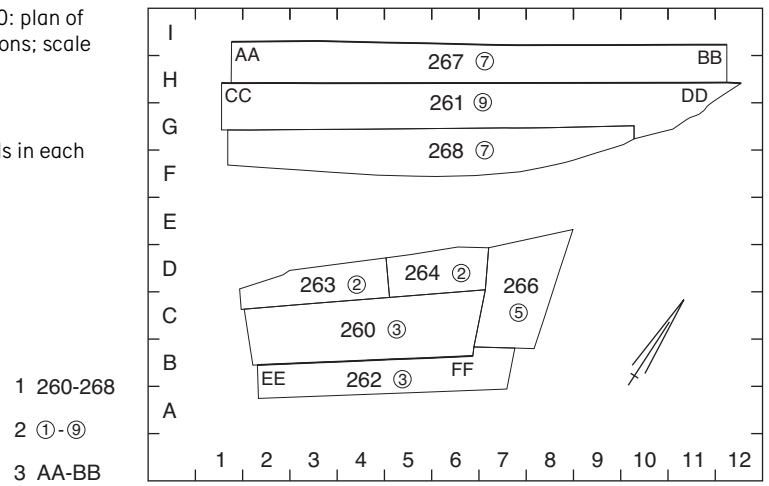


Fig. 3 Dorestad, Hoogstraat 0: plan of trenches with position of sections; scale 1:1600.
Legend:
1 trench numbers;
2 number of excavation levels in each trench;
3 sections.

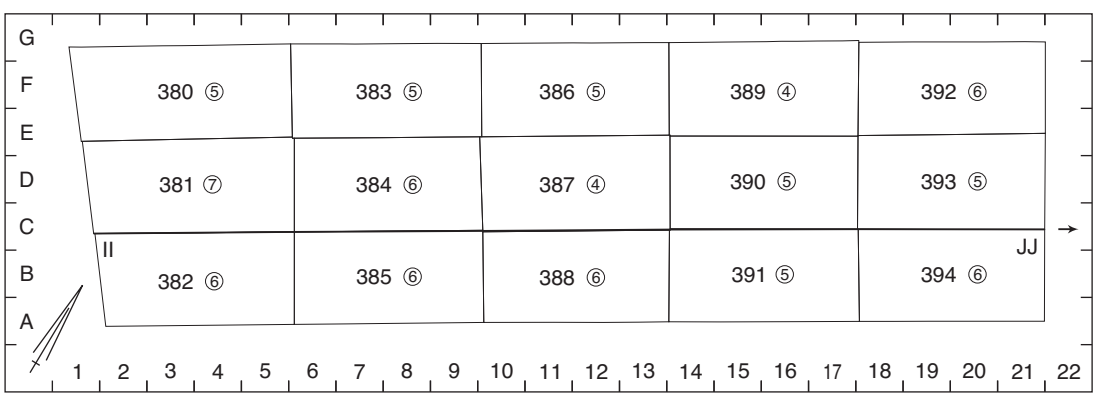


Fig. 4 Dorestad, Hoogstraat II: plan of trenches with position of section; scale 1:1600.
Legend: see fig. 3.

2 Van Es & Verwers 1980, 20.

Fig. 5 Dorestad, Hoogstraat III: plan of trenches with position of section; scale 1:1600.
Legend: see fig. 3.

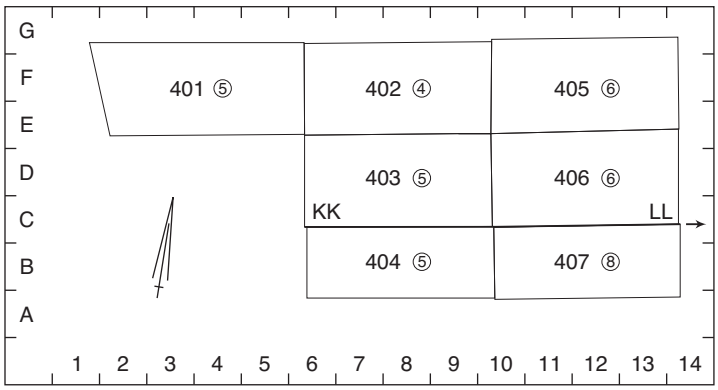


Fig. 6 Dorestad, Hoogstraat IV: plan of trenches with position of section; scale 1:1600.
Legend: see fig. 3.

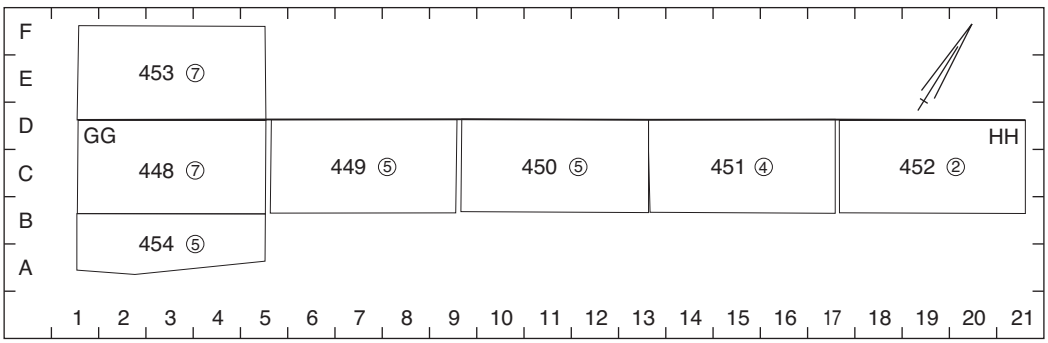


Fig. 7 Dorestad, Hoogstraat 0: excavation Hoogstraat 0, with well-point drainage, ca 1970.

TABLE 2 Dorestad, Hoogstraat 0
Surface area per trench in m².

trench number	surface area	riverbed	riverbank
260	650		
261	900	360	540
262	320		
263	240		
264	230		
266	230		
267	945	405	540
268	715	200	515
total	4000	965	1595

TABLE 3 Dorestad, Hoogstraat II
Surface area per trench in m².

trench number	surface area
380	920
381	860
382	820
383	800
384	800
385	800
386	800
387	800
388	800
389	800
390	800
391	800
392	800
393	800
394	800
total	12 200

TABLE 4 Dorestad, Hoogstraat III
Surface area per trench in m².

trench number	surface area
401	860
402	800
403	800
404	600
405	800
406	800
407	600
total	5 260

TABLE 5 Dorestad, Hoogstraat IV
Surface area per trench in m².

trench number	surface area
448	800
449	800
450	800
451	800
452	800
453	800
454	460
total	5 260

TABLE 6 Dorestad, Hoogstraat 0–IV
Total excavated area in m².

excavation	surface area
Hoogstraat 0	4 000
Hoogstraat I	20 853
Hoogstraat II	12 200
Hoogstraat III	5 260
Hoogstraat IV	5 260
total	47 573

II Observations in the sections: changes in the course of the river

We do not intend to give a detailed description of the features encountered at each of the Hoogstraat sites 0 and II–IV. We decided to rely in the first place on drawings when attempting to record the large number of occupation traces which were discovered during these excavations. The figures 8–13*, which illustrate a number of vertical sections, and the combination plans in figures 15–8* are intended to serve this purpose. Although they do contain a substantial amount of information, it has not been possible to include all the information which had been recorded in the – coloured – field drawings during excavation. In combining the features from successive excavation plans, data, and not merely data of minor importance, had to be left out. Only a selection of the sections was chosen for publication. Our drawings, therefore constitute an incomplete, and also a subjective record.

1 Introduction

Vertical sections

The sides of the excavation trenches in Hoogstraat 0, II–IV produced twenty longitudinal sections and roughly the same number of transverse sections. The longitudinal sections are virtually at right angles to the Carolingian Rhine bed. They are referred to here as west-east sections, even though they all clearly deviate from the exact west-east orientation: most of them are almost southwest-northeast. Most of the transverse sections at right angles to these – the 'north-south sections' – run more or less parallel to the riverbed. Their actual position varies from approximately north-northwest-south-southeast in Hoogstraat III to almost northwest-southeast in the remaining locations. For our purposes it is the longitudinal sections that are important. Six of them are shown in figures 8–10*: AA–BB, CC–DD, EE–FF (Hoogstraat 0); figure 11*: GG–HH (Hoogstraat IV); figure 12*: II–JJ (Hoogstraat II); figure 13*: KK–LL (Hoogstraat III).[3] At least one complete west-east section of each excavation is shown, and in some cases, parts of sections which did not link up in the excavation have been combined in the illustrations (*cf.* figs. 3–6*). The transverse sections have not been shown.

The sections are mostly represented in the same way as those of Hoogstraat I. The vertical scale has been considerably exaggerated: 1:80; the horizontal scale is 1:400. In addition, the figures have been considerably simplified: many details had to be left out, and only the outlines are shown.

The grey values chosen to distinguish the various soil horizons only give a rough indication of their lithological composition. Pure sand is light grey (see legend fig. 8*: 4); (sandy) clay (or clayey sand) is darker (see legend fig. 8*: 3). Both these layers

3 The letter code of the sections has been deliberately chosen so as to avoid any confusion with that of the sections of Hoogstraat I (A–B to Q–R).

are of course fluvial deposits. Their composition is subject to great variation. The sand layers vary from fine to coarse sand with gravel, and the clay layers also differ considerably in texture and colour. None of these differences are reflected in our illustrations. The schematization of the natural soil layers has been carried through to an even greater extent than was the case in the Hoogstraat I sections, where a distinction was made between the generally fine sand encountered at the base of the sections and the coarser, gravel-rich sand bar forming the eastern end of the west-east sections (see, for example: I/J–20/26). This distinction has been omitted in the Hoogstraat 0 and II–IV sections.
The same applies to the sandy clay layer covering this eastern sand bar. In the section diagrams in this book it no longer has a separate grey colour. There are only two types of dark grey for the clay layers and these indicate, however roughly, the degree of pollution. The lightest colour (see legend fig. 8*: 3) is reserved for clay layers with no, or very little human influence. Sediments which are clearly polluted are darker (see legend fig. 8*: 2). These layers contain settlement refuse and/or are unnaturally dark in colour. Extremely polluted layers are shown in very dark grey (see legend fig. 8*: 1). In actual fact they were black, or at any rate, dark grey. These black layers will, to some extent, have been 'natural' layers. In other words, they developed during a process of sedimentation and some settlement refuse must have entered these layers while they were being formed. In other cases, though, the anthropogenic element may have predominated. It is possible that some of the black layers were formed entirely or predominantly by dumping refuse and that sedimentation only played a minor part.
Features that are certainly anthropogenic are, of course, those dug or driven into the soil (pits, trenches and posts). The posts and post-ghosts are always marked black. The fills of the dug-in features are indicated by light or dark hatching or are black, depending on the degree of pollution. The hatching of these fills does not necessarily mean that the dug-in features had (largely) silted up naturally, although this would often have been the case. Generally speaking, the bottommost part of the fill is badly polluted, while higher up it resembles 'clean' natural clay. This gives the impression that the dug-in feature had lain open for some time and gradually became filled up in a natural way. In the case of depressions which are completely filled with clean soil it is often difficult to decide whether they have actually been dug or whether the depression is naturally caused – for example, by the erosive force of water.
Finally the topsoil, completely disturbed in recent times, is left white in the diagrams. The bases of most of the sections are at a depth of *c.* 2.50 m NAP. It was not possible to go any deeper due to the level of the ground water. Artificial lowering of the ground water level by means of well-point drainage was only done in the eastern sections of the excavation trenches 267 and 261 where the sections AA–BB and CC–DD extended deeper than usual. At other spots it was only possible to expose the sections in places to just below ground water level for a short period. The bases of the sections are therefore random and never reach the base of the riverbed.

2 The behaviour of the river

The west-east sections primarily provide insight into the behaviour of the river. The Hoogstraat I excavation has already given a picture of this and we take this as our starting-point.[4] It became clear that the excavation area east of Hoogstraat was part of a *kronkelwaard* or crevass splay. This *kronkelwaard*, named Noorderwaard (north holm) after its location to the north of Wijk bij Duurstede, is presently bordered on the east by the broad bend in the river Rhine immediately north of Wijk. Hoogstraat and Cothense Zandweg form the basis of Noorderwaard. It has been established that

4 *Van Es & Verwers 1980, 41–53.*

this *kronkelwaard* began to develop at the time of Dorestad. In other words: the shifting of the riverbed which eventually resulted in the meander still present in the landscape began at the time that the north part of Dorestad was situated here.

At the end of the occupation period the river flowed about halfway between Hoogstraat and its present bed. At the beginning of the occupation period the left bank of the Rhine lay directly east of Hoogstraat. The Hoogstraat I sections demonstrate this process of shifting. On the basis of differences in the river sediments they were divided into four zones.

1 The original riverbank in the west, where the basal sand layers slope down relatively steeply eastward.
2 The shoal in front of the bank, where the basal sand together with the layers of sandy clay in and on it were roughly horizontal.
3 The actual – Carolingian – riverbed shifting in an easterly direction, where the bases of the sections were characterized by a complex of thin sedimentary layers consisting alternately of fine sand and fine sandy clay and shelving more or less steeply from west to east.
4 The sand bar at the eastern end of the sections, recognizable as a ridge in the terrain. The layers of coarse sand often rich in gravel of which the sand bar consisted appeared to have been deposited while older layers were being eroded, at any rate in some sections (particularly I–J). The sand bar was covered with a layer of clay extending further west than the sand bar itself and at least partially covering the older layers which had formed during the Carolingian Period.

In this chapter we shall consider the extent to which the observations from the sections in the other Hoogstraat excavations are able to confirm and supplement or possibly correct the results of the Hoogland I excavation summarized above. In one respect, new information will certainly be provided by the Hoogstraat 0 and IV sections, since the west ends of sections AA–BB to GG–HH cut into a zone virtually untouched by the other Hoogstraat excavations. This is the zone on the bank, adjacent to the river, but located beyond the actual bed. This zone must be added to the four zones identified in Hoogstraat I: zone 5. For the rest there is a larger section of the eastern border zone (zone 4) present in two of the new sections (II–JJ and KK–LL) than was the case in Hoogstraat I.

2.1 The original bank (zone 1)

It was only possible to give a preliminary definition of the characteristics of this zone in Hoogstraat I, but the other excavations have yielded much supplementary information. The zone is characterized by a complex of alternate sand and clay layers, sloping away steeply from west to east. The base of the sections by no means reaches the bottom end of this complex. Even in the deepest section (AA–BB, squares 8/9), where a complex of steeply sloping clay layers can be traced almost down to NAP, no estimate can be given of how far down they continue, but that they do so, is certain. It is clear that these and the other sharply dipping layers in zone 1 were deposited in a deep bed. In other words, the (or a) stream channel of the Rhine was located for a short or a longer period in zone 1. This is evident from the thickness or rather the breadth of the complex of sloping layers.
In all the sections, at least one continuous cut or line of incision forms part of the complex. A continuous line of incision means a line running without interruption from the bottom of the section as far as the recently disturbed topsoil and cutting all older sediments (*i.e.* those situated west of the line). This line has been eradicated in the present topsoil, but originally it continued up to the surface. A line like this clearly represents a phase in the development of the Rhine bed in that a new left bank of the river is formed.

Hoogstraat I had not yet produced a complete line. The sandy clay layer between 2.20 and 3.40 m NAP in C/D-2 may, however, have formed part of the (eastern) line of incision observed in the sections of other Hoogstraat excavations. The situation of C–D, square 2 corresponds to that in II–JJ, square 2, where the cut cannot be completely traced either because the section does not go far enough west. In Hoogstraat III the situation is even more unfavourable. The illustrated section KK–LL does not yet show a sign of a continuous line of incision. It must therefore lie further to the west, though not much further, for in the (not illustrated) south section of excavation trench 401 a small section of the line is just visible down in the west corner.

The northernmost sections provide the best opportunities for observation, and in fact two cuts can be detected: a west and an east one. The space between the two is small: *c.* 2 m in EE–FF, squares 6/7; *c.* 10 m in AA–BB, squares 7/8. In Hoogstraat IV one single line of incision can be recognized in its entirety (GG–HH, squares 4/5). To the west of it, at the bottom of square 3, a kind of cut is visible, but this does not continue to the top and cannot therefore be compared with the western line of incision of Hoogstraat 0.

If there were also two cuts at Hoogstraat IV, the west one must have been situated west of the end of the section which is not very likely. This would make the space in between very large indeed. For this reason we assume that there was only one cut in Hoogstraat IV and the same probably also applies to Hoogstraat I, II and III. As far as can be judged at present, no cuts continuing up as far as the topsoil occurred west of Hoogstraat. This was also the case in the excavation trenches 524–527 on either side of Nieuweweg, which continued almost as far as Hoogstraat I and which will be briefly discussed below. The cuts at the west end of these pits came from a lower level and can consequently be compared with the older cuts in Hoogstraat IV mentioned above.

As far as we can ascertain, the Hoogstraat 0 situation with its two beds was an isolated case. Furthermore, it seems reasonable to assume that the two cuts here represent two phases of one bed. An argument for this is that both slopes run parallel. It would appear that the river at Hoogstraat 0 has partially eroded its left bank and in a second phase has again cut into its own bank. The time elapsed between both phases can to a certain extent be determined from two ^{14}C-dates of samples originating from section CC–DD: GrN-6328 (finds no.11995) and GrN-6330 (finds no.12160).[5] The sample for GrN-6328 was taken from a bluish-grey sandy clay layer in the oldest bed, at *c.* 3 m NAP, approximately halfway between the first and second cutting lines (section CC–DD, square 7). The second sample came from the younger bed, at *c.* 2.25 m NAP in a sand layer (section CC–DD, square 10). The two dates were 1680 ± 35 BP and 1225 ± 30 BP respectively. The relation between the two dates is certainly acceptable, since the figures confirm each other. Naturally, neither date marks the exact beginning of the riverbed phase in question since they are *termini-ante-quos*. However, their stratigraphical position leads one to assume that, in both cases, the moment the bed was cut did not long precede the period in which the ^{14}C-dated horizon was formed. If this hypothesis is correct, the incision of the older bed may have occurred around the beginning of our era. The second cut would then have taken place in the 6th or 7th century. Apart from these – somewhat uncertain – absolute dates, an interval between both incidents of some four or five centuries on the basis of the two ^{14}C-dates appears reasonable. Moreover, the older date indicates that the river existed in the area east of Hoogstraat at least from the middle of the Roman Period and possibly even earlier, while the sedimentation of the younger bed must have started before the middle of the 8th or even before the end of the 7th century.

The drop of the lines of incision is very steep at the base of the sections: approximately 2:3. However, in some sections one can see that the steepness levels

5 Sample GrN-6328 was not actually taken in the section itself, but in the adjoining level, and was subsequently projected into the section.

off at the top: apparently the bank was less steep closer to the surface. The points where the continuous lines of incision met the surface can be estimated from the sections. Figure 9* shows the points at which the lines cut the 3 m NAP level. This intersection has been chosen because the cuts are clearly recognizable here. The points at which the cuts reached the surface at the top of the bank will have been located about 10 m further back (*i.e.* further west) than the intersections at 3 m NAP. These points have also been shown in figure 14. They can be used to reconstruct the approximate course of the bank as it was encountered by the founders of this part of Dorestad, and for this reason it is referred to here as the original bank. The river Kromme Rijn, whose course has constantly changed, existed long before Dorestad. However, from the point of view of Dorestad's inhabitants, the bank in question was in fact the original one, for it was the bank in the initial period of this part of Dorestad.
On the basis of the two ^{14}C-dates just mentioned, we may assume that the west cuts in Hoogstraat 0 represent a riverbank from the Roman Period, and that the east cuts developed during the Late-Merovingian Period (not long before 725 AD).
Hoogstraat II also yielded a ^{14}C-date which is important for dating the cuts. It came from a sample of a wattle revetment which will be discussed again later (chapter VII 2.7). The sample itself was taken from the excavation level. The revetment and with it the ^{14}C-date can, however, easily be projected into the section: section II–JJ, square 2. As a result, the stratigraphical relation between the revetment and the line of incision in the same square becomes clear. The distance between the two is so small that the ^{14}C-date of the revetment can in fact also be applied to the incision of the riverbed in Hoogstraat II. This date is: 1305 ± 35 BP (GrN-7447). The riverbed incision therefore dates from the middle of the 7th century and appears to be just as old as the east cuts in Hoogstraat 0. It would be natural to assume that the cuts in Hoogstraat I, III and IV – for which there are no ^{14}C-dates available – also developed in the Late-Merovingian Period. Traces of human activity from the Dorestad period were discovered in extremely close proximity to the cuts both in the Hoogstraat IV sections as well as those from Hoogstraat II. The latter cannot, therefore, be much older than the date of settlement on the riverbank. This is confirmed by the fact that the west cuts in Hoogstraat 0 do not yet show signs of human activity.
The points on the bank which, according to the above line of reasoning, are assumed to have developed contemporaneously, are linked together in figure 14, *cf.* figure 49. This connecting line represents the original bank in the Hoogstraat area in the Dorestad period. A remaining question is: where should one seek the continuation of the Roman bank from Hoogstraat 0? The hypothesis that the counterparts of the west cuts of Hoogstraat 0 in the sites situated further south are to be found west of the section ends has already been rejected. A second hypothesis to the effect that the bank in Hoogstraat I–IV was situated at exactly the same spot from the Roman to the Merovingian Period is equally untenable. It would conflict with what the Hoogstraat 0 sections tell us about the behaviour of the river. A considerable stretch of the Roman bank there appears to have been broadened and flattened by alluviation when a new riverbed was cut into the existing layers in the Merovingian Period. As far as we can see, only one solution remains: the Roman bank south of Hoogstraat 0 was eroded and in Hoogstraat I–IV lay in front of (east of) the Merovingian/Carolingian bank. Since a fragment of the Roman bank has remained intact in Hoogstraat 0 it is unlikely that it was far from the original bank line from Hoogstraat I–IV. Significant changes will not have occurred in the Hoogstraat area between the Roman and the Merovingian Period.

The original bank from Dorestad's initial period had a virtually straight course, and only in the north, at Hoogstraat 0, did the riverbed begin to bend slightly eastward. At first the left bank was steep and it must have been scoured, though it is

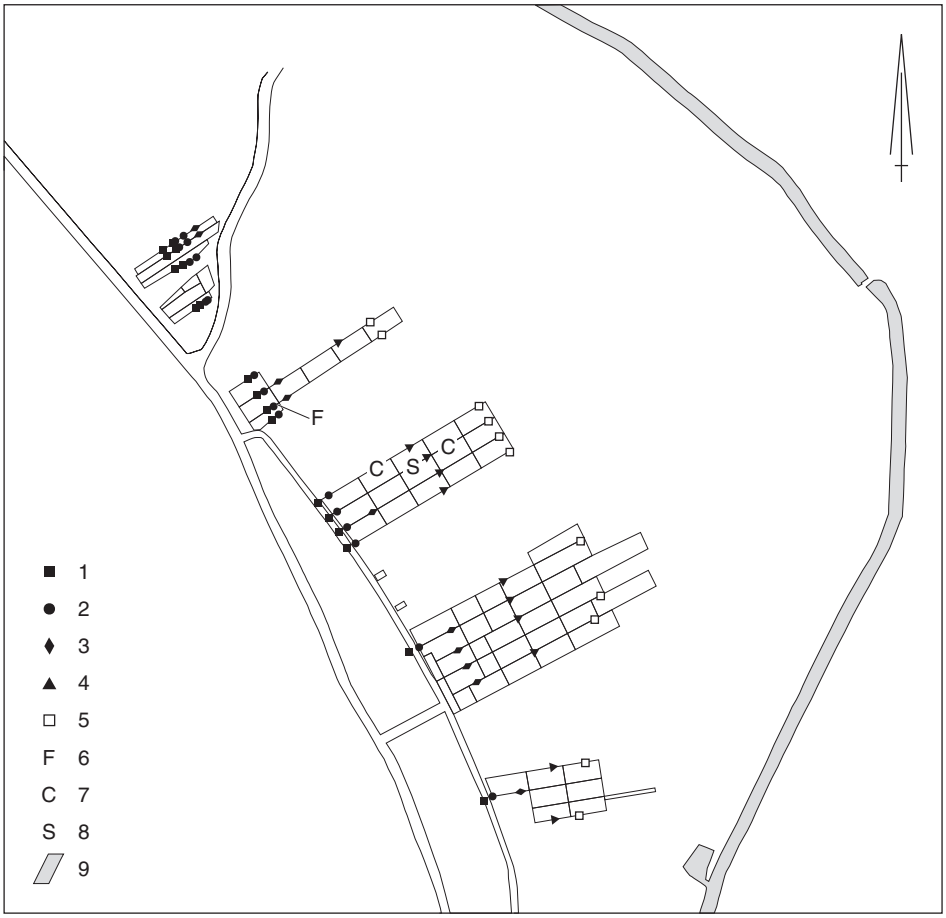


Fig. 14 Dorestad Intersections of the successive riverbank lines.
Legend:
1 reconstructed 'original' bank from the Dorestad period at the surface level of that time;
2 line of incision of the 'original' bank observed in the vertical sections at 3 m + NAP; of the two incisions observed in Hoogstraat 0, the oldest dates from the pre-Dorestad period; the second (youngest) reconstructed bank line at surface level is therefore the 'original' one there;
3 end of the riverbank zone with the sharply dipping layers;
4 end of zone 2 with the horizontal stratification;
5 end of zone 3 (in Hoogstraat III and the southern part of Hoogstraat I the end of zone 3 is eroded);
6 fykes;
7 creel;
8 ship remains;
9 current river.

questionable whether this continued for long since all sections show that a complex of alternate sandy and clayey layers was deposited against the steep original bank. The bottommost (oldest) of these layers still have a sharp drop, whereas the younger horizons are much flatter. It is clear that the original left bank had begun to silt up: the actual water-holding riverbed began to shift eastward. Judging from the information available, the silting-up process began immediately or shortly after the first incision of the riverbed. The cause of the silting-up of the bank in the Hoogstraat area probably lies further south. There, the river probably started to cut into its left bank, creating a bend which widened increasingly to the west. As a result, the pressure further downstream on the left bank along Hoogstraat decreased, making way for a process of bank accretion.
Bank accretion has been established in all the Hoogstraat sites on the basis of the sections. There are, however, indications that the process of accretion did not take place everywhere at the same speed. In Hoogstraat 0 accretion appears to have begun in the Roman Period. Elsewhere, the possible Roman sedimentary layers have been eroded, but at Hoogstraat 0 part has been preserved between the two incisions. Accretion layers, or in other words a complex of sediments deposited under a more or less steep slope against a line of incision, are also found in Hoogstraat 0 against the original (Merovingian-Carolingian) bank. The youngest (east) complex of layers of bank accretion is not broad here, especially if one considers only the higher parts of the complex above 3 m NAP. In sections AA–BB and CC–DD no clearly sloping layers are to be found above this level east of square 8 or 9.
Nor in Hoogstraat IV does the complex of sloping accretion layers in front of the original bank above 3 m NAP appear to have been much broader than *c.* 20 m (GG/

HH-5/6 or 7). Further south, the corresponding deposits were certainly broader (for example: II–JJ, squares 2/6; C–D, squares 2/5) or 8?!; KK–LL, squares 2? /7?. The conditions for accretion of the original bank were apparently more favourable at the south sites (Hoogstraat I–III) than further downstream at Hoogstraat IV and 0. At the latter two locations the scouring effect of the river on its left bank must have been stronger. In the north section of the excavation area accretion of the original bank was apparently less than in Hoogstraat I–III.
This difference in growth rate may have meant that the left bank of the Rhine along Hoogstraat followed a somewhat winding course at a comparatively early stage, with a slightly convex bend in the south and a gentle concave bend in the north. It is, furthermore, feasible that the slightly convex section at Hoogstraat I–III had a gentler and broader slope than the section north of Hoogstraat II where the distance between the land surface and the actual river course was perhaps shorter, so that the bank sloped more steeply. This conception, however, is highly hypothetical. The changes to which the original bank was subject cannot be reconstructed step by step. The sections do not provide sufficient leads for us to do so. In fact, in most of the sections it is even difficult to recognize with any certainty the east end of the complex with the sloping horizons deposited on the Late-Merovingian riverbank. This end is theoretically important enough for it marks the transition from the original bank zone to zone 2, which is characterized by the horizontal position of the sedimentary layers. In practice, however, the transition is often difficult to localize, precisely because it is so gradual. Nevertheless in figure 14 an attempt has been made to do so. In it the points are indicated – as far as possible – where the most easterly sloping layer cuts the 3 m NAP level. Excavation of Hoogstraat I led to the conclusion that even in the case of low (summer) water levels the river would still have reached this level.[6] Above 3 m NAP the bank may therefore frequently have lain dry. The end of the sloping layers complex against the original bank would then, at a certain point in the development, have formed the foot of the slope leading from the riverbed to the top of the bank.
This 3 m NAP-line of the foot has been reconstructed in figure 14 by joining up the above-mentioned points of intersection. This line is anything but reliable: it is based on too few points and these in turn are often uncertain. For instance, the end of the sloping layers rising up against the original bank in Hoogstraat I appears to run through squares 5 or 6. On the basis of section C–D one might assume, however, that this line ran further eastward, as far as square 8. Uncertainties of this kind are to be found elsewhere in the Hoogstraat excavations. Nevertheless, the 'end line' in figure 14 does give an impression of the distance across which the original bank shifted eastward as a result of accretion. It is clear that the bank silted up along the whole line of Hoogstraat, but the result of this process was less in the north than in the south of the excavation area. The cause has already been mentioned: greater pressure by the river on the northern section of the Hoogstraat bank at the time that the process of accretion was taking place.

2.2 The shoal in front of the bank (zone 2)

In this zone the position of the sediments is no longer influenced by the original bank. They are predominantly horizontal, at least as far as they are present in the sections. It is worth remembering that the sections only provide information about comparatively superficial sediments. The lower limit of the observations lies between approximately 2 and 2.50 m NAP. The upper limit does not exceed 3 or 3.50 m NAP. The disturbed topsoil (above this) no longer yields any information as to the position and nature of the sediments. Up to a level of 2.50 or 3 m NAP the deposits in this zone consist of generally fine, occasionally, somewhat coarser sands alternating with thin, very sandy bluish-grey horizons. Above 3 m NAP only (sandy) clay horizons occur. In this zone the present surface in most of the sections is at *c.* 4 m NAP, the sole exception being Hoogstraat IV, which we shall return to later (chapter II 4).

6 Van Es & Verwers 1980, 47. The height of the oldest revetment from Hoogstraat II could point to a somewhat lower water level (chapter III 1).

In the publication on Hoogstraat I it has already been argued that the sedimentation in zone 2 must already have reached a level of about 4 m NAP before the end of the Dorestad period (*i.e.* before *c.* AD 900).[7] A Carolingian sedimentation level of at least 3.50 m NAP is at any rate beyond doubt. This means that the zone lay dry in the summer, if we assume a normal (summer) water level of no more than 3 m NAP. It would then have formed a passable shoal in front of the actual bank zone, but would have been submerged during high water levels, forming a shallow between the bank and the deep part of the riverbed. The sections do not allow a precise determination of the time it took for the shoal to develop, but our impression is that was formed within a short time. In view of the horizontal position of the sediments in zone 2, our opinion is that, at a given moment, the river rapidly retreated from the (direct front of) the bank zone and shifted the deeper part of its bed eastward (to zone 3) in one or at most a couple of phases.

In Hoogstraat I, zone 2 was clearly present in squares 6/13 and possibly 8 or 9/13, if squares 6/8 or 9, where the layers at the base of the section sometimes showed a gentle slope, can still be considered as belonging to zone 1. Zone 2 is clearly and entirely present in the west-east sections of Hoogstraat II and IV. In Hoogstraat 0 only the west part of zone 2 is visible. The sections break off here before the east end of the zone has been reached. In Hoogstraat II a sloping band of clay was encountered in the basal sand about halfway through zone 2, at the bottom of section II–JJ (squares 10–12, between *c.* 3 and 2.50 m NAP). This band of clay would suggest that at a certain moment in the development of zone 2 the beginning of the deep part of the riverbed was located here, indicating that the zone did not reach its final length in one phase, but in (at least) two. The evidence, however, is weak, for the band of clay may possibly be a purely local phenomenon. Similar sloping horizons were not observed anywhere else in the subsoil of zone 2, nor were they found in the (not illustrated) sections of Hoogstraat II which run parallel to II–JJ. The latter sections do not usually go much deeper than 3 m NAP, so the sloping band of clay may have gone unobserved.

Section II–JJ has another peculiarity: a broad depression in the basal sand approximately half a metre deep and filled with clayey sediments (squares 7–9). This depression must have been fairly extensive since it is more or less easily recognizable in the other west-east sections of Hoogstraat II (not illustrated) in approximately the same place. The bottom layer in the depression in II–JJ, squares 7/9, was highly polluted with charcoal and/or wood remains. The black in the section drawing is slightly exaggerated, for it implies that this layer also contained a lot of settlement refuse in the form of sherds and bones, which was not the case. Nevertheless it is stratigraphically clear that the depression silted up in the Dorestad period. It is uncertain whether the depression ever lay on the surface of the shoal in zone 2, in other words: whether it was still present when this shoal had silted up to such a high level that its surface stood clear of the water and was passable during the summer water level. Judging from the level at which it occurred (below 3 m NAP), this is doubtful.

Depressions in the sandy basal layers were also observed in other places, as, for example, the hollow at about 3 m NAP in the southern west-east section of excavation trench 386 (also in Hoogstraat II) in which the ship fragments were found (this chapter under 3.6). However, this depression was probably also covered with sediments before the shoal section concerned became passable. As far as we can ascertain, the surface of the shoal was predominantly flat at the time it became regularly accessible. Any hollows in the sandy subsoil would already have been levelled over by clayey sediments, and the surface would have been no more than gently undulating.

We shall now pursue the question of whether the shoal developed in one go or in phases. With regard to Hoogstraat I, the answer is as follows:[8] the shoal did develop within a short time, but in phases. The shoreward part silted up during each phase to

7 *Van Es & Verwers 1980, 47.*
8 *Van Es & Verwers 1980, 47.*

approximately 4 m NAP. The riverside end continued to form a gently sloping beach, which if located between 3 and 4 m NAP, regularly stood clear of the water and was passable. Only on the part that had silted up to a higher level were permanent structures (causeways) built. The shoal gradually widened in easterly direction and the structures became longer as the higher part became broader. This conclusion is generally corroborated by the section data from the other Hoogstraat excavations. Sustaining arguments can be found in the position of the layers showing a high degree of human influence (the black layers in the section drawings). The situation is clearest in section II–JJ which is why we have chosen it to demonstrate our views. The black layers in it are actually present over the entire length of zone 2, and especially between *c.* 3 m NAP and the underside of the disturbed topsoil at *c.* 3.50 m NAP. A few are also found in zone 3 (east of zone 2). The various layers do not all reveal the same phenomena. The black layer in squares 11/13, immediately below the topsoil, is the oblique cut of a ditch whose base is at *c.* 3 m NAP. The level at which the ditch was dug lay in the topsoil, so at least at, but probably above 3.50 m NAP. In the west, a highly polluted layer runs down the slope of the bank zone (zone 1), only to continue horizontally in square 6 – which we already count as zone 2. The base of it continues roughly horizontally at *c.* 3 m NAP as far as square 8, and drops slightly in the above-mentioned depression (which had already filled up by then). We consider the section in squares 6–9 as the beach in front of the original bank zone, which in the summer season generally lay dry and where the sediments washed in during high water levels mixed with the settlement refuse.

The same phenomenon repeats itself several times in an easterly direction. At the east end of square 8 the black layer rises, or, put another way: the black layer declines here from an (eradicated) level in the topsoil over a short distance before running more or less horizontally in square 9 just above 3 m NAP. Possibly a structure which had been built on the first section of the shoal, which had by then silted up to above 3.50 m NAP, ended in square 8. The sloping part of the black layer in square 8 would then have been formed against the end of this structure, and the horizontal part on the beach in front of it. Another possibility is that the beach in front of the bank zone originally continued as far as the east end of square 9. We do not know which of these solutions is correct. The temporary end of a structure was undoubtedly located at the division between squares 9 and 10, for here begins a black layer descending from the topsoil which marks that end. The structure itself must therefore have been located in the topsoil (and higher than 3.50 m NAP). On the lower part of the shoal in front of the structure the polluted layer again lies more or less horizontally, with its base at 3 m NAP (squares 10/11). We would also draw attention to the black layer sloping downward from the topsoil at the beginning of zone 3 (square 15). It also marks the end of a construction phase. This layer has a noticeably steeper drop than the previous one: the transition from shoal to riverbed was shorter in zone 3. As far as zone 2 is concerned, the observations in section II – JJ lead to the following conclusion: this zone developed in two or three phases. In the first phase, a beach developed in front of the original bank zone in squares 6/8 or 9 which subsequently silted up to at least 3.50 m NAP. In the course of time the beach shifted to squares 9 or 10/13. This too became higher due to sedimentation and was finally brought into use, or at least structures were built on it. Where the deep part of the riverbed was located during the formation phases of the shoal is not entirely clear, but (part of) it may still have been located in (the east part of) zone 2 during the first phase, and during the last phase it was certainly in zone 3.

The picture outlined here corresponds on all the main points with that of Hoogstraat I, except for the total length of zone 2 which is 10 to 20 m longer in Hoogstraat II. The end of zone 2 is located at the spot where the basal sand from about 3 m NAP starts to show a stratigraphy with a sharp easterly decline. This point could be clearly established in Hoogstraat I, and the same applies to Hoogstraat II and IV. In

Hoogstraat 0 it must be located east of the excavation. The situation in zone 2 differs in Hoogstraat III. Section KK–LL reveals peculiarities which were not observed in the other Hoogstraat excavations. They indicate that in Hoogstraat III the process of sedimentation in zone 2 was less continuous and more turbulent than further north. In KK–LL a cut can be observed at the east end of square 6 running downward from at least *c.* 3.20 m NAP and disappearing into the subsoil in square 7. This line of incision cuts the horizontally deposited older sediments west of it. We consider it to be (part of) the western edge of the deeper part of the riverbed where, in contrast to the other Hoogstraat sites, its presence is characterized by traces of erosion. This deeper section of the riverbed has a turbulent sedimentation pattern. The most striking element in it is a ridge of coarse sand with a top at *c.* 3.30 m NAP. In section KK–LL this ridge is clearly recognizable, approximately in the middle of square 7; the western edge is shown in figure 13*. It was also observed in the opposite sections (not illustrated) of Hoogstraat III. The direction of the current at the time this deposit of coarse sand was being formed can be reconstructed from the position of the ridge. It appears to run parallel to the original bank zone. The generally more clayey sediments covering the coarse sand ridge originally showed a marked decline from west to east, and did not become horizontal until square 8, where one finds a similar situation to that of zone 2 in the other Hoogstraat sites. The stretch with the horizontal sediments is surprisingly short. The transition to zone 3 is located in the middle of square 9.
Another peculiarity of zone 2 in Hoogstraat III is that the polluted layers do not drop much below 3.50 m NAP. One might wonder whether this implies that the Hoogstraat III site had silted up to a higher level when it was taken into use. The coincidence with which the anthropogenic elements cut through the sections is, however, so great that the above observation should not be taken too seriously. Whatever the case may be, it is remarkable that even the present surface level in Hoogstraat III, zone 2, is at least half a metre higher than anywhere else in this zone. In figure 14, the east ends of zone 2 are indicated for all the Hoogstraat excavations as far as they can be inferred from the information available. They appear to lie in a line which bends sharply to the south of Hoogstraat I. The shoal in zone 2 therefore became convex in shape at the end of its formation. This final limit of the shoal approximately marks the place apparently occupied by the western edge of the deeper part of the riverbed at a certain moment during its shift eastward. The formation of a convex bend in the Rhine along Hoogstraat began to manifest itself clearly. The direction of the current, especially in Hoogstraat III, drastically changed with respect to the old direction, parallel to the original bank zone. The turning point of both current directions must have been situated a short distance south of Hoogstraat III. It now becomes understandable why the sedimentation conditions at this site in zone 2 were more turbulent, sometimes even erosive. Hoogstraat III cannot have been far from the point of transition from a probably already concave river bend further south to an increasingly convex bend along Hoogstraat. The apex of the latter bend lay opposite Hoogstraat I and II.

2.3 The deeper part of the – Carolingian – riverbed (zone 3)

Characteristic of this zone is the eastwardly dipping stratification (alternate fine sandy and bluish-grey sandy clay layers) of the subsoil. These inclined layers were certainly deposited in a riverbed. The angle at which they dip varies. It was still fairly low at the transition from zone 2 and 3, but further east the drop became generally steeper, more or less corresponding to that of the layers deposited in zone 1 against the original bank. The angle of dip continues to show great variation in the east part of the zone also. The sharply dipping sediments probably point to a considerable rate of flow. It goes without saying that during a certain period, which was when Dorestad existed, the actual bed of the river – *i.e.* the deeper and navigable part –

ran through zone 3. In zone 3 the riverbed was also in motion, for it shifted further and further east. The complex of dipping sediments reflects, of course, the silting up of the left bank.
Unfortunately, the sections do not offer any possibilities of measuring the rate at which this process took place. The thinness of the sedimentary layers might indicate a high rate, though the differences in composition of the layers must correspond to differences in sedimentation conditions. The sandy layers were probably deposited in faster flowing water than the bluish-grey bands of silt. Possibly the latter were deposited in the summer season, and the former in the winter months, for they are most numerous at places where the layers dip the steepest, sometimes as many as one or two per linear metre. If one could consider each pair of sand and silt layers as the harvest of one year's sedimentation, one would have a measure for the rate of silting up. This would amount to 1 or 2 m per year on average where the edge of the bank was steep. At places where the layers are less steeply inclined, the rate would possibly have been higher. Starting from this hypothesis, the river would have required no more than half a century to run the wide stretch of zone 3 in Hoogstraat I, II and IV. The absolute dates available for Hoogstraat I point in the same direction. As we shall explain later (chapter VII 1–2), the formation of zone 3 must have taken place roughly in periods 2A and B of Hoogstraat I, *i.e.* between 700/725 and 775.
The silting up speed within the period in which zone 3 developed was naturally not uniform. This is apparent from the differences in the angle of dip at which the riverbed sediments were deposited. It is interesting to note that in all the sections of Hoogstraat I–IV the layers of sediment in the subsoil at the end of zone 3 dip sharply (the incomplete sections of Hoogstraat 0 do not provide any information about zone 3). From this, we may conclude that the silting up speed at the end of the zone was relatively low. The west edge of the actual riverbed remained more or less stable for a long time here, only shifting a small distance. In Hoogstraat IV the last layers of zone 3 generally appear to dip slightly less than at the sites south of it. Possibly the slope of the edge of the actual riverbed was less pronounced here, which is understandable since Hoogstraat IV lay in the convex river bend which had formed along Hoogstraat.
The shape of this river bend at the end of zone 3 can be seen in figure 14. The tendency which had caused a somewhat convex left bank to develop had continued. Comparison with the line connecting the end points of zone 2 (or rather the starting points of zone 3) shows that the concavity of the bank line has greatly increased. The apex of the bend must have been located approximately opposite (the north edge of) Hoogstraat I. The bend, the southern part of which must originally have been somewhat wider (see the description of zone 4 below), has become clearly asymmetrical. The distance between the original left bank and the east end of Hoogstraat 0 cannot have been great.

2.4 The sandbar – from the Post-Dorestad period – at the east end of the sections (zone 4)

The boundary between zones 3 and 4 lies at the west end of the coarse sandy sediment of which zone 4 consists. This boundary raises a question: is this the end of zone 3 or the beginning of zone 4? In the Hoogstraat I and III sections zone 3 does not appear to have a completely 'natural' end. The deposits in zone 4 cut off older layers, including those showing anthropogenic influence. This discontinuity in sedimentation indicates that the riverbed was eroded before the coarse sediments were deposited, which is not surprising so close to the transition from concave to convex river bend. Erosion will have been strongest closest to the turning point of the bend. Here possibly lies the explanation why the complex of sharply dipping layers which generally mark the end of zone 3 is absent in Hoogstraat III and in the southern sections of I (G–H and I–J): it may have been eroded. This is the reason for

our previous remark that the southern part of the river bend was originally wider at the end of zone 3. It is not likely though that this erosion was extensive. The river edge of zone 3 would have been pushed back over a distance of, say, 20 or 25 m at the most. In Hoogstraat III and (the south of) I, the boundary between zones 3 and 4 is in fact the beginning of zone 4 rather than the end of zone 3. Further north, this is no longer the case. There was no question of any discontinuity in Hoogstraat II and IV. Here, the deposits in both zones merge into one another without any interruption: erosion was not detected here. The end of zone 3 and the beginning of zone 4 converge here.

The deposits in zone 4 consist, for the greater part, of layers of sand. Their composition varies from fine to coarse and often gravelly sand. On the whole, these deposits are much coarser than in the other zones at the base of the sections. In zone 4 the sand was also often deposited to a much higher level, to over 4 m NAP. Somewhat clayey layers are sporadically found in the sandbar, especially in the western part of the zone. The sandbar is covered by a brownish-yellow, very sandy clay, and its structure is highly complex: the section diagrams certainly do not do it justice in this respect. Section II–JJ contains a virtually complete cross-section through the bar, almost as far as the present bed of the Rhine. In the western part of the zone, as far as square 33, the layers are horizontal, and a horizontal stratification was also observed in the sandy sediments. This horizontal position distinguishes zone 4 from zone 3 with its dipping stratification in the lower layers, and in this respect, zone 4 reminds one of zone 2. The way in which this part of zone 4 developed is basically similar to that of zone 2: sedimentation in a shallow part of or outside the actual riverbed on the inner side of a river bend.
In square 33 the picture is different. Layers dipping eastward are again found between squares 33 and 42. Possibly the western edge of the actual riverbed was located here at a certain stage so that the sediments west of square 33 were deposited from this bed. East of square 42 the stratification is again horizontal and now slightly undulating. This part of the section has been disturbed by recent digging to a great depth. The sediments found here may have been deposited from the present Rhine bed. One gets the impression that the process which had previously taken place in zones 2 and 3 has repeated itself – probably twice – in zone 4. In the first place the river has shifted its left edge: approximately from square 23 to squares 33–42. This probably took place rapidly, in fits and starts. A shallow developed in squares 23–33 which filled up with sediment, and a subsequent 'jolt' then brought the actual riverbed back to more or less the spot where it is now located.
The western part of zone 4 was silted up to a considerable height. In section II–JJ, squares 22–36, the ground level was 5–5.25 m NAP. In Hoogstraat III (section KK–LL, squares 12–19) it must originally have been at the same level. In KK–LL, squares 12–13, the surface was still intact; to the east of this area it appears to have been artificially lowered. In squares 13–20 a series of trench-shaped pits became visible immediately below the recently disturbed topsoil which cut each other from west to east in squares 13–17. These pits had a polluted mixed fill and were undoubtedly dug to extract sand and gravel from the subsoil after which they were filled up again with the unusable clayey material covering the sandbar. This sand and gravel extraction took place – as elderly people living in the neighbourhood still recall – 'before the war' (1940–'45), and resulted in the lowering of the ground level by about 50 to 75 cm. The base of the pits is approximately 3.50 m NAP; the depth below the original surface was therefore 1.50–1.75 m.
Similar pits were also found in the eastern part of section II–JJ, though their shape is far less regular. At the far east end, the deepest pits go down to *c.* 2.50 m NAP (squares 50–56); in the western adjoining part to *c.* 3 m NAP (squares 41–50). It is

highly unlikely that the recent pits in Hoogstraat II were deeper than those in Hoogstraat III, for they would then have been over 2 m deep! If one assumes the same depth, the surface level must have been at *c.* 4.50–4.75 m NAP in square 41, sloping down to *c.* 4–4.25 m NAP near to the present riverbank. In squares 35–40 the surface level, which is still intact there, already reveals a tendency to dip. This decline begins at the very spot where the sloping layers in the subsoil indicate the edge of a riverbed.
This means that the western part of zone 4 developed into a ridge in the landscape. East of this ridge the terrain became lower and sloped down towards the still existing Rhine bed. The top of the sand ridge in II–JJ, squares 22–39, consisted of sandy clay. This layer of clay probably developed when the west edge of the riverbed was still halfway through zone 4. At any rate, the clay layer dips from square 36 in an easterly direction. Whether the eastern, lower part of zone 4 was covered with clay can no longer be determined, due to recent digging. It is possible that sediment of this nature was no longer deposited here since the Kromme Rijn was rendered inactive shortly after arriving at its present position (see chapter IV).

Clayey sediments similar to those covering the ridge at the beginning of zone 4 were also deposited further to the west. The sections of Hoogstraat I, II and IV clearly show that these deposits spread over part of zone 3 as well, though the extent to which they penetrated west can no longer be ascertained, for they quickly merge into the disturbed topsoil. In the Hoogstraat I sections the deposits can only be traced for a short distance. In Hoogstraat II, they can still be observed as far as square 16 of section II–JJ, and in Hoogstraat IV the uppermost clay layer peters out in section GG–HH, square 15, in a probably excavated depression dating from the Dorestad period. This depression, probably a ditch, is one of the youngest traces of Carolingian activity in the riverbed. The ditch was still largely open when the clay was deposited. 'Young' clay was also discovered in the excavation sites of Hoogstraat II and IV in many spots at the end of the complex of structures in the riverbed, particularly in depressions belonging to the final phases of this complex. In the book on Hoogstraat I, the clay in question is referred to as Post-Carolingian, which now appears to be less correct: the clay was deposited during or shortly after the Dorestad period. The latter is most likely because no traces of human influence were observed in the clay itself. The section diagrams suggest that the clay concerned was deposited synchronously, and prior to the formation of the ridge at the western edge of zone 4. In chapter IV 2 it will be explained that this cannot have been the case.
As previously stated, the western expansion of the clay layer deposited from zone 4 can no longer be precisely determined. Zone 2, however, had already silted up to a level of at least 3.50 m NAP, and probably even higher, to just below the present surface level before it was taken into use for habitation. By contrast, at the moment that the development in zone 4 began, the surface level at the end of zone 3 would have been somewhat lower. After the formation of the sand ridge in zone 4, the end of zone 3 probably formed a depression in which the water which flowed over the ridge during high river levels collected and the clay was deposited. It is remarkable that the surface level in Hoogstraat III is slightly higher than in zones 2 and 3 of the other sites. Apparently sedimentation in Hoogstraat III took place more rapidly than elsewhere, probably not only at the time zone 4 was being formed but even earlier. At this site there was less room for the deposition of sediments than elsewhere in the Hoogstraat area.
Zone 4 is an example of major changes in the landscape. In the course of time the river shifted through this zone eastward over a great distance. Section II–JJ touches the existing river bend only a short distance downstream from its apex, indicating the virtual maximum shift of the river which was at least 400 metres, *i.e.* about twice as much as in zones 1–3. The time taken by zone 4 to develop is probably no longer than that of zones 1–3. The fact has already been mentioned that the

sediments in zone 4 are coarser than those previously deposited by the river in the Hoogstraat area. Moreover, the coarser sediments were deposited to a higher level, to over 5 m NAP. The surface in zones 2 and 3 was generally not much higher than 4 m NAP. All this points to a radical change in the river regime.
What can have happened? The best explanation in our view is that the Kromme Rijn became obstructed downstream from Dorestad (or perhaps already from Dorestad's successor, Wijk).This caused the water level in our study area to rise and the river's carrying capacity to decrease. Sediments which had previously been transported further downstream now remained in the Hoogstraat area and flooding was frequent. As a result, a relatively high ridge was deposited on the inside of the river bend excavated by us. That the area west of this ridge (zones 2 and 3) did not silt up higher is probably due to the river becoming blocked fairly quickly. It may, however, be assumed that these zones frequently had to contend with flooding during the formation of zone 4. The assumption has already been expressed above that the end of zone 3 silted up to a somewhat lower level than zone 2 and the rest of zone 3 and, consequently, at least part of the floodgate collected in the depression which developed in front of this ridge.
Where exactly the obstruction in the course of the Kromme Rijn occurred is not actually of great importance in our case. Formerly, it was often assumed that the mouth of the river Oude Rijn at Katwijk must have silted up as early as the 8th or 9th century, but this has since proved to be a matter for debate. This Rhine estuary probably did not silt up before the second half of the 12th century.[9] The obstruction occurred further upstream according to current opinions. The Oude Rijn silted up between Utrecht and Harmelen (shortly?) after the 8th century.[10] Subsequently, the Kromme Rijn was no longer able to drain into the Oude Rijn, but only into the Utrechtse Vecht. This reduction in drainage possibilities will have resulted in the blockage of the water of the Kromme Rijn, which in turn led to this river silting up. The river course still present nowadays must be regarded as a fossil riverbed. Before the silting up process began, the actual (water-transporting) bed must have been much wider than it is now.[11] The construction of a dam in the mouth of the Kromme Rijn at Wijk speeded up a natural process that had begun some time earlier.[12]

2.5 On the original bank (zone 5)

Zone 5 is located west of zone 1 and, for the most part, no longer belongs to the riverbed area but to the settlement site on the bank. Only the east end, situated directly near or just on the edge of the sharply dipping part of the original bank, can be considered as part of the riverbed area. In fact the zone only counts in Hoogstraat 0 and IV, for elsewhere the zone on the bank is only just grazed by the excavations. Most of the sections correspond with regard to the height of the present surface level in zone 5. West of Hoogstraat this is at 5 m NAP or even slightly more. This level applies to the entire strip of land between Hoogstraat and Cothense Zandweg. Even before the start of the Dorestad excavations, this strip was largely built over, so that little research was possible here. The demolition of houses on either side of Nieuweweg in 1980 offered the opportunity of digging four excavation trenches (nos. 524–527), almost adjoining the southwest section of Hoogstraat I. These four trenches are clearly located outside the riverbed and are only dealt with briefly. The surface in trenches 524–527, *i.e.* in the strip between Cothense Zandweg and Nieuweweg, was 5.30–5.40 m NAP. The level from which the settlement traces of Dorestad had been dug was no longer recognizable. It had been incorporated into the topsoil which had often been disturbed here to a depth of well over one metre. The occupation level of Dorestad possibly corresponded to the present surface level, or it may have lain some dozens of centimetres below it. The latter case is the most probable: the surface may have been slightly raised after the Dorestad period by recent building activities along Nieuweweg.

9 Van der Linden 1982, 61.
10 Berendsen 1982, 168, where reference is also made to Henderikx 1980, 247.
11 Berendsen 1982, 98–9.
12 Dekker 1980.

In Hoogstraat IV, the surface at the time of the excavation lay at the west end of zone 1 at about 5 m NAP. It dipped slightly in the direction of the river. Here too, the Carolingian surface level may more or less correspond to the recent surface.

In this respect, Hoogstraat 0 poses us a problem. In section EE–FF the surface level at the west end does not exceed 4.75 m NAP, and in the two most northerly sections, the surface level is even lower: 4–4.50 m NAP. Section AA–BB in particular is remarkable in this respect for here the surface level in the west dips again to 4 m NAP. It is questionable whether the bank here was really lower in the Dorestad period. The limited thickness of the disturbed topsoil appears to indicate that soil was dug away here in recent times, possibly in connection with the construction of Wijkerweg, which branches off from Cothense Zandweg in the direction of Neerlangbroek, or with the construction of the grain silo De Eendracht (which has since disappeared). Wijkerweg is old, certainly medieval; De Eendracht was built more recently. The location of sections AA–BB and CC–DD is wedged in between both features. The Dorestad settlement-traces are at about the same height in Hoogstraat 0 as elsewhere in the original bank zone. The corresponding surface level cannot have been much lower. It must also have been located here at roughly 5 m NAP, with a slight eastward dip towards the river.
The subsoil of zone 1, which consists of sandy clay, is very 'turbulent' in Hoogstraat 0 and I, revealing all kinds of natural cutting lines. Most of these do not continue as far as the recently disturbed topsoil and are deposits preceding the Dorestad period which will not be discussed here. Finally, we shall take a closer look at two – natural – depressions in Hoogstraat 0. One of them is visible in section CC–DD, squares 3–5, though it is uncertain whether it existed at the time of Dorestad. The fill consists of natural, sandy clay sediments. The layer directly beneath the topsoil is characterized by a yellowish-green colour which must have been caused by phosphates, and consequently, this layer has been shown as polluted in the diagrams. This pollution may very well have been caused after the Dorestad period by phosphates washing in from the occupation layer which was situated at a higher level. Finds indicating that the layer formed during the Dorestad period were not found. The topsoil appeared to subside into the depression. This may be connected with the presence of a recent (at least, Post-Dorestad) trench or ditch obliquely cutting the depression. At the site of the depression, the Dorestad settlement traces were surprisingly few in number, and those that were present cut the fill of the depression. All in all, we assume that this depression, which was of a limited size, did not play any part in the topography of Dorestad. It was no longer visible in the south section (not illustrated) of excavation trench 268 and probably preceded the period of occupation.
The reverse is true of the other depression which was located in squares F/G-5/7 and was more or less circular with a diameter of over 15 metres. The base, which was below 2 m NAP, was not reached during excavation (fig. 15*). The depression appeared to have developed naturally. The bottom layers of the fill consisted of unpolluted sediments, whereas the top layers were highly polluted with settlement refuse, among other things. It is clear that the depression filled up during the Dorestad period, or even perhaps that the uppermost 50–100 cm were deliberately filled in; furthermore, there was a large number of posts in the depression indicating that the latter was partially open and formed an obstacle, certainly for part of the settlement period. The formation of the depression is difficult to explain. We assume that it was formed by the riverbank collapsing as a result of the strong current when the river cut into it for the second time. At any rate, the depression is stratigraphically younger than the oldest line of incision of the riverbed. The line of incision of the second bed and the east rim of the depression must have met at surface level. In short, the depression formed an irregularity in the bank of the Rhine at the time of Dorestad.

3 Traces of human activities in the riverbed area

The horizontal sections or plans give a far more detailed insight into the activities of the inhabitants of Dorestad in the riverbed than the vertical sections or sections (see chapter III), so we can confine ourselves to some remarks mainly concerning the relation between human activities and the various stages in the behaviour of the river.

3.1 The beginning of the activities (zones 5 and 1)

Of the three ^{14}C-dates mentioned in chapter II 2.1, two (those from Hoogstraat 0) relate exclusively to the behaviour of the river and have no connection with human activities. The third, GrN-7447, 1305 ± 35 BP (*c.* AD 650), however, comes from a bank revetment in Hoogstraat II (more on this revetment in chapter IV 4.2). The rods around which the twigs of the wattle revetment were plaited went down to a maximum depth of 1.50 m NAP in the soil. The wattle itself had largely decayed; there were only a few remains from the base, located at a level of *c.* 2.20–2.50 m NAP. Assuming that the wattle screen was 50 cm in height, the upper side of the revetment can be estimated at about 3 m NAP. In this lies a corroboration of the assumption that the normal water level in the Carolingian riverbed did not exceed 3 m NAP, at least not in the summer season. From the projection of the revetment in the section (II–JJ, square 2) it appears to have been built very close to the original bank, when hardly any sediment had been deposited against it and the bank was still steep. The revetment is irrefutably the oldest sign of human activity encountered at Hoogstraat II.

The next traces of human presence are considerably younger stratigraphically. They consist of slight pollution (charcoal) in a layer observed in section II–JJ, square 2/3, between *c.* 3.75 and 2.70 m NAP, and formed at a time when the bank was far less steep. The traces of structures, as far as they were discovered in this zone, derive from a higher and therefore stratigraphically even younger layer. The pits and postholes in Hoogstraat II, squares A/G-1/3, do not generally go deeper than 3 m NAP, and are often far less deep. The tops of these pits and postholes must have been at a level (considerably) higher than 4 m NAP.

The same situation was observed in Hoogstraat I with the exception that there was no equivalent for the older revetment. Already in the case of Hoogstraat I the conclusion was that the activities on the (original) Rhine bank only really started when the bank had become (more or less) flat and silted up. This was when the structures of Hoogstraat I, period 1 were built. Nevertheless, (stratigraphically) older activities preceded them which could be classified in a period 0. The old revetment in Hoogstraat II would then belong to that period 0.

In this respect, Hoogstraat III has not yielded any convincing information: no clear period 0 phenomena were observed there. For that matter, zone 1 did not produce much information at all in this excavation. The only excavation trench from Hoogstraat III dug in this zone (no. 401) contains many traces from the Post-Carolingian Period which confuse the issue and which have probably virtually eradicated the Dorestad traces.

In Hoogstraat IV, convincing traces of activities are again found which, based on the stratigraphy, may derive from period 0 (section GG–HH, square 5). First of all the remains of two fyke nets (chapter VI 4) were discovered which were situated almost immediately against the original line of incision at a depth of *c.* 2.40–1.90 m NAP. These were followed by several polluted layers still with a sharp upward dip, which also lay close to the original bank. Unfortunately there is no ^{14}C-date for the fyke nets, but judging from the stratigraphy, they must have been about the same age as the revetments from Hoogstraat II or possibly slightly older. The sharply dipping polluted layer between 3 and 2.50 m NAP in section GG–HH, square 5, may, from the

point of view of stratigraphy, have formed at the same time as the construction of the revetments of Hoogstraat II or a little later, but it certainly does not belong to the time of Hoogstraat I, period 1, though this may possibly be the case with the sharply dipping polluted layer above it (between *c.* 4 and 2.80 m NAP).
The postholes of the structures in the riverbed in Hoogstraat IV, squares B/F-4/5, are remarkably deeper than in the comparable zone of Hoogstraat II, squares A/G-1/3. The deepest go down below 1.50 m NAP; the shallowest still reach down to 2.50 m NAP. The same is also observed in Hoogstraat 0, though to an even greater extent. The posts of the apparently oldest structures even reach a depth predominantly lower than 1.75, or 1.50 m NAP. Another remarkable feature of Hoogstraat 0 is that here the sediments with evidence of human influence lie right up against the original bank. The conclusion must be that the original bank in the north near Hoogstraat 0 and IV was less silted up and steeper when it was brought into intensive use than in the south at Hoogstraat I–II, and probably also -III.
Another similarity between Hoogstraat 0 and IV is that immediately in front of (west of) the oldest structures there are rows of small postholes close together: Hoogstraat 0, squares A/I-6/7; Hoogstraat IV, squares A/F-4. The rows run roughly north-south, *i.e.* parallel to the bank, and represent – in our opinion – frequently replaced wattle revetments. Some of these postholes in Hoogstraat 0 still go down to a depth of *c.* 3.00 m NAP, though most of them were far less deep: no more than 3.50–4 m NAP. The revetments must therefore have been situated right at the top of the bank. They cannot have served as protection against the river-water for they were too high up the bank. Perhaps they were meant to protect the (steep) edge of the bank from becoming damaged. Similar revetments were not discovered in Hoogstraat I–III, though it is possible that they were once there but went unnoticed. The Hoogstraat II revetment which was situated much lower does not correspond to that of Hoogstraat 0 and IV.
The oldest genuine structures appear to have been built on a steeper bank in Hoogstraat 0 and IV than at the other sites. An answer to the question of whether the oldest structures were realized everywhere contemporaneously can only be found by analysing the find material in relation to the excavation plans; this is described in chapter VII. We shall only briefly discuss the results of this analysis here. It does in fact look as if the building activities all started at about the same time. The intensive use of the bank, with which these structures are linked, began in the period referred to as period 1A in Hoogstraat I. The revetment in Hoogstraat II dated from an earlier period. The date of the revetment was determined not only by the ^{14}C-date GrN-7447 (*c.* 650 AD) but also by an archaeological item. Behind the revetment a Late-Merovingian, rough walled pot was found which had not so far been encountered among the pottery types characteristic of the Dorestad period 1A (fig. 120). The pot cannot be precisely dated but it could well date from the first half or middle of the 7th century. It is, at any rate, topologically older than the oldest find material from the riverbed area. On archaeological grounds, the Hoogstraat II revetment is also older than the structures from period 1A. During the construction of the revetment, the bank in Hoogstraat II was still steep. By the time the first structures were built along the whole bank line in period 1A the bank in Hoogstraat I–III had already flattened considerably, whereas in Hoogstraat 0 and IV it was still steep and less silted up.
The actual settlement traces in zone 5 will not be discussed here (see chapter V 3 and V 4).

3.2 The activities on the shoal and in the Carolingian riverbed (zones 2 and 3)
Structures in the form of causeways were built over zones 2 and 3. In Hoogstraat I this appeared to have taken place in phases. The causeways were lengthened in a number of consecutive stages, undoubtedly as the river receded and the shoal grew

in an easterly direction. Basically the same phenomena were observed in the other Hoogstraat excavations, where a similar phased development eastward of the complex of riverbed structures was seen. The fact that the level on which the causeways were built must have been over 3.50 m NAP, and probably up to *c.* 4 m NAP, applies to all the sites. This level corresponds more or less exactly to the surface level encountered in the excavation, and could, at most, have been slightly lower. An alluvial layer was observed at the end of zone 3 which must have formed at the end of the Dorestad period or (shortly) after. This Post-Dorestad sediment may also have extended over zone 2, but this can no longer be verified. However, that the site was substantially raised here after the inhabitants had abandoned this area, is out of the question.

3.3 Depths of posts

Wooden posts with a long point driven vertically into the soil were a vital part of the structures in the riverbed area and were even the only remains of these structures to be recovered during the excavations. If the posts went down deep enough, the bottom part of the wood could be preserved. Above *c.* 3 m NAP the wood had completely perished, and only a post-ghost was left, but even below 3 m NAP, wood was not preserved from all the posts driven down to this depth. It is theoretically possible that posts were removed during the Dorestad period, for re-use, for example, or because they formed an obstacle to the expansion of the complex, but hardly any evidence for this has been found. Nor were the posts of which no wood remained even though they had apparently penetrated deep enough into the soil, necessarily pulled out. The preservation of the wood is dependent on a range of factors: the type of wood itself, the thickness of the post, the nature of the sediment and many others. Which factors were of influence on which object is difficult to establish, but whether or not remains of a post have been preserved is irrelevant to the reconstruction of the developments in the riverbed area, and will not be dealt with.[13]

On the other hand it is important to take the depths of the posts (the level of the base of the posts or post-ghosts) into consideration here (see also chapter III 2.6). The depths of the posts vary enormously. The extremes for the entire riverbed area vary from >3.50 to <1.50 m NAP: this means a difference of over 2 m, and sometimes considerably more, between the deepest and shallowest posts. These extreme differences in depth can even occur over a short distance. It is by no means exceptional when two posts side by side and forming part of the same structure differ a metre or more in depth. Apparently standard-length building material was not used. At first sight an overall survey of post depths gives an impression of confusion, but on closer examination tendencies can be detected which surpass the individual differences. Certain zones or parts of zones or certain structures differ from others by the overall picture of their post depths. The tendencies become most clearly visible if one takes an overall look at the data. For this purpose the depths of posts have been divided into four classes: *a* >3.00; *b* 3.00–2.50; *c* 2.50–2.00; *d* 2.00–<1.50; in metres above NAP.

The frequencies with which the various 'post-depth classes' occur, are not the same everywhere. Significant differences can be observed within a single zone, as we have seen in the description of zone 1 where the depths of posts, particularly those from the easily identifiable structures, are on average deeper in the north than in the south. Hoogstraat 0 and IV are characterized in zone 1 by the frequently occurring post-depth classes *c* and *d*, whereas classes *a* and *b* are typical of the more southerly sites. Similar differences between the zones themselves were found in Hoogstraat I, but there the frequency of the greater post depths increased from west to east.[14] Furthermore certain structures stood out in Hoogstraat I, as, for example, those from the beginning of period 1A which differ in their remarkably regular plans with a

13 The wood remains themselves are of course important to our study. During the excavation, a sample was taken from most of the post stumps (unfortunately, this was occasionally forgotten). The botanical analysis of these samples has yielded important information (chapter III 2.5). The material was also of importance for ^{14}C-analysis (chapter VII 2). It was, unfortunately, unsuitable for dendro-chronological analysis: the posts used in the harbour area were young trunks with less than fifty tree rings.

14 Van Es & Verwers 1980, 48–9.

relatively large number of deeply set posts (classes *c* and *d*). The same applies to the structures at the east end of the complex (zone 3).[15]

The differences in post depths are due to at least two factors.

1 The desire (or necessity) to anchor a certain structure (or parts of it) more or less firmly in the ground. Even though standard-length building timber was not used, unnecessarily long posts were not, of course, used either. Unusually deep anchoring of a structure must be a sign of special care. The owner or client possibly had a special status and wealth to match. Another possibility is that the structure in question was intended for a special purpose. Differences in depth within the same structure may also be functionally determined. For example, the side-revetments of a causeway were possibly less deeply founded than the supports of a superstructure or building; repair posts were possibly less deep than the elements of the original structure.
2 Differences in the level from which the posts were driven in. Differences in resistance of the subsoil will not have had much influence since the sediments into which the posts penetrated did not differ much in this respect.

It is not always clear which of these two factors will have been of influence in a given case. Significant differences in post depths will probably have been the result of a situation as mentioned in factor 2, for instance: the difference in post depths between the north and the south part of zone 1. Another example is the increase in the depths of posts from west to east in Hoogstraat I. More local peculiarities – a structure which stands out from its surroundings – qualify for the 'human' explanation as in factor 1, or for a combination of the two factors.

We will now take a closer look at the post depths in zones 2 and 3, which together contain by far the largest proportion of all the riverbed structures. Shallow posts from class *a* are also found in great numbers all over zones 2 and 3, and, on estimate, account for one-third to a half of the total number.[16] Hoogstraat III differs from the other sites in its relatively shallow post depths, particularly seen in zone 2. Almost all the post depths there belong to class *a*. The deepest posts in this area fall into class *b*, with the odd exception falling into class *c*. These deepest posts are very rare indeed and form part of remarkably regular structures. Elsewhere zone 2 is characterized by class *c* and *d* posts, apart from those from class *a* which are also frequently found; class *b* is not found there. The picture of post depths is remarkably uniform in Hoogstraat I, II, and IV. No opinion can be expressed about Hoogstraat 0 because zone 2 has hardly been excavated there.

The difference in the depths of posts from Hoogstraat III can undoubtedly be explained by the unusual sedimentation conditions that prevailed there. The shoal here had silted up to a higher level than in the other sites when it was taken into use. The boundary between zones 1 and 2 is difficult to determine in Hoogstraat III: perhaps it would be better to include the area in squares A/G-5/8 in zone 1. This would then imply that the shoal in zone 2 hardly developed in Hoogstraat III, which is quite possible in the case of a spot so close to the turning point of the Rhine bend. The conditions in the other Hoogstraat sites differed from those in Hoogstraat III, but corresponded mutually according to the uniform depths of the posts. The shoal here was able to develop unhindered. As far as Hoogstraat 0 is concerned, this can only be assumed since there are no reliable data. The Hoogstraat II situation corresponds completely with that of Hoogstraat I with regard to the depths of posts in zone 2. The same probably applies to zone 2 of Hoogstraat IV, but the narrowness of the excavation makes it less easy to judge. The common feature is the presence of many surprisingly deeply dug posts (class *d*) in remarkably regular structures, about halfway through the zone. In Hoogstraat I they mark the beginning of period 2A. Their presence in Hoogstraat IV cannot be established with certainty. The sections do not supply any evidence that these exceptional structures were built as a result of unusual environmental conditions; in all probability the reasons were constructional.

15 See, for example: Van Es & Verwers 1980, figures 15b and 17b.

16 The bases of the posts and post-ghosts which did not penetrate deeper than 3 m NAP were not exactly determined (by measuring the height with a level). Most were no longer observed in the deepest excavation level. Only the NAP level of the points of the posts which were present there was measured. Unfortunately, omissions occurred: the levelling of the posts from the deepest excavation level was occasionally forgotten – which is understandable since the total number of posts and post-ghosts in Hoogstraat 0, II, and IV was at least 10–15 000. In the plans of figures 15, 16* and 18*, the posts which were found in the deepest excavation level in the riverbed area* (i.e. *not in zone 5) are indicated in black, although here too, errors were made. The number of 'black' posts was certainly greater than the illustrated plans suggest.*

The shallow posts from class *a*, which are found both in zone 2 and 3, probably come from less important construction parts.
In zone 3 the picture of the post depths is again more differentiated. In Hoogstraat III class *c* post depths are now well represented. The presence of those from class *d* remains exceptional: they are only found in a small concentration at the east end in squares E/F-12/14. There is now not much difference between these post depths and those from Hoogstraat I, though the pattern in Hoogstraat III is far more diffuse. Moreover it is uncertain which posts belong to the Dorestad period and which to later settlement, traces of which have been observed here. Of zone 3 in Hoogstraat II only the south part in squares A/C-13/19 corresponds to Hoogstraat I, but it does so very precisely: the greatest depths of posts all fall into class *c* and, at the east end, several into class *d*. In the north part of Hoogstraat II and in Hoogstraat IV relatively few remains of structures occur. Those which were built here were simpler than elsewhere: they consisted mainly of simple rows of posts. The depths of these posts can only exceptionally be rated class *c*, and usually belong to *a* or at the most *b*. The contrast between the remarkably deeply set posts at the east end of the causeway structures in Hoogstraat I and II (south) on the one hand, and the rows of shallowly dug posts in Hoogstraat II (north) and -IV on the other hand, is striking. It can only be explained by functional differences (factor 1).
Attention has repeatedly been drawn to the fact that the surface of the shoal in zones 2 and 3 had silted up to approximately 4 m NAP before any structures were built on it. This means that the construction posts were driven into the ground to a great depth. For instance, a post going down deeper than 1.50 m NAP – *i.e.* one of the deepest posts – was sunk more than 2.5 m into the soil. The posts there were not dug into the soil: no postholes were found during the excavation of the riverbed area. Digging a posthole would not have been practicable in the waterlogged and therefore unstable soil. Without well-point drainage we were unable to dig deeper than *c*. 2.50 m NAP, even though the subsoil is now probably drier than at the time of Dorestad. However, driving in the posts down to such a depth with simple tools was probably quite possible: see chapter III 2.3. As mentioned above, the posts had a long, sharp point.

One problem over which we have racked our brains, especially during the excavations in Hoogstraat I and II, was the question of whether the causeways had been artificially raised, and if so, whether any evidence of this could be seen in the sections. The conclusion in the Hoogstraat I study was that the latter was impossible. If there had been any question of raising the causeways it would have taken place above 4 m NAP and would no longer be visible, as it would have been eradicated by the disturbance of the top layer. This conclusion was partly based on a minor investigation carried out by the 'Foundation for Soil Survey' (*Stichting voor de Bodemkartering* or STIBOKA, at present: SC-DLO) in Wageningen.[17] This research has shown that the somewhat polluted layers which occasionally reminded us of artificially raised 'dams' were natural sediments. The pollution was possibly the result of human activities which polluted the water in which sedimentation took place.[18]

3.4 Pits

Apart from the structures mentioned, the traces of human activities in zones 2 and 3 also comprised ditches and pits. Pits, incidentally, are not a common feature in the riverbed area. Nevertheless, they are found in a few spots in remarkable concentrations: mainly in zone 3 and the eastern part of zone 2 of Hoogstraat I, II, and IV. These are generally large, rectangular pits with rounded corners, occasionally very elongated, and usually situated in rows. From their position it is clear that they belonged to the complex of riverbed structures. Their (chronological)

17 Van Es & Verwers 1980, 43; see also 48–51.
18 The STIBOKA research is based on 6 samples taken from the north-south sections of excavation trench 386 (not illustrated). Samples 1–4 (finds numbers 386.0.5–8) come from a section situated between c. *3.10 and 3.70 m NAP. They represent the natural subsoil under the north edge of a clearly recognizable causeway. Samples 5 and 6 (finds numbers 386.0.9–10) were taken at a depth of* c. *3.40–3.70 m NAP. They come from an area in which no clear causeways are found. Two other samples (7–8, finds numbers 392.0.1–2) were collected from the eastern north-south section of excavation trench 392, at a depth of 4.30–4.60 m NAP. These relate to the (so-called) Post-Carolingian clay layer.*

relation to the causeways was not clearly demonstrable in Hoogstraat I. Were they dug into the causeways or had they previously been dug in places where no causeways had yet been built? The stratigraphical data from Hoogstraat I were ambiguous on this point, and at the most they allow us to surmise that the latter was the case.[19]
The situation in Hoogstraat II, squares F/G-13/17, now makes this assumption almost a certainty, for here was a row of these pits on a site where no causeways had been built. A number of these pits cut a ditch-shaped depression (it is uncertain whether a ditch had actually been dug there) which in square 11 joined up with the end of the nearest causeways. The latter had therefore already been built as far as that point when the pits were dug on a site which had not yet been built on. The generally somewhat smaller pits in Hoogstraat IV, squares C/D-13/15, also appear to have been dug in the foreshore of the complex of structures in an area which was not yet covered with causeways. It is not possible to determine exactly where the structures in Hoogstraat IV end, due to the limited breadth of the excavation. However the situation in Hoogstraat II, squares F/G-13/17, is not open to misinterpretation: the pits were located in an un-built area of the foreshore. This would originally have been the case everywhere. At most spots the pits would later have been 'overtaken' by the structures and, consequently, would have come to lie within the causeways. By that time the pits would probably have been filled up and no longer serviceable.

What the function of the pits was has not been entirely clarified (see also chapter V 2.3), but they were certainly not ordinary (refuse) pits. Pits such as those found in such great numbers on the settlement site of Dorestad, beyond the riverbed, do not actually occur at all in the riverbed area, with the exception of the far west edge, high up on the bank. As far as can still be determined, the many pits of Hoogstraat III date predominantly from the Post-Dorestad period. The small numbers of pits in zones 2 and 3 are not inexplicable. It is rather a matter for surprise that people ventured to dig pits at all in this soggy terrain with its unstable soil. The pits discussed in the previous paragraph were, in fact, not very deep. Their bases hardly reached 3 m NAP or below, which amounts to a maximum depth of 1 m below surface level. The pits and the ditches had this shallow depth in common, for the bottoms of the ditches were generally no deeper. Only in some places, and then, it would seem, mainly at the east end of the riverbed area were they occasionally several decimetres deeper. The difference between the pits and the ditches is that the ditch walls were dug at an oblique angle, thus reducing the danger of caving in. By contrast, the walls of the pits were too steep to remain standing unless they were reinforced with planks or rather wattle. No remains of the latter have been preserved in any of the pits, but this does not mean that it did not exist. The pits hardly went down to the lowest excavation level, and wattle was only preserved at a deeper level. The fill of the pits generally consisted almost entirely of clean clay which had the appearance of a natural sediment. Apparently the river filled up the pits. Along the edges of the pits there was usually a narrow, slightly polluted zone whose brown to dark-grey colour contrasted sharply with the remaining light-coloured fill. The dark discolouration of the edge zone may perhaps have been caused by decayed organic material, and in that case it could be an indication for a wattle revetment of the pit walls.

3.5 'Enclosure' and wickerwork boxes

In Hoogstraat II, square G-7, a wattle structure was found, consisting of three parts: a closed 'enclosure', two hurdles of wickerwork which connected with the north corners of the enclosure, and a wickerwork box standing in the enclosure.
The enclosure surrounded a space with a rounded-rectangular to oval ground plan of *c*. 0.9 x 3 m with a roughly west-east oriented longitudinal axis. It was discovered at

19 Van Es & Verwers 1980, 24.

a level of *c.* 2.55–2.60 m NAP (excavation level 4). At *c.* 3 m NAP (excavation level 3) there was still no trace of it to be seen , which is why the level of decay was probably at *c.* 2.60 m NAP. The base of the wattle fence was at *c.* 2.15–2.30 m NAP; the pointed rods around which the horizontal twigs were plaited stuck out another *c.* 20–30 cm below. The wattle fence stood at an angle of 30–45° slanting outwards. On the east short side the fence had folded over inwards, so that the east part of the south long wall of the enclosure had been preserved to a height of 50 cm. The enclosure must have been shaped more or less like a basket without a base, with slanting walls, and must have been plaited on the spot. It is possible that it formed the lining of a pit, reminding us of the pits described in the previous paragraph, but they had straight walls. The pit can have been no more than 85 cm deep, for at 3 m NAP (excavation level 3) no traces of it were found. The walls of the 'basket' were at least 50 cm high; whether they were higher can no longer be determined. Because of the oblique position of the walls, the surface area within the enclosure increased upwards. At 2.50 m NAP the width was already 1.25 m; if the walls were higher, the surface area would possibly have been *c.* 2 x 4 m.

Within the enclosure lay a remnant of the base of a large rectangular wickerwork box (see also chapter VI 3). The box was constructed on a framework of four slats with a surface area of *c.* 1.45 x 1.70 m (including the projecting corners of the framework). Scarcely anything remained of the walls, but about half the base was preserved; it is not known whether it had a cover. The base fragment was found at *c.* 2.50 m NAP and was in poor condition: only parts of the framework could be recovered; the wickerwork consisting of twigs plaited around crosswise rods could only be drawn. The box did not fit upright into the enclosure, at least not at the level on which the base of the box was found, and had sagged in rather lopsidedly. The southwest part, which must have been highest, had completely decayed. Higher up there was no such problem and perhaps two of these boxes could have fitted inside the enclosure.

The hurdles connecting to the north corners of the enclosure ran in a slightly curved line from west to east and were visible over a length of about 3 m, though they may have been longer. At a distance of 2 m parallel to the east hurdle, remains of a small wattle screen, which must have been at least 3 m long, were also found. At first sight these hurdles might appear to be parts of a revetment of the side of a 'dam/causeway', but this is impossible since they were far too deep.

One gets the impression that at any rate the enclosure and the connecting hurdles belonged together. This entity originally looked like a basket (possibly partly dug in) situated between upright wattle screens set at right angles to the direction of the current. How far the various parts projected above the ground can no longer be ascertained, nor is their function obvious. Was the basket really intended to hold the box, possibly a creel, or did it end up there by accident? And what would have been the purpose of the wattle screens in that case? Perhaps we are dealing here with a construction for the purpose of fishing. The screens may have served as guide ways to drive the fish towards the enclosure which would have worked as a kind of fyke net. It is certainly probable that the construction was under water, or that it could be submerged, due to its low position. A possible indication is perhaps the enclosure, which is partly folded over, possibly due to the force of the water.

The low position is, at any rate, evidence that the construction is connected with activities preceding the building of dams at this spot. The level at which the wickerwork of the screens and enclosure was erected was between 2.15–3 m NAP or higher if both components were partly dug in, though certainly no more than 3 m NAP. The dams were not raised until the area had silted up to a level of 4 m NAP. As a matter of fact, several posts of the local dam are located inside the enclosure which had long been forgotten by the time a dam was built here. It is interesting to note that the height of the construction precisely corresponds to that of the old

revetment against the original bank, which is also situated within Hoogstraat II. Apparently there were times when the riverbed lay dry to the extent that (building) activities could be carried out at 2 m NAP. Perhaps the wattle construction in question was built during a period of low water on a possibly relatively low section of the terrain where water normally came, in other words on the edge of, or on a shallows in the actual riverbed itself (the level of the fyke nets was 2.26–1.67 m NAP, see chapter VI 3).

A fragment of a second, almost identical box was discovered in square E-15 in Hoogstraat II. This specimen, with a base size of *c.* 1.35 x 2.10 m, was embedded in natural sediments. This fragment has already been identified in a publication as a creel.[20] The creel, or what was left of it, lay askew in the soil: its highest point in the northeast at *c.* 2.40 m NAP and the lowest point in the southwest at *c.* 2 m NAP. In actual fact, only fragments of the frame consisting of four slats supporting a wickerwork of base and walls were recovered. The wickerwork itself had almost completely perished. Possibly the box was no longer complete when it ended up on this spot, or perhaps it decayed here later. Nevertheless, the frame still lay more or less in its original structure: of the crosswise rods connecting both long slats several slight traces in the form of almost decayed wood remains were visible. Just like the wickerwork of the walls, the twigs woven around these rods forming the base of the basket did not leave any traces behind in the soil, or if they did, these went unnoticed, possibly due to the fact that the wood remains could not be carefully excavated. They were discovered by chance,[21] and, moreover, at a depth at which steady excavation was hindered by flooding. There are also other reasons for emphasizing this depth. The indication of the location in figure 16 incorrectly implies that the creel was situated on the edge of one of the ditches of the dam complex and immediately against a row of posts, but in actual fact, the creel had nothing to do with the ditch, nor the posts. After all, it had ended up in natural sediments which, in view of their level, were deposited before the ditch was dug. When this finally took place, the remains of the creel had already been covered over by almost 2 m of soil, and at least two of the posts were stuck through the creel remains.

3.6 Fragments of a shipwreck

Hoogstraat II yielded another remarkable find: the scattered remains of a ship which were discovered at the end of zone 3 in squares D/E-11/12 (the finds themselves are discussed in chapter VI 4; here, we deal with their location). They lay at a depth of *c.* 3.10–2.40 m NAP and partly in a natural hollow, the shape of which – as far as it has been excavated – reminded one of a ship (fig. 207–8).[22] The hollow had silted up naturally. At least one metre of sediment had been deposited on top of it before the posts of the causeway/dam constructions were driven in. Among the ship fragments were part of a quern (finds number 387.4.86) which was found at *c.* 2.20 m NAP, and a round wickerwork basket filled with stone and bone fragments at *c.* 2.10–1.70 m NAP (finds number 387.4.87; the basket itself could not be recovered due to its deep location and the poor condition of the wickerwork). The ship remains lay scattered in a virtually straight line over a distance of about thirty metres. The locations of the parts of the find complex are shown in figure 207–8. The greatest concentration, to which the quern and the basket belonged, was situated in squares D/E-11/12.

The parts of the ship consisted mainly of fragments from a clinker-built wooden ship's hull. Only at the north and south ends of the find complex were wood remains found which could not positively be identified as fragments of the ship's hull. The most northerly fragment is possibly part of a rib. The two largest side fragments were *c.* 1.40–1.70 m long and *c.* 0.70 m. wide. They consisted of pieces made up of four planks and joined together with iron nails. Separate nails were found with the

20 Van Es 1974.

21 The wooden fragments emerged during the digging of a drainage ditch for the northern west-east section of excavation trench 390. Investigation of the deepest excavation level, which had been located at c. 3 m NAP in this excavation trench, had of course already ended, only the drawings of the sections had to be done. Digging drainage ditches along the sections was standard procedure at that stage. By doing so, it was possible to expose the walls of the excavation trenches to just below the lowest excavation level for a short time – the pressure of the ground water being great.

22 Vlierman 2002, 135.

wood remains of the hull, and most of these did not lie in a recognizable association with the preserved fragments of wood, in fact some were found a considerable distance away. However, near the large side fragment in squares D-11/12 , which just reached into the southern west-east section of excavation trench 386 (fig. 207–8 section detail), a number of stray nails were discovered still lying more or less in their original positions. It is clear that part of this hull fragment, where the wood had rotted away between the nails, decayed on the spot, leaving only the nails behind. This situation is similar to that of Sutton Hoo.[23]

In the section detail (fig. 207–8) one can see that the process of decay was active down to a depth of *c.* 2.90 m NAP. All the wood remains preserved lay below this level, usually between *c.* 2.70 and 2.50 m NAP. Figure 207–8 also shows that the presently decayed part of the side fragment projected to at least 3.10–3.20 m NAP. It may, of course, have projected even higher, but it is impossible to say how far. The wood remains were firm and well-preserved. Consequently, below a level of *c.* 2.90–2.70 m NAP there must have been a favourable climate for preservation here. This was no local phenomenon: throughout the riverbed the wood of the construction posts has been preserved at about this level or deeper.

The ship's fragments pose countless questions. For a start: did they lie on the surface for a long time or were they quickly covered by silt? The latter case is probable, since the ship's remains were deposited (by man or by water) in one or more shallow depressions. This must have happened in the period that the beach-like transitional zone between the highly silted up section of the shoal and the actual riverbed was located in this area. The depressions containing the wood remains were therefore on a beach. If the wood remains had remained uncovered for a long time they would undoubtedly have drifted away. The situation of the hull fragment in the section leaves open the possibility that the end of this fragment continued to project above the ground – and the water – until it had rotted away.

One might ask oneself whether the wood fragments acquired their shape by decaying *in situ*; in our opinion this is not generally the case. The corner of the fragment in the section which had rotted away on the spot must be an exception. The other edges of the same fragment and the edges of the other fragments all lie 20–40 cm below the level at which decay took place. Many edges, for that matter, are surprisingly intact. In many cases, the long edges are formed by the original plank sides. The short edges of the fragments are breaks which are mostly sharp and generally run more or less perpendicular to the longitudinal direction of the planks. It is furthermore remarkable that there are no ribs left on the ship's skin. The break edges in fact gave the impression of being caused by mechanical tools, such as an axe. The shape of the fragments was determined at another spot from the one at which they were found. This other spot need not necessarily have been far from the find spot; we shall return to this point later.

The similarities in type of wood, size of planks and nails makes it likely that the fragments originated from a single ship. From the location of the fragments, however, it becomes obvious that the original relation between the fragments has been lost. The longitudinal axis of the planks of which the fragments consist points in a different direction from fragment to fragment. It can be considered impossible that the ship's parts found were the last remnants of a ship that had disintegrated at that spot and that the fragments recovered had remained in their exact original position. In our case, circumstances such as those in Sutton Hoo are out of the question as far as the entire ship is concerned. The find complex rather conveys the impression of being driftwood. Perhaps the separate nails, found up to several metres from the wood remains, were also shifted by water.[24] The question now is: where did the ship to which the excavated fragments belonged meet its end?

The possibility that this may have happened in the immediate vicinity has just been alluded to. It is even theoretically possible that the ship may have lain at a spot more

23 Carver 1998.

24 At the time of the Dorestad excavation, metal detectors were not yet available to us so it is quite possible that odd nails went unobserved.

or less corresponding to the site of the fragments. The 'ship shape' of the depression in which part of the fragments lay forms a (very faint) indication. One might visualize the following situation: there on a beach in front of Dorestad, parallel to the edge of the riverbed and therefore perpendicular to the direction of the dams, the ends of which were located further westward at that time, lay a ship that had foundered. Due to erosion around the base a slight depression formed into which the ship began to sink. Since it formed an obstacle, it was dismantled. There is a possibility that it disintegrated due to decay, but, in our view, that does not seem likely. Serviceable parts may have been removed, and some of what remained will have been washed away. Several fragments which were left in the depression were shifted a short distance by the current and these quickly silted up. Not much was left behind: the fragments discovered together hardly measure 3 m^2, which is a fraction of what must have been present.
The quern, situated slightly deeper than the wood remains, may in this version have belonged to the ship's inventory. The basket with the stones and bone fragments probably also came from the ship, although it had sunk some 70 cm deeper into the soil than the nearest wood remains. In view of its weight, that is quite feasible. Various functions are imaginable for the basket of stones: ballast, cooking stones, portable hearth etc.
This may have been what happened, but there is no evidence that it actually did. The possibility can certainly not be excluded that the pieces of wreckage washed in from further away, if, indeed, they did not end up at the find spot as a result of human intervention. Possibly the pieces of wreckage had been used for some time secondarily, as part of the structures in the dams, before ending up at their final location. The wreck of the ship to which they once belonged cannot be reconstructed with certainty, but that the fragments found came from a ship that once ran aground off Dorestad can hardly be open to doubt.

Finally, one more peculiarity from Hoogstraat II, this time concerning the beginning of zone 2. On the boundary with zone 1, in squares E/G-4 (or 5?), a natural depression some metres wide was observed, which was particularly visible in the two west-east sections of excavation trench 380. The base was below 2.40 m NAP; the level of the upper edge was at least 3.20 m NAP. The sediments with which the depression was filled were partly slightly polluted. In the midst of the natural deposits at *c.* 2.60 m NAP there was a 5–10 cm thick layer of highly compressed wood remains. The presence of the wood remains was only established in the two sections. The trench was not excavated down to the level of these remains (the deepest excavation-level was at *c.* 3 m NAP). One can only assume that there were also wood remains in the area between the sections, therefore over a distance of 20 m (the width of the excavation trench) and perhaps beyond. The idea is that these wood remains represent faggots compressed by the weight of the soil covering them. But again there is no absolutely certain explanation. Perhaps the wood remains came into the depression naturally – by water. It is more likely, though, that human activities were the cause: possibly an irregularity in the ground surface was filled up with brushwood. The stratigraphical position of the depression suggests that this took place at an early stage in the formation of the shoal in zone 2. The hollow must have been situated roughly at the foot of the original bank line. The wood remains are the only – albeit poor – indication for the use of brushwood to reinforce the ground surface in the riverbed area. This material would of course have been ideal for this purpose in the form of faggots or woven mats, and one may expect it to have been frequently used in this damp environment.

4 The decline of Dorestad (zone 4)

By the end of the 9th century, Dorestad must have lost its function as an international port.[25] The area in the riverbed in Hoogstraat fell into disuse for the greater part. In the original bank zone (zone 1) and the area behind it (zone 5: the settlement area on the bank) some forms of activity managed to continue even after the 9th century, as is apparent from the late-medieval pottery discovered there. The left bank of the Rhine in the Hoogstraat area probably remained partly inhabited in the Post-Dorestad period. As far as we can gather, in most places this settlement was no longer situated immediately along the riverbed, which was then located in zone 4. In four of the five excavation sites there is absolutely no indication that the intermediate shoal in zones 2 and 3 was systematically used after the 9th century. In this respect, Hoogstraat III is the exception.

4.1 Traces of late-medieval occupation in Hoogstraat III

Traces of late-medieval occupation were found in Hoogstraat III, zones 2 and 3. These traces consist of a number of pits, including wells, and numerous sherds of pottery. The late-medieval pottery types discovered in the pits are (in order of importance): *Kugeltopf*, Pingsdorf, Paffrath, Maasland, Duisburg, and stoneware (for a detailed description see chapter VI 1.4; the numbers per type are given in table 7).

TABLE 7 Hoogstraat III
Late-medieval occupation, composition of the pottery complex from post-Dorestad period pits.

trenches	Pingsdorf	Paffrath	Maasland	Kugeltopf	Stoneware	Dorestad period
405–407	251	72	38	98	4	891
402–404	29	16	4	ca 330	3	494
401	5	2	–	17	1	149
total	285 (33 %)*	90 (10.2 %)*	42 (4.8 %)*	ca 445 (51.1 %)*	8 (0.9 %)*	1532

* Percentages of the total number of late-medieval sherds.

The *Kugeltopf* pots are all hand-formed with the odd exception which is wheel-thrown. Stoneware is hardly found in the complex. Of the total of eight specimens,[26] four come from the bottom of the well situated in square D-10. These are four sherds (possibly from a single specimen, but they count as four in the table) of a stoneware-like material undoubtedly from the beginning of stoneware development. It is actually uncertain whether these sherds can already be considered stoneware. The stoneware found in the remaining four pits is of post-medieval or recent date. One of these pits contained a recent, brick well (square F-3). In two of the other three pits more recent sherds were discovered together with the stoneware. These pits probably also date from after the Middle Ages. If this is not the case, the stoneware sherds, like the other recent sherds, must be regarded as intrusions from a later period. Our conclusion is that stoneware does not in fact form part of the late-medieval pottery complex from the pits.
As the table shows, many Carolingian sherds from the Dorestad period were found in the pits. They are even almost twice as many in number as the late-medieval pottery types together. This older – secondarily shifted – material naturally has no influence on the dating of the pits.
The pottery complex characterizing the late-medieval occupation in Hoogstraat III consists of hand-formed *Kugeltopf,* Pingsdorf and Paffrath pottery, and wheel-thrown Pingsdorf, Maasland and Duisburg ware. Pits containing this pottery were found in: zone 1; at the transition from zones 1 to 2; in particularly high density in zone 3; at the beginning of zone 4 (only a few pits). The number of pits which can be dated on the basis of their finds in the Late Middle Ages is comparatively small. It may be assumed that some of the posts and post-ghosts in zone 3 also date from the Post-Carolingian Period. Unfortunately, an archaeological dating of the individual

25 Van Es & Verwers 1980, 297–9, 303.
26 Fourteen sherds from a single specimen were found in a pit: entered in the table as 1.

posts is not possible. Nor does zone 3 offer any possibility of stratigraphically distinguishing posts from the various periods.

Zones 1–3 in Hoogstraat III yielded information indicating occupation, not only for the Dorestad period but also for the centuries that followed. The Post-Dorestad occupation period is typified in the find material by the '*Kugeltopf*/Pingsdorf complex'.[27] In fact Hoogstraat III is the only one of the excavated riverbed sites where occupation (settlement?) from the latter period has been established directly along the river itself.
Hoogstraat III is also the only site where traces of settlement have been found in zone 4. These traces occurred at the beginning of zone 4, squares A/G-11/13, and consist of pits (including several of those mentioned above with the late-medieval sherds) and rows of posts. The rows of posts run in two directions, one of which is the same as the longitudinal axis of the Dorestad structures: roughly west-east. It is remarkable that, especially in squares E/F-12/13, several of the posts in question were driven in unusually deep, to below 1.50 m NAP. On stratigraphical grounds, these posts belong to the Dorestad structures because they were covered by sandy deposits of zone 4 and only became visible in the excavation below these, at *c.* 2.80 m NAP. On studying the sections it already became apparent that erosion had taken place at the east end of zone 4 before the coarse sandy sediments of zone 4 were deposited. Apparently only the deeply-situated elements of the Dorestad structures in the erosion zone were preserved. The west-east rows of posts show that the dams of Dorestad originally extended at least as far as square 13. There is a possibility that they even continued further eastwards. The deeply-set posts in squares E/F-12/13 can be compared to the also deep posts that were found at the end of the riverbed structures in Hoogstraat I and the southern part of Hoogstraat II.
In squares E/F-11/13 rows of posts were also found running roughly north-south and parallel to the riverbed. The posts in these rows were very close together (in fact they were closed rows) and undoubtedly formed bank revetments. These revetments are stratigraphically younger than the riverbed structures from the Dorestad period because the posts projected through the coarse sandy deposits of zone 4 and were already visible in the first excavation level at *c.* 3.60–4 m NAP; the deepest point of the posts reaching *c.* 3.30–3 m NAP. The revetment posts were therefore driven in from a level of 4 m NAP or higher, at a time when the riverbed of zone 4 had already begun to silt up and the first coarse sandy sediments were deposited. The silting up of the bed is also demonstrated by the presence of several revetments. In squares E/F-12/13 there were, for example, four, or possibly five, running parallel to each other at short intervals, the various revetments cannot have functioned simultaneously, but were probably installed in succession, as the edge of the riverbed shifted eastwards. The revetments concerned can be stratigraphically compared to the pits located in squares A/C-11/12, in which the late-medieval pottery was found. Both elements will probably date from the same period, *i.e.* Post-Dorestad.

From the information available so far, the development at the transition from zone 3 to zone 4 in Hoogstraat III can be reconstructed as follows. At the end of the Dorestad period the east end of the riverbed structures lay in squares A/F-12/13, or slightly further east. Where exactly the actual riverbed was located at that time can no longer be determined, but it was probably not far from the end of the structures. At the end of the Dorestad period, or some time after, a certain degree of erosion (probably not extensive) took place in the final zone of the complex. The erosion did not penetrate any further west than approximately as far as squares A/F-11/12. Subsequently – probably not long after – the riverbed again began to silt up and was filled with gravel-rich sandy deposits. This or at least some of this took place at the time of the *Kugeltopf*/Pingsdorf pottery.

27 Reference is made in the text to the Kugeltopf/*Pingsdorf complex. For practical reasons, this name is used here and henceforth. The LME pottery is described by J. van Doesburg, and a typology has been added. The* Kugeltopf/*Pingsdorf complex refers to the following types: Pingsdorf LM W I–V; Duisburg LM W VI–VII; Maasland LM W VIII–XIII; white-fired LM W XIV; Kugeltopf LM H I; frying pan LM H II; Paffrath LM H III; Pingsdorf LM H IV–VI (see chapter VI 1.4).*

The late-medieval occupation cannot have extended far north of Hoogstraat III. At the east end of Hoogstraat I several (short) rows of posts were found in squares A/L-20/21 which were to a certain extent reminiscent of the revetments in Hoogstraat III, squares A/F-11/13. On further consideration, there are, however, clear differences. The space between the posts is smaller in the Hoogstraat III rows than in Hoogstraat I. The posts concerned in Hoogstraat I are also much deeper than those of the revetments in Hoogstraat III: up to 1.80–1.50 m NAP and even deeper. The rows in Hoogstraat I must have belonged to the Dorestad structures. Conclusive traces of late-medieval occupation are also lacking in zones 3 and 4 of the remaining sites.
Apart from the direct evidence for occupation in the form of pits and rows of posts, zone 4 of Hoogstraat III has also produced other indications of human activities, namely the very numerous pottery sherds which were embedded in the sandy and gravelly sediments of zone 4.

4.2 The pottery sherds in the sandy sediments of zone 4

The majority of these sherds was found in the excavation levels at the end of zone 3 and at the beginning of zone 4: approximately in squares A/D-11/13 and E/G-12/13. The number of sherds that could be collected from the section of excavation trench 408 is small. Most of the sherds discovered in the sediments in the excavation levels came from the sand and gravel deposits at the beginning of zone 4. Also included are the comparatively small quantities of sherds found in the more clayey sediments, which we count as belonging to the end of zone 3. Table 8 gives a survey of the frequencies of the various pottery types. The figures presented are merely approximations. Firstly, there are problems concerning the location: it is not clear in several cases whether certain sherds did actually come from undisturbed natural sediments. Secondly, there are problems with identification: the difference between Pingsdorf and Badorf, between Maasland and Badorf, between hand-formed *Kugeltöpfe* from the Dorestad period and those from a later time, can be tricky in individual cases. However, the quantity of sherds is so great that the general tendency emerging from the figures is bound to be correct.

TABLE 8 Hoogstraat I–IV
Late-medieval occupation, composition of the pottery complex in the sediments of zone 4.

sites	Pingsdorf	Paffrath	Maasland	Kugeltopf	Stoneware	Dorestad period
HS-III	ca 1600 (37 %)*	ca 900 (21 %)*	ca 50 (1 %)*	ca 1800 (41 %)*	ca 10	ca 8000
trench 408	2	–	–	3	–	45
HS-I	48 (35 %)*	18 (13.2 %)*	2 (1.5 %)*	68 (50 %)*	1	not counted
HS-II	1	–	2 ?	1 or 2	1?	not counted
trench 463	21 (30 %)*	5 (7.1 %)*	1 (1.4 %)*	43 (61.5 %)*		704
HS-IV	–	1 ?	–	–	–	not counted

* Percentages of the total number of late-medieval sherds.

We have already seen that the sandy sediments from the beginning of zone 4 were deposited at the time of the late-medieval occupation, and this is corroborated by the pottery finds. That the late-medieval sherds ended up in these sediments during this period is plausible for two reasons. First, in a few cases many or almost all the sherds from one pot were found together at one spot which excludes the possibility that they were conveyed over a large distance by the river. The sherds discovered in the sediments of Hoogstraat III squares A/G-11 (-12)/13 have more or less remained on the spot where they had been lost during the late-medieval occupation. The second argument supporting this conclusion is that the composition of the find complex in the sedimentary layers basically corresponds to that of the find complex of the late-medieval pits in Hoogstraat III (compare tables 7 and 8). Late-medieval

sherds were not only found in the sandy sediments of zone 4, but also in deposits at the end of zone 3. It is possible that these sherds only ended up in these sediments after the erosion phase which preceded the deposition of the sand and gravel sediments in zone 4, though this cannot be precisely established from the data available. A more overall conclusion is, however, permissible: the transition from zone 3 to zone 4 took place during the *Kugeltopf*/Pingsdorf pottery period.
It would, of course, be useful if one could determine the exact moment when this transition occurred within the period mentioned. The differences between the contents of the pits and those of the sediments may be connected with the time factor. For example, the pits contain relatively less Paffrath and more Maasland, but there is no saying whether this is characteristic of a later period. Consequently, we do not venture to use this information to date the transition from zone 3 to zone 4 early in the late-medieval period of occupation because there are too many uncertainties. At any rate the (extremely scarce) presence of *Steinzeug* in the sediments must not be taken as an indication for a 'late' date. The same applies to this *Steinzeug* as to the stoneware from the pits (see p. 39).
The Dorestad pottery found in the sediments of squares A/G-11 (-12)/13 in the same density (almost twice as numerous as the late-medieval pottery) as in the late-medieval pits, can only have ended up there after its period of use, because the formation of the sediments in zone 4 is dated to the time of the *Kugeltopf*/Pingsdorf complex. The hypothesis that the Dorestad pottery must have been secondarily moved during the late-medieval occupation in Hoogstraat III is reasonable. In our view, it seems probable that the presence of this pottery in the sediments was, at any rate partly due to human activities. It is remarkable that the northern west-east section of trench 408 (its southern counterpart has not been investigated) did contain a relatively large amount of Dorestad pottery but hardly any of late-medieval origin (table 8: trench 408). The absolute numbers are small, and perhaps for this reason not too much importance should be attached to the differences in frequency between the contents of the sediments in this section and that of the sediments in the excavation levels. The section from Hoogstraat II, excavation trench 463, also shows the same phenomenon. Before going back to this point, we shall first focus attention on the finds in the excavation levels at the beginning of zone 4 in the other Hoogstraat sites.
As far as the late-medieval sherds are concerned, these finds have been included in table 7. Only in Hoogstraat I were appreciable quantities of late-medieval material found in the excavation levels of zone 4. The picture is even somewhat flattering, for the table includes all the late-medieval sherds discovered in the eastern excavation trenches (trenches 368, 376, 357/370, 371, 356/363, 372). For some of them it is uncertain whether they came from the sediments at the end of zone 3 or at the beginning of zone 4. On the other hand, the sediments of zone 4 were not fully investigated in this excavation. In trenches 363 and 370 only one and two levels respectively were dug. A more detailed investigation would probably have yielded more late-medieval sherds. The absolute numbers in Hoogstraat I are much smaller than in Hoogstraat III, but the relative frequency of the various late-medieval pottery types is about the same in both excavations. To the north of Hoogstraat I the quantity of late-medieval sherds in the sediments of zone 4 appears to decrease even further. In the eastern six excavation trenches of Hoogstraat II only a few sherds were found, and in the eastern two of Hoogstraat IV in fact none. Hoogstraat 0 cannot be included in this discussion because the excavation did not extend as far as zone 4.
The decrease in number of late-medieval finds from north to south can be explained as follows: in Hoogstraat I, II, and IV no traces of late-medieval occupation were found in zones 3 and 4. The late-medieval sherds found nevertheless in the sediments from zone 4 in these sites must have been brought in from elsewhere,

most of them probably by the current from the south. The closest spot where late-medieval material could have been picked up by water was Hoogstraat III, although the (settlement) area immediately south of Hoogstraat III, at the west outskirts of the later urban area of Wijk bij Duurstede, offered another possibility for the river to carry away sherds from the *Kugeltopf*/Pingsdorf complex.

The excavation levels only penetrate a short distance into zone 4, which is why they only provide information on the oldest sediments in this zone. Two trial trenches continue further eastward: trench 408 in Hoogstraat III, and 463 in Hoogstraat II. The latter contains a virtually complete cross section of zone 4 at its broadest point. The investigation in these test trenches showed that pottery sherds were embedded in the sediments over – roughly speaking – the full breadth of zone 4. The total numbers are appreciable (see table 8). In the northern west-east section of trench 408 no sherds were discovered above *c.* 3.35 m NAP; this is – possibly – also the case in trench 463. The NAP level of the finds from this trench is, however, not precisely known.[28] In trench 408 the upper part of the section from which the finds were collected has, to a large extent, been dug away in recent times, so it is not absolutely certain whether the presence of finds was indeed linked to an upper limit. In trench 463, the horizontal distribution of sherds among the sediments was anything but even. Virtually nothing was found for the first thirty metres (section II–JJ, squares 22/24). Only from square 25 up to square 40 were considerable quantities of sherds (twenty and more per square) found. Ninety percent of the total number of finds lay in squares 25–40; the rest were found scattered in small quantities over the east part of the trench. The distribution in trench 408 was more even, but here too the concentration of finds decreased from west to east. Approximately 85 % of the finds came from the first thirty metres (section KK–LL, squares 14/17).
The information given concerns the total find-complexes from trenches 408 and 463. If one only focuses on the late-medieval sherds, the following picture emerges for trench 463. The *Kugeltopf*/Pingsdorf complex was not found in squares 22/30. Only in squares 30/31 was it first observed, with a concentration (*c.* 70 %) in squares 34/39. Late-medieval sherds are more or less regularly found as far as square 44, but east of this and up to the end of the trench they are very scattered and only occur in relatively very small numbers. In trench 408 the (few) late-medieval sherds were more or less evenly distributed over squares 16/18 of section LL–KK. The composition of the find complexes from both trial trenches differs significantly from that of the find complexes from the late-medieval pits and from the sediments at the beginning of zone 4 (see tables 7 and 8). The main point of difference is the much larger number of sherds from the Dorestad period in the trial trenches.
The presence of the sherds in the sediments of zone 4 is, at the most, partly connected with the human activities in zones 3 and 4. A connection of this kind is in fact only plausible in the case of the finds from the oldest sediments from zone 4 in Hoogstraat III. It is possible that (most of) these finds ended up at this spot as a result of and during the late-medieval occupation in zone 3 and the beginning of zone 4. For the sherds from the other sites, particularly Hoogstraat II, there is no such direct connection, since traces of late-medieval occupation there were lacking. The presence of finds in the other sites was, in our opinion, caused by the current. That the material was not carried away by the water over a great distance is apparent from the fact that the edges of the breaks in the sherds are generally not, or only slightly, rounded off. Naturally, the place of origin cannot be established exactly, but it is obvious that it must have been situated in Hoogstraat III and the area adjoining it in the south.

The observed differences in composition between the find complexes from trenches 408 and 463 on the one hand, and those from the late-medieval pits and excavation

28 In trench 463, the sherds were collected from the base and walls of the trench per 10 m-long section. The precise locations of the individual sherds were not determined, but this was done in the case of trench 408. However, in this trench, only finds from the northern west-east section were collected. It explains why the number of finds from 408 is so much smaller than that from 463. In actual fact the sediments in 408 will certainly have contained no fewer sherds than those in 463.

levels in Hoogstraat III on the other hand also indicate that, in these two cases, different factors must have been involved: the influence of the river in the first case and human activities in the second. The time in which the find complexes from trenches 408 and 463 were deposited by the river cannot, unfortunately, be precisely determined, but it is certain that the sediments from the beginning of zone 4 were deposited during the late-medieval occupation in Hoogstraat III. The many sherds from the Dorestad period which were collected from trenches 408 and 463 are of absolutely no importance for dating. After their period of use they ended up in the sediments of zone 4 together with the late-medieval material. The value of the late-medieval sherds in determining the period in which the sediments formed is also limited, for they may have been swept away by the river and deposited within their own period of use or (long) after. However, a number of considerations makes the latter improbable.
In Hoogstraat III the erosive influence (for some length of time) of the river was visible at the transition from zone 3 to zone 4. The late-medieval occupation there dates, however, from after this phase of erosion. Further south, the situation may have been different, but in Hoogstraat III most of the material swept away by the river will have been thrown into the water by the late-medieval inhabitants. This consideration does not constitute proof, but it is an indication that the material deposited by the river in the Hoogstraat sites ended up there still in the time of the *Kugeltopf*/Pingsdorf complex. On the basis of the vast quantities of predominantly Dorestad sherds in trenches 408 and 463, one might even assume that deposition took place relatively early in the period dated by the late-medieval complex, *i.e.* before the late-medieval material was in common use in the former Dorestad area. There are too many uncertainties, however, to accept this view.

4.3 The formation of the ridge in zone 4

It is hardly possible that the late-medieval occupation in Hoogstraat III was able to hold its ground when the ridge was being formed in sections KK–LL, squares 12/19, and II–JJ, squares 22/40, because the settlement area was flooded during the deposition of the sediments between *c.* 4 and 5 m NAP. On the ridge itself, no traces of late-medieval occupation were found: occupation therefore preceded the ridge. With the help of the find complex from the pits concerned, the late-medieval occupation in Hoogstraat III could be dated with some degree of precision. The various components of this complex cover a time span from the 10th to at least the beginning of the 12th century (see chapter VI 2.4). The period of occupation itself need not, of course, have lasted this entire period. The contents of the well in Hoogstraat III, square D-10, to which, among other things, a kind of early *Steinzeug* material belongs, demonstrates that the end of the late-medieval occupation may not be long before the end of this time span.
There may have been a causal connection between the end of the occupation in Hoogstraat III and the formation of the ridge. The differences in density of finds between the various sections of zone 4, particularly those in trench 463, are probably solely the result of the river's behaviour. One must bear in mind the fact that we only have information on the relatively superficial sediments in the riverbed. We cannot give a satisfactory explanation for the differences. At the most, one could say that the (superficial) sediments in the eastern part of zone 4, from square 40 or 45 in section II–JJ, were deposited at a time when the river still only conveyed little material. That no sherds were observed above the level of *c.* 3.35 m NAP can be explained by assuming that, above this level, the current was no longer strong enough to wash away sherds. In that case, this observation has no dating value. It is even possible that the observation is based on coincidence.
Whatever the case may be, chronological differentiation for the various sections of zone 4 is impossible on the basis of the purely archaeological means which we have

at our disposal. The total find complex from the sediments of zone 4 does not fundamentally differ chronologically from that from the late-medieval pits in Hoogstraat III. The occupation belonging to these pits and the formation of zone 4 are, from an archaeological point of view, 'contemporaneous'. In actual fact, zone 4 probably only assumed its present form after the occupation in Hoogstraat III had ended. The only thing one can say on the basis of the archaeological finds is that the formation of zone 4 took place within the period dated by means of the finds. That would have to be at the end of this time span, and, at the earliest at the end of the 11th or at the beginning of the 12th century. A (much) later date is unlikely, due to the absence of younger find material. *Steinzeug* and glazed sherds were not found in trenches 408 and 463. The only recent sherd from trench 408 must be an intrusion. This unfortunately rather overall conclusion does not conflict with the historic evidence concerning the date of zone 4. This is the construction of a dam in the Rhine at Wijk, which is currently dated in the year 1122.[29] The building of this dam may have completely cut off the Kromme Rijn a short distance south of our excavation sites. Perhaps one should consider the possibility that an opening was left in the dam, which occasionally let in some Rhine water, but even then it still seems impossible that any significant sedimentation could have taken place in zone 4 in the Hoogstraat area. To assume that the dam was once breached would be pure fantasy. In 1164 the dam was still there, 'as of old' (*antiquitus*). The final formation of zone 4 must have occurred before the dam was built. The archaeological data available permits this conclusion, though only just.

In our view, this leaves only the period between the end of the occupation in Hoogstraat III and the year 1122 for the formation of (the upper part of) the ridge in section II–JJ, squares 22/40, and the silting up of the riverbed east of it. The end of the occupation cannot be dated precisely, but it must have been in or after the middle of the 11th century. If the end is set at *c.* 1050, and an earlier date is hardly possible in view of the archaeological data, only 75 years remain (which is short, though perhaps not too short). At the time of Dorestad, the river had shifted 150 m eastward in Hoogstraat I and II, in zones 2 and 3, in just about the same length of time. It should be noted that zone 4 is *c.* 400 m wide at Hoogstraat II. Most of the western half of the zone, however, must have developed even earlier, at the time of the late-medieval occupation in Hoogstraat III. In this view, only the sediments located higher than *c.* 3.50 m NAP in section II–JJ, squares 22/40, would have been deposited after the occupation; anything below this was older. We therefore assume that in the second half of the 11th century the actual riverbed was already situated east of square 40 in section II–JJ. The highest part of the ridge on the west side of zone 4 (the deposits located between *c.* 4 and 5 m NAP) developed from this riverbed. The sharp decrease in density of finds east of square 40 is possibly linked to the fact that there was no longer any occupation in the immediate surroundings during the formation of this part of the zone.

Acceptance of the above also has consequences for the view regarding the end of the Dorestad period. For over a century, in the 10th- and in part of the 11th century, the river shifted eastward in zone 4, in a manner similar to that in zone 3. From the point of view of sedimentation, a change did occur: in zone 4 the river deposited coarser sediments (sand and gravel) to a higher level. As far as the landscape was concerned, not much changed, only the distance between the original bank in zone 1 and the deep section of the riverbed kept increasing. The shoal which had begun to form in zone 2, continued to grow, though it remained a shoal. At the transition from zone 3 to zone 4 in Hoogstraat III and I some erosion was observed. Nevertheless, occupation continued after the Dorestad period, or it returned there after an interlude; continuity cannot be strictly proven. On the other hand, the erosion in Hoogstraat III cannot have been the reason for abandoning the whole riverbed area which had been reclaimed at the time of Dorestad. For in Hoogstraat II and I there

29 *Dekker 1980.*

was no question of any erosion. A radical change in landscape only took place later, with the formation of the ridge on the west side of zone 4 which must have involved flooding and which would have rendered the area previously utilized in the riverbed unsuitable for settlement. When the ridge had finally formed, it offered the possibility of settlement due to its high position, but this did not happen. The relation between the original bank in zone 1 and the river had been broken off much earlier (apart from Hoogstraat III), namely at the end of the Dorestad period.
The conclusion must be that no direct (causal) relation existed between the abandonment of the riverbed area (*i.e.* the actual end of Dorestad as a supra-regional port) and the landscape developments in the area. If one had so wished, the occupation could have been continued for another century or more under local conditions which did not fundamentally change. One can only remark that the deposition of coarser sediments in zone 4 might point to the fact that the drainage of water from the Kromme Rijn, downstream from Dorestad, was hampered at the time. This possibly meant that the river lost value as a course of navigation to the north. Incidentally, the Kromme Rijn was still a major waterway at the time it was dammed, and the disputes over the building of the dam were precisely because of this.[30] A mono-causal explanation for the decline of Dorestad due to local changes in environment is certainly incorrect. Nor, in our view, did changes elsewhere in the river system play a significant part.

Finally, a minor stratigraphical problem. In chapter II 2.4 attention was drawn to the fact that on the west side of zone 4 the ridge was covered with sandy clay, and that this layer of clay expanded westward across at least zone 3. Ditches and other hollows still belonging to the Dorestad complex were filled with this clay. The hypothesis that the sandy clay referred to, which appeared more or less the same everywhere, was also deposited at about the same time, causes problems. The consequence would be that the hollows from the Dorestad period would have to have lain open for another century or more until after the formation of the ridge. Moreover, between the end of Dorestad and the formation of the ridge no sedimentation could have taken place in zone 3, which, in our opinion, is inconceivable. The solution must be that the clay was deposited over a long period, in fact throughout the whole period of formation of zone 4. The similarity in appearance between the clay deposits from various periods can be explained by the similar circumstances under which the clay was deposited. These circumstances do not differ basically from those under which the uppermost, also sandy clay sediments were deposited in zones 2 and 3. That the Post-Dorestad clay was regarded during the excavation as something special is probably due to the absence of anthropogenic pollution characterizing the sediments deposited during the Dorestad period. In actual fact, it was a continuous process: sandy clay was deposited outside the actual riverbed at extreme water levels, particularly during the winter months.

5 Summary

An analysis has been given above of the development of the behaviour of the river in the area east of Hoogstraat and of the human activities connected with it, as far as revealed by the vertical section of the excavation site. For convenience's sake, markers have been created for the benefit of the analysis. They divide a process which, in actual fact, was continuous and smooth into apparently separate episodes, with the risk of losing track of the complete picture. To prevent this happening, we conclude this chapter with a brief summary of our views. As far as these concern the natural developments in the riverbed, they are also summarized in figure 14.

30 Dekker 1980.

Exactly when the course of the Rhine shifted to the Hoogstraat area is still unknown. According to a few ^{14}C-dates, the river already existed here in the Roman Period (see chapter II 2.1). No traces of occupation on the then bank have been discovered, but, theoretically, they may have been there. A line of incision in the riverbed dating possibly from the Roman Period was only observed in Hoogstraat 0. In the other sites the Roman bank appears to have been subject to erosion. Any possible traces of Roman occupation could therefore have disappeared there. One might even wonder whether the (small quantity of) Roman sherds found among the early-medieval material in the riverbed from the time of Dorestad were not the remains of local occupation from the Roman Period, but this does not seem very likely to us.[31] In any case, a bank line from the Roman Period cannot be reconstructed at the present stage of the investigation.

The oldest west-bank of the Rhine, which can more or less be reconstructed, dates from the Late-Merovingian Period. This date is based on a ^{14}C-determination of wood remains from a wattle revetment in Hoogstraat II, which gives the second quarter of the 7th century AD (see chapters II 2.1 and VII 2.7). To date, this revetment is the oldest indication for occupation on the Rhine bank in the Hoogstraat area. The Late-Merovingian occupation appears to have been limited: outside Hoogstraat II no settlement traces from this period were found. The fyke nets from trench 448 in Hoogstraat IV, however, show that early access to the river was sought in other places as well for the purpose of using it (in this case for fishing). The stratigraphical position of the fykes reveals that they date from a stage preceding the period in which occupation expanded along the entire left bank of the Rhine in the Hoogstraat area. On the basis of the results of the excavation in Hoogstraat I, it may be assumed that this period of expansion took place towards the end of the 7th century, after which occupation period 1 began. From this, we may now conclude that period 1 was preceded by a period 0, encompassing approximately two generations.

At the beginning of the period of occupation, the riverbank at what was later Hoogstraat still had a fairly straight course and a steep profile, but shortly after – though still before the beginning of period 1 – this original bank began to silt up and the tendency leading to the formation of a convex bend became visible. It would seem logical to assume that the development, or the widening of a concave river bend in the adjoining area in the south, where nowadays the late-medieval town centre of Wijk is situated, corresponded to this. In the Hoogstraat area the above tendency originally manifested itself most clearly in the southern excavation sites. The original riverbank silted up faster in the Hoogstraat I–III area, and also became less steep than was the case in Hoogstraat IV and 0. This situation still prevailed at the time of (the beginning of) period 1, as indicated by the greater post-depths of the oldest structures in front of the original bank in the latter two sites. The period of bank accretion from which zone 1 developed was followed by a period in which the actual riverbed began to shift from the original bank zone. Between the high bank and the deep part of the riverbed a shoal developed which widened in a number of phases.

The individual phases cannot be clearly distinguished. On the basis of differences in the position of the deepest layers observed in the sections, a distinction was made between zones 2 and 3. In zone 2 the position of the deepest layers reached during excavation was more or less horizontal; in zone 3 the position of the layers dipped sharply, and they generally succeeded each other at short distances. In our view it is probable that the bottom layers of zone 2 were deposited in a shallow part of the riverbed, at the edge of or beyond the actual bed, in contrast to those of zone 3. The bottom layers consisted predominantly of sand with some gravel here and there. The deposits became more clayey towards the surface. Only after part of the shoal had silted up to a level of *c.* 4 m NAP were structures in the form of dams built on it by the inhabitants of Dorestad.

31 Van Es & Verwers 1980, 137.

Whether the shoal grew steadily at roughly the same speed or in fits and starts cannot be determined solely by the section data. Possibly broader sections stood clear of the water simultaneously in zone 2 than in zone 3 at least as far as the central part of the convex bend was concerned. The Hoogstraat I and II sites were located there. The latter site in particular was situated under the apex of the convex bend in the making. Hoogstraat IV and 0 were located further downstream, while Hoogstraat III must have been situated not far from the hinge point with the adjoining concave bend in the south. The shoal of zones 2 and 3 was not only much narrower here than further northward, but it also appears to have silted up rather higher. In Hoogstraat 0 the excavation did not reach the east boundary of zones 2 and 3. In Hoogstraat I and II the shoal grew over a length of *c.* 150 m in the Dorestad period.

As previously stated, the shoal developed in successive stages and not in one go. In each of these stages we visualize the situation as follows. On the land side, there was an area that had silted up to a level of *c.* 4 m NAP, with dams on it, which was separated from the actual (navigable) riverbed by a somewhat dipping, beach-like transitional zone. During the (summer) season in which the area was at any rate in use, the water in the river was generally no higher than 3 m NAP. The landward facing section of the shoal which had silted up to a high level broadened during the Dorestad period. The beach-like transitional zone did indeed shift further and further eastward, but it may have remained more or less the same breadth from beginning to end. How broad it was cannot be deduced from the sections: several dozen metres at the most, we assume. As referred to above, the construction of the dams only took place after the silting up process on a certain section of the shoal had been completed. Naturally, this does not imply that the section where this was not yet the case (particularly the 'beach') was not used at the time.

The period in which zones 2 and 3 developed was comparatively short. The ^{14}C-data available from Hoogstraat I suggest that the riverbed structures at the end of zone 3 were built around the beginning of the 9th century. This would mean that, in this site, the boundary between zones 3 and 4 must already have been reached in the first half of the 9th century. The same probably applies to the other sites. At any rate, the Rhine bed in the Hoogstraat area followed a very clear curve at the end of zone 3, and the area exploited by the inhabitants of Dorestad was located on the inner side of this curve.

Erosion occurred in the Hoogstraat III area, possibly still during, though probably after the Dorestad period. Here, the end of the shoal that had formed in the time of Dorestad was eroded over a distance of probably no more than several dozen metres. In Hoogstraat I, at the end of zone 3, indications of (slight) erosion were also found, but further north there are no such signs. The sedimentation process by which the actual riverbed shifted further and further eastward appears to have been continuous in Hoogstraat II and IV – *i.e.* without an erosive intermediate stage. However, the process may well have slowed down, possibly even to a temporary standstill. The data available suggest that this was in fact the case at the transition from zone 3 to zone 4.

It has already been assumed that the boundary between zones 3 and 4, discovered by us in the various sites, roughly corresponds to the actual bank line from the end of the Dorestad period. This is naturally only an approximation because some erosion had taken place in the south, especially near Hoogstraat III. The date at which this erosion began cannot be exactly determined; it was probably after the Dorestad period, in the second half of the 9th century at the earliest. Nor was the duration of the erosive phase easy to determine. The loss of land that occurred in the Hoogstraat-III and -I areas at that time was not, apparently, extensive. This need not signify that the duration of the erosive phase in the south of the Hoogstraat bend was short. One might assume that, say from the late 9th century, the situation was

more or less stable for a considerable time. In the south of the convex bend there was some erosion at that time, whereas no sedimentation of any importance occurred around the northern sites. In other words, nothing much happened for some time after the Dorestad period. The actual riverbed remained more or less in place. From this bed clayey sediments were deposited at high water and these quickly filled up any open hollows in the riverbed complex.
The differences in character of the sediments from (the beginning of) zone 4 indicate that the behaviour of the river during the formation of this zone clearly differed from that in the Dorestad period. What factors exactly determined the deposition of the by now so much coarser sediments (sand and gravel) is difficult to say. Was it an increased rate of flow, a blockage downstream or a combination of the two? An explanation for the change in the river's behaviour is perhaps not absolutely essential in this respect, but the change in itself is remarkable. As stated in the preceding paragraph, it seems plausible to us that the two different stages in behaviour of the river were separated by a more or less stable period.
The pottery sherds found in the oldest deposits of zone 4 also support this assumption. These sherds belong to a pottery complex in which the dating elements are the *Kugeltopf*/Pingsdorf pottery. The first two types may have been deposited since the 10th century, but the other two not before the 11th century. This suggests that the formation of zone 4 only got into its stride in the 11th century. We regard the sherds as refuse from a late-medieval occupation which left its traces in Hoogstraat III as far as the beginning of zone 4. Nevertheless, Hoogstraat III stands out from the other bank sites: only here were late-medieval pits, wells and bank revetments, in other words classic occupation traces, found. The revetments cut the sediments at the beginning of zone 4, demonstrating that the formation of zone 4 began before this occupation came to an end. In view of the presence of several early *Steinzeug* sherds in one of the wells, occupation must have ended around or after the middle of the 11th century. On the basis of these data, we assume that the process of sedimentation in zone 4 did not take place before the 11th century. If this is correct, the late 9th and the 10th century must have been a more or less stable phase in which the eastward shift of the actual riverbed was temporarily halted. The high ridge on the west side of zone 4 can hardly have formed during the occupation in Hoogstraat III. Zone 4 must therefore only have acquired its final form after the middle of the 11th century, which in turn implies that the great landscape changes in the Hoogstraat area to which zone 4 bears witness, cannot be linked to the end of Dorestad. The final point in the development of zone 4 appears to be determined by a historical fact: the construction of the dam at Wijk in 1122. That the Kromme Rijn fundamentally changed its course after this date is impossible.

III The structures in the riverbed

1 Introduction

Figures 15*–18* give a survey of the features discovered in Hoogstraat 0 and II–IV which is as comprehensive as possible. They have been effected in the same way as the general plan of Hoogstraat I: by combining the data from the successive excavation levels.[32]

The features present in Hoogstraat 0 and II–IV did not differ from those in Hoogstraat I, being mainly the remains of posts and post holes, or rather, post-ghosts. Most of the posts appeared not to have been dug in, but worked or driven into the soft soil of the riverbed, which is why the ends were pointed. The posts or post-ghosts present in the deepest excavation levels are shown in solid black in figure 15*–18*. For the rest, the features were predominantly pits, including several wells. Apart from these pits, the major polluted spots and zones have also been indicated on the general plans. Unusual 'features' observed are: the two fyke nets from Hoogstraat IV (squares C/D-5/6); the ship remains from Hoogstraat II (squares C/F-11/12) and the creel (square G-7).

The picture of the structures in the riverbed revealed by the excavations is far from complete. This is due to various factors, the most important of which are listed below.

1 The features excavated came from a lengthy building process, characterized by the continual extension of existing structures, but undoubtedly also by repairs and alterations to older parts. Allowance must be made for the fact that remains may have been obliterated, even in the time of Dorestad.
2 The structures were such that comparatively little could be preserved during the post-sedimentation processes: in actual fact, only the bottommost part of the vertical posts which had penetrated deep enough into the soil could be traced in the excavation levels. Virtually nothing was left of the superstructure: this fell prey to tillage in the post-Dorestad period. In the case of many of the posts absolutely no wood at all had been preserved, and these were only observed as post-ghosts. Other unfavourable post-sedimentation processes involved are: erosion (especially in Hoogstraat III), activities from the Post-Dorestad period such as in particular the medieval occupation in Hoogstraat III, and recent groundwork.
3 The excavation procedure was not very sophisticated. The intensity of observation differed from place to place: a varying number of excavation levels per trench, and the differences in size of the five excavations in the bank zone. Some features will undoubtedly have gone unnoticed. Measuring the features was done 'freehand' and generally under pressure of time, so an error rate of several centimetres cannot be excluded. This was particularly a problem in the case of the posts and post-ghosts because they were often located close together in clusters, which makes it difficult to recognize posts in various excavation levels. Moreover, the majority of posts were not absolutely vertical, without it

32 Van Es & Verwers 1980, fig. 7.

being clear whether this was their original position, or whether they had sagged later. In fact, it was no longer possible to establish the original position of many of the posts. It must be assumed that in the plans some posts have been indicated twice, while others have been omitted. Other omissions also occurred during excavation: the depth (in relation to NAP) of some of the posts, for example, was not, or was incorrectly measured; in other cases, the determination of the type of wood was forgotten. Fortunately, these kinds of mistake are comparatively rare.

4 The published (general) plans are the result of combining data from various excavation levels, which means that not all the details observed have been represented. The illustrated contour of a feature is almost always based on a choice. This is particularly so in the case of the large elements: the dark zones and spots, and the pits.

As a result of one or more of the above-mentioned factors the picture of the structures has various flaws. It is incomplete because features have been eradicated in the past or more recently, without it always being clear where or to what extent this happened. On the one hand the picture is vague due to the lack of details, and on the other hand it is complicated because it includes several building phases. The separate phases could not usually be recognized with certainty. In effect, we can state that it was often impossible to precisely determine the dimensions and boundaries of the structures.

2 Construction method

Analysis of the features in Hoogstraat I revealed that the structures in the riverbed, located east of Hoogstraat, must have been dams or causeways built of wood and earth. They did not appear to have been built in one go but in an often large number of successive phases. The beginning was located against the 'original' left bank which roughly followed the line of the present Hoogstraat (see chapter IV). As the river retreated from this bank because a meander began to form there, the dams were extended eastwards.

In the description of Hoogstraat I emphasis was laid on the long sides of the dams.[33] Long rows of posts in the riverbed, running from west to east, initially attracted attention. They may, among other things, have formed part of the side-revetments of the dams, which developed – as mentioned above – in several phases, in contrast to the short end-revetments at right angles to them, which were built in one operation as the conclusion of a building phase. The number of short, roughly north-south oriented rows of posts is overwhelming. A survey of them gives a good impression of the location of the dams (see figs. 62*–6*). The phasing is not immediately visible because not every transverse row of posts can automatically be regarded as an end-revetment, *i.e.* as a marker for a building phase. The function of some of the transverse rows is consistent with this, while others appear to have served as supports for a platform on which possibly a structure was built (for more on this, see chapter VIII 2.4). It is possible that in some cases both functions – that of end-revetment and that of substructure of a platform – were combined. At any rate, the functions cannot often be deduced from the form of a transverse row.

2.1 Transverse rows: end-revetment or substructure

We distinguish three forms of transverse row, which are described below.

Type 1 *thin closely-set stakes* (fig. 19)

The stakes with a maximum diameter of 10 cm stood 10–20 cm apart and were probably joined together by wickerwork. This type of transverse row was in the form of a wattle screen and can only have been an end-revetment, marking a building phase. Instead of stakes, narrow planks and triangular (split) beams were also used

33 *Van Es & Verwers 1980, 22–3.*

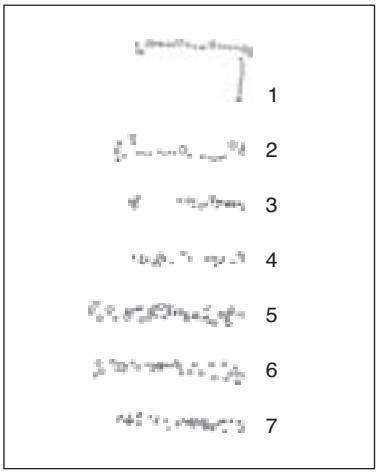


Fig. 19 Dorestad, Hoogstraat 0-IV: type 1 end-revetments; scale 1:400. Legend: see list of Illustrations, p. 371.

(fig. 19: 3, 4). Here and there one can see that the wickerwork has been repaired or replaced (fig. 19: 5, 7).
Wickerwork revetments were relatively seldom found. This is understandable, since the flimsy construction does not leave evident traces. For this reason, type 1 is certainly under-represented. It is, for that matter, questionable whether this type was an independent structure, since the stakes were generally found in combination with thicker round-wood posts, as a transverse row belonging to one of the two following types. It is hard to prove, but it is likely that the wattle screen together with the heavier posts formed a single structure. The wickerwork would not then be a separate revetment but part of a revetment type 2 or 3.
Type 2 *sturdy, closely set round-wood posts* (fig. 20)
The posts are *c.* 15–30 cm in diameter; the gaps between them vary from 0 (seldom) to 50 cm, and incidentally even more (possibly due to the ravages of time or other influences). It was apparently the intention to space the 10 to 15 posts regularly right across the breadth at the head of the dam. We assume that the posts were installed at the same time, even though there is no strict evidence for this. In a few cases planks or beams were used instead of round-wood (fig. 20: 12).
In the case of a characteristic example of type 2 there is little doubt that it is an end-revetment, but it is often difficult to decide whether a transverse row belongs to type 2 or 3 because these two types cannot be clearly distinguished. In the examples in figure 20: 11–7, (most of) the intervals between the posts are 50 cm or more. On the basis of the large number of posts and the irregularity of the intervals they are classified as type 2, but they do not differ much at all from type 3.
Very rarely a dark discolouration was observed at the back of the row of posts, possibly caused by a plank laid sideways, or by a horizontally placed beam or post (fig. 20: 15–7).[34] In such a case the revetment apparently resembled a closed wall. However, a shadow effect may also have been caused by the wickerwork screens. It is understandable that this kind of discolouration leaves few traces: the structure in question need not have been secured deep in the soil, so that traces of discolouration are not often found in the excavation record.
Type 3 *sturdy, widely- and regularly-spaced round-wood posts* (fig. 21)
The posts are similar to those of type 2 but are occasionally surprisingly thick; the gaps are 1 m or (much) more. The posts are few in number and divide the transverse row into four, three or two (approximately) equal sections. At the corners there is often a cluster of 'extra' posts, and this is also the case with type 2. With type 3, however, one sometimes gets the impression that the corner-posts were shored (fig. 21: 8, 11). It is possible that the shores were placed at an oblique angle, but this is not verifiable; they may just have stood upright.
Type 3 is an example of an elegant construction: the posts were placed at the edges of the dam, in the middle of the dam and/or on either side of it. In most cases this will not have been an end-revetment concluding a building phase, but a transverse row incorporated in the body of the dam and belonging to the substructure of a platform, or possibly a building.

2.2 Compartments

As a result of repeated expansion the dams became increasingly longer. An expansion of this kind is referred to here as a compartment. These differ in length: from (very) short to very long.
1 *The (very) short compartments* (figs. 22–9)
Over much of their length many of the dams had posts, mainly transverse rows, succeeding each other at short intervals. This is a common phenomenon. The examples shown in figures 22–9 come from all the Hoogstraat excavations. During the interpretation we assumed – in these cases – that each transverse row must have been an end-revetment. Most of the compartments are in fact very short,

34 *Van Es & Verwers 1980, 49–50.*

Fig. 20 Dorestad, Hoogstraat 0-IV: type 2 end-revetments; scale 1:400. Legend: see list of Illustrations, p. 371.

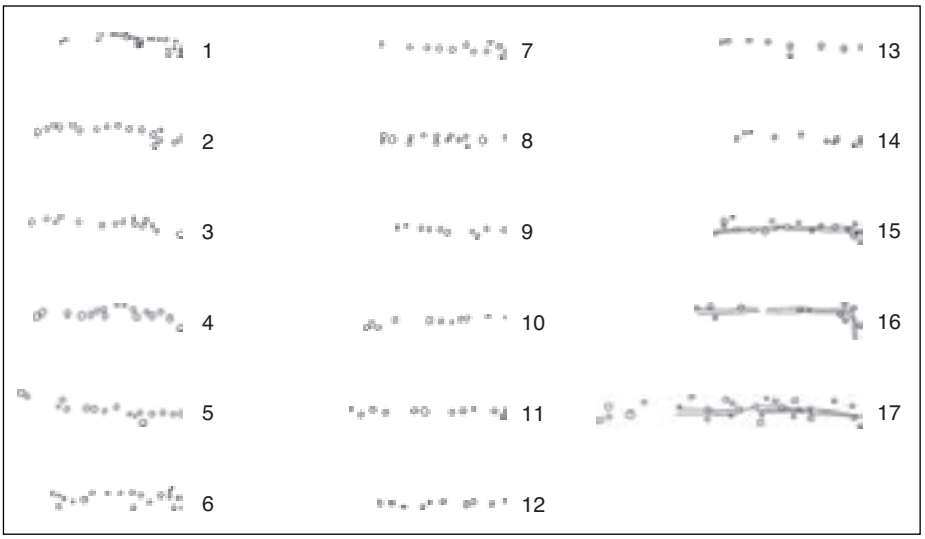
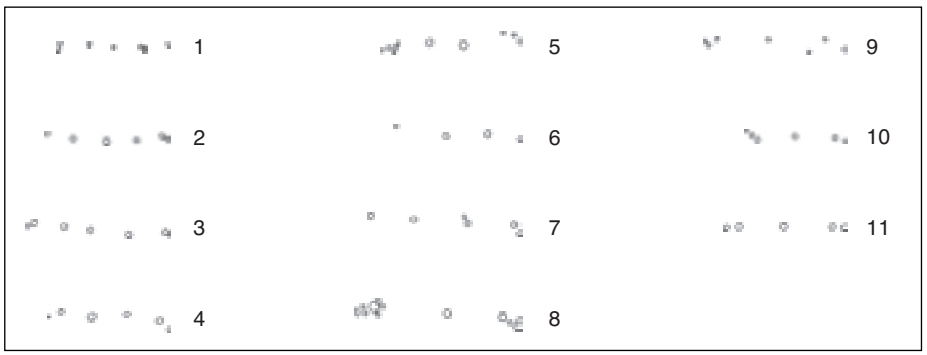


Fig. 21 Dorestad, Hoogstraat 0-IV: type 3 end-revetments; scale 1:400. Legend: see list of Illustrations, p. 371.



implying that, per building phase, only a short section of the dam was extended. According to our interpretation, dam HS-I 10, for instance, has (at least) 32 compartments over a length of 23 m: *i.e.* an average length of 0.7 m (fig. 22). Interpretations leading to comparable compartment lengths can be found in figures 23–6. Figures 27–9 show dam segments containing somewhat longer compartments besides very short ones, but none are actually longer than 2.5 m.

The starting point of these interpretations, however, is not absolutely certain. The transverse rows of the dam segments shown in figures 22–9 belong to all the three types discussed in the last paragraph, with a clear preference for type 2 and especially for type 3. In other words: by no means all the transverse rows can be interpreted for certain as end-revetments. The latter only applies to the relatively rare type 1 and to a certain extent also to type 2. Transverse rows of type 3 need not necessarily mark the end of a compartment. As stated above, their function may have been limited to supporting a superstructure, and consequently, a shadow of doubt hangs over our interpretations. Because the posts in the transverse rows of type 3 – and to a certain extent also in those of type 2 – are regularly distributed across the width of the dam, this creates the effect of long rows of posts running lengthwise along the dams, which increases the uncertainty whether every type 3 transverse row should be regarded as an end-revetment. In many cases it seems very probable that at least some of the transverse rows were realized simultaneously, as substructures for buildings or other structures. We shall return to this point in chapter VIII. In the examples given, the main impression is that most of the transverse rows were also end-revetments. Short compartments undoubtedly often occurred, but in the individual cases the length of the compartments is often

dubious. It is quite possible that buildings or other structures were built on dam segments with very short compartments since there were plenty of posts there which could serve as a substructure.
A remarkable phenomenon is the often dense concentration of posts on the short sides of the compartments, which can have various causes. Firstly, a relatively large number of posts was required at the sides in order to connect the old work with the new. Not all these posts were perhaps installed at the same time; repairs are generally to be expected especially along the sides. Moreover, double counts are certainly possible in these concentrations of posts. The small rows of posts at the corners often revealed a curved course, which could sometimes be more clearly observed on the one side than on the other (figs. 22–3). Possibly the side with the curved rows was an 'outer side', *i.e.* a side of the dam not directly adjoining another. There was enough room for this, and there was also undoubtedly a need for repairs. Thickening the sides as a result of repairs may have led to the widening of the dams, though this was not always the case. The (original) breadth of the dam appears to vary from 5 or 6 to 7 or 8 m: The exact breadth was sometimes difficult to determine.
2 *The (very) long compartments* (figs. 30–2)
This appears to have been an exceptional form, well over 5 m long. The breadth appears to vary from *c.* 6 to 7.5 m. In the example shown in figure 30, an originally 6 m-wide dam appears to have been widened on one side over a considerable length, but this interpretation is not entirely reliable. The concluding compartment of the original dam also appears to have been unusually long – over 5 m. Very long compartments are shown in figures 31 and 32. The end- and side-revetments enclosing these compartments are basically similar. In the compartment shown in figure 30–1, the revetments were renewed once or twice, causing it to increase in length and breadth.

2.3 The existing dams of Holm near Schleswig (Germany)

At the west end of the Schleswiger Noor (formerly the Haddebyer Noor), the impressive semi-circular earthen rampart of Haithabu keeps alive the memory of the early-medieval European trade system to which Dorestad also belonged. Diagonally opposite, to the south of the small fishing village of Holm near Schleswig, a row of narrow dams juts out from the bank into the water of the Noor. These dams have nothing to do with the Early Middle Ages and yet they have always reminded us – despite all the differences – of the structures in the riverbed, which is why we include here a description of the work done on the extension to one of the dams at Holm, some of which we were, by chance, able to observe in the late summer of 1995.
The space between the Holm dams varies considerably, but at one spot four of them are close together. The most easterly one now consists entirely of concrete. It is located in the continuation of an alley leading from the village street to the bank, and was constructed for the purpose of the fire brigade. The other three are private property and serve as jetties for the small boats used for fishing on the Noor. There

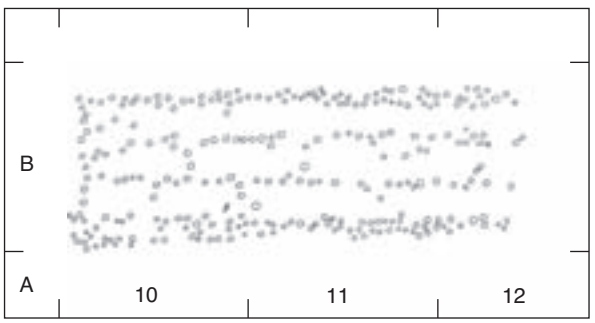


Fig. 22 Dorestad, Hoogstraat I: short compartments, HS-I 10; scale 1:400.

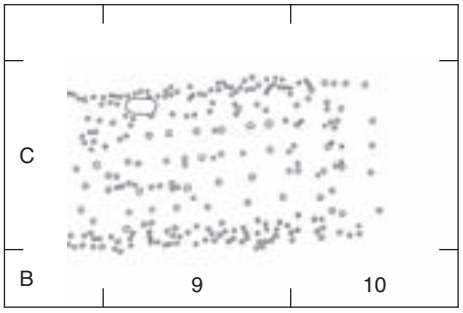


Fig. 23 Dorestad, Hoogstraat II: short compartments, HS-II 6; scale 1:400.

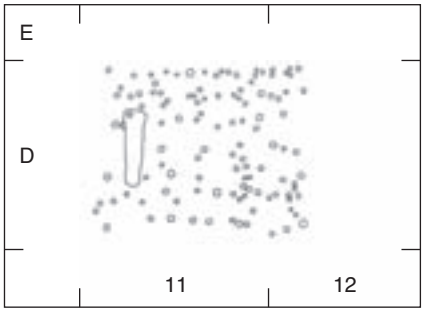


Fig. 24 Dorestad, Hoogstraat I: short compartments, HS-I 9; scale 1:400.

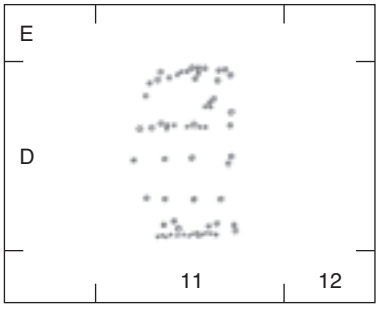


Fig. 25 Dorestad, Hoogstraat II: short compartments, HS-II 5; scale 1:400.

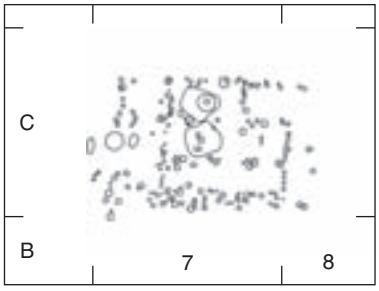


Fig. 26 Dorestad, Hoogstraat 0: short compartments, HS-0 8; scale 1:400.

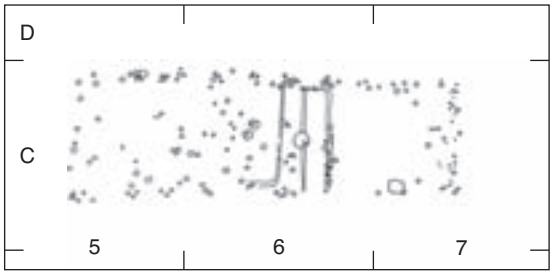


Fig. 27 Dorestad, Hoogstraat IV: short compartments, HS-IV 4; scale 1:400.

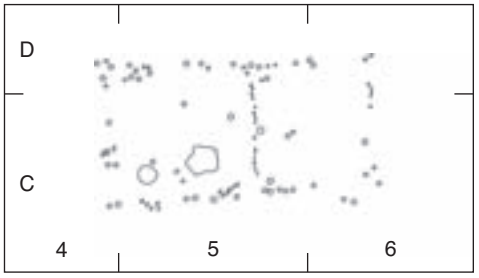


Fig. 28 Dorestad, Hoogstraat II: short compartments, HS-II 5; scale 1:400.

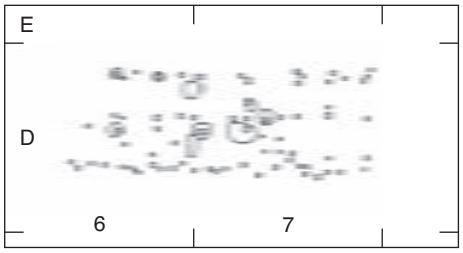


Fig. 29 Dorestad, Hoogstraat III: short compartments, HS-III 4; scale 1:400.

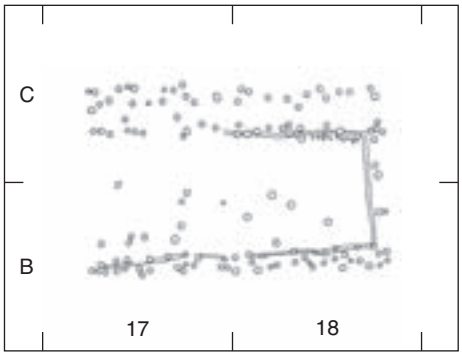


Fig. 30 Dorestad, Hoogstraat I: long compartments, HS-I 10; scale 1:400.

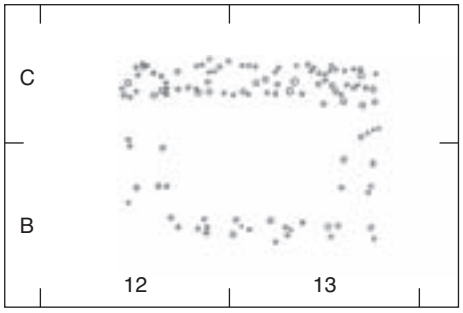


Fig. 31 Dorestad, Hoogstraat II: long compartments, HS-II 8; scale 1:400.

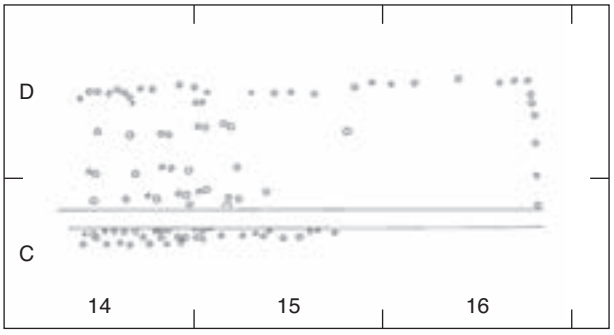
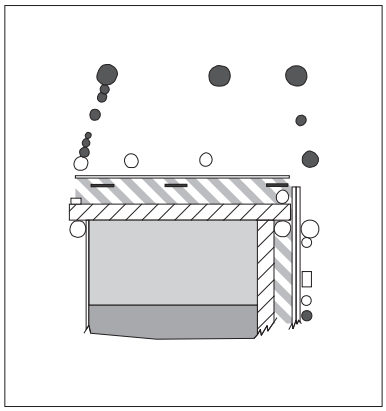


Fig. 32 Dorestad, Hoogstraat I: long compartments, HS-I 9; scale 1:400.

is no relation between the dams, the houses and plots on the bank. These three structures are built of wood, rubble and earth, as are the dams further on. They look extremely old, though in actual fact they are not. Construction of the dams at Holm only started around 1950, so one of the owners told us. The intervals between the four dams built close together vary in breadth from 3.70 to 6.00 and 6.50 m. The length of the three wooden dams and the breadth is not the same everywhere. The middle dam is 2.60 m wide at the beginning and 3.70 m wide at the end. The dam on which the extension work was being done was the third from the west, and prior to extension it was *c.* 2.50 m wide and 10 m long.

In the afternoon of 2 September 1994 we came across six men at work. Two were standing on the dam, three were in a rowing boat and one man was standing up to his middle in the water. He was wearing oilskins and was armed with a high-pressure spray-gun. The men had started to extend the dam with a compartment approximately 1.5 m in length. For that purpose posts were driven into the soil – under water – first at the end and subsequently along the sides of the new compartment. For the three posts at the far end the best material was used: about 5 m-long, new (?) pine telegraph poles, *c.* 20 cm in diameter. They were not so fussy about the sides and apparently used whatever they could get: usually new pine posts *c.* 10–13 cm in diameter, but also part of an old ship's mast *c.* 8 cm in diameter. We observed them drive in some of the posts. The material was brought in over land in a wheelbarrow and then floated to its destination. Once there, a post was pulled upright by the men in the boat – which was heavy work with the end posts – and held fast while the man in the water drove the posts into the soil with the help of the spray-gun. The other two men on the dam assisted. The spray-gun was borrowed or rented. In the past they would have done without, but they assured us that it was quite possible, as in the case of the mooring posts further away in the water: they had all been worked into the soil from a boat. In this way the posts, which had



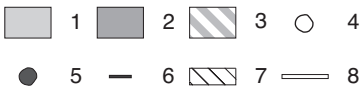


Fig. 33 Schleswig: plan of part of a dam built out into the Nor; scale ca 1:100.
Legend:
1 concrete;
2 grass;
3 filled with rubble;
4 post;
5 added post;
6 iron clamps;
7 split tree trunk;
8 planks.

pointed ends, could be fairly easily driven into the saturated bed of the bay, and they sank down until they met a firmer layer.
The posts of the new dam compartment naturally did not end up at the precise spot desired, nor were they exactly vertical. By means of slats and planks which were nailed down, the posts were forced into a straight row as far as possible. It was clearly the intention to manoeuvre the three heavy posts at the end into the corners, and into the centre. That this was not entirely a success can be seen from the plan we sketched on the spot (see fig. 33). Some of the posts on the sides were placed up against each other. A number of posts, especially those at the end, continued to protrude far above the dam and were possibly later sawn off, though we did not actually observe this. Fitting the revetment along the side- and end-walls and filling in the compartment took place after our departure – probably one or two days later. How many man-days the extension of the dam actually took we do not know. Driving in the eleven posts probably took six (?) men two (parts of) afternoons. Figures 33 and 34 give an idea of what the dam looked like after this period of work.
At the beginning of the work the existing end-revetment appears to have been partially dismantled. At any rate a new post had been added at the southwest corner and the old planking had partly come loose. This revetment must originally have been wedged in between four posts (two at the corners and one approximately in the middle) and three metal strips (elements of a steel sheet piling, by the look of it). The use of metal was an exception at this location. In figures 34 and 35 it can be clearly seen that the sides of the dams consist of wood (usually planks or beams) and are built in various ways. The posts supporting them on the outside are irregularly distributed: sometimes they are close together but more often they are widely spaced. Apparently use was often made of old material: round-wood and scrap-wood indiscriminately. It is obvious that not all the posts were placed during construction. Some were added to an existing structure as repairs. An example of this can be seen on the west side of the dam described by us, where a new post was sticking up. The side-revetment to which this post was attached does not seem original either. It was probably added in front of an older one, thus widening the dam by about 30 cm (figs. 33, 34: c).

The dams are 0.5–1 m above water. The water at the end of a new compartment was about 1m deep. The end-revetment here must therefore have been at least 1.5 m in height. To fill up the compartment would have required at least 5 m^3 of filling material, probably rubble. The surface of the dams is more or less flat, though rather uneven. It is usually covered with a layer of earth and grass; occasionally a section has been finished off with cement. Some of the revetment posts, mainly the heaviest, project another 0.5 m above the dam. Thin slats are often attached to the revetment and these are joined together with horizontal slats at a height of about 2 m. These racks are used to dry the nets and to hang all sorts of things on. Apart from nets, the fishermen of Holm also use creels (fig. 35: d). Full of fish, these are fastened in the water to one of the posts in front of the dams.
The dams were not built in one phase. According to reports, a start was made by sinking old wooden fishing boats weighted with stones from the bank and then building the revetments around them. Whether this was the procedure with all the dams is questionable. Often large chunks of natural stone were used for the connection with the beach, and subsequently the dams were built out, probably in several stages. How long the compartments were is now difficult to see, but they were certainly not very short. The compartment that we watched being built could prove to be an exception with its short length of 1.5 m. The fishermen gave us a combination of two reasons for the construction of the dams. One was that the old boats and rubble from the settlement had to be got rid of, and the other was that the dams were intended so that boats could moor alongside them even at low water. The latter reason appears to us to

be the more important. The water level in the bay is subject to variation due to changes in the wind direction; there is no ebb and flow activity. With an easterly wind the water there is pushed up to a higher level; a westerly wind causes a lower water level. The function of the dams is therefore primarily that of a jetty. The small basins between the dams offered the boats added protection. The boats could also be hauled up on to the beach at the end of the basins.

2.4 The construction of the dams in Dorestad

The function of the dams in Dorestad was not identical to that of the dams at Holm. The former were probably intended rather as a means of raising a low and soggy area than as jetties projecting into open water. Nevertheless, the building process in Dorestad was probably very similar to that in Holm. For instance, the fact that in Holm the posts used to be worked into position in the soggy soil is enlightening. The procedure may have been the same in Dorestad, without the help of a pile frame. The dams of Dorestad and Holm would have resembled each other, certainly from a distance, although their construction certainly differed. One point of difference may have been the construction of the revetments. There are few concrete indications for side-revetting with planks in Dorestad. This method remains virtually limited to a few long compartments, at least if the narrow dark bands along the edges may be interpreted as the impressions made by planks laid edge on (fig. 30).
As noted above, revetments of closely positioned posts were the great exception in Dorestad (fig. 20: 1); the revetment of the dam-walls probably consisted of wattle. Revetments of type 1 must have been made of wickerwork which was probably

Fig. 34 Schleswig: photographs of dam from fig. 33.

woven on the spot around stakes embedded in the soil. In the case of type 2 it is also quite conceivable that the wickerwork was fitted between the sturdier posts standing close together. Another possibility is that a prefabricated wattle-screen was placed against the posts on the inside. This solution may also apply to type-3 revetments, but with intervals of 3 m or even slightly more, which are found in this type, one wonders whether the wattle screen received enough support to prevent it from bulging. Perhaps in such cases the edge was lined with planks or – more probably – with thin stakes which did not leave any traces in the excavation levels because the screen was not embedded deep enough in the soil.
We did not manage to deduce a certain method of construction from the available data, and the question remains whether the same method was used in all cases. In figure 36 six alternatives for the reconstruction of a segment from the beginning of dam HS-II 2 have been set side by side, and these are described below.

1 In this reconstruction the short compartments are lined with a wattle screen placed against the revetment posts on the inside. The spaces in the compartments may have been filled with earth; the surface covered with grass, for example. One objection to this reconstruction is that most of the

Fig. 35 Schleswig: photographs of other dams.

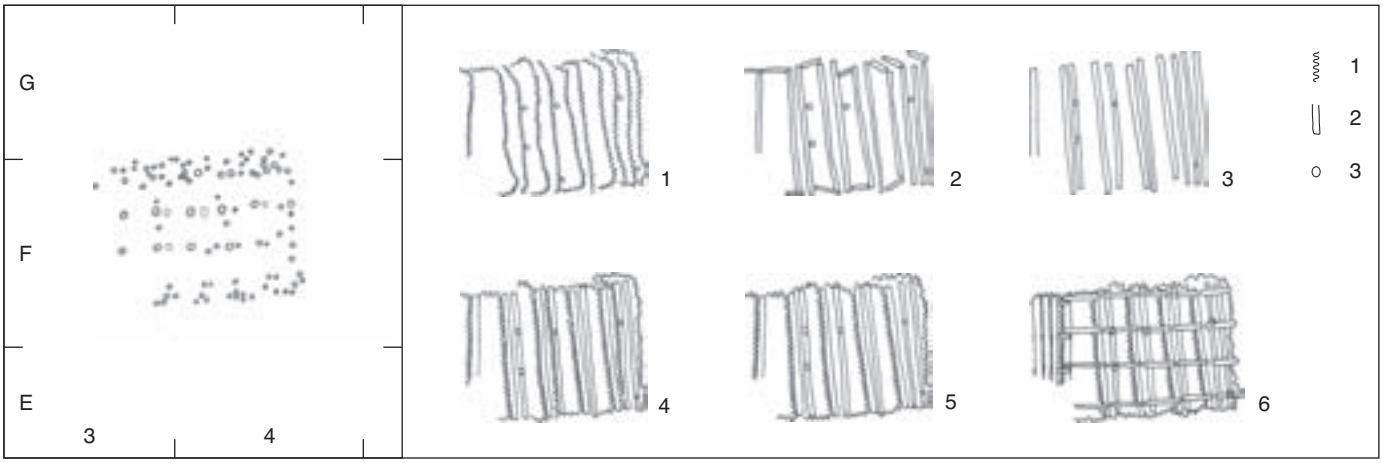


Fig. 36 Dorestad, Hoogstraat II: reconstruction of dam segment HS-II 2 and six alternatives; scale 1:400.
Legend:
1 end revetment;
2 horizontal beam;
3 additional post.

endrevetments belong to type 3 and possibly provided insufficient support for a wattle screen.

2 Instead of wickerwork, small stakes, beams or planks have been used as compartment walls. To give these walls a certain amount of height, several of them would have to be piled (horizontally) on top of each other. In fact this reconstruction is a caisson. This method of construction is not practical in our opinion, because of the short length of the compartments, so we shall ignore this alternative.

3 Another possibility is that the end-revetment served to support a stake or beam which in turn supported a superstructure. This superstructure may have consisted of a road surface of, for example, wicker mats, possibly covered with sods (for another form of 'road surface', see under 5). It may also have been a building. A drawback with this reconstruction is that posts are 'left over' on the sides in the case of an end-revetment such as type 2. In this case the beams are supported by an unnecessary number of posts and come to lie very close together. The space between the beams is then 50 cm at the most: from the point of view of supporting power alone this seems to us to be far too little.

4 In this reconstruction, alternatives 1 and 3 have been combined, which largely cancels out the objection to 1: the supporting beam on the end-revetment can also serve to anchor the wattle wall of the compartment. The same applies to the objections to 3. An attempt has been made to explain the situation of the (too) closely placed horizontal supporting beams by assuming that not every end-revetment forms the beginning of a new compartment. Some posts would then only have been repairs to already existing revetments and need not necessarily have supported a beam (these beams, however, are also shown in the drawing).

5 This alternative is a refinement of the previous one and takes into account as much as possible the great regularity seen in the plan. The whole complex can be split up into five more or less equally long compartments of *c.* 2 m. The reason for doubling the number of supporting beams at the divisions of the compartments now becomes clear: it was considered necessary to build a support for a superstructure also at the beginning of a new compartment. This was built of beams placed lengthwise which in turn had to support a platform or a building (for superstructure, see fig. 36: 6).

With most of the above alternatives we remain within the interpretation of the wooden structures as dams (causeways): frames filled with (probably) earth, and possibly supporting a platform or building. It is, of course, obvious that the third alternative fundamentally differs. It is not a frame, but a platform supported by posts above the surface of the water: in other words a jetty. We do not exclude the possibility

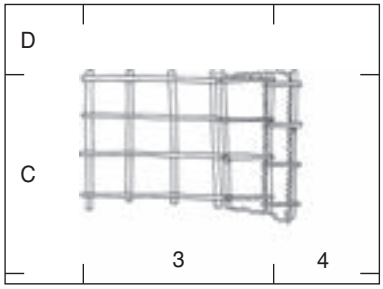


Fig. 37 Dorestad, Hoogstraat II: reconstruction of dam segment HS-II 5; scale 1:400. Legend: see fig. 36.

that this structure also occurred; the beginning of dam HS-II 5 appears to be an example of it (fig. 37). The first element of this dam is a splendidly regular grid of posts: average interval breadthways *c.* 2 m and lengthways 2.25 m. Here no other reconstruction is conceivable than a framework of posts supporting a platform or building. The adjoining two compartments have been reconstructed according to the fifth alternative, though they may well have been jetties. The first section of dam HS-II 5, however, is located in an unusual position: it is still on the sloping bank and not yet in the riverbed. It is questionable whether the platform was much above the surface. It possibly served to bridge a difference in level which would make it an exceptional structure.

In general, a type of causeway would appear to be the best interpretation. Anything else is hardly imaginable in the case of the (rarely found) long compartments, though in our view the same applies to the short ones. In another example we point to a segment from dam HS-II 6 (fig. 38; *cf.* also fig. 23). Almost every end-revetment here belongs to type 2. One gets the impression that each revetment also represents a separate phase of building. The building process would then amount to the continual replacement of 'old' revetments by new ones. Naturally finishing off the tops of the revetments with a beam or stake was also one of the possibilities, in fact it may even have been necessary for the reinforcement of the wattle screen (see fig. 36: 4 and 5). In figure 38b one can see that these beams were very close together which was not really necessary with a jetty, though perhaps in this case wicker mats were used as (the base of) a kind of road surface so that frequent support was by no means superfluous. Another possibility which cannot in this case be excluded is that the beams had to support a building or something similar.
Even if our impression is correct, and the structures in the riverbed are generally the remains of dams made of wood and earth, and not jetties in the form of freestanding platforms, there is still enough scope for variation. It is, for instance, quite possible that alternative constructions were used by turns in a dam. An example is shown in figure 39 (see also fig. 27), in which the alternatives 1 and 5 have been drawn in. In fact, the variation may have been even greater, for the fourth alternative can also be considered. Thus the sections of the dams which were covered with grass may have alternated with sections surfaced with wicker mats or wooden planks, with or without a building on them as assumed in alternative 5. The latter form of covering in particular was labour intensive and therefore expensive. Unfortunately, the extent to which this was done cannot be determined; as already stated, it is also quite possible in the third alternative. In dam HS-0 7 a trace has been preserved, probably of a platform.

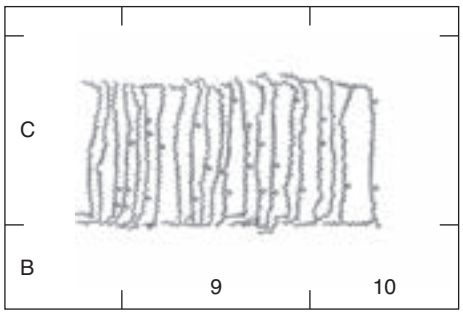


Fig. 38 Dorestad, Hoogstraat II: reconstruction of dam segment HS-II 6; scale 1:400. Legend: see fig. 36.

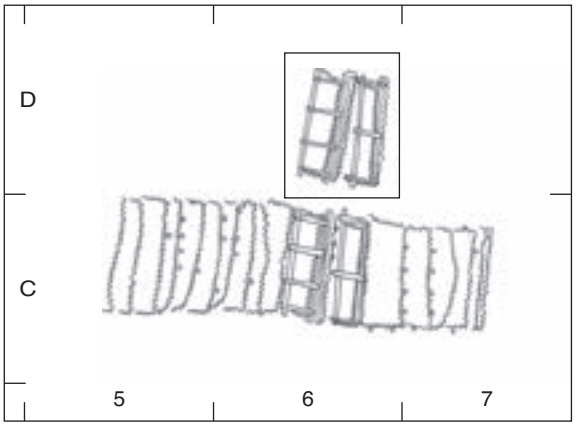


Fig. 39 Dorestad, Hoogstraat IV: reconstruction of dam segment HS-IV 4; scale 1:400. Legend: see fig. 36.

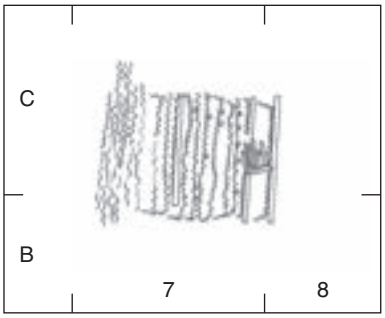


Fig. 40 Dorestad, Hoogstraat 0: reconstruction of dam segment HS-0 7; scale 1:400. Legend: see fig. 36.

Only a small section at the beginning of dam HS-0 7 was excavated. It appears to link up with a series of at least five successive bank revetments. Figure 40 shows a reconstruction by analogy with what is shown in figure 39; variants are naturally also possible here. The evidence for a platform is a mark left behind in the soil, possibly by part of a platform (the wood had completely decayed). This discoloured area comprised six planks roughly 20 cm wide running close together across the breadth of the dam. The planks were probably supported by the beam or plank whose mark could be seen on one side, in the longitudinal direction of the dam. The thickness of the planks or beams could not be determined. From the differences in length and the sometimes pointed ends of the planks it is clear that this is a fragment of a structure. Possibly this is a (part) of a platform which had decayed in the soil at this spot and was apparently located close to the site of the structure to which it belonged. One gets the strong impression that the mark originated from a platform approximately 2 x 1.5 m which was discovered in the middle of one of the compartments. One would then have to assume that originally there were two beams laid lengthways on the (supporting beam of the) old and new end-revetments and that the former supported the actual platform. This explanation, however, is not completely watertight, for the following reason.

The mark was observed at a depth of *c.* 3.00 m NAP, which is perhaps more than a metre below the surface of the dam. The field drawing suggests that the mark was situated more or less horizontally in a pit, but the latter is by no means certain. If the platform originally lay on the dam, a pit would have to have been dug there at a certain moment so that the platform would come to lie at the bottom of it. It is difficult to see why something like this would have been done. Two other possible explanations are conceivable. The first is that the platform was clearly above the level of the water: in other words, it was a jetty which had somehow fallen off its supports and remained behind in the riverbed. This brings us to the third alternative of figure 36; a structure which we do not rule out, but consider less probable. In the second explanation the mark does not come from a platform, but from a piece of walling which formed part of an end-revetment. In that case it would have been upright and was possibly left behind during the construction of a new compartment, close to where it had been placed. A part of an end-revetment could, for whatever reason, have fallen over, leaving behind a similar mark in the course of time.

Unfortunately, there are no decisive arguments to opt with certainty for one of the above-mentioned explanations. The 'part of an end-revetment' explanation could supply us with information about the height of the dams which is now lacking. The height of the dam would have to be at least 1.5 m, which is much higher than the 0.5 m which we previously assumed in the case of the Hoogstraat I dams.[35] This half metre, however, is based on an extremely disputable estimate. At some places in Hoogstraat I there were even indications for side- and end-partitions made of planks, which were possibly as much as one metre in height.[36] We would now certainly not want to exclude a similar height or more for a dam close to the original bank. Our former starting point that 'the dams were the same height everywhere' is no more than a hypothesis. The 'platform' explanation leaves open the question of whether only the middle of the dam segment was 'surfaced'. In itself, this is quite conceivable, and has previously been put forward as one of the possibilities.[37] The situation of dam HS-0 7 would not provide certainty in this respect, even if it had been established that the mark came from a platform, because the discolouration is clearly incomplete. In the case of a reconstruction as 'jetty', it is difficult to imagine that the platform would not have covered the entire breadth. The presence of a 'building', whose floor would then have been the platform, is yet another possibility.

35 Van Es & Verwers 1980, 51.
36 Van Es & Verwers 1980, 49.
37 Van Es & Verwers 1980, fig. 15c.

2.5 Use of wood

A comprehensive study of the use of wood in the riverbed at Dorestad has been carried out by Casparie and Swarts.[38] In it, they made use of their own identifications of the wood samples from the Hoogstraat-I, and part of the Hoogstraat-II and -III sites. Meanwhile, all the wood remains from Dorestad have been identified by them, so that the information which now follows is based on the total data from the riverbed. The conclusions of Casparie and Swarts are confirmed by the new evidence on all the fundamental points, and for this reason we shall confine ourselves to a few supplementary remarks.

The number of wood identifications from Dorestad is substantial: approximately 9400, of which 6715 originated from the riverbed and *c.* 2700 from the settlement; the latter will not be discussed here. Despite their large number, the wood samples are only a poor reflection of the use of wood. In the first place, they represent no more than a small proportion of the total quantity of wood required to build the riverbed structures. Most of the samples come from the posts, generally saplings, from the substructure of the dams. Generally speaking, 10–20 % of these posts at the most were sampled. The superstructure of the dams left virtually no traces (therefore no wood samples either). Only a few samples were left of the wickerwork which we assume to have been used frequently in the bank zone. A random sample is therefore certainly not representative. Moreover, wood that could be identified was very irregularly distributed over the riverbed area, as can be (partly) seen in table 9. This table shows the part of the riverbed in which traces of wooden structures were found, split into three zones running parallel to the bank. Table 10 indicates which excavation trenches were located in the various zones plus the surface area of the zone in m^2. For the sake of convenience, we have let the zone limits coincide with the trench boundaries. The division into zones is not, therefore, (primarily) based on phases in the development of the complex. The boundaries are rather arbitrary, but attempts were made to keep the breadth of the zones more or less uniform. The division into zones does, of course, roughly represent a succession of three periods.

zone	HS-0			HS-I			HS-II			HS-III			HS-IV			
	N	%	N/m²	N	%	N/m²	N	%	N/m²	N	%	N/m²	N	%	N/m²	
													with trench 449			without fykes
1	987	100	0.62	154	8	0.02	189	11.4	0.07	182	23.5	0.08	1351	99.5	0.84	0.46
													without trench 449			
													763	56.2	0.95	0.18
													without revetment			
													without trench 449			
2				829	42.8	0.12	1278	77.0	0.27	594	76.5	0.54	7	0.5	0.004	
													with trench 449			
													595	43.8	0.25	
3				952	49.2	0.15	192	11.6	0.05				0	0	0	

TABLE 9 Dorestad, Hoogstraat 0–IV
Number of wood determinations per zone (determination: Casparie and Swarts).

The most interesting figures in table 9 are those which represent the number of samples per m^2 (table 9: N/m^2, obtained by dividing the number of samples (N) by the surface area of the zone in question). They vary from 0 (Hoogstraat IV zone 3) to 0.95 (Hoogstraat IV zone 1). The data concerning the Hoogstraat-I, -II and -III sites are vastly underrepresented in the foremost zone, and the highest density of samples is in the middle zone (Hoogstraat II and III?), and/or even in the outer zone

38 Casparie & Swarts in: Van Es & Verwers 1980, 262–85.

Excavation	HS-0	HS-I	HS-II	HS-III	HS-IV
Zone					
1	261 (part), 262, 266, 267 (part), 268 (part)	352, 355, 359, 360, 364, 365, 373, 374, 377, 378	380, 381, 382	401 (part), 402, 403, 404	448 (part), [449], 453 (part), 454 (part)
	1600 m²	*6600 m²*	*2600 m²*	*2300 m²*	*1600 m²* without 449 *800 m²*
2		353, 354, 358, 361, 362, 366, 367, 369, 375, 379	383, 384, 385, 386, 387, 388	405 (part), 406 (part), 407 (part)	450, 451, [449]
		7200 m²	*4800 m²*	*1100 m2*	*1600 m²* with 449 *2400 m²*
3		356, 357, 363 (part) 368, 370 (part), 371, 372, 376	389, 390, 391 (part), 392 (part), 393 (part), 394 (part)		452
		6400 m²	*3600 m²*		*800 m²*

TABLE 10 Dorestad, Hoogstraat 0–IV
Surface area in m² per zone.

(Hoogstraat I). By contrast, Hoogstraat 0 and IV have extremely high values precisely in the bank zone. This situation could be slightly influenced by differences in the intensity of sampling but must be mainly due to other causes. The explanation probably lies in (a combination of) two factors: the preservation conditions and building activities, the latter being again linked with the local influence of the river. In the relatively highly silted up riverbed area of the Hoogstraat-I to -III sites, the preservation conditions were unfavourable, in contrast to those of Hoogstraat 0, which lay at (the beginning of) a concave bend. Incidentally, the chance of finding wood (remains) is greater with deeply founded, relatively heavy structures, which is probably also the case in Hoogstraat IV. Even if one ignores the wooden remains of the two fyke nets discovered there and allocates excavation trench 449 to the middle zone, the frequency of samples in zone 1 is still relatively high there. The middle zone of Hoogstraat I to III was comparatively low, thus providing relatively favourable conditions for preservation. It is worth noting that the situation in Hoogstraat III becomes obscured by activities from after the Dorestad period; a (substantial?) proportion of the samples dates from this period.
Great differences are again seen in zone 3 between the Hoogstraat I and II sites on the one hand and Hoogstraat IV on the other. The 'chances of survival' for wood were probably not very different here. The differences in frequency of the samples are mainly connected with differences in the intensity of the building activities. In Hoogstraat I, zone 3, dams were still being built in abundance in a period when – in all probability – the river was already exerting a strong influence here, making the construction of more robust structures a necessity. In the north-eastern part of Hoogstraat II building activities appear to have been far less intensive in zone 3. At any rate, a sharp decrease in the number of structures could be observed, and the same applied to Hoogstraat IV, zone 3. Whether this decrease was exclusively the result of a less forceful current – one can imagine that the dams in Hoogstraat I which projected far into the river also provided protection – could not be established. It is also conceivable that the owners of the plots in question were less active or wealthy (labour costs effort and/or money). The human and the natural factors are, once again, difficult to unravel.
The incompleteness of the riverbed sections in the Hoogstraat-0 and -III sites (Hoogstraat IV is actually too narrow) adds to the uncertainty. For research into the use of wood

during the beginning phase of building the wooden structures one has to turn to the Hoogstraat-0 and -IV sites. For a study of the later phases, Hoogstraat I and II in particular are the appropriate sites. Despite the uncertainties mentioned, one can arrive at a general analysis of the choice of wood without any problem. Table 11 clearly shows that only a few types of wood were actually important. Two which were certainly important are *Quercus* and *Fraxinus* with an average of *c.* 53 and 22 % of the total number of samples. They are followed by four types which are reasonably well represented: *Alnus*, *Betula*, *Salix* and *Ulmus* (*c.* 9.3, 3.4, 7.7 and 2.8 % respectively). The rest is virtually negligible. This actually also applies to *Betula* as building timber, because without the 223 samples from the fykes in Hoogstraat IV hardly any birch samples are left. *Salix* comprises 395 samples from the same fykes. Without these, the numbers of this type do drop sharply, but they maintain a relatively reasonable level of *c.* 1.8 %. What it comes down to is that use was made especially of *Quercus* and *Fraxinus* and to a lesser degree of *Alnus*, *Ulmus* and *Salix* as building material for the riverbed structures. Casparie and Swarts have already indicated that *Quercus* and *Fraxinus* were used as the main components of the substructure of the dams, for the end- and side-revetments, and for transverse rows supporting buildings. Apparently other types of wood were only exceptionally used for these purposes. The few *Alnus* and *Ulmus* posts were perhaps used as repairs, or had perhaps been accidentally mixed up with the right building material and used by mistake. The problem of course remains that the majority of posts had decayed and so could no longer be identified. The preponderance of the relatively hard types of wood *Quercus* and *Fraxinus* over the softer *Alnus* and *Salix* may be linked with the difference in durability, though this appears to be no more than a theoretical possibility, since in well-preserved dam segments it could be clearly observed that oak and ash had been deliberately chosen for the main construction posts. It is possible that *Alnus* and *Salix* were used preferably for wickerwork because of their specific characteristics. The old 7th-century bank revetment in Hoogstraat II was an indication of this. It is virtually the only wicker structure of which something remained, and consisted mainly of *Alnus* with in some places *Salix* and a small amount of *Fraxinus*. If this assumption is correct, *Alnus* and *Salix* are certainly underrepresented. These types of wood, incidentally, were not the only ones suitable for wickerwork. The wattle revetment in Hoogstraat IV, squares B/C-7, consists of *Fraxinus,* and oak is also ideal for woven structures.

TABLE 11 Dorestad, Hoogstraat 0–IV
Types of wood per Hoogstraat excavation: numbers and percentages (determination: Casparie and Swarts).

excavation	**HS-0**		**HS-I**		**HS-II**		**HS-III**		**HS-IV**		**Total**	
type of wood	N	%	N	%	N	%	N	%	N	%	N	%
Quercus	556	56.3	1210	62.5	752	45.3	528	68.0	518	38.1*	3564	53.1
Fraxinus	181	18.3	565	29.2	496	29.9	128	16.5	103	7.6	1473	21.9
Alnus	121	12.3	93	4.8	268	16.2	70	9.0	71	5.2	623	9.3
Ulmus	106	10.7	19	1.0	19	1.1	12	1.5	32	2.4	188	2.8
Salix	12	1.2	16	0.8	74	4.5	18	2.3	397	29.2	517	7.7
Populus			1	0.05	5	0.2	1	0.1			7	0.1
Fagus	4	0.4	6	0.3	9	0.5	6	0.8	6	0.4	31	0.5
Tilia					3	0.2	4	0.5			7	0.1
Corylus	1	0.1					1	0.1	1	0.1	3	0.04
Carpinus					1	0.06					1	0.01
Betula	3	0.3	1	0.05	1	0.9			223	16.4	228	3.4
Malus type	2	0.2	2	0.1	21	0.2	3	0.4	4	0.3	32	0.5
Prunus type					1	0.4	1	0.1	2	0.1	4	0.06
Acer	1	0.1			1	0.06					2	0.02
Rhamnus					1	0.06					1	0.01
Abies			21	1.1	4	0.2	2	0.3			27	0.4
Pinus			1	0.05							1	0.01
undetermined					3	0.2	2	0.3	1	0.1	6	0.1
total	987		1935		1659		776		1358		6715	
% total	14.7		28.8		24.7		11.6		20.2			

* without Salix and Betula 68 %

The use of wood was probably more or less as follows: for the main and heaviest structural elements *Quercus* and *Fraxinus* were chosen, and in view of the extremely high proportion of oak in all the Hoogstraat excavations, there was undoubtedly a preference for this type of wood. This is understandable because it was the hardest species regionally present which produced nice straight trunks, and which also had favourable characteristics for use in damp environments. We can safely assume that the platforms and buildings (partially) covering the dams were also of oak. The wickerwork of all the revetments used, both on the bank and at the ends would have consisted – as far as (oak) planks were not used – of stakes and twigs of *Alnus* and *Salix*, and (to a lesser extent?) of *Fraxinus* and *Quercus*. For the surfacing of the dams wicker mats would also have been used. The use of *Ulmus* is not entirely clear. Probably this species and *Alnus* and *Salix* were occasionally used additionally or to repair the main structural elements, and perhaps also in wickerwork. According to Casparie and Swarts, *Ulmus* was not very suitable for posts because of its lack of straight trunks. This is possibly the reason why it was less popular as a building material than *Quercus* and *Fraxinus*, although it is otherwise good quality building timber.

The question of whether local differences in the choice of wood can be observed is difficult to answer with any certainty, due to the problematical representativeness of the sample collection. In table 12 the data are divided per zone, with the poorly represented wood types combined. In zone 1 there are no fundamental differences as far as *Quercus* and *Fraxinus* are concerned. *Quercus* accounts for some 75 % of the samples everywhere. In Hoogstraat II the *Quercus* and *Fraxinus* percentage is reduced by the *Alnus* wickerwork of the old revetment. Without this wickerwork the percentages of *Quercus* and *Fraxinus* rise to *c.* 82 and 11 % (though the number of samples is no more than *c.* 60). In Hoogstraat 0 the *Quercus* percentage is also adversely influenced: by *Alnus*, *Salix* and *Ulmus* samples which probably come from wickerwork. They were found in a depression on the bank (Hoogstraat 0, squares F/G-6), so outside the actual riverbed. *Fraxinus* is slightly overrepresented in Hoogstraat 0 because this type of wood was also preserved in this depression, and the same applies to *Ulmus*. The general impression is that the choice of wood during the initial phase of the activities was more or less the same everywhere.

In zone 2 an interesting difference occurs between the data from Hoogstraat I and Hoogstraat II. In the latter excavation, a sharp relative increase could be observed in this zone of *Fraxinus* (more than double) at the cost of *Quercus*. This was mainly caused by the use of a surprising quantity of *Fraxinus* in the two dams HS-II 6 and 7 (in squares A/C-7/11), especially in the side-revetments. We suspect that this was a local variant, if it was not the result of unusually favourable preservation conditions. It would seem that in zone 2 a virtually identical situation developed in Hoogstraat III as in Hoogstraat I, only the database of Hoogstraat III is less reliable due to later activities. The situation of Hoogstraat IV does not differ essentially in zone 2 from that in Hoogstraat I. Possibly the same building method was generally followed in zone 2 as in zone 1, namely with a preference for oak. The anomaly which occurs in Hoogstraat II then becomes all the more remarkable. The percentages of *Alnus*, *Ulmus* and *Salix* are subject to considerable fluctuation in zone 2, but since these percentages are generally comparatively low, we hesitate to draw any conclusions from the fluctuations.
In the third zone the difference between Hoogstraat I and II in the use of *Quercus* and *Fraxinus* has virtually disappeared. This is due, remarkably enough, to the drop in the percentage of *Quercus* in Hoogstraat I, or in other words: the tendency of zone 2 of Hoogstraat II now continues in Hoogstraat I. This tendency has also been observed by Casparie and Swarts, and they wondered whether it was a result of 'oak becoming scarcer' in the immediate surroundings, or perhaps a change in the building technique of the dams making it possible for second rate wood to suffice.

zone	excavation	HS-0		HS-I		HS-II		HS-III		HS-IV with trench 449		HS-IV without trench 449	
	wood types	N	%	N	%	N	%	N	%	N	%	N	%
1	*Quercus*	556	56.3	98	74.2	51	27.0	143	78.6	513	70.0	125	86.2
	Fraxinus	181	18.3	19	14.4	7	3.7	15	8.2	101	13.8	4	2.8
	Alnus	121	12.3	1	0.8	98	51.9	6	3.3	71	9.7	9	6.2
	Ulmus	106	10.7	10	7.6	2	1.1	2	1.1	32	4.4	4	2.8
	Salix	12	1.2	3	2.3	29	15.3	13	7.1	2 (395)	0.3	0 (395)	0
	other	11	1.1	1(19 *Abies*)	0.8	2	1.1	3	1.6	14 (223 *Betul.*)	1.9	3 (223)	2.1
2	*Quercus*			678	81.8	622	48.7	385	64.8	393	66.1	5	71.4
	Fraxinus			119	14.4	420	32.9	113	19.0	99	16.6	2	28.6
	Alnus			19	2.3	147	11.5	64	10.8	62	10.4		
	Ulmus			3	0.4	16	1.3	10	1.7	28	4.7		
	Salix			8	1.0	29	2.3	5	0.8	2	0.3		
	other			2	0.2	44	3.4	17	2.9	11	1.8		
3	*Quercus*			434	45.6	79	41.1						
	Fraxinus			427	44.9	69	35.9						
	Alnus			70	7.4	23	12.0						
	Ulmus			6	0.6	1	0.5						
	Salix			5	0.5	16	8.3						
	other			10	1.1	4	2.1						

TABLE 12 Dorestad, Hoogstraat 0-IV
Types of wood per zone: numbers and percentages.

The latter explanation would appear to apply particularly to the situation in Hoogstraat II where in the third zone mainly light structures were in fact built with few transverse rows which, by tradition, preferably consisted of oak posts. In Hoogstraat I on the other hand, transverse rows in close succession are found in many places in zone 3, and here, sturdy structures were still generally found. *Quercus* was mostly used for the transverse rows which were possibly part of the substructure of buildings, but especially at the end of the complex it looks as if *Fraxinus* was also used for this purpose. The reason for this may have been the 'scarcity of oak'. The information available is, however, relatively modest, so not much can be concluded from it.

Casparie and Swarts' research has shown that by far the most wood of which samples have been identified comes from riverine forests, *i.e.* wetland forests in a more or less damp environment. This does not only apply to the five main species but also to some which are only very rarely found, such as *Malus* and *Prunus* which also include *Crataegus* and *Rosaceae*, and C*orylus*, *Populus* and *Betula*. The latter are regarded as 'impurities' which came along accidentally with the building timber. As building material, they did not play an important part. As we have seen, birch was used in the form of twigs for making fykes, as were osiers. It is possible that certain species were intended for special purposes far more than the collection of samples can demonstrate. After all, it only represents certain parts of very specific structures. *Corylus*, for instance, is also suitable for wickerwork, according to finds from Haithabu. The wetland forests where the necessary timber was felled were very probably located in the immediate vicinity of Dorestad. The selection for size of 40-, 60- and sometimes 100 year-old oaks and ashes and the extent of the demand for wood may have exceeded the regenerative capacity of the forests. In the environs of Dorestad this could have led to progressive deforestation. In the neighbourhood of the settlement the landscape became increasingly open, all the more since the higher-lying areas were probably already being used for agriculture and stock breeding. The need for wood must have been considerable, but there are too many uncertainties for a reliable quantification. For this reason the following is merely an indication.

In the Hoogstraat I site traces were found of at least 10 000 posts which could have served as a substructure. Hoogstraat I covers a length of 100 m of the part of Dorestad situated in the riverbed which was at least 1 km long. If the use of wood in Hoogstraat I is representative of the entire northern sector of Dorestad, as far as it was situated in the riverbed, a total of *c.* 100 000 (oak and ash) trees may have been felled in order to supply the demand for posts. However, the situation in Hoogstraat I is probably not representative. The dams appear to have been longer there than elsewhere, since Hoogstraat I was located near the broadest section within the river bend which had developed here in the Dorestad period. Possibly a total of 50 000 tree-trunks were used as for the dams. Casparie and Swarts propose that woodcutting in the neighbourhood of Dorestad was a continuous process: a little each year, so an annual average of some 300–400 trunks for the dam posts. Naturally, far more wood was required for the riverbed structures in the form of beams, planks, trunks and wattle for revetment, surfacing and for buildings, though how much more is beyond estimate. In addition, there was also the rest of the settlement's demand for building timber and firewood. The riverine forests could certainly not meet Dorestad's entire demand for building timber. Oak, for example, which was required for the most important structural elements of the houses, did not grow there. The rapidly and irregularly growing trunks from the riverine forests were good enough for dam-revetment and as the substructures of buildings, but indications have been found in the riverbed area which point to the use of oak from other than the local forests. A very limited number of samples of oak from all the Hoogstraat excavations (no more than a few percent) shows characteristics of slow and regular growth, typical of forests in Pleistocene areas. Such oak was practically never used for posts in the dams. In the cases referred to, one might also consider secondarily used (older) material. The presence of such unusual oak posts at the beginning of a structure in Hoogstraat I, squares G/H-3/4, which, moreover, have a deviant early radiocarbon-date, indicates the re-usage of older material.[39] Where this came from and when it was transported to the Dorestad area, is unknown.

It is interesting that the very scarce samples from planks from Hoogstraat I also proved to be 'Pleistocene' oak. The 20 cm-wide 'planks' which lay at the location of the discolouration in Hoogstraat II (fig. 36) must have been made, one would think, from a sturdy oak trunk which had probably grown on Pleistocene soil. For this reason, one may assume that for the planks, platforms and buildings in the riverbed oak was brought in from forests on Pleistocene subsoil. One would not actually have had to travel far, for the Utrechtse Heuvelrug – a Pleistocene ridge partly forming the north edge of the Rhine valley – was nearby. These forests, situated *c.* 10 km east of Dorestad (near the present town of Amerongen), were easily reached since the river flowed past them. The transport of wood could take place by water from here downstream to Dorestad. Perhaps the better quality wood could be obtained not too far away, though import from more distant areas is of course also a possibility. The extremely rare samples of *Fagus*, *Tilia*, *Carpinus* and *Acer* from the river area of Dorestad also point to the use of wood from 'forests situated outside the river area'. According to Casparie and Swarts, the presence of posts of deviant types of wood may be an indication of unusual structures (hoists, for example), though evidence for this is seldom very clear. *Abies* wood, in the form of barrels, must certainly have been imported from a great distance. The wood for these barrels was probably cut in the upper Rhine area.

In figures 41 (*cf.* fig. 40), 41, 42 (*cf.* fig. 27 and 39), 43 (*cf.* fig. 23 and 38), 44 (*cf.* fig. 22), 45, 46 (*cf.* fig. 32), 47 (*cf.* fig. 30) and 48 the wood identifications are shown of a number of relatively well-documented dam segments. The percentage of posts from which wood samples have been identified is generally between *c.* 30 and 60 %. It is clear that there was a preference for oak for the main posts in a substructure. From the segments of dams HS-I 10 and HS-II 6 (fig. 43 and 44) it appears that there was a certain preference

39 Mook & Casparie in: Van Es & Verwers 1980, 286–91 (samples XI and XII); cf. 296.

for the use of ash posts in side-revetments, and sometimes also for posts of *Alnus*. This suggests that there was a deliberate division in the use of wood: *Quercus* for the transverse rows and *Fraxinus* (or if need be *Alnus*) along the sides. The first section of dam HS-I 5A (fig. 46) may have been built according to this principle. The softer ash will in this case have decayed, leaving only the oak posts. In dams HS-0 7 and HS-IV 4 one gets the impression that *Fraxinus* and *Alnus* (and also *Ulmus* and *Salix*) were used for the same purposes as *Quercus*, but then as second rate material. The use of wood in the side-revetment of the long compartments in HS-I 5 and -5A (fig. 46), HS-I 9 (fig. 47), and HS-I 10 (fig. 30) is comparable, with a preference for oak and, as second choice, ash.

The oak posts which could still be identified as such often form together a remarkably regular pattern. An unusually fine example is the first section of dam HS-I 5A in figure 46. In such a case, but also in many other cases, there need be no doubt that the oak posts supported a platform. Casparie and Swarts also point to the fundamental differences in construction of the long compartments in which – they assume – a covering of wicker mats resting on crossbeams (which had been laid on the ground?) was used. With the extremely regular grid patterns the question urges itself upon us whether several transverse rows could have been built at the same time in one building phase (see chapter III 2.2). If this was so, there may also – temporarily (?) – have been elevated platforms or jetties (see chapter III 2.4).

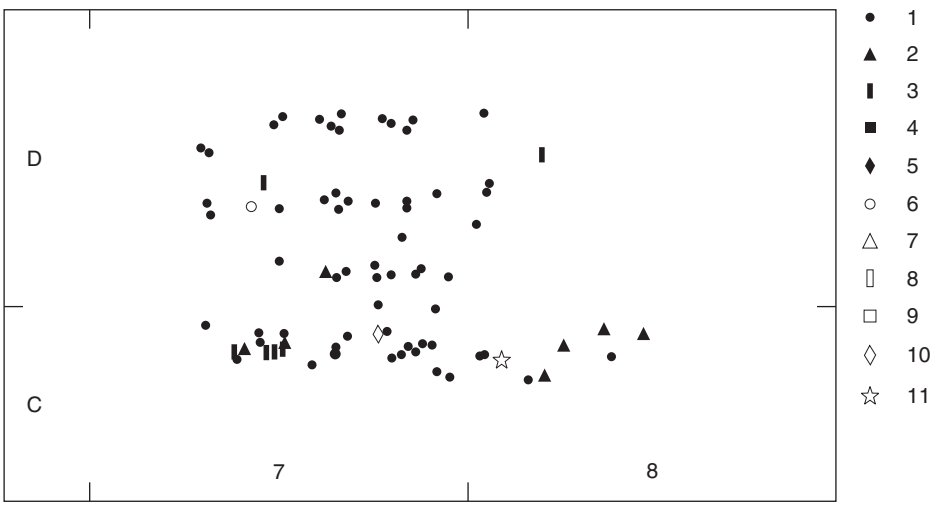


Fig. 41 Dorestad, Hoogstraat 0: types of wood in dam segment HS-0 7; scale 1:200.
Legend:
1 *Quercus*;
2 *Fraxinus*;
3 *Alnus*;
4 *Ulmus*;
5 *Salix*;
6 *Fagus*;
7 *Malus* type;
8 *Betula*;
9 *Abies;*
10 *Pinus*;
11 *Acer*.

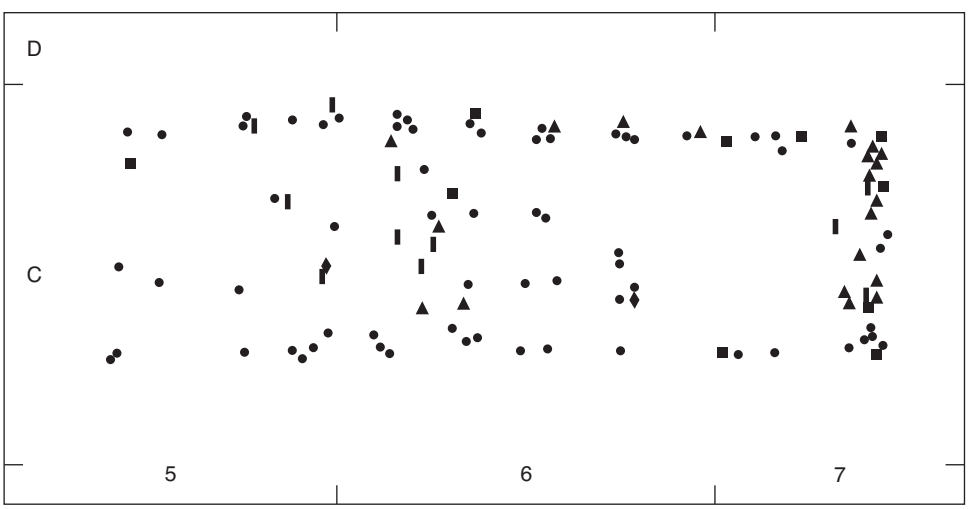


Fig. 42 Dorestad, Hoogstraat IV: types of wood in dam segment HS-IV 4; scale 1:200. Legend: see fig. 41.

Fig. 43 Dorestad, Hoogstraat II: types of wood in dam segment HS-II 6; scale 1:200. Legend: see fig. 41.

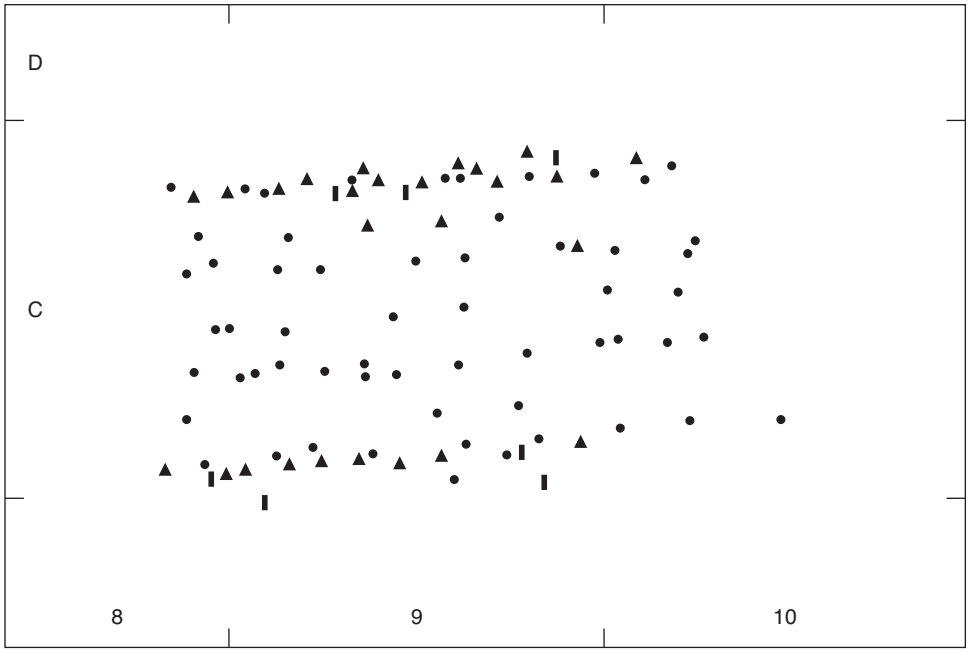


Fig. 44 Dorestad, Hoogstraat I: types of wood in dam segment HS-I 10; scale 1:200. Legend: see fig. 41.

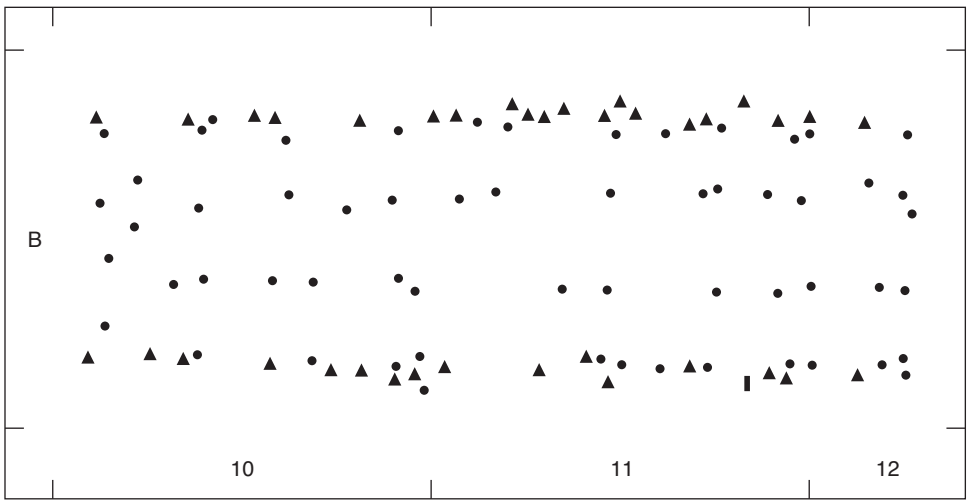
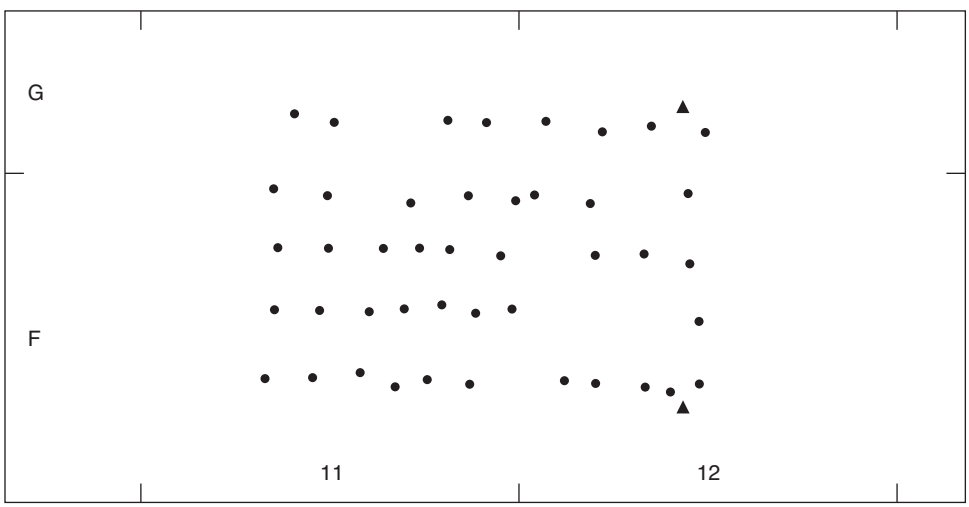


Fig. 45 Dorestad, Hoogstraat I: types of wood in dam segment HS-I 5A; scale 1:200. Legend: see fig. 41.



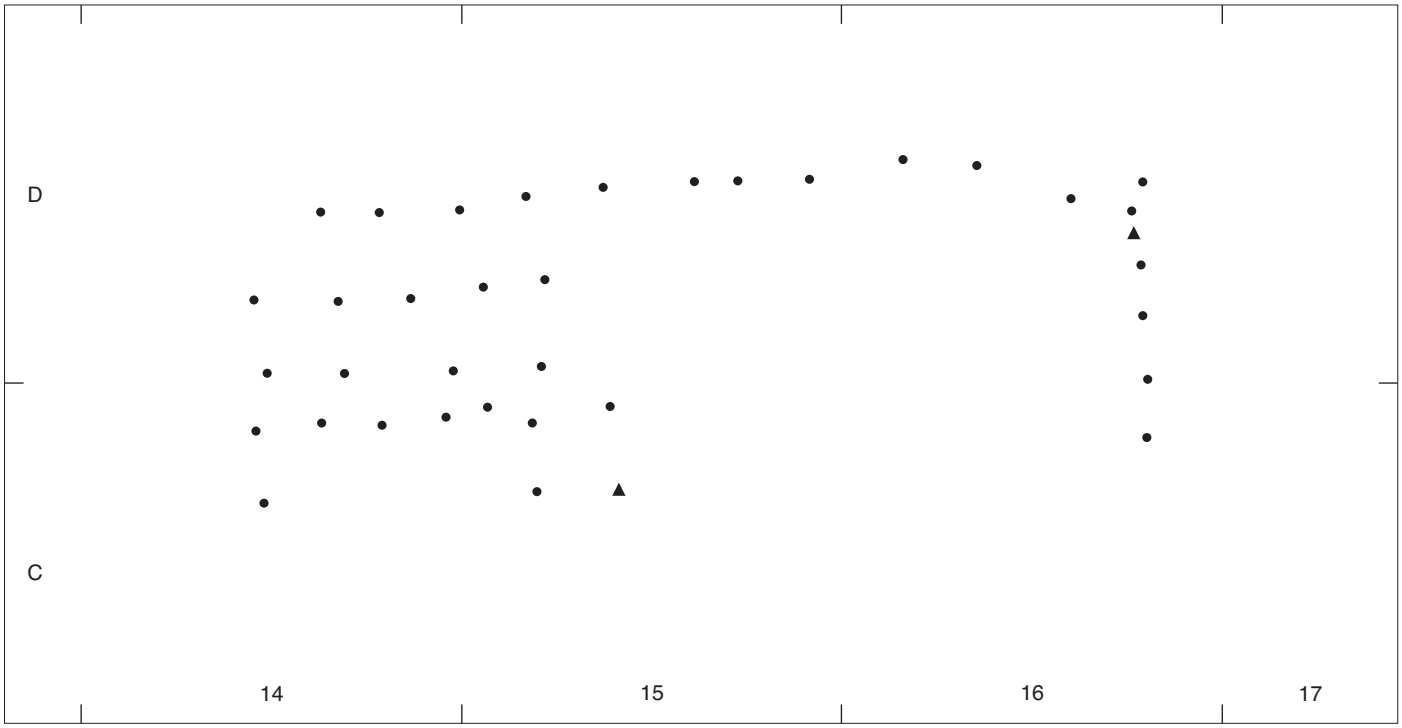


Fig. 46 Dorestad, Hoogstraat I: types of wood in dam segment HS-I 9; scale 1:200. Legend: see fig. 41.

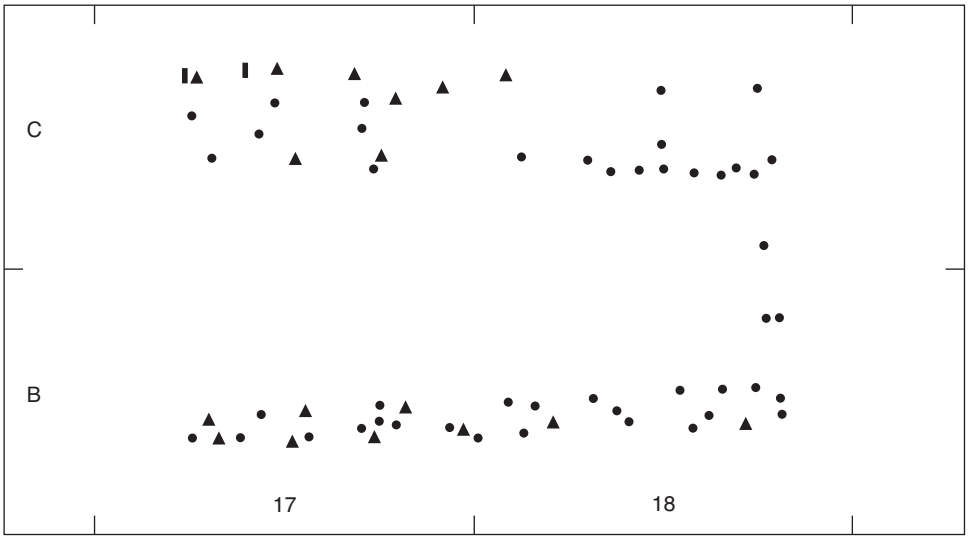
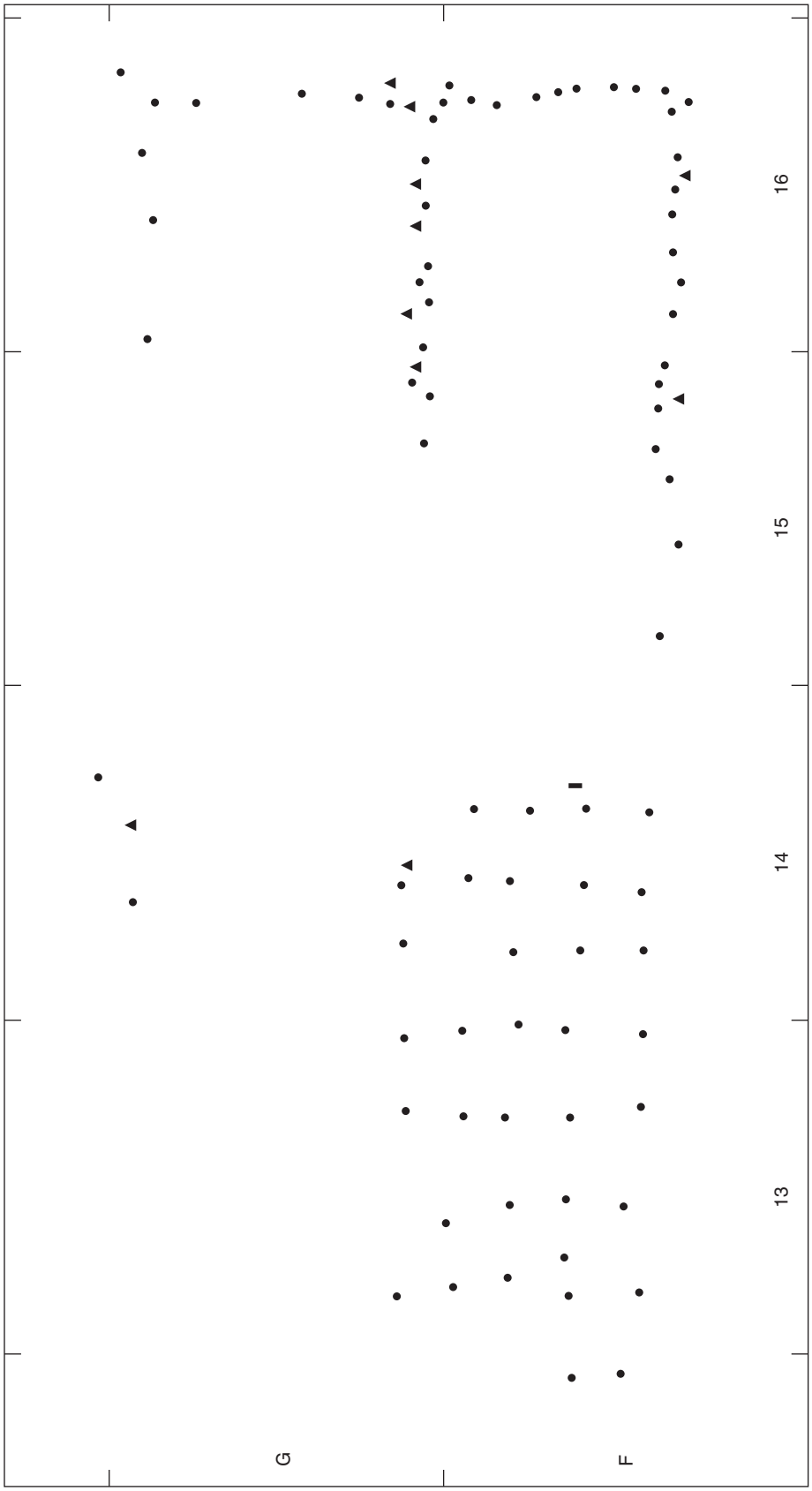


Fig. 47 Dorestad, Hoogstraat I: types of wood in dam segment HS-I 10; scale 1:200. Legend: see fig. 41.

2.6 Depths of posts

The depth down to which the posts were driven into the riverbed varies considerably, sometimes as much as 2 m. Some posts extend down to (well) below 1.50 m NAP, others hardly reach below 3.00 m NAP, if at all. The differences in depth are not randomly distributed over the riverbed, as can be seen in figure 49, which gives a rough indication of the maximum depth which the posts attained in different parts of the riverbed. The NAP level of the bottoms of the posts has therefore been divided into five classes, each with a different colour. In the figure, the *deepest* class per area is indicated which is regularly found in the area concerned. If the class above it is frequently present, the area is shaded in two colours. In each area posts are found which are deeper or less deep than the class indicated.

Fig. 48 Dorestad, Hoogstraat I: types of wood in dam segment HS-I 5 and 5A; scale 1:200. Legend: see fig. 41.



What strikes one first is that the post depths increase or decrease in zones, parallel to the 'original' riverbank. This phenomenon is possibly caused by differences in the soil conditions due to the behaviour of the river in the course of time. The fact that these zones almost precisely coincide with the periodization of the river's behaviour, as deduced from the sections, points in the same direction (fig. 14 and fig. 49). These zones were found in every Hoogstraat excavation, though their order was not always the same. Hoogstraat I and III were characterized by a broad zone with relatively shallow posts located in front of the 'original' bank (classes 2 and 3; class 1 does not actually belong to the riverbed, but only to the bank). The deep posts were only found further on in Hoogstraat I and III (classes 4 and 5). On the contrary, in Hoogstraat IV and 0 the deep posts were located right at the beginning against the 'original' bank, followed in Hoogstraat IV by a more or less equally broad zone with shallower posts. In this zone the number of posts also sharply decreased. Hoogstraat II has a transitional position: the initial zone with shallow posts was less broad there than in Hoogstraat I, and this was also the case with the zone with the deep posts. The latter was then followed by another zone with shallower posts in Hoogstraat II, as in Hoogstraat IV. This zone was broader (longer) here than the one in Hoogstraat IV, and only the northern half corresponds to that of Hoogstraat IV with regard to the 'sharp decrease in the number of posts'. The southern half on the other hand is comparable to Hoogstraat II concerning the numbers of posts.
In our view, the differences sketched can be understood as follows: shortly before or immediately after the bank was taken into use, the course of the river began to retreat from the 'original' left bank in Hoogstraat I, III, and to a lesser extent, in -II. This beginning of meander formation resulted here in the sedimentation of the riverbed in front of the 'original' bank. In this silting-up zone in the convex bend shallower posts were required for the wooden structures than further along the bank, for example in Hoogstraat IV and 0, where, in the initial period, the river still flowed directly past the original bank and where less sedimentation took place in the riverbed. After the shallower zone against the bank had silted up, a 'flow situation' continued to prevail in Hoogstraat I and III with relatively little sedimentation, whereas in Hoogstraat II and IV (and -0?) by contrast a great deal of sedimentation took place in this later phase – making the riverbed less deep – so that now shorter posts could be used there. In this phase, the Hoogstraat II and IV sites must already have been located on a convex bend. The behaviour of the river, for that matter, was not the only factor influencing the depths of posts, for human activities were also involved. This can be seen in figure 49, where, apart from the zones parallel with the bank, there were also – though far less clearly – shallow zones at right angles to the bank. The latter is revealed best in the broadest excavations, especially at Hoogstraat I and II. In Hoogstraat I several dams situated next to each other show significant differences in post depths which cannot possibly have been caused by differences in the depth of the base of the riverbed. The dichotomy of the broad eastern zone in Hoogstraat II is a comparable phenomenon: this too must have been a result of human activities, since it is not likely that the riverbed would have differed so much over such a short distance that robust structures were still built in the southern half of the zone and not at all in the northern half. Apparently some of the owners or users of a plot in the riverbed area opted for heavier material for their structures than the others did. In table 13 the post depths found in the segments of two dams from Hoogstraat I, are compared with each other and with those of two dam segments from Hoogstraat II. The dam segments selected were about the same distance from the bank and were characterized by a regular structure. The dam segment from Hoogstraat I 5A appears to have been astonishingly lightly constructed: the posts there were embedded 0.5 m less deeply than was usual in the area.[40] There will probably have been (far) more of these types of differences, but they were difficult to trace due to lack of sufficient data.

40 The average depth works out higher than in reality, because for every post the maximum value of the class of depth to which it belongs was taken.

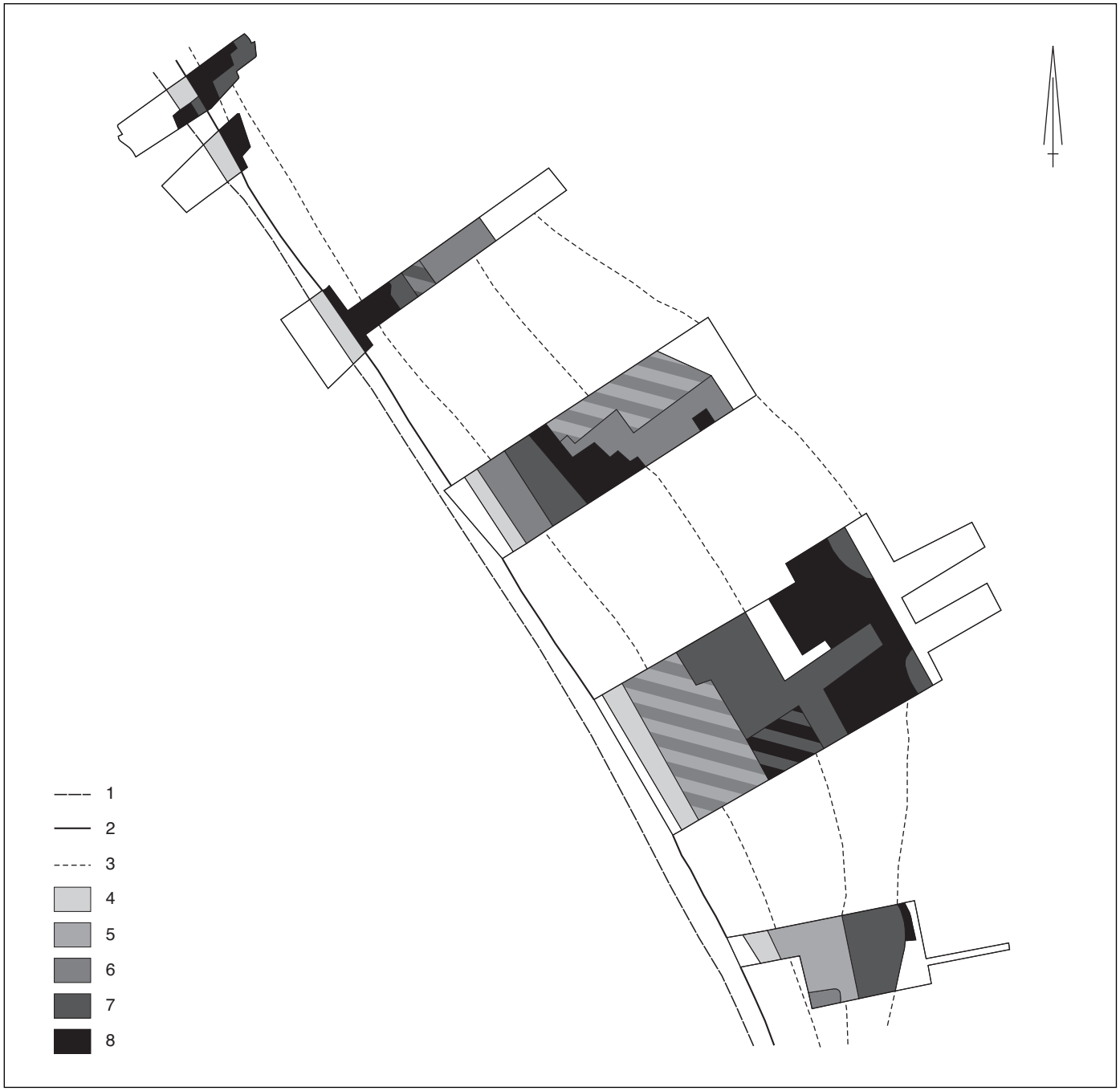


Fig. 49 Dorestad, Hoogstraat 0-IV: approximate depths of posts in relation to NAP; scale 1:4000.
Legend:
1 older bank;
2 original bank;
3 zone boundary;
4 up to 3.00 m + NAP;
5 to 2.50;
6 to 2.00;
7 to 1.50;
8 to 1.00 m + NAP.

	dam HS-I 5A squares G/F-9/12		dam HS-I 10 squares A/B-9/12		dam HS-II 6 squares C-8/10		dam HS-II 7 squares B-8/11	
Depth per post in m NAP								
	length 29 m		length 30 m		length 32 m		length 32 m	
	N	%	N	%	N	%	N	%
(3.00–) 2.75	2	1.2						
2.50	42	25.0			5	2.7	5	2.9
2.25	78	46.4	21	17.1	38	20.3	29	16.6
2.00	38	22.6	22	17.9	33	17.6	51	29.1
1.75	6	3.6	15	12.2	38	20.3	35	20.0
1.50			34	27.6	32	17.1	19	10.9
1.25	2	1.2	31	25.2	41	21.9	36	20.6
total	168		123		187		175	
average depth in m NAP		2.23		1.68		1.77		1.75

TABLE 13 Dorestad, Hoogstraat I and II. Depths of posts in relation to NAP in four dam segments.

IV The development of the edge of the riverbank

1 Introduction

The riverbank area forms the transition from the riverbed to the settlement site on top of the bank, to which it in fact belongs. It begins where the structures in the riverbed end and it includes the foremost edge of the occupation area. On the riverside, the riverbank area still dipped rather sharply, while the most easterly strip in fact formed the upper edge of the riverbank. This zone was not equally clear in all the Hoogstraat excavations, and was investigated best in Hoogstraat 0 and IV, where *c.* 3000 and 1500 m^2 of it were excavated respectively. In both cases the riverbank was exposed over a length of more than 50 m (56 and 52 m, resp.). The area excavated in Hoogstraat 0 is almost twice as broad (in west-east direction) as that in Hoogstraat IV (50–58 m versus 30 m). The disadvantage, unfortunately was that the Hoogstraat 0 excavation fell into two parts: a northern and a southern part, divided by the unexcavated stretch of the present road to Langbroek. Hoogstraat IV, by contrast, did contain a continuous section of the riverbank area. In Hoogstraat II the excavated strip of riverbank proved to be even narrower (20 m), but even in this approximately 1200 m^2 area important observations on the organization of the riverbank area were made, which was not the case in Hoogstraat I and III. The results from these excavations hardly add anything to the picture formed on the basis of the information from Hoogstraat 0, IV, and II.
The features found in the riverbank area during the excavation differ totally from those in the riverbed. No (remains of) endless rows of posts were discovered here, but only traces of posts (postholes and post-ghosts), and compared with those from the riverbed they are not very numerous. Apart from post remains, there were mostly pits in the riverbank area, with the occasional small ditches. The relative scarcity of post traces was mainly due to the quite deeply disturbed soil of the riverbank area, which was also observed throughout the rest of the settlement area of Dorestad, and which had not only been caused by agricultural activities but also by 19th-century bone-digging.[41] It was only possible to excavate the features which were deep enough in the soil. Pits larger than postholes apparently met this condition. The pits discovered often proved to have been entirely or partially re-dug, probably at the time of the bone-digging activities.
The pits are generally (rounded) rectangular to oval in shape, with a usually more or less flat base and rather steep sides. The surface area of the pits varies from 0.5 to 10 m^2, at the level of the higher excavation levels. Towards the base, the surface area generally becomes smaller, but towards ground level it will originally have been greater. The depth of the pits also varies. The average pit had a surface area of 3 m^2 at ground level and from thence was almost 1 m deep. Altogether these pits caused a vast amount of soil to be shifted: in the riverbank area along Hoogstraat alone this must have accounted for many thousands of cubic metres. The pits were the most important source for the reconstruction of the layout of the edge of the riverbank.

2 Analysis of Hoogstraat 0

2.1 Introduction

The distribution of the pits over the site of Hoogstraat 0 was anything but random.

41 *Van Es & Verwers 1973.*

The pits were embedded in a settlement structure which was clearly recognizable, especially in the southern part (squares A/D-1/6). The separate pits lay with their longitudinal axis parallel to or at right angles to the riverbank; besides which, the pits were lined up in groups and rows. In the area referred to, three concentrations of pits could be distinguished: two of which were located on the west side (squares A/D-1/4), and the third occupied a 10 m-wide zone parallel to the bank (squares A/D-6). The first two concentrations were separated from the third by a strip about 7 m wide which contained very few settlement features.

2.2 Remains of buildings, southern part

The two western concentrations of pits each formed a long rectangle (total length: over 30 m) at right angles to the river. The long sides of the concentrations in particular were densely packed with pits, which was less clearly the case with the short sides: the eastern end of the rectangle probably lay in squares B/C-5. The pits on the long sides were so close together that they partly overlapped and in some places in the highest excavation level joined together to form an irregular ditch. Within the rectangular concentrations the number of features was much smaller: there were pits here too, but far fewer. The pits were more clearly separated from each other and were generally located at right angles to the longitudinal direction of the rectangles. Between these more centrally situated pits and the pits on the long sides, rows of postholes were found in a few places (especially in squares C-4/5 and B-4/5). The inner space in both rectangles was approximately 6 m wide.

We interpret these large rectangles made up of pits as two elongated rectangular strips situated close together (parcels 8 and 9) on which at least two or three times, possibly more, a house – or at least a large building – had been built. Within these large rectangular concentrations smaller groups were also observed consisting of some inner pits and a number of pits on the long sides: the actual house sites. On each of the two plots two of these house sites were (almost) entirely excavated, but there proved to be a third whose eastern short side was discovered just inside the western perimeter of the excavation (in squares C/A-2). These pits formed the contours of the house sites, while several postholes here and there still indicated the position of the walls (fig. 50*).[42] The chronological order of these house sites could not be precisely established from the overlaps of the pits which were frequently too indistinct. Moreover, our reconstruction of the house sites is no more than an attempt, and the details are by no means certain (fig. 51*). The interpretation of the data concerned is tricky: was the house site with the grey pits (parcel 9) the oldest, and did habitation shift from east to west thus explaining the relatively good preservation of the features from that period, or was it vice versa, so that the house site with the light grey pits belongs to the oldest occupation phase? It is also conceivable that "grey" and "light grey" date from the same period and that the house site with the dark grey pits was the youngest. Dating remains difficult, even if the finds are taken into consideration. We shall return to this matter in chapter VII.

The few pits which could not be directly linked to a house site can to some extent be regarded as parts of the interior of the buildings (see the following paragraph). It is, however, also possible that the presence of the pits is an indication that the building history of the parcels was more complicated than has been put forward here, and that several building phases were involved. It seems likely that the east and (probably also the west) ends of the buildings standing on both parcels in the same period were more or less aligned.

As to the form and layout of the buildings, little can be said. The walls appear to have consisted of single uprights, set in rows. Apparently there was no room here for obliquely placed outer posts such as those found in house sites elsewhere in the settlement. On the other hand, with so much uncertainty we do not wish to exclude

42 The illustration differs in certain details of the pits from the general plan in fig. 15 because slightly different choices were made on the basis of the excavation data.

the possibility that (outer) shores were used. If our interpretation of the pit concentrations is correct, the houses were not much wider than 5.5 m on the inside and their length varied from *c.* 16 to 19 m. If there had been more than three building phases, the houses would have been even shorter. The position of the entrances is unclear: perhaps in the middle of the east (and west?) front walls and slightly eccentric in the long walls (several possibilities have been indicated in fig. 50*). From figure 50* it appears that within the house site with the dark grey pits on plot 8, the building with the longest section (the working as opposed to living section?) faced the river. Some of the 'indoor pits' may have served as cellars (shaded in fig. 51*). Cellars of this kind were found elsewhere in the settlement.[43] The narrow trenches along the walls of the house from the house site with the dark grey pits on plot 8 must have belonged to the building, although their function is uncertain. The trenches at the eastern end may have been slots for the front wall. Between the two plots, in every period, a narrow zone at least 2 m wide has remained free of pits. In the western part of it many ghosts of stakes were found, more or less aligned in west-east oriented rows, which appear to date mainly from the phase with the dark grey pits. Possibly they were plot boundaries, though another equally likely explanation is that these stakes came from side revetments and/or from the foundation for a lane consisting of wicker mats, planks or sods. This lane would then have joined up precisely with a gap in the wooden structures in squares B -7/8. Unfortunately, the excavated site in the southern part of Hoogstraat 0 was too narrow to establish at what distance from the two house parcels recovered the next house was located. To the north of the house sites on plot 8 the number of pits clearly decreased, showing that the space between these houses and the next may have been greater in a northerly direction than the space between house plots 8 and 9.

2.3 The 'land abutments', southern part

The concentration of pits along the riverbank in squares A/D-6 revealed a feature partly corresponding to that of the house sites. This concentration consisted of three or possibly four pits arranged in a square, with two of these groups lying in the continuation of the two house sites. The division into groups, shown in figure 50*, becomes more comprehensible when the division of the riverbed structures into parcels is also considered (see chapter VI). On the one hand the location of the pits on the bank appears to be also and mainly determined by the layout of the area within the riverbed, while on the other hand the relation with the foremost house sites of the settlement on the bank is also evident. Apparently the parcels in the riverbed led to a kind of front yard or 'land abutment' at the front of the bank, and these in turn linked up with the parcellation of the settlement site on the bank. The transitional zone between the settlement on the bank and the riverbed was therefore divided into square to rectangular plots on the riverside, and pits were situated along the three sides (front and sides) of these 'land abutments'. Cuts have shown that not all the pits were dug in the same period here, either. Even though the rows of pits were sometimes unbroken, as, for example, the row at the front of the abutment opposite house parcel 8, there must, at a given moment, have been an open space between the pits. It is, incidentally, questionable whether the pits lay open for a long period. The back (riverside) of the 'land abutments' was not marked by pits. In our opinion, the end of the 'land abutments' lies at the beginning of the wooden structures. A few metres before these structures began to stand out clearly as separate units, there was a bundle of rows of closely-set post- or stake-holes. Apparently the bank was revetted with wicker several times. Information for an exact dating of the revetments is lacking. It cannot be established whether they had been installed earlier than the 'land abutments' and wooden structures or whether they were (partly) realized at the same time. It is striking that the rows of postholes on the boundary between house parcels 8 and 9 fell out of line. Between both parcels clear differences as to the number of rows

43 *Van Es & Verwers 1991, fig. 5.*

were observed, and this also applies if one compares the back of the abutment in front of house parcel 9 with the section of the bank which adjoined in the north. All this possibly points to the simultaneous construction of revetments and 'land abutments', but the revetments at any rate appear to have been built at a time when the bank had already been divided into narrow parcels. The revetments must have reinforced roughly the upper edge of the bank. The deepest stakes were embedded down to *c.* 3.00 m NAP; consequently the upper part of the wicker will have been between 3.50 and 4.00 m NAP, which corresponds to the present surface. If the revetments were in fact installed against the top of the bank, the level of the 'land abutments' must have been more or less horizontal. In this case the abutments were situated actually *on* rather than *against* the bank. At the most, their surface area would have sloped up slightly: from the revetment to the pits along the front. In contrast to the 'land abutments' in the northern part of Hoogstraat 0, hardly any postholes were found in the southern part, possibly as a result of poor preservation, due to deep bioturbation. Between the 'land abutments' and the two house parcels behind them there was a virtually 'empty' zone 8 to 10 m wide. This was not due to the poor preservation of the features: postholes and pits (with the odd exception) were not present there. Only in the continuation of the northern boundary of house parcel 9 were two pits discovered which undoubtedly mark the side of this parcel. Parcellation therefore continued into this 'empty' zone. A similar situation occurred in house parcel 1 where a narrow trench which connected with the northeast corner of the easternmost house cut the 'empty' zone only to continue further on the abutment. This was a drainage ditch which carried the water from the house site through this possibly already slightly sloping terrain to the riverbed. This drain may have been (partly) covered.

2.4 Remains of buildings, northern part

The nature of the settlement evidence in the northern part of Hoogstraat 0 (squares F/I–1/5) was roughly identical to that from the southern part: here too were house sites indicated by pit complexes. The density of pits on the settlement site was, however, slightly lower, which hampered the localization of the house sites. Our interpretation is shown in figure 52*. Attention is once again, possibly unnecessarily, drawn to the fact that it contains many uncertainties, though the broad outlines appear clear. Figure 52* shows that the actual settlement site was divided into (probably) three long narrow strips which were built on in various periods. According to our interpretation, a section of the southern edge of the third strip would just have fallen inside the north boundary of the excavation. Three house sites could be distinguished on each of these three strips, as in the southern section of Hoogstraat 0. The houses which stood on these sites cannot all have dated from the same period, but in this case the layout is more uncertain than it was in the southern section. What is clear is that the house sites were built over more than once: several building phases could be identified per house site. Probably a similar phasing also took place per house site in the southern section of Hoogstraat 0, but was more difficult to recognize there because the house sites overlapped more. In the northern section a shift appeared to have occurred in the course of the building phases from north to south (or from south to north: it is difficult to say which order), mainly on the middle house sites but possibly also on the western sites. The breadth of the houses corresponds to those in the southern section, as far as can be ascertained: *c.* 5.50 m or slightly more. The length of the houses on the middle house sites did not exceed 13–14 m at the most. Nothing can be said about the internal layout of the houses because the buildings themselves have hardly left any traces. The number of pits belonging to a house must have been relatively small. On the middle house site (fig. 52*) there was an average maximum of ten per building phase, and on the (very uncertain) other sites far less. The pits were located on the short and (one of) the long sides, and in the latter case probably mainly at the entrances.

2.5 The 'land abutments', northern part

On two of the three 'land abutments' on the riverbank which were found in this part of the excavation there were pits: along the sides, but especially along the front on the land side. There were no pits on the southernmost abutment. Instead there were rows of postholes very reminiscent of the rows in the actual riverbed and with undoubtedly the same function, since at this spot the riverbank proved to be irregularly formed (see chapter II 2.5): a depression present here apparently had to be made passable in the same way as the shoal which had formed in the riverbed in front of the original bank. At the riverside of the northernmost abutments, as in the southern section of Hoogstraat 0, rows of stake impressions were observed which pointed to a form of bank protection. In contrast to the southern section, many postholes and post-ghosts were discovered on the abutments. It was not entirely clear what purpose these posts served; the smaller ones – the stake impressions – possibly came from older (?) revetments higher up on the bank. The features in question were observed between 3.70 and 3.20 m NAP, in contrast to the revetments located slightly more to the west whose postholes were between 3.30 and 3.00 m NAP. Another possibility is that the post-ghosts were caused by 'surfacing' with planks or hurdles. Along the sides of the abutment behind dam HS-0 3 a row of large postholes ran in the continuation of the sides of the dam itself. This may have been a fence closing off the sides of the abutment.

The front on the land side of the southernmost abutment could not be closed off with pits because of a gap in the bank. It was, however, striking that precisely at the spot assumed to be the front (in view of the adjoining parcels; squares F/G-6), there were two north-south oriented multiple rows of closely set posts. The space between the two rows was about 2 m. We consider these rows of posts to be the – repeatedly – repaired side revetment of a dam running through the damp depression immediately in front of the abutment. It seems likely that the dam was part of a road which ran past the other 'land abutments' as well. That this road only left clear traces at this spot can be explained: only here was a special construction necessary because of the damp subsoil. In our opinion the eastern edge of the road was marked elsewhere by the rows of pits along the north side of the 'land abutments'. It was remarkable that in the 'empty' zone between the actual house sites and the abutments there was a narrow strip immediately in front of these rows of pits which was completely featureless, apart from the odd drainage ditch (see also the two pits in square C-5). On the basis of these indications we assume that an approximately 2 m-wide road ran from north to south along the fronts of the abutments, linking the parcels which lay at right angles to the river. This road may have been surfaced with wicker, planks and/or sods. It is true that no trace was found of any posts anchoring such a road surface in the soil, but this may have been due to the fact that the highest excavation level was comparatively deep under the Carolingian surface. Between the road and the far end of the easternmost house sites there was a virtually empty zone *c.* 8 m wide. The location of several pits in the south part of Hoogstraat 0 suggested that this zone had also been divided up into parcels. In front of the southernmost abutment, in the northern section of the excavation area, rows of posts were also observed which indicated a reinforcement of the subsoil. In this zone there apparently lay what one might call the front yards of the foremost houses.

2.6 Summary

The overall picture produced by the analysis of the features in the riverbank area of Hoogstraat 0 boils down to the following: the bank was divided into relatively narrow long parcels on which houses, or at least large buildings, stood in different places, probably in different periods. The building history covers several phases per house site. The 'shifting' of the house sites mainly took place from east to west or vice versa, *i.e.* along the length of the parcels, although shifts could also occur along the breadth. The house sites were marked by pit complexes. The houses themselves

were *c.* 5.50 m wide and probably between 12 and 16 m long. The foremost houses were separated from a 2 m-wide road by front yards approximately 8 m long. This road *may* have had a wooden surface, though no evidence for this was found.
On the other side of the road, at the edge of the bank, lay the abutments of the riverbed structures. These abutments linked up with the parcellation of the settlement site, whereas the constructions in the riverbed continued the parcellation of the riverbank area. The abutments were possibly 'surfaced'; their surface level will not have been (very) sloping. At the riverside of the abutments a revetment marked the edge of the bank (or the deeper part of the bed as far as the water regularly reached?). The sides of the abutments may in some cases have been enclosed with fences.

3 Analysis of Hoogstraat IV

3.1 Introduction

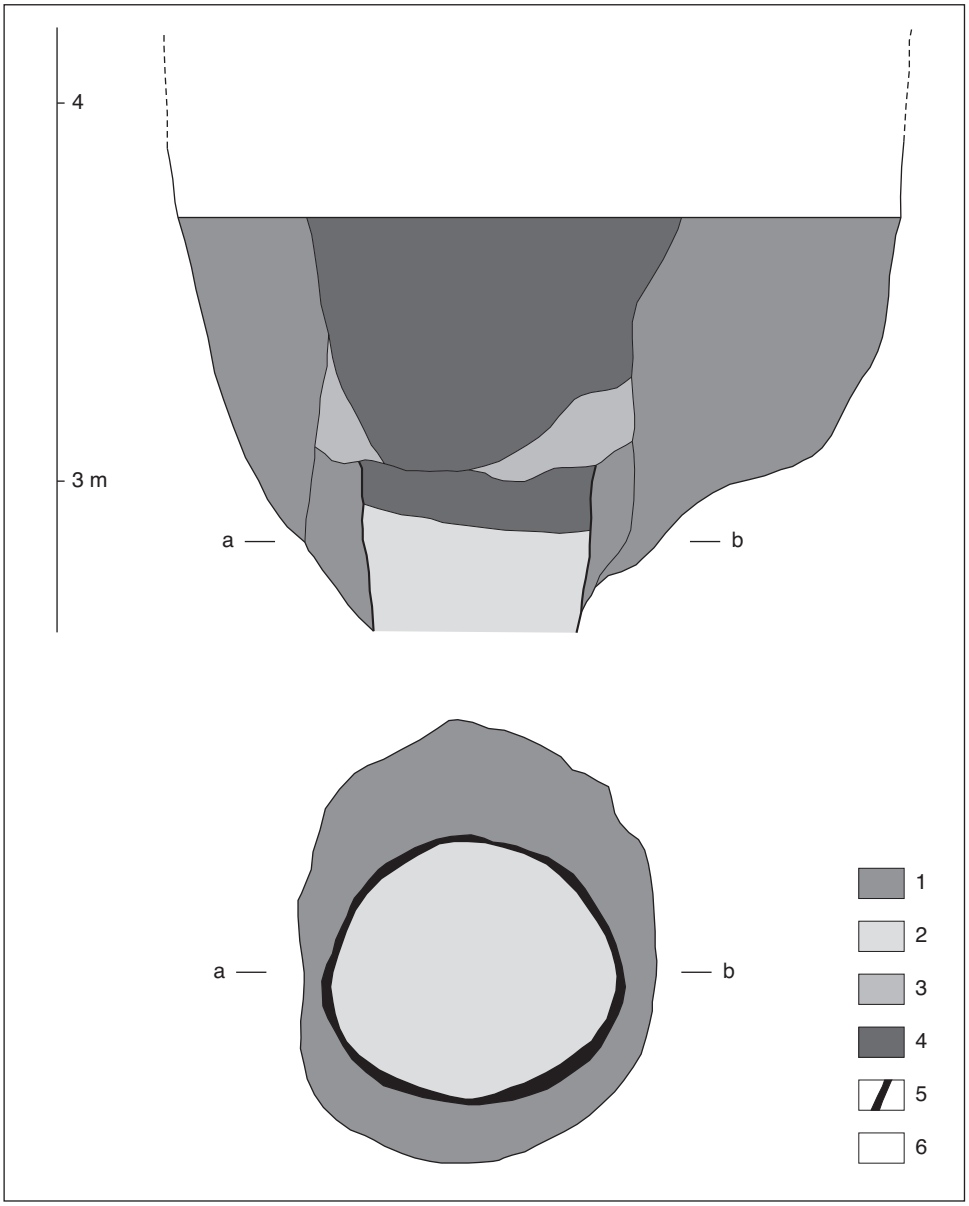
The riverbank area in Hoogstraat IV basically revealed the same features as in Hoogstraat 0: here too large pits formed the dominant features, though to a somewhat lesser extent, and the number of post-ghosts in the actual occupation area was somewhat larger. As in Hoogstraat 0, pit complexes were found on the west side of Hoogstraat IV which were an indication for house sites. The distribution of pits on the riverside also implied the presence of 'land abutments' here which joined up to the structures in the riverbed. However, the house sites here came much closer to the fronts of the abutments, probably due to the difference in the form of the bank between Hoogstraat IV and 0. At the level of Hoogstraat 0 the bank must have been long and flat; in fact there was no question of a sloping bank there at all. The present surface level in the riverbed was *c.* 4.00 m NAP in Hoogstraat 0 and it only exceeded this in the riverbank area by some 20 cm; on the west side it even appeared to have a dipping tendency (fig. 8*). By contrast, in Hoogstraat IV the present surface dropped at least 1 m over a short distance: from *c.* 5.50–5.20 m NAP to 4.50–4.20 m NAP at the edge of the bank (fig. 11*). The level at the house sites in Hoogstraat IV was between 5.00 and 4.50 m NAP at least.

3.2 The house sites

The analysis of the pit complexes in squares A/F-1/4 did not produce very detailed and entirely reliable results but it does give an impression of where houses, or large buildings, stood in this part of the riverbank area. As far as could be ascertained, five house sites in Hoogstraat IV were completely excavated and a sixth on the northern edge was partly excavated (fig. 53*). At most of these sites two or more building phases could be distinguished, in which a total of 10 or 11 houses were built. Data on the form and size of the houses are scarce. No complete house plans were recovered, but only parts in the form of rows of postholes, most of which were probably from the wall posts. These must have been embedded 1 m deep or slightly less, but because of the deeply disturbed topsoil only one or two decimetres of the postholes remained in the excavation levels. The postholes were in more or less straight rows – so the walls were straight. In some cases it was clear that the wall posts were 1–1.25 m apart, but rows were also found where the gaps between the postholes were smaller. It is possible that in this latter case the uprights had indeed been placed closer together, but it is also conceivable that the postholes in question came from more than one building phase. Most of the postholes were rectangular, others were more or less round: perhaps both dressed beams as well as (raw) round-wood were used for the uprights. Whether the gaps between the wall posts were filled with planks or wicker is not known. Several stake impressions were found in the small ditches in square F-3 marking the riverside front of one of the houses at house site 2, so they may have come from a wattle screen. Stake impressions in a row of wall posts were also observed in other places.

No convincing traces of shores, set on the outside of walls, were found. At house site 4 several pairs of postholes were found in squares C/D-2/3, but the two postholes of each pair were not – apparently – from the same period, so they must have belonged to different plans.
In two or three houses postholes of doorposts were discovered in the middle of the short wall on the riverside (squares E-3 and C-3). The entrances concerned must have been about 1 m wide. Whether these houses also had other entrances remains unknown, unless the two postholes in square E-2, which lay a short distance inside the northern long wall of one of the houses on house site 2, also belonged to an entrance. In the other houses there was no evidence at all for doorposts, and consequently it was difficult to determine whether the buildings were divided into separate rooms. The position of the pits around the houses may indicate that they were divided into two. The pits were especially found along the section of the house facing away from the river with the central axis of the rear side generally remaining pit-less. Perhaps (some of) the houses had an entrance in both the short walls and possibly also in one or both of the long walls. A division of the buildings into a living section and a working or storage section would then be feasible, but which of the two sections lay on the riverside could not be established with certainty. Moreover, sometimes several pits were also found along the house front on the riverside. It was not possible to link each pit with certainty to a specific building period, but it is clear that the number of pits per building phase was small: at the most 10, though generally fewer. The uncertainty as to the periodization of the pits had its repercussions on determining the size of the houses. Their breadth appears to have varied from 5 to 6 m, while their length was probably between 10 and 15 m.
The west part of the rectangular pit in squares A/B-3 contained a well (fig. 54). That part of the pit was square with rounded off corners and sides *c.* 1.5 m wide, which went down to a depth of *c.* 2.5 m NAP, which is approximately 2.5 m below the present and probably also the Carolingian surface level. No wood was found, but at 2.80 m NAP a 5–10 cm-broad, roughly circular grey band, with a maximum diameter of *c.* 80 cm, was observed inside the pit which was very probably from a wooden well which had completely rotted away. This well may have been made from a hollowed-out tree trunk, but it is more likely that a barrel was used for the well. The bottommost 30 cm of the well fill consisted of clean yellow sand which had apparently been forced upwards by the pressure of the ground water: the so-called well sand observed in many of Dorestad's wells. The diameter of the well at a level of 2.80 m NAP was 60–70 cm. The rest of the well fill consisted of highly polluted soil with burnt remains. It looked as if the well had been filled up in one go, apart from a dark bottom layer which probably formed gradually during its use. The fill of the pit in which the well was located was far less polluted. About 1.5 m west of the middle of the well was a rectangular pit. One can imagine that a heavy post or some other structure to which a lever with a well-rope was attached once stood there.
It is uncertain whether the well belonged to house site 5 or 6. If the above-mentioned pit and well do belong together, they very probably date from the same period as house site 5. The pit lay right in front of the house at house site 6, where there was probably an entrance; however this argument is not conclusive. The relative chronology of the house sites and of the various building phases at the house sites cannot be interpreted in one single way from the data available, but at any rate the house sites were not all in use simultaneously, as demonstrated by the overlapping of house sites 2 and 3 and of 5 and 6. It is conceivable that these overlaps occurred as a result of the lateral shifting of houses within a parcel. The parcel on which house site 4 was situated would possibly have been too narrow for a lateral shift, so only a longitudinal shift took place here. Incidentally, longitudinal shifting of houses was also observed on the other parcels. We assume that the houses located closest

Fig. 54 Dorestad, Hoogstraat IV: well; scale 1:20.
Legend:
1 unpolluted clay;
2 quicksand;
3 slightly polluted;
4 highly polluted;
5 wood;
6 recent.



to the 'original' riverbank were the oldest. Theoretically, three or four house sites could have been built over in one and the same period, for example, house sites 1, 3, 4, 6, and 1, 2, 4, 5.

3.3 The 'land abutments' and the road

The clusters of pits on the abutments revealed more or less the same pattern as those in Hoogstraat 0: here too there were pits along the land side, and probably also along the sides. It looked as if the pits along the sides lay in the continuation of the rows of pits next to the houses. The lateral shifting of a number of houses may have been the reason why the pattern of the pit complexes on the abutments was obscure in places. Possibly the shifting of boundaries in the course of time must also be taken into consideration in the case of the abutments. The total number of pits found there was relatively small: probably only a few were in use at the same time.
Apart from pits, several trenches and elongated trench-like pits were also found. These were situated on the sides of the abutments and possibly served as drains.

A considerable number of post-ghosts were revealed in the zone with the abutments in Hoogstraat IV, as in the northern part of Hoogstraat 0. Rows of postholes on the riverside (especially in squares C/D-4) were an indication of bank revetments there. Others may have served as a base for wooden paving or fencing along the sides of the abutments, but we could not form a clear picture. The rows of posts along the fronts of the 'land abutments' were remarkable. It is questionable whether they originated from wicker fences – perhaps repeatedly repaired and shifted – or whether they were connected with the substructure of the road which also in Hoogstraat IV must have run in front of the 'land abutments'.
The presence of this road is indicated by the fact that a 2–4 m-wide zone between the 'land abutments' and the house sites remained virtually free of settlement remains. Unfortunately no more concrete indications have been found. In front of the middle of house site 5 a (drainage) ditch crossed the road zone: was the ditch covered?

4 Analysis of Hoogstraat II

4.1 Introduction

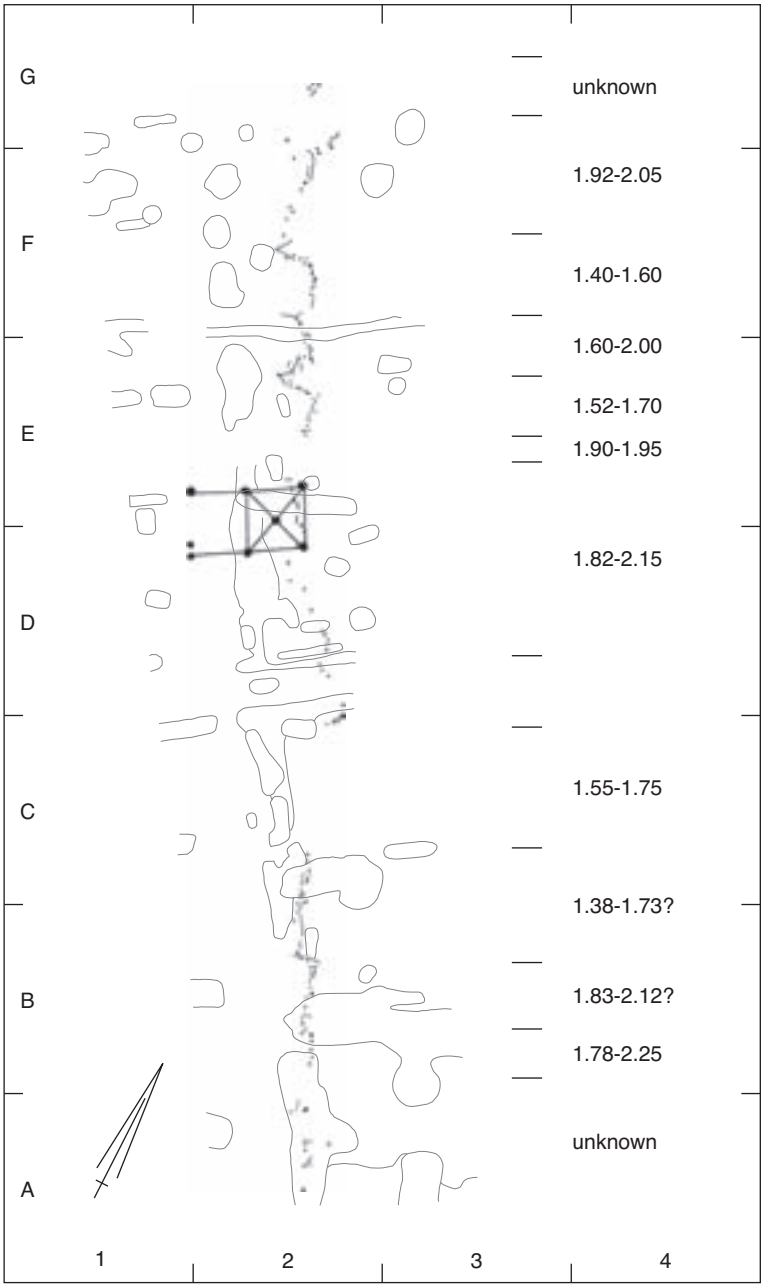
Of the riverbank area in Hoogstraat II only the strip with the 'land abutments' – and the road (?) – was excavated; the house sites situated behind it were not included in the excavation. The Hoogstraat II excavation did bring to light a new feature: the remains of an upright wickerwork feature discovered in squares A/G-2 parallel to the riverbed and at a great depth. This wickerwork has been discussed briefly in chapter II 5. It must have come from a bank revetment which was the oldest sign of activity in the bank area of Dorestad observed in the Hoogstraat excavations.

4.2 Old bank revetment

What remained of the wickerwork was predominantly the lower ends of vertical stakes (rods, fig. 55). Here and there small pieces of the actual wickerwork itself had been preserved: fragments of the bottommost horizontally woven twigs. In trenches 380 and 381 (squares C/G-2) the wickerwork was revealed at a level of 2.20–2.50 m NAP; the depth to which the rods extended varied from 1.50 to 2.10 m NAP.[44] The highest level at which wood from the wickerwork was found was *c.* 2.50 m NAP. Naturally, this level does not correspond to the original top of the wickerwork: the uppermost part would have rotted away, leaving no traces which could be observed during excavation. The – bottommost – woven twigs were observed between a level of *c.* 2.10 and 2.50 m NAP. How tall the actual wickerwork originally was can no longer be established, but it can hardly have been more than half a metre. All this makes it unlikely that the wattle screen, which was not supported by any heavier posts, was tall. In fact, it can only have been a bank revetment. From the above it may be concluded that the bank at the site of the revetment was *c.* 3 m NAP, and that it probably gradually rose in a westerly direction. Of importance in this connection are the five postholes found on the boundary between squares D and E-2. These postholes were so deep – their bases lay between 1.50 and 1.70 m NAP – that the wood of the posts which had once stood in them had partly been preserved. They were alder posts, arranged in a square with one post in the centre of it, and, in view of their depth, had been driven instead of dug into the soil. It is most unlikely that they were driven-in from the present surface level which at this spot is about 5 m NAP: in that case they would have had to be driven into the ground over a length of 3.5 m. It is more probable that this was done from a lower and therefore older surface level which possibly connected up with the upper part of the revetment. The position of the posts also suggested a relation with the revetment: the two east posts stood just in front of the wickerwork which bent backwards precisely at the northeast corner of the square formed by the posts. In addition, the posts and the

44 While establishing the depths in trench 382, a miscalculation of at least 1, and probably 1.5 m must have been made. According to the measurements recorded, the wickerwork here was found between c. 0 and 1.10 m NAP, but this cannot possibly be correct. The projection of the wickerwork in the north profile of this trench (the wickerwork was not actually observed in any of the sections) also indicates that it went down as far as c. 2.30 to 1.70 m NAP at this spot (square C-2). It may be assumed that the wickerwork was preserved everywhere in Hoogstraat II where it was found between c. 1.50 and 2.50 m NAP, though with comparatively large differences regarding the bases of the rods.

Fig. 55 Dorestad, Hoogstraat II: old revetment and 8-pole structure (jetty?) probably belonging to it; scale 1:400. Per section of the revetment, the depth of the poles is indicated in relation to NAP.



greater part of the revetment were of the same type of wood: *Alnus* (fig. 56*). This was all the more remarkable because in the other – younger – wooden structures *Quercus* and *Fraxinus* were most frequently used for the heavier posts. The five posts and the revetment were apparently installed in an early period, in other words: in the oldest period of human activity observed in the riverbed area. However, this does not exclude the possibility of a small discrepancy in time between the two features: the revetment possibly came first and the structure to which the posts belonged a short while after.

The three posts whose holes were found on the boundaries of squares D/E-1 and 2 probably also belonged to this structure. These posts were relatively shallow and only reached down to 3.30–3.40 m NAP. The difference in depth with the other five posts may perhaps be explained by the rise in level of the bank. The level of the

surface from which the total of eight posts were placed could no longer be determined. We estimate that it dipped at this spot from west to east: from *c.* 4.20 m NAP down to the revetment at 3 m NAP. The shallowly embedded posts in the west were visible in the excavation level at *c.* 3.60 m NAP; of the five deeply embedded posts the south-westerly one and the middle one were visible at *c.* 3.50, and the others at *c.* 3.20 m NAP. How we envisage the situation is shown in figure 58. During the use of the structure, the original surface level may have been slightly raised due to sedimentation and/or the deposition of rubbish. A fragment of a Merovingian pot was discovered behind the revetment in square B-2 (fig. 120: 1; chapter VI 1.3). Finally the area at the site of the structure had silted up to *c.* 1–2 m before any new large-scale activities for developing the riverbank area took place. Whether the structure with the eight posts remained standing for such a long time is uncertain. What the function of the structure was, has not been completely established. The rectangular plan of *c.* 3 by 6 m, made up of two squares of *c.* 3 by 3 m, reminded us one of a short jetty or loading platform (fig. 57). Its situation against the slope of the original bank appears to correspond best with this explanation. Another possibility, though a less likely one in our opinion, is that the structure was a *Speicher* – a storehouse. Possibly the fact that it was situated at the precise spot where the side of an abutment was later situated is not accidental. The old revetment did not form a continuous straight line, and especially in squares D/G-2 it had a very winding course. In square C-2, where no remains of wickerwork were discovered, there was possibly no revetment, since there is no other explanation for there being no traces of it here. The length of the wickerwork rods was variable; the difference in the average length of the rods in adjacent sections of the revetment could amount to several decimetres. The use of the various types of wood was not entirely uniform. The rods were generally made of alder, occasionally with a slight admixture of willow or ash. The actual wickerwork appears to have been alder or willow. In one place (square E-2), however, the revetment consisted almost entirely of willow. The general impression is that the old revetment was constructed in segments, possibly an indication that the riverbank had already been divided into parcels in this oldest phase. In that case, different owners or users did or did not reinforce the riverside of their plots with wickerwork. Unfortunately, there is insufficient evidence to establish with certainty the existence of parcellation at the time of the old revetment, and we cannot even think of reconstructing it reliably. The changes in the course of the revetment and in the length of the wickerwork rods appeared to correspond to plot boundaries from later periods. It is, therefore, possible that the later parcellation was roughly the same as that at the time of the old revetment. The pits which were found on the west edge of the excavation (squares A/G-1) may also date from the oldest phase. An argument for this could be that the pits here were unusually close to the later river zone: in Hoogstraat 0 and IV the 'empty' zone between the 'land abutments' and the actual settlement area on the bank was markedly broader. If one combines these pits with the old revetment (fig. 55), a picture emerges which supports the assumed division of the bank into narrow strips. The width of the strips was not exactly equal, but in most cases it was approximately 6–7 m. It is, therefore, quite possible that the division of the riverbank area into narrow strips, possibly with 'land abutments' on the riverside which joined up with house sites higher up, already existed in Hoogstraat II at the time of the old revetment.

The old revetment was only observed in Hoogstraat II, though it should not be concluded that it only occurred there. In the other Hoogstraat excavations the trenches were not excavated so deeply as to recover any possible remains of the revetment. However, indirect evidence, for example in the form of rows of pits pointing to an earlier use of the bank, was not found either in Hoogstraat 0 and IV. The latter, incidentally, is still no proof that the old revetment was lacking there: it may have been situated at the level of the later revetments on the riverside of the

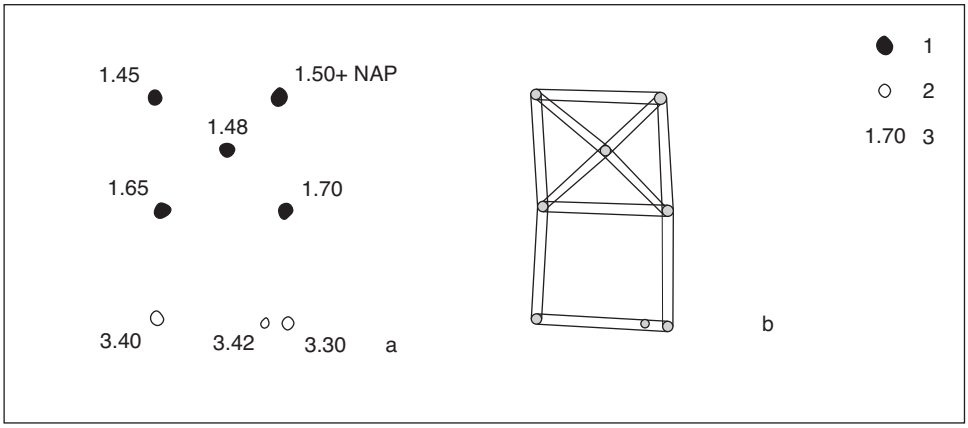


Fig. 57 Dorestad, Hoogstraat II: plan of the structure near the old revetment; scale 1:200.
Legend:
a post depths, type of wood;
b structure (jetty?);
1 post *Alnus*;
2 post, wood type unknown;
3 depth of post (+ NAP).

'land abutments'. It is also possible that the traces of the oldest parcellation were so few that they could not be distinguished from later traces. It is therefore unclear how far the old revetment extended, but it must have continued at least some way beyond both ends of Hoogstraat II.

4.3 The 'land abutments' and the road

The front of the 'land abutments' from a later period coincided in the south part of Hoogstraat II with the old revetment, whereas they were *c.* 4 m behind it in the north part (fig. 59). This could mean that the accretion of the bank on the south side was quicker than in the north. The younger river front was clearly recognizable by a row of pits running from north to south. Most of these pits had a depth of *c.* 3.50–3.80 m NAP, and the level from which they were dug was at *c.* 5 m NAP, so more or less equivalent to the present surface level at that spot.
The riverbank area in Hoogstraat II was divided by six 'land abutments' – a seventh in

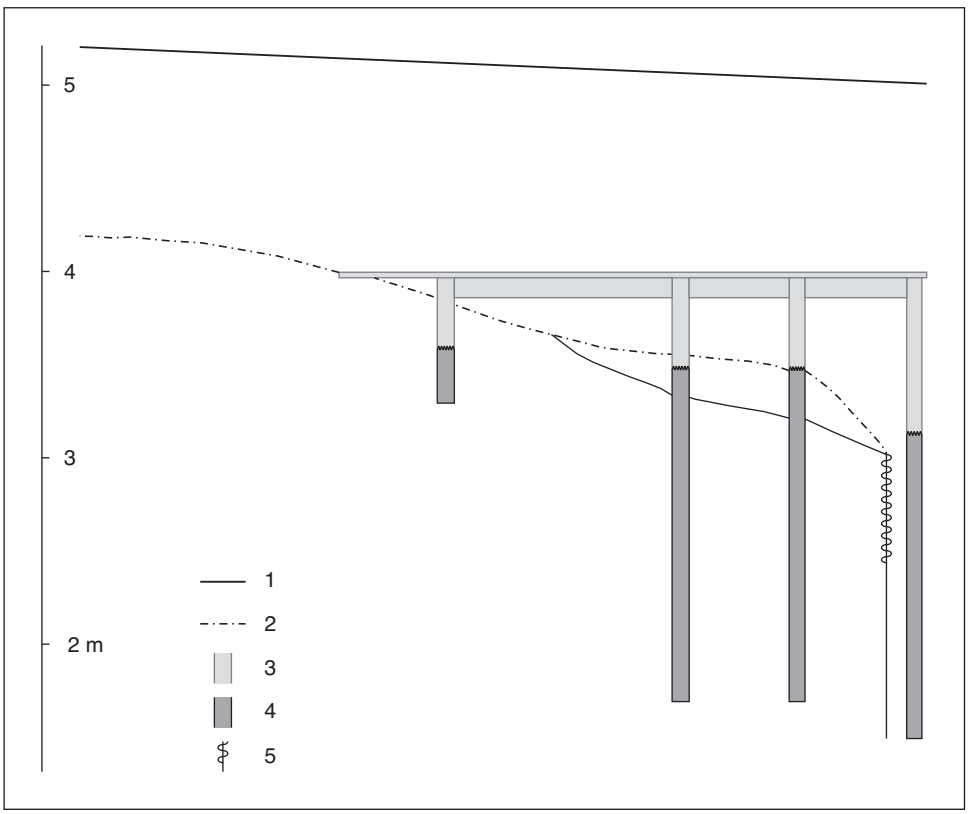
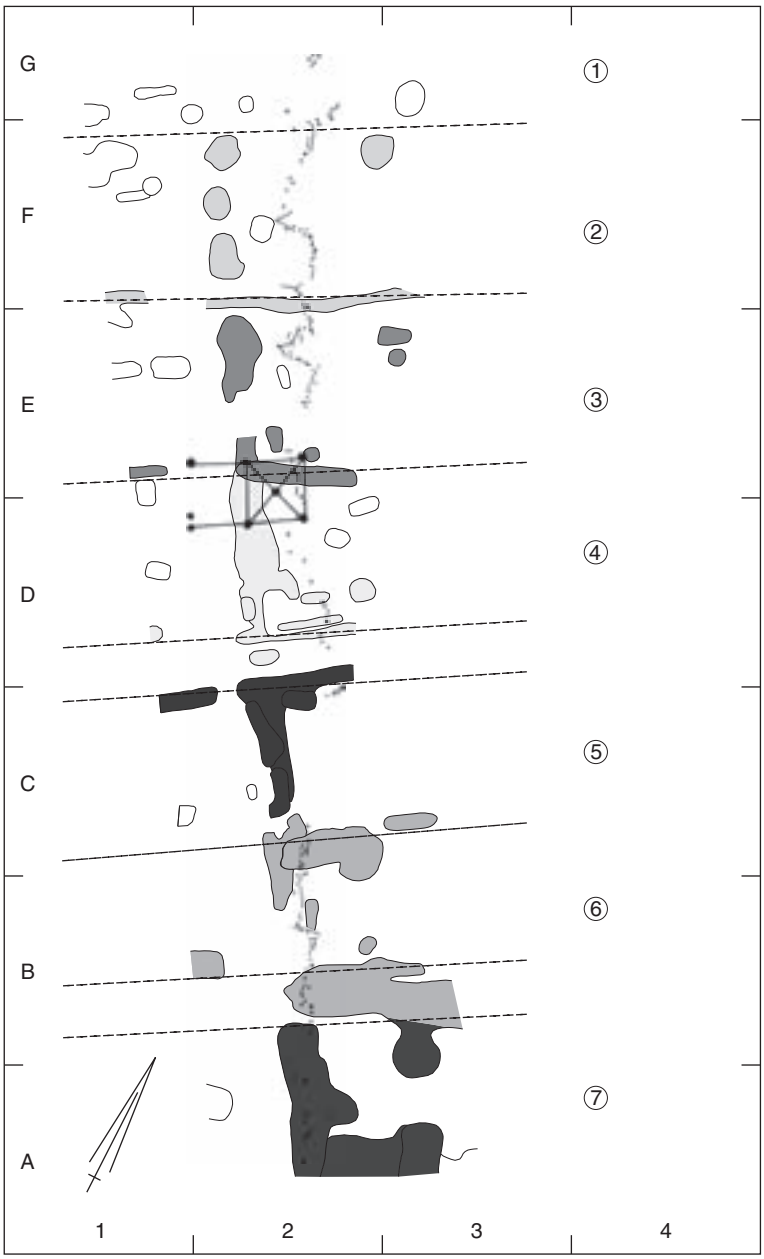


Fig. 58 Dorestad, Hoogstraat II: cross-section through structure (jetty?) near the bank; scale 1:200.
Legend:
1 present surface level;
2 reconstructed old surface level;
3 diagram of superstructure jetty;
4 postholes and posts of jetty;
5 old revetment.

Fig. 59 Dorestad, Hoogstraat II: riverbank area; old revetment and younger pits, with parcel numbers; scale 1:400.



the north was just dug into by the excavation – which were separated from each other by trenches and pits along the sides (fig. 60). The breadth of the parcels was 7–8 m. Between parcels 4 and 5, 6 and 7, and possibly also 2 and 3, there appears to have been a 2–3 m-wide open strip, while the others were adjoining. The length of the 'land abutments' was more difficult to determine, since here, in contrast to Hoogstraat 0 and IV, no traces of revetments were found along the far end on the riverside. The rear side was probably marked by the row of pits on the boundary of squares A/G-2 and 3. In that case, the 'land abutments' must originally have been 6–8 m long. A second row of pits somewhat further east indicated that the 'land abutments' had been lengthened later, when the bank had silted up further. The pits at the original back were generally rather large and round – they were lacking in parcel 5 – but their depth was not unusual: 2.80–3.80 m NAP whereas the present surface there was 4.60–5.00 m NAP. There is no evidence that they were wells.

At the rear of 'land abutments' 4–7, traces of posts were found which were almost certainly from platforms. Land abutment 4 gives the impression that only a strip along the central axis was surfaced. The other 'land abutments' had post patterns across their full breadth, and in particular the pattern on 5 was unusually regular (it has already been referred to in chapter III 2.4). In this case there was hardly any doubt that these posts had supported a platform which was constructed on the – sloping – bank. No clear evidence of partitions along the sides of the 'land abutments' were found, although several posts on the division between 5 and 6, and also 6 and 7, possibly form an indication. No posts were found at the front in Hoogstraat II. Along the fronts of the 'land abutments' there was a strip of 3–4 m which was virtually free of traces, even if one includes the possibly older pits as belonging to the later period. This empty zone is only transected by some (drainage)

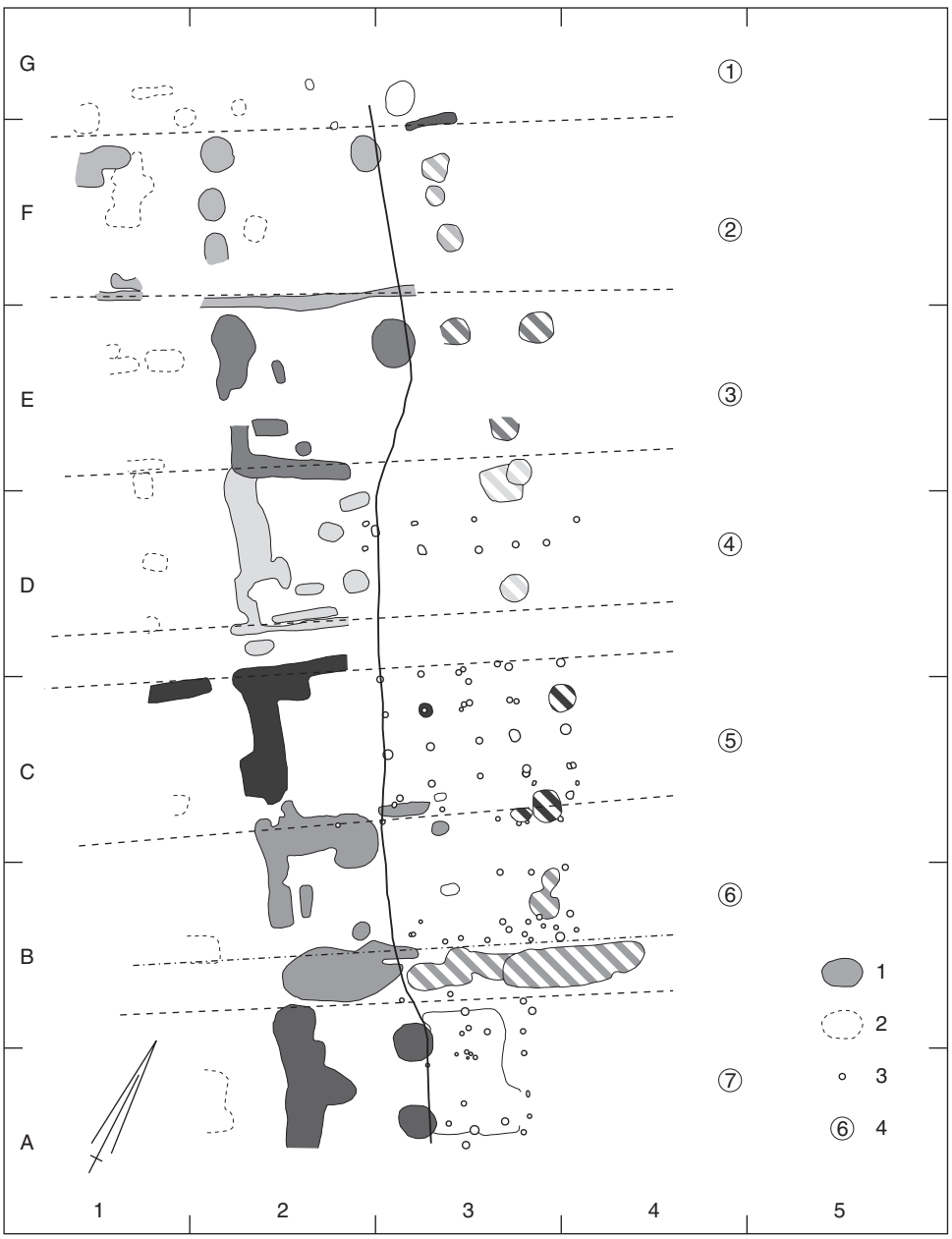


Fig. 60 Dorestad, Hoogstraat II: riverbank area; scale 1:400.
Legend:
1 pits in various phases per parcel;
2 possible older pits;
3 posts;
4 parcel number.

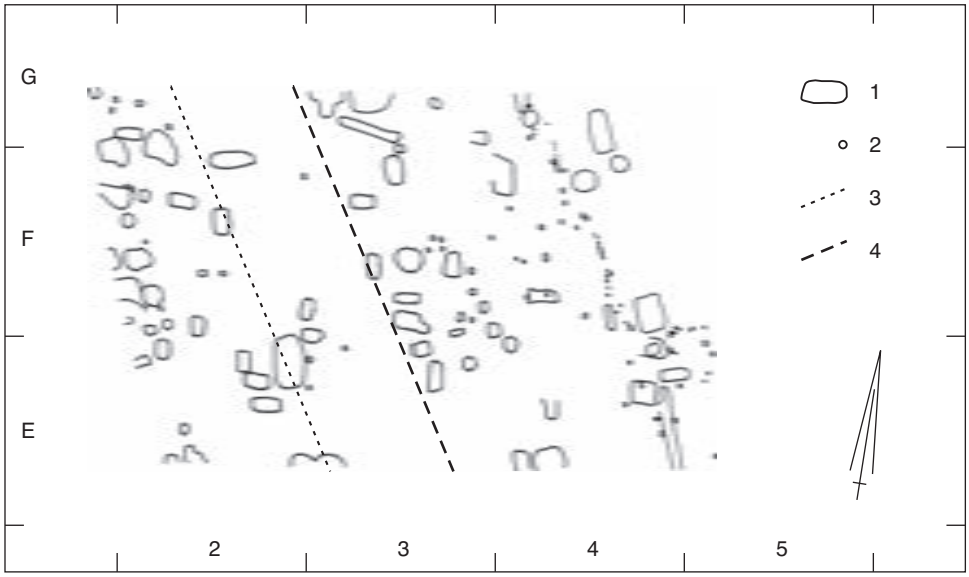


Fig. 61 Dorestad, Hoogstraat III: riverbank area; scale 1:400.
Legend:
1 pit;
2 postholes;
3 presumed boundary settlement area;
4 presumed boundary riverbed parcels.

trenches connecting to the sides of the 'land abutments'. We assume that a road also ran here between riverbed area and the settlement on the bank. Nothing was excavated of this settlement site, except for a few of the easternmost pits.

5 Analysis of Hoogstraat I and III

5.1 Hoogstraat I

A small strip of the riverbank area here was excavated, but the features were few in number and did not produce a clear picture.[45] The row of pits on the boundary between squares H/K-1 and 2 possibly indicate the riverbed area.

5.2 Hoogstraat III

The riverbank area here was excavated over a length of *c.* 25 m and a breadth of 20 m. The number of features here was remarkably great. Some of them certainly dated from after the Carolingian Period because of the sherds of Pingsdorf, Paffrath and Andenne pottery, or of 10th-century and later *Kugeltöpfe* found in them. Some trenches and pits did not produce any identifiable finds, others produced exclusively Carolingian pottery. In figure 61 the features which are definitely Post-Carolingian have been omitted. What remains need not necessarily date from the Dorestad period, and even the pits containing only Carolingian finds may be from a later period. Based on their similarity in direction to later pits, this is in fact probable in the case of a number of these pits (for example, the group in square E-2). The Carolingian sherds must then have ended up secondarily in later pits.
The picture of the Carolingian features was seriously disturbed by later digging activities. The main characteristics of the organization of the riverbank area were scarcely recognizable. The boundary of the riverbank area probably lay near the row of pits running roughly north to south through squares E/G-2/3. A row of closely-spaced postholes in squares E/G-4 probably came from a bank revetment possibly indicating the back (riverside) of the zone with the 'land abutments'. The distance from there to the assumed front zone was approximately 10 m. A division of the riverbank area into separate 'land abutments' 7–8 m wide is probable, but could not be recognized clearly. The empty zone, involving a road running from north to south which was observed everywhere apart from Hoogstraat I immediately in front of the riverbed, could be seen clearly here. On the other side of it lay the beginning of the settlement area on the

45 *Van Es & Verwers 1980, fig. 7.*

bank, as evidenced by the many pits. No details about the layout of the settlement area are known because only its utmost eastern edge was excavated.

6 Summary

As far as can be ascertained, the edge of the riverbank basically appears to have been organized in the same way in all the excavation sites. On the riverside there was a narrow strip of land adjacent to the riverbed which was divided up into small parcels at right angles to the bank: the 'land abutments' which linked up with the riverbed structures. These 'land abutments' were characterized by the pits which had been dug along the fronts and sides of the parcels. On the riverside of these, the riverbank was reinforced with a revetment, the top of which we assume lay at 3.50–4.00 m NAP. These revetments were replaced repeatedly in the course of time. We assume that they were constructed, at least partly, at the same time as the 'land abutments' and that the repairs were carried out per parcel, *i.e.* each owner/user was responsible for his own bit of revetment. The revetments possibly had to compensate for a difference in height of the bank at the transition with the dams in the riverbed. Another possibility is that the revetments dated from the initial period when there were still few or no dams, and served exclusively to protect the bank from the force of the water. The surface of the 'land abutments' was probably more or less sloping, since they were built from a dipping bank, though this could not be established with certainty because the Carolingian surface level has not been preserved. As appears from the post traces, the surface was probably (often) covered with some form of wooden surfacing. It is possible that the 'land abutments' were closed off by fences on the sides and perhaps also on the land side, but no definite evidence for this has been found.
In Hoogstraat II it appeared that another revetment had preceded the 'land abutments'. It looked as if this earlier revetment had also been installed per parcel, in which case the parcellation of the bank may date from the time of the old revetment.
In front of the 'land abutments' ran a narrow, *c.* 2 m-wide road which was possibly paved with wood. The settlement area on the bank began on the far side of the road. The foremost buildings along the river were of wood and were not big: *c.* 5–6 x 10–15 m. The excavation yielded very little information as to the building method and layout of these structures. Perhaps they were houses with a living and a working section, but this is pure conjecture. In several cases it has been established that there was a *c.* 1 m-wide door in the middle of the wall on the riverside. They were freestanding houses, each with its own yard. These yards or house sites linked up, across the road, with the parcellation of the riverbank and the bed. In some places, especially in the southern part of Hoogstraat 0, the layout of the house sites clearly corresponded to that of the riverbed structures. The yards may have been enclosed, but there is no reliable evidence for this. The building up of the settlement area was a complicated and lengthy process. It has been established that the house sites shifted sideways and lengthways in the course of time, and that there may have been several building phases per site. The succession of building phases could not be determined in detail, and consequently, it was impossible to establish with certainty where the houses from the same phase were situated. The space between the house sites probably varied. In the south part of Hoogstraat 0, there appears to have been a narrow alley between the two yards corresponding in the riverbed with the space between two dams. Similar situations occurred in other places. In Hoogstraat 0 the distance between the foremost houses and the road along the 'land abutments' was substantially greater than at other locations, probably as a result of a deviant form of the bank which was *c.* 1 m lower there than elsewhere, and was, moreover, almost flat, whereas at other locations it was clearly sloping. The houses in Hoogstraat 0 were possibly also at an almost 1 m-lower level: *c.* 4.00 instead of 5.00 m NAP. Wells were extremely rare in the riverbank area: only in Hoogstraat IV was one found, in combination with one of the foremost houses.

V The organization of the riverbed area

1 Introduction

The results of the analyses from chapters III and IV are summarized in figures 62–6*. In the case of the riverbed structures, the emphasis has been placed on the end revetments: (almost) all the end-revetments have been shown (the uncertain ones are indicated by a dotted line). The dams have also been distinguished by shading. In the riverbank area the most important pits in the 'land abutments' are indicated; in the settlement area on the bank the main pits and the house sites have also been indicated. In Hoogstraat I and III, where most of the house sites and 'land abutments' were outside the excavation site, the pits are not included. The dams and house sites have been numbered from north to south per excavation.

2 Parcellation of the riverbed

2.1 Lay-out of the complex of dams

Figures 62–6* clearly show that the dams were distributed along the bank according to a certain system. They do not appear to have formed a continuous complex, but were systematically spaced. These (inter) spaces were *c.* 4 m wide and were situated in such a way that at least one side of each dam adjoined a space. Some of the dams were separate, with a space on either side. Frequently, however, two dams – and never more than two, in principle – were built against each other, so that in this case each of them adjoined an open space on only one side.
Dams and spaces divided the riverbed into long, relatively narrow parcels. We assume that each parcel, apart from the dam itself, also included half of one or both adjoining spaces.

A glance at figures 62–6* is sufficient to determine that the dam parcels did not differ much in breadth. Table 14 gives a survey of the average breadths of the parcels in the various Hoogstraat excavations. Due to various reasons, the results do not have a high level of accuracy. Firstly, it was not always possible to precisely determine the perimeters of the dams. Even though measurements were taken from derivative and comparatively small-scale survey maps, they were verified as far as possible with the field data. In Hoogstraat IV the number of parcels was too small for a reliable estimate. In Hoogstraat 0 two of the seven parcels were not excavated, so the results are hypothetical. In Hoogstraat III the pattern of dams and spaces in between was exceptionally difficult to recognize, and moreover, the analysis of dams 6 and 7 is rather uncertain. It is not certain whether dam HS-III 7 was completely excavated, though several features were found which may point to the re-building of the initial sections of 6 and 7. All in all there are enough reasons for not considering the results in table 14 down to the precise centimetre: they all have margins of error varying from one to perhaps several decimetres.

excavation	HS-0	HS-I	HS-II	HS-III	HS-IV
no. of complete dam parcels	7(?) (nos. 2–8)	10 (nos. 2–10)	5 (nos. 2–6 and 3–7)	7(?) (nos. 1–7)	3 (nos. 3–5)
total width at bank	65 m	93 m	48 m	59–60 m(?)	28.5 m
total width in middle		94 m	47 m		
total width at end		94 m	47 m		
average width at bank	9.30 m	9.30 m	9.60 m	8.40–8.60 m	9.50 m
average width in middle		9.40 m	9.40 m		
average width at end		9.40 m	9.40 m		

TABLE 14 Dorestad, Hoogstraat 0–IV
Average width of the parcels in the riverbed.

The widths of the parcels found in the riverbed varied from 8.40–8.60 m in Hoogstraat III, to 9.60 m on the bank in Hoogstraat II; most were around 9.30/9.40 m. Although the relatively narrow width observed in Hoogstraat III is somewhat uncertain, an error of more than a few decimetres is unlikely. On the one hand the impression is given that the width of the parcels was not precisely the same everywhere, and on the other hand a standard width of approximately nine metres was apparently aimed for. The riverbank naturally displayed irregularities and (slight) changes of direction. An example of the former was the hole in the bank in Hoogstraat 0. Between dams 1–5 and 6–11 in Hoogstraat I there was a change in direction, though not a substantial one, right at the beginning, while the space between dams 5 and 6 appears to have been extra wide there. Possibly two sectors of the riverbed area met here. At any rate, problems arose in this zone at a later stage and these led to the re-orientation of the dams (4a-7; see below).[46] Adaptation to the conditions of the terrain may have involved a slight alteration to the desired standard width, though the differences observed are relatively small and can be classified under a measuring system with a standard measurement of *c.* 30 cm, which more or less corresponds to 1 foot (original: *voet*, a local measure). The use of the foot as a unit of measurement in the Dorestad area is also acceptable. We assume that the desired width of the parcels was approximately 9.20–9.40 m, which possibly corresponded to 30 feet. In Hoogstraat II a width of 31 feet (*c.* 9.50–9.70 m) was perhaps originally measured out, though further on in the riverbed a width of *c.* 9.30 m was also observed. In the case of Hoogstraat III, a width of 2 feet less than the norm aimed at may have been used: *c.* 8.60–8.80 m.

In figures 67–71* an attempt has been made to reconstruct the parcellation, starting from the parcel widths referred to above. In other words: as many as possible from category 9.20–9.40 m (23 mm/scale 1:400), those at the beginning of Hoogstraat II 9.50–9.70 m (24 mm), and the widths from Hoogstraat III 8.60–8.80 m (21.5 mm). The middle of the northernmost completely excavated space between two dams was chosen as the starting point in each excavation site. The central axis of such an inter-space would seem to be the logical place for a parcel boundary, as would the dividing line between two dams built up against each other.

Surprisingly, the reconstruction came up to expectations. In the case of two adjacent dams a parcel boundary always runs along the dividing line of the two structures. The small deviations here and there are negligible, given the many uncertainties. The relation between the other parcel boundaries and the central axis of the interspaces is less convincing: occasionally a parcel boundary ends up on the side of a space (though rarely or never completely outside it). It is questionable whether these are in fact deviations, for the parcel boundary may in certain cases have run alongside a space. Genuine problems were encountered at two spots in Hoogstraat I: at the beginning, dams 3, 4a, and 5 (partially) cannot be reconstructed with certainty, and further on in squares Hoogstraat I 12–14 the situation of dams 6 and 7 becomes unclear; and the final situation of dams 1–7 also leaves much to be desired (see fig. 70*).

46 *Van Es & Verwers 1980, fig. 21.*

2.2 The pollution of the riverbed

Up to now, the reconstruction of the dams has only been based on the remains found of posts. However, there is another factor which can tell us something about the location of the dams and this is the pollution of the riverbed in which substantial local differences were observed. This had immediately attracted attention during the excavation of Hoogstraat I. There the soil in the riverbed directly in front of the 'original' bank was dark-grey to black in colour down to a depth of 2.50 m NAP. This pollution could also be clearly observed in the sections. A striking feature was that light-coloured patches occurred in certain places. The name given to these during the excavation was 'clean patches', which precisely reflects their nature: soil which was clean, or at least less polluted than the rest. The clean patches were observed between 3.20 and 3.60 m in Hoogstraat I. In our view, the explanation for this phenomenon may be that the dams there preserved the subsoil from becoming heavily polluted. It is also possible that the clean patches were formed by the addition of 'clean' soil used to raise the cores of the dams. Which of the two possibilities is correct remains unclear, since the level of the riverbed on which the dams were built could not be precisely determined. The same applies, for that matter, to the height of the raised soil cores: 1 m would probably have been the maximum height.

The degree of pollution of the riverbed soil in the Hoogstraat excavations has been shown in a series of plans (figs. 72–6*). In them, three stages of pollution have been distinguished: heavily polluted (dark-grey), polluted (light-grey), and slightly or not polluted (white). The picture given by these plans is a selection of the data recorded in the field drawings, and therefore slightly subjective. This is apparent when one compares figure 75* with figure 7* from Van Es & Verwers 1980. As a result of different choices, these two figures reveal numerous differences in detail in their reflection of the soil pollution. They are, in fact, two variants based on the same database, and they complement rather than contradict each other. The wide range of options is due to the fact that the soil pollution in the successive excavation levels continually assumed different forms. However, the comparison of the two variants reflecting the situation in Hoogstraat I also shows that the differences do not concern the main issues: these correspond in both plans. In addition to the pollution, the parcellation as derived from the reconstruction of the dams is also shown in figures 72–6* (see also figs. 67–71*).

The picture was more or less the same in all the excavations. Light strips (the dams) alternated with narrower dark zones (the spaces in between). The differences between both were not restricted to their widths alone. The spaces in between were characterized by lengthwise structures, while the light dam zones were partitioned mostly by narrow transverse strips. These transverse strips developed during phases of rest in the construction of the dams: during such a phase, polluted soil could accumulate against the temporary end point of the dams. The flanks of the dams were also frequently polluted (depending on the width of any possible road surface). This is apparent from the fact that a narrow polluted strip could frequently be observed on the dividing line between two adjacent dams. The pattern of light and dark strips was considerably obscured in Hoogstraat III, due to later activities, but was easily recognizable in the other excavation sites. In Hoogstraat 0 the disadvantages of the restricted length of the excavation site became evident, whereas Hoogstraat I was not wide enough. The overall picture of Hoogstraat I and that of Hoogstraat II provide the best overview, because of the size of these excavation sites. Of the two, the picture given by Hoogstraat II is the clearest.

The reconstructed parcellation of Hoogstraat II corresponds exactly with the pattern of pollution observed there. If one were to assume the same parcel width at the beginning of Hoogstraat II along the bank as in the other excavation sites (with the exception of Hoogstraat III) – *i.e.* a width of 9.30 m instead of 9.60 m – the parcel

boundaries between dams HS-II 4 and 5, and between HS-II 6 and 7, would come closer to the central axis of the spaces. The dams were easily recognizable especially in the zone immediately in front of the original bank. From the succession of dark transverse strips, which represent phases of rest in the development, it appears that the dams were begun as short, tongue-shaped projections from the bank, and were subsequently extended further and further. Given the accumulation of pollution in the initial phases – particularly visible in dams HS-II 6 and 7 – the progress of construction seems at first to have been slow. The continuity in construction of the complex of dams is impressive. Regarding the layout of the complex, the parcellation measured out at the beginning was adhered to throughout the entire process. In the course of time there were some slight fluctuations in the orientation of the dams, but no fundamental deviations in the parcel boundaries were observed.
In Hoogstraat 0 the tongue-shaped beginnings of the dams were also easily recognizable. Dams and spaces were situated here at the spots where they would be expected from the analysis of the post remains. The reconstructed parcellation here also corresponds fully with the pattern of pollution, but the picture of the continuity of the parcel boundaries in Hoogstraat 0 remains unclear. There is, however, no reason to doubt this continuity.

In Hoogstraat IV, continuity was again abundantly evident: the space between dams 3 and 4 ran from front to back. At the back of the complex in squares 15–17 a layer of clay had been deposited in this space (see chapter II). This showed that the space had still formed a depression at the end of the development. As far as parcellation was concerned, Hoogstraat IV also came up to expectations, but a problem arose when filling in the parcels. The analysis of post remains suggested that dam HS-IV 4 was abutted by another dam (HS-IV 5). However, the pattern of pollution appeared to indicate that there (once) was a space of the customary 4 m width between dams 4 and 5. As to the situation south of parcel 5 and north of 3, nothing at all can be said with any certainty. The limited breadth of the Hoogstraat IV excavation site had an adverse effect on the reconstruction of the situation.
Hoogstraat III could not tell us much in this connection, due to the uncertainty of the pattern of pollution. In actual fact, only the space between dams 4 and 5 could be easily recognized. Deviations in the reconstructed pattern of parcellation were not observed.

Finally, we will discuss the Hoogstraat I excavation, which produced the most extensive survey. Figure 75* shows that here too the degree of conformity between the pattern of pollution and the reconstructed pattern of parcellation is high. Nevertheless, one gets the impression that in the northwest section (squares E/K-2/10) the interpretation is not quite watertight. For this reason, a second analysis of Hoogstraat I is again given in figure 77*, this time exclusively based on the pattern of light and dark strips. From this analysis, it appears that the riverbed structures in Hoogstraat I could not be extended without interruption. Only in the southern section did we observe the continuity known from Hoogstraat II and IV. The dams HS-I 8–11 ran continuously from front to back, but in the rest of the complex there was a break slightly before the middle. It was not possible to determine the exact position of this break, though it was clear that the dams did not link up exactly in squares D/K-8/10. The cause was also clear: changes in direction during construction caused dams to collide. The process of changes in direction was basically as follows: originally the longitudinal axis of the southern dams HS-I 6–11 was several degrees more to the south than that of HS-I 1–5. The dams in Hoogstraat I therefore appear to have been divided originally into two groups with slightly different positions, which were separated by the extra wide space between dams 5 and 6. Fairly early on in the construction, *c.* 20 m from the bank, both groups

had already changed direction: the southern group to the north, and the northern group to the south. In actual fact the groups 'moved' towards each other causing a dam in the middle (HS-I 6) 'to get stuck'.
Figure 78* is intended to give a schematic survey of the growth of the complex of dams in Hoogstraat I. The light strips from the western part of the plan in figure 77* have been shown here in light grey (fig. 78*: 1) and combined with the dam-strips derived from the post remains (fig. 78*: 3; the overlaps of the last mentioned dams with the 'light grey' ones have been omitted). The problem confronting the dam builders was evident: the two groups of light dams which curved toward each other resulted in the narrowing of parcel 6, which finally ended in a point (indicated in the figure by an arrow). At the level of the arrow, or possibly just before it, the situation was corrected in a simple though effective way: parcel 6 disappeared, while the direction of the parcels from the northern block (1–5) was adjusted to match that of the southern parcels. What struck one most in this operation was the care taken to adhere – as far as possible – to the existing pattern of parcellation, and this too can be seen in figure 78*. Here, the parcellation already familiar to us from figure 70* is shown by the interrupted line in fig. 78*: 5. Added to it, in uninterrupted line in fig. 78*: 4, is a parcellation linked with the changes of direction of the dams in their initial phases of development. It was assumed that the width of the parcels remained the same from beginning to end. All this shows that there was the possibility to carry out the correction made necessary by the change in direction while retaining the parcel width of *c.* 9 m.
Despite an initial change in direction, the southern parcels 8–11 ran from front to back without interruption, so no correction was required. In the northern section the suppression of parcels seems to have caused a shift which was adjusted on a line running from the 'vanishing point' of parcel 6 northwards. Consequently, the continuation of parcels 1–5 was far less evident than that of parcels 8–11. In fact, they followed a zigzag course which was not noticed during the reconstruction of the dams based on the post remains. We had the impression – though this may be wrong – that dams 1–5 ran straight on from beginning to end, although it is also possible that during the correction the rearranged parcels were extended front-wards. This was perhaps accompanied by the construction of new platforms in the new ('straight') direction. However, the latter is less likely, in our view, because it would, in fact, imply a shift in the division of property: the 'owner' of parcel 1 received parcel 2, and so forth, up to parcel 6. Unfortunately, the condition of the dam remains in the area of squares G/K-3/9 was too poor to establish the exact course of the dams there. We assume that they followed the zigzag line as indicated by the parcel boundaries in figure 78*: 4.
In the north-eastern section (squares G/K-10/20) of the complex, where the correction was carried out, the determination of the spaces between the dams proved somewhat problematical. Between dams 4 and 4a there was originally a space of the customary width. The dam on parcels 4a and 5 was apparently relatively narrow at first (dark grey shaded in fig. 78*) and the space to the north of it was only later filled in with an unusually long compartment (dam HS-I 5 old numbering; see fig. 79 or 21* in Van Es and Verwers, 1980). This space was probably kept open until the end of the development of the complex, although this is not clear in the plan of figures 75* and 77*. The space south of parcel 5 (dam 5A old numbering) certainly remained open. According to the traces of pollution in the riverbed it lay along the northern edge of the parcel. The space left on the south side was probably occupied by a dam: HS-I (6 and) 7. Figure 78* suggests that it linked up with HS-I 8, which was, however, irregular since it was contrary to the rule that two connected dams should be followed by a broad space. The next 4 m-wide space did not occur until between dams HS-I 9 and HS-I 10. This space certainly remained open right until the end, and so did the spaces between dams HS-I 10 and HS-I 11.

The situation on parcel 2, where no clear traces of a dam in the form of post remains were found, was uncertain. There probably once was a dam here, but it may have consisted partly of very long compartments which left comparatively few post remains. It looked as if it had once been built against dam HS-I 4 (old numbering) on parcel 3. In that case, there must have been a space along the north boundary of parcel 2. If the dams on parcels 2 and 3 were connected, a space must have followed between the dams on parcels 3 and 4, and this may, in fact, have been the case. A highly polluted strip did run along the parcel boundary between 3 and 4 (fig. 78*, squares I-13/21) but it was not of the required width everywhere. It is possible that here too, room for a 4 m-wide space was lacking, though the reason for this is not absolutely clear. North of parcel 1 everything was in order: there was a broad space on the division between parcels 1 and 0 which was left open right up to the end.

2.3 The function of spaces between dams and large pits in the riverbed

The polluted soil in the riverbed came about in two ways. In one case polluted soil accumulated against the (temporary) end or sides of a dam. In this way the more or less broad polluted strips on the division of (some of the) compartments of a dam or on the division between two dams built against each other developed. In the other case the polluted soil was deposited in the excavated hollows present there. Examples of such hollows were the large rectangular pits found especially in Hoogstraat I and II at right angles to the longitudinal direction of some of the parcels, for instance parcel 1 in Hoogstraat I and 3 in -II. The function of these pits already preoccupied us in the Hoogstraat-I publication.[47] At the time, we assumed that the pits were dug for the purpose of placing creels in them. However, we no longer believe this 'wild hypothesis'. We consider it far more likely that these large pits excavated in the riverbed were caused by the extraction of sand to raise the dam compartments situated behind them. The distinction between the pits and the – broad – polluted zones at the ends of compartments is not well defined. It is quite conceivable that soil was regularly dug up from the riverbed at the heads of the dams in order to raise them. The hollow left would then fill up with more or less polluted soil, either by sedimentation by the river or by the dumping of refuse by the users of the dams, or probably both. Depending on the way in which the digging in the riverbed had taken place, the resulting hollow could be observed in our excavation levels as a sharply defined pit or as a irregularly shaped polluted spot.

The spaces between the dams may also be included among the excavated hollows, according to the vertical sections. In the excavation levels the spaces were characterized by elongated structures running parallel to the dams. Apparently, the excavated hollows in the spaces eventually took the shape of long trenches or ditches. Again, we assume that the primary intention was to extract soil. The reconstruction in figure 79 shows the relation between the spaces and the dams. A space had to yield enough soil to build 1, 1.5 or 2 dam(s), depending on whether the adjacent dams were single or double ones. If one assumes the average width of the dams to be 7 m and the soil extracted from the spaces to be 4 m^3 per metre, the dams in the three possible situations could be raised with soil from the space slightly less than 60, 40 and 30 cm respectively. The amount of soil extracted has possibly been slightly overestimated: it is questionable whether 1 metre of soil could be dug over the full breadth of the space. On the other hand, the dams were certainly (far) less than 7 m wide at first, in addition to which it is uncertain whether all the planned dams were raised as high as this. It is clear that the spaces were able to supply enough soil to raise the core of the dams at least 0.5 m. Perhaps it was also possible to extract soil several times from the same section of the inter-space, because the river was constantly bringing in sediments. We have already seen that soil was also extracted in front of the heads of the dams, and it must always have

47 *Van Es & Verwers 1980, 24.*

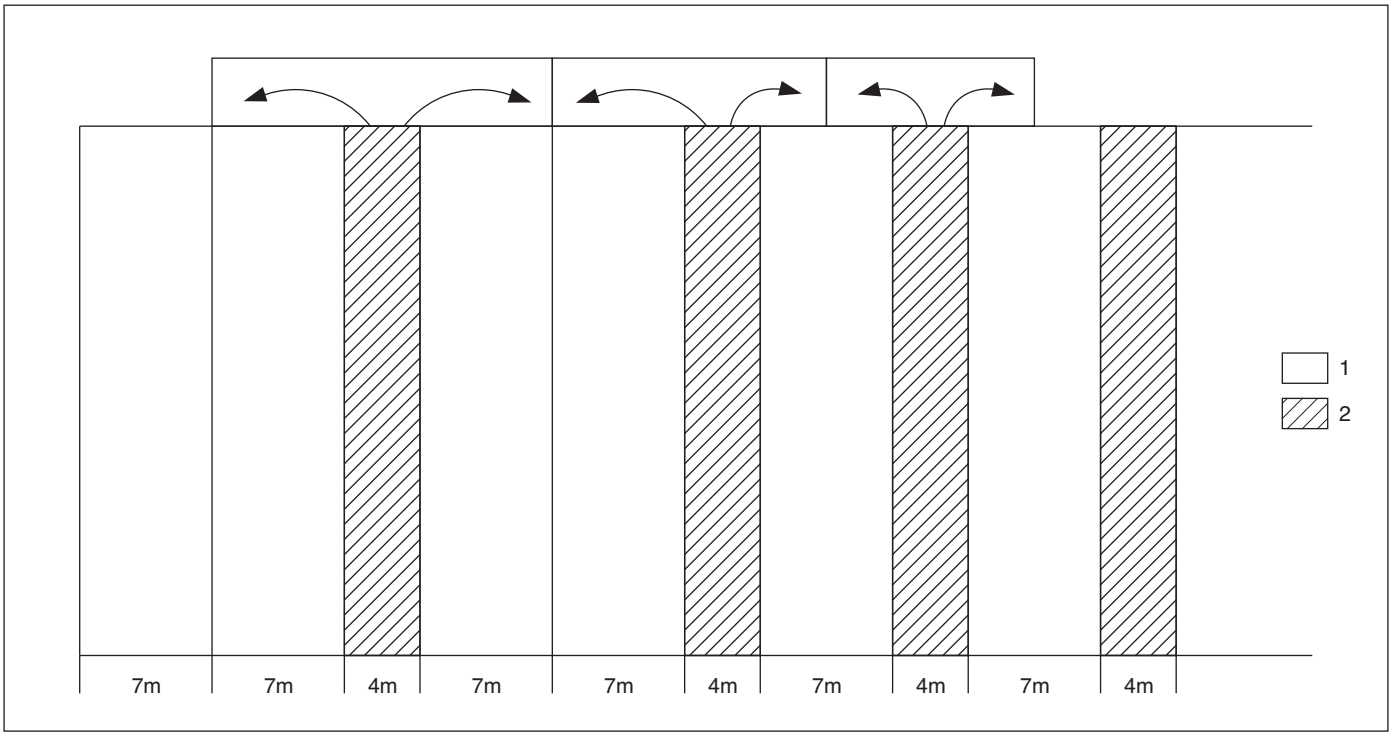


Fig. 79 Dorestad, Hoogstraat 0-IV: diagram of the construction of the dams; scale 1:400.
Legend:
1 dam;
2 excavated zone (interspace).

been possible to bring in material from elsewhere. The latter would preferably have been restricted to a minimum, but it is conceivable that some of the settlement refuse was dumped in the riverbed.
All in all we can safely assume that the dams were raised to a height of at least 0.5 m, mainly with soil extracted on the spot. One might wonder whether the spaces were kept as depressions in the terrain right up to the end of the development. Several paragraphs earlier, when speaking of the continuity of development of the complex of wooden structures in the riverbed, we mentioned that the spaces between the dams were kept 'open'. Our view is that one should not imagine that the spaces remained open over their entire length. This would be inconsistent with the polluted soil found in the spaces between the dams, most of which must have ended up there during the period in which the complex in the riverbed was in use. We may also assume that depressions gradually became filled up as a result of sedimentation. This leads us to the conclusion that, each time, only the most recently dug sections lay open. Earlier parts had already been more or less filled up, though it is possible that they could still be distinguished from the dams for a long time because of a slight difference in surface level. The more or less polluted sediments in the spaces would in any case have been of a different composition (more clayey) than the soil of the dams. This would explain why the pattern of dams and spaces was still recognizable in 1970, when a soil resistivity measurement was carried out by the *Rijks Geologische Dienst* (State Geological Service) in the riverbed area of Dorestad along Hoogstraat.[48] The above was confirmed by the situation found at the end of Hoogstraat IV. A tongue of clayey (?) sediment had penetrated the end of a space. This tongue was *c.* 30–40 m long and apparently filled a cavity in the space measuring the same length. The preceding 100 m had meanwhile already filled up with polluted soil.
There were generally fewer posts in the spaces than in the dam sections, but they were not altogether lacking. This means that as the spaces in between started to silt up they began to be used for purposes other than soil extraction. Our impression is that the filled-up sections of the spaces were successively incorporated in the dams.

48 Overzee 1978, 220.

This could be achieved by the lateral expansion of the dams, but in many cases it appeared that transverse partitions were put into the spaces, similar to the end-revetment of a dam, but in this case in between two dams. Occasionally, for example in the case of the incompletely excavated dam (?) HS-IV 5, it was difficult to distinguish between the dam and the space on the basis of the post remains. The places where we thought we recognized these partitions have been indicated in figure 62–6*. Whether the resulting compartments in the spaces were artificially raised, up to the level of the dams, for instance, we cannot say. They may have been somewhat lower. If they were artificially raised, the soil must have been brought in from elsewhere, one would imagine, though it does not seem likely that this was done on a large scale. We therefore assume that the surface of the spaces remained permanently at a lower level than that of the dams, though it is difficult to say how much lower: one metre or less? It is also uncertain whether the surface of a space was surfaced in some way after it had been filled up, but it is possible.

One of the functions of the spaces was undeniably soil extraction. One might query whether this was the primary or even the sole function, although the latter, in our view, is unlikely. It is probable that they also had a drainage function, certainly if we assume that, for a long time or perhaps permanently, they formed depressions, also in the older parts of the complex. In that case they could serve as drainage ditches. Nor can one completely exclude the possibility that the spaces also served as traffic routes. One can imagine that they might be used as canals, so that one could sail some way into the complex of wooden structures in order to come alongside the dams. This could only have been done over a distance of some dozen metres, for it is, in our opinion, impossible that there would have been canals that were navigable. The development of the complex of dams meant, in fact, that the bank was moved forward. One might then rightly ask what the new artificial bank in the Dorestad period looked like, and whether it was possible for reasonably sized ships to come alongside the dams.

The latter part of the question is certainly important; unfortunately, we cannot be absolutely certain about the answer. If one accepts that it was possible – which is not entirely inconceivable – one would have to assume that the riverside front of Dorestad had a lobed contour. Some of the dams must then have projected at least 20–30 m further than the dams situated next to them for there to have been enough room for large ships to moor alongside them. Such situations are not impossible. The 'white' dam in figure 77*, squares G/F-10/15, gives the impression that it was situated for some time alone (on two parcels) amid relatively broad spaces. However, this might be an exception, connected with the 'redistribution' of land previously mentioned (chapter V 2.2). We do not see any opportunity of establishing whether the projection of single dams did in fact regularly occur. This would in effect imply that certain parcels had an advantage because they could be more easily reached by ships. However, this is not the first impression one gets. The frequent linking up of two dams rather suggests that two neighbours were working at the same pace during construction, unless one assumes that two linked dams would have been in the hands of a single user. He could then have organized one of his parcels differently – with regard to ships – from the other one. Nevertheless, the hypothesis that the sides of the dams could be used as mooring places does also seem a logical option.

If the only possibility of entering the complex with the wooden structures was via the spaces between the dams, ships, as stated above, were only able to sail a short distance into them. What is even more important is that they could not have been very large ships, since the spaces were only 4 m wide at the most. It is, moreover, debatable whether this breadth could be fully exploited. The sides of the dams, at least as they were found during excavation, did not usually appear to be very straight. They were certainly not smooth, vertical quay walls, and a ship with a breadth amidships of 3–4 m would quickly get stuck. A boat of this size was, in fact, only able to moor with its prow between the two dams. Smaller vessels 2–3 m in

width may perhaps have been able to find a safe mooring place between the dams for the whole boat, as long as there was sufficient water there. People may have been satisfied with these possibilities, but the navigational function of the spaces appears to have been limited, to say the least.

2.4 Conclusions

The above considerations lead to the following conclusions.

1 The riverbed was divided into parcels which were generally *c.* 9 m wide. Only in Hoogstraat III do the parcels appear to have been slightly narrower.
2 The parcels were equipped with dams 6–7 m wide on average in such a way that next to every dam at least one 4 m-wide space was kept open.
3 The structures in the riverbed revealed a surprising degree of continuity: in principle, dams and spaces ran from front to back without interruption.
4 During the development process the dams could deviate more or less sharply from the originally planned direction. In Hoogstraat I this resulted in the loss of one parcel. During the subsequent readjustment the system remained intact.
5 The spaces in between were essential for soil extraction. They may also have had other functions in addition to this, such as drainage, and possibly served to a limited extent as harbours or canals.

3 The parcellation of the riverbank area

3.1 Introduction

The riverbank area is understood to mean the foremost settlement area situated on the river. For the reconstruction of the parcellation there, we only include the results from the Hoogstraat 0, II and IV excavations, since insufficient information on the organization of the riverbank area was collected in Hoogstraat I and III (see chapter IV). In Hoogstraat 0 and IV it was possible to establish the sites of large buildings or houses. The Hoogstraat-II excavation did not extend far enough into the riverbank area for this, but the beginnings of the parcels in the riverbed (the so-called 'land abutments') were excavated there. In this way an impression was gained of the organization of the riverbed there too. It was expected that the parcellation pattern on land would link up with that of the riverbed. In fact it was, of course, the other way round: the parcellation of the settlement site was continued into the riverbed. In figures 62–4* and 67–9* the information from the riverbank area has been combined with the reconstruction of the dams.

3.2 The relation between houses and dams

The houses were located in rows parallel to the river, with their longitudinal axis (roughly) perpendicular to the bank (figs. 62–3*). There appeared to be a clear relation between the house sites and the dams. The latter were constructed in front of the houses, in such a way that a house site was not (in principle) situated opposite a space between two dams. There appeared to be an exception to this rule in Hoogstraat IV: according to the reconstruction in figure 63*, house site 5 lay opposite the space between dams 5 and 6. It has, however, already been pointed out that the reconstruction of the dams in this area is very uncertain (chapter V 2.2). It is certainly possible that, in actual fact, dams 4 and 5 were separated by a 4 m-wide space, and that dams 5 and 6 were adjacent to one another. In that case, the location of house sites 5 and 6 in Hoogstraat IV would not have been abnormal. Since no deviations were observed in Hoogstraat 0, the available information allows the following conclusion: the location of the dams reflected that of the house sites, and the spaces in the riverbed corresponded with spaces between the houses. The latter could be observed particularly well at house sites 8 and 9 in the Hoogstraat-0 excavation.

In figures 67* and 68* the system of parcellation which could be reconstructed in the riverbed, was extended into the riverbank area. Including the house sites in this system did not pose any problems, and certainly not for the house sites from Hoogstraat IV, which are all neatly situated inside the parcel boundaries (fig. 68*). The problem in Hoogstraat 0 was that the dams in the riverbed were only traced over a short distance, making it difficult to establish the direction of the parcel boundaries clearly. For this reason, the orientation of the parcellation in Hoogstraat 0 was mainly derived from that of the house sites. That the long sides of these house sites lay parallel to the parcel boundaries has been convincingly demonstrated in the case of Hoogstraat IV. In Hoogstraat 0 the bank was concave, so that the house sites and also the parcel boundaries turned with the curve in the bank. A definite change could be observed in the orientation of the house sites at the transition between parcels 3 and 4. It cannot be coincidental that there was an irregularity in the bank at this spot (parcel 4 and possibly 5): the 'gap' in the bank which has frequently been referred to. When measuring the widths of the parcels of thirty feet (9.20–9.40 m) along the bank, a small section was left no more than 1–1.5 m wide, which we situated on the boundary between parcels 3 and 4.[49] In this way, a tapering piece of land begins on this parcel boundary, becoming wider and wider the further it goes inland. According to this reconstruction, the house sites from Hoogstraat 0 are now situated inside the parcellation system.

The concave form of the bank caused a change in the direction of the parcels in Hoogstraat 0, which had been readjusted at the site of an irregularity in the bank. On the land side, the concave bank posed no problems, for it left extra space in the form of the tapering piece of land. However, the opposite was the case in the riverbed. Here, a similar situation arose to that in Hoogstraat I, where two parcel boundaries converged, eventually causing the loss of a complete parcel (HS-I 6) (see chapter V 2.2). The same possibly occurred in Hoogstraat 0, with dam 4 as the 'victim'. It was remarkable that the orientation of parcels HS-0 1, 2 and 3, which we inferred from the reconstruction of the dams, curved further southward than the direction based on the house sites (both directions are shown in fig. 67*). It is conceivable that these dams changed direction during their extension, a phenomenon also observed in Hoogstraat I. It is also possible that an existing situation was later altered, as part of a process of reorganization caused by the removal of parcel 4. The excavation data do point in this direction, but the area examined was too small to be certain.

Two types of dam are found: the 'single' type, with a space on either side, and the 'paired' type. The latter originally consisted of two adjacent dams which had 'fused' along one long side. Due to the lack of reliable evidence, we cannot find out how often these paired dams occurred, or whether there was a system in the alternation between paired and single dams. The latter does not appear to have been the case, and it has at least been established that paired dams were not exceptional. In the Hoogstraat II excavation, which provided the best overview in this respect, at least four (HS-II 3 and 4; 5 and 6) and possibly even eight of the nine dams were paired (also: HS-II 1 and 2; 8 and 9). The combination of two dams often lasted from the beginning to the end of the development. Just as was the case in Hoogstraat II, good examples could be also be found in Hoogstraat I, in particular HS-I 8 and 9. The joining of two dams can be explained in various ways. Two owners or users may have decided to do so, in order to obtain more space on their dams. Another possibility is that both parcels together formed one unit of use or property. Theoretically, the location of the houses could provide a decisive answer. Unfortunately, practice is, as always, obstinate: we found no house sites in the riverbank area in front of the many dams of Hoogstraat I and II, and in Hoogstraat IV and -0, where we did find them, there were too few dams. Consequently, we do not have a definitive answer to this problem.

In the Hoogstraat IV excavation, one got the impression that the location of the houses on the parcels was comparable to that of the dams. House site HS-IV 4 was

49 It is, in fact, questionable whether this anomaly actually existed. The Hoogstraat 0 excavation consisted of two parts, with a strip of land in between which could not be excavated in connection with the building of a road. It is conceivable that the small deviation that appeared to occur in the parcellation of Dorestad may be traced back to a measuring error during the excavation or during the mounting of the plans of both sections of the excavation.

situated more or less in the middle of the parcel with an empty space on either side, one of which was certainly an inter-space (the space between parcels 3 and 4). The house site had been built on several times, though always roughly on the same spot without any lateral shifts worth mentioning. The situation of the house site resembled that of an isolated dam. By contrast, the house sites on parcels 2 and 3, and 5 and 6 were situated with one long side adjacent to each other on the common parcel boundary. They only bordered a space on one side and their location resembled that of paired dams. It was not possible to establish whether house sites 2 and 3 corresponded to a pair of dams. In our reconstruction, no concordance was observed between house site 4 and an isolated dam, nor between 5 and 6 and a paired dam. It has, however, already been pointed out that there may well have been such a concordance. The possibility therefore remains that in Hoogstraat IV the only single house site belonged to an isolated dam, while the two paired house-sites were situated behind paired dams.

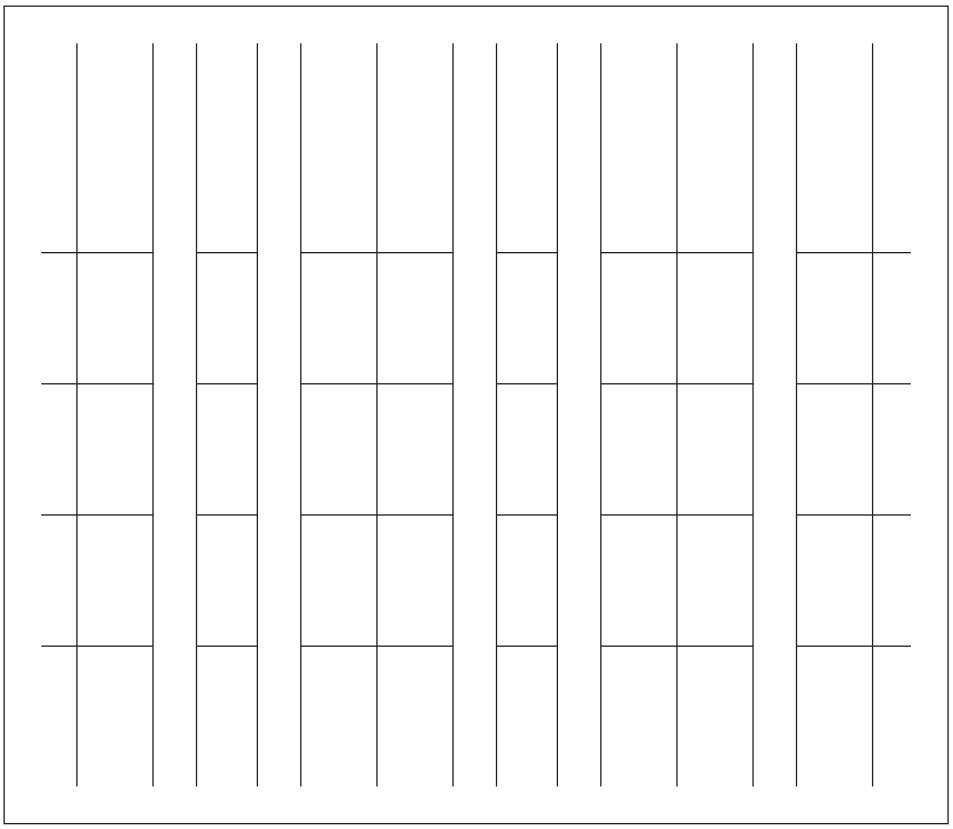
The situation in Hoogstraat 0 appeared to corroborate this assumption. House sites 8 and 9 were separated by a wide space, but the other sides were each up against the parcel boundary. Whether these sides lay against a house site on the neighbouring parcel (paired) is possible, but could not be ascertained (dams 7 and 8 were certainly paired). House site 6 may have been freestanding, but was not excavated. House site 5, also unexcavated, may have been linked with 4. The house site on parcel 3 was situated behind an isolated dam and, as far as the front was concerned, also appeared to have been freestanding. A little further from the bank, a lateral shift appeared to have occurred during rebuilding. This could only have taken place here exceptionally, if one assumes that the remaining part of the tapering piece of land was allocated to parcel 3. House-site 2 was separated from 3 by a space and *may* have been linked/paired with house site 1.

All in all, there are still many uncertainties regarding the details of the house locations, but it is conceivable that the house sites and dams were systematically linked: a freestanding house site behind an isolated dam; a pair of linked dams in front of two adjacent house-sites on the common parcel-boundary. This location system is shown in figure 80 in the form of a diagram, and is based on the situation which we consider to be the most probable in the case of Hoogstraat 0. In this example, the paired house-sites are twice as frequent as the freestanding sites, though this does not reflect the actual frequencies of both types of house site. Once again we wish to point out that the situation shown in the diagram is mainly based on supposition.

That pairing occurred, has meanwhile been implied by the data available. This gives rise to the question whether two adjacent house sites, situated at the edge of their parcel, could have been built at the same time. There are only two places where an answer to this question can be sought: the two paired parcels HS-IV 2–3, and 5–6. This is not of course enough for a definitive answer, but the possibility of the question being answered in the negative cannot be excluded. In both cases it concerned pits, which had apparently been dug along the outer wall of a building on one of the house sites, but which also appeared to be situated inside the house site on the adjoining parcel. This can only mean that both parcels were not continuously occupied at the same time. Therefore, two paired house-sites were possibly built on alternately. This may be an indication that both parcels had a single owner or user.

The situation in Hoogstraat 0 in fact revealed a longitudinal shifting of the house sites on all the built on parcels. This resulted in overlapping: the row of house sites closest to the riverbank (row 1) overlapped or was overlapped by – it was not possible to determine the exact order from the excavated features – a second row which lay somewhat further westward. It is remarkable that not only the fronts of row 1 were aligned more or less parallel to the bank, but also the backs of the second

Fig. 80 Dorestad, Hoogstraat 0-IV: parcellation in the riverbank area and riverbed (diagram); scale 1:400.



row. Behind there appeared to be a narrow vacant space – perhaps an inter-space – similar to the west-east oriented spaces which we have come across so far. On parcels 3 and 4 the beginning of another possible row of houses could just be observed, but this row remained largely outside the excavation. In fact the zone at the beginning of the 'land abutments' can also be regarded as an inter-space. The 'land abutments' were marked by a row of pits forming an almost closed front in some places, for example in Hoogstraat II and 0 (parcels 2, 3 and 9). We assume that this row of pits followed a north-south oriented parcel-boundary. On one side of it were the pits, and on the other side a *c.* two-metre-wide free zone which – as we assumed (chapter IV 2.5) – had been used as a road. It would appear that this complex must be considered as an inter-space at least 4 m wide, with a parcel boundary along its central axis.

It looks as if the settlement site was divided by an orthogonal system of (4 m-wide?) interspaces. The parcels had a standard breadth and possibly also a fixed length, although this could not be ascertained, due to insufficient evidence. Our interpretation of the settlement traces in Hoogstraat 0 suggests a length of 150 or possibly 120 feet (*c.* 36–38 and 45–47 m respectively) for a house parcel. Figure 81 gives an overview of how we envisage the layout of the riverbank area in Hoogstraat 0 in diagram form. On the east side of the parcel boundary which followed the row of pits along the bank, were the 'land abutments' with a length of 30 feet. On the other side of the same boundary, at a distance of another 30 feet were the fronts of the first row of houses. At least six houses at a time stood in this foremost row, implying that at least 60 % of the parcels were simultaneously built on. Assuming that the occupied parcels were 120 to 150 feet long, this would leave a vacant space of some 20 m behind the first row of houses, allowing for a house length of *c.* 15 m. It is possible that a vacant space was used as a yard, though it is rather too big for this

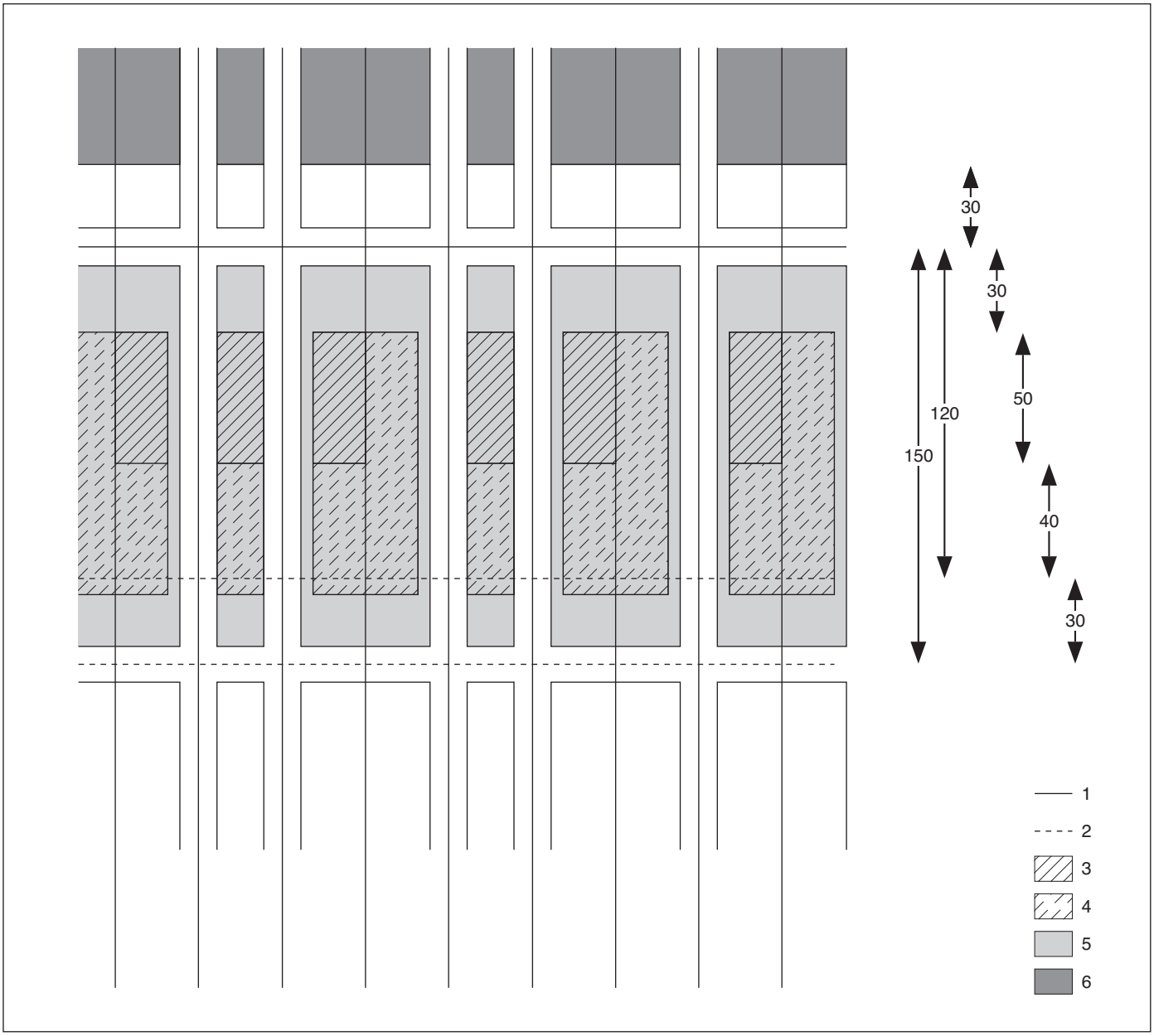


Fig. 81 Dorestad, Hoogstraat 0-IV: location of houses and dams (diagram); scale 1:400.
Legend:
1 parcel boundary;
2 possible parcel boundary;
3 house;
4 house from older phase?;
5 house parcel;
6 dam.

purpose, especially since there was already a vacant space of *c.* 8 m *in front of* the houses. It is also conceivable that two houses were situated one in front of the other on these parcels (of 120–150 feet). In that case the building density would be doubled. In Hoogstraat 0 clear traces of a second row of houses were found behind the foremost row, but it remains uncertain whether both rows were present simultaneously. All in all, the building plan reconstructed in figure 81 remains highly hypothetical.

4 The pits of the settlement site on the bank

4.1 Introduction

The pits in the riverbank area have already been referred to in the previous chapter. We shall now discuss them in more detail. The pits are the main – if not the only – evidence at our disposal for a reconstruction of the settlement in the zone bordering the river. Unfortunately, they did not receive much attention during the excavation because most of the attention was focused on the riverbed area itself. Only in Hoogstraat 0 and IV was a considerable part of the front (riverside part) of the settlement excavated. The pits found there were all mapped, their depths were measured and in many cases they were also drawn in vertical section. In addition, the pits were examined more or less precisely 'by hand' for finds. In other words, they were dug out completely or sometimes partially by spade, and any finds noticed were collected. Looking back, it is regrettable that the contents of the pits were not sieved, not even at random. The result is that only a proportion of the objects from the pits has been preserved, so that certain categories of finds are clearly underrepresented or are even lacking. There are, for example, hardly any small archaeological artefacts; there are no fish remains or small bones or bone fragments, nor any archaeo-botanical remains.[50] Finally, one should take into account the possibility of a difference in intensity of collection between the oldest Hoogstraat excavation (HS-0) and the most recent (HS-IV). This is hinted at by the fact that the average number of sherds collected from a pit in Hoogstraat IV was four times as many as that from a pit in Hoogstraat 0.

Despite all these deficiencies, the pits yielded all kinds of information. They provided indications for the chronology of settlement in the riverbank area (for this, see chapter VII). In the next section the issue of the function of the pits is central, and what the pits can tell us about the nature of the activities which took place in this part of the settlement. We have no choice but to restrict ourselves to the Hoogstraat-0 and -IV excavations.

4.2 The function of the pits

4.2.1 Location

The function of pits in settlements cannot always be established with certainty. Unfortunately, Dorestad is no exception. In our case, the location perhaps provides the most useful information. There is a certain pattern in the distribution of the pits over the site. Their location can briefly be described as along the edges of the parcels. This was clearly visible in the zone containing the 'land abutments' on the actual bank (also in Hoogstraat II). The pits there were located along the sides of the abutments in the continuation of the spaces between the dams in the riverbed. They were also found along the north-south parcel boundary separating the 'land abutments' from the settlement site on the bank. On the site itself, the pits were dug along the edges of the house sites, especially along the long sides. This means that here too, a large number of pits lay in the continuation of the spaces between the dams in the riverbed. The centre of a space in the settlement was left vacant over a breadth of 2 m for traffic: based on the impression received from the southern part of Hoogstraat 0 there was probably a pavement there possibly made of wood. Pits were also dug along the fronts and backs of houses, in addition to the long sides, and possibly even inside some of the houses.

The location of the pits along the spaces on the parcel boundaries led us to suspect that they were primarily dug for the purpose of soil extraction, as were the quarries (pits in the spaces in the riverbed.) The soil supposedly extracted in this way was a more or less sandy clay. It was possibly used to repair bad paths, to raise floors of

50 *Prummel 1983, 40–2.*

houses or to stop up wicker screens. However, the pits need not all have had the same function. Pits situated next to houses may have served as latrines or work-pits. It is also conceivable that pits were intended for refuse right from the start. Pits located inside a house may well have served as cellars.

4.2.2 Form

Not much could be concluded about the function of the pits from their shape, which was generally approximately square or rectangular, with a surface area varying from 1 to 3 m^2. Larger pits were exceptional, though occasionally neighbouring pits formed rather irregular complexes or strips. This does not mean that the pits belonging to a complex or strip were all open at the same time. The number of pits in simultaneous use on a parcel must have been small. In the excavated part of parcels 8 and 9 in Hoogstraat 0 approximately 40 pits were found on each of the two parcels. This amounts to a maximum of 40 pits per house site or less if one assumes that this area contained (parts of) two house sites per parcel. Even if it were one house site which was only in use for a short time, the average frequency at which the pits were dug could not have been more than 1 per year, and was probably far less than this. Since the pits were dug on different occasions, a younger pit could cut an older one which had already been filled up, thus creating the irregular complexes of pits which were visible particularly in the higher excavation levels. How long a pit remained open is impossible to say. The walls of pits could be preserved for some time in the clayey soil of Dorestad, but certainly not for years. In other words: the inconvenience the pits may have caused cannot have been great. The excavation plan shows the sum of all digging activities spread over a long time. This overall picture suggests that one could hardly have been able to move as a result of all the pits on the parcels, though in actual fact the situation cannot have been that bad. In general, the pits were not deep. There were few in the riverbank area that were deeper than 3 m NAP. This depth, which probably corresponded to 1 m or slightly more below ground level, may have been determined by the level of the ground water in the wet seasons: one dug down to ground water level. The pits certainly had nothing to do with the water supply. The fact that the pits were not really round is an indication. It is, incidentally, surprising that there were so few obvious wells in the riverbank area. Not one was found in Hoogstraat 0, and only one in Hoogstraat IV. This was located right at the front of parcel 6 and probably served the house behind it. The well pit was more or less square in shape in excavation level 3 (at *c.* 3.60 m NAP) and had a dark round core about 1 m in diameter (for a detailed description see chapter IV 3.2).

In the Hoogstraat II excavation, a remarkably deep (down to 2.40 m NAP) round to oval pit was discovered on either side of the land abutment on parcel 7. It was not clear whether these pits were actually wells. The relatively great depth can also be explained by the fact that the pits were situated on the edge of the riverbed, where the surface level was lower than further up in the riverbank area. There were obvious wells though in Hoogstraat I: no fewer than six![51] Two were located there on the edge of the riverbed, at the beginning of dams HS-I 5 and 7 (pits 1 and 2), and a third in the riverbed, at least 20 m from the bank on the edge of parcel HS-I 7 (pit 3). It is not entirely certain whether the remaining three pits were actually wells. They were also situated some distance from the bank (20–30 m): two of them appeared to belong to parcel HS-I 2 and one to parcel 1. The two wells, a tree-trunk well and a barrel well, which were found in Hoogstraat III (square D-10) dated from the Post-Dorestad period, according to the finds (chapter VI 1.4.3).

4.2.3 Contents

The contents of the pits did not contribute much to determining their function, and, in many cases, were not very impressive. In the Hoogstraat 0 excavation, over 60 %

51 Van Es & Verwers 1980, 29–32.

of the pits contained no finds. In the case of the pits in the riverbank area of Hoogstraat IV, which were possibly investigated more thoroughly, it was still slightly less than 50 %. The pits which did yield something generally contained few finds. Often the entire yield consisted of a single potsherd or some animal bones. The average number of pottery sherds per pit from which finds were collected was *c.* 10 in Hoogstraat 0, and *c.* 40 in Hoogstraat IV. The actual numbers vary from 1 to 185, and 1 to 495 respectively. A small number of pits was therefore rich in finds, but the majority contained little to no archaeological objects.

Potsherds and bones, however, were not the only finds. The total range of objects can be divided into three categories. The first comprises *kitchen waste*, which we take to include potsherds and animal bones (if not worked), which can be considered to be refuse because of their fragmentary state. The few fragments of glass ware from Hoogstraat IV are also included in this category. The second category is *industrial waste.* This includes loom weights and (the few) pottery spindles; slag (not yet fully investigated: not everything recorded as slag was necessarily connected with metalworking); bone and antler fragments, with traces of working (very few); amber (the odd piece). This leaves a remaining category of *uncertain nature*, in which we include the lumps of baked clay or daub. These may originate from household structures, such as walls or hearths, but also from craft equipment such as an oven or a smith's forge. Also of uncertain nature are the un-worked stones which may have been used both in the house or household and in industrial processes. Fragments of limestone, for instance, may point to the manufacture of mortars. For that matter, all objects of stone (quern and mortar fragments, grindstones), bone (combs, needles, gliders) and metal (nails, needles, knives) are in this respect dubious, since they may be expected in household waste as well as in waste from craft processes. The number of objects from the latter is small.

All pits with finds appeared to contain objects from the *kitchen waste* category. This implies that the pits were used as rubbish dumps, though this may only have been a secondary function: if there was a pit handy, and rubbish needed to be disposed of, it was dumped in it. A clear indication that the pits were not primarily intended as refuse pits is the fact that few or no archaeological objects at all were found in them. There was no difference in this respect between the pits on the 'land abutments' and those on the bank: the former also contained mainly kitchen refuse.

The presence of certain objects from the last two categories does not, in our opinion, say very much about the function of a pit. A good example is the large, rectangular pit found in Hoogstraat 0, square G-5. This only really 'rich' pit in Hoogstraat 0 contained: 185 pottery sherds, 8 fragments of loom weights, 8 lumps of clay, 23 un-worked stones, 13 quern fragments, 2 mortar fragments, 1 bone glider, 2 Roman roof-tile fragments and many fragments of animal bone. It appeared to be a collection of refuse from very different activities, possibly both household and craft activities. The pit, therefore, probably had a secondary function as a refuse dump; its possible primary function remains uncertain. The contents of the pit, however, did provide an indication for craft activities in the neighbourhood, since it is unlikely that one would be allowed to dump refuse on one's neighbour's parcel. Possibly crafts were practised on the parcel where the pit was found, such as weaving, metalworking (industrial waste), perhaps also the manufacture of gliders and mortars, and the finishing of tephrite querns (refuse of uncertain nature).

Very little industrial waste was found in the Hoogstraat 0 excavation. Even if one were to add to it the refuse of an 'uncertain nature', the evidence for craft activities would be little. This may be due to the fact that the pits were not investigated thoroughly enough. The evidence we have comes from the land abutment on parcel 2, and the house sites on parcels 3, 8 and 9. It concerns finds indicating several crafts per parcel, though the information is insufficient to allow us to specify any differences and specializations.

In Hoogstraat IV several crafts were also represented at almost every house site and on several 'land abutments.' The house site on parcel 4 stood out somewhat from the others because of its lack of evidence for metalworking. In Hoogstraat IV several crafts were also represented per location. They could be weaving, bone-, metal-, stone- and even amber-working. It is clear that the evidence is not concrete enough to demonstrate the crafts conclusively, let alone supply more information about them. However, together they constitute a strong implication that at many, if not all, house sites and 'land abutments' in the riverbank area, several crafts were practised, and not only those referred to above, but others, such as leatherworking or wood turning, which do not generally leave traces among the archaeological finds.

VI The finds

1 Pottery

1.1 Early-medieval pottery

The Hoogstraat excavations produced a large quantity of pottery. In the publication on Hoogstraat I ample attention has been paid to the Carolingian pottery from that part of the riverbank area. The fabric and form were discussed in detail. Later, archaeometrical analyses of the fabrics were carried out by A.C. Bardet.[52]
Since the publication of the Hoogstraat I book, the classification of the pottery into fabrics and types has hardly undergone any changes. For this reason, a short recapitulation of the classification of Carolingian pottery as it was drawn up in 1980 will suffice (wheel-thrown pottery: fig. 82–92; handmade pottery: fig. 111–15; tables 19-30). In a number of types, deviations and peculiarities were observed in the decoration. We shall look at some of these peculiarities in detail per type.

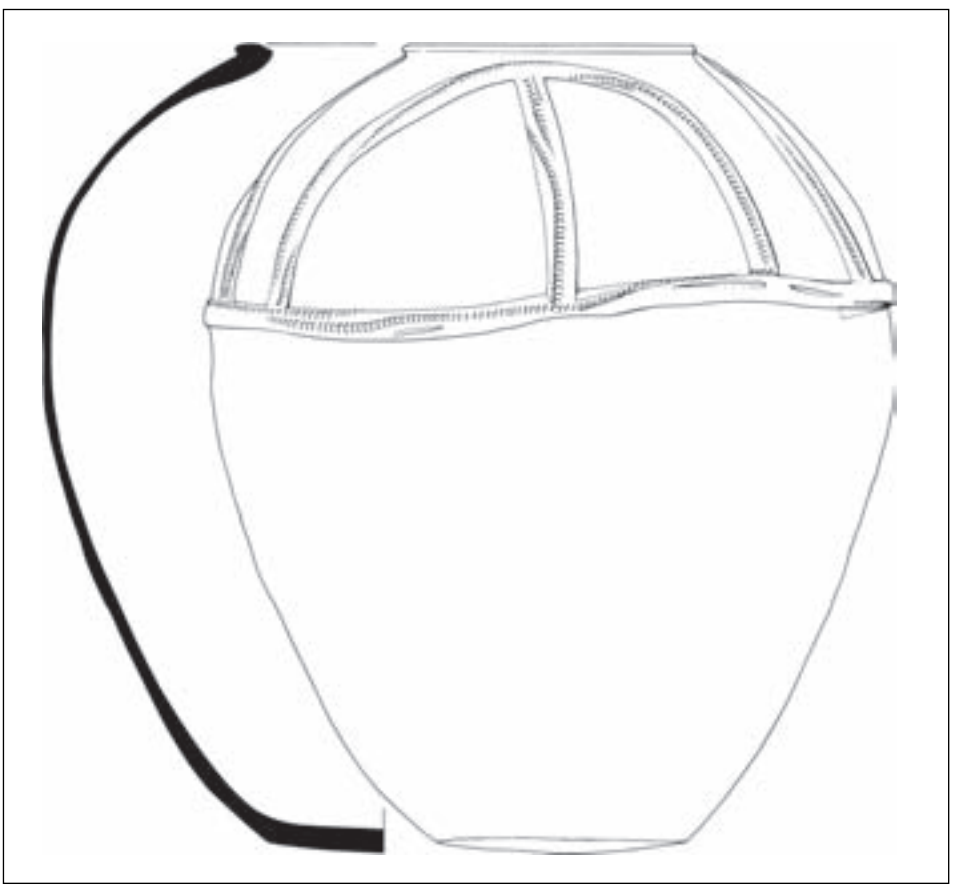


Fig. 82 Dorestad: pottery type EM W I.

52 *Bardet 1995.*

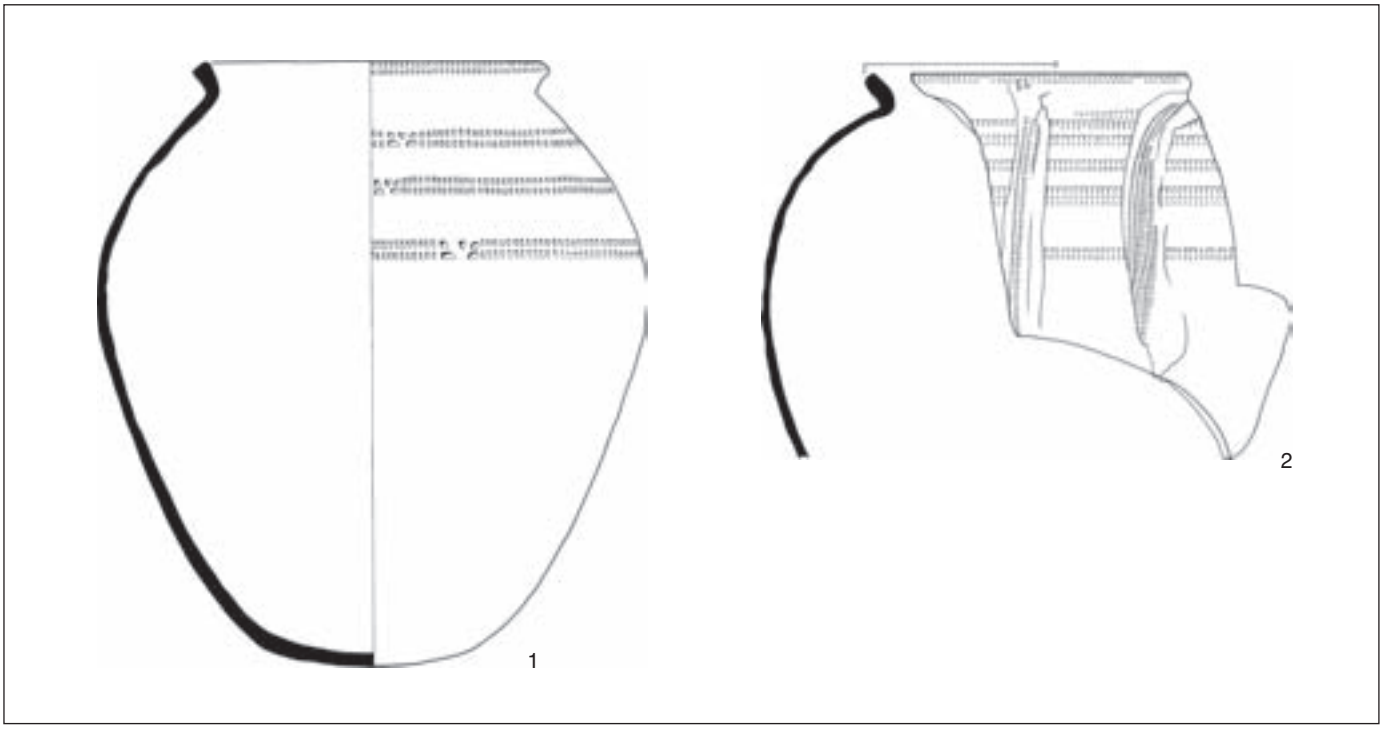


Fig. 83 Dorestad: pottery type 1 EM W II and 2 W I/II.

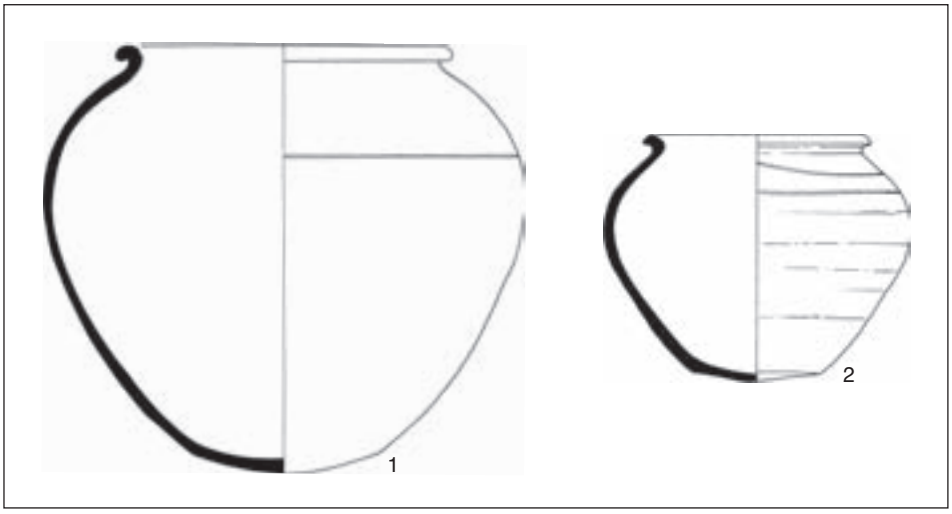


Fig. 84 Dorestad: pottery type 1 EM W III and 2 W IV.

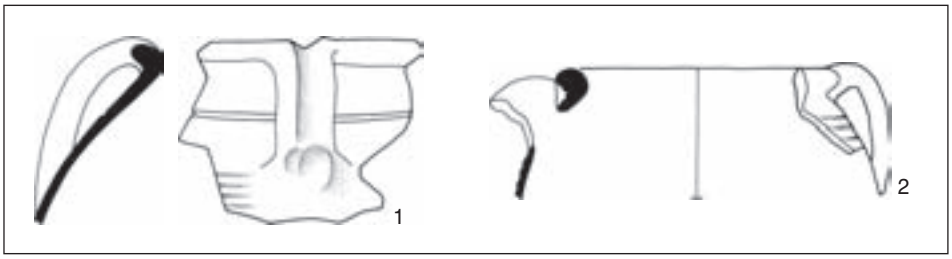


Fig. 85 Dorestad: pottery type EM W V.

Fig. 86 Dorestad: pottery type EM W VI.

Fig. 87 Dorestad: pottery type EM W VII.

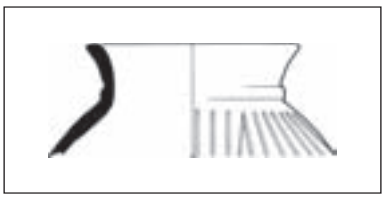


Fig. 88 Dorestad: pottery type EM W VIII.

Fig. 89 Dorestad: pottery type EM W IX.

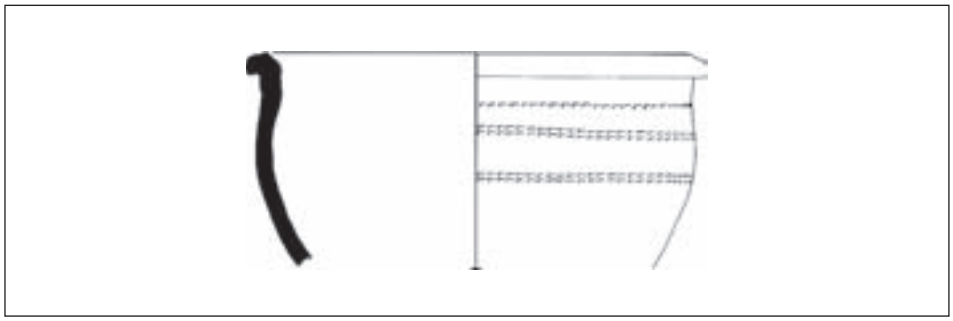


Fig. 90 Dorestad: pottery type EM W X.

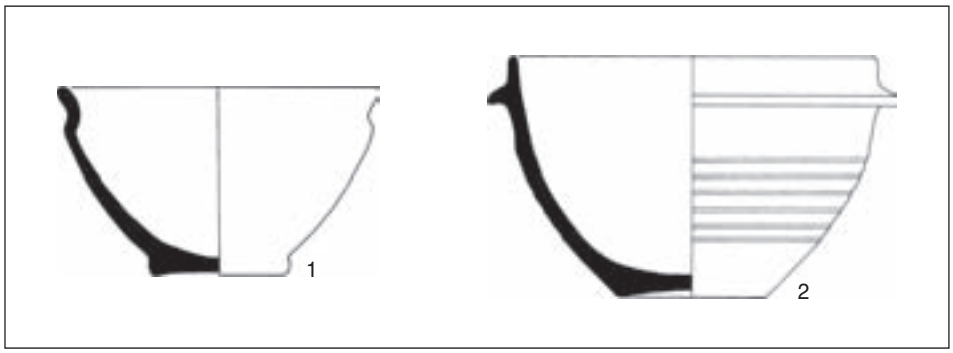


Fig. 91 Dorestad: pottery type EM W XI.

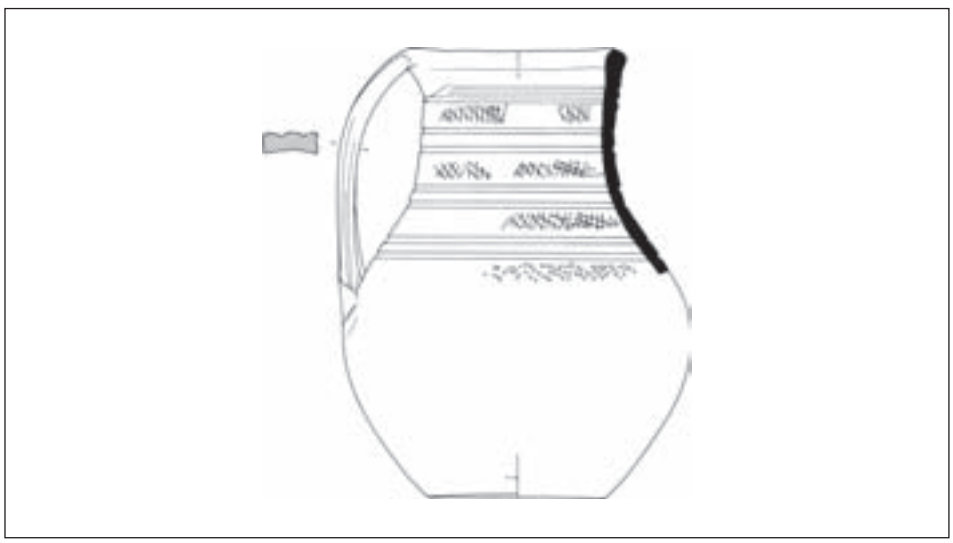


Fig. 92 Dorestad: pottery type EM W XII, 1 W XIIA, 2 W XIIB.

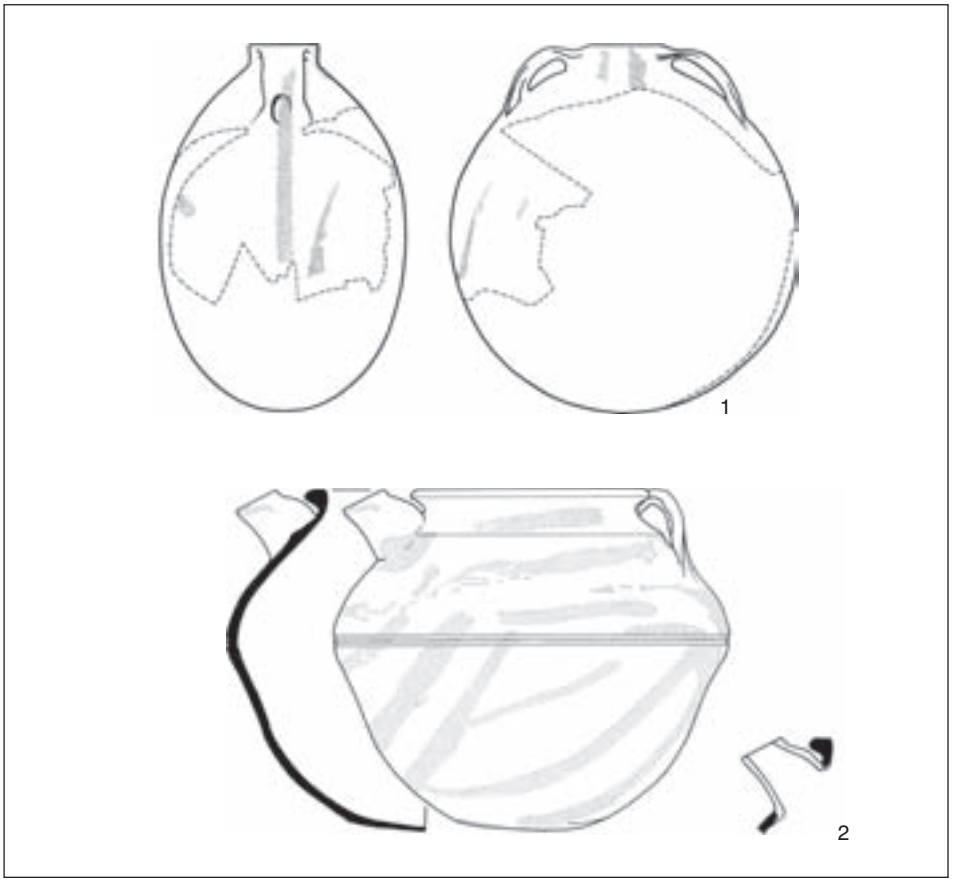


TABLE 15 Dorestad, Hoogstraat 0
Composition of find complex in absolute numbers.

R Roman;
EM Early-Medieval;
LM Late-Medieval;
PM Post-Medieval;
W Wheel-thrown;
H Hand-made;
rs rim sherd(s);
ws wall sherd(s);
bs base sherd(s).

types			sherds/fragments	specimens
pottery				
rs	W	R	-	1
rs	H	R	-	-
rs	W	EM	1060	1034
rs	H	EM	174	159
rs	W, H	LM	-	7
ws, bs	W	R	-	4
ws	H	R	-	1
ws	W	EM	-	8030
bs	W	EM	-	835
ws	H	EM	-	368
bs	H	EM	-	-
ws, bs	W, H	LM	-	8
rs, ws, bs	W, H	PM	-	-
lamps	R	-	-	
tiles	H	R	66 (1 stamped)	
loomweights	H	EM	-	151
spindle-whorls	H	EM	-	1
lid	-	1		
glass				
bracelet		La Tène	-	- see chapter VI 5
vessel ws		R	-	-
bead		R	-	-
vessels rs		EM	-	-
vessels ws, bs		EM	-	-
beads		EM	-	-
linen smoothers		EM	-	-
vessels rs, ws, bs		PM	-	-
metal				
coins		R	-	- see chapter VI 4
coins		EM	-	-
coins		LM, PM	-	-
iron slags		EM	-	82
stone (see Kars 1984)				
mortars		EM	-	8
querns		EM	-	7
weights		EM	-	3
grindstone		PM	-	-
whetstones		EM, later	-	18
limestone worked		-	2	
unworked flint		-	10	
limestone		-	10	
schist		-	48	
tuff		-	5	
basalt lava		-	22	
diverse		-	205	
amber (see Kars 1984)				
pendant		EM (?)	-	-
beads		EM (?)	-	-
spindle-whorl		EM (?)	-	-
unworked fragments		-	3	
bone				
unworked animal bones		EM	-	-
The bone material has not been included in this publication. This category of finds calls for a separate study.				
wood				

TABLE 16 Dorestad, Hoogstraat II
Composition of find complex in absolute numbers:
R Roman;
EM E arly-Medieval;
LM Late-Medieval;
PM Post-Medieval;
W Wheel-thrown;
H Hand-made;
rs rim sherd(s);
ws wall sherd(s);
bs base sherd(s).

types			sherds/fragments	specimens
pottery				
rs	W	R	-	11
rs	H	R	-	-
rs	W	EM	3352	3227
rs	H	EM	1007	958
rs	W, H	LM	-	16
ws, bs	W	R	-	27
ws	H	R	-	-
ws	W	EM	-	22111
bs	W	EM	-	2291
ws	H	EM	-	2664
bs	H	EM	-	-
ws, bs	W, H	LM	-	63
rs, ws, bs	W, H	PM	-	-
lamps	R	-	-	
tiles	H	R	228 (1 stamped)	-
loomweights	H	EM	390	-
spindle-whorls	H	EM	1	-
glass				
bracelet		La Tène	-	- see chapter VI 5
vessel ws		R	-	-
bead		R	-	-
vessels rs		EM	-	-
vessels ws, bs		EM	-	-
beads		EM	-	-
linen smoothers		EM	-	-
vessels rs, ws, bs		PM	-	-
metal				
coins		R	-	- see chapter VI 4
coins		EM	7	-
coins		M, PM	-	-
iron slags		EM	at least 197 2x a large quantity	-
stone				
(see Kars 1984)				
mortars		EM	-	-
querns		EM	-	-
weights		EM	-	-
grindstone		PM	-	-
whetstones		EM, later	-	-
unworked:				
flint		27	-	
limestone		41	-	
schist		82	-	
tuff		18	-	
basalt lava		38	-	
diverse		580	-	
amber				
(see Kars 1984)				
pendant		EM(?)	-	-
beads		EM(?)	-	-
spindle-whorl		EM(?)	-	-
unworked fragments			13	-
bone				
unworked animal bones		EM	-	-
The bone material has not been included in this publication. This category of finds calls for a separate study.				
wood			1428	-

TABLE 17 Dorestad, Hoogstraat III
Composition of finds complex in absolute numbers:
R Roman;
EM Early-Medieval;
LM Late-Medieval;
PM Post-Medieval;
W Wheel-thrown;
H Hand-made;
rs rim sherd(s);
ws wall sherd(s);
bs base sherd(s).

types			sherds/fragments	specimens
pottery				
rs	W	R	-	30
rs	H	R	-	-
rs	W	EM	2513	2463
rs	H	EM	473	448
rs	W, H	LM	1086	1076
ws, bs	W	R	-	65
ws	H	R	-	-
ws	W	EM	-	15111
bs	W	EM	-	1130
ws	H	EM	-	1338
bs	H	EM	-	-
ws, bs	W, H	LM	-	5559
rs, ws, bs	W, H	PM	-	-
lamps	R	-	-	
tiles	H	R	241 (1 stamped)	-
loomweights	H	EM	118	-
spindle whorls	H	EM	4	-
glass				
bracelet		La Tène	-	- see chapter VI 5
vessel ws		R	-	-
bead		R	-	-
vessels rs		EM	-	-
vessels ws, bs		EM	-	-
beads		EM	-	-
linen smoothers		EM	-	-
vessels rs, ws, bs		PM	-	-
metal				
coins		R	-	- see chapter VI 4
coins		EM	-	-
coins		M, PM	-	-
iron slags		EM	146	-
stone				
(see Kars 1984)				
mortars		EM	-	-
querns		EM	-	-
weights		EM	-	-
grindstone		PM	-	-
whetstones		EM, later	-	-
unworked:				
flint		84	-	
limestone		47	-	
schist		101	-	
tuff		63	-	
basalt lava		124	-	
diverse		1007	-	
amber				
(see Kars 1984)				
pendant		EM(?)	-	-
beads		EM(?)	-	-
spindle-whorl		EM(?)	27	-
unworked fragments				
bone				
unworked animal bones		EM	-	-
The bone material has not been included in this publication. This category of finds calls for a separate study.				
wood			695	-

TABLE 18 Dorestad, Hoogstraat IV
Composition of find complex in absolute numbers.
R Roman;
EM Early-Medieval;
LM Late-Medieval;
PM Post-Medieval;
W Wheel-thrown;
H Hand-made;
rs rim sherd(s);
ws wall sherd(s);
bs base sherd(s).

types			sherds/fragments	specimens
pottery				
rs	W	R	-	2
rs	H	R	-	-
rs	W	EM	1170	1146
rs	H	EM	304	277
rs	W, H	LM	-	20
ws, bs	W	R	-	5
ws	H	R	-	1
ws	W	EM	-	6045
bs	W	EM	-	905
ws	H	EM	-	858
bs	H	EM	-	-
ws, bs	W, H	LM	-	74
rs, ws, bs	W, H	PM	-	-
lamps	R	-	-	
tiles	H	R	68	-
loomweights	H	EM	127	-
spindle whorls	H	EM	1	-
glass				
bracelt		La Tène	-	- see chapter VI 5
vessel ws		R	-	-
bead		R	-	-
vessels rs		EM	-	-
vessels ws, bs		EM	-	-
beads		EM	-	-
smooting-glasses		EM	-	-
vessels rs, ws, bs		PM	-	-
metal				
coins		R	-	- see chapter VI 4
coins		EM	-	-
coins		M, PM	-	-
iron slags		EM	209	-
stone (see Kars 1984)				
mortars		EM	-	-
querns		EM	-	-
weights		EM	-	-
grindstone		PM	-	-
whetstones		EM, later	-	-
unworked:	flint		21	-
	limestone		43	-
	schist		40	-
	tuff		6	-
	basalt lava		15	-
	diverse		176	-
amber (see Kars 1984)				
pendant		EM(?)	-	-
beads		EM(?)	-	-
spindle whorl		EM(?)	-	-
unworked fragments			ca 50	-
bone				
unworked animal bones		EM	-	-
The bone material has not been included in this publication. This category of finds calls for a separate study.				
wood			677	-

TABLE 19A Dorestad, Hoogstraat 0
Rim sherds

Specification of the pottery part of the find complex in absolute numbers and percentages of grand total.
R Roman;
EM Early-Medieval;
LM Late-Medieval;
W Wheel-thrown;
H Hand-made;
rs rim sherd(s);
ws wall sherd(s);
bs base sherd(s).

types		specimens	percentages
R W	terra sigillata	-	-
	terra nigra-like	-	-
	smooth-walled	-	-
	thick-walled	-	-
	rough-walled	-	-
R H		1	0.1
R W and H	*total*	1	0.1
EM W	I	31	2.6
	II	128	10.6
	I/II	5	0.4
	III	627	52.2
	IV	24	2.0
	V	61	5.1
	VI	14	1.2
	VII	8	0.7
	VIII	3	0.2
	IX	48	4.0
	X	42	3.5
	XI	-	-
	XII	8	0.7
	XIII	5	0.4
	XIV	30	2.5
EM W	*total*	1034	86.1
EM H	I	147	12.2
	II	1	0.1
	III	10	0.8
	IV	1	0.1
	V	-	-
	miscellaneous	-	-
EM H	*total*	159	13.2
EM W and H	*total*	1193	99.3
LM W	I (Pingsdorf)	2	0.2
	II (Maasland)	-	-
H	I (*Kugeltopf*)	2	0.2
	Greyware	1	0.1
	II (Paffrath)	-	-
	miscellaneous (*Stoneware*)	2	0.2
LM W and H	*total*	7	0.6
R, EM, LM W and H	*grand total*	1201	100

TABLE 19B Dorestad, Hoogstraat 0
Wall sherds and base sherds

Specification of the pottery part of the find complex in absolute numbers and percentages of grand total.
R Roman;
EM Early-Medieval;
LM Late-Medieval;
W Wheel-thrown;
H Hand-made;
rs rim sherd(s);
ws wall sherd(s);
bs base sherd(s).

types		sherds	percentages
R W	terra sigillata	1	-
	terra nigra	-	-
	terra nigra-like	2	-
	varnished	-	-
	smooth-walled	-	-
	thick-walled	1	-
	rough-walled	-	-
R H		1	-
R W and H	*total*	5	0.1
EM W	ws decorated I	172	1.9
	ws decorated (rouletting), mainly II	391	4.2
	ws decorated I/II	5	0.1
	ws decorated V	5	0.1
	ws undecorated V	77	0.8
	ws decorated VI	28	0.3
	ws undecorated VI	31	0.3
	ws decorated VII	10	0.1
	ws decorated + spouts VIII	-	-
	ws undecorated VII+VIII	28	0.3
	ws decorated XII	11	0.1
	ws handles	16	0.2
	ws spouts	20	0.2
	ws remaining, decorated	36	0.4
	ws remaining, undecorated	3600	38.9
EM W	*total*	8030	86.8
EM W	bs flat	154	1.7
	bs convex	681	7.4
EM W	*total*	835	9.0
EM W	ws and bs *total*	8865	95.9
EM H	ws	368	4.0
EM H	bs	-	-
EM H	ws and bs *total*	368	4.0
LM W	ws and bs I (Pingsdorf)	-	-
	ws and bs II (Maasland)	-	-
H	ws and bs I (*Kugeltopf*)	-	-
	ws and bs II (Paffrath)	-	-
	ws and bs (*Stoneware*)	6	-
	ws and bs miscellaneous/ Redware	2	-
LM W and H	ws and bs *total*	8	0.1
R, EM, LM W and H ws and bs	*grand total*	9246	100

fabrics W		1	2	3	4	6	8	9	10	11	12	13	14	15	16	17	18	20	total
types W																			
I	A	21	1	1															23
	B	5		1															6
	C	1		1															2
total		27	1	3															31
II	A	16		1			2												19
	B	42	7	1					1										51
	C	40	6	1															47
	D	5	2																7
	E	2	1	1															4
total		105	16	4			2		1										128
I/II	A	1																	1
	B	4																	4
total		5																	5
III	A	22	22	48	11	54	5	41	13		122						1		339
	B	6	5	3		60		42	1		102				1				220
	C	25	2	6															33
	D	5	1	1	1	5		4	1		7								25
	E									5									5
	F	2			1			2											5
total		60	30	58	13	119	5	89	15	5	231				1		1		627
IV	A	3		1															4
	B	4																	4
	C	7																	7
	D	9																	9
total		23		1															24
V	A											60							60
	B											1							1
total												61							61
VI													14						14
VII		3													5				8
VIII														3					3
IX	A	30	2	9		2											1		44
	B	1																	1
	C	2		1															3
total		33	2	10		2											1		48
X	A	2		1															3
	B	1				3							1			3			8
	C			5		3										5			13
	D	6		2				1								2	1		12
	E							2			2	1					1		6
total		9		8		6		3			2	1	1			10	2		42
XII	B					2		1											3
	E	2																	2
	F	3																	3
total		5				2		1											8
XIII			1						1				1		1		1		5
XIV		11		12	1													6	30
fabrics total		281	50	96	14	129	7	93	16	6	233	62	16	3	7	10	5	6	1034

TABLE 20A Dorestad, Hoogstraat 0 Frequency of Carolingian wheel-thrown pottery types and fabrics, and their interrelations; the table is based upon the numbers of *specimens* represented by *rim* sherds.

Absolute numbers (specimens) The table shows the number of specimens of each type occurring in the different fabrics; it also gives the sum total of specimens occurring of each fabric (bottom line) and the sum total of specimens occurring of each type (extreme right-hand column).

fabrics W		1	2	3	4	6	8	9	10	11	12	13	14	15	16	17	18	20	total
types W																			
I	A	91.3	4.3	4.3															2.3
	B	83.3		16.7															0.6
	C	50.0		50.0															0.2
total		87.1	3.2	9.7															3.1
II	A	84.2		5.3			10.7												1.8
	B	82.3	13.7	2.0					2.0										4.9
	C	85.1	12.8	2.1															4.5
	D	71.4	28.6																0.7
	E	50.0	25.0	25.0															0.4
total		82.0	12.5	3.1			1.6		0.8										12.4
I/II	A	100																	0.1
	B	100																	0.4
total		100																	0.5
III	A	6.5	6.5	14.1	3.2	15.9	1.5	12.1	3.8		36.0						0.3		32.8
	B	2.7	2.2	1.4		27.3		19.1	0.5		46.4				0.5				21.3
	C	75.7	6.1	18.2															3.2
	D	20.0	4.0	4.0	4.0	20.0		16.0	4.0		28.0								2.4
	E									100									0.5
	F	66.6			33.3														0.3
total		9.6	4.8	9.2	2.1	19.0	8	14.2	2.4	0.8	36.8				0.2		0.2		60.6
IV	A	75.0		25.0															0.4
	B	100																	0.4
	C	100																	0.7
	D	100																	0.9
total		95.8		4.2															2.3
V	A											100							5.8
	B											100							0.1
total												100							5.9
VI													100						1.4
VII		37.5													62.5				0.8
VIII																			0.3
IX	A	68.2	45	20.4													2.3		4.2
	B	100																	0.1
	C	66.6		33.3															0.3
total		68.7	42	20.8													2.1		4.6
X	A	66.6		33.3															0.3
	B	12.5		37.5									12.5			37.5			0.8
	C			38.5		23.0										38.5			1.3
	D	50.0		76.6		8.3										16.6	8.3		1.2
	E							33.3			33.3	16.6					16.6		0.6
total		21.4		19.0		14.3		7.1			4.8	2.4	2.4			23.8	4.8		4.1
XII	B					66.6		33.3											0.3
	E	100																	0.2
	F	100																	0.3
total		62.5				25.0		12.5											0.8
XIII			20.0							20.0			20.0		20.0		20.0		0.5
XIV		36.7		40.0	3.3													20.0	1.9
fabrics total		27.2	4.8	9.3	1.4	12.5	0.7	9.0	1.5	0.6	22.5	6.0	1.5	0.3	0.7	1.0	0.5	0.6	100

TABLE 20B Dorestad, Hoogstraat 0 Frequency of Carolingian wheel-thrown pottery types and fabrics, and their interrelations; the table is based upon the numbers of *specimens* represented by *rim* sherds.

Percentage (of specimens) The table shows the numbers of specimens of each type occurring in the different fabrics, expressed as percentages of the total number of specimens belonging to the type concerned; it also gives the total number of specimens occurring of each fabric expressed as a percentage of the sum total of all specimens (bottom line), and the total number of specimens occurring of each type, expressed as a percentage of the sum total of all specimens (extreme right-hand column).

TABLE 21A Dorestad, Hoogstraat 0
Frequency of Carolingian hand-made pottery types and fabrics, and their interrelations; the table is based upon the number of *specimens* represented by *rim sherds*.

Absolute numbers (specimens) The table shows the numbers of each type occurring in the different fabrics; it also gives the sum total of specimens occurring of each fabric (bottom line) and the sum total of specimens occurring of each type (extreme right-hand column)

fabrics H	**1**	**2**	**types total**
types H			
IA small	7	-	7
A large	44	23	67
B	7	18	25
C	46	2	48
IA–C total	104	43	147
II	1	-	1
III	9	1	10
IV	1	-	1
V	-	-	-
VI	-	-	-
fabrics total	115	44	159

TABLE 21B Dorestad, Hoogstraat 0
Frequency of Carolingian hand-made pottery types and fabrics, and their interrelations; the table is based upon the number of *specimens* represented by *rim sherds*.

Percentages (of specimens) The table shows the numbers of each type occurring in the different fabrics, expressed as percentages of the total number of specimens belonging to the type concerned; it also gives the total number of specimens occurring of each fabric, expressed as a percentage of the sum total of all specimens (bottom line), and the total number of specimens occurring of each type, expressed as a percentage of the sum total of all specimens (extreme right-hand column).

fabrics H	**1**	**2**	**types total %**
types H			
IA small	100	-	4.4
A large	65.7	34.3	42.1
B	28.0	72.0	15.7
C	95.8	4.2	30.2
IA–C total	70.7	29.3	92.4
II	100	-	0.6
III	90	10	6.3
IV	100	-	0.6
V	-	-	-
VI	-	-	-
fabrics total %	72.3	27.7	100,-

TABLE 22A Dorestad, Hoogstraat II
Rim sherds

Specification of the pottery part of the find complex in absolute numbers and percentages of grand total.
R Roman;
EM Early-Medieval;
LM Late-Medieval;
W Wheel-thrown;
H Hand-made;
rs rim sherd(s);
ws wall sherd(s);
bs base sherd(s).

types		sherds	percentages
R W	terra sigillata	6	0.1
	terra nigra-like	-	-
	varnished	1	0.0
	smooth-walled	2	0.1
	thick-walled	1	0.0
	rough-walled	1	0.0
R H	-	-	
R W and H	*total*	11	0,3
EM W	I	150	3.6
	II	798	18.9
	I/II	12	0.3
	III	1789	42.5
	IV	114	2.7
	V	69	1.6
	VI	44	1.0
	VII	30	0.7
	VIII	37	0.9
	IX	37	0.9
	X	70	1.7
	XI	-	-
	XII	9	0.2
	XIII	20	0.5
	XIV	48	1.1
EM W	*total*	3227	76.6
EM H	I	888	21.1
	II	20	0.5
	III	42	1.0
	IV	4	0.1
	V	-	-
	miscellaneous	4	0.1
EM H	*total*	958	22.7
EM W and H	*total*	4185	99.4
LM W	I (Pingsdorf)	4	0.1
	II (Maasland)	1	0.0
H	I (*Kugeltopf*)	3	0.1
	II (Paffrath)	-	-
	miscellaneous, incl. Redware	8	0.2
LM W and H	*total*	16	0.4
R, EM, LM W and H	*grand total*	4212	100

TABLE 22B Dorestad, Hoogstraat II
Wall and base sherds

Specification of the pottery part of the find complex in absolute numbers and percentages of grand total.
R Roman;
EM Early-Medieval;
LM Late-Medieval;
W Wheel-thrown;
H Hand-made;
rs rim sherd(s);
ws wall sherd(s);
bs base sherd(s).

types		sherds	percentages
R W	terra sigillata	12	0.0
	terra nigra	-	-
	terra nigra-like	-	-
	varnished	1	0.0
	smooth-walled	5	0.0
	thick-walled	4	0.0
	rough-walled	4	0.0
	miscellaneous	1	0.0
R H	-	-	-
R W and H	*total*	27	0.1
EM W	ws decorated I	793	2.9
	ws decorated (rouletting), mainly II	3082	11.3
	ws decorated I/II	26	0.9
	ws undecorated V	172	6.3
	ws decorated VI	44	0.2
	ws undecorated VI	105	0.4
	ws decorated VII	32	0.1
	ws decorated and spouts VIII	19	0.7
	ws undecorated VII and VIII	145	0.5
	ws decorated XII	26	0.9
	ws handles	76	0.3
	ws spouts	68	0.3
	ws remaining, decorated	102	0.4
	ws remaining, undecorated	17421	64.1
EM W	ws *total*	22111	81.4
EM W	bs flat	224	0.8
	bs convex	2067	7.6
EM W	bs total	2291	8.4
EM W	ws and bs *total*	24402	89.8
EM H	ws decorated		19
EM H	ws undecorated	2642	
EM H	handle/spout	3	0.1
EM H	ws and bs *total*	2664	9.8
EM W and H	ws and bs *total*	27066	99.6
LM W	ws and bs I (Pingsdorf)	12	0.0
	ws and bs II (Maasland)	21	0.1
H	ws and bs I (*Kugeltopf*) and Greyware	5	0
	ws and bs II (Paffrath)	-	-
	ws and bs (*Stoneware*)	5	0.0
	ws and bs (miscellaneous), Redware	20	0.1
LM W and H	ws and bs *total*	63	0.2
R, EM, LM W and H ws and bs	*grand total*	27156	100

fabrics W		1	2	3	4	6	8	9	10	11	12	13	14	15	16	17	18	20	total
types W																			
I	A	119	2	7	1	1													130
	B	13		3															16
	C	4																	4
	D																		-
total		136	2	10	1	1													150
II	A	126	30	7		2					1								166
	B	292	23						1										316
	C	167	11						1								1		180
	D	101	10																111
	E	13	2																15
	F	10																	10
total		709	76	7		2			2		1						1		798
I/II	B	5																	5
	D	6																	6
	E	1																	1
total		12																	12
III	A	125	81	213	59	187	24	81	100		259						1		1130
	B	25	23	3	3	110		45	25		161				6				401
	C	31		8				1											40
	D	51	14	18	7	21	3	6	14		18						1		153
	E									33									33
	F	5		2															7
	G	5	3	2	1	7	1		1		4						1		25
total		242	121	246	70	325	28	133	140	33	442				6		3		1789
IV	A	17		2															19
	B	36	3	1															40
	C	18							1										19
	D	30	4	2															36
total		101	7	5					1										114
V	A											65							65
	B											3							3
	C											1							1
total												69							69
VI													44						44
VII		19	1												10				30
VIII														37					37
IX	A	26		5		1													32
	B	2			1	1													4
	C			1															1
total		28		6	1	2													37
X	A	1	1	1		1													4
	B	1	1	1	1											1			5
	C	3	1	4	2	6		2					1			3			22
	D	21	1	3												1			26
	E	3			2						3	3							11
	F			1								1							2
total		29	4	10	5	7		2			3	4	1			5			70
XI																			-
XII	A	3																	3
	B					4		2											6
total		3				4		2											9
XIII		12	1	1								1		3			2		20
XIV		18		20														10	48
fabrics total		1309	212	305	77	341	28	137	143	33	446	74	45	40	16	5	6	10	3227

TABLE 23A Dorestad, Hoogstraat II Frequency of Carolingian wheel-thrown pottery types and fabrics, and their interrelations; the table is based upon the numbers of *specimens* represented by *rim sherds*.

Absolute numbers (specimens) The table shows the number of specimens of each type occurring in the different fabrics; it also gives the sum total of specimens occurring of each fabric (bottom line) and the sum total of specimens occurring of each type (extreme right-hand column).

fabrics W		1	2	3	4	6	8	9	10	11	12	13	14	15	16	17	18	20	total
types W																			
I	A	91.5	1.5	5.4	0.8	0.8													4.0
	B	81.2		18.7															0.5
	C	100																	0.1
	D																		-
total		90.7	1.3	6.7	0.7	0.7													4.6
II	A	75.9	18.1	4.2		1.2					0.6								5.1
	B	92.4	7.2					0.3											9.8
	C	92.7	6.1					0.6									0.6		5.6
	D	91.0	9.0																3.4
	E	86.7	13.3																0.5
	G	100																	0.3
total		88.6	9.5	0.9		0.2		0.5			0.1						0.1		24.7
I/II	B	100																	0.1
	D	100																	0.2
	E	100																	0.3
total		100																	0.4
III	A	11.0	7.2	18.8		16.5	7.2	8.8	71.4		22.9						0.0		35.0
	B	6.2	5.7	0.7		27.4	11.2	6.2	17.8		40.1				1.5				12.4
	C	77.7		20.0			2.5												1.2
	D	33.3	9.1	11.8	4.6	13.7	3.9	9.1	100		11.8						0.6		4.7
	E									100									1.0
	F	71.4		28.6															0.2
	G	20.0	12.0	8.0	4.0	28.0	4.0	4.0	0.7		16.0						4.0		0.8
total		13.5	6.8	13.8	1.6	18.2	1.6	7.5	7.8	1.8	24.7				0.3		0.2		55.5
IV	A	89.5		10.5															0.6
	B	90.0	7.5	2.5															1.2
	C	94.7							5.3										0.6
	D	83.3	11.1	5.5															1.1
total		88.6	6.1	4.4					0.9										3.5
V	A											100							2.0
	B											100							0.0
	C											100							0.0
total												100							2.1
VI													100						1.4
VII		63.3	3.3													33.3			0.9
VIII														100					1.1
IX	A	81.2		15.6		3.1													1.0
	B	50.0			25.0	25.0													0.1
	C			100															0.0
total		75.7		16.2	2.7	5.4													1.1
X	A	25.0	25.0	25.0		25.0										20.0			0.1
	B	20.0	20.0	20.0	20.0											13.6			0.1
	C	13.6	4.5	18.2	9.1		27.3	9.1					4.5			3.8			0.7
	D	80.8	3.8	11.5															0.8
	E	27.3			18.2						27.3	27.3							0.3
	F			50.0								50.0							0.1
total		41.4	5.7	14.3	7.1	1.0		2.8			4.3	5.7	1.4			7.1			2.2
XI																			-
XII	A	100				66.7		33.3											0.1
	B																		0.2
total		33.3				44.4		22.2											0.3
XIII		60.0	5.0	5.0								5.0		15.0			10.0		0.6
XIV		37.5		41.7														20.8	1.5
total fabrics		40.6	6.6	9.4	2.4	10.6	0.9	4.2	4.4	1.0	13.8	2.3	1.4	1.2	0.5	0.2	0.2	0.3	100

TABLE 23B Dorestad, Hoogstraat II Frequency of Carolingian wheel-thrown pottery types and fabrics, and their interrelations; the table is based upon the numbers of *specimens* represented by *rim sherds*.

Percentage (of specimens) The table shows the numbers of specimens of each type occurring in the different fabrics, expressed as percentages of the total number of specimens belonging to the type concerned; it also gives the total number of specimens occurring of each fabric expressed as a percentage of the sum total of all specimens (bottom line), and the total number of specimens occurring of each type, expressed as a percentage of the sum total of all specimens (extreme right-hand column).

TABLE 24A Dorestad, Hoogstraat II
Frequency of Carolingian hand-made pottery types and fabrics, and their interrelations; the table is based upon the number of *specimens* represented by *rim sherds*.

Absolute numbers (specimens) The table shows the numbers of each type occurring in the different fabrics; it also gives the sum total of specimens occurring of each fabric (bottom line) and the sum total of specimens occurring of each type (extreme right-hand column)

fabrics H	**1**	**2**	**types total**
types H			
IA small	25	-	25
A large	298	185	483
B	33	271	304
C	62	14	76
IA-C total	418	470	888
II	8	12	20
III	35	7	42
IV	4	-	4
V	-	-	-
VI	3	1	4
fabrics total	468	490	958

TABLE 24B Dorestad, hoogstraat II
Frequency of Carolingian hand-made pottery types and fabrics, and their interrelations; the table is based upon the number of *specimens* represented by *rim sherds*.

Percentages (of specimens) The table shows the numbers of each type occurring in the different fabrics, expressed as percentages of the total number of specimens belonging to the type concerned; it also gives the total number of specimens occurring of each fabric, expressed as a percentage of the sum total of all specimens (bottom line), and the total number of specimens occurring of each type, expressed as a percentage of the sum total of all specimens (extreme right-hand column).

fabrics H	**1**	**2**	**types total %**
types H			
IA small	100,-	-	2,6
A large	61,7	38,3	50,4
B	10,9	89,1	31,7
C	81,6	18,4	7,9
IA-C total	47,1	52,9	92,7
II	40,-	60,-	2,1
III	83,3	16,7	4,4
IV	100,-	-	0,4
V	-	-	-
VI	75	25	0,4
fabrics total %	48,8	51,2	100,-

TABLE 25A Dorestad, Hoogstraat III
Rim sherds

Specification of the pottery part of the find complex in absolute numbers and percentages of grand total.
R Roman;
EM Early-Medieval;
LM Late-Medieval;
W Wheel-thrown;
H Hand-made;
rs rim sherd(s);
ws wall sherd(s);
bs base sherd(s).

types	specimens	percentages	
R W	terra sigillata	11	0.3
	terra nigra-like	6	0.1
	varnished	3	0.1
	smooth-walled	-	0.1
	thick-walled	6	0.1
	rough-walled	-	-
R H	-	-	
R W and H	*total*	30	0.7
EM W	I	61	1.5
	II	680	16.9
	I/II	20	0.5
	III	1139	28.3
	IV	70	1.7
	V	170	4.2
	VI	52	1.3
	VII	17	0.4
	VIII	43	1.0
	IX	87	2.2
	X	51	1.3
	XI	1	0.0
	XII	4	0.1
	XIII	20	0.5
	XIV	48	1.2
EM W	*total*	2463	61.3
EM H	I	398	9.9
	II	12	0.3
	III	27	0.7
	IV	4	0.1
	V	2	0.2
	miscellaneous	5	0.1
EM H	*total*	448	11.2
EM W and H	*total*	2911	72.5
LM W	I (Pingsdorf)	223	5.6
	II (Maasland)	39	1.0
H	I (Kugeltopf) H and W	508	12.6
	II (Paffrath)	291	7.2
	Stoneware	3	0.1
	miscellaneous/Redware/ Jute	12	0.3
LM W and H	*total*	1076	26.8
R, EM, LM W and H	*grand total*	4017	100

TABLE 25B Dorestad, Hoogstraat III
Wall and base sherds

Specification of the pottery part of the find complex in absolute numbers and percentages of grand total.
R Roman;
EM Early-Medieval;
LM Late-Medieval;
W Wheel-thrown;
H Hand-made;
rs rim sherd(s);
ws wall sherd(s);
bs base sherd(s).

types		sherds	percentages
R W	terra sigillata	18	0.07
	terra nigra	-	-
	terra nigra-like	16	0.06
	varnished	12	0.05
	smooth-walled	12	0.05
	thick-walled	9	0.03
	rough-walled	9	0.03
R H	-	-	
R W and H	*total*	65	0.3
EM W	ws decorated I	378	1.6
	ws decorated (rouletting), mainly II	1899	0.8
	ws decorated I/II	32	0.1
	ws undecorated and decorated V	348	1.5
	ws decorated VI	40	0.2
	ws undecorated VI	165	0.7
	ws decorated VII	9	0.03
	ws decorated and spouts VIII	15	0.06
	ws undecorated VII and VIII	123	0.5
	ws decorated XII	27	0.1
	ws handles	57	0.2
	ws spouts	66	0.3
	ws remaining, decorated	24	0.1
	ws remaining, undecorated	11928	51.5
EM W ws	*total*	15111	65.3
EM W	bs flat	266	1.1
	bs convex	864	3.7
EM W	bs *total*	1130	4.9
EM W	ws and bs total	16241	70.2
EM H	ws decorated	14	0.06
EM H	ws undecorated	1324	5.7
EM H ws	*total*	1338	5.8
LM W	ws, bs I (Pingsdorf)	2219	9.6
	ws, bs II (Maasland)	164	0.7
LM H	ws, bs I (Kugeltopf) and Greyware	2122	9.2
	ws, bs II (Paffrath) 985 ws and 1 bs	986	4.3
	ws, bs (Stoneware)	33	1.4
	ws, bs miscellaneous/ Redware	39	0.2
LM W and H	ws and bs total	5563	24.0
R, EM and LM; W and H; ws and bs	*grand total*	23207	100

fabrics		1	2	3	4	6	8	9	10	11	12	13	14	15	16	17	18	20	total
types W																			
I	A	37	2	7	1												2		49
	B	8																	8
	C	2		2															4
	D																		
total		47	2	9	1												2		61
II	A	93	30	3		1	1				1								129
	B	230	22	2	1			1	2										258
	C	165	18						2										185
	D	85	9			1													95
	E	1																	1
	F	11		1															12
total		585	79	6	1	2	1	1	4		1								680
I/II	A	1																	1
	B	18																	18
	C																		
	D	1																	1
total		20																	20
III	A	74	64	111	22	109	17	51	62		128						2		640
	B	29	11	3	1	74		39	5		96				2				260
	C	61		16		1													78
	D	42	16	8		11		5	1		9								92
	E									23									23
	F	6		8	1														15
	G	15	3	3		4		1	1		2						2		31
total		227	94	149	23	199	17	96	69	23	253				2		4		1139
IV	A	10	1																11
	B	23		1															24
	C	10	1																11
	D	15	5	1					3										24
total		58	7	2					3										70
V	A											159							159
	B											6							6
	C											5							5
total												170							170
VI													52						52
VII		9	1												7				17
VIII														43					43
IX	A	60	5	13	1				1										80
	B	4																	4
	C	1		2															3
total		65	5	15	1				1										87
X	A	3		1	1							1							6
	B	2	1	1							2		2						8
	C	3		3	1	1							1			4			13
	D	14	3	4															21
	E	1									1	1							3
total		23	4	9	2	1					3	2	3			4			51
XI													1						1
XII	A	2																	2
	B					2													2
total		2				2													4
XIII		9	1	5						1			1		1		2		20
XIV		28		13	1													6	48
fabrics total		1073	193	208	30	204	18	97	77	24	239	172	57	43	10	4	8	6	2463

TABLE 26A Dorestad, Hoogstraat III Frequency of Carolingian wheel-thrown pottery types and fabrics, and their interrelations; the table is based upon the numbers of *specimens* represented by *rim sherds*.

Absolute numbers (specimens) The table shows the number of specimens of each type occurring in the different fabrics; it also gives the sum total of specimens occurring of each fabric (bottom line) and the sum total of specimens occurring of each type (extreme right-hand column).

fabrics		1	2	3	4	6	8	9	10	11	12	13	14	15	16	17	18	20	total
types W																			
I	A	75	4.1	14.3	2.0												4.2		2.0
	B	100																	0.3
	C	50		5.0															0.2
	D																		
total		78.7	3.3	14.7	1.7												3.3		2.5
II	A	72.1	23.2	2.3		0.8	0.8				0.8								5.3
	B	89.1	8.5	0.8	0.4			0.4	0.8										10.5
	C	89.2	9.7						1.1										7.6
	D	89.5	9.5			1.0													3.9
	E	100																	0.04
	F	91.7		8.3															0.5
total		86.0	11.6	0.9	0.1	0.3	0.1	0.1	0.6		0.1								27.8
I/II	A	100																	0.04
	B	100																	0.7
	C																		
	D	100																	0.04
total		100																	0.8
III	A	11.6	.10	17.3	3.4	17.0	2.6	8.0	9.7		20.0						0.3		26.1
	B	11.1	4.2	1.1	0.4	28.5		15.0	1.9		36.9				0.8				10.6
	C	78.2		20.5		1.3													3.2
	D	45.6	17.4	8.7		11.9		5.4	1.1		9.8								3.7
	E									100									0.9
	F	40.0		53.3	6.7														0.6
	G	48.4	9.7	9.7		12.9		3.2	3.2		6.4						6.4		1.3
total		19.9	8.2	13.1	2.1	17.5	1.5	8.4	6.1	2.0	20.6				0.2		0.4		46.5
IV	A	90.9	9.1																0.4
	B	95.8		4.2															1.0
	C	90.9	9.1																0.4
	D	62.5	20.8	4.2					12.5										1.0
total		82.8	10.0	2.8					4.3										2.8
V	A											100							6.5
	B											100							0.2
	C											100							0.2
total												100							6.9
VI													100						2.1
VII		52.9	5.9												41.2				0.7
VIII														100					1.7
IX	A	75.0	6.2	16.2	1.2				1.2										3.3
	B	100																	0.2
	C	33.3		66.7															0.1
total		74.7	5.7	17.2	1.1				1.1										3.5
X	A	50.0		16.7	16.7							16.7							0.2
	B	25.0	12.5	12.5							25.0		25.0						0.3
	C	23.1		23.1	7.7	7.7							7.7			30.8			0.5
	D	66.7	14.3	19.0															0.8
	E	33.3									33.3	33.3							0.1
total		45.1	7.8	17.6	3.9	2.0					5.9	3.9	5.9			7.8			2.1
XI													100						0.04
XII	A	100																	0.08
	B					100													0.08
total		50.0				50.0													0.2
XIII		45.0	5.0	25.0						5.0			5.0		5.0		10.0		0.8
XIV		58.3		27.1	2.1													12.5	1.9
fabrics total		43.6	7.8	8.4	1.2	8.3	0.7	3.9	3.1	1.0	9.7	7.0	2.3	1.7	0.4	0.2	0.3	0.2	100

TABLE 26B Dorestad, Hoogstraat III Frequency of Carolingian wheel-thrown pottery types and fabrics, and their interrelations; the table is based upon the numbers of *specimens* represented by *rim sherds*.

Percentage (of specimens) The table shows the numbers of specimens of each type occurring in the different fabrics, expressed as percentages of the total number of specimens belonging to the type concerned; it also gives the total number of specimens occurring of each fabric expressed as a percentage of the sum total of all specimens (bottom line), and the total number of specimens occurring of each type, expressed as a percentage of the sum total of all specimens (extreme right-hand column).

TABLE 27A Dorestad, Hoogstraat III
Frequency of Carolingian hand-made pottery types and fabrics, and their interrelations; the table is based upon the number of *specimens* represented by *rim sherds*.

Absolute numbers (specimens). The table shows the numbers of each type occurring in the different fabrics; it also gives the sum total of specimens occurring of each fabric (bottom line) and the sum total of specimens occurring of each type (extreme right-hand column).

fabrics H	**1**	**2**	**types total**
types H			
IA small	15	2	17
A large	215	41	256
B	12	30	42
C	79	4	83
IA-C total	321	77	398
II	8	4	12
III	26	1	27
IV	3	1	4
V	2	-	2
VI	4	1	5
fabrics total	364	84	448

TABLE 27B Dorestad, Hoogstraat III
Frequency of Carolingian hand-made pottery types and fabrics, and their interrelations; the table is based upon the number of *specimens* represented by *rim sherds*.

Percentages (of specimens). The table shows the numbers of each type occurring in the different fabrics, expressed as percentages of the total number of specimens belonging to the type concerned; it also gives the total number of specimens occurring of each fabric, expressed as a percentage of the sum total of all specimens (bottom line), and the total number of specimens occurring of each type, expressed as a percentage of the sum total of all specimens (extreme right-hand column).

fabrics H	**1**	**2**	**types total %**
types H			
IA small	88,2	11,8	3,8
A large	84,-	16,-	57,1
B	28,6	71,4	9,4
C	95,2	4,8	18,5
IA-C total	80,6	19,4	88,8
II	66,6	33,3	2,7
III	96,3	3,7	6,-
IV	75,-	25,-	0,9
V	100,-	-	0,4
VI	80,-	20,-	1,1
fabrics total %	81,2	18,8	100,-

TABLE 28A Dorestad, Hoogstraat IV
Rim sherds

Specification of the pottery part of the find complex in absolute numbers and percentages of grand total.
R Roman;
EM Early-Medieval;
LM Late-Medieval;
W Wheel-thrown;
H Hand-made;
rs rim sherd(s);
ws wall sherd(s);
bs base sherd(s).

types		sherds	percentages
R W	terra sigillata	1	0.1
	terra nigra-like	-	-
	smooth-walled	-	-
	thick-walled	-	-
	rough-walled	-	-
R H		1	0.1
R W and H	*total*	2	0.1
EM W	I	42	2.9
	II	172	11.9
	I/II	4	0.3
	III	589	40.8
	IV	33	2.3
	V	89	6.2
	VI	28	1.9
	VII	9	0.6
	VIII	7	0.5
	IX	87	6.0
	X	44	3.0
	XI	2	0.1
	XII	3	0.2
	XIII	14	1.0
	XIV	29	2.0
EM W	*total*	1146	79.3
EM H	I	251	17.4
	II	5	0.3
	III	20	1.4
	IV	1	0.1
	V	-	-
	miscellaneous	-	-
EM H	*total*	277	19.2
EM W and H	*total*	1423	98.5
LM W	I (Pingsdorf)	4	0.3
	II (Maasland)	-	-
LM H	I (Kugeltopf) Greyware	3	0.2
	II (Paffrath)	-	-
	(Stoneware)	13	0.9
	miscellaneous/Redware	-	-
LM W and H	*total*	20	1.4
R, EM, LM W and H	*grand total*	1441	100

TABLE 28B Dorestad, Hoogstraat IV
Wall and base sherds

Specification of the pottery part of the find complex, in absolute numbers and percentages of grand total.
R Roman;
EM Early-Medieval;
LM Late-Medieval;
W Wheel-thrown;
H Hand-made;
rs rim sherd(s);
ws wall sherd(s);
bs base sherd(s).

types		sherds	percentages
R W	terra sigillata	2	0.02
	terra nigra	-	-
	terra nigra-like	-	-
	varnished	-	-
	smooth-walled	-	-
	thick-walled	-	-
	rough-walled	3	0.03
R H		1?	0.01
R W and H	*total*	6	0.07
EM W	ws decorated I	217	2.8
	ws decorated (rouletting). mainly II	563	7.1
	ws decorated I/II	6	
	ws undecorated V		302
	ws undecorated VI	62	0.8
	ws decorated VI	25	0.3
	ws decorated VII	14	0.2
	ws decorated and spouts VIII	2	0.02
	ws undecorated VII and VIII	54	0.7
	ws decorated XII	21	0.3
	ws handles	24	0.3
	ws spouts	16	0.2
	ws remaining; decorated	37	0.5
	ws remaining; undecorated	4702	59.6
EM W	ws *total*	6045	76.6
EM W	bs flat	205	2.6
	bs convex	700	8.9
EM W	bs total	905	11.5
EM W	ws and bs *total*	6950	88.1
EM H	ws decorated	11	0.1
EM H	ws undecorated	847	10.7
EM H	ws and bs *total*	858	10.9
LM W	ws, bs I (Pingsdorf)	5	0.06
	ws, bs II (Maasland)	3	0.03
LM H	ws, bs I (Kugeltopf) + Greyware	7	0.09
	ws, bs II (Paffrath)	1?	0.01
	ws, bs (Stoneware)	18	0.2
	ws, bs miscellaneous/Redware	40	0.5
LM W and H	ws and bs *total*	74	0.9
R, EM, LM W and H ws and bs	*grand total*	7888	100

fabrics W		1	2	3	4	6	8	9	10	11	12	13	14	15	16	17	18	20	total
types W																			
I	A	22	1	4													1		28
	B	7	1	1	2														11
	C			2	1														3
total		29	2	7	3												1		42
II	A	16	4	4															24
	B	65	5						1										70
	C	37	5						1										42
	D	18	5			1													24
	E	2																	2
	F	1																	1
total		139	19	4		1			2										172
I/II	A	1																	1
	B	3																	3
total		4																	4
III	A	35	(21)	54	6	48	10	32	(23)		63						2		294
	B	9	8	3		43	1	21	(5)		60				3				153
	C	33	1	7		2													43
	D	15	32	4		5		6	4		10								76
	E									2									2
	F	1		3															4
	G	2				11					4								17
total		95	62	71	6	109	11	59	32	2	137				3		2		589
IV	A	1																	1
	B	8	4																12
	C	11																	11
	D	7	2																9
total		27	6																33
V	A											84							84
	B											5							5
total												89							89
VI	A												28						28
VII	A	2	2		1										4				9
VIII														7					7
IX	A	55	3	22	1			4									1		86
	B				1														1
total		55	3	22	2			4									1		87
X	A	2		2									1						5
	B	4	2	3		2							2			1			14
	C	1	1	4												3			9
	D	4	1	2	1	1										1			10
	E											5					1		6
total		11	4	11	1	3						5	3			5	1		44
XI															2				2
XII	B					3													3
XIII		6	1			1				1			1		1	1	2		14
XIV		14		12														3	29
fabrics total		382	99	127	13	117	11	63	34	3	137	94	33	7	10	6	7	3	1146

TABLE 29A Dorestad, Hoogstraat IV Frequency of Carolingian wheel-thrown pottery types and fabrics, and their interrelations; the table is based upon the numbers of *specimens* represented by *rim sherds*.

Absolute numbers (specimens) The table shows the number of specimens of each type occurring in the different fabrics; it also gives the sum total of specimens occurring of each fabric (bottom line), and the sum total of specimens occurring of each type (extreme right-hand column).

fabrics W		1	2	3	4	6	8	9	10	11	12	13	14	15	16	17	18	20	total
types W																			
I	A	78.6	3.6	14.3													3.6		2.5
	B	63.6	9.1	9.1	18.2														1.0
	C			66.7	33.3														0.3
total		69.0	4.8	16.7	7.1												2.4		3.7
II	A	66.7	16.7	16.7															2.1
	B	91.5	7.0						1.4										6.2
	C	86.4	11.4						2.3										3.8
	D	75.0	20.8			4.2													2.1
	E	100																	0.2
	F	100																	0.1
total		84.2	11.5	2.4		0.6			1.2										14.4
I/II	A	100																	0.1
	B	100																	0.3
total		100																	0.4
III	A	11.9	(7.1)	18.4	2.0	16.3	3.4	10.9	(7.8)		21.4						0.7		25.7
	B	5.9	5.2	2.0		28.1	0.6	13.7	(3.3)		39.2				2.0				13.4
	C	76.7	2.3	16.3		4.6													3.8
	D	19.7	42.1	5.3		6.6		7.9	5.3		13.1								6.7
	E									100									0.2
	F	25.0		75.0															4
	G	11.8				64.7					23.5								1.5
total		16.1	10.6	11.6	1.0	18.6	1.9	10.1	5.5	0.3	23.4				0.5		0.3		51.6
IV	A	100																	0.1
	B	66.7	33.3																1.1
	C	100																	1.0
	D	77.8	22.2																0.8
total		81.8	18.2																2.9
V	A											100							7.4
	B											100							0.4
total												100							7.8
VI													100						2.5
VII		18.2	18.2		9.1										54.5				0.8
VIII														100					0.6
IX	A	63.9	3.5	25.6	1.2			4.6									1.2		7.5
	B				100														0.1
total		63.2	3.4	25.3	2.3			4.6									11		7.6
X	A	40.0		40.0									20.0						0.4
	B	28.6	14.3	21.4		14.3							14.3			7.1			1.2
	C	11.1	11.1	44.4												33.3			0.8
	D	40.0	10.0	20.0	10.0	10.0										10.0			0.9
	E											83.3					16.7		0.5
total		25.0	9.1	25.0	2.3	6.8						11.4	6.8			11.4	2.3		3.9
XI													33.3		66.7				0.3
XII	B					100													0.3
XIII		42.8	7.1			7.1				7.1			7.1		7.1	7.1	14.3		1.2
XIV		52.0		36.0														10.3	2.5
fabrics total		33.3	8.6	11.1	1.1	10.2	1.0	5.5	3.0	0.3	11.9	8.2	2.9	0.6	0.9	0.5	0.6	0.3	100

TABLE 29B Dorestad, Hoogstraat IV Frequency of Carolingian wheel-thrown pottery types and fabrics, and their interrelations; the table is based upon the numbers of *specimens* represented by *rim sherds*.

Percentages (of specimens) The table shows the numbers of specimens of each type occurring in the different fabrics, expressed as percentages of the total number of specimens belonging to the type concerned; it also gives the total number of specimens occurring of each fabric, expressed as a percentage of the sum total of all specimens (bottom line), and the total number of specimens occurring of each type, expressed as a percentage of the sum total of all specimens (extreme right-hand column).

TABLE 30A Dorestad, Hoogstraat IV
Frequency of Carolingian hand-made pottery types and fabrics, and their interrelations; the table is based upon the number of *specimens* represented by *rim sherds*.

Absolute numbers (specimens). The table shows the numbers of each type occurring in the different fabrics; it also gives the sum total of specimens occurring of each fabric (bottom line) and the sum total of specimens occurring of each type (extreme right-hand column).

fabrics H	**1**	**2**	**types total**
types H			
IA	117	22	139
B	8	34	42
C	66	4	70
IA-C total	191	60	251
II	5	-	5
III	19	1	20
IV	1	-	1
V	-	-	-
VI	-	-	-
fabrics total	216	61	277

TABLE 30B Dorestad, Hoogstraat IV
Frequency of Carolingian hand-made pottery types and fabrics, and their interrelations; the table is based upon the number of *specimens* represented by *rim sherds*.

Percentages (of specimens). The table shows the numbers of each type occurring in the different fabrics, expressed as percentages of the total number of specimens belonging to the type concerned; it also gives the total number of specimens occurring of each fabric, expressed as a percentage of the sum total of all specimens (bottom line), and the total number of specimens occurring of each type, expressed as a percentage of the sum total of all specimens (extreme right-hand column).

fabrics H	**1**	**2**	**types total %**
types H			
IA	84,2	15,8	50,2
B	19,-	81,-	15,2
C	94,3	5,7	25,3
IA-C total	76,1	23,9	90,6
II	100,-	-	1,8
III	95,-	5,-	7,2
IV	100,-	-	0,4
V	-	-	-
VI	-	-	-
fabrics total %	78,-	22,-	100,-

During the investigation in the riverbed a large quantity of late-medieval sherds were discovered, especially in Hoogstraat III. J. van Doesburg has undertaken the analysis of the greater part of this finds category (chapter VI 1–4). In describing this pottery, the letters lm have been added to the late-medieval types.[53] Again, a distinction has been made between wheel-thrown (w) and handmade (h) pottery.
After completing the manuscript in 2001, our attention once again focused on several pottery types, particularly those made in fabric EM W-2 and 10. The reason for this was the results of the investigation in Tiel. There a distinction was made between Late-Badorf and Early-Pingsdorf ware. It was no longer possible to include this in tables 19A-B, 22A-B, 25A-B, 28 A-B, and consequently figures were put in brackets in these tables, especially in the case of EM W III-2 and 10. This material, including several rims of types W IIIA and C, has been included as Late-Badorf and Early-Pingsdorf pottery. Both these groups will be discussed in chapter VI 1.4

Late-medieval pottery
Their numbers are also shown in the figures of late-medieval pottery (figures 160-4). This new classification could no longer be applied in the tables of the Hoogstraat 0, II-IV rim-sherds (tables 19A, 22A, 25A, 28A).

1.1.1 Early-medieval wheel-thrown pottery
Apart from a few peculiarities in some types, the pottery classified as type W XIII in the last publication deserves special mention. This type contained unusual or unique sherds regarding form, fabric or both elements. When the material was analysed for a second time, as was done in the case of the remaining Dorestad material, there proved to be a

53 If pottery types are referred to in the text without preceding letters, they are always early-medieval material. In some cases the letters em (early-medieval) have been added.

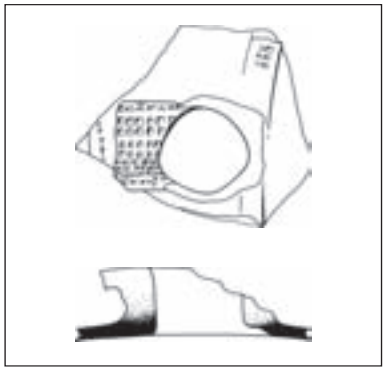


Fig. 93 Dorestad, Hoogstraat IV: pottery type EM W I.

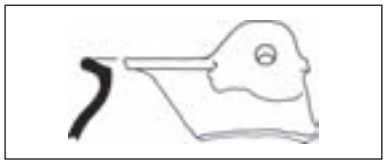


Fig. 94 Dorestad, Hoogstraat II, pottery type EM W IIIB.

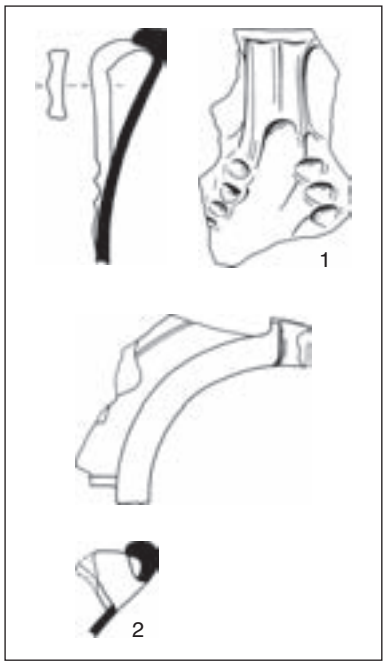


Fig. 95 Dorestad, Hoogstraat IV: pottery type EM W V.

54 Van Es & Verwers 1980, 108–11. Type W XIII: nos. 1–2 (fig. 62: 1–10), 12 (fig. 62: 21–2), 16 (fig. 62: 24).
55 Van Es & Verwers 1980, fig. 46: 7.
56 Rim no. HS-I 15774, originally with the irregular decoration of type d (Van Es & Verwers 1980, 93; fig. 50: 15), is now ascribed to type b.

group of sherds whose form and/or fabric clearly differed from the other Carolingian wheel-thrown pottery.[54] This group will be discussed further with type W XIV.

Types EM WI-XIV

W I *Relief-band amphora* Because of the fragmentary nature of the rim-sherd in fig. 93, the form of the rim is unknown. The vertical collar points to type W IB. Remarkable in this specimen, which has two wide, decorated handles which merge into the rim, is the narrow opening.

W III *Cooking-pot* A rim-sherd of type W IIB had a perforated knob-handle, standing on the rim (fig. 94). A similar handle was already known from type W V.[55] In general, cooking-pots of this type have band-shaped handles, although they are rare.

W V *Medium-sized, flat-based pot* The rim in fig. 95: 1 has the pinched spout characteristic of this type. Remarkable is the presence of a band-shaped handle at right angles to the spout. This handle most probably had a counterpart. It is not known whether there was a third handle opposite the spout. The end of the handle in fig. 95: 2 was decorated in an unusual fashion. Deep fingertip impressions marked the spot where the handle was attached to the shoulder.

W VI *Medium-sized, flat-based pot; decoration* Among the rim-sherds of type W VI which are large enough to show decoration, *c.* 40–50 % of the rim is ornamented, and decoration is lacking on a small proportion (*c.* 11–21 %). The remaining rims are too fragmentary to distinguish whether they are decorated or not.
On the complete specimens of this type, decoration occurs only on the shoulder of the pot, from just below the neck to halfway down the body. In general the ornamentation was applied in several, usually 3–5, horizontal zones.
In order to distinguish various types of decoration, rim- and body sherds are used. Decorated body sherds were ascribed to this pottery type, especially because of the fabric. There is a chance, however, that some decorated body sherds do not belong to type W VI, but to the jug type W XI. This is assumed particularly in the case of wall sherds with decoration types *f* and the combination of *f* and *g*.
A survey of the various types of decoration now follows (fig. 96).

a Horizontal rouletted zones consisting of 2–4 rows of square or oblong impressions in vertical position The single row of rouletting on several sherds may be compared to the ornamentation of the Merovingian biconical pots. Rouletted stamp impressions as usual on Badorf pottery (type W II), consisting of a double row of rouletting, form another decoration pattern on type W VI.

b Horizontal rouletted zones Whereas the square or oblong impressions of type *a* are placed in a vertical position, type *b* shows similar impressions in oblique position. The long sides of the rouletted stamp impressions may vary from a nearly vertical to an oblique position. Under- and upper sides of these stamp impressions are almost exclusively oblique. The pattern seems to have been rather carelessly applied. In contrast to the ware from Hoogstraat I, the irregularly grooved decoration is now included with type *b*, because this irregular type of decoration on several sherds may be considered to be a degeneration of this type.[56]

c Horizontal rouletted bands, consisting of regular triangular and lozenge-shaped impressions They make it possible to recognize intersecting W- and M-figures.

d See type 'b' (Hoogstraat I).

e Horizontal bands of three or four closely set wavy lines On a body sherd from Hoogstraat II the pattern is rather regular. Where the lower line rises, a vertical line is visible. The space at the top is filled with a V.

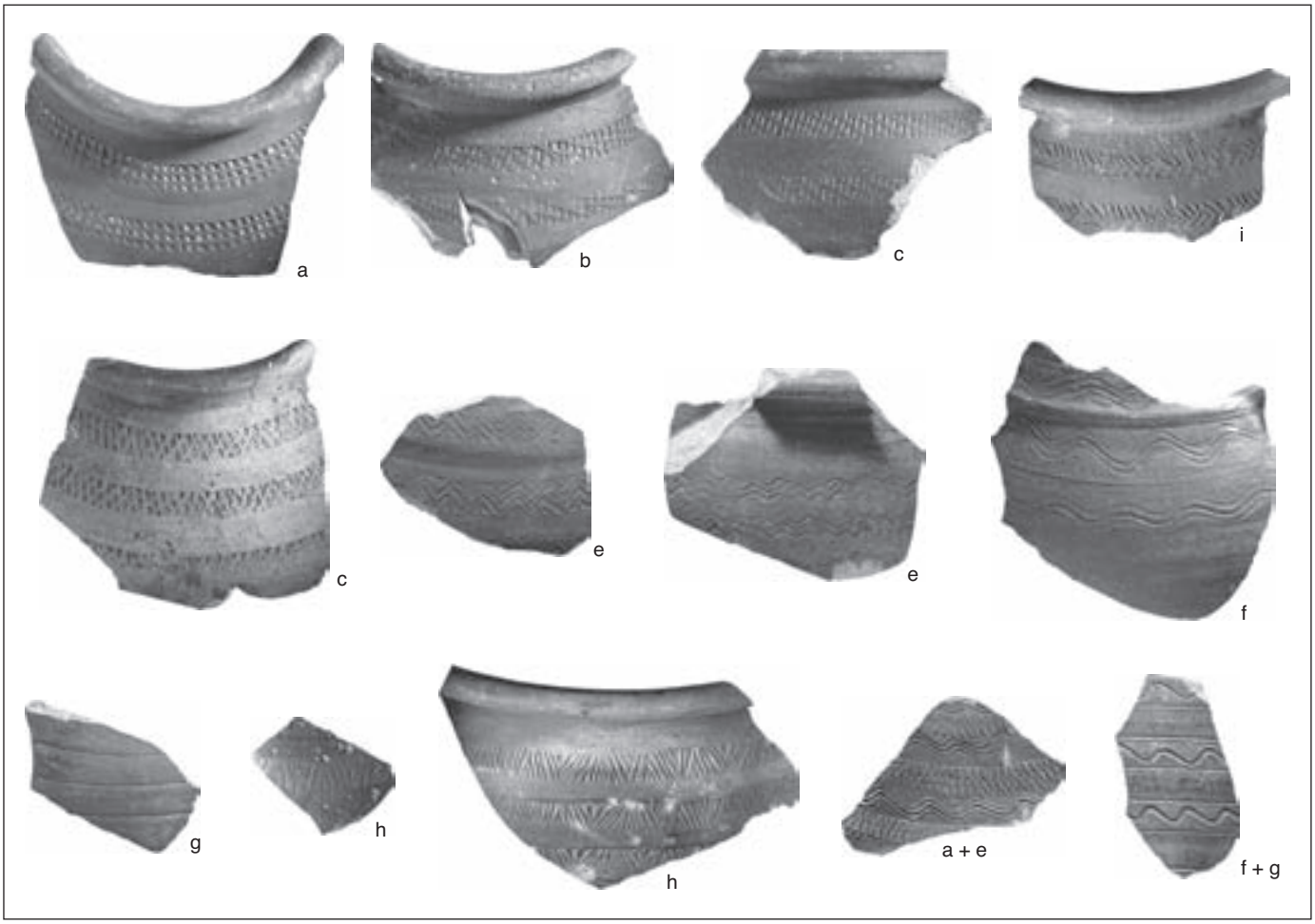


Fig. 96 Dorestad, Hoogstraat 0-IV: decoration on pottery type EM W VI.

f *Horizontal bands of widely spaced wavy lines* Some body sherds which are decorated with bands of several wavy lines may come from jugs of type W VI.

g *Horizontal grooves spread over the shoulder* The sherds from Hoogstraat II decorated with this ornament may be ascribed to fabric W-13.

h *Horizontal bands consisting of a V-shaped pattern* The legs of the V are shaped by several more or less parallel lines.

i *Horizontal bands, consisting of a row of >-shaped figures*

Finally, combinations of decoration types are found: *a–e* and *f–g*.

W VII *Biconical pot; decoration* When descripting the material from Hoogstraat I a classification was made for decorative motifs of type W VII. Because of the relatively large number of sherds found in the Hoogstraat 0, II–IV excavation areas, it was possible to define this classification more clearly. In doing so, use was made of decorated rim- and wall sherds. The latter were difficult to classify according to form; in such a case, the W-16 fabric was decisive for an attribution to type W VII. In the other cases, with fabrics W-1, -2 and -4, the sherds could be attributed to this type on the basis of their form.
As far as the limited number of sherds permitted us to observe, the decoration proved to be on the shoulder exclusively. An exception is a rim-sherd from Hoogstraat III, no. 406.4.1. The decoration consisting of *eingeglättete Linien* (impressed lines) continued on the neck.

The various types of decoration (fig. 97) are listed below.

a *Horizontal rows of rouletting* Alternating with horizontal undecorated zones, and varying in width. The rouletting may consist of single stamp impressions such as the usual decoration on the Merovingian biconical pot (a-1), or may be similar to the Badorf ornamentation: a double row of stamp impressions (cf. a-2). This type of decoration includes short straight lines of rouletting, forming different patterns – for example V-shaped.

b *Decoration with vertical or oblique lines of spatula impressions* On a wall sherd from Hoogstraat II this type of ornament is combined with a decoration of *eingeglättete Linien*.

c *Eingeglättete Linien* Several patterns can be recognized in this type of decoration.

- 1 Vertical or oblique *eingeglättete Linien*, sometimes interrupted by a horizontal groove, ridge, or line. The parallel lines are spread over the shoulder of the pot with more or less equal inter-space. On one wall sherd the lines seem to be placed in groups with different directions. The space between the intersecting groups is filled with small curved lines. On a rim-sherd from Hoogstraat III the decoration continued on the neck, which is exceptional.
- 2 Regular diamond-shaped pattern, covering the complete shoulder. This type of ornament is in one case interrupted by a horizontal groove in the middle of the shoulder. The horizontal ridge as present under the neck of this type caused the diamond-shaped decoration to move towards the middle of the shoulder.
- 3 Diverse patterns. Because of the presence of a spout, the ornament round the spout is difficult to recognize. It is probably a combination of type *c*1 and *c*2. The shoulder of a sherd from Hoogstraat IV is decorated with irregular patterns of intersecting lines, alternated with a ladder-shaped ornament in vertical position. A sherd from Hoogstraat 0 shows vague traces of *eingeglättete Linien*.

d *Grooved decoration* The most simple decoration of this type consists of horizontal grooves on the shoulder. In addition, ornamentation of vertical zig-zag lines also occurs. There are also sherds with a linear pattern of grooves on the shoulder.

e *Round stamp impressions* Three types of round stamp impressions spread over the shoulder are distinguished.

- 1 Circle of more or less trapezium-shaped impressions with undecorated inner zone. This type of decoration is sometimes combined with short straight lines of rouletting, forming different patterns (*cf*. decoration type *a*2). In the Hoogstraat I publication this composite type of decoration was attributed to type C 3. Round stamp impressions in the form of a cross are also ascribed to *e*1
- 2 Rosette stamp impressions. In one case this decoration seems to be combined with a short line of rouletting.
- 3 Diverse stamp impressions. Placed obliquely on the shoulder.

f *Finger-impressions* In general the most frequently represented type of decoration consists of vertical, straight finger-impressions spread over the shoulder. There is some variation in the depth of the impressions. Few specimens show V-shaped impressions on the shoulder. On a wall sherd of Hoogstraat III an impressed horseshoe-shape is added.

W XII *Painted pottery* The painted Carolingian pottery has already been the object of study.[57] However, no attention was then paid to a number of painted fragments from the Hoogstraat excavations. To rectify this omission, the entire collection of painted pottery from the riverbed is shown here (fig. 98–100).

W XIIA *Costrel of Zelzate type* Flasks of the Zelzate type, made of Badorf fabric, were represented in Hoogstraat II and III by three and two rim-sherds respectively, and a number of walls and bases (fig. 98: 2–5). This complex also includes the

57 *Van Es & Verwers 1975.*

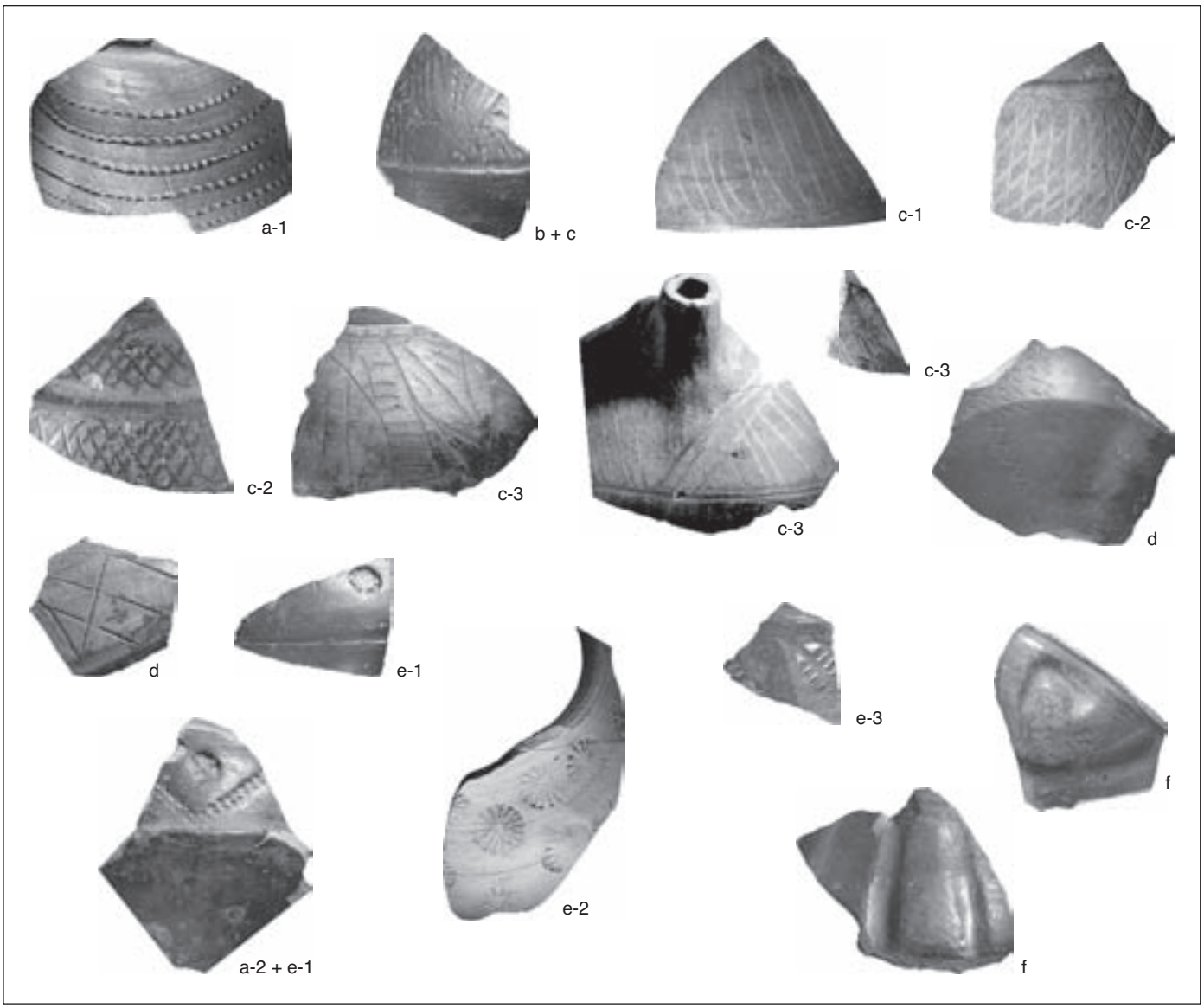


Fig. 97 Dorestad, Hoogstraat 0-IV: decoration on pottery type EM W VII.

undecorated complete specimen from Hoogstraat II (fig. 98: 1). The other two Hoogstraat excavations only produced two wall sherds of this type. The large fragment from Hoogstraat IV, made of EM W-1 fabric (fig. 98: 6), was painted with thick, ferriferous orange-coloured paste, characteristic of this type of pottery. The straight lines of the painted decoration possibly imitate a net made of leather bands or strings (fig. 98: 7–8).[58] This type also yielded other patterns of decoration (fig. 98: 9–18).

W XIIB *Jug* Painted jugs, made of W-6 fabric, were found mainly in Hoogstraat II, and in a smaller quantity in Hoogstraat 0 and III. In this type, obliquely everted rims predominate, and these more or less correspond to those of type W IIIB (fig. 99: 1–8). The rims which are comparable to those of W IIIA, are far less common (fig. 99: 9–12). The decoration consists of watery, almost transparent, orange-brownish red paint (ferriferous paint) applied in various patterns. Occasionally a jug has rouletting (fig. 99: 5).

58 This sherd was not included in the article on the painted pottery from Dorestad: Van Es & Verwers 1975.

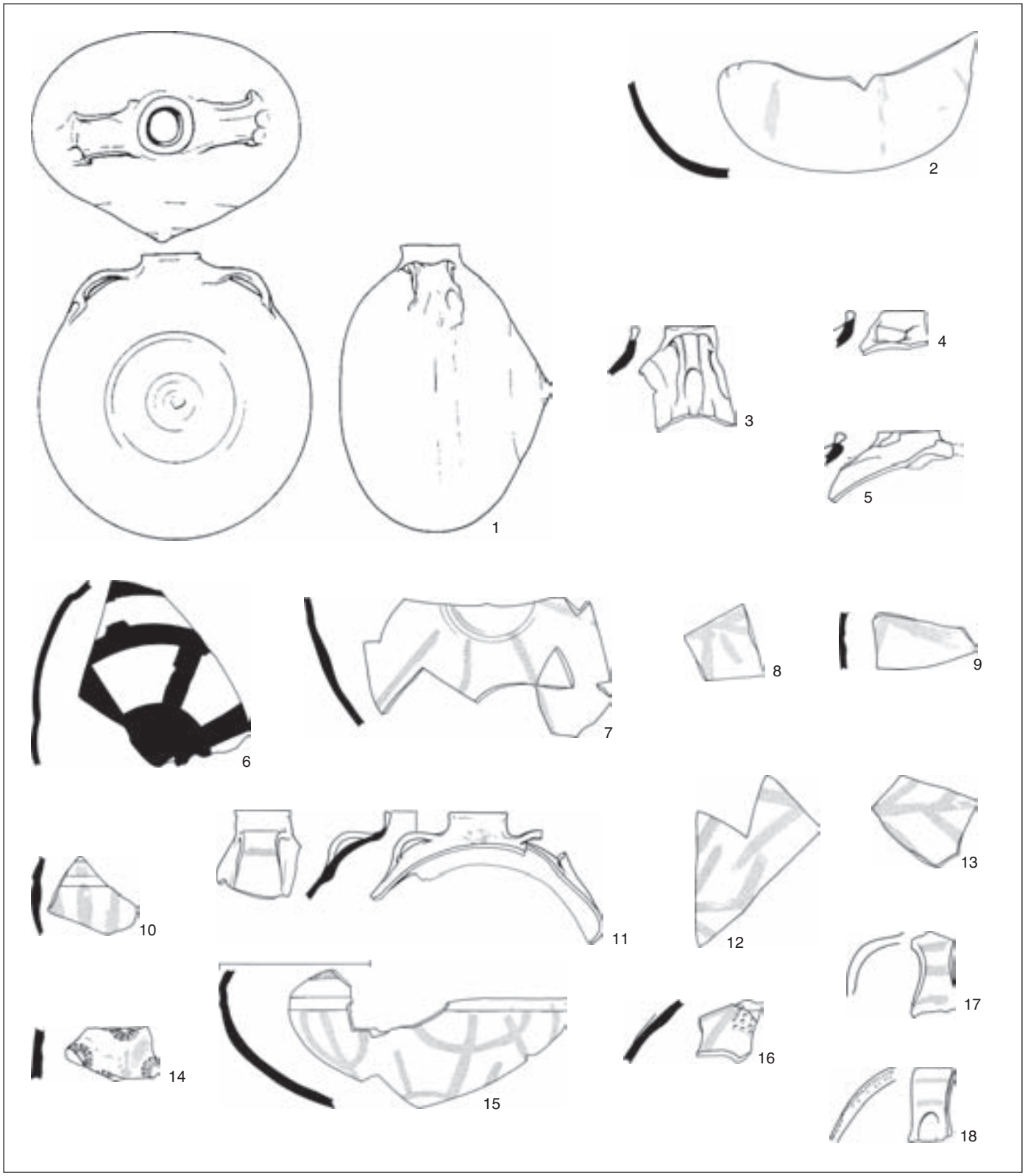


Fig. 98 Dorestad, Hoogstraat IV: pottery type EM W XIIA, painted decoration.

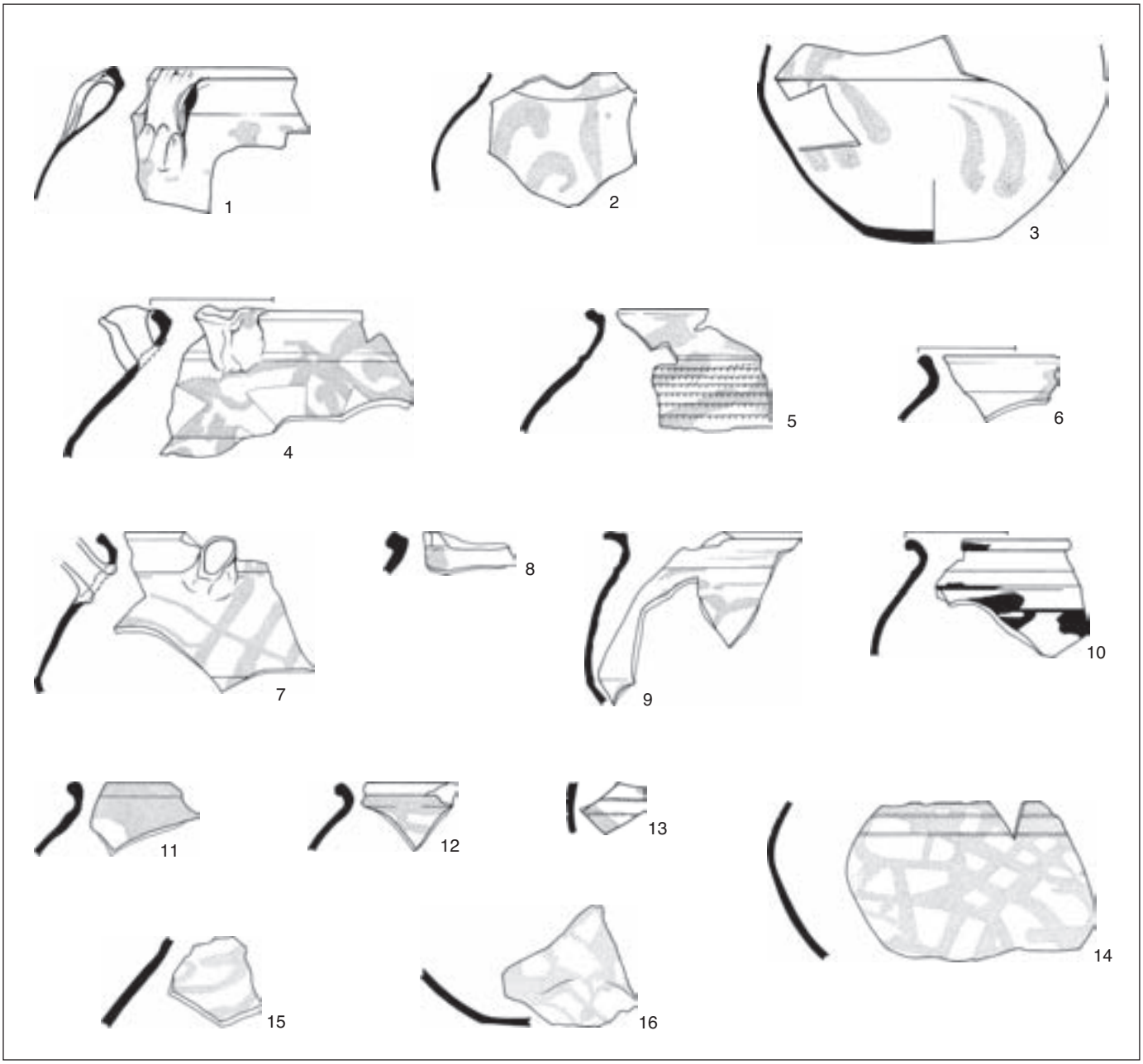


Fig. 99 Dorestad, Hoogstraat IV: pottery type EM W XIIB, painted decoration.

W XIIE *Jug belonging to the so-called Hunneschans type* These are extremely rare. Characteristic of this type are the Badorf fabric, the rouletting and the painted decoration known from type W XIIB (fig. 100: 1).

W XIIF *Pot or jug* From Hoogstraat 0 came a rim-sherd in Badorf fabric which was decorated with vertical bands in which horizontal notches had been applied in a thick paint as also found on flasks of type w xiia (fig. 100: 2). The form of the rim is comparable to other rim-sherds from Hoogstraat 0 (fig. 100: 3–4), which are also made of Badorf fabric and have a thick, pasty painted decoration. Moreover, the handle is decorated with triangular spatula impressions (fig. 100: 5). These sherds possibly belong to a type more or less similar to Dorestad type W VII.

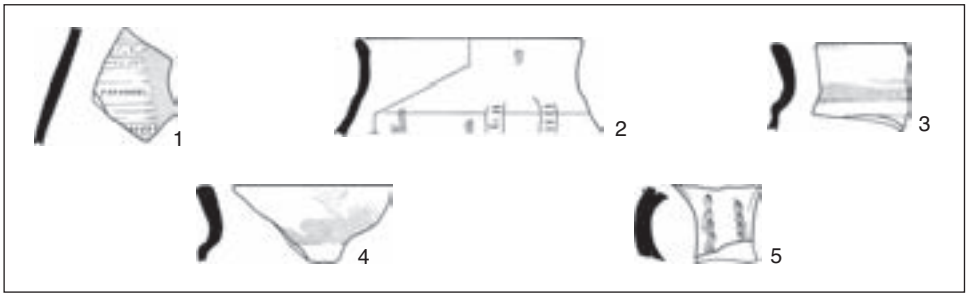


Fig. 100 Dorestad, Hoogstraat IV: pottery type EM W XIIE-F.

The production of costrels began in the course of the 8th century, and that of the Mayen jugs at the end of the 7th century. Based among other things on the early Badorf fabric of one of the sherds, it is possible that the pots or jugs of type W XIIF date from the same period (fig. 100: 2, see below under W XIV).
The Hunneschans pottery can be dated after the middle of the 9th century (see section VI 1.4.1).

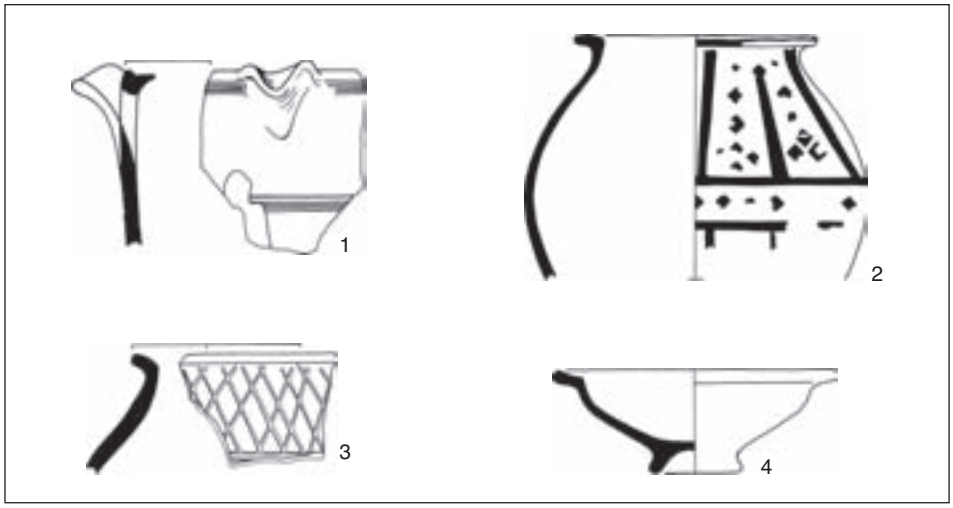
W XIII *Miscellaneous* Early-medieval rim fragments, which cannot be attributed to one of the Dorestad pottery-types EM W I-XII or EM W XIV (see below), have been grouped under this heading. These are often individual sherds of exceptional, or even unique shape or fabric. Only a few of these will be described separately and in some detail.
Attention is drawn to four exceptional rim fragments (fig. 101).

- 1 Rim fragment of steep-walled pitcher in fabric Dorestad EM W-15, the Tating fabric (fig. 101: 1). Details: grooved, horizontally inverted rim; a trefoil spout at the rim; zones of four horizontal grooves on the outside, one immediately below the rim and another one further down the vessel.
- 2 Rim fragment of globular pot (jug?) with so-called Tating decoration in fabric Dorestad EM W-16 (fig. 101: 2). Details: horizontally everted unthickened rim; decoration of applied tinfoil (some of them fallen off), such as: a horizontal strip on the outside of the rim, a frieze of vertical strips alternating with vertical rows of lozenges on the shoulder, two horizontal strips with a row of lozenges in between on the widest circumference.
- 3 Rim fragment of biconical pot in a slightly rough grey fabric (fig. 101: 3). Details: horizontally inverted, unthickened rim; a long, straight shoulder decorated with lozenge-pattern formed by *eingeglättete Linien*; a horizontal groove on the carination.
  In a recently-published study on Tating ware, it appears that the composition of this material clearly differs from the burnished ware of Mayen, which probably corresponds to Dorestad W-16.[59] The article also refers to the presence of forms other than the usual Tating jugs. Deviant forms of Tating ware are not only known from Birka and Medemblik, for Dorestad also yielded an unusual pitcher.
- 4 Bowl. Details: complete (fig. 101: 4); beige, soft fabric and slightly polished; Late-Roman (?).

W XIV *Late-Merovingian or Early-Carolingian pottery* During the analysis of the pottery from Hoogstraat I, a group of rims of wheel-thrown pottery was included under 'type' W XIII which at the time were thought to belong to the Late-Merovingian Period.[60] Special attention was paid to this type of pottery during the analysis of the remaining Hoogstraat pottery. In addition, the pottery from the remaining part of the settlement was examined a second time after a preliminary analysis during the excavation. This examination revealed a large group of pottery which was related to the Late-Merovingian material from Hoogstraat I. A preliminary classification follows.

59 Stilke, Hein & Mommsen 1996.
60 Van Es & Verwers 1980, 108–11; type W XIII, fig. 62: 1–10 and 16–17.

Fig. 101 Dorestad, Hoogstraat 0-IV: pottery "type" EM W XIII.



It should first be mentioned that type W XIV comprises a number of different forms. Pots of this type may be steep-walled, globular or biconical. In addition, so-called flasks, jugs and bowls or dishes are found. There are substantial differences in size. Not only are there small specimens, but also medium-sized and large (storage) pots. The types are as follows:

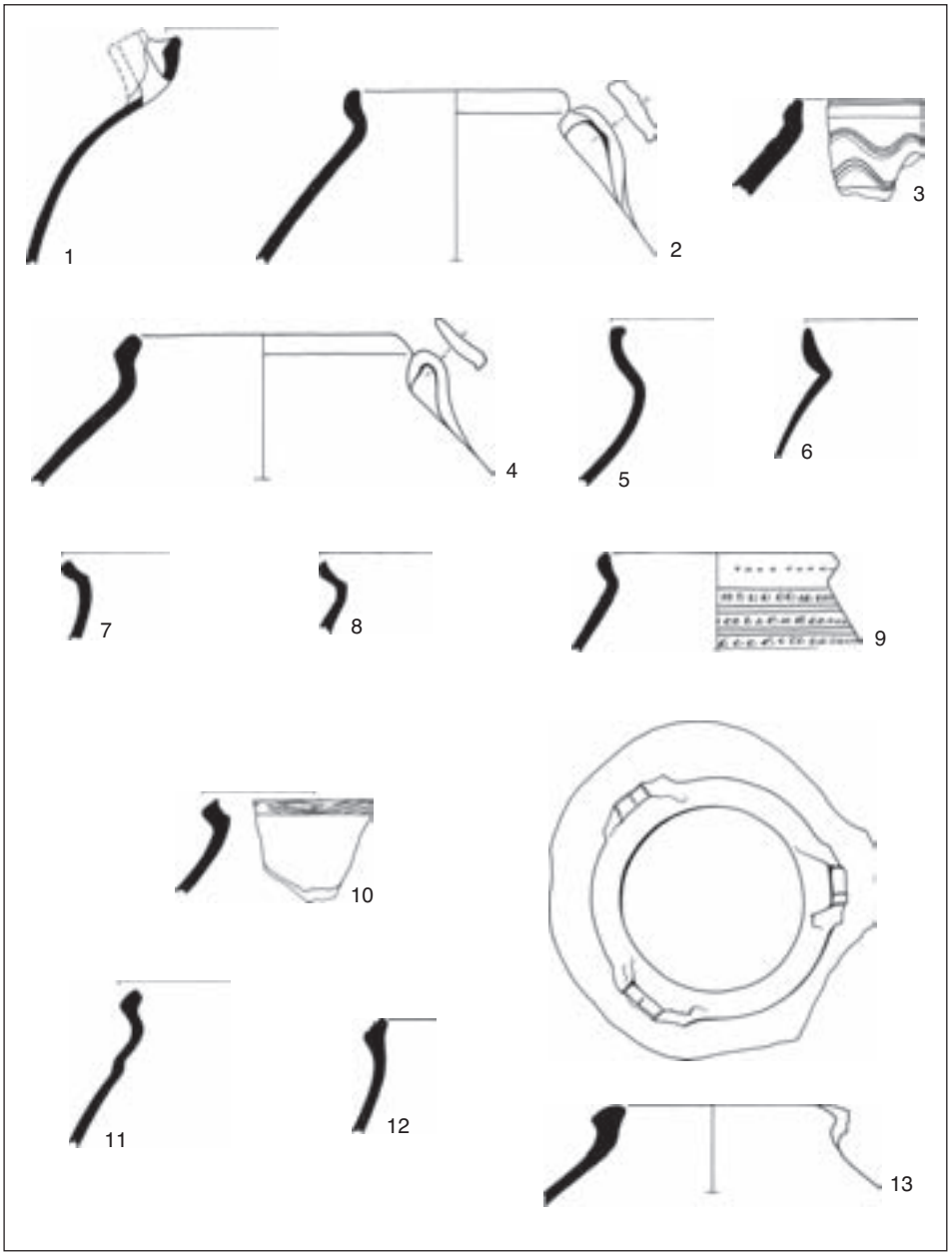
EM W XIVA amphorae;
EM W XIVB globular pots and jugs;
EM W XIVC large storage pots;
EM W XIVD bucket-shaped pots;
EM W XIVE flasks;
EM W XIVF jugs with trefoil or cylindrical mouth;
EM W XIVG biconical pots;
EM W XIVH bowls;
EM W XIVK globular pots with everted rim and ribbed shoulder.[61]

The rim-sherds and one complete specimen found at Hoogstraat I had features which are paralleled among the pots from the well-known Merovingian cemetery of Walsum.[62]
A number of fabrics can be distinguished among these types of pottery. Some show a clear link with the Carolingian fabrics W-1 and W-3, and are consequently classified as such here. Apart from these, two new types of fabric are introduced,W-20 and W-21. The former is generally rough-walled, coarsely tempered and moderately highly fired. The colour is usually dark brown, with all kinds of variants from beige to grey. There is a striking similarity to the rough-walled Merovingian fabrics. The smooth-walled reduced or oxidized fabric of the Merovingian biconical pots is classed as fabric W-21. The different types are now listed.

W XIVA *Amphorae* The Walsum amphorae have a high and slender, ovoid body and a rather long everted neck, which is usually grooved on the inside. As far as is known, these pots have a lenticular base. Two or three band-shaped handles with longitudinal grooves are attached to the outer side of the rim; the handles emerging from just below the rim. This type has been taken to include large, less ovoid, somewhat globular pots similar in form to the Walsum amphorae and with a cylindrical spout (fig. 102: 1). Due to the fragmentary nature of the material it is not always clear whether the rim belongs to an amphora or to a flask. Their rims have similar forms: they may be long or short, vertical (fig. 102: 2–3), inverted (fig. 102: 4) or obliquely everted (fig. 102: 5–10). Sometimes the outside of the rim is flattened

61 To avoid confusion with the numbering of the pottery types in Roman figures, the rim types W XIVI and W XIVJ have not *been used here.*
62 Stampfuss 1939.

Fig. 102 Dorestad, Hoogstraat II-IV: pottery type EM W XIVA.

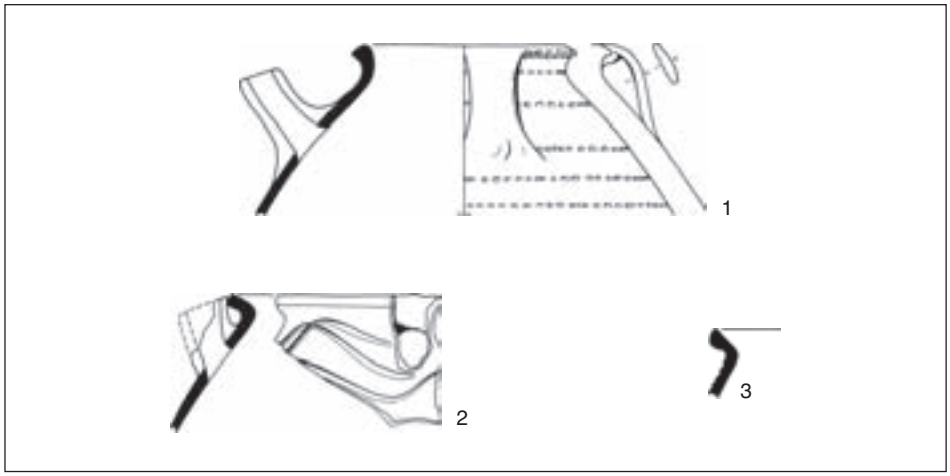


(fig. 102: 11). The lid seating is more or less clearly developed (fig. 102: 7 and 12). In general, this type of pottery is not decorated. Sometimes a decoration of wavy lines or single rouletting is seen on the shoulder.
This type of pottery is mainly found in fabrics W-1 and W-3. The pots of this type can be compared to the *Flaschen* and *zwei- en dreihenkel Krüge* described by Siegmund. Since there are only pottery fragments, it is uncertain whether the Dorestad rims belong to the relatively early or late types. At any rate, type W XIVA can be attributed to Siegmund's phases 10 and 11: the end of the 7th and the beginning of the 8th century.[63]

W XIVB *Globular pots and jugs* This type is represented by medium-sized globular pots and jugs with – as far as can be ascertained – flat bases. The pots greatly resemble the Carolingian cooking-pots W III.

63 Siegmund 1998, 143–50, Phase 10–1: 670–740; Kleeman 1991, Typentafel 24, type 1–2, 309–11, Stufe I–II: 670/80–730/40.

Fig. 103 Dorestad, Hoogstraat 0-IV: pottery type EM W XIVB.



Predominantly short rims are found in type W XIVB. The turned down rim (rim form A of type W III, fig. 103: 1) is well represented in the Dorestad pottery from the settlement, but is less frequently found in the Hoogstraat pottery than the obliquely everted rim (rim form B, fig. 103: 2–3). The pots are almost always undecorated, though occasionally a decoration of wavy lines or single roller stamping is present on the shoulder.
Many pots or jugs have a handle, attached to the outer side of the rim. One has a circular mouth (fig. 103: 1), and two have a tubular spout with a pinched trefoil opening (fig. 103: 2). A few jugs have a horizontally turned down rim, but usually the rather long neck with grooved inner side is everted. Some pots have a cylindrical neck, others occasionally a pinched mouth.
Characteristic of this type are fabrics W-1, W-3 and W-20.
This type can be compared to Kleeman's type 3a, which he dates to the end of the 7th century.[64] Because only rims are available, they can hardly be ascribed to one of Siegmund's *zwei- und dreihenkel Krüge* types, which are dated in his Phase 10 and 11. Since early fabrics predominate (W-3 and W-20), preference is given to the first phase: 670–705.[65]

W XIVC *Large storage pots* These are large globular pots or storage vessels (larger than type W XIVB).[66] There is not a single complete specimen. Most of the sherds of this type have a folded rim resembling the Carolingian W IIA form (fig. 104: 1). Also found are thickened, roll-shaped rims (fig. 104: 2), and obliquely everted rims, some thickened, others not (*cf.* W IIB or W IID, fig. 104: 3). Some pots have a band-shaped handle. Type W XIVC is made of fabric W-1, W-3 or W-20. The decoration consists of rows of single or double rouletting, horizontal grooves or wavy lines.
An unusual group, made in a deviant coarse sandy fabric, has straight or obliquely everted rims flattened at the top. In this group the colour orange with a grey break predominates. This type was not found in the Hoogstraat excavations.
The large globular pots, which are much thicker walled, belong to a variant of type W XIVC.
The rims mainly consist of forms W IIB and -D. Most of the specimens have rouletting. Outside the settlement area on the riverbank this variant was only found in Hoogstraat I.[67] Although there are no parallels which could provide a date for type W XIVC, it is assumed that this type came into use at the end of the 7th century and remained in use until into the 8th century.

W XIVD *Bucket-shaped pots* The bucket-shaped pots have a steep-sided body, generally with a flat base. Most of the rims are unthickened and turned down.

64 Kleeman 1991, Typentafel 24, type 3a, 311–312; Stufe I: 670/80–700/10. His remark that type 3b can be compared to Dorestad type W III-W VI (p 313) must be an error.
65 Siegmund 1998, 147–50.
66 Several sherds from Hoogstraat I belong to this type: Van Es & Verwers 1980, fig. 62: 1–7.
67 Van Es & Verwers 1980, 108–10, fig. 62: 6–7.

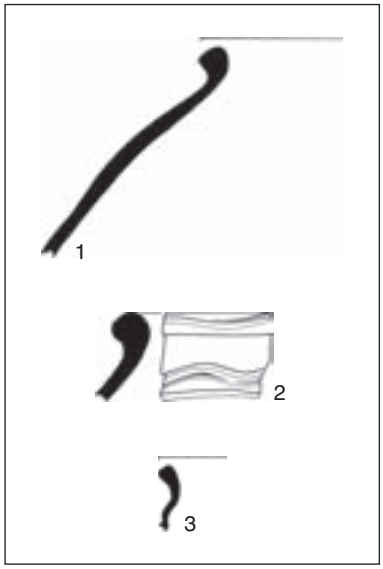


Fig. 104 Dorestad, Hoogstraat 0-IV: pottery type EM W XIVC.

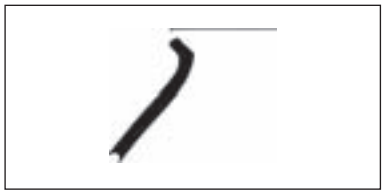


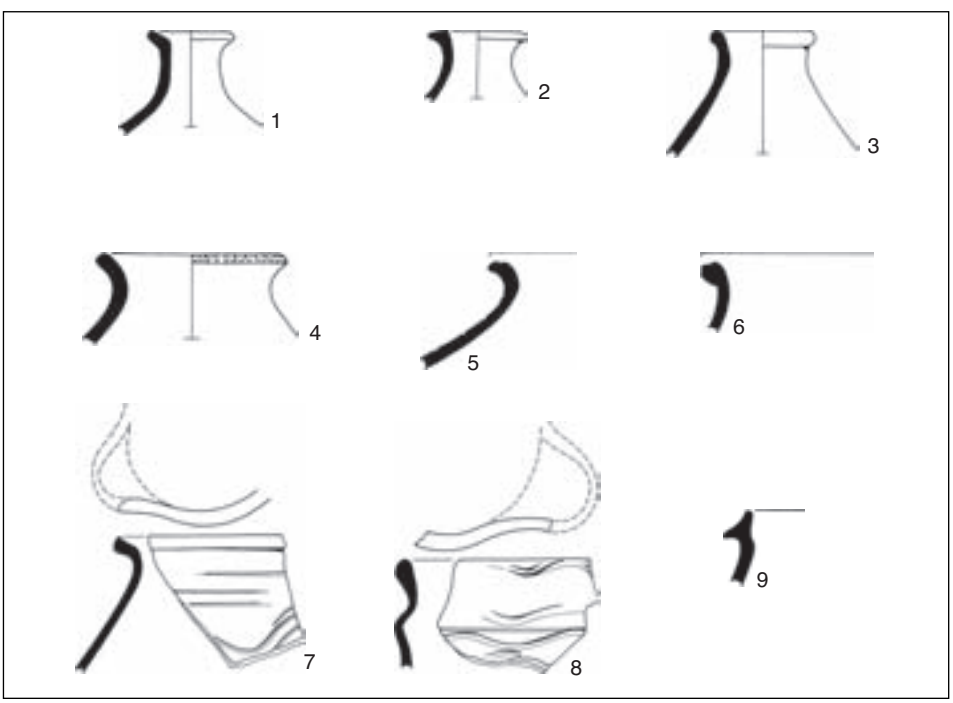
Fig. 105 Dorestad, Hoogstraat 0-IV: pottery type EM W XIVD.

Fig. 106 Dorestad, Hoogstraat 0-IV: pottery type EM W XIVE.

Several sherds have an obliquely everted rim with a vague lid seating (W XIVB). In type W XIVD fabric W-20 predominates (fig. 105). This type, which we consider to be the predecessor of the Carolingian type W IXA, belongs to the so-called *Wölbwandtöpfe*. The Dorestad specimens correspond to Siegmund's types 2.21 and 2.22. A special feature of these is the width of the base. The narrower ones date from phase 10 (670–705), and the broader ones from phase 11 (705–740). No distinction in the dating can be made on the basis of the form of the rims, which came from the Hoogstraat excavations. Since this type mostly occurs in fabric W-20, it is assumed that it was in use mainly in the second half of the 7th century.[68]

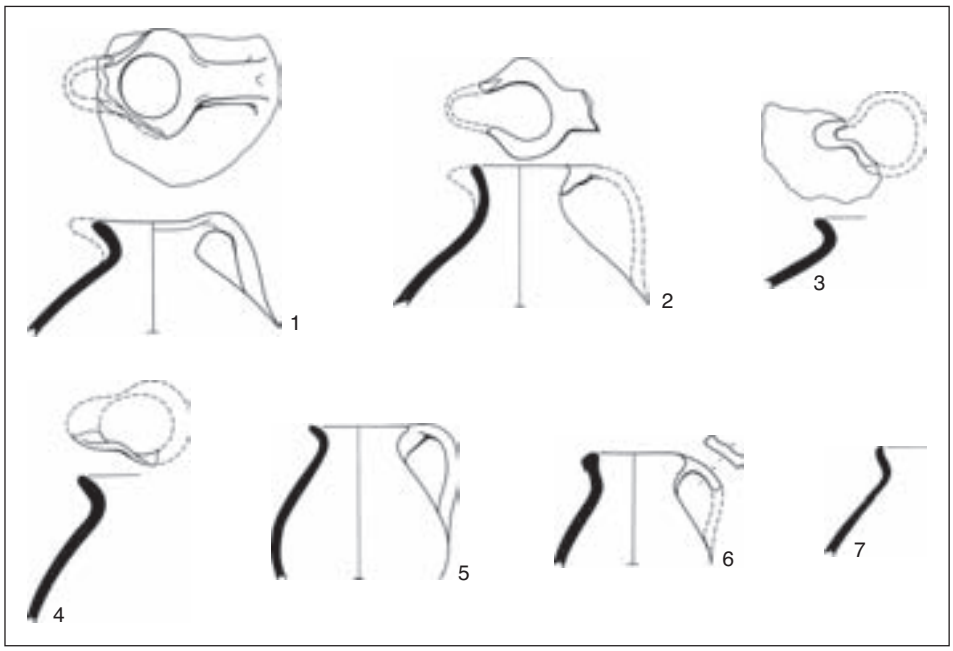
W XIVE *Flasks* Two variants can be distinguished: narrow- and wide-mouthed flasks. The first has a rim diameter of less than 5 cm (fig. 106: 1–3), while that of the wide-mouthed variant is larger than 10 cm (fig. 106: 4–7). The rim may be flattened or obliquely everted, or it may be thickened and – occasionally – grooved on the inside. Unusual rim forms are shown in figure 106: 8–9. The type is made in fabrics W-1, W-3 and W-20.
The narrow-mouthed flasks from the Hoogstraat excavations are not decorated. The wide-mouthed flasks are occasionally decorated with horizontal grooves, wavy lines or rouletting.
The same distinction into narrow- and wide-mouthed flasks was also made by Siegmund. He dates the former in phase 8 (605–640), possibly 9 and 10 (resp.: 640–670 and 670–705), and the second in 11 (705–740).[69]

W XIVF *Small, rough-walled jugs with trefoil or circular mouth* The type is represented by 7 rim fragments, made in fabric W-20 (fig. 107). As far as can be established, all had a globular body. The handle was attached to the rim on the outside. Although a complete jug is lacking, there are indications that this type is related to the Krefeld-Gellep type 151, which is dated to around the transition from *Stufe* II to III, *c.* 525.[70] Such an early dating is not likely because of the absence of other early finds. Siegmund dates *Kleeblattkannen* with globular body in phase 8 (605–640).[71] There is also an affinity with type Böhner D3 belonging to the 7th century.[72]



68 Siegmund 1998, 142–3. See also for example: Stampfuss 1939, Tafel 13: 10, Tafel 21: 6–7.
69 Siegmund 1998, 143–6.
70 Pirling 1966, 139–40.

Fig. 107 Dorestad, Hoogstraat 0-IV: pottery type EM W XIVF.



W XIVG *Biconical pots* One rim fragment of a biconical pot with a straight shoulder: decorated with rouletting and horizontal grooving; a vague *Wulst*; sharp transition from belly to shoulder; fabric W-21 (fig. 108: 1). According to Siegmund's classification, these pots were not found until the beginning of *Phase* 7, at the earliest, and certainly in *Phase* 8, respectively: 585–610, 610–640 or slightly later.[73] A rim-sherd from a relatively narrow-mouthed biconical pot with a straight shoulder on which there was horizontal grooving, without *Wulst*, shows some similarity to type EM W VII-1. Because of its Badorf fabric this sherd appears to be slightly younger than the biconical pots: possibly end of the 7th or beginning of the 8th century (fig. 108: 2).

W XIVH *Bowls* Some of these coincide in shape with Dorestad type EM W XD which has a globular body with a flat base and an obliquely everted rim (fig. 109).

W XIVK *Globular pots with turned down rims and grooves on the shoulder* Included in this type are the globular pots similar in size to W III. There is no complete specimen. The overall shape must have been the same as Dorestad type W III. Two rim shapes occur, which are reminiscent of types W IIA and -B, respectively. The snout-shaped rim of the W IIA type may have a curved or flattened upper side. There may be a groove on the inside of the rim and in these cases the rim is usually sharply triangular in section (fig. 110: 1–8). The other rim type, comparable to that of W IIB, is parallel-sided and everted; it may be grooved on the inside (fig. 110: 9–11). The characteristic feature of the type is the ribbed or undulating shoulder. The undulation may take the form of sharp and pronounced ridges, but can also be flatter. Pots of this type have flat or lenticular bases. The type was made in Dorestad fabrics W-1 and -3. Ornamentation occurs rather frequently.
The following motifs are found.

a Rouletting consisting of one or two horizontal rows of rectangular impressions; on rim and shoulder (fig. 110: 11).

b Rouletting in narrow bands of lozenge-shaped impressions; on rim and shoulder (fig. 110: 1).

71 Siegmund 1998, 150–1, type Kan 1.2.
72 Böhner 1958, 51–2.
73 Siegmund 1998, 131, type 3.22 and 3.2.

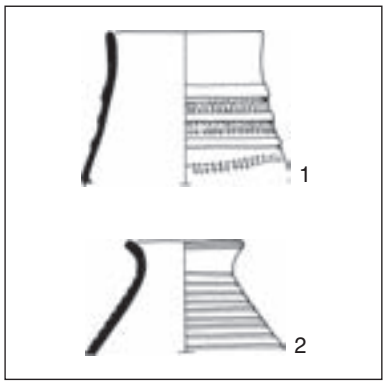


Fig. 108 Dorestad, Hoogstraat 0-IV: pottery type EM W XIVG.

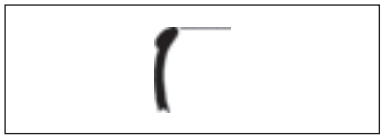


Fig. 109 Dorestad, Hoogstraat 0-IV: pottery type EM W XIVH.

Fig. 110 Dorestad, Hoogstraat 0-IV: pottery type EM W XIVK.

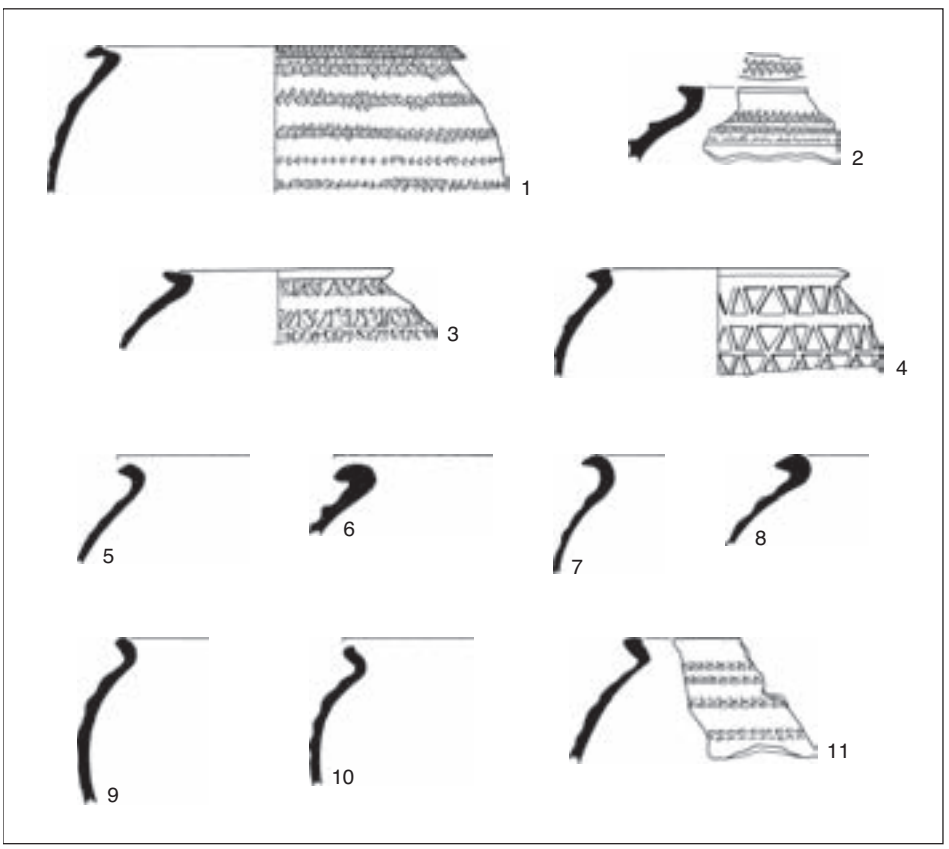
c Rows of incised triangles or oblique notches suggesting a triangle pattern; on the shoulder (fig. 110: 3-4).

About 30 % of the rim fragments is decorated. Pattern *b* is reminiscent of pattern *c* found on Dorestad type W VI (p. 141-2).

There is no independent dating evidence. The date will correspond to that of Dorestad types W IIA and -B.

The dating scheme of early-medieval wheel-thrown pottery drawn up for Hoogstraat I has been adopted here for the other Hoogstraat excavations.[74] However, some alterations and additions to it need to be made. These are mainly to do with the earliest and the last phases of settlement. In determining the beginning of settlement, recognition of type W XIV and fabric W-20 played an important part (table 31); characteristic of the end is the presence of Pingsdorf (-like) pottery.

For the dating of the Late-Merovingian material, use was made, among other things, of Siegmund's study. In the analysis of the Merovingian pottery, he distinguishes three groups of fabrics which are characteristic of certain types of pottery. One of these is the rough-walled fabric which is found in a number of forms.[75] We have compared it with Dorestad fabric W-20. This fabric is actually a range of fabrics with a number of specific elements: highly fired; usually coarsely tempered; rough-walled; dark brown/grey/beige in colour; rather thick-walled. Some forms in the Merovingian rough-walled fabric are very similar to several types in category EM W XIV. These may also be made in fabrics W-1 and W-3. Other EM W XIV types somewhat resemble the globular pots of Dorestad type EM WIII. An obvious difference is that they were not manufactured in a Carolingian fabric but in a fabric referred to by us as W-20. As far as this kind of pot is



74 Van Es & Verwers 1980, 152, fig. 80.
75 Siegmund 1998, 119–20.

TABLE 31 Dorestad, Hoogstraat 0, II, III, IV
Specification of type W XIV, numbers of rims of the various 'subtypes'.

subtype	HS-0	HS-II	HS-III	HS-IV
W XIVA-1	5	6	8	11
W XIVA-3	1	3	-	2
W XIVA-20	-	-	-	-
W XIVB-1	1	1	1	1
W XIVB-3	8	5	2	2
W XIVB-20	1	1	-	1
W XIVC-1	2	4	10	-
W XIVC-3	3	8	3	5
W XIVC-20	3	4	3	1
W XIVE-1	-	2	1	1
W XIVE-3	-	2	-	-
W XIVE-20	-	1	2	-
W XIVF-1	1	-	1	-
W XIVF-3	-	-	-	-
W XIVF-20	2	4	1	-
W XIVG-1	-	-	1	-
W XIVG-21	-	-	-	1
W XIVK-1	2	5	6	1
W XIVK-3	-	2	8	3
W XIVK-4	1	-	1	-
total	30	48	48	29

decorated, the decoration is to be found on the shoulder and consists almost exclusively of horizontal rows with single roulette impressions. No precise date can be given for fabric W-20. On the basis of the forms, manufactured in a Merovingian fabric, it is assumed that fabric W-20 was in use from the second half of the 7th century until the beginning of the 8th century. The nature of the decoration also points in this direction.

Apart from rough-walled Merovingian sherds, the Hoogstraat excavations have also yielded Merovingian biconical pottery. Siegmund's study has provided additional information for dating this material. In the Lower Rhine area around Düsseldorf biconical pots are mainly found up to and including phase 8 (610–640 AD) and sometimes even in phase 9 (640–670 AD).[76] This means that type EM W XIVG-21 was not manufactured after AD 670.

Siegmund divides the Badorf ware into a *Badorfer Machart* group and a *Niederrheinische Nachahmung* group. His research showed that the latter type of pottery came into use in phase 10 (670–705 AD). Two kinds of fabric are distinguished among the Badorf *Machart* pottery. One of these is characterized by its moderate hardness and not too fine, dense tempering. In our opinion, this refers to the Old Badorf pottery.

To explain the term Old Badorf pottery, we return once again to the cemetery of Walsum.[77] This cemetery played an important part in the dating of Badorf pottery. The fabrics of the pots excavated in the cemetery of Walsum show a considerable degree of variation. Tischler (1952) distinguished at least three fabrics among this material: his fabrics I (imitation of Böhner's *Vorgebirgston*), II (imitation of Badorf ware) and 2 (real Badorf ware). The 'imitations' would have been made in production centres somewhere along the Lower Rhine. Tischler's fabric 2 may be equated with Dorestad fabric W-1. Consequently, his fabric II would be an imitation of genuine Badorf ware.

The situation is complicated by the fact that Tischler also uses the same denotations in a typological sense, even with a chronological meaning. Used in this way, *Gruppe* II comprises all flasks – which are always slender – the tall jugs, a few tall and slender amphorae, and also a few wide-mouthed bucket-shaped pots. Group II is also called earlier Badorf ware (*ältere Badorf Produktion*).

76 Siegmund 1998, 120–35, types Kwt 2.43, 4.3, and 4.52.
77 Stampfuss 1939.

The pots attributed to *Gruppe* I are not only distinguished by their fabric, but also by their more rounded, less slender shape. This group contains narrow-mouthed buckets, some bowls, and particularly the more globular (*bauchige*) amphorae. It is implied that group I is the earliest one in the Walsum cemetery.
In contrast to group II, *Gruppe* 2 is characterized as later Badorf ware (*jüngere Badorf Keramik*). The latter term is used by Tischler in a chronological sense: group 2 is the latest of the three; at least that appears to be the implication. At Walsum, group 2 is rare; only one specimen is mentioned: lower part of pot in grave 18 (not illustrated by Stampfuss). From a typological point of view, however, group 2 does not have a strictly defined meaning. It covers the pot types attributed to group II, but also the classic Badorf types of Dorestad series EM W II – and in fact also EM W I (relief-band amphorae). It must be granted that this is all rather confusing.
Admittedly, Tischler will have grasped the general trend in the development of the Late-Merovingian wheel-thrown wares. It has often been observed that, from the 7th century onwards, Merovingian pots tended to become taller, and this tendency may have grown more marked as time went on. But the clear-cut typological and chronological division between groups I and II, as advocated by Tischler, strikes us as being slightly over-sophisticated. It would certainly be surprising if two pottery groups which are so closely related in shape, could be proved to occur without any overlapping in a cemetery whose duration was relatively short. Walsum was used for no longer than a century, and as far as we can see, definite proof that the two groups were sharply separated in this cemetery, is hard to come by. Stampfuss' earlier attempt to work out a typological classification of the Walsum pots, mainly on the basis of their rim profiles, must be considered to have failed completely. To give just one example: a typologically early jug in grave 6, which is now known to be relatively late within the cemetery. For the time being it is advisable not to try and divide up the Walsum pottery complex, but to take it as an undivided – typological and chronological – group.
Another question which arises in this context is whether Tischler's fabric II, which occurs frequently in the Walsum group, should really be defined as an *imitation* of genuine Badorf ware (Tischler's fabric 2: Dorestad W-1). Both fabrics are certainly akin, but it seems possible, even likely, that the former was the precursor of the latter.
The original absolute dating of the Walsum cemetery by Stampfuss in the period from (shortly before) 700 to at least 775, but possibly even to some time after AD 800 cannot be maintained. We share Stein's view (1967) that it was certainly in use between *c.* 680 and 750, though an even earlier beginning in about AD 650 is conceivable. The same applies to the final dating which could be at the beginning of the 8th century, on the basis of the virtual absence of group 2, real Badorf ware, and other factors.
Pottery of type(s) EM W XIV reached our study area in phase 10 (AD 670–705). The finer and more densely tempered pottery, also belonging to Old Badorf ware, appeared at the transition from phase 10 to 11, around 705. Since the original Badorf must be older than its imitation(s), the genuine Badorf is assumed to have made its first appearance in about AD 670.[78] This date links up closely with our statement on the dating of the Badorf material from Hoogstraat I. On the basis of the dating of Madelinus coins to the second quarter of the 7th century, it was assumed that the Old Badorf pottery was manufactured in the second half of the 7th century. Thanks to Siegmund's research, we can now be a little more specific. The genuine Badorf pottery appeared in the middle of the 8th century.[79]

1.1.2 Early-medieval handmade pottery
Types EM H I–VI (figs. 111–5)
H IA-B *Kugeltopf* A peculiarity encountered once in the Hoogstraat I material on a *Kugeltopf* pitcher of type H IA-1, was a spout.[80] The shoulder of pots with rim types H IA and -B, made in fabric H-2, had a similar spout (fig. 116: 1–2).

78 *Siegmund 1998, 227–8.*
79 *Van Es & Verwers 1980, 77–8.*
80 *Van Es & Verwers 1980, fig. 64: 23.*

H VI *Miscellaneous* Rims from Hoogstraat II and III have a fragmentary bar lip (fig. 117). Under the lip, at an angle, there was a small hole which appeared to have been deliberately made.

Decoration on handmade pottery
Various types of decoration were observed on the handmade pottery.

a Several types of stamps

1 Round stamp impressions are the most numerous. The inner part and the size of the stamps show variation (fig. 118: 1–5). Because the material is fragmentary, the pattern of the decorations is hard to distinguish. Apart from individual stamp impressions (fig. 118: 1–2) the decoration may also consist of a horizontal row of stamp impressions (fig. 118: 3–4). On another rim-sherd at least four stamps are grouped (fig. 118: 5).

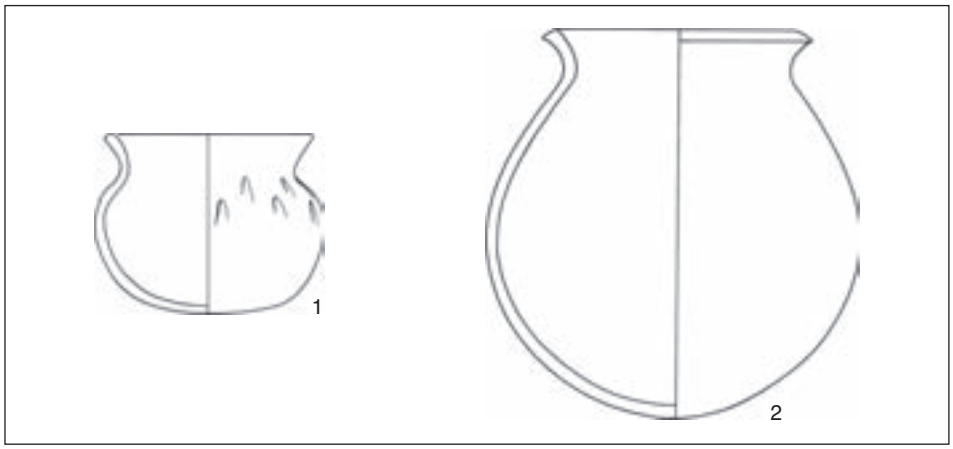


Fig. 111 Dorestad: pottery type EM H I; 1 small model.

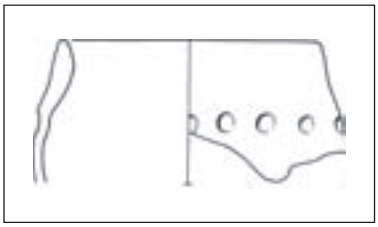


Fig. 114 Dorestad: pottery type EM H IV.

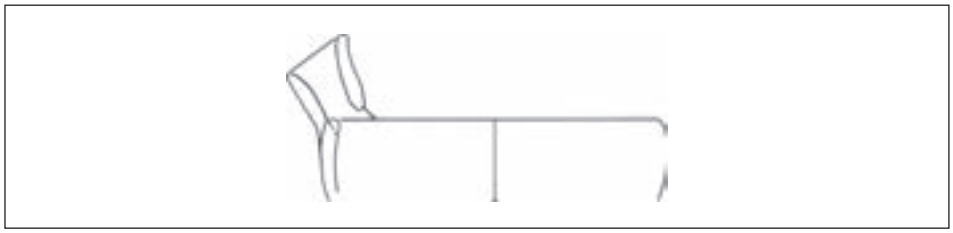


Fig. 112 Dorestad: pottery type EM H II.

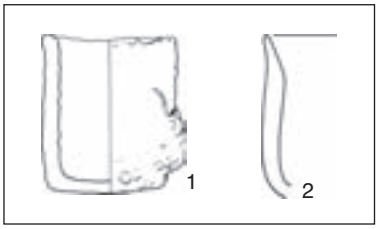


Fig. 115 Dorestad: pottery type EM H V.

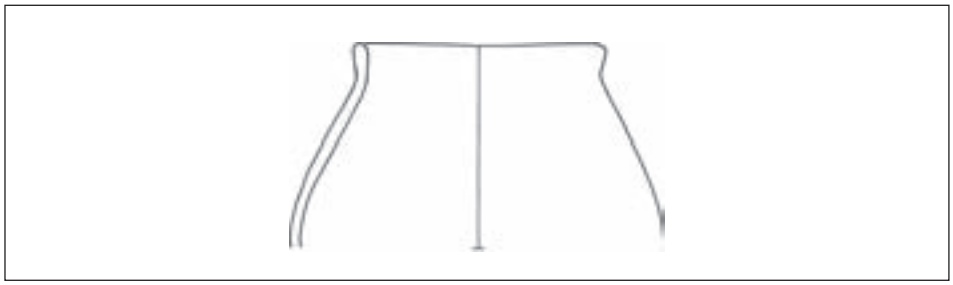


Fig. 113 Dorestad: pottery type EM H III.

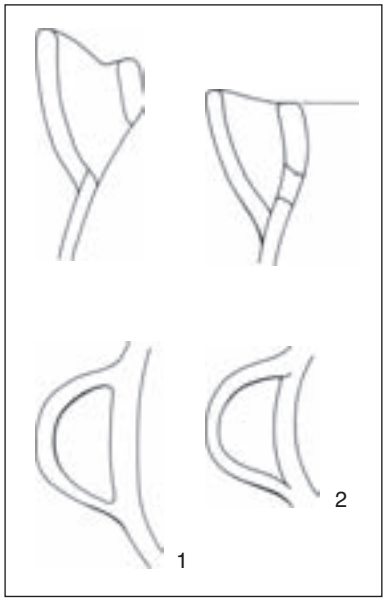


Fig. 117 Dorestad: pottery type EM H VI.

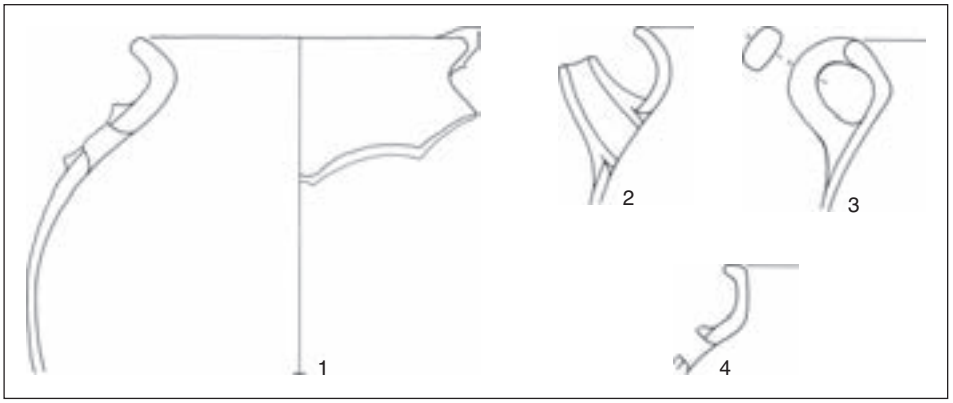


Fig. 116 Dorestad: pottery type EM H IA-B, pitcher.

2 Square stamp impressions with an inner part similar to *a*1. A rim-sherd from Hoogstraat II shows two alternating rows with this type of decoration (fig. 118: 6).
3 Triangular stamp impressions ('church window', fig. 118: 7–8). The stamps are placed in a horizontal row (fig. 118: 7) or individually in a random position.
4 Rectangular stamp impressions (fig. 118: 9).

b Spatula impressions
Triangular or square in shape, in horizontal and vertical rows (fig. 118: 10–2).

c Wavy lines (see figure 118: 13).

d Fingertip impressions

1.2 Roman pottery

A small amount of Roman material was discovered in the Hoogstraat excavations. Of this, pottery was by far the largest group, and consisted almost exclusively of Roman imported wheel-thrown pottery: 44 rims and 101 wall and/or base fragments. Of the rims, more than half came from Hoogstraat III. The majority of the *terra sigillata* originated from workshops in Eastern Gaul, but sherds from Southern Gaul and Argonne were also found. The high percentage of rims of this type of pottery is striking: 44 % (19 specimens). Although these were stray finds, the percentage would appear to indicate the possibility of a military camp in the vicinity.[81]
The following types of wheel-thrown pottery are represented:

- terra sigillata, 19 rims	Drag. 27, 31, 32, 37 and 40;
- terra nigra-like, 8 rims	Stuart 1963, type 201 and 210; Holwerda 1941, type 141/2; Bloemers 1978, type I/II; Bloemers 1978, type 793; lid;
- colour-coated, 3 rims	Stuart 1963, type 1B and 2; Brunsting 1937, type 5;
- smooth-walled, 5 rims	Brunsting 1937, type 4, 5c and 20;
- thick-walled, 1 rim	
- coarse ware, 7 rims	Stuart 1963, type 201; Oelmann 1914, type 89; Brunsting 1937, type 20.

The earliest imported Roman pottery dates from the end of the 1st century AD, though the emphasis lies on the 2nd and beginning of the 3rd century. The odd sherd can be dated to the 4th century. Generally speaking, the dates of the Roman material correspond to the data from Hoogstraat I.[82] Only four fragments of handmade material were found.Finally, dozens of Roman tiles and loom-weights were discovered. Four of the tiles bore stamps in relief letters. Three of the stamps are read as: EXGERINF, set in a rectangular frame (fig. 119: 1–2), one of which with a ligature (fig. 119: 3).[83] The text of the fourth stamp is: PRIMACORT (fig. 119: 4).[84]

81 Verwers 1998, 117–9, table 21.
82 Van Es & Verwers 1980, 125–6.
83 cf. Holwerda 1923, 103: 21a.
84 Bogaers 1974.

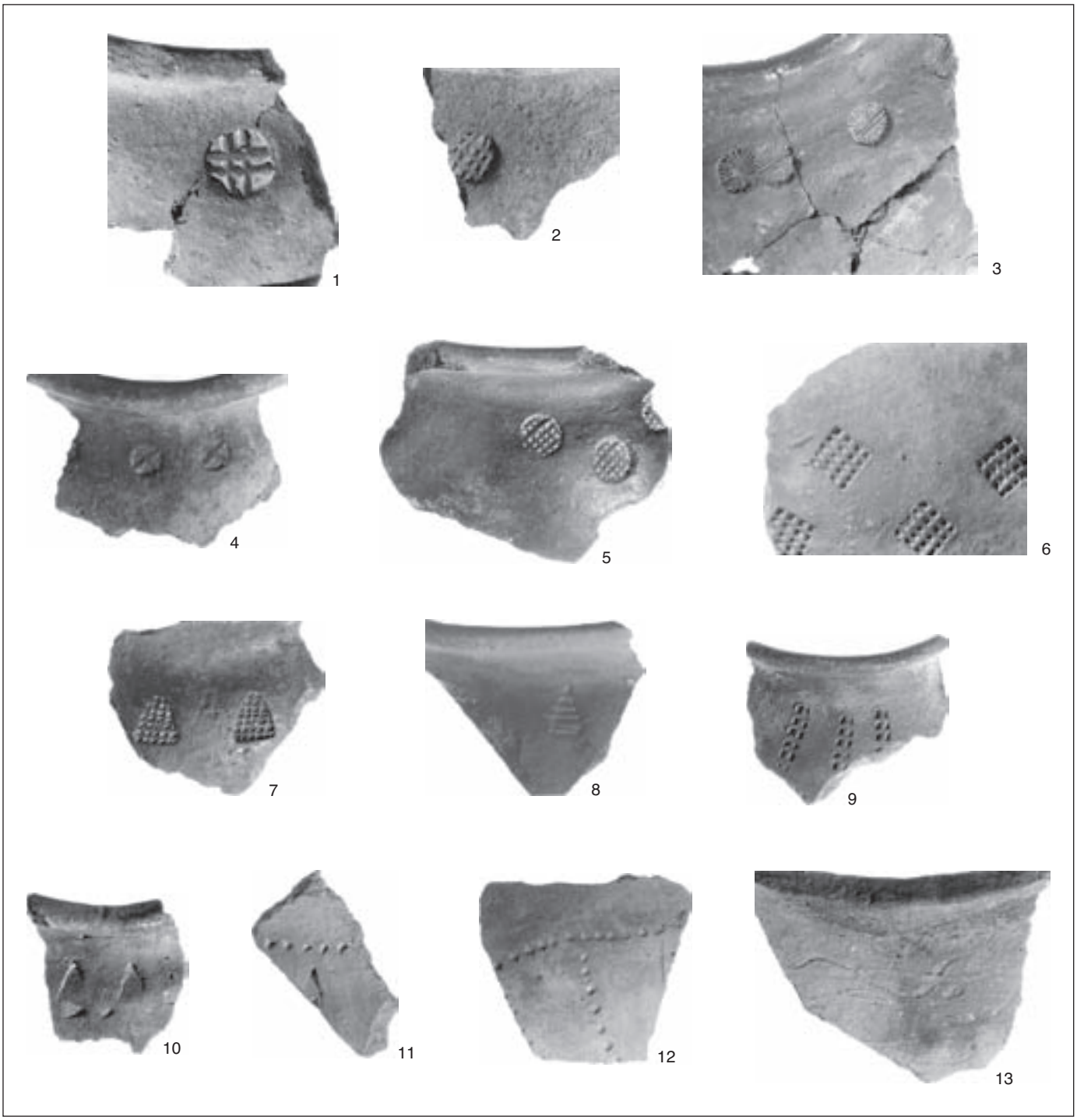


Fig. 118 Dorestad: decoration on hand-made pottery.

1.3 Merovingian pottery

Miscellaneous

Three rim-sherds could be Merovingian, but this is very uncertain. They are: rim of pot with everted, grooved neck (fig. 120: 1); rim of shallow bowl (fig. 120: 2); rim of pot with vertical neck (fig. 120: 3). The former two are in a fabric comparable to Dorestad W-13; the fabric of the latter resembles Dorestad W-1.

Between the wooden revetments excavated at a deep level in Hoogstraat II (chapters II 2.1 and VII 2.7) whose radiocarbon dating indicated the middle of the 7th century, a rough- and thick-walled Merovingian sherd was found, which originated from a steep-walled pot with a thickened and folded rim (fig. 120: 1).

Fig. 119 Dorestad: stamps on Roman roof tiles.

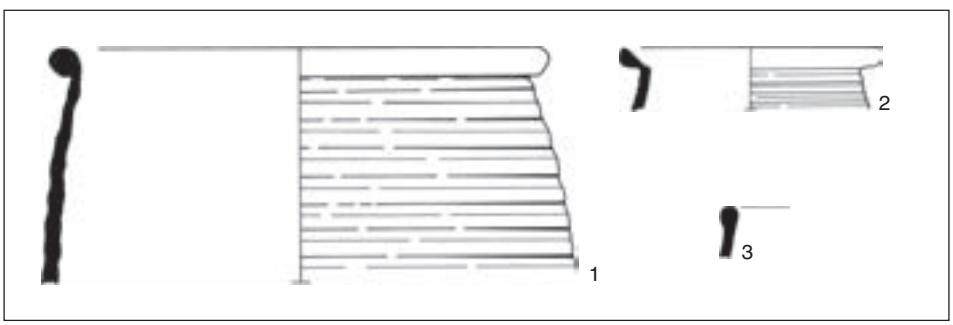


Fig. 120 Dorestad: Merovingian pottery.

1.4 Late-medieval pottery
J. van Doesburg

Late-medieval pottery was discovered in a number of places in the riverbed area, especially in Hoogstraat III. Only a small amount came from settlement traces such as wells, pits and trenches. The majority of the late-medieval pottery was recovered from various fluvial deposits in the old bed of the Kromme Rijn. Interestingly, the pottery collected from the sedimentary layers in the riverbed often covered a period of several centuries. Almost all the layers contained both relatively early, often Late-Carolingian or 10th-century sherds as well as fragments of later pottery types. There were hardly any closed pottery complexes with a relatively short period of use. Most of the late-medieval layers also contained older sherds. The percentage of Carolingian pottery was occasionally higher than that from the period in which the layers were deposited, indicating that the find material was very mixed. The reason for this lies particularly in the (post-) depositional processes which took place on the site. There is strong evidence in Hoogstraat III, in particular, that sections of the sedimentary layers dating from the Carolingian Period were eroded in a later phase. This is evident from the profiles, among other things (see chapter II 2.4). The Carolingian pottery recovered from the late-medieval layers was moved from its primary context. This is also evident from the fact that a large proportion of the material has a weathered surface and rounded off fractures. Some of the late-medieval pottery has also been eroded. This can be seen not only from the weathered appearance of the sherds, but also from the fact that various sherds from different layers in the same excavation trench, and even sherds from different excavation trenches, can be fitted together.[85]
Since there are hardly any closed find-complexes in the Hoogstraat excavations and the majority of the pottery was shifted from its primary find complex and became mingled with other, often younger material, the late-medieval sherd material recovered is only to a certain extent suitable for typo-chronological analysis. In addition, there are hardly any hard dating facts available, apart from dates obtained on the basis of comparison with other, well dated pottery complexes. Against this background, the late-medieval pottery is regarded as one big find complex and is treated as such, with the exception of pottery from features where the issue of find material being mixed poses far less of a problem. Nevertheless, the late-medieval pottery found in the Hoogstraat excavations has one advantage over most other pottery complexes, namely that it contains relatively large numbers of sherds including several almost complete pots.

The classification of late-medieval pottery presented below is largely based on the sherd material found in Hoogstraat III. The other Hoogstraat excavations produced relatively little late-medieval pottery, with the exception of Hoogstraat I whose material has already been published.[86] However, several rim forms which were lacking in Hoogstraat III but which were represented in one of the other excavations in this area have been added.
For the classification of the late-medieval pottery as much use as possible, was made of the pottery types mentioned in the literature.[87] Late-Badorf and Early-Pingsdorf pottery are the exception. Until recently, these pottery types were usually classified as Badorf,[88] but in recent publications a distinction is made between these types and the older, more 'classic' Badorf ware. Various terms are used in the literature for these pottery types. Possibly the so-called *engobierte Badorfware*, which we know from various German and Dutch (late-) 9th-century find-complexes, can be attributed to Late-Badorf.[89] Some researchers use the term Carolingian-Pingsdorf ware (*karolingische Pingsdorfware*) for Early Pingsdorf.[90] The former is less suitable

85 Sherds which fit: finds nos. 402.2.33 and 406.4.1; finds nos. 406.3.21 and 407.2.23; finds nos. 406.4.1 and 406.5.22.
86 Van Es & Verwers 1980, 127–33.
87 In the description of the pottery, the problem of the names of the various types will not be dealt with. It is generally known that when Badorf or Pingsdorf pottery is referred to this does not automatically imply that the material actually originated from the Badorf or Pingsdorf kilns in Germany, but that this is a common designation for a type of pottery with certain characteristics. See: Janssen 1987; Heege 1995; Sanke 2003.
88 The same also applies to the publication of the material in Hoogstraat I, where both pottery types are combined under fabric EM W-10. Van Es & Verwers 1980, 57.
89 Among others: Cologne-Heumarkt, Bonn-Postcarrée and -Scandic-Hotel, Zülpich-Sinzenich, Mönchengladbach-Wanlo, Burg Friedestrom in Zons, Emden, Tiel, Kerk Avezaath, Deventer-Noordenbergschild, Zutphen-Stadhuis. Sanke 1999, 255–6.
90 Sanke 1999, 255.

than the latter term because it embodies a chronological aspect that is not altogether correct. As we shall see below, Early Pingsdorf pottery is only found in the Late-Carolingian Period.
The classification of the late-medieval pottery differs from that of the early-medieval material from Dorestad which is mainly based on fabric (EM W-1 up to and including W-18) as well as form (EM W I–XIV). The main reason for this is that, in the case of late-medieval material, the differences in tempering, hardness and colour between the types of pottery are generally too small to permit a reliable subdivision into groups of fabrics. Only in the Pingsdorf ware was the variety of fabrics (macroscopic criteria: hardness, tempering, surface treatment and colour) wide enough for a subdivision into various groups of fabrics.
Following the terminology used in classifying the early-medieval pottery in Hoogstraat I, two groups of pottery have been distinguished: wheel-thrown (W) and handmade (H) pottery.
- Wheel-thrown: Late-Badorf, Early-Pingsdorf, Hunneschans, Pingsdorf, Duisburg ware, Maasland ware, Whiteware, proto-stoneware and stoneware.
- Handmade: *Kugeltopf* ware, Paffrath, Pingsdorf, Elmpt and Jyte pots.
The fabrics are indicated by an Arabic numeral (1, 2, etc.), preceded by capital letters LM (Late Medieval) and W (Wheel-thrown) or H (Handmade). The pot forms or types differentiated within the groups of fabrics have a Roman number (I, II, etc.) after LM and W or H. On the basis of the various rim forms, subtypes can be distinguished, and these are referred to by a capital letter (A, B etc.). A complete class mark may therefore appear as follows: LM W IA-2 (the fabric designation is at the end).
It is not always easy to establish the difference between Carolingian and late-medieval pottery. This applies particularly to certain types of pottery which are closely related as far as the fabric is concerned, such as (Late-) Badorf and the earliest painted Pingsdorf ware. These types of pottery are the same colour and both have a fine sand tempering. Undecorated wall sherds, in particular, cannot, or only with difficulty, be attributed to one of these two pottery types, especially when the surface has been weathered as a result of transportation by water. The possibility cannot, therefore, be excluded that some sherds of (Late-) Badorf ware have been wrongly attributed to Pingsdorf ware and vice versa. With pottery types which were still in use in the Late-Carolingian Period and, like Eifel ware, hardly changed with regard to rim and pot forms as well as fabric, it is not always clear whether individual sherds should be classified as (early) late-medieval or Late-Carolingian. Late-Carolingian Eifel ware *Kugeltöpfe*, are only sporadically found among the material in Hoogstraat III, in contrast to (early) late-medieval specimens which occur in relatively large numbers. The fact that this pottery type also occupies a modest place in other contemporaneous settlements, such as Tiel and Deventer, shows that this is not a misrepresentation caused by the lack of diagnostic features.[91] However, this does not exclude the possibility that some of the late Eifel pottery may have been erroneously classified as type EM W III. Some types of pottery, including Hunneschans ware, are difficult to recognize, certainly in the case of undecorated fragments. Hunneschans ware comes from the same production centres in the German Rhineland as does Late-Badorf and (Early-) Pingsdorf ware, and is therefore scarcely distinguishable from them as regards fabric. It is possible that some undecorated or weathered sherds of Hunneschans pottery have been erroneously classified as Late-Badorf or Pingsdorf ware, though their number is few.

91 Bartels, Oudhof & Dijkstra 1997, 8–9; Dijkstra 1998, 28–9, fig. 14; Van Doesburg & Bakker 1999, 30–1, fig. 19.

1.4.1 Late-medieval wheel-thrown pottery

Late-Badorf ware

Various early-medieval pottery centres in the German Vorgebirge region, including Badorf, Eckdorf and Walberberg, are known to have produced Badorf pottery until into the Late-Carolingian Period. It was also manufactured in the neighbouring centre Brühl-Pingsdorf.[92] This pottery-making centre is mainly known for the production of painted Pingsdorf ware which developed from the 10th century. Badorf pottery is only found there among material from the oldest phases of production. Despite the fact that the Late-Carolingian Badorf ware was manufactured in the same kilns as the 'classic' Badorf ware, which was massively represented in Dorestad (see chapter VI 1), minor differences exist between the two. These are mainly visible in the fabrics. The Late-Badorf fabrics are generally harder than the EM W-1 and 2 fabrics, and consequently do not feel chalky but smooth. The colours of the fabrics also differ from those of the 'classic' Badorf ware. In the latter group, white and yellowish fabrics predominate. By contrast, the vast majority of Late-Carolingian Badorf ware is yellowish-orange, light brown or grey in colour on the inside as well as the outside. Sometimes the outside has orange-like streaks. The core is often darker in colour than the in- and outside of the pots. The tempering corresponds to that of the older material, and consists of fine sand (up to 0.1 mm), with or without pottery grit or soil aggregates (up to *c.* 1 mm).

On the basis of the macroscopic differences observed in the fabrics it is possible to differentiate the later pottery, manufactured in the Badorf tradition, from the 'classic' Badorf ware and to describe the former here as a separate pottery-type. The term 'Late-Badorf ware' is used here for this type. The name refers on the one hand to the provenance and origin of this type of pottery, namely pottery manufactured in the Badorf tradition, and on the other hand it contains a chronological component to distinguish it from the 'classic' Badorf ware, but more on this later.

The range of forms of Late-Badorf ware more or less corresponds to that of the older Badorf pottery, although small-sized pots (EM W IV) appear to be lacking among the younger material. Most are relief-band amphoras (EM W I) and Badorf vessels (EM W II), and to a lesser extent, cooking-pots (EM W III, see chapter VI 1.1.1.).

Relief-band amphoras

In particular, the relief-band amphoras of Late-Badorf ware are easily distinguished from those of the Carolingian Period. They generally have a 3- to 4 cm-high, un- or slightly thickened upright rim which is substantially taller than in type EM W IB.[93] Sometimes the rim is obliquely everted. On the basis of complete specimens from, among other places, Tiel-Koornmarkt,[94] Neuss-(church of) St. Quirinus,[95] Trier,[96] Xanten-(church of) St. Victor,[97] and Duisburg-Hamborn,[98] it may be concluded that the form of the relief-band amphoras gradually changed from ovoid to cylindrical. In addition, the type became larger and taller in the course of time. The volume of relief-band amphoras showed a sharp increase, especially in the 9th- and in the first half of the 10th century.[99] The 11th-century specimens are often over 75 cm in height. To what extent this is connected with a change in function is uncertain.[100] In contrast to the older early-medieval Badorf-ware amphora, the rim usually has four wide strap handles. These handles often project several centimetres above the upper edge of the rim. They are often decorated with bands of rouletting, though handles decorated with grooved lines and undecorated handles also occur. The decoration on the relief bands is almost exclusively rouletting (Dorestad decoration type *b*). Relief bands with finger impressions are only incidentally found (Dorestad decoration type *e*).[101] Relief-band amphoras with rouletting on the body of the pot as well as on the relief bands (hybrid form EM W I/II), constitute a very small group among the Late-Badorf ware.[102] Both types appear to date mainly from the

92 Janssen 1987, 80–94, 97–101; Sanke 2003.
93 For an outlined survey of the development of relief-band amphoras, see Giertz 2001. Further, for the existing rim forms: Bader 1962; Binding 1971; Van Es & Verwers 1985, 26, fig. 2: 1; Treling 1986; Van Heeringen 1995, 153, fig. 104, 155, 108: a–c; Proos 1996, 146, fig. 7; Dijkstra 1998, 30–1, fig. 16, 17; Van Doesburg & Bakker 1999, 33, fig. 21: 1–2.
94 Dijkstra 1998, 30–1, fig. 16:1, 2 and 5, fig. 17.
95 Aldenkirchen 1882; Borger 1965, 15–27; Giertz 2001.
96 Hussong 1936; Hussong 1939.
97 Bader 1955, 72–4; Bader 1962, 204–6.
98 Binding 1971.
99 Giertz 2001, 270, appendix 1.
100 Giertz 2001, 259.
101 Van Heeringen 1995, 155, fig. 108.
102 Van Heeringen 1995, 155, fig. 108: d; Dijkstra 1998, 30, fig. 15: 3.

Carolingian Period. The roulette decoration is often applied more roughly on Late-Badorf specimens than on early ones. Sometimes different bands of rouletting overlap and intersect. The relief bands are relatively thin and narrow, compared with those from the Carolingian Period, and are even hardly in relief since they were flattened and smeared out after attachment to the body of the pot. As a result, the rouletting is often partly obscured or even completely erased, and the bands are triangular in section. This tendency of flattening the relief bands reached its peak in the 11th century. On the youngest relief-band amphoras of Late-Badorf pottery the relief bands have been reduced to faint elevations on the walls. They are still recognizable because they bear bands of rouletting.[103] We still occasionally find 12th- and 13th-century (relief-band) amphoras. These are made of grey-firing pottery and only have a rudimentary roulette decoration.[104]
The patterns formed by the bands also differ from those of type EM W I. Generally speaking, the motifs on relief-band amphoras of Late-Badorf ware are more complex than those on the older, Carolingian specimens.[105] The amphoras often have a relief-band ornament on the upper half of the body of the pot. This decoration consists of two or three zones of several connected or intersecting semi-circular arcs, or of vertically or diagonally placed bands.[106] The zones are bordered by continuous horizontal strips. Often the various bands are combined to form extremely complicated decorative motifs. The bands often continue to below the maximum diameter of the belly.
A rim from a Late-Badorf relief-band amphora was discovered in the Dorestad riverbed area. It came from the Hoogstraat I excavation, and is described as a representative of type EM W ID.[107] Several sherds with relief-band decoration from Hoogstraat III can be attributed to Late-Badorf ware on the basis of their fabric and the finish of the bands. The sherds are tempered with fine sand and are orange-red in colour on the in- and outside; the core is grey.

Badorf vessels
Apart from relief-band amphoras, medium-sized Badorf vessels also occur in Late-Badorf ware (type EM W II).[108] This group consists of medium- to narrow-mouthed jars (type EM W IIx) and narrow-mouthed pitchers (type EM W IIy). The medium- to narrow-mouthed jars have a thickened or unthickened everted rim similar to that of types EM W IIA and D (fig. 121: 1–2); occasionally there is a shallow lid seating. The narrow-mouthed pitchers have a long, more or less cylindrical neck and a slightly thickened rim. The upper side of the rim is often rounded off; sometimes a slight lid seating is found there on the inside. This type of rim appears to be a continuation of type EM W IIC. In both pot types the upper and outer side of the rim and the uppermost part of the wall bear a single or double roulette decoration in horizontal bands.
Several rims of Badorf vessels (type EM W II) of Late-Badorf ware were actually found in Hoogstraat III. These were both narrow-mouthed pitchers (type EM W IIy), and medium-mouthed jars (type EM W IIx, fig. 121: 1-2). The narrow-mouthed pitchers have a relatively long, cylindrical neck and rim profiles corresponding to those of type EM W IIC. They also demonstrate an affinity to several rims of paint-decorated Pingsdorf spouted pots from Hoogstraat III (*cf.* fig. 130: 2–4). The rims of the medium-mouthed jars also strongly resemble those of Carolingian predecessors of type EM W IIA. However, on closer inspection they do differ somewhat from this type of rim. They are just a little rounder and thicker, but the differences are very slight.
The Late-Badorf vessels are yellowish-orange, light-brown or grey in colour on the in- and outside; the core is often darker. The clay is tempered with fine sand.
Some sherds have roulette decoration on the rim and on the shoulder. The rouletting consists of single or double horizontal rows of square or triangular stamp impressions (decoration type *b*).

103 Dijkstra 1998, 31, fig. 17; Kleij 2000, 109–10.
104 Giertz 2001, 261-3, Abb. 13.
105 cf. Van Es & Verwers 1980, 63–5.
106 cf. Dijkstra 1998, 30 (fig. 16), and 31 (fig. 17); Giertz 2001, 246–7.
107 Van Es & Verwers 1980, 68, fig. 27: 4.
108 Sanke 2003, 184–5.

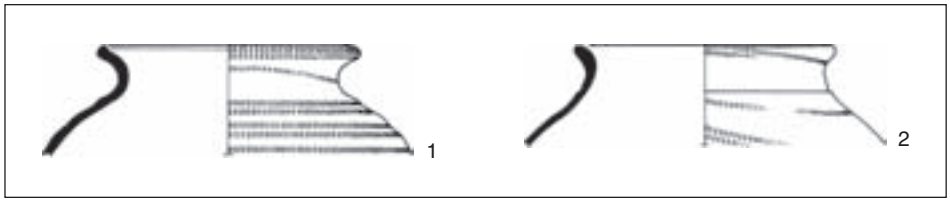


Fig. 121 Dorestad, Hoogstraat II: Late-Badorf pottery.

Cooking-pots
Globular cooking-pots of Late-Badorf ware are incidentally found.[109] Apart from the fact that their fabric is harder and smoother than their predecessors of type EM W III, the later cooking-pots are characterized by slightly different rim profiles. These are usually thickened, rounded or triangular in section, and everted. Angular or rectangular rims are rare.
Rims of Late-Badorf cooking-pots were not found among the material from the Hoogstraat excavations. It is not clear why this pot type did not occur here, in contrast to other parts of Dorestad where it was found.

Chronology Late-Badorf ware is represented both in the Late-Carolingian horizon in Eckdorf, Badorf and Walberberg, and among the oldest material from the kilns of Brühl-Pingsdorf. These finds demonstrate that the production of this type of pottery continued until the end of the 9th century, at any rate, and possibly even longer.[110] Of particular importance in this respect is the Late-Badorf material manufactured in Brühl-Pingsdorf, for it marks the *beginning* of the production of Pingsdorf pottery, in contrast to other production centres between Cologne and Bonn where this type of pottery represents the *final phase* in a long pottery-making tradition. It was manufactured there in large numbers and in a wide area during the High Middle Ages. The first production phase in Brühl-Pingsdorf (period 1), which is dated in the third quarter of the 9th century, largely consists of pottery manufactured in the Badorf tradition. In this period, both relatively soft, whitish and yellow fabrics – which we would typify as Late-Badorf ware – and hard fired, stoneware-like, dark fabrics – referred to in the classification of the Dorestad material as Early Pingsdorf ware – were found alongside each other. Late-Badorf ware was still produced in period 2, and roulette decoration was still present when painted pottery made its entry. This period marks the end of roulette decoration and is a prelude to the production of pottery decorated exclusively with orange-red paint in period 3. On the basis of several well-dated contemporaneous find complexes, the transition from period 2 to period 3 can be dated around the beginning of the 10th century, possibly to about 900.[111] After period 3 no Late-Badorf ware was manufactured in Brühl-Pingsdorf, with the exception of relief-band amphoras. These were produced there at least until the middle of the 11th century (period 4).[112]
The youngest datable finds of relief-band amphoras are sound vessels which were installed in the walls and floors of churches apparently in order to improve the quality of the acoustics. In St. Victor's cathedral at Xanten a barrel-shaped relief-band amphora with a tall rim was found underneath a clay floor, with an absolute date of 1081–1083.[113] Until several years ago, this find was, chronologically speaking, somewhat isolated. However, in recent years, several find complexes have been excavated in Utrecht-Lange Lauwerstraat and Tiel-Koornmarkt and Tiel-Tol, among other places, which can be dendrochronologically dated to the second half of the 11th century. These also include fragments of relief-band amphoras.[114] It is even possible that in view of their sturdy construction, relief-band amphoras were used even longer, and may sporadically turn up in even younger contexts.
This chronological development can roughly be traced in various contemporaneous pottery complexes in the Netherlands, such as those from the

109 Van Doesburg & Bakker 1999, 33, fig. 21: 6; Sanke 2003, 184–5.
110 Janssen 1987, 81–94; Sanke 2003.
111 Sanke 2003, 180–1.
112 Janssen 1987, 45–6; Sanke 2003, 180–1 and 186–7.
113 Bader 1962.
114 Treling 1986; Dijkstra 1998.

old town centres of Tiel,[115] Deventer[116] and Zutphen,[117] as well as from Oost-Souburg,[118] Medemblik,[119] and Kerk-Avezaath.[120] Of particular importance here is the Late-Badorf ware excavated at various sites in the present town centre of Tiel, since this material comes from pottery complexes which can be relatively precisely dated on the basis of the vertical stratigraphy and the dendrochronological dates. Late-Badorf pottery was found in large quantities at the Koornmarkt and Tol-Zuid excavations. Only Pingsdorf ware is found here in even greater quantities.[121] A relatively large amount of Late-Badorf pottery was recovered especially from the oldest features and layers. This consisted mainly of fragments of relief-band amphoras (EM W I) and, to a lesser extent, of Badorf vessels (EM W II). Surprisingly enough, small cooking-pots (EM W III) were relatively scarce. This is possibly linked to the fact that this type of pot was mainly produced in the period that preceded the rise of the trade settlement Tiel. After the middle of the 10th century, Late-Badorf ware is hardly found in the pottery complexes of Tiel, with the exception of relief-band amphoras which continued to be used until into the 11th century.[122] This confirms the idea that Late-Badorf pottery was no longer manufactured around 950; it was replaced by Pingsdorf ware.[123] Late-Badorf relief-band amphoras remained in use in Tiel longer than the other Late-Badorf products, and they are amply represented in the 11th-century complexes. It was not possible to give a final date for the use of relief-band amphoras on the basis of the Tiel material because there are no dendrochronological dates for this period. The production of Late-Badorf relief-band amphoras possibly ended somewhere in the second half of the 11th century.

Early-Pingsdorf ware

As well as Late-Badorf pottery in soft whitish or yellow fabrics, the oldest material from the kilns of Brühl-Pingsdorf (period 1) also includes a group of extremely hard fired, stoneware-like cooking-pots which are dark in colour.[124] It would appear that these pots were deliberately fired as hard as possible, possibly in connection with their function as cooking-pots. These globular pots are related to the Carolingian cooking-pots EM W III, but differ from them on a number of points (see chapter VI 1.1.1.[125] First, the body of the pot tapers less fluently. It is more angular, especially at the point of the widest circumference, which is higher than in most Carolingian cooking-pots. Second, most have a fairly flat, horizontal shoulder which merges directly into the rim. Third, the rim forms differ from those of type EM W III. The rims show some resemblance to EM W IIB, but especially to EM W IIA. Both types can easily be confused. Most rims are short, thickened, rounded or triangular (in section) and folded over horizontally. Unthickened, rectangular rim profiles are seldom found.

The main difference lies in the fabric. Cooking-pots of Dorestad type EM W III are manufactured in fabric W 1–12. A stoneware-like fabric is characteristic of the cooking-pots from Brühl-Pingsdorf. The tempering is fine and consists mostly of fine grains of sand. The surface feels like fine sandpaper. The colour is brown-yellow, olive-green or blue-grey. The core is sometimes yellow or yellow-brown and very dense.[126] In view of the hardness, colour and texture, the fabric reminds one more of Pingsdorf pottery than (Late-) Badorf ware, and is consequently also referred to in the literature as 'Carolingian Pingsdorf-ware'.[127] Following the use of the term 'Late-Badorf ware', and also to prevent confusion with the later painted Pingsdorf ware, we have opted here for the term 'Early-Pingsdorf ware' for this type of pottery. It is preferable to the term 'Carolingian Pingsdorf-ware' because this type of pottery appears only to have been produced in the Late Carolingian Period (see below).

Variability In the Hoogstraat excavations Early-Pingsdorf cooking-pots of various sizes were found. Most have a rim diameter of 14 to 16 cm. The rims are often

115 Dijkstra 1998, 30, fig. 15; Van Doesburg & Bakker 1999, 3, fig. 21: 3–6.
116 Proos 1996; Spitzers 1996; Sanke 1999.
117 Sanke 1999.
118 Van Heeringen 1995, 155, fig. 107.
119 Besteman 1989.
120 Kleij 2000, 109–10, 112, fig. 5.8: a–d; Kleij 2001.
121 Dijkstra 1998, 28, fig. 14.
122 Dijkstra 1998, 29–30.
123 Janssen 1987, 81–94.
124 Sanke 2003, 180.
125 Sanke 1999, 265, Taf. 2: 3–5; Sanke 2003, 184, Abb. 68.
126 Sanke 1999, 270, Farbtafel 1: 6–7.
127 Sanke 1999, 254–5.

thickened, bevelled and folded back horizontally or rounded and everted.[128] The neck is very short or nearly absent. Small curved band-shaped handles occur rarely in this pottery type. They are attached to the shoulder at one end and against the outer edge of the rim at the other end. Pots of this type may have more than one handle.
Many sherds are too small to show whether they are decorated on the shoulder, nevertheless one type of decoration can be distinguished. The decoration consists of a horizontal groove on the shoulder and on the top of the rim. Sometimes two or three horizontal grooves on the shoulder occur.

Chronology Only the earliest phase of production of Pingsdorf ware was represented in Brühl-Pingsdorf. This phase (period 1) is dated by Sanke in the third quarter of the 9th century. In period 2, whose starting date has been set at around 875, Early-Pingsdorf ware is no longer found.[129] This would appear to indicate that Early-Pingsdorf ware, like Hunneschans pottery (see below), is a transitional product, which was only manufactured during a brief period.
It is possible that the use of Early-Pingsdorf pottery continued slightly longer than has been assumed on the basis of the kiln material from Brühl-Pingsdorf. An indication for this is the find complex Deventer-Noordenbergschild which was excavated in 1997.[130] During this excavation in the centre of the present town, the remains of a wooden building which had been destroyed by fire were uncovered among other things. This devastation is linked to a Viking raid on the (trade) settlement of Deventer in 882, known from the written sources. Shortly after this attack a rampart was raised around the settlement which covered the burnt and demolition layers on the site. The find material gathered from these layers therefore has a *terminus ante quem* of 882. Among the pottery finds there was, apart from (Late-) Badorf ware (52.1 %) and Walberberg pottery (0.5 %), a reasonable percentage of Early-Pingsdorf ware (5.5 %).[131] Nevertheless, the final date of the use of Early-Pingsdorf pottery cannot be stretched much further than somewhere in the last quarter of the 9th century. This is apparent from the fact that hardly any sherds of Early-Pingsdorf pottery were found at various excavations in the centre of Tiel, whereas there were reasonable quantities of Late-Badorf and Hunneschans pottery. It is generally assumed that the trade settlement of Tiel was developing at the end of the 9th century, possibly around *c.* 890.[132] This is an interesting assumption, since this type of pottery was found in Dorestad in fairly large numbers. The end of Dorestad as an interregional trade centre can be dated to the period between 850 and 875.[133] As a result, the Early-Pingsdorf ware would appear to be linked more to the early-medieval trade in pottery than to that of the Ottonian Period and Late Middle Ages. This type of pottery reflects the chronological gap between the end of Dorestad and the rise of Tiel as a trade centre.[134] The conclusion is that Early-Pingsdorf pottery was produced in the second half of the 9th century, with the emphasis probably on the period between 850 and 885.

Hunneschans pottery
This type of pottery is characterized by the combined presence of roulette decoration, lines of red paint, and a fabric similar to that of Late-Badorf ware (LM W-2). It is named after the early-medieval fortification the Hunneschans on lake Uddelermeer in the Veluwe, where pottery with these characteristics was found for the first time during excavations in the 1930s.[135] Hunneschans pottery was manufactured in various pottery-making centres in the German Vorgebirge region, including Badorf and Brühl-Pingsdorf.[136] The range of forms is limited mainly to narrow-mouthed pitchers (type EM W IIy). Apart from these, medium- to narrow-mouthed jars (type EM W IIx), wide-mouthed bowls (type EM W IIz), and, incidentally, relief-band

128 cf. Sanke 2003, 320, rim forms 1.1, 1.6 and 1.7.
129 Sanke 2003, 180.
130 Sanke 1999.
131 Sanke (1999, 256) refers to this pottery type as Karolingische Pingsdorfware*.*
132 Dijkstra 1998, 18; Sarfatij 1999.
133 Van Es & Verwers 1980.
134 Dijkstra (1998, 28–32) suggests the same on the basis of a comparison between the Badorf pottery in the Tiel-Koornmarkt and Tiel-Tol Zuid excavations and that from Dorestad.
135 Braat 1937; Renaud 1968; Heidinga 1987.
136 Lung 1955; Janssen 1970; Janssen 1987; Sanke 2003.

amphoras (EM W I) are sometimes found.[137] The pottery is tempered with fine sand, and is predominantly white or whitish-yellow in colour. The core is generally slightly darker than the outside and inside. The colour at the break varies from grey to pink. The core sometimes consists of thin, differently coloured layers.

Painted decoration on pottery was not new either. Already in the Carolingian Period paint was incidentally used as a decoration in some pottery-making centres in the Vorgebirge and Eifel regions. Painted spouted pots (EM W XIIB) from the Eifel region are known, for instance, with rim types similar to those of types EM WIIA and B. These will not be discussed here.
Badorf pottery (EM W XIIA, C–F) has a combination of roulette and paint decoration. This material is classified in the literature as 'painted Badorf ware'.[138] In addition to the combined use of roulette and paint decoration, the combination of rosette or cross-hatched squares and painted lines is also incidentally found among painted Badorf ware.[139]
Hunneschans pottery differs on a number of points from painted Badorf ware, and it is relevant to compare the two types since the differences also constitute a chronological development. Painted Badorf ware includes forms such as costrels (EM W XIIB), dishes (EM W XIIC) and storage- or medium-sized pots (EM W XIID), which do not occur in Hunneschans pottery or the later Pingsdorf ware.[140] Another significant difference is the texture of the paint. The paint of painted Badorf ware is thick, almost paste-like, whereas that of Hunneschans pottery is thin and watery.[141] The way in which the paint is applied also differs: the paste-like paint is applied with a brush or spatula. Because the paint – a ferriferous slip – is relatively thick, it forms a thin layer on the surface of the pot. The roulette impressions are filled up completely with paint and covered over. The paint used on Hunneschans pottery is much thinner and watery, as was the case in EM W XIIB. The colour of the paint also differs: that on painted Badorf ware is predominantly orange or pink, while the paint on Hunneschans pottery is red or reddish-brown.
A final difference is the fabric. Painted Badorf ware is fired less hard than Hunneschans pottery and feels softer. The fabrics are identical to EM W-1 and 2, while those of Hunneschans pottery are akin to those of Late-Badorf ware. However, the differences in fabric are not always evident, so that the two pottery types cannot always be distinguished from each other solely on the basis of this criterion.

Decoration On Hunneschans pottery this is a combination of rouletting and painted lines. The edge and outside of the rim and the upper part of the pot were decorated with rouletting, which was almost always double. Subsequently streaks of paint were applied with the fingers to the body of the pot. The colour of the ferriferous paint is orange-red. Because the paint was often extremely watery, the stripes ran, creating a drip effect. As a result of the watery consistency of the paint, the depressions of the roller stamps were insufficiently filled with paint and therefore remained visible. The most frequently applied pattern of decoration consists of horizontally, vertically or diagonally placed straight or slightly curved short streaks of paint on almost the entire outer surface of the pot, with the exception of the rim.[142] The upper edge and inside of the rim also hardly ever bear paint streaks, nor do the spout and handle.

Variability In contrast to the painted Badorf and Eifel pottery, which is fairly well represented in the pottery complexes of Dorestad, Hunneschans pottery hardly ever occurs here. That the presence of this type of pottery in Wijk bij Duurstede is extremely rare, probably has a chronological significance, according to Van Es and Verwers (see below).[143]
No rims of Hunneschans pottery were found during the Hoogstraat excavations, so that the pot forms could not be determined here. However, several wall fragments

137 For the range of forms of Hunneschans pottery, see for example: Janssen 1987, 181–2, Tafel 11–2; Sanke 2003, 185, Abb. 69.
138 Van Es & Verwers 1975; Van Es & Verwers 1980, 106–8.
139 Van Es & Verwers 1975, 140 (fig. 4: 1a and 9), 147 (fig. 7: 4, 15 and 16); Van Es & Verwers 1980, 106 (fig. 59: 7), 108 (fig. 61: 2–3).
140 Van Es & Verwers 1975, 139–40 (fig. 3, 4), 147 (fig. 7); Van Es & Verwers 1980; Janssen 1987, Tafel 11, nos. 21, 23.
141 Janssens (1987, 118–20): the remark that Hunneschans pottery has a paste-like paint is incorrect. Sanke's research into the Hunneschans pottery produced in Brühl-Pingsdorf shows that a thin, watery paint engobe was used here exclusively. Sanke 1999, 256, note 25; Sanke 2003. Paste-like paint decoration is exclusively found on painted Badorf pottery. See Van Es & Verwers 1975: for a detailed description of this pottery type.
142 The diversity of the decorative motifs used on Hunneschans pottery is most clearly seen in the pottery complex of St. Walburg's church at Meschede. See, for example, Sanke 2003, 162–3.
143 Van Es & Verwers 1975, 159–61.

were found. These are probably from narrow-mouthed pitchers (type EM W IIy). In view of the fact that the painted decoration on Hunneschans pottery is only applied in narrow streaks on the upper part of the pots, and that the fabric corresponds to that of Late-Badorf ware, both pottery types are difficult to distinguish from each other, especially in the case of highly fragmented material. Consequently, the possibility exists that some Hunneschans sherds may have been erroneously classified as Late-Badorf, though these are probably so few in number that the proportions of the two types of pottery will hardly be affected.

Chronology As stated above, Hunneschans pottery may be regarded as one of the last manifestations of pottery manufactured in the Badorf tradition. Together with Late-Badorf ware and Early-Pingsdorf pottery it marks the transition from the (Late-) Carolingian pottery production in the Vorgebirge region (as we know it from, for instance, Brühl-Badorf, -Eckdorf, Bornheim-Sechtem and -Walberberg), to that of the High Middle Ages, whose most prominent exponents are the Pingsdorf products decorated with paint streaks.
Hunneschans pottery may be regarded as a hybrid intermediate phase in which new decoration techniques on existing pot types were experimented with.[144] This can be seen most clearly from the composition of a pottery complex found in St. Walburg's church in Meschede. The complex consists of a great number of spouted pots with lenticular bases of Hunneschans pottery, spouted pots of (Late?) Badorf ware decorated with rouletting, spouted pots with lenticular bases and paint streaks, and painted spouted pots with foot-ring which had been installed as sound vessels in the walls and floor of the church. The fact that both Late-Badorf and Hunneschans and Pingsdorf-like pottery are represented in this pottery complex confirms the assumption that these types of pottery partly overlap each other as regards dates, and that they were in use alongside each other for a short period. On the basis of dendro-chronological dating, the sound vessels may date from between 897 and 913, probably around 900.[145]
In contrast to the painted Badorf pottery, which was probably produced during the major part of the Carolingian Period, Hunneschans pottery only appears to have had a short-lived production.[146] Until several years ago, it was assumed that this type of pottery was produced in the period between the second half of the 9th century, possibly from 870–880, and the middle of the 10th century.[147] On the basis of several recently published pottery complexes, the date of Hunneschans pottery can be made more precise. One of these complexes is that of Deventer-Noordenbergschild, already referred to above. Hunneschans pottery does not appear in this find complex, which must have come about shortly before 882. The argument that Hunneschans pottery is rare in Deventer – partly in view of the relatively small number of sherds of which the complex consists (399 items) – and consequently will possibly scarcely be present there, if at all, does not appear to apply, since it was found in reasonable quantities in other parts of the settlement.[148] This means that Hunneschans pottery only developed after *c*. 882. This suggestion appears to be corroborated by the production refuse from Brühl-Pingsdorf, where Hunneschans pottery is only present in period 2. This production phase is dated in the last quarter of the 9th century.[149] In the following, third phase of production, Hunneschans pottery no longer occurred. It is uncertain whether this development also concerned the other production centres of Hunneschans pottery or whether it was specific to Brühl-Pingsdorf.
In the Netherlands, Hunneschans pottery is mainly found in settlements with a clear 9th- to early 10th-century component, such as, for example, the trade settlements of Deventer[150] and Tiel,[151] the *ringwalburg* (circular fortress) of Oost-Souburg,[152] the agrarian settlements of Malburg[153] and Stenen Kamer,[154] excavated near Kerk Avezaath.

144 *Sanke 1999, 257, note 25.*
145 *Winkelmann 1975; Hollstein 1980, 96; Claussen & Lobbedey 1989, 17–9; Heege 1995, 68–71.*
146 *A flask of painted Badorf pottery (EM W XIIA), found at Zelzate, Belgium, containing a large quantity of denarii from the period 870–880, is considered to be one of the latest examples of painted Badorf pottery. Verhaeghe 1969, 107–8; Van Es & Verwers 1975, 149–60.*
147 *Janssen 1987, 45.*
148 *Van Es & Verwers 1985; Spitzers 1996; Proos 1996.*
149 *Sanke 2003, 180.*
150 *Van Es & Verwers 1985; Spitzers 1996, 117–8; Proos 1996, 148–9.*
151 *Bartels, Oudhof & Dijkstra,1997; Dijkstra 1998; Van Doesburg & Bakker 1999, 36.*
152 *Van Heeringen 1995, 154–5.*
153 *Kleij 2000, 110.*
154 *Kleij 2001, 212.*

The final date of the find complexes in which Hunneschans pottery is found lies – as far as could be established – shortly before the middle of the 10th century.

Pingsdorf pottery

In the 10th century there was a complete switch in the Vorgebirge region to the production of painted pottery. The old Carolingian decoration techniques were abandoned, except for roulette decoration on relief-band amphoras, and were replaced by new methods of decoration; at the same time, all sorts of new pot forms made their appearance. These new ornamental techniques were also applied in northern France in this period – possibly slightly later than in the Pingsdorf area – especially in the surroundings of Beauvais, and in Hoei in the Central Meuse Region, and were later adopted by other pottery production centres, including those in Brunssum-Schinveld and Nieuwenhagen, in the southern part of the province Limburg. In the period between the 11th and 13th centuries large quantities of pottery decorated with paint streaks were imported into the Netherlands.[155] Despite the fact that this painted pottery was produced in large quantities and in a wide area for more than three centuries, we still know relatively little about the chronological development of this type of pottery. Much pioneering work has been carried out by A. Bruijn. On the basis of the analysis of the heaps of sherds excavated in Zuid-Limburg, and of historically dated burnt layers in Limburg castles and several ^{14}C-dates, he arrived at a typo-chronological development model for the pottery produced in the area.[156] Some later researchers made use of Bruijn's classification of the painted pottery from Zuid-Limburg in classifying and dating Pingsdorf ware. The latter in particular proved problematical, since complexes with ^{14}C-dates did not appear to fit well into the typo-chronological framework drawn up for the Zuid-Limburg material.[157] Other researchers, for want of a typo-chronological classification of the painted pottery excavated in the production area, made their own classification on the basis of one or more find complexes.[158] In 2002 a detailed report of the production refuse excavated in Brühl-Pingsdorf was published.[159] This study does not only give an overview of the typo-chronological development of painted Pingsdorf ware, but also its relation to older and younger products from this pottery-making centre, and is currently considered to be the leading publication on this type of pottery. A considerable amount of Pingsdorf pottery was found in Hoogstraat III. It is, therefore, possible to make a division of this pottery into fabrics and types.

Fabric

Almost all the pottery found in the Hoogstraat area is wheel-thrown. Only a small group of pots is handmade and they will be described with the other handmade pottery groups (see chapter VI 2.4.1). Five types of fabrics can be recognized among the wheel-thrown material: LM W-1–5. The fabrics LM W-1 and LM W-2 are more or less similar to the Dorestad fabrics EM W-1 and W-2.

- LM W-1 Consists of clay without tempering. It feels very smooth and belongs to loW-fired oxidized ware. In general it is white in colour. Although it is rare, the fabric mainly occurs in type LM W IA, B and sometimes in W IIB.
- LM W-2 Also oxidized, but it is much harder than LM W-1. Because the very fine sand particles of the tempering protrude from the surface, it feels like sandpaper. The colour varies from white, yellow to orange-grey.
- LM W-3 Very hard fired. The material is tempered with a large amount of fine sand and consequently feels rough to the touch. The tempering is generally coarser than in fabric LM W-4. The colour varies from olive-green to purplish-grey. Although it is rarer than other fabrics it mainly occurs in type LM W ID and sometimes in W IC.

155 See Verhoeven (1990),172–4: for a survey of the distribution of Pingsdorf pottery and Zuid-Limburg pottery, in the Netherlands.
156 Bruijn 1960–1; 1962–3.
157 Jelgersma, De Jong, Zagwijn et al. 1970, 120–1 and 144–6, fig. 11; Waterbolk 1990; Lanting 1990.
158 See, for example: Janssen 1987; Lüdtke 1988; Lüdtke 1989; Van Heeringen 1995, 146–8; Verhoeven 1998, 70–8.
159 Sanke 2003.

- LM W-4 Hard fired. The clay consists of a large amount of very fine grit tempering with some bigger grit particles. The outer surface feels rather rough and the tempering elements have been drawn over the surface of the pot leaving small scratch marks. The colour varies from orange-yellow to grey. The inside of the sherd may have a different colour. Fabric LM W-4 probably comes from a different production centre from fabric LM W-1, 2 and 3. Only a few wall-sherds have been found of this fabric that cannot be attributed to a specific type.
- LM W-5 Hard fired. The outer surface feels smooth or greasy. Tempering is almost absent except for a few organic inclusions.

Decoration

Paint (A)
Painting on this type of pottery is a common feature. Painted decoration is usually found on the shoulder of this pottery between the neck or rim and the greatest circumference.
The height of the painted zone varies. The ornament may occur on the upper part of the shoulder or it may cover the complete shoulder. Spouts and handles are sometimes painted, as well as the upper side of the rims. Occasionally, finger impressions occur on the inside of the rim. They show where the painter held the vessel in his hand, full of paint. Small lines or dots found on the complete pot, even on and under the base, are the result of careless painting or of dripping.
The paint, a watery substance, was generally applied with the fingers, except for one sherd in decoration type Aa3. This ornamental pattern may have been painted with the help of something like a little stick or brush. On oxidized pottery, the colour of the paint varies from light orange to red and brown. Darker colours, from (red-) brown to violet are found on reduced ware. The fragmentary nature of the pottery makes it difficult to recognize the decoration patterns reliably. Only the complete specimens reveal two types of decoration patterns. At least three other motifs based on the decoration of the remaining pottery can be added. They partly form a subdivision of the two main motifs: painted stripes and dots.

Painted stripes (a)
-1 Garlands They consist of individual or overlapping U-shaped strokes (commas), placed in two or more horizontal rows (fig. 122: 1–3). The shoulder of the complete vessel from Hoogstraat III, in figure 130: 2, shows this pattern. The careless painting of this vessel is due to a combination of painted commas, dots, thick vertical stripes, and circles. Although these motifs differ from the actual garland pattern, their position on the pot makes it clear that they also belong to the garland ornament. Because of the variety of this decoration pattern it is difficult to ascribe, especially the small painted sherds to this motif. Several sherds show a regular garland ornament (fig. 122: 4).
This type of ornament is often interrupted by the presence of handles and spouts around or on which dots may be painted.
A subdivision is formed by strokes of vertical garland-decoration. In several cases, however, the vertical garlands may be caused by dripping: figures placed in a horizontal row drip downwards; this results in vertical lines which are included in a second horizontal row. Sometimes this resulted in rows of curls or a vertical spiral-decoration (fig. 122: 5–7). In contrast to the material from Hoogstraat I this type of decoration is not rare at Hoogstraat III, but is found on a relatively large number of sherds.
- 2 Horizontal short straight or wavy stripes Sometimes in combination with diagonal lines. This type of ornament occurs among sherds of type LM W I, II and IIIB (fig. 123: 1–2).

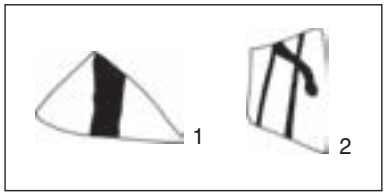


Fig. 123 Dorestad, Hoogstraat III: decorated Pingsdorf pottery, motif Aa2.

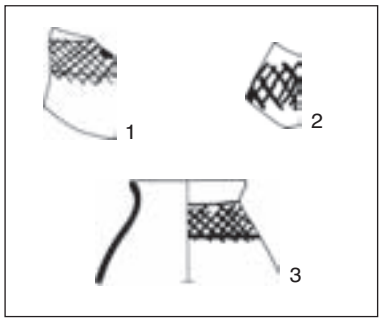


Fig. 124 Dorestad, Hoogstraat III: decorated Pingsdorf pottery, motif Aa3.

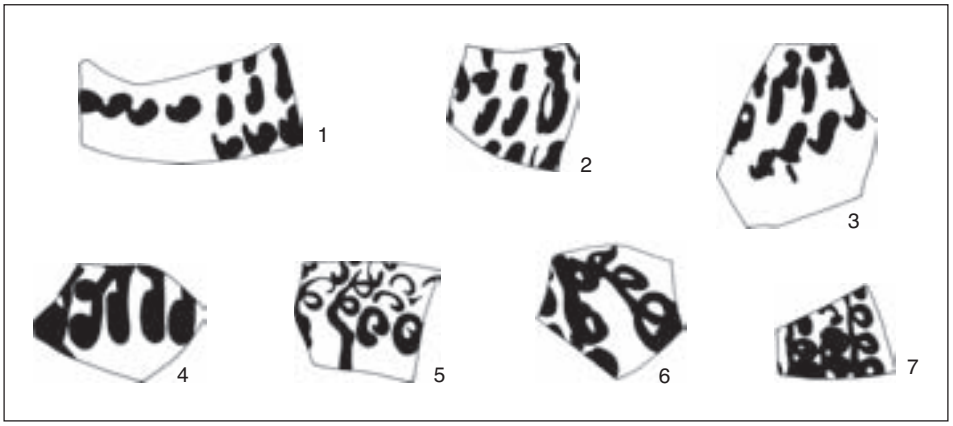


Fig. 122 Dorestad, Hoogstraat III: decorated Pingsdorf pottery, motif Aa1.

- 3 Other stripes They show a painted row of diagonal stripes bordered by horizontal stripes (fig. 124: 1–3) and forming a diamond pattern. This decoration was probably applied with a brush or little stick. This ornament is relatively rare and occurs only among sherds of type LM W II (fig. 133: 1–2).
- 4 Diverse Several sherds show painted oblique stripes placed in rows (fig. 125: 1, 3). They probably belong to the dotted type of painted ornamentation. On other sherds the stripes are painted without a recognizable pattern due to the fragmentary nature of the material. It is possible that the latter ornament belongs to the garland motif (fig. 125: 2). Some sherds show long curved painted lines, other Z-shaped figures. This ornament may be compared with the horizontal wavy lines of type A2. A rectangular pattern is probably painted on the wall sherd of figure 125: 4.

Dots (b)
The shoulder or base sherd in figure 126: 1 shows a decoration of dots. It consists of four horizontal rows of dots. Some sherds show vertical zones with vertical rows of dots, sometimes in combination with vertical stripes (fig. 126: 2). A more irregular pattern of painted dots can be seen on the sherd in figure 126: 3. Several dots give the impression of small thick lines. It is, therefore, difficult to decide especially in the case of small sherds whether the ornament belongs to the dotted type of decoration or whether it forms part of the garlands (Aa1), or even of the oblique striped decoration (Aa4).

Ridge (B)
One sherd in fabric LM W-2 has a horizontal ridge on the shoulder (fig. 127). This type of decoration probably occurs on Pingsdorf vessels that show great similarity with type EM W IIC. Generally speaking, it is not possible to distinguish between the two types on the basis of the fabric.

Fig. 125 Dorestad, Hoogstraat III: decorated Pingsdorf pottery, motif Aa4.

Fig. 126 Dorestad, Hoogstraat III: decorated Pingsdorf pottery, motif Ab.

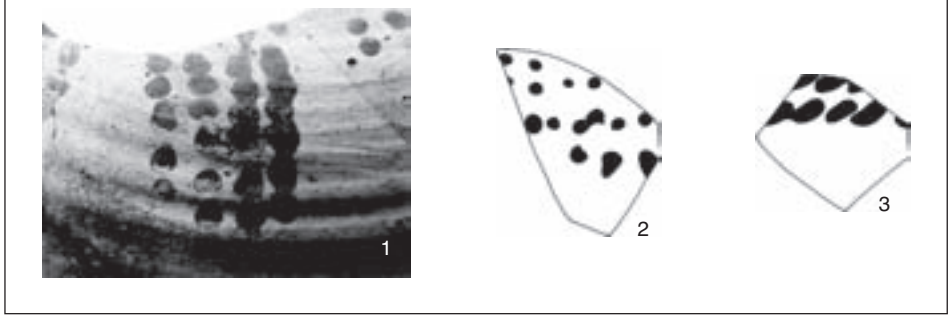
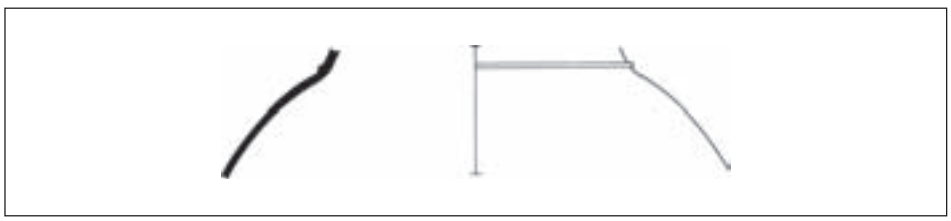


Fig. 127 Dorestad, Hoogstraat III: decorated Pingsdorf pottery, motif B.



Description of the types

LM W I Jug

General characteristics:
1 low, hollow pinched-out foot, usually with undulations at the outside (*Wellenfuss*) or a narrow strip of clay without profile;
2 well-defined transition from foot to body;
3 ovoid body;
4 mostly short neck or without neck;
5 relatively narrow-mouthed with short thickened or unthickened rim;
6 short, tubular spout, placed on the shoulder, sometimes just below the rim. Short strap-handles attached to the rim;
7 medium-sized vessel;
8 the upper part of the body has a red paint decoration;
9 sand-gritted fabrics: LM W-1, 2 and 3; one specimen in fabric W-4.

Variability and subdivision
The shape of the jug except for that of the rim is described in the Hoogstraat I publication under 'general characteristics'. In the Hoogstraat III material there seems to be a wide range of variations. Based on the differences in the shape of the rim, the position of the spouts and the shape of the handles, five subtypes (LM W IA, B, C, D, E) have been distinguished. There are transitional forms, which hamper determination in individual cases. In general however, the sub-types can be clearly separated.

LM W IA The characteristic elements in this subtype are a rather long everted neck and a slightly thickened, snout-shaped, everted rim (fig. 128: 1–3). The top of the rim is rounded or angular. This rim-type resembles Dorestad type EM W IIC. There is some variety in the shape of the rim. One specimen has a more rounded rim (fig. 128: 4). No complete specimens are present so it is not clear if this subtype has a spout or handles. The subtype probably has an ovoid body.
The upper part of the body is decorated with a red-painted ornament. One rim-sherd is decorated with oval shaped garlands, others with rows of commas.

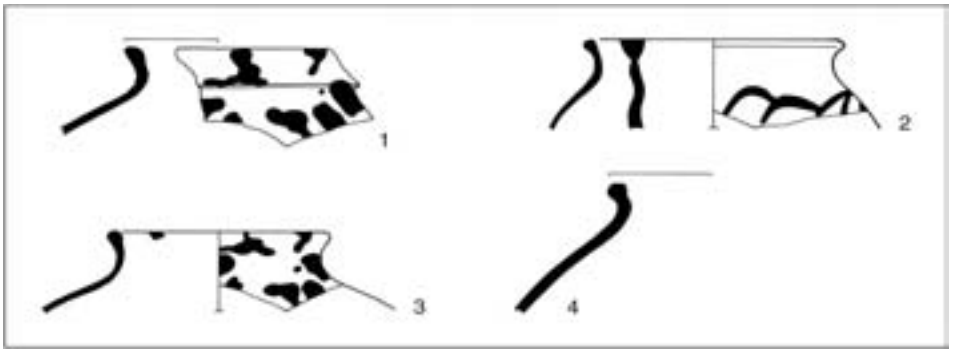


Fig. 128 Dorestad, Hoogstraat III: Pingsdorf pottery, type LM W IA.

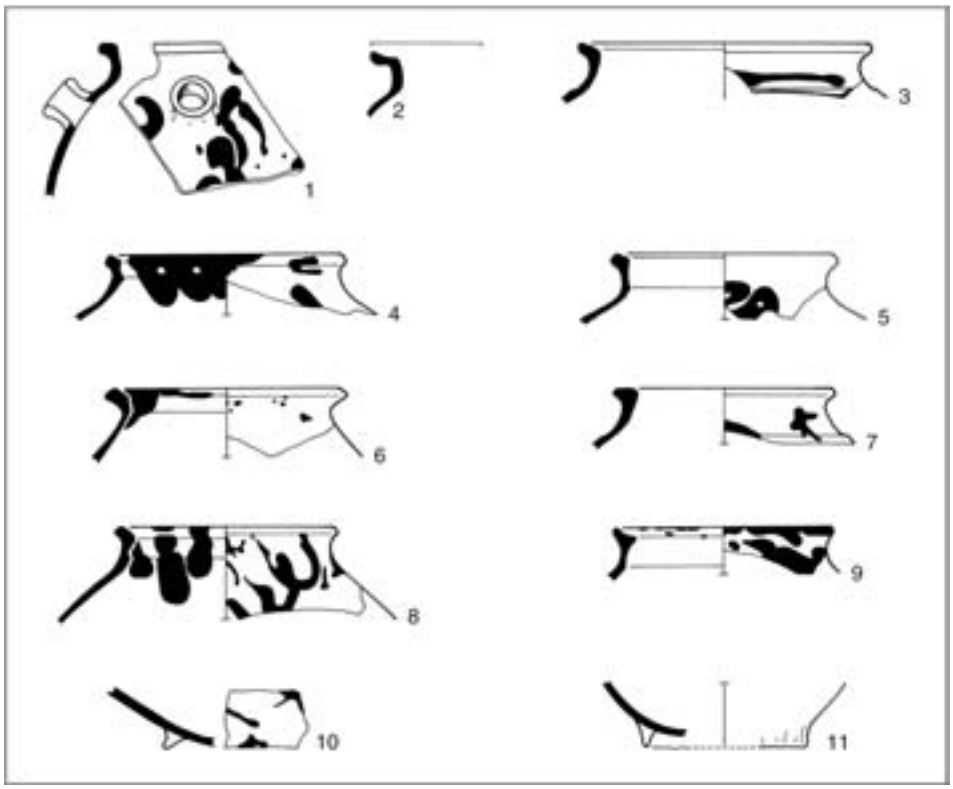
This subtype is mainly manufactured in fabric LM W-1. Fabric W-4 occurs once. The fabric feels rather smooth. With the exception of the grey sherd in fabric W-4, the colour of the fabric is white or yellow. In one case the core is light-orange.

LM W IB In this type complete specimens are absent. The type consists of wheel-thrown narrow-mouthed, medium-sized jugs. The shape of the rim shows some variation. Several rims have a thickened outer side which can be round or pointed but mostly the rims are square. The upper side of the rim is usually flat or inwardly bevelled (fig. 129: 1). Sometimes there is a groove at the top (fig. 129: 2). There is a fluent transition from globular body to neck. The latter may be short or somewhat longer and more or less cylindrical. Characteristic is the wide, sometimes narrow groove at the inside of the neck (fig. 129: 3–9). As far as could be determined, most specimens have a short, tubular spout attached to the outside of the shoulder. The way in which these spouts are attached to the outside of the shoulder is identical to the technique of the Badorf spouts, manufactured in fabric EM W-1, 2.[160] Narrow strap handles also occur. These are attached to the upper side of the rim. Their shape is similar to handles from the Carolingian Period. This type probably also includes lenticular bases with a low, un-pinched narrow foot-ring (fig. 129: 10–11).
The decoration consists of streaks of paint applied both to the inside and outside of the rim as well as the upper part of the outside of the pot. Streaks or splashes of paint also occur incidentally on the handles.
Various decoration patterns can be distinguished, but since there are no complete specimens or large fragments, they cannot always be established with certainty. Both decoration types Aa1 and Aa2 and Aa4 occur. Decoration type Aa2 appears to be the most frequent. The decoration consists of short, diagonally positioned wavy stripes on the shoulder and uppermost part of the wall, and short, straight stripes are found at the top of the rim. Occasionally the commas form continuous wavy patterns. In a few cases the thin paint has partly run over the lower part of the body of the pot on the outside, or on the inside over the neck and shoulder.
The spouted pots of this type are mainly manufactured in fabric LM W-1 and occasionally in fabric 2.

LM W IC This type of jug is represented by three more or less complete specimens from Hoogstraat III, which show the same general characteristics as the Carolingian type EM W IIC. Their rims may be compared to the rim types EM W IIB and IIIB, but they are thicker and more angular (fig. 130: 1–9).
The rims are square and diamond-shaped in section. The upper side of the rim may be flat or somewhat inverted. The shape of the outside varies: straight and vertical or oblique. Sometimes there is a horizontal groove on the outside of the rim (fig. 130: 7). The underside of the rim generally shows a fluent transition to the neck or to the shoulder.

160 Van Es & Verwers 1980.

Fig. 129 Dorestad, Hoogstraat III: Pingsdorf pottery, type LM W IB.

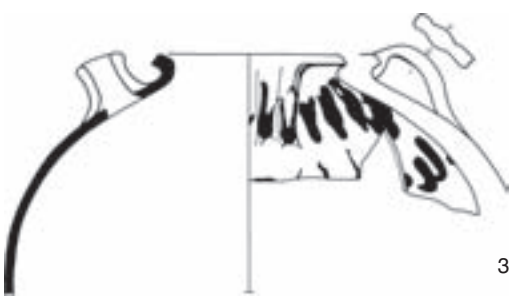


Nearly all sherds have spouts or handles or both. This means that this type of vessel probably served to pour liquids. The tubular spouts are placed on the shoulder. There is a small variability in the shape of the handmade Pingsdorf spouts, but the cylindrical short shape is the main distinctive element.
Strap-handles occur between the upper side of the shoulder and the outside of the rim. Where the handles are attached to the rim, there may be finger-impressions present on top. The width of the handles varies between 3.5 and 6 cm. Most handles are between 5 and 6 cm wide, and two-, three-, four-, five- or six fold or they give this impression, because several broad single handles are decorated with a number of vertical grooves. Spouts are somewhat bigger than on type LM W IB and placed between a pair of opposite strap-handles. A third handle may be added opposite the spout. The presence of a jug with one or four handles could not be proved. Vessels with a spout, but without a handle do not occur here. All vessels have a low, hollow, pinched-out foot, usually with undulations on the outside.
Decoration consists of a band of painted short vertical stripes or dots on the shoulder and the greatest circumference. The band of stripes consists of individual or overlapping U-shaped strokes placed in two, three or more horizontal rows. Also rows of curls or a spiral decoration occasionally occur. The dots are placed in more or less regular lines. Sometimes there is also a row of painted stripes on the top of the rim and the lower part of the handles. In contrast to type LM W IB, the painted stripes on the rim are not present on the inside of the pot. Sometimes the outside of the foot is also decorated with painted stripes.
This subtype is manufactured in fabric LM W-2 and 3. The hardness varies from medium hard to hard. Most sherds are yellow in colour but brown-grey and violet-grey also occur.

LM W ID The rim of this type can to some extent be compared to the Carolingian rim-types EM W IIA and IIIA: thickened, snout-shaped and rounded at the top (fig. 131: 1–6).

1

2



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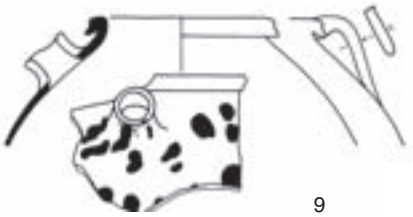
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Fig. 130 Dorestad, Hoogstraat III: Pingsdorf pottery, type LM W IC.

Several sherds have rolled-over rims. The rim is inwardly bevelled and often concave on the outside. Handles or spouts are present on nearly all specimens of this type. The handles have no or only a few grooves. The spout attached to the underside of the rim is relatively short, shorter than in type LM W IC. The strap-handles are also generally narrower than those of type LM W IC, and grooves are often lacking. The jug in figure 131: 1 has a spout, but it misses a handle. One spout is thickened in the middle (fig. 131: 7). The jugs have a pinched-out foot-ring which is often clearly moulded.
This type is mainly decorated with paint streaks on the shoulder. The decoration is applied in a narrow band on the shoulder of the pot. The paint streaks usually form a continuous garland pattern.
The vessels of this subtype are manufactured in fabric LM W-2 and 3. The hardness varies from medium hard to hard. Some sherds are tempered with a large amount of fine sand. Most sherds are yellow, but brown-grey and violet-grey also occur.

LM W IE The characteristic form of type W IE is the short, mostly parallel-sided, unthickened, fluently bent-out rim. The following varieties in the rim-type may be observed (fig. 132: 1–4). Most rims were obliquely everted. The outer edge of the rim may be rounded or rather angular. The rounded inner side of this rim type is contrasted with the angular profile of type LM W IC. The rims may come from ovoid pots with handles and a spout.
Decoration is present on the upper part of the pot.
This subtype is manufactured mostly in fabric LM W-1, but fabric W-2 also occurs occasionally.

LM W II Beaker

General characteristics:
1 lower part unknown, flattened convex base or low hollow pinched-out foot (?);
2 more or less globular body with fluently curved profile;
3 steep upper part;
4 slightly everted or straight neck;
5 relatively wide-mouthed with thickened or unthickened rim;
6 small-sized;
7 the upper part of the body has a red paint decoration;
8 sand-gritted fabrics, LM W-2 and 3.

Characteristics and range of variation
A small number of wheel-thrown sherds may be ascribed to beakers. The type is characterized by a more or less globular body with fluent everted neck (fig. 133: 1–4). Bases are not preserved. The bent-out, unthickened or thickened rims may be parallel-sided or grooved at the inside. The top of the rim is rounded or flattened. The diameter of the rim is between 6 and 8 cm. The sherds are relatively thin-walled, and this, among other things, distinguishes them from type LM W IIB. Because of the extremely fragmentary nature of the material, this distinction cannot always be clearly established. The decoration consists of rows of commas on the upper part of the body (Aa1, fig. 133: 3), rows of short horizontal or wavy lines (Aa2, fig. 133: 4) or horizontal and diagonal lines which form a diamond-shaped pattern (Aa3, fig. 133: 1, 2). The latter type of decoration seems to be typical of small beakers.
The beakers are mainly produced in fabric LM W-2; tempering elements consist of fine sand. One specimen has a rather dense tempering (fig. 133: 2). The fabric is medium-hard or hard. The colour ranges from yellow to light-grey.

Fig. 131 Dorestad, Hoogstraat III: Pingsdorf pottery, type LM W ID.

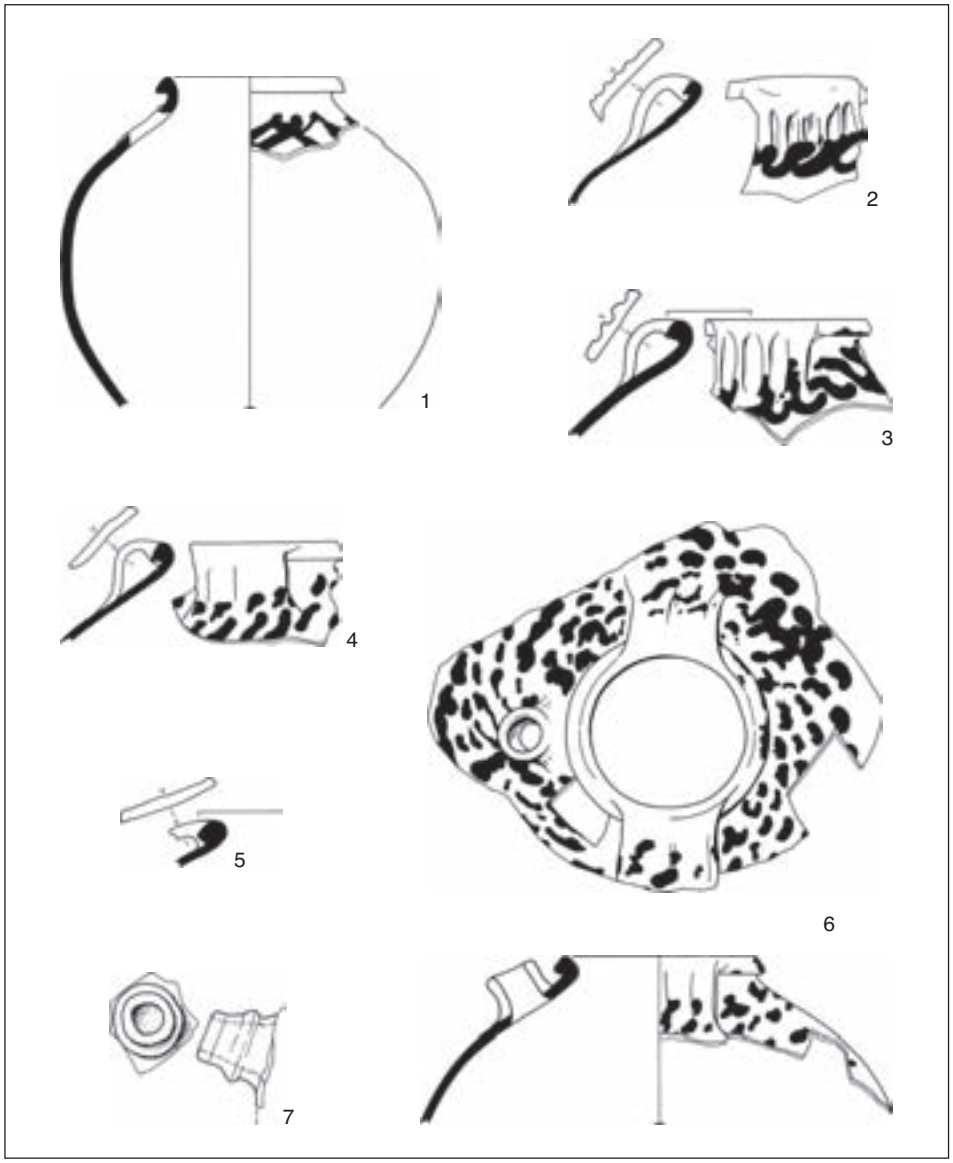


Fig. 132 Dorestad, Hoogstraat III: Pingsdorf pottery, type LM W IE.

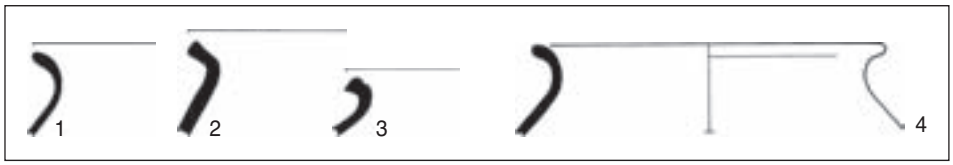
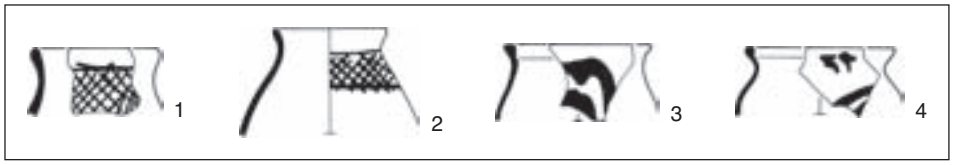


Fig. 133 Dorestad, Hoogstraat III: Pingsdorf pottery, type LM W II.



LM W III Cooking-pot

General characteristics:
1 lenticular trimmed base or flattened convex base;
2 sharp or fluent transition from base to body;
3 wide-bellied, globular body with fluently curved profile;
4 slightly everted, short neck;
5 relatively wide mouthed with short thickened or unthickened broadened rim; handles sometimes occur;
6 medium-sized vessel;
7 the upper part of the body is sometimes decorated with horizontal grooves, rouletting or painted stripes;
8 sand-gritted fabrics, LM W-1, 2 and 4.

Variability and subdivision
It is not certain that all rim-sherds of cooking-pots belong to pots with a lenticular base. They may have a more or less flat base.
The shoulder of the sherds of subtype LM W IIB, especially those manufactured in fabric LM W-2, is straight, relatively long and nearly vertical. The greatest width of these pots is found lower down than in cooking-pots of type LM W IIA. The transition from body to rim is fluent. A short neck is present.
Decoration – if present – consists of one or more horizontal grooves, painted short horizontal or wavy lines, and, in a few cases, rouletting on the rim and body.
The variety of rim shapes makes it possible to make a subdivision: LM W IIA-C. The first was manufactured in fabric LM W-4 that is almost completely restricted to this rim type.

LM W IIA The characteristic form of type A is the short, thickened snout-shaped rim which is everted or folded back horizontally (fig. 134: 1–9). Several varieties in the shape of the rim occur. Most specimens have a short straight neck, but sometimes a neck is absent. These specimens have rims that are folded back very far. The outer edge of the rim may be rounded, pointed or square. Sometimes the inner and the upper side of the rim is flat, or has a kind of groove. The rims show some resemblance to Dorestad EM W IIB, but especially to EM W IIA. It is easy to confuse the two types. The main difference lies in the fabric. Dorestad type EM W IIA is manufactured in fabric W-1–12 and LM W IIA in fabric W-4.
Small curved band-shaped handles rarely occur in this subtype. They are attached on one side, on the shoulder and on the other side against the outer edge of the rim. Pots of this type may have more than one handle.
Many sherds are too small to show whether they have decoration on the shoulder. Nevertheless, two types of decoration can be distinguished.
- a The most usual type of decoration is constituted by a horizontal groove on the shoulder and on the top of the rim. Sometimes two or three horizontal grooves on the shoulder occur.
- b Some sherds have rouletted decoration on the rim and on the shoulder. The rouletting consists of single or double horizontal rows of square or triangular stamp impressions.

LM W IIB This type is characterized by a short, mostly parallel sided, unthickened everted rim (fig. 134: 10-1). The inner side of the rim sometimes has a groove. The most common rim profile is angular. Most specimens have a short neck, but occasionally longer, everted necks occur.
Several varieties in the shape of the rim can be distinguished. The outer edge of the rim may be rounded and such sherds resemble to some extent rims of type IIIA. They

are ascribed to type W IIB because they are unthickened. In most cases the rim stands out obliquely.
Handles are absent on rims of this type and the pots are not decorated.
The type is manufactured in fabric LM W-1 and sometimes in W-3.
LM W IIB Globular pot with a rim diameter of 8 to 11 cm, a steep shoulder and a short everted neck (fig. 134: 12–17). The neck is not always as clearly everted in all specimens. The rim is generally rounded, and a lid seating is often present. An almost horizontally flattened rim was observed in one case (fig. 134: 15). Soot

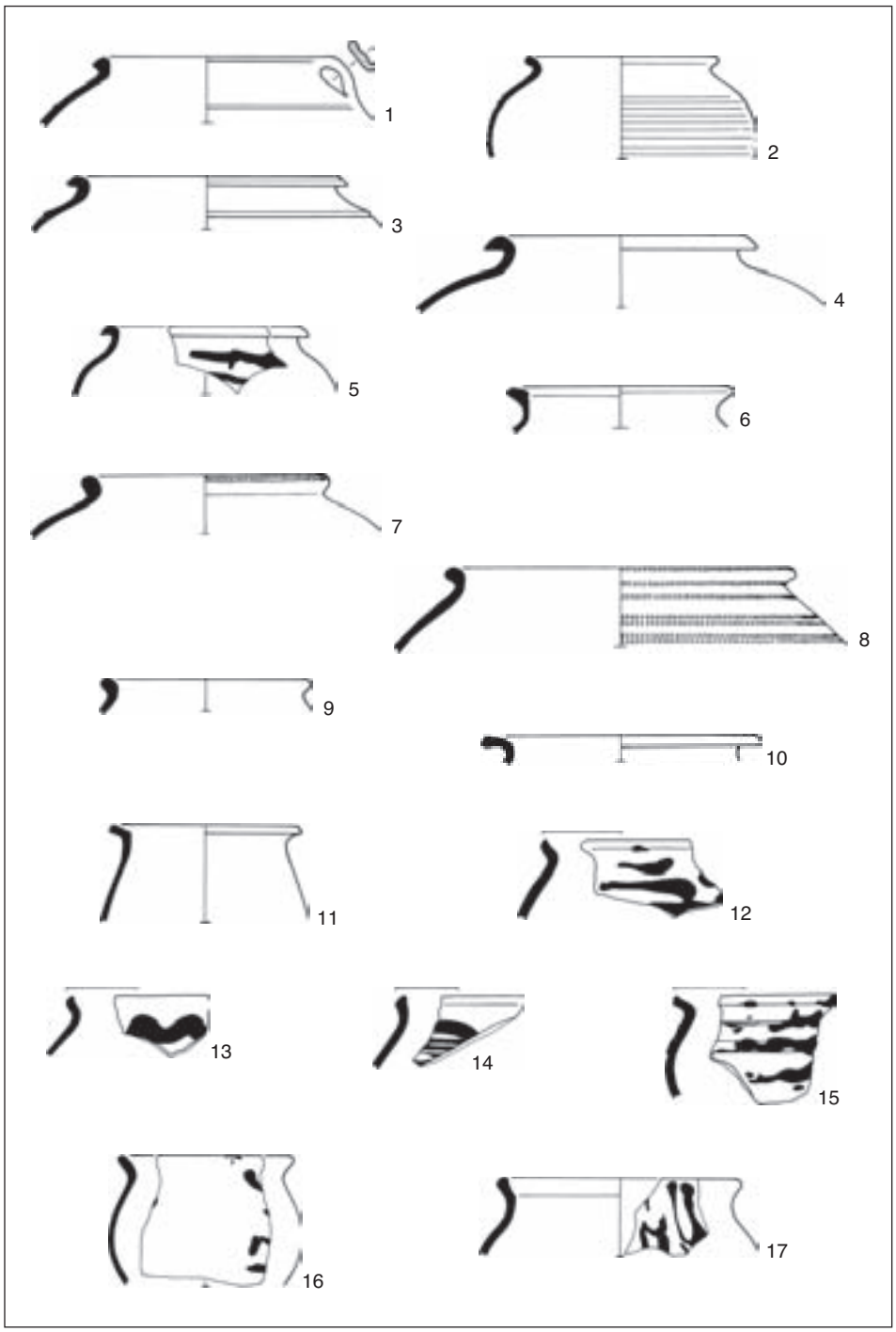


Fig. 134 Dorestad, Hoogstraat III: Pingsdorf pottery, type LM W III, 1-9 W IIIA, 10-11 W IIIB, 12-17 W IIIC.

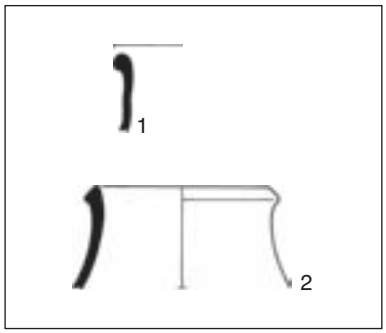


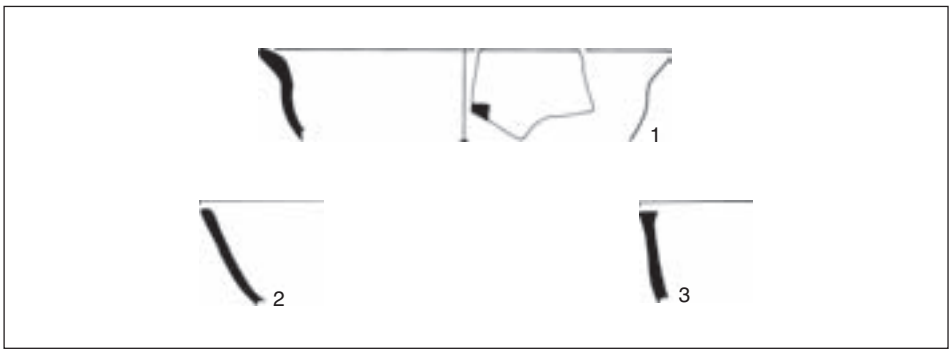
Fig. 135 Dorestad, Hoogstraat III: Pingsdorf pottery, type LM W IV.

Fig. 136 Dorestad, Hoogstraat III: Pingsdorf pottery, type LM W V.

remains are present on over half the rim-sherds. One type of decoration occurs: 'Aa'. Two or three rows of painted short horizontal or wavy lines on the upper part of the pot. There is a wide interval between the lines in one row.
Pots of this type are manufactured in fabric LM W-2.

LM W IV Tall pot

Variability and subdivision
This type is characterized by a thickened rim which is everted (fig. 135: 1). The outer edge of the rim is mostly rounded, but sometimes square (fig. 135: 2). The top of the rim is rounded and in one case more inwardly bent. The neck is cylindrical and rather long, much longer than in type LM W I. Not much is known about the shape of the vessel because of the fragmentary nature of the material. Spouts and handles were not found.



Decoration only occurs on two specimens, but the fragments are too small to reveal the decoration pattern.
This subtype is manufactured in fabric LM W-2 and -3. Most sherds are yellow, but occasionally brown or grey is also found.

LM W V Bowl

This type is represented by three rim-sherds (fig. 136: 1–3). The base is missing, so the complete form cannot be described. One rim is thickened, everted and rounded-off on the upper side (fig. 136: 1). The other rims are not thickened (fig. 136: 2–3). Traces of soot are visible on the upper side of the rim. Below the rim there is a horizontal groove. The decoration probably consists of vertical streaks of paint.
This type is manufactured in fabric LM W-2.

Chronology
Until recently, archaeologists were convinced that the complete switch to pottery decorated with paint streaks took place in the 10th century, possibly around 950.[161] This assumption was based on the Wermelskirchen hoard, which consisted of a small handmade pot with red painted decoration containing 107 silver coins, buried in about 960.[162] For a long time this find was considered to be the earliest demonstrable form of Pingsdorf pottery. However, in recent years more and more relatively early find-complexes with painted Pingsdorf pottery have been excavated. Examples of these in the Netherlands include the ^{14}C- or dendro-chronologically dated complexes of Amsterdam-Poppendam,[163] Oost-Souburg,[164] Tholen-Westkerke,[165] Spijkenisse-Hartel West,[166] Assendelft,[167] Alkmaar,[168] Leeuwarden,[169] Rotterdam-Blaak,[170] and Tiel.[171] In addition, several early German complexes with painted Pingsdorf pottery are known, such as the *motte* of Husterknupp,[172] Elten-Eltenberg,[173] and the Alte

161 A suggestion previously put forward by Hübener (1959, 132), on the basis of finds of pale-yellow pottery from the so-called Bachbrett-stratigraphie in Haithabu, that the production of Pingsdorf pottery starts around 900, is seriously queried by later researchers, including Lobbedey (1968, 123) and Van Es & Verwers (1980, 129).
162 Berghaus 1955/1956.
163 1000 ± 25 BP (GrN 13841), 1000–1015 ± 25 BP (GrN 13842), Bos 1986.
164 1095 ± 20 BP (GrN 18429), Van Heeringen 1995.
165 989 ± 10 BP (GrN 18257), Van Heeringen 1991, 193; Van Heeringen 1992, 173.
166 1090 ± 30 BP (GrN 16391), Döbken 1988; Van Veen 1992.
167 1195 ± 45 BP (GrN 13031), Besteman & Guiran 1986.
168 1065 ± 30 BP (GrN 6306), 1115 ± 25 BP (GrN 6307), Cordfunke 1990, 353 , Table I.
169 1000 ± 30 BP (GrN 17464), 1115 ± 45 BP (GrN 17392), Stilke 1993.
170 1060 ± 40 BP (GrN 22350), 1150 ± 20 BP (GrN 22351), Carmiggelt & Guiran 1997.
171 890/900–c. 965 AD, Dijkstra 1998.
172 964 ± 8 BP, Holstein 1980, 68.
173 Middle of the 10th century, Binding, Janssen & Jungklaass 1970; Heege 1995, 63–8.

TABLE 32A Dorestad, Hoogstraat III. A width of the middle part of Pingsdorf spouted pots (type LM W I).

Circumference	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6/0-6.9	total
Type						
LM W IA						
LM W IB	1					1
LM W IC		6	12	23	2	43
LM WID		2	2	3		7
total	1	3	14	26	2	51

TABLE 32B Dorestad, Hoogstraat III. Workmanship of handle on Pingsdorf spouted pots (type LM W I).

Decoration	grooves	notches	undecorated
Type			
LM W IA			
LM W IB			1
LM W IC	12	26	4
LM WID	3	3	1

Burg Lürken.[174] The pottery complex from the church of St. Walburg in Meschede (897–913, possibly around 900 AD), already mentioned above, is also regarded by some researchers as an early example of the presence, but the pot forms and fabrics differ too much for this to be stated with certainty.
As a consequence of these well-dated find complexes, the discussion on the starting date of painted Pingsdorf pottery has been regenerated. An important contribution to this has been Sanke's research into the production refuse excavated in Brühl-Pingsdorf. It should be observed here that the dates which he uses are partly derived from those of other find complexes, including some of those mentioned above.[175]

The starting date of painted Pingsdorf pottery is currently set around the beginning of the 10th century, although there is a suspicion that it was possibly (sporadically) produced as early as the late 9th century.[176]

Due to the lack of closed, well-dated pottery complexes, the Hoogstraat excavations are not able to make a contribution to the dating of Pingsdorf pottery. Only in the case of type LM W I is it possible to give a rough outline of the typo-chronological development, by analogy with other well-dated find complexes. The other types are not sufficiently represented to allow a classification.
The oldest spouted pots (type LM WIA) of Pingsdorf ware have a relatively long neck and a rim type related to Dorestad type EM W IIC, which may indicate that this subtype possibly dates back to the late 9th century. This rim type is also found in Oost-Souburg but is rather scarce among the material from Brühl-Pingsdorf.[177]
Rims of type LM W IB, with a slightly thickened rim that is bent nearly horizontal, appear to be a little later than LM W IA. This subtype has a groove on the inside of the neck, a narrow handle, a short spout and a low, hollow, pinched-out foot, without undulations (table 32A and B). Decoration is present on the upper part of the outside, the rim and the upper part of the inside of the vessel. The presence of paint on and at the inside of the rim is one of the most characteristic features of this subtype, and hardly occurs in the other subtypes. The colour of the fabric is mostly white or yellow (fabric LM W-1) and soft to the touch, but also harder fired, and more sandy fabrics occur occasionally (fabric LM W-2). In Brühl-Pingsdorf this rim type is found mainly in period 3.[178] It is also found in, among other places, Oost-Souburg,[179] Tiel,[180] Kerk Avezaath-Stenen Kamer,[181] and Elten-Eltenberg.[182] The majority of specimens belonging to this subtype can be dated in the 10th century. Subtype LM W IE also appears to date from this period, or from the early 11th century.[183]
Square, more or less thickened rim types (type W IC) also appear to occur occasionally from the late 10th century onward. The rims are mainly bent out

174 10th century, Piepers 1981; Heege 1995.
175 Sanke 2003, 129–83.
176 Van Heeringen 1995; Sanke 2003, 181–2.
177 Van Heeringen 1995, 140, rim type 2.
178 Sanke 2003, 186.
179 Van Heeringen 1995, 147, fig. 98: b and d.
180 Dijkstra 1998, 32, fig. 19: 1, 3 and 6.
181 Kleij 2001, 213, fig. 6.3.
182 Sanke 2003, 154, Abb. 56: 1–3 and 5–7, especially 6.
183 cf. Van Heeringen 1995,147, fig. 98: o, p and q; Spitzers 1996, 121, fig. 18: 6.

horizontally but sometimes they stand out obliquely.[184] Other are thicker and bent out horizontally. They either have a very short neck or no neck at all. This group appears to occur especially in the 11th century and the early 12th century.[185] At the same time as this rim type, wide strap handles with grooves or notches made their entry. In addition, the pots were given a heavy, pinched-out foot-ring. They were decorated with streaks of paint running as far as or even over the maximum diameter of the belly. This subtype was also found in Hoogstraat I.[186]
After the thickened square rims (subtype LM W IC), obliquely bevelled rims of subtype LM W ID appeared. Naturally, there are all kinds of intermediate forms as well, so that it is not always easy to distinguish the two forms.[187] According to Verhoeven, this rim type developed at the beginning of the 12th century, and continued throughout the entire production period.[188] In the second half of the 12th century, pots with a bevelled rim mainly occurred. These have a short, tubular spout attached to the underside of the rim, relatively narrow strap handles – at any rate narrower than those of subtype LM W IC – with rudimentary grooves, and a large, everted and clearly marked foot-ring or *Wellenfuss*. The decoration of these pots consists of short streaks of paint applied in a narrow band on the shoulder of the pot.[189] In general, the pots are harder fired than those of subtype LM W IC and are tempered with coarser sand. Specimens of this subtype were relatively scarce in Hoogstraat III. Only one specimen of this subtype was found in Hoogstraat I.[190]
Even less can be said about the dates of the other Pingsdorf pot forms discovered in the Hoogstraat excavations. Most of the forms occurred during the entire production period without any fundamental changes, so that the distinction between early and late(r) specimens is not always straightforward.[191] However, later types often have a harder fabric (LM W-3). The rim fragment of a small beaker (type LM W II, fig. 133: 3) can perhaps be dated in the 10th century, on the basis of a similar piece from Tiel.[192]
From a chronological point of view, the cooking-pots of Pingsdorf ware are the successors to those of Badorf- and Eifel ware. As regards shape, they hardly underwent any changes, apart from the rims which did undergo a typological development.[193] A rim fragment from a cooking-pot, of type LM W IIIA (fig. 134: 3), shows great similarity to a rim-sherd from the Kerk-Avezaath-Stenen Kamer excavation, which was discovered in a 10th-century slag pit.[194] Subtype LM W IIB is possibly slightly younger than LM W IIA, or else it remained in use longer. This is evident among other things from the fact that, in Tiel, this subtype was also found in younger, 11th–12th-century layers.[195] The tall pots of type LM W IV also appear to date from this period.[196] Dishes (type LM W V) occurred in Brühl-Pingsdorf throughout the entire production period, and can only be roughly dated on the basis of pot and rim forms. The dishes found in Hoogstraat III probably belong to the later types.[197]

The fabrics and the various patterns of decoration also provide leads for the dating of the pottery complex in Hoogstraat III, though to a lesser extent than the pot and rim forms. They support the chronological trend which can be inferred from the typo-chronological development of the spouted pots, namely that the area was in use from the 10th to the 12th century. The prevailing view in the older literature, that, regarding fabric, Pingsdorf pottery underwent a gradual development from soft to hard, must be rejected. Already in the 10th century both relatively soft (W-1) and harder fabrics (W-2, 3) occurred. This picture is substantiated by several pottery complexes in Tiel, where olive-green, extremely hard fired pots from the 10th century are found.[198] Nevertheless, the softer, whitish-yellow fabric W-1 from the same period still predominates. It looks as if a shift took place in the 11th century in the proportions between soft and hard fabrics. From then on, the darker, harder fired variant (fabric W-3) mainly occurs. Among the youngest Pingsdorf material in Hoogstraat III there is a group of sherds with a relatively coarse sand tempering. These broad trends are confirmed by the analyses performed on the material from Brühl-Pingsdorf.[199] They

184 cf. Van Heeringen 1995, 147 (fig. 98: e, f and k); Carmiggelt & Guiran 1997, 98 (fig. 29: 1); Dijkstra 1998, 32 (fig.19: 2)
185 cf. Van Heeringen 1995, 147 (rim type 5, fig. 98: c); Dijkstra 1998, 33 (fig. 20: 4, 5 and 6); Verhoeven 1998, 72 (rim type 4); Sanke 2003, 320–1 (rim types 2.5 up to and including 2.11).
186 See Van Es & Verwers 1980, 128 (fig. 75: 2, 5, 8, 9, 15 and 20).
187 For the typological development from thickened square to beveled rims: see Sanke 2003, 134 (Abb. 52a).
188 Verhoeven 1998, 75.
189 cf. Dijkstra 1998, 33 (fig. 20: 7).
190 Van Es & Verwers 1980, 128 (fig. 75: 1).
191 An exception are the beakers which have a clear typo-chronological development: Sanke 2003, 131 (Abb. 51).
192 Dijkstra 1998, 32, fig. 19: 4.
193 See Sanke 2003, 184–94 en 328–9.
194 Kleij 2001, 213, fig. 6.3: c.
195 See Dijkstra 1998, 33, fig. 20: 2.
196 They occur in Brühl-Pingsdorf from period 4; cf. Sanke 2003, 323–4, rim forms 4.2 and 4.9a. Further: Dijkstra 1998, 33, fig. 20: 3.
197 cf. Sanke 2003, 325–6, rim forms 6.3, 6.4 b and 6.11.
198 Dijkstra 1998, 34.
199 Sanke 2003, 195–204, especially Abb. 81–3.

reveal slight fluctuations in the degree to which the material was fired, which was mainly high in the earliest (period 1) and final (period 10) period, and lower in the intervening periods. The colours of the fabrics also underwent a certain development. In the oldest periods, white and yellow are dominant, while in the later production phases it was mainly the darker colours which were used. The grain size of the tempering gradually increased in the course of time, except in periods 2, 9 and 10. In period 8 (beginning to the middle of the 13th century) pottery is found with tempering particles up to 0.5 mm. Such coarsely tempered pottery appears to be largely lacking in the Hoogstraat excavations.
Summing up, it may be stated that no dates can be given on the basis of a few sherds, and that it is only possible to say something on the basis of the proportions between the various fabrics. This means that there must be a fairly large quantity of sherds available for a reasonably reliable dating. The same applies to a certain extent for the decoration patterns. An additional problem is that the material is often too incomplete to establish the type of decoration used (table 33). Most types of decoration, such as Aa1, for instance, appear to have been used for a long period. Only type Aa4 is probably only found on early, 10th-century pots. In the course of time changes occurred in the places where the painted decoration was applied. This development is most clearly observed in the spouted pitchers. The earliest spouted pitchers of Pingsdorf ware have streaks of paint, mostly decoration types Aa1 or Aa4, applied both to the in- and upper-side of the rim as well as over the larger part of the outside of the pot. With late 10th- and early 11th-century spouted pitchers the painted decoration is concentrated more on the upper part of the pot and the outside of the rim. Many pots from this period have paint streaks in the form of swirls or garlands (type Aa1).[200] In the 11th and 12th centuries, the contraction of paint decoration in a zone on the shoulder of the pots increased further. Examples of this can be seen among the finds from Hoogstraat III (type LM W IC, fig. 130: 1–3). The youngest spouted pitchers of Pingsdorf ware are characterized by a rudimentary band of paint streaks on the shoulder.[201] An example is a spouted pitcher of type LM W ID found in Hoogstraat I.

TABLE 33 Dorestad Hoogstraat III. Painted decoration on Pingsdorf spouted pots (LM W I-III).

Type of decoration	Aa-1	Aa-2	Aa-3	Aa-4	b	Aa-1/b	total
Type							
LM W IA	1	1		2			4
LM W IB	3			8			11
LM W IC	15				11	2	28
LM W ID	9					3	12
LM W II	2		2	2			6
LM W III	3	10		1			14
total	33	11	2	13	11	5	75

Duisburg ware
In 1977 a kiln was found in the centre of Duisburg. A second specimen was later found in the same area. The production waste belonging to it mainly consisted of grey to blackish-grey fired pottery, most of which had a simple roulette decoration. Some pots bore round stamps, similar to those on *Kugeltopf* ware. Systematic analysis of the material showed that three types of pot were produced: globular cooking-pots, amphoras or storage pots, and spouted pitchers with small handles.[202] Most of the pots had a flat base, and lenticular bases were exceptional.

Fabric
The clay from which this pottery is made naturally contains fine to coarsely rounded quartz sand. The grains of sand are visible on the break as tiny round white dots. Possibly some of the sand was added as tempering. On the break the sherds are

200 See Oudhof & Bartels (1996) and Van Doesburg & Bakker (1999, 35): for several early 11th-century examples from Tiel.
201 Sanke's (2002) period 7 (second half of 12th century).
202 See Kluge-Pinsker 1988: for a detailed description of the pot types produced in Duisburg-Averdunkgelände.

porous in structure, and light-grey to grey and occasionally partially orange in colour. The pots were built up in coils and subsequently smoothed out further on the wheel. During the latter process the sand grains were partly drawn out over the surface, causing the horizontal grooves typical of Duisburg ware. This type of groove is mainly found on the underside of the pot.[203]

LM W VI Cooking-pot

General characteristics:
1 probably flat base;
2 well defined transition from base to body;
3 globular body;
4 mostly short, everted neck;
5 relatively narrow-mouthed with short thickened rim;
6 medium-sized vessel; in comparison to type LM W VII, relatively thin-walled;
7 the upper part of the body is decorated with lines of rouletting;
8 sand-gritted fabric.

Variability
The main differences between this type and type W VII I are the size of the vessel, the width of the outer rim diameter and the thickness of the wall. The outer rim diameter of W VI varies from 12 to 15 cm and that of W VII is always more than 15 cm. Type W VI is relatively thin-walled compared to type W VII. The shape of the rim however is almost similar in both types. The rim is short and thickened and somewhat everted. The upper side is mostly rounded, occasionally flattened (fig. 137: 1–2). The outer side may be rounded, or is tapering and ends in a fairly sharp ridge (fig. 137: 3). There is some variation in rim types. Some specimens have a shallow groove on the inside of the rim. The neck is relatively long and everted. In contrast to type W VII, the body is wide-bellied and globular.
No bases were found, but on the basis of the complete specimens known from the literature, it may be assumed that the pots had a flat base, which was probably scraped during forming.
Pots with and without decoration occur alongside each other. The decoration, which consists of simple roulette impressions, starts about 3 cm below the upper side of the rim. The rectangular or somewhat triangular stamps have sometimes been partly filled up during the finishing of the pot.

LM W VII Amphora

General characteristics:
1 probably flat base;
2 well defined transition from base to body;
3 ovoid body;
4 mostly short, everted neck;
5 relatively narrow-mouthed with short thickened rim;
6 fairly large vessel;
7 the upper part of the body is decorated with rows of rouletting;
8 sand-gritted fabric.

Variability
This type is only represented in the Hoogstraat III material by four rims, but some relatively thick-walled wall sherds can probably also be attributed to this type.

203 See Kluge-Pinsker 1988, 203–28: for a description of the production method.

Fig. 137 Dorestad, Hoogstraat III: Duisburg pottery, type LM W VI.

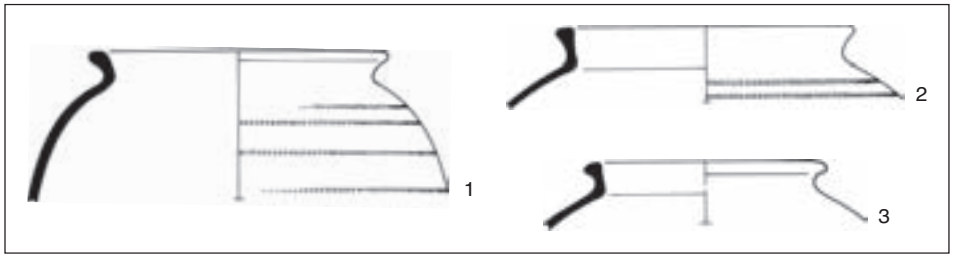
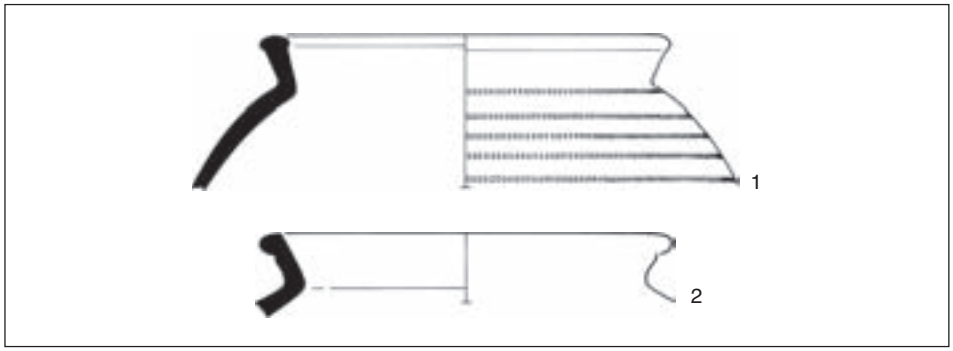


Fig. 138 Dorestad, Hoogstraat III: Duisburg pottery, type LM W VII.



The rim type is more or less comparable to that of type LM W VI, but is thicker-walled. The pot has a relatively steep shoulder because of the ovoid body (fig. 138: 1). The rim in figure 138: 2 has a different shape. The sherds are decorated with lines of rouletting.

Chronology

Tischler, in 1950, was the first to describe Duisburg ware in detail and publish it.[204] He suspected that this dark-grey type of pottery must have been produced in the Duisburg area between the 9th and 11th centuries. This is surprising, since only a few decades later remains of kilns with production waste of Duisburg ware were discovered in Duisburg-Averdunkgelände.[205] Duisburg ware is dated roughly to the 9th and 10th centuries. Export of this product took place mainly in the late 9th and the 10th century.

A recent inventory of Duisburg ware has shown that it can probably be associated with trade activities.[206] In the Netherlands, this type of pottery is known from a number of sites, particularly along the great rivers,[207] such as: Oosterbeek,[208] Herpt,[209] Deventer,[210] Rhenen,[211] Tiel,[212] Kerk-Avezaath,[213] and Wijk bij Duurstede.[214] It is also found in the western coastal area, including: Medemblik,[215] Middelburg,[216] possibly Rijnsburg,[217] Assendelft,[218] Rotterdam,[219] and Abbekinderen.[220] The majority of the material was found at the trade centres of Tiel, Deventer and Medemblik.

A relatively large amount of Duisburg ware was discovered during the various excavations in the centre of Tiel.[221] The excavations showed that Duisburg ware did not occur in Tiel in the 9th century, whereas it was relatively frequently found in 10th-century find complexes. In 11th-century features it is no longer found in primary contexts. The dates of the Tiel pottery complexes show that Duisburg ware may be a marker for the 10th century in the Netherlands. This impression corresponds to that of contemporaneous Dutch and German complexes such as: Rotterdam-Blaak,[222] Elten,[223] Hamborn,[224] Duisburg,[225] and Haus Meer (Büderich).[226] The material from the latter site is known to have been situated under an occupation layer which was dendro-chronologically dated in 1001.[227] A 10th-century dating for this type of pottery may also be deduced from the associated finds with which it was excavated in Elten Burg Broich and Duisburg, although the evidence for this here is less convincing.

The type LM W VI cooking-pots found in Hoogstraat III are similar in (rim) form to those from *Horizont C* in Duisburg-Averdunkgelände.[228] This *Horizont C* can be

204 Tischler 1950.
205 Tromnau 1979; Tromnau 1983; Kluge-Pinsker 1988.
206 Bartels, Oudhof & Dijkstra 1997.
207 Bartels, Oudhof & Dijkstra 1997, 10, fig. 9.
208 Glazema 1951, 73–4, fig. 6: 6.
209 Halbertsma 1953.
210 Spitzers 1990, 97; Proos 1996, 147, fig. 9.
211 Spitzers 1990, 98.
212 Bartels, Oudhof & Dijkstra 1997; Dijkstra 1998, 37, fig. 24; Van Doesburg & Bakker 1999, 37, fig. 26.
213 Kleij 2000, 111–2, fig. 5.5; Kleij 2001.
214 Van Doesburg 2000, 74, fig. 5.
215 Besteman 1974.
216 See Proos 1996, 147, note 49.
217 Spitzers 1990, 97–8.
218 Besteman & Guiran 1986, 194–5 (note 70), fig. 12. Here incorrectly referred to as kogelpot pottery.
219 Carmiggelt & Guiran 1997, 98.
220 Trimpe Burger 1958, 137 fig. 20: 3.
221 See Dijkstra 1998, 40, fig. 28; Van Doesburg & Bakker 1999, 40, fig. 29.
222 Carmiggelt & Guiran 1997, 98.
223 Binding, Janssen & Jungklaass 1970.
224 Binding 1971.
225 Tromnau 1979.
226 Janssen & Müller-Wille 1968.
227 Hollstein 1968.
228 Kluge-Pinkser 1988, 119–35.

roughly dated to the first half of the 10th century, though it should be noted that the exact final date cannot be given.

Maasland ware

Maasland ware, also referred to as Andenne ware, was produced in the Belgian part of the Meuse valley around the towns of Hoei,[229] Wierde,[230] Mozet,[231] Andenne,[232] and Andenelle.[233] It was also manufactured in Northern France and in England.[234] Typical of this type of pottery is the use of lead glaze on Whiteware, which has a yellowish, orange or pinkish colour depending on the colour of the fabric.

Maasland ware was found in larger quantities in Hoogstraat III than in Hoogstraat I. As a result, it can be divided into types.[235] On the basis of the pot and rim forms, 6 different types can be distinguished: amphoras (LM W VIII), globular (spouted) pitchers (LM W IX, XI), jugs (LM W X), tall pots (LM W XII), and small beakers (LM XIII). The Maasland ware found in Hoogstraat III can be divided into two groups of fabrics: a coarsely and a finely tempered fabric.

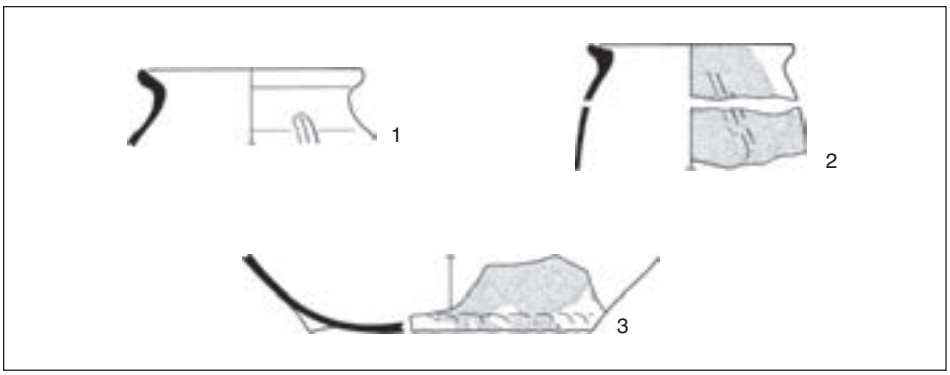


Fig. 139 Dorestad, Hoogstraat III: Maasland ware, type LM W VIII.

LM W VIII Amphora

General characteristics:
1 lenticular base, with a thin strip of clay;
2 gradual transition from base to wall;
3 ovoid body;
4 mostly short neck;
5 relatively narrow-mouthed with a thickened rim;
6 short, tubular spout, placed on the shoulder; short strap handles attached to the rim;
7 medium-sized vessel;
8 body is decorated with yellowish lead-glaze and applied thin strips of clay;
9 sand-gritted fabric.

Variability

In this type complete specimens are absent. Typical of amphoras are a short tubular spout attached to the inside of the wall and a thin, narrow strap handle. There is some variation in the rim forms. Most amphoras have a sickle-shaped rim, and a dirty-yellow glaze and a decoration of vertical strips of clay on the outside (fig. 139: 1–2). The pitchers probably have a lenticular base, and possibly a thin strip of clay attached to the edge of the base to create a kind of narrow foot-ring (fig. 139: 3). The pots found were manufactured in a fine sandy fabric; one specimen was in a coarser sandy fabric (fig. 139: 1). The colour of the fabrics varies from white/buff to yellow.

229 Bit, Dehamende, Cocquier & Lauwerijs 1985/86; Giertz 1996.
230 Lauwerijs & Petit 1967.
231 Plumier & Dumaut 1996.
232 Borremans & Warginaire 1966.
233 Borremans & Lassance 1987.
234 Verhaeghe 1995.
235 In Hoogstraat I, apart from a virtually complete globular spouted pot, only a few other sherds of Maasland ware were found. Van Es & Verwers 1980, 129–30.

LM W IX Globular (spouted) pot

General characteristics:
1 lenticular base, sometimes with three pinched out foot lobes;
2 gradual transition from base to wall;
3 ovoid body;
4 relatively short or no neck;
5 relatively narrow-mouthed with a thickened rim;
6 strap handle attached to upper or underside of the rim;
7 medium-sized vessel;
8 the shoulder of the jug is decorated with yellow/green or orange lead glaze; occasionally there is rouletting (*Gittermuster*);
9 the fabric is gritted with very fine sand.

Variability
There is some variation in the rim types. The most common are globular (spouted?) pots with a collared rim (type LM W IXA). In one case a more rectangular rim profile occurs (type LM W IXB). The pots have a short, slightly everted neck. Sometimes there is a groove in the inside of the neck. Several specimens have strap handles.

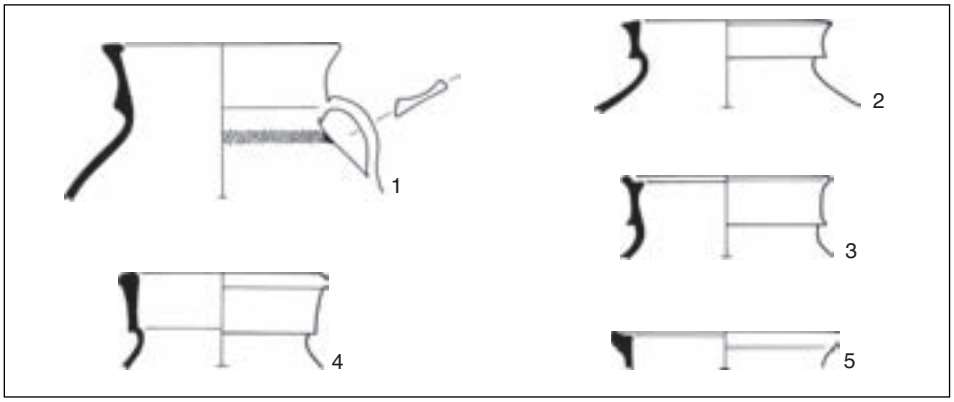


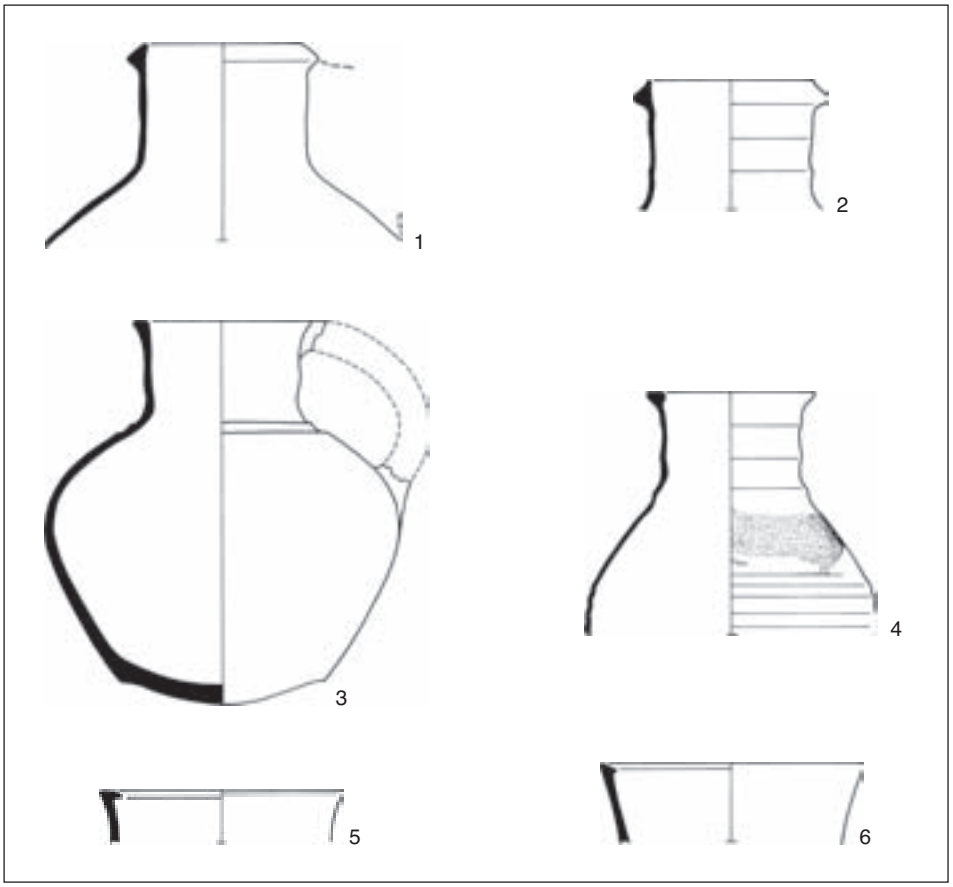
Fig. 140 Dorestad, Hoogstraat III: Maasland ware, type LM W IX, 1-4 W IXA, 5 W IXB.

LM W IXA This type of pot has a narrow or a wide collared rim, which may be flattened on the upper side (fig. 140: 1) or obliquely everted (fig. 140: 2). One specimen has a more rounded upper edge (fig. 140: 4). Occasionally there is a shallow groove on the upper side of the rim (fig. 140: 3). All specimens have a short, straight neck and a groove on the inside of the neck. The jugs have one or two narrow strap handles which are attached to the upper or underside of the rim and to the shoulder. The pots will have had a tubular spout.
On the outside of the pot a band of orange or greenish-yellow lead glaze has been applied to the shoulder. The handles are sometimes completely or partly covered with glaze. One specimen has *Gittermuster* decoration on the shoulder (fig. 140: 1). Most of the pots have a medium hard whitish-yellow or pink fabric. The material is tempered with fine sand.

LM W IXB Only one rim fragment of this type has been found (fig. 140: 5). The rim is thickened and is almost horizontal. The outside is more or less angular. The upper side of the rim is slightly bevelled off towards the inside and has a shallow groove. The colour of the fabric is orange, though the core is darker. The tempering consists of fine sand. The fragment is too small to say anything about the form of the pot, but the rim is similar to that of a specimen from Hoogstraat I: a globular spouted pot without strap handles, in a different fabric from that of the sherd.[236]

236 Van Es & Verwers 1980, 129, fig. 76: 1

Fig. 141 Dorestad, Hoogstraat III: Maasland ware, type LM W X, 1-2 W XA, 3-4 W XB, 5-6 W XC.



LM W X Jug

General characteristics:
1 lenticular base, sometimes with three pinched out foot lobes;
2 gradual transition from base to wall;
3 ovoid body;
4 mostly long, cylindrical neck;
5 relatively narrow-mouthed with a thickened rim;
6 strap handles attached to the upper side of the rim;
7 medium-sized vessel;
8 the shoulder of the jug, and sometimes the handle, is decorated with yellow or orange lead-glaze; sometimes rouletting occurs;
9 the fabric is gritted with very fine sand.

Variability
Several virtually complete specimens of this type have been found. There is some variation in size. Three subtypes (LM W XA–C) have been distinguished on the basis of differences in the shape of the rim; there are, as always, transitional forms which hamper determination in individual cases. All specimens of this type are decorated with yellow or orange lead glaze that is applied to the shoulder of the jug, and sometimes the handle. This band of lead glaze is sometimes very narrow. In other cases it is rather broad. In one case there is a combination of lead glaze and rouletting on the upper part of the body of the jug.

LM W XA These are jugs with a triangular, thickened rim profile (fig. 141: 1–2). The jugs are relatively slim in shape, with a cylindrical neck, a globular belly, and a rod handle. The handle is attached to the upper side of the rim. As far as could be ascertained, these jugs have a lenticular base, occasionally with three pinched out foot lobes. In general, the fabrics are darker in colour than the previous type. The colour of the fabric varies from orange/pink, brownish-grey to purple; the darker fabrics are lighter on the fracture. The jugs have a narrow band of lead glaze on the shoulder and sometimes on the outside of the handle.

LM W XB Three specimens (probably all jugs) have a tall raised rim (fig. 141: 3–4). This is triangularly thickened and flattened on the upper side. The only more or less complete specimen has a rod handle attached to the upper side of the rim, and a convex base. On the outside a wide band of lead glaze is applied to the shoulder and belly. One specimen also has a simple roulette decoration. The fabrics are white/buff and orange in colour.

LM W XC Four rims, probably of pots, have a rim which is flattened on the upper side (fig. 141: 5–6). It is thickened on the inside as well as the outside, and the rim is concave on the inside. The largest fragment has a narrow band of lead glaze on the shoulder and spots on the upper side of the rim. The fabric of this type is light yellow in colour.

LM W XI Pitchers

Five rims have a more or less sickle-shaped rim profile (fig. 142: 1–5). The outside is almost vertical, and there is a lid groove on the inside. Three specimens have a concave rim (fig. 142: 1–3). The pots have a short, almost straight neck.
One pot has a handle, a spout and *Gittermuster* decoration (fig. 142: 1). The other fragments are too small to determine the type of decoration used. Two rims have spots/specks of lead glaze, and one of them also has spots of red paint on the inside of the rim. The pots are made of a fine sandy fabric. The colour of the fabric is white/buff. One rim is sooted on the inside.

LM W XII Tall pot

This type is represented by two specimens, one of which is virtually complete (fig. 143: 1–2). It is a fairly slim, tall pot or beaker on three small, pinched out foot lobes. The pot has a rectangular, slightly everted thickened and flattened rim and a long, slightly everted cylindrical neck. The transition from neck to wall is marked by a thin band of orange lead glaze and a horizontal ridge. There are also ridges on the rest of the wall of this pot. The colour of the fabric varies from white/buff to orange. The almost complete specimen has a fairly soft, orange fabric and is tempered with very fine sand. The other specimen has a slightly coarser sandy fabric.

LM W XIII Small Beaker

General characteristics:
1 lenticular base or flat base;
2 sharp transition from base to wall;
3 globular body;
4 short neck;
5 relatively wide-mouthed with an unthickened, triangular rim;
6 small-sized;
7 outside decorated with orange lead glaze;
8 the fabric is gritted with very fine sand.

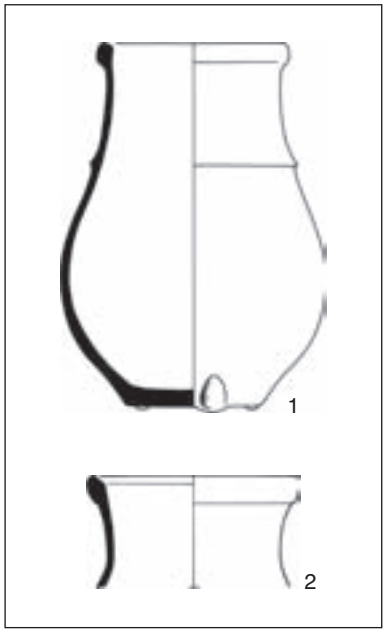


Fig. 143 Dorestad, Hoogstraat III: Maasland ware, type LM W XII.

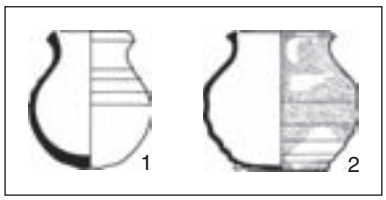


Fig. 144 Dorestad, Hoogstraat III: Maasland ware, type LM W XIII.

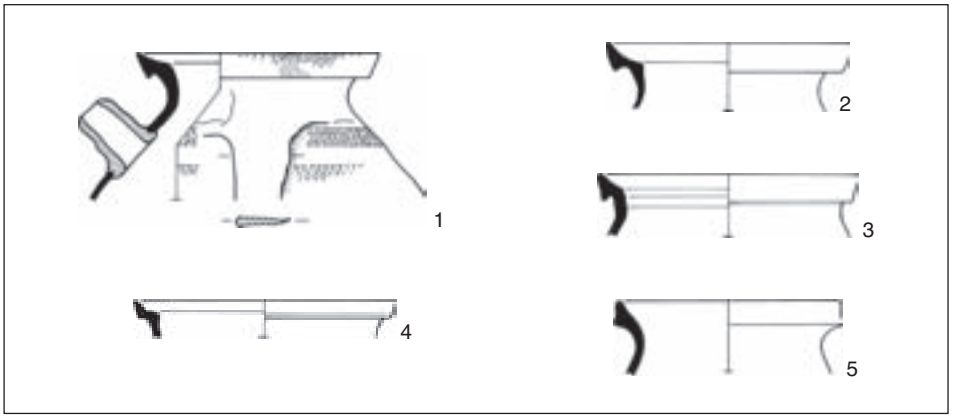


Fig. 142 Dorestad, Hoogstraat III: Maasland ware, type LM W XI.

Variability

In the Hoogstraat III complex four small beakers were found, one of which was complete (fig. 144: 1) and another specimen had a complete profile (fig. 144: 2). The rim is triangular and outwardly bevelled. The beakers have a short neck, a globular pot body and a lenticular base or a slightly pronounced flat base. One base has traces of scraping on the underside. The maximum rim diameter is *c.* 5 cm and the beakers are *c.* 6 cm tall. The outside has orange lead glaze and occasionally there are turning rills. The fabric is light yellow or orange in colour. The tempering is very fine sand.

Chronology

Until recently, it was assumed that Maasland ware was produced between the end of the 10th century and the beginning of the 14th century. However, recent studies have now shown that this material was already in use at a much earlier date.[237] The excavations at Hoei (Belgium) in particular have demonstrated that Whiteware with lead glaze was already manufactured here at the beginning of the 10th century, and possibly even at the end of the 9th century.[238] This early example of Maasland ware is characterized by a coarser fabric than that of the more 'classic' Andenne ware. The pots have a green or yellowish glaze with brownish spots. Apart from pitchers, early beakers and lids are found. Maasland ware in this coarser fabric has been found in various places in the Netherlands and Belgium, including: Alkmaar,[239] Tiel,[240] Oost-Souburg,[241] Maastricht,[242] and Antwerp.[243] Some of the amphoras (type LM W VIII, fig. 139) excavated in Hoogstraat III probably also belong to the earliest products from the Meuse valley. The sherds are glazed green or yellow, occasionally with small brown inclusions.[244] *Gittermuster* and applied strips of clay are found as decoration. The lenticular bases have a narrow strip of clay forming a kind of foot-ring. The rim fragment in figure 139 is very similar to a fragment found in Tiel which dates from the last quarter of the 10th century.[245]

The majority of the Maasland ware found in Hoogstraat III has a fine to very fine fabric and can be classified as Andenne ware. The material is hard fired, and the colour of the fabric varies from whitish-buff, orange-pink, buff-grey to purplish-grey. In the darker coloured specimens the core is often lighter, either pale beige to orange or rather purplish in colour. Depending on the colour of the fabric, the lead glaze is either yellow or orange. Roulette decoration is incidentally found in this group.

These fabric types largely date from Borremans and Warginaire's period I–IIA, from 1075 to *c.* 1200.[246] According to Verhaeghe, period I begins a quarter to half a century earlier than they had assumed at the time.[247] The darker fabrics mainly seen in type LM W X are younger: they date mainly from the 12th century.

237 Verhaeghe 1995; Giertz 1996.
238 Verhaeghe 1995, 163–6; Giertz 1996.
239 Cordfunke 1979, 52–4; 1990a, 355–7; 1990b, 78.
240 Dijkstra 1998, 39–40, fig. 26.
241 Verhaeghe 1998, 155–69.
242 Dijkman 1993, 223–4.
243 Verhaeghe 1967, 208 and 221.
244 Also referred to as 'blood spots' by Verhaeghe (1995, 156).
245 Dijkstra 1998, 39, fig. 26: 6.
246 Borremans & Warginaire 1966, 86–7.
247 Verhaeghe 1995, 161.

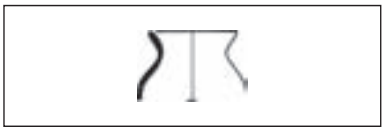


Fig. 145 Dorestad, Hoogstraat III: whiteware, type LM W XIV.

Relatively speaking, globular pots and jugs occur most frequently. The globular pots, some of which probably had a tubular spout, have a sickle-shaped rim (LM W XI), and the slightly later specimens have an angular (collared) rim (LM W IXA, B). The sickle-shaped rim appeared from the late 10th century, and probably remained in use until into the beginning of the 12th century.[248] Pots with a collared rim (a) are regarded by Borremans and Warginaire as characteristic examples of period I (late 11th century–*c.* 1175).[249] Recent research has also shown that this type of rim already existed around the middle of the 11th century and that it remained in use until the end of the 12th century, possibly even until the early 13th century.[250]
Slim jugs also feature prominently among the Maasland ware in Hoogstraat III. In general, they are younger than most of the other Maasland pot forms. A total of 3 subtypes can be distinguished. Jugs with a triangular, thickened rim (LM W XA) have a rod handle, and almost all of them have a lenticular base.[251] The virtual absence of pinched out foot lobes in this subtype indicates that despite the fact that these jugs are sometimes manufactured in a deviant grey fabric and have a rod handle,[252] they possibly belong in Borremans and Warginaire's period I b (first half of the 12th century to 1175) rather than in period II (1175–1225).[253]
The other types of jugs (LM W XB and C) are far more difficult to date. They probably belong in period I up to and including period II b (between 1075 and 1125).[254]
The tall pots (LM W XII) and small beakers (LM W XIII) are also difficult to date precisely. Small beakers are lacking in Borremans and Warginaire's typology, though they are found in Hoei.[255] Both forms probably date from the second half of the 11th and from the 12th century.[256] The same probably applies to type LM W XII.

Whiteware with green lead glaze

LM W XIV Miniature pot

General characteristics and variability
Two fragments of globular miniature pots were recovered, including one rim fragment (fig. 145). The pots are too incomplete to allow an adequate description of the form. They have an unthickened rim which is flattened on the upper side and a globular body. The rim fragment has a rim diameter of 4 cm. Miniature pots of this kind are usually between 2 and 8 cm tall.

Fabric
The colour of the fabric is white. The tempering consists of very fine sand and grog. The outside and the upper part of the inside is covered with a lead glaze to which copper oxide has been added. The colour of the glaze is green to dark-green.

Chronology
The miniature pots form a geographically and chronologically close group. They are mainly found in early-urban contexts or sites connected with nobility in Germany.[257] Examples worth mentioning here are the finds from various excavations at Höxter, including: the investigation of the town hall (44 specimens from the town centre and 11 fragments from the excavation of the town hall),[258] the *Wüstung* Corvey near Höxter (*c.* 44 items),[259] the monastery at Roden (35 items),[260] Nienburg/Weser (22 fragments),[261] and Ribe (19 specimens).[262] In the Netherlands, as far as we know, a similar find was made in Zierikzee,[263] and at Wijk bij Duurstede.
The oldest items, date from the second half of the 11th century, most specimens, however, date from the 12th and 13th centuries.[264] Indications pointing to the production of these pots at the end of the 12th and the beginning of the 13th century were found in Epterode near Grossalmerode in the Kaufungerwald [265] and at

248 Verhoeven 1998, 68. See also: Janssen 1983, 193, fig. 2: 4.
249 Borremans & Warginaire 1966.
250 Borremans & Lassance 1987, 53–105; Giertz 1996, 55; Verhoeven 1998, 68.
251 Borremans & Warginaire 1966, 73–88; Clarke 1975, 178, fig. 2: 2 and 3.
252 Verhoeven (1998, 69) states that rod handles only occur from the late 12th century on, but the discovery of a number of jugs of Maasland ware with rod handles in the fill of a well, dendro-chronologically dated 1062 ± 8, at the Kerk-Avezaath-Malburg excavation, would imply – even if one assumed a life of c. 100 years – that this assumption is not entirely correct. Kleij 2000, 126–9.
253 Janssen 1983, 218, note 37.
254 cf. For subtype B: Clarke 1975, fig. 2: 1.
255 Giertz 1996, fig. 6: 2, 3.
256 Clarke 1975, 180 (fig. 4: 1, 2, and 3); Giertz 1996, period VII a/b, 55.
257 Inventory Dirks 1994; later supplements particularly for the eastern part of Germany, see Dirks 1998.
258 Dirks 1994, 229.
259 Dirks 1994, 229.
260 Röber 1990, 49.
261 Dirks 1994, 229.
262 Madsen 1991, 430–7.
263 Personal communication: H. Uil, Werkgroep Stadsarcheologie Zierikzee.
264 Dirks 1994, Abb. 4, 233.
265 Stephan 1987, 430–7.

Bensdorf in the Reinhardswald, both in Hessen.[266] The fragments from Steimke in Bramwald, which were probably produced in the Reinhardswald and glazed in Bramwald, date from the first half of the 13th century.[267] In the 13th century, similar miniature pots were also produced in Coppengrave, Landkreis Hildesheim,[268] and in Paffrath in the German Rhineland. Production ceased at the end of the 13th century. With the exception of six specimens which were placed as reliquaries in a pillar of St. Godhard's church in Hildesheim, the function of these pots is not entirely clear.[269] They are often interpreted as children's toys, following the miniature pots found in children's graves from the Roman Period, but there is virtually no evidence to support this.[270] On the basis of the glaze covering the entire surface, one might consider the possibility of a container for precious liquids, salves etc. as, for instance, cosmetics, oils, herbs, medicines or perfume.[271] The pots were probably sold together with their contents, and have been found as far north as Scandinavia. It is conceivable that, after use, the pots served as toys.

Proto-stoneware

A total of 38 sherds of proto-stoneware were found in Hoogstraat III, including two rim fragments and several bases. It is not possible to draw up a typological classification of the proto-stoneware on the basis of the material from Hoogstraat III. We shall have to wait until the proto-stoneware material from other sections of the Dorestad excavations has been analyzed before a more detailed classification of this material can be prepared.

In the case of the proto-stoneware pottery from Hoogstraat III, we are probably dealing with tall, cylindrical jugs with a strap handle and pinched out foot-ring. One rim fragment (fig. 146: 1) has several heavy, projecting ridges on the outside and is thickened on the upper side obliquely inverted. The jug has a ribbed cylindrical neck. There is a groove on the inside of the neck. The strap handle is attached to the shoulder just below the upper side of the rim. The rim opposite the handle is slightly pinched out to form a spout. The jug has a slightly globular body. The rim fragment in figure 146: 2 has less clearly pronounced ridges on the outside. The upper side of the rim is thickened a little and obliquely inverted.

The jugs are made of partly sintered clay. The largest fragment has an oxidizing, orange-brown surface and is orange on the break. The other fragment is orange in colour. The tempering of both fragments consists of fine sand and grog. The fabric shows some similarity to fabric LM W-3, but is more coarsely tempered. The other proto-stoneware sherds are tempered with fine sand, sometimes with slightly larger inclusions which project through the outside of the wall, causing the surface of the sherds to feel rough to the touch. The colour of the fabric varies from grey to brown.

Dating

The proto-stoneware can be roughly dated within the period 1200–1280.[272] The typical Pingsdorf forms such as the spouted pot and painted decoration disappeared at the end of the 12th century. Proto-stoneware sherds are generally slightly thicker than those of Pingsdorf ware, in addition to which, proto-stone ware is more coarsely tempered and therefore rougher to the touch. In the course of time the handles became thicker and the foot-rings heavier and less pronounced, and the spout was replaced by the pouring lip. The rims are also sturdier than those of the Pingsdorf types. The jug fragments in Hoogstraat III have a rim profile which is characteristic of Rhineland material from the first quarter of the 13th century.[273]

Stoneware

The stoneware consists of fully sintered pottery. A total of seven stoneware sherds were excavated in Hoogstraat III, including two small rim fragments of slim cylindrical jugs (fig. 147: 1–2), and a strap handle and several bases with a pinched

266 Leineweber 1982, 22.
267 Heege 1993, 42.
268 Stephan 1981, 77.
269 Keller 1988, 33.
270 Speck 1993, 13–25.
271 Stephan 1986, 229; Gläser 1989, 557; Madsen 1991, 432.
272 Bartels 1999, 44–7.
273 Parallels from Siegburg: Beckman 1975, Tafel 15–7. However, the dates in Beckman are often incorrect. Dates: Alders 1985: 1200?–1250; Janssen 1988: 1200–1250; Bartels 1999, 527, fig. 1–4: 1220–1240.

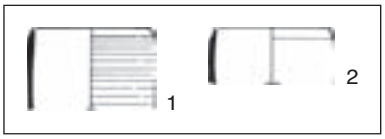


Fig. 147 Dorestad, Hoogstraat III: stoneware.

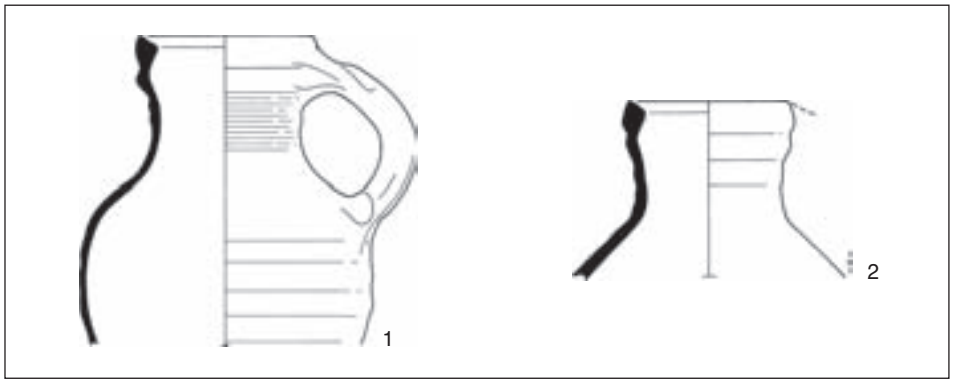


Fig. 146 Dorestad, Hoogstraat III: proto-stoneware.

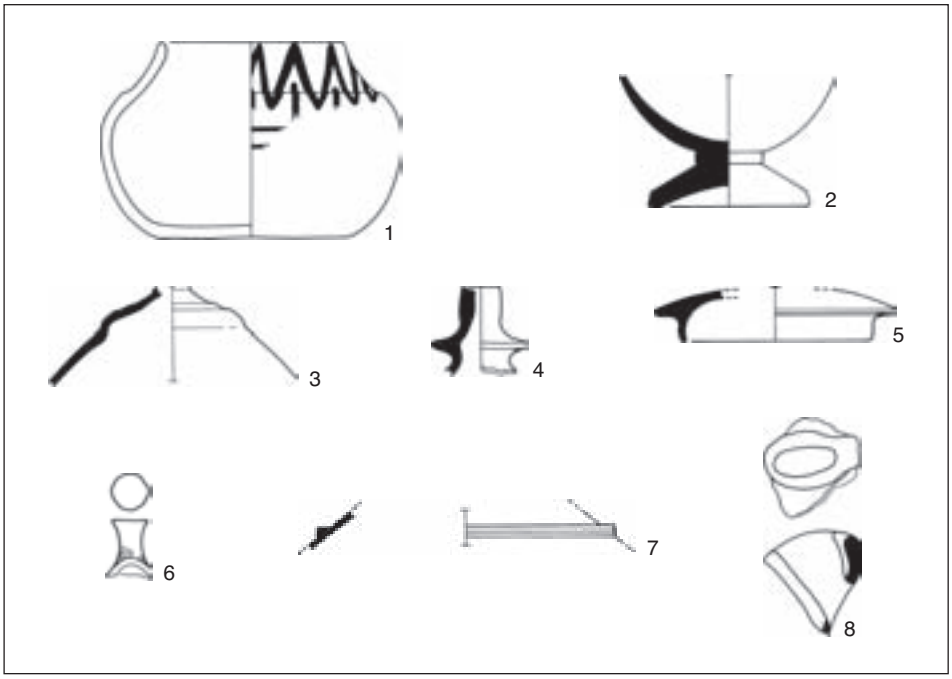
out, pronounced foot-ring. One of the wall fragments has a rosette-shaped appliqué, and probably originates from a 15th-century funnel beaker. The quantity found is too small for a typological classification.
The fabric is greyish-white in colour and does not have iron engobe and/or salt glaze. There are, however, orange patches on most of the sherds which were probably caused by wood ash blowing around in the kiln.[274]

Dating
The transition from near-stoneware to fully sintered stoneware took place between 1270 and 1290.[275] Stoneware without slip or salt glaze was mainly produced in the 14th century. Judging from the colour of the fabric, the material probably originates from Siegburg.

Miscellaneous
A number of sherds cannot be attributed to a specific pottery group since their form and/or fabric lies beyond the scope of the classification system used here. The most striking rim and base fragments from this group are described below.
- 1 Almost complete pot (fig. 148: 1), whose fabric and form and decoration differ too much from the classification system used here. The rim is slightly everted, is rounded off and unthickened. The transition from rim to neck is smooth, and the shoulder is marked by a horizontal groove. The pot has a globular body and a virtually flat base. The underside of the base is slightly irregular and concave.
  The pot is slightly uneven in form, giving the impression that this is a poor-quality product which did not come from one of the major pottery-making centres.
  The decoration consists of orange paint-stripes in a geometrical pattern on the upper part of the pot in the form of a horizontal band of triangles with short, vertical stripes inside them. There are also painted figures below the horizontal band. No clear pattern can be detected here, since this part of the pot's surface is worn.
  The fabric is greyish-white in colour. The tempering consists of fairly coarse sand, which partly projects through the wall of the pot and which has been drawn over the surface during the finishing. In a number of places one can clearly see that the surface has been smoothened. It is not clear where this pot was manufactured. The fabric, form and pattern of decoration deviate from those of the Pingsdorf material. In view of the form and decoration, it is probably not a product of Zuid-Limburg.
- 2 Base sherd (fig. 148: 2), consisting of a foot, a stem and a wall. The foot is quite thick and has been trimmed along the edges and the underside. Just above the base the fragment has a short, cylindrical stem, which is accentuated by two horizontal grooves. The stem supports a cup-shaped body, the upper part of which is missing.

274 Moerman 1959.
275 Alders 1988.

Fig. 148 Dorestad, Hoogstraat III: miscellaneous.



The fabric is similar to fabric LM W-2, so one would naturally assume that the object was made in the German Rhineland – possibly in the Pingsdorf area.

- 3 Fragment of a lid (fig. 148: 3). The body, to which part of a knob was attached, shows a sharp angle which is accentuated by a ridge. The upper part of body and rim are missing. The fabric resembles fabric LM W-1: sandy and smooth. The colour is yellowish-grey. This specimen can be compared to a lid from the Hoogstraat I excavation.[276] Both lids date from the Late Middle Ages. This type of lid was produced in the Meuse area and German Rhineland.[277]
- 4 Sherd (fig. 148: 4), probably the upper part of a lid. The handle has a small hole in the top and a collar halfway up the stem. The fabric may be compared to fabric LM W-1: soft and rather smooth; the colour is white.
- 5 Fragment of a lid (fig. 148: 5). It has an almost vertical rim with a ridge. Only a small part of the conical body has been preserved. The fabric can be compared to that of Maasland ware. There is, however, no glaze present on the sherd. The fabric is yellow in colour.[278]
- 6 Handle of a rattle (fig. 148: 6). The handle has a biconical shape and is decorated with lead glaze. This type of rattle was probably mainly manufactured in the Meuse area.[279]
- 7 Part of a conical lid (fig. 148: 7), with a horizontal ridge on the outer side. The fabric resembles fabric lm W-1, but has a higher degree of porosity.
- 8 Spout (fig. 148: 8), tubular and slightly flattened, and attached to the upper side of the rim. The outer side has been attached to the wall and trimmed.

The fabric is orange-yellow in colour, tempered with coarse quartz sand, and shows some similarity to Dorestad fabric EM W-3. Possibly this is a Late-Pingsdorf product with a relatively coarse tempering, although an older dating cannot be excluded.

1.4.2 Late Medieval handmade pottery

Fabric LM H-1 This fabric is stone-gritted. It differs from fabric EM H-1 mainly in that it is better fired (harder) and usually contains a smaller number of large stone particles. However, the composition of the gritting material shows much variation. Sometimes pottery grit has been added. Many sherds have a fair number of relatively large stone fragments penetrating the outer and inner surfaces. The colour of the fabric is predominantly grey and black.

276 Van Es & Verwers 1980, 111, fig. 62: 26.
277 Verhaeghe 1995, 159, fig. 112; Giertz 1996, 43, fig. 3: 24–6.
278 Verhaeghe 1995, 159, fig. 112.
279 Borremans & Warginaire 1966, 49, photograph no. 40, fig. 20: no. 3 and fig. 21: nos. 9–10.

It is mainly the combination of harder firing and finer tempering which distinguishes this fabric from that of the Carolingian *Kugeltopf* (EM H-1). It is not as brittle and, on the whole, it is less coarsely tempered. The two fabrics, however, are very similar and the attribution of individual sherds to either one of them may be extremely difficult.

Fabric LM H -2 This fabric is sand-gritted. Sometimes pottery grit or shell is also added. It differs from the EM H-fabrics mainly in that it is much harder. The size of the tempering varies from very fine to fine, rounded grains of sand. Relatively many sherds present a section with a black core surrounded by a lighter, grey outer surface. Some sherds have a grey core surrounded by a yellow or orange outer surface. The fabric is dense and solid. The outer and inner surfaces are more or less smooth, but they may also have a pimpled appearance as a result of the gritting ingredients showing through.

LM H I *Kugeltopf*

General characteristics:
1 probably convex base with fluent transition from base to body; foot-rings occur occasionally;
2 globular or bag-shaped body with fluently curved profile;
3 fluent transition from body to neck; sometimes the shoulder is thickened;
4 rather long, everted neck;
5 relatively wide mouth;
6 medium-sized or large;
7 decoration rare: almost exclusively large and shallow; roundish or oval finger-impressions;
8 stone- or sand-gritted fabric: LM H-1, LM H-2.

Variability and subdivision
No complete specimens were found, so the exact shape is unknown. No information is available about the lower part of the pots in particular. There is some variation in size. Small specimens are, however, rare exceptions. The outer rim-diameter usually exceeds 15 cm. The width of the shoulder also varies, but most sherds have a rather broad and bulging shoulder.
Five subtypes (LM H IA, B, C, D, E) have been distinguished on the basis of differences in the shape of neck and rim, not to mention the usual transitional forms, which hamper determination in individual cases. In generation however, the subtypes can be clearly separated.
The overall similarity in shape of the type under discussion to the *Kugeltopf* of type Dorestad EM H I is evident. The difference mainly lies in the fabric and sometimes in the rim shapes.

Decoration
Decoration is rare, but not much rarer than in type EM H I. It occurs on rim-sherds of all three subtypes in a frequency of about 4–5 %. The ornament is, however, more uniform than in the case of EM H I, as it is practically restricted to one kind of decoration: rather large oval or roundish impressions, placed on the shoulder just below the neck (compare EM H I, decoration *c*, fig. 149: 14–5, 21; fig. 150: 10; fig. 151: 10).
The impressions may have been made with the thumb or a finger, and they are usually found in pairs. Two impressions of each pair are set close together. The complete pattern may have consisted of a row of widely spaced pairs encircling the neck.

Stamped ornament (EM H I, decoration *a*) occurs on two rim-sherds of subtype LM H IA (fig. 149: 12–3, fig. 151: 19). Rouletted ornament is found on a rim-sherd attributed to subtype LM H IC (not illustrated).
A few wall-sherds which may come from pots of the type under discussion bear a decoration (cross-barred triangle?) or rouletted ornament. One wall-sherd is decorated with wavy lines.

LM H IA The characteristic feature of the subtype is its usually rather long, everted neck and unthickened rounded rim (fig. 149). There is some variation in the position of the neck, which is mostly in an oblique position but may occasionally have been bent out almost horizontally. Most necks are straight, some are slightly curved. The relative length of the neck allows for some variation.
The distinction from subtype LM H IB, -C and -D, is to some extent obscured by the occurrence of intermediate forms. Subtype h ia, is not basically different in shape from type Dorestad EM H IA.
There is variation in size, but the average outer rim diameter of most pots is well over 15 cm. A few specimens have a small diameter (fig. 149: 28). In most cases the complete shape of the vessel is unknown. Most of the pots have a rounded base. There is some variation in the width of the shoulder and the length of the neck.
One rim-sherd attributed to this type has a bar-lip (*Schwalbennest*) that is attached to the outside of the upper part of the rim (fig. 149: 27); another one possesses a short tubular spout (fig. 149: 16).
Two types of decoration occur:
a oval impressions at the base of the neck (fig. 149: 14–5, 21);
b stamp impressions at the base of the neck (fig. 149: 12–3).
Both large and small varieties are mainly manufactured in fabric H-2, but fabric H-1 also occurs occasionally. There is some variety in the hardness and the amount and size of the tempering elements. Some specimens in fabric H-2 have a grey outer surface and a black core. They are tempered with fine quartz sand. The outer surface is sometimes uneven but the inner surface is smooth. They form a separate group within this subtype.
Relatively few sherds are orange or red in colour. The core of these specimens is grey.

LM H IB The two distinctive features of the subtype are: a relatively long, everted neck with hollow inside, and a thickened, rounded rim (fig. 150). Characteristic representatives of the type posses the two features in combination, but rim-sherds showing only one of these two elements have also been included. All rims are round, but some of them are only slightly thickened, or even unthickened. The hollow on the inside of the neck is not always well pronounced. Consequently, the distinction between subtypes LM H IA and -B becomes blurred and the attribution of individual sherds may present difficulties. The characteristic form – the thickened, sometimes moulded rim – has no forerunner in the Carolingian *Kugeltopf* types. The relatively few sherds with really moulded rim usually have a ridge on the outside at the base of the neck. This ridge forms an indication that the moulding of the rim was effected by some kind of special treatment, possibly by means of a wooden implement (*Formholz*). These moulded rims belong to large pots in a grey fabric, sometimes with a dark grey or black core, reminiscent of the so-called late medieval Greyware. They constitute a separate group within the subtype. This subtype consists almost only of pots with an outer rim-diameter above 15 cm.
Decoration is rare: only oval impressions at the base of the neck are known.
Pots of this subtype are manufactured in fabric H-1 and especially in fabric H-2. There is some variation in the hardness and the amount and size of the tempering elements. Most vessels have a grey outer surface and only seldom does an orange-red outer surface occur.

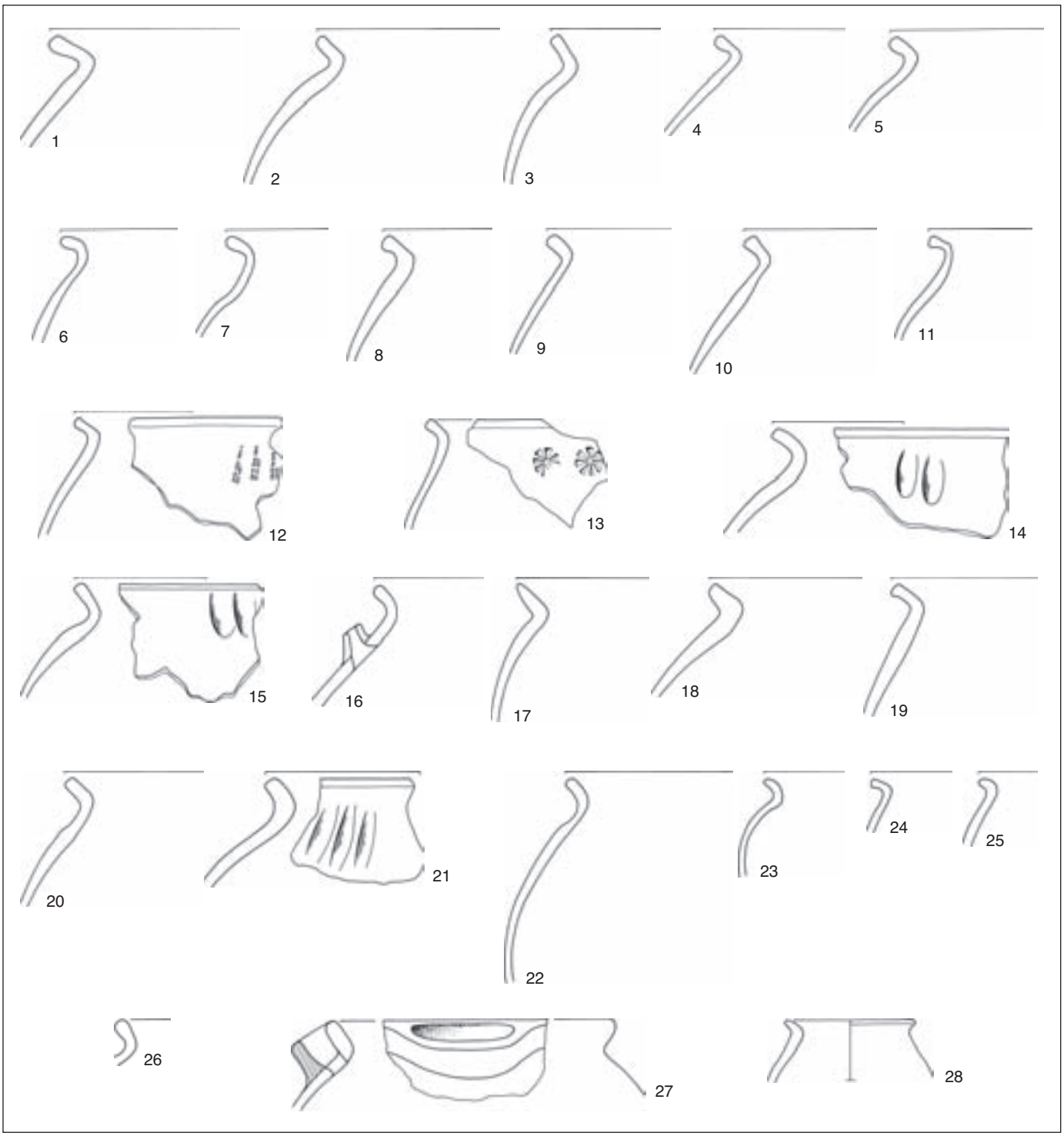


Fig. 149 Dorestad, Hoogstraat III: type LM H IA; 28 small model.

LM H IC The principal characteristic is the flattened and bevelled rim (fig. 151). There may have been a groove just inside the rim. The rim is usually slightly widened. Its position is not always oblique but, occasionally, almost horizontal. The relatively long, everted neck is almost straight, rarely slightly curved. In exceptional cases, the inside of the neck is vaguely hollow. The shape is similar in all aspects to that of the Carolingian 'Dorestad EM H IC type'. The outer rim-diameter of the large vessels is over 15 cm. Small specimens were also represented in this type (fig. 151: 17–9). Decoration is rare: oval and round impressions at the base of the neck (fig. 151: 10 and 19).
The pots of this subtype are mainly manufactured in fabric H-2. There is some variation in the hardness of the fabric and the number of tempering elements. Most sherds are in a grey fabric that is tempered with fine sand. Only a few specimens are tempered with coarse sand. One fragment (fig. 151: 12) is hard fired and tempered with fine quartz sand. The outer surface of the sherd is grey. The core is partly orange and partly grey. Only a few sherds have an orange or red outer surface.

LM H ID The most distinctive feature of the subtype is an everted, thickened, angular rim with a grooved inner edge (fig. 152). Several variations in the shape of the rim can be distinguished. The common rim profile is angular. The outer edge of the rim may be slightly rounded (fig. 152: 4). Especially rounded specimens resemble rims of type H IB; but they are ascribed to h id because of the presence of a grooved inner edge. In most cases the rim is bent horizontally, but sometimes the rim stands out obliquely. The pots have a short, everted neck. In some cases there is a ridge on the neck (fig. 152: 1–2). This subtype only consists of pots with an outer rim diameter well over 15 cm. No decoration was found.
The subtype is manufactured in fabric H-2. The tempering consists of very fine sand. One specimen is tempered with fine sand and pottery grit. The outer surface of the sherds is grey. The core is darker: dark grey or black.

LM H IE This subtype has a vertical, thickened rim and no neck. The rim forms a kind of collar around the mouth of the vessel. This collar is slightly everted. The inside of the rim has a shallow groove. In section, the shape of rim e is roughly round. The underside of the rim leans slightly inwards. The transition from body to rim is sharply defined, giving the pot a rather broad shoulder. The Hoogstraat III material has yielded one specimen of this subtype (fig. 153). No decoration was found.
The vessel is manufactured in fabric H-2. The tempering consists of very fine sand. The outer surface is light-grey; the core is orange.

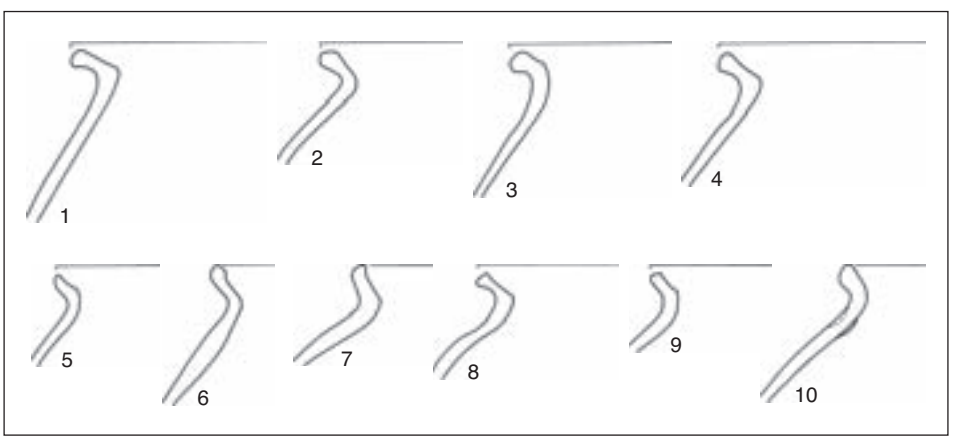
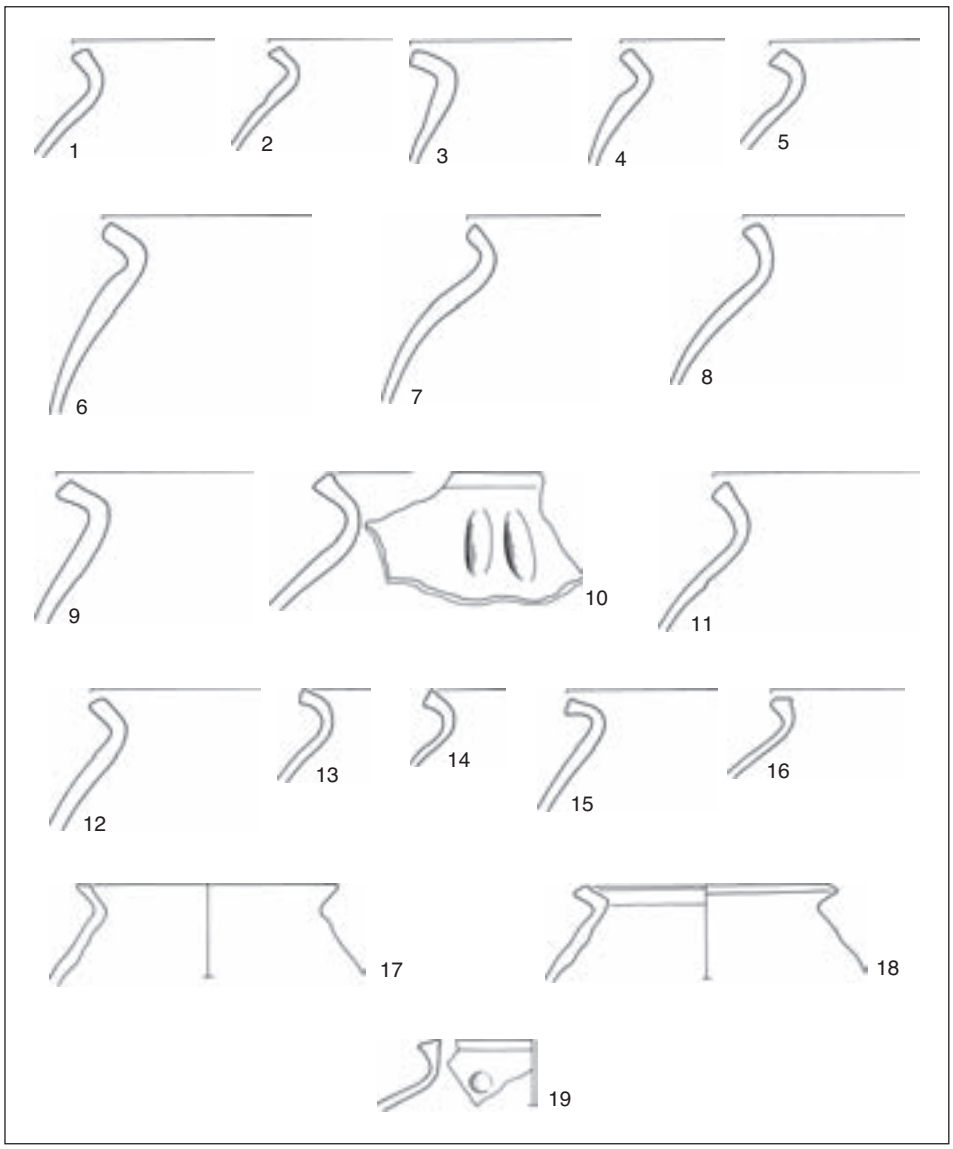


Fig. 150 Dorestad, Dorestad, Hoogstraat III: type LM H IB.

Fig. 151 Dorestad,Dorestad, Hoogstraat III: type LM H IC; 17-19 small model.



Chronology

No clear dates for the various types can be given on the basis of the finds from Hoogstraat III. There is a great variety of rim forms and tempering. The fact that sand-tempered material occurs relatively frequently (H-2) could point to a 10th–12th-century dating, but the rim forms appear to link up perfectly with the Carolingian types, so that some types possibly even date from the 9th century. The virtual absence of foot-rings, brushed decoration and dish-shaped pot types are an indication that the youngest material dates from the beginning of the 13th century.

The Hoogstraat III material is largely similar to that of, for example, Tiel. There, type lm h ic is lacking;[280] subtype lm h ia is the successor to Dorestad type EM H IA. A fragment with a similar rim profile – plus fingertip impressions – from the Deventer-Sandrasteeg excavation, dates from the 10th–11th century. This type probably remained in use for a reasonably long time.[281] The *Kugeltopf* rim-types I–V, distinguished in Oost-Souburg, are also represented in the Hoogstraat-III material by one or more specimens.[282] Type lm h id, made in a grey fabric, forms a remarkable group. The rims of these pots are carefully finished and possibly turned once on a

280 Dijkstra 1998, 37–8, fig. 25; Van Doesburg & Bakker 1999, 38–9, fig. 28.
281 Magdelijns et al. 1996, 152, fig. 14: 1.
282 Van Heeringen et al. 1995, 148–53.

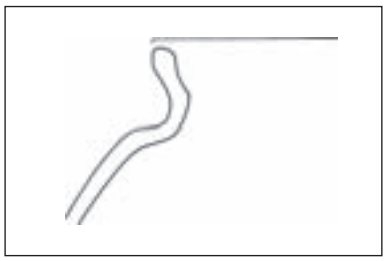


Fig. 153 Dorestad, Hoogstraat III: type LM H IE.

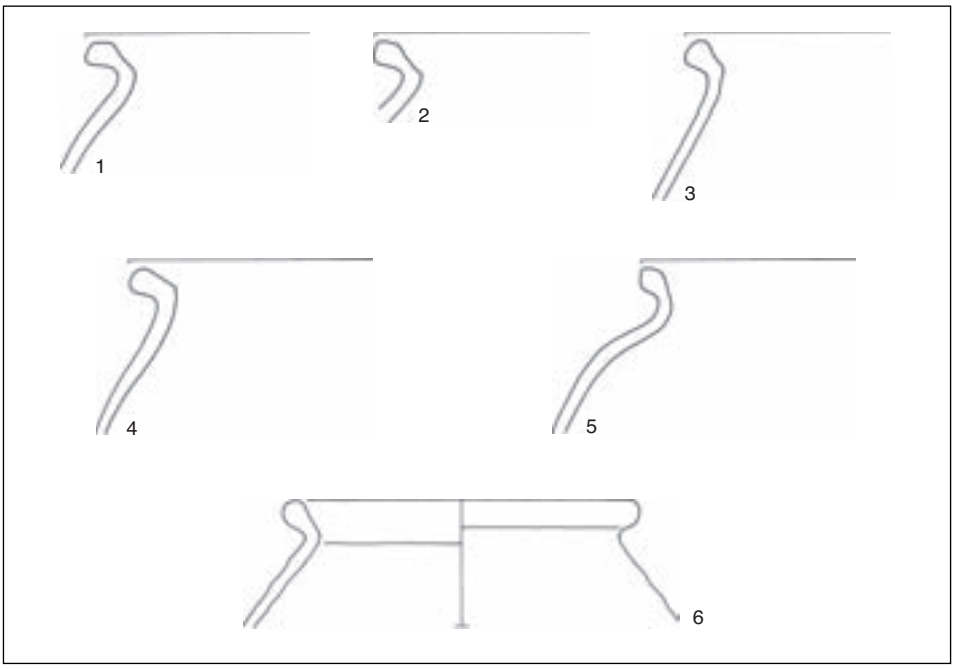


Fig. 152 Dorestad, Hoogstraat III: type LM H ID.

slow wheel. Similar pots have also been found in Rotterdam, Utrecht and Tiel, so that this is possibly a regional rather than a local product.[283]

LM H II 'Frying-pan'

General characteristics:
1 probably flattened convex base;
2 fluent transition from base to sides;
3 wide, shallow body; fluently curved sides;
4 simple rim;
5 hollow socket attached to the rim; the socket points obliquely upwards;
6 no decoration;
7 fabric LM H -1 and 2.

Variability
No complete specimens have been found. No subdivision could be made because of the small amount of available specimens. The socket is rather short (fig. 154) and in most cases shorter than that of most Carolingian specimens. Apart from that it is not easy to make a distinction between this type and the Carolingian frying-pans EM H II.[284] The main difference lies in the fabric, which is much better fired than fabric EM H-1 and 2.

Paffrath
Fabric LM H-3 The pottery is tempered with fine, homogeneous sand. The tempering elements sometimes project through the wall, making the surface feel rough. The sherds generally have a clear layering in cross section. The material at the break is white. The surface is pale grey, often with a blue or black metallic sheen on the outside. The pots are fired extremely hard.

283 Dijkstra 1998, 38.
284 Van Es & Verwers 1980, 199, fig. 67; Van Heeringen et al. 1995, 152, fig. 103.

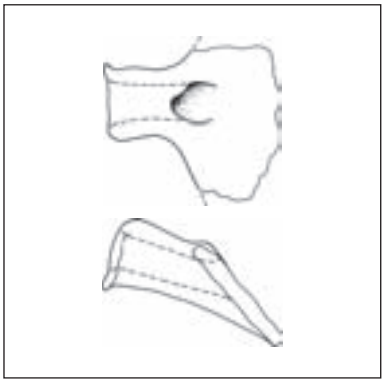


Fig. 154 Dorestad, Hoogstraat III: type LM H II.

Chronology
Although Lung had already come to the conclusion in the 1950s that the pottery he discovered during his investigation of kilns in Paffrath had to be dated from the 10th to the 13th century, it was still assumed, until recently, that the earliest imported Paffrath products in the Netherlands dated from the 11th century.[285] The recently-published finds from Oost-Souburg,[286] Tiel-Koornmarkt and -Tol Zuid,[287] and Rotterdam-Blaak,[288] have also revealed that the import of Paffrath pottery was already under way in the 10th century. The rims forms of these early imports deviate from those of later Paffrath pottery.[289] Subtype LM H IIIA may perhaps be included among the early rim forms. The later pots have sharp, bevelled edges, similar to those of subtype LM H IIIB. They probably date from the 11th–12th century.

LM H III Pot

General characteristics:
1 probably convex base with fluent transition from base to body;
2 globular or bag-shaped body with fluently curved profile;
3 more or less fluent transition from body to neck; sometimes the shoulder is thickened;
4 sometimes relatively long, everted neck; also short necks occur;
5 relatively wide-mouthed;
6 medium-sized;
7 decoration very rare: exclusively small and shallow, roundish or oval finger impressions;
8 sand-gritted fabric: LM H -3.

Variability and subdivision
Only sherds of medium-sized *Kugeltöpfe* of this material were found in Hoogstraat III. No complete specimens were found, but enough is known about the complete form from other complexes. The size of the pots is fairly uniform. The diameter of the outer rim varies from 10 to 12 cm. In most cases one can clearly see how the pot has been constructed, and how – during the production process – a clay coil was attached to the upper side of the finished body of the pot from which neck and rim were made. At the spot where this coil was attached there is a bulge, giving the pot a distinct shoulder. Sometimes thumb impressions are visible on the shoulder, possibly connected with the method of production. The rim has usually been turned again later on a slow wheel. Two subtypes (LM H IIIA, -B) have been distinguished on the basis of differences in the shape of the rim. There are transitional forms, which hamper determination in individual cases. These subtypes correspond to types 1a and b in Lung's classification.[290] A number of sherds with a slightly deviant fabric (not stratified at the break) though with the typical Paffrath form (a clear shoulder bend and a triangular, outwardly bevelled rim) have been included in this group. The pots from which the sherds come were probably produced in the immediate surroundings of Paffrath. Most of the pots show signs of rust, which leads one to suspect that they served as cooking-pots.

LM H IIIA The main characteristics of this subtype are: a thickened rim, rounded off or bevelled on the upper and outer side, and a relatively long neck (fig. 155: 1–4). The rim is usually slightly everted and sometimes there is a narrow groove present on the inside. The neck is also slightly everted. Decoration is absent.
The colour of the fabric varies from blue-grey to almost white. Most sherds have a metallic sheen; the inside is often lighter in colour.

285 Lung 1956; Bult 1994.
286 Van Heeringen 1995, 154.
287 Dijkstra 1998, 35–6.
288 Carmiggelt & Guiran 1997, 97.
289 See: Carmiggelt & Guiran 1997, 98, fig. 29: 7–10; Verhoeven 1998, 72, rim-types 1 and 2.
290 Lung 1956.

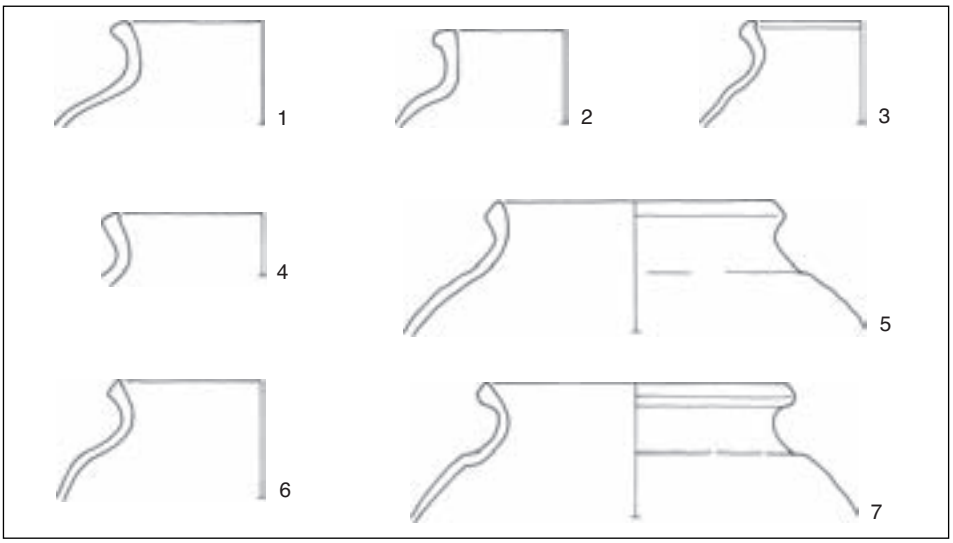


Fig. 155 Dorestad, Hoogstraat III: Paffrath, type LM H III: A 1-4, B 5-7.

LM H IIIB This subtype is characterized by a thickened, triangular, outwardly bevelled rim (fig. 155: 5–7). Sometimes there is a groove on the inside of the rim. The rim itself is usually slightly everted, although some slightly inverted rims also occur. There are specimens with a relatively short neck as well as specimens with a longer neck; pots with a short neck are the most common. Most specimens have a distinct, thickened shoulder; this subtype was also found in Hoogstraat I.[291]
Decoration is rare: only oval impressions at the base of the neck are known.
The colour of the fabric is usually blue-grey with a metallic sheen, White sherds are only rarely found. The inside is often lighter in colour.

Chronology
Paffrath pottery is dated by Lung in the 10th–13th century. Based on the results of the pottery analysis from various excavations in Tiel it can be concluded that Paffrath pottery in the central river-area first appeared in the first quarter of the 10th century.[292] Subtype lm h iiia probably belongs to the earliest Paffrath forms; subtype LM H IIIB mainly dates from the 11th–12th century.

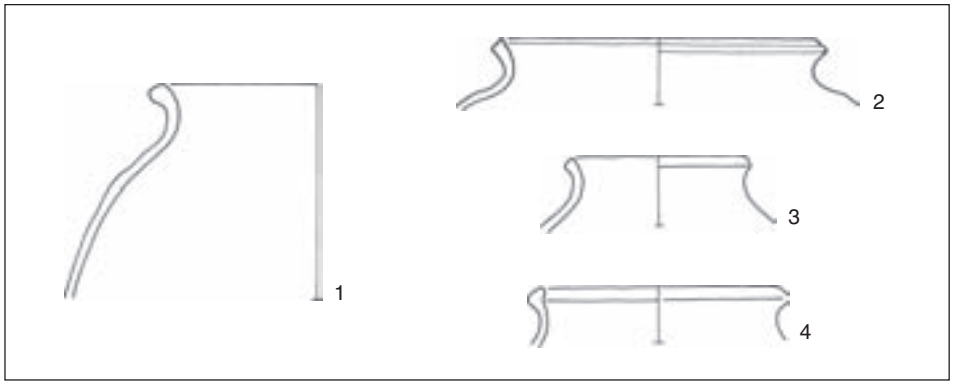
Handmade Pingsdorf

LM H IV Globular pot

A small quantity of handmade Pingsdorf pottery was discovered in Hoogstraat III. However, this did not include any complete specimens, so that we are dependent on parallels known from the literature for the determination of the pot forms. These are small, bag-shaped pots with a short, slightly everted neck and a thickened , triangular, outwardly bevelled rim (fig. 156).[293] The rim form strongly resembles that of *Kugeltöpfe* of Paffrath pottery. Most of the specimens found in Hoogstraat III have a smooth transition from neck to body, without any clearly pronounced shoulder.
The main difference between these pots and the Paffrath *Kugeltöpfe* are the fabric and the absence of a clear shoulder bend. No decoration occurs.
The colour of the fabric is off-white or grey. The Pingsdorf *Kugeltöpfe* are tempered with fine sand. The fabric is more or less similar to that of LM W-2.[294] In contrast to those from Paffrath, the Pingsdorf *Kugeltöpfe* are not layered in cross section.

291 Van Es & Verwers 1980, 130–1, fig. 78.
292 Dijkstra 1998, 35–6.
293 cf. Verhoeven 1998, 72, rim-type 3A–C; Sanke 2003, 327, rim forms 8.3 and 8.4.
294 Sanke (2002) distinguishes between Grau- and Irdenware, 182.

Fig. 156 Dorestad, Hoogstraat III: Pingsdorf hand-made, type LM H IV.



Dating
Small handmade *Kugeltöpfe* with a bevelled, triangular rim were already produced in reasonably large quantities in the first half of the 12th century, but the greatest production is slightly later, in the second half of that century.[295] Handmade Pingsdorf *Kugeltöpfe* are still found in reasonable quantities in the 13th century too.[296]

Elmpt ware
Fabric LM H-4 The pottery is tempered with quartz sand or very fine grit, and is reduced. Sometimes a few larger tempering elements occur, which project through the outer wall. Most sherds are grey or blue-grey in colour, often with a metallic sheen on the outside. The surface has sometimes flaked, leaving white patches. Most of the sherds are light-grey or white/buff at the break. The material is extremely hard fired.

LM H V Kugeltopf

General characteristics:
1 probably convex base with fluent transition from base to body;
2 globular or bag-shaped body with fluently curved profile;
3 fluent transition from body to neck; sometimes the shoulder is thickened;
4 rather short neck;
5 relatively small mouth;
6 medium-sized or large;
7 decoration is absent;
8 sand-gritted fabric: LM H-4.

Variability and subdivision
No complete specimens were found in Hoogstraat III. This group is only represented by a total of six rim-sherds, all belonging to one and the same type: the globular *Kugeltopf*. There is some variation in size; there are no small specimens. The outer rim diameter exceeds 15 cm. Two subtypes (LM H VA, -B) have been distinguished on the basis of differences in the shape of the neck and rim. Similarity in shape between this type and the late-medieval *Kugeltopf* (LM H I) is evident. The difference lies in the fabric.

LM H VA
The two distinctive features of the subtype are: a relatively short neck and a thickened, rounded rim (fig. 157: 1–2). Characteristic representatives of the type possess both these features, but rim-sherds with only the first of these two elements have also been included. All rims are rounded, but some of them are only slightly thickened, or are even unthickened (fig. 157: 1–2). This subtype shows a great similarity to type LM H IB. The main difference lies in the fabric, which is harder and tempered with quartz sand. Decoration is absent.

295 Janssen 1987, 98; Sanke 2003, 182.
296 Verhoeven 1998, 74–8; Sanke 2003, 182–3.

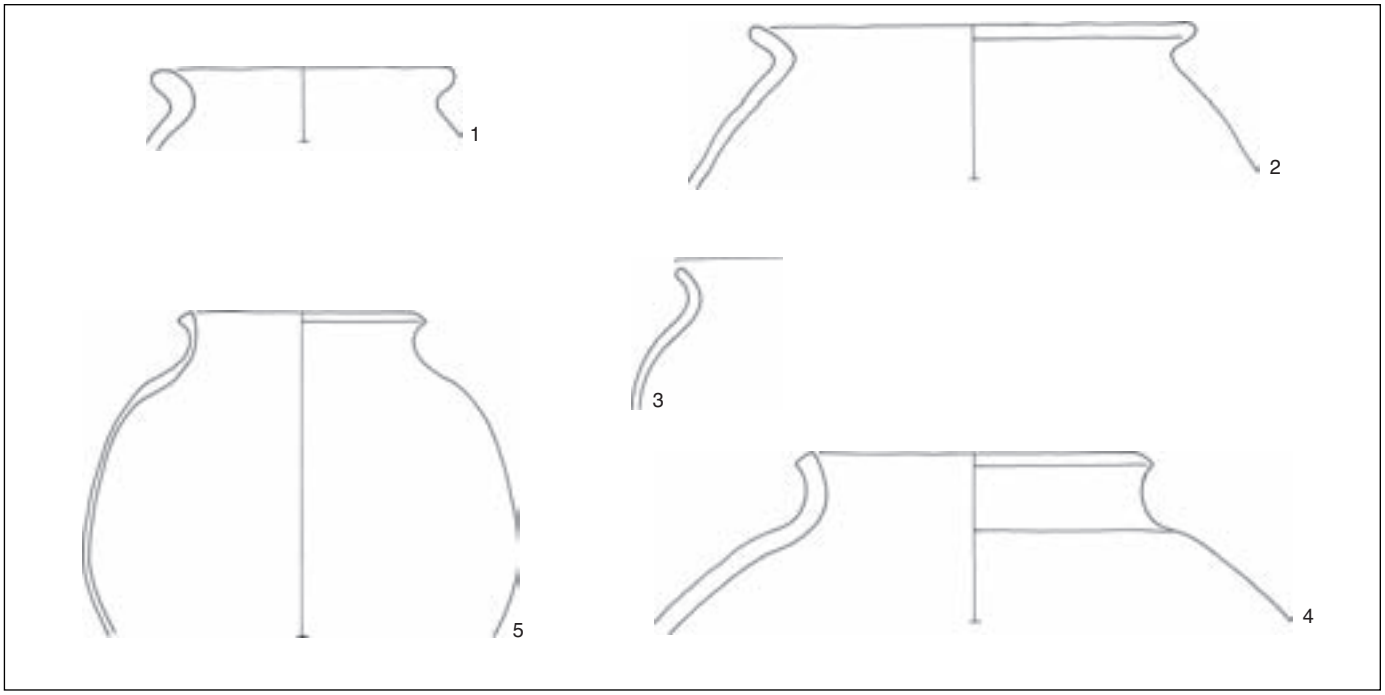


Fig. 157 Dorestad, Hoogstraat III: Elmpt, type LM H V: A 1-2, B 3-4.

LM H VB The most important feature is the thickened, triangular, outwardly bevelled rim (fig. 157: 3–4). This subtype has a distinct neck, which is virtually straight; as a result, the rim is generally slightly everted. Most specimens have a well-defined, thickened shoulder (fig. 157: 2–3). The rim form of this subtype somewhat resembles type LM H IC, but it has a different fabric. Decoration is rare: only oval impressions at the base of the neck are known.

LM H VI Bowl

This type is represented by two rim-sherds (fig. 158: 1–2). The base is missing, so the complete shape cannot be described. The rim is not thickened and is inwardly bevelled. There is rilling on one of the rim fragments, so it is possible that this specimen was partly or wholly wheel-thrown.

Chronology

Type LM H V shows some variation in rim forms. Unthickened, everted rims occur, as well as triangular, outwardly bevelled and thickened everted rims. As far as could be determined, the various rim forms do not have any chronological significance. Elmpt pottery was produced in a large number of centres, including Elmpt and Brüggen, Brunssum-Schinveld, Oebelt, Brühl, and possibly also Siegburg. In the literature, Elmpt ware is often dated between the middle of the 12th and the beginning of the 14th century.[297] The analysis of the pottery from various excavation sites in the centre of Tiel has shown that Elmpt ware, or a fabric group related to it, also occurred there around 1150. This early material is tempered with sand or very fine grit, and is reduced. Occasionally it has a red core.[298] The possibility cannot be excluded that some of the Hoogstraat-III pottery may also belong to this group, although rim form LM H VB, which appears to be younger, is also found here.

297 Verhoeven 1989, 225. The earliest dating here is given as the second and third quarter of the 12th century.
298 Dijkstra 1998, 35.

Fig. 158 Dorestad, Hoogstraat III: Elmpt, type LM H VI.

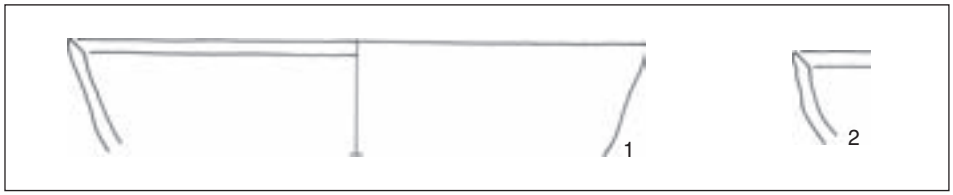
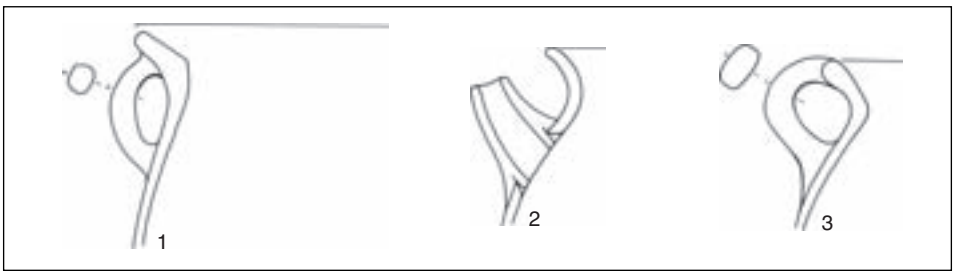


Fig. 159 Dorestad, Hoogstraat II-III: Jyde pots, type LM H VII.



Jyde pots

Fabric LM H-5
The clay is tempered with fine sand and mica. The fabric is dark-grey or black in colour. On the outside, the surface is shiny, possibly a result of the firing process. There are also indications that the surface was sometimes polished.

LM H VII Jyde pot

General characteristics:
1 probably convex base with three supports;
2 globular body with fluently curved profile;
3 fluent transition from body to neck;
4 rather short, everted neck;
5 relatively wide mouth;
6 medium-sized;
7 decoration is absent; handles as well as a tubular spout occur;
8 sand-gritted fabric: LM H -5.

Variability
This type consists of wide-mouthed pipkins with rod handles on tall feet. One specimen has a tubular spout which is attached to the outside of the wall (fig. 159: 2). There is some variety in rim forms. Thickened as well as unthickened rims occur. The rims are everted and rounded on the upper side. One specimen has a sharp bend on the inside, at the transition from rim to wall (fig. 159: 1).

Dating
The name 'Jyde pot' refers to the main centre of production: the mainland of Denmark (Jutland). However, this type was also made on the Danish islands. The range of forms comprises large pipkins, bowls and pots. Jyde pots have been found at various sites in the Netherlands.[299] They occurred there from 1575, with a boom in the 17th and 18th century, disappearing after 1900.

1.4.3 Conclusions about the late-medieval pottery
A section of the riverbed area at Dorestad remained in use until the Late Middle Ages. This is demonstrated by the late-medieval pottery found during the excavations along Hoogstraat, particularly in Hoogstraat III. A number of sherds show features indicating movement through water, such as a weathered surface and rounded off breaks. Some of

299 Van Reenen 1992; Van Reenen & Jensen 1995.

these finds came from archaeological contexts, but the majority was found in the various fluvial sediments. Consequently, and also based on the distribution pattern of the various types, it can be concluded that most of the material had been shifted by water. For this reason, a typo-chronological classification of the late-medieval material from the riverbed is not possible, in contrast to the Carolingian material from Hoogstraat I.
The oldest late-medieval material consists of relief-band amphoras, spouted pots and globular cooking-pots of Late-Badorf pottery. As far as pot and rim forms as well as decoration techniques are concerned, this type of pottery is clearly related to the Carolingian Badorf pottery from Dorestad (types EM W I, II and III), though it does slightly differ. The fabric, in particular, is different: the material is harder fired and is a slightly different, yellow or orange colour. The most acceptable dating for this pottery type would be the second half of the 9th century.
At the end of the 9th century or at the beginning of the 10th, forms, fabrics and decoration techniques appeared which clearly differ from Carolingian pottery. These are the oldest products from late-medieval pottery-making centres in the German Vorgebirge – such as Pingsdorf and Paffrath, and in the Belgian Meuse area, including Hoei – which were found in large quantities in Hoogstraat III. Pottery types including

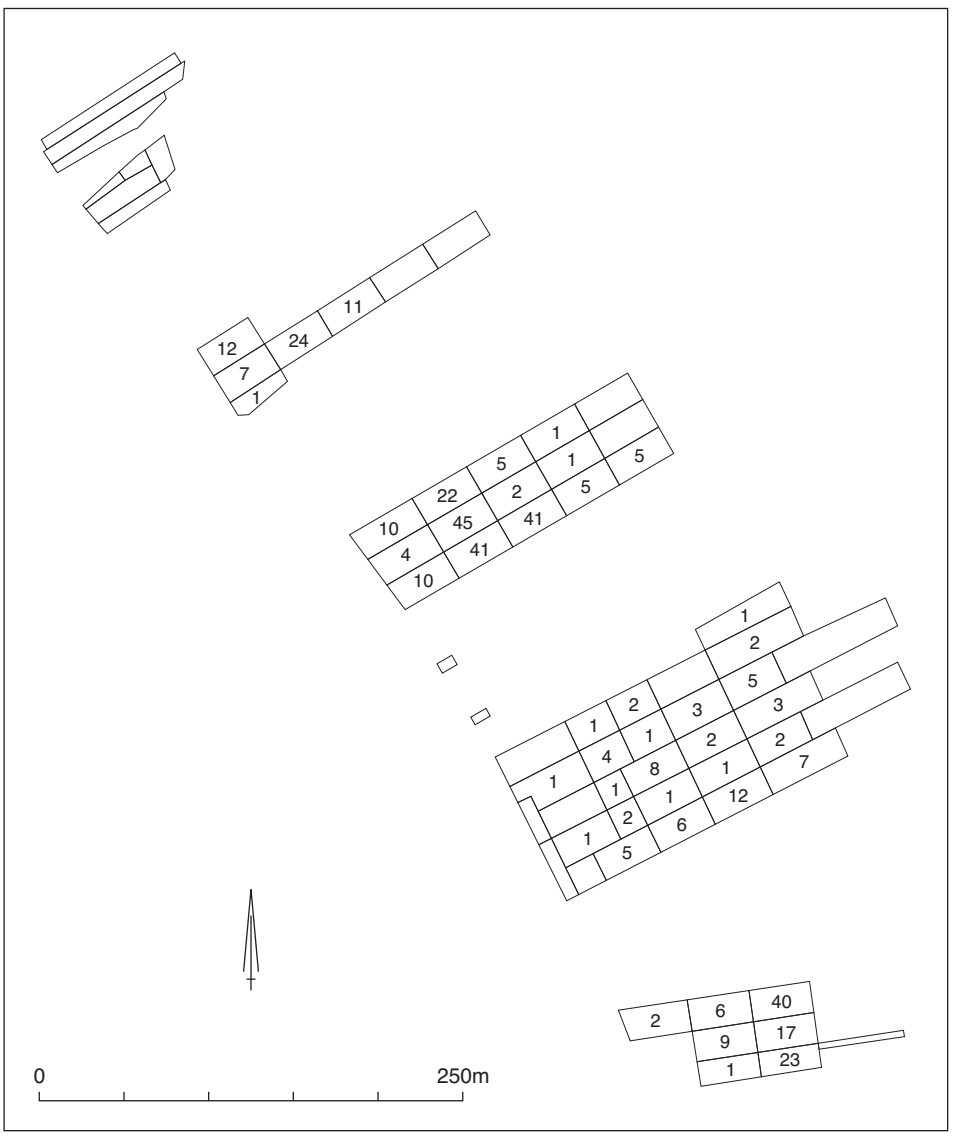


Fig. 160 Dorestad, Hoogstraat: numbers of rims type LM W IIIA per trench.

Hunneschans and Early-Pingsdorf pottery, which may be regarded as transitional products, also date from this period. These pottery types appear to indicate that for a short period in the German Rhineland, potters experimented with new decoration techniques on old pot forms and deviant fabrics. These pottery types disappeared again around 880–900. This brought an end to the early-medieval range of forms and to the decoration techniques belonging to them; roulette decoration was replaced by orange-red paint decoration. From this period the Pingsdorf forms are predominant among wheel-thrown pottery, and this was to remain so until the 12th century.
The rim-forms of spouted pots of Pingsdorf ware in particular display a typo-chronological development from the 10th century until well into the 12th century. The presence of various rim types (types LM W IA–E) shows that the riverbed area was probably continuously in use until the end of the 12th century. The distribution patterns of the late-medieval pottery are various. Pingsdorf pottery types from the second half of the 9th century, particularly LM W IIA, were represented in reasonably large quantities throughout the entire riverbed area (fig. 160). The 10th-century rim types (LMW IA, -B, -E) were mainly concentrated in the vicinity of Hoogstraat III (fig. 162). In this area we also found most of the sherds of Duisburg ware (fig. 163). In addition, most of the 11th- and 12th-century Pingsdorf rim-types were also found here (fig. 164-5). The total number of 12th-century Pingsdorf rim-sherds here decreased, however (fig. 161). This appears to support the assumption that the riverbed area of Dorestad was used intensively until the second half of the 9th century, after which only the south part of the northern settlement remained in use. This section continued to be exploited until the late 12th century, as evidenced by the revetments and wells found in Hoogstraat III. Virtually no material from later periods was found. The Hoogstraat III excavation only yielded a small amount of pottery from the 13th to the 15th century, together with some fragments of even younger Jyde pots.

The late-medieval pottery from the Dorestad riverbed area, especially from Hoogstraat III, is largely comparable to that from other excavation complexes with regard to forms and fabrics. Nevertheless, there are some striking differences. On comparing the oldest late-medieval material from Dorestad with that from contemporaneous find-complexes in Tiel and Deventer, Late-Badorf relief-band amphoras, Hunneschans pottery and Duisburg ware only appeared to occur in relatively very small quantities in the Dorestad riverbed area. These pottery types were far better represented in Tiel and Deventer. The poor representation of Hunneschans pottery in Dorestad had already been observed by Van Es and Verwers, leading them to conclude that this probably had a chronological meaning.[300] An argument against this is that other pottery types from the second half and the last quarter of the 9th century, such as Early-Pingsdorf pottery which possibly even came from the same kilns as Hunneschans pottery, were found in Dorestad in relatively large numbers.
Also remarkable is the fact that the Duisburg ware from Hoogstraat III largely consists of cooking-pots (type LM W VI), whereas in Tiel, for example, and especially in the harbour area on the river Linge, many amphoras (type LM W VII) were found.
A comparison between the 10th–12th-century pottery from Hoogstraat III and a number of complexes from the same period, such as Tiel-Bleekveld, Tiel-Tol/Koornmarkt, and Kerk-Avezaath-Malburg, produces some striking similarities and differences (fig. 161).[301] The Hoogstraat III and Kerk-Avezaath-Malburg pottery-complexes are very similar with regard to the proportions of the various types of pottery, but they differ considerably from the Tiel complexes. The two first-mentioned complexes have a relatively high percentage of handmade pottery (40 % and 38 % respectively), which is higher than that of Pingsdorf pottery (37 % and 32 % respectively). Paffrath pottery also occurs relatively frequently in both complexes (19 % and 20 %). In the Tiel complexes, however, imported pottery predominates (84 % and 87 %). Some pottery forms, such as relief-band amphoras, are found there in larger quantities than in the two other

300 Van Es & Verwers 1975.
301 Van Doesburg 2000, 74, fig. 5.

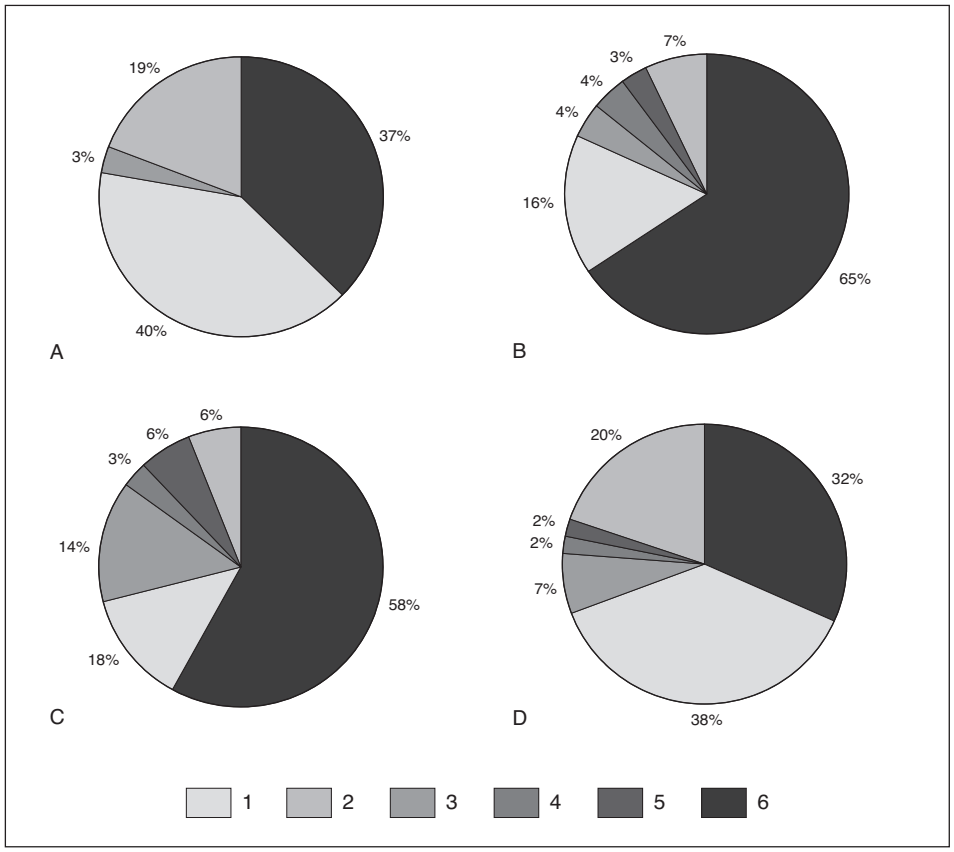


Fig. 161 Percentages of late-medieval pottery (rim, wall and base sherds) in various excavation complexes.
Legend:
A Dorestad, Hoogstraat III (N=6568 sherds);
B Tiel-Bleekveld (N=1538 sherds);
C Tiel-Tol Zuid/Koornmarkt (N=5773 sherds);
D Kerk-Avezaath-Malburg (N=21698 sherds).
Legend:
1 *Kugeltopf*;
2 Paffrath;
3 Elmpt;
4 Duisburg pottery;
5 Maasland ware;
6 Pingsdorf pottery.

complexes. Remarkably, the composition of the pottery complexes excavated in Tiel is very similar on a number of points to that of the early-medieval material from Dorestad. The explanation for the similarities between the Hoogstraat III and Kerk-Avezaath-Malburg pottery-complexes and the differences with the material from Tiel, must be sought in the function of the settlements and the position which they held in the existing settlement hierarchy in the period in question.
At the end of the 9th century, Tiel developed into an important trade-centre, as did Deventer, also situated on the river IJssel. Consequently, both towns are often regarded as Dorestad's successors, even though – certainly in the case of Tiel – there appears to be a chronological hiatus between the decline of Dorestad and the rise of its successors.[302] In the 10th and 11th centuries Tiel expanded to become a major trade-centre which maintained intensive contacts with the German Rhineland, England, Scandinavia, and, to a lesser extent, with the Meuse region. From this angle, it is not surprising that, among the pottery finds from Tiel, the percentage of imported pottery is extremely high. The majority of the pottery (65 %) comes from the German Rhineland; a smaller percentage (15 %) is from the Meuse region. The settlement of Kerk-Avezaath, situated approximately 15 km northwest of Tiel had a mixed agrarian character. Extensive research of the historical sources has shown that the abbey of Thorn had a demesne in the parish of Avezaath. It is assumed that the agrarian surplus from the demesne was sold in neighbouring Tiel or exchanged for products such as wheel-thrown pottery, tephrite querns and salt.

The fact that relief-band amphoras of Late-Badorf pottery were hardly found in Hoogstraat III, whereas they frequently occurred in Tiel, as did their predecessors of Badorf pottery in Dorestad, makes one suspect that Tiel, as a successor to Dorestad, had a fundamentally different function.[303] Relief-band amphoras, and possibly also

302 Sarfatij 1999, 267.
303 Van Es (1990, 163) states that the end of Dorestad as an interregional trade centre must be dated around 850–875.

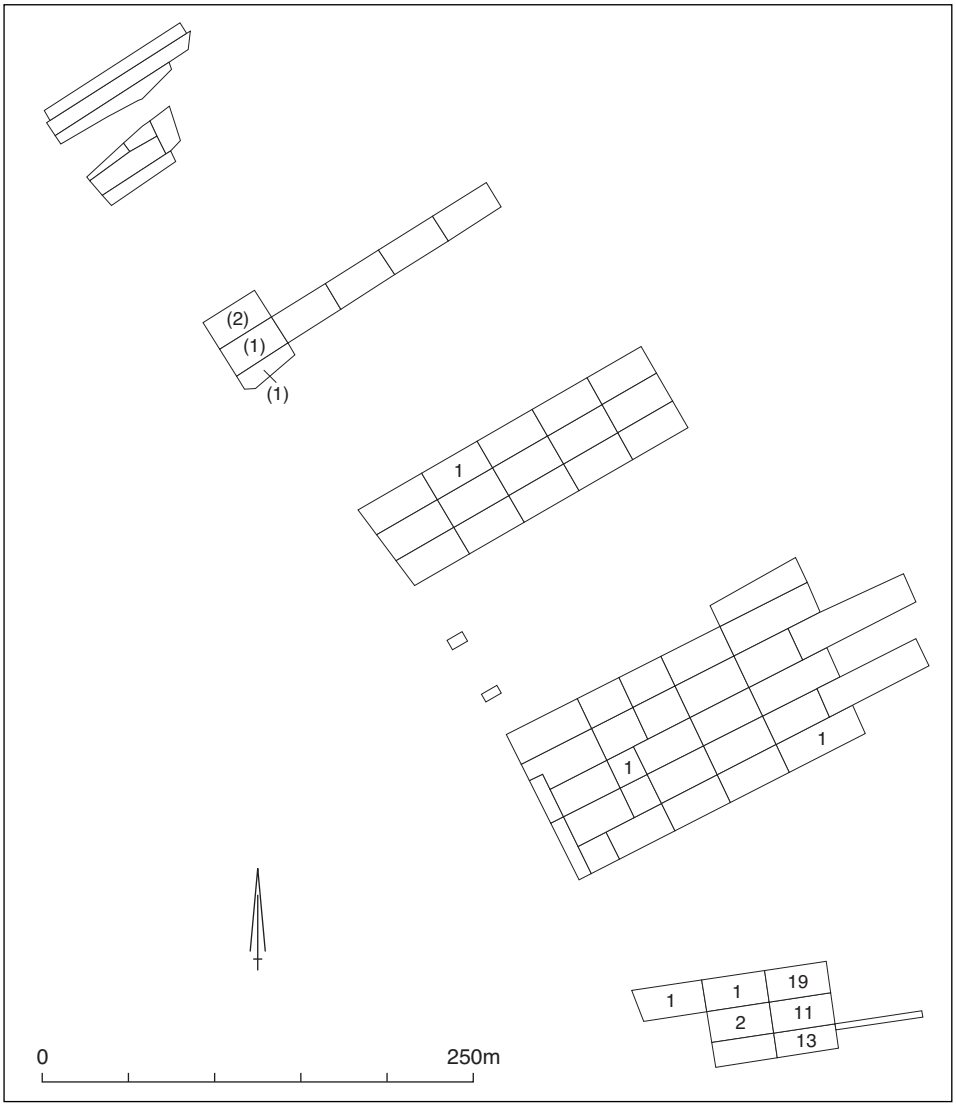
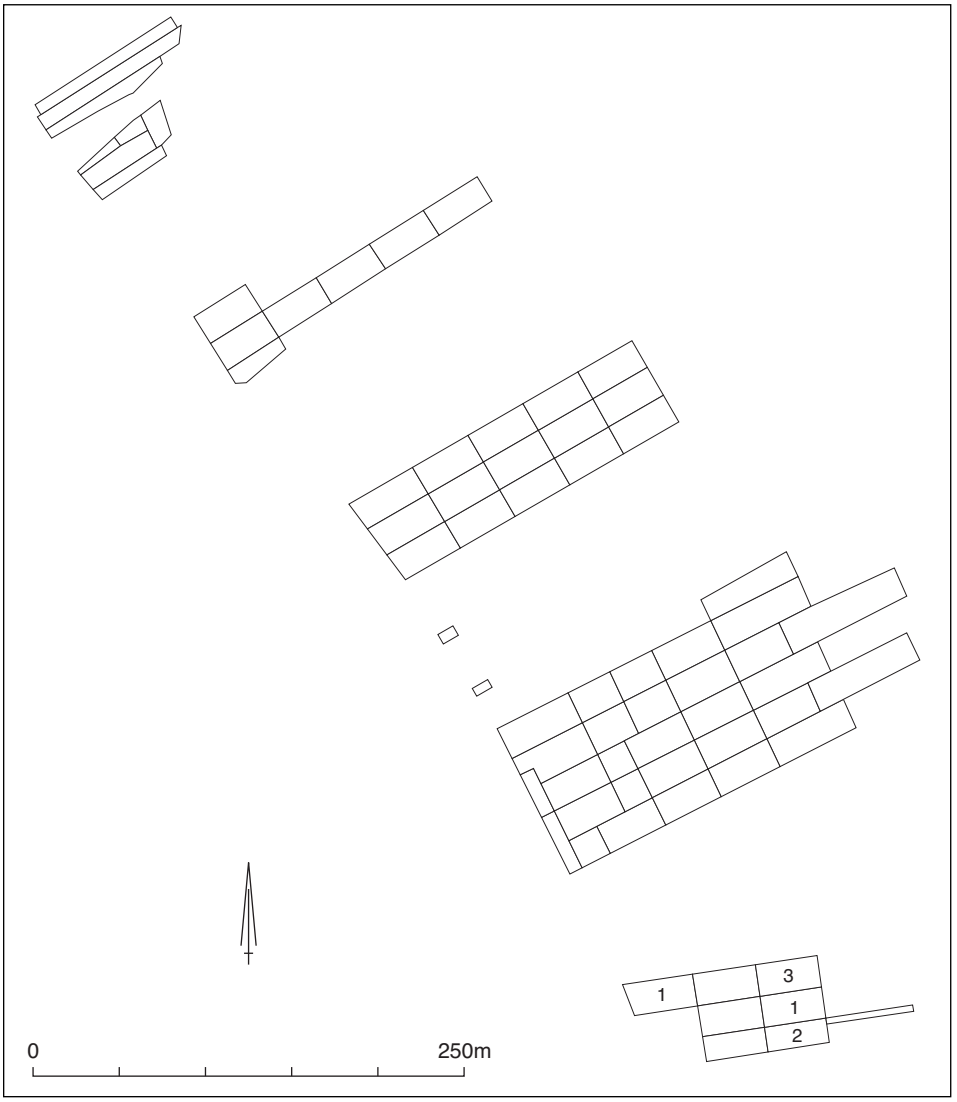


Fig. 162 Dorestad, Hoogstraat: numbers of rims type LM W IA and IB per trench. Numbers between brackets: determination uncertain.

the Duisburg amphoras, were probably used to transport oil and wine from the Moselle valley. This relatively costly commodity was shipped almost exclusively to major trade centres, from whence it was transported, probably only incidentally and in small quantities, to other settlements. That amphoras of Duisburg ware were found in large quantities in Tiel is probably due to the intensive contacts between both settlements in that period. Both Tiel and Duisburg underwent a phase of significant political and economic prosperity in the 10th and 11th centuries.
The remarkable similarity between the material from Kerk-Avezaath-Malburg and Hoogstraat III implies that Dorestad's successor was more of an agrarian settlement. Evidence for this is also found in the written sources. In the *commemoratio* of St. Maarten from 948 there is mention of a settlement, referred to as *villa .... die eens Dorestad heette, maar thans Wijk (Uuik) wordt genoemd* (.... once known as Dorestad, but now named Wijk (Uuik). The fact that the name Dorestad is still mentioned makes one suspect that the change of name must have been fairly recent. This villa, as later records state, consisted of two demesnes: one was belonging to the abbey of Deutz near Cologne, and one belonging to the provost of Oud-Munster.[304] The demesnes comprised a number of scattered farmsteads, including several along Steenstraat and in the vicinity of Hoogstraat. The nature and size of these dwellings is open to conjecture. Thanks to an

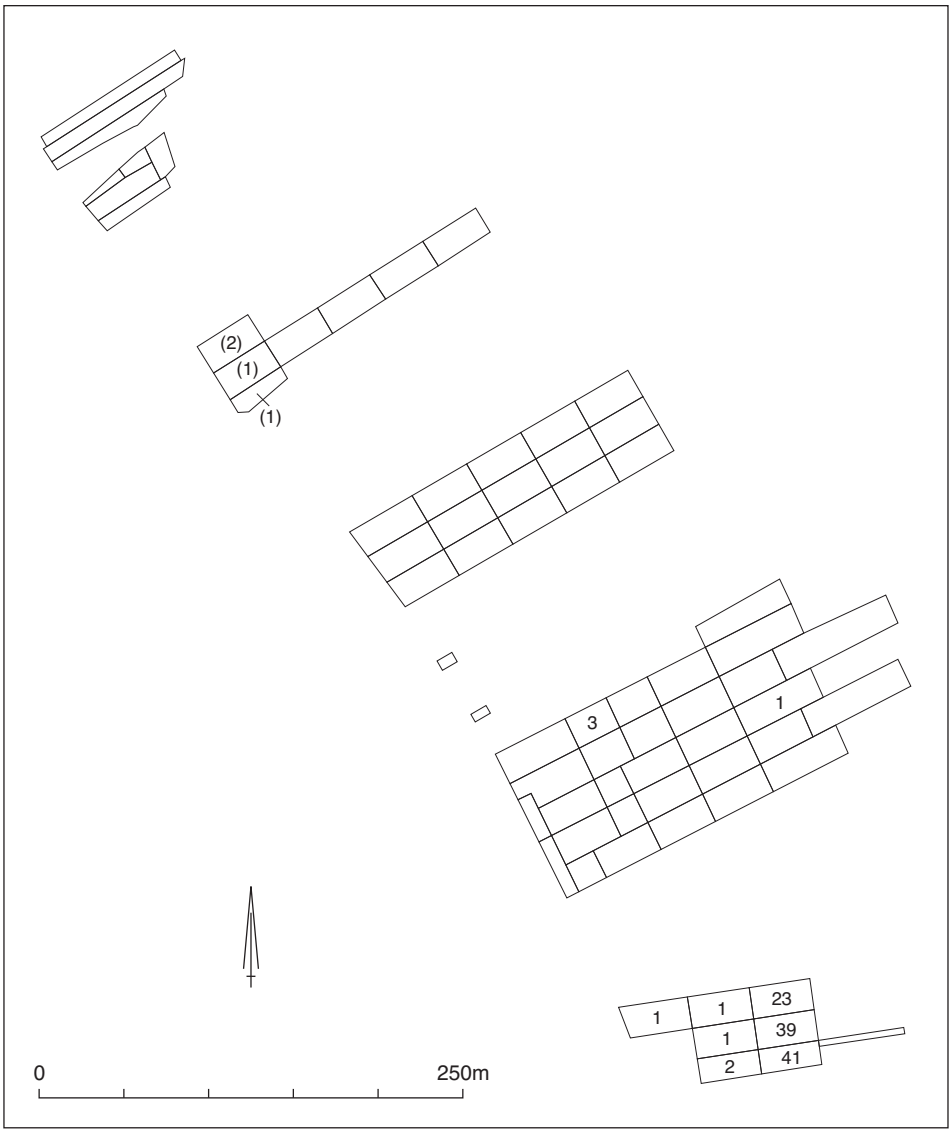
304 See Dekker (1983): for a detailed description of the demesnes in Wijk; further Van Doesburg 2000.

Fig. 163 Dorestad, Hoogstraat: numbers of rims of Duisburg pottery.



administrative document of the abbey of Deutz from the period between *c.* 1155 and 1165, we know that, among other things, beans and oats were cultivated. The delivery of a sturgeon is also mentioned, indicating fishing. In a charter from the third quarter of the 12th century, mention is made of a market in the neighbourhood of the Kromme Rijn, where the bailiff of Deutz acted as magistrate. Agrarian surpluses were probably sold or exchanged here for tools and utensils, such as wheel-thrown pottery and tephrite querns. It is uncertain to what extent the goods were conveyed to Wijk directly or by way of Tiel. The fact that the old wooden constructions in the riverbed area of Dorestad were still maintained indicates that transport by water was still an option. However, the fact that luxury products, such as (relief-band) amphoras containing wine or oil were probably only transported to Wijk in dribs and drabs shows that this trade did not amount to much, certainly compared to that in the Early Middle Ages.
Settlement in the riverbed area probably sharply decreased after the damming up of the Kromme Rijn in 1122. From then on, the Lek became the main through shipping route and the Kromme Rijn served mainly as a drainage canal for the reclamations in Lange Broek and the basin areas situated further downstream. The amount of pottery from the 13th–15th century is so small that we may assume that the riverbed area was no longer intensively used.

Fig. 164 Dorestad, Hoogstraat: numbers of rims type LM W IC (11th century). Numbers between brackets: determination uncertain.



2 Metal finds

The excavations in Hoogstraat 0, II–IV yielded a wide variety of metal finds. The overall picture is similar to that of Hoogstraat I.
The analysis of the metal finds from Hoogstraat was done in various ways. X-ray photographs were taken of all the iron finds from Hoogstraat 0; these served as a basis for the illustrations. With the iron finds from the other Hoogstraat sites the traditional method was used: only those objects whose form was already more or less recognizable were restored as far as possible and then drawn.
The forms of many of the metal objects show hardly any development, so that the individual finds cannot be dated any more precisely than 'Carolingian'. Only a few items allowed a more exact dating. This was mainly achieved with the help of Kleemann's study (1991) of 8th- and 9th-century Carolingian burial finds. One problem is that many of the artefacts are dated to the 8th century on the basis of other grave gifts. Although they were not discovered in 9th-century graves, one cannot exclude the possibility that these objects were still in use in the 9th century.

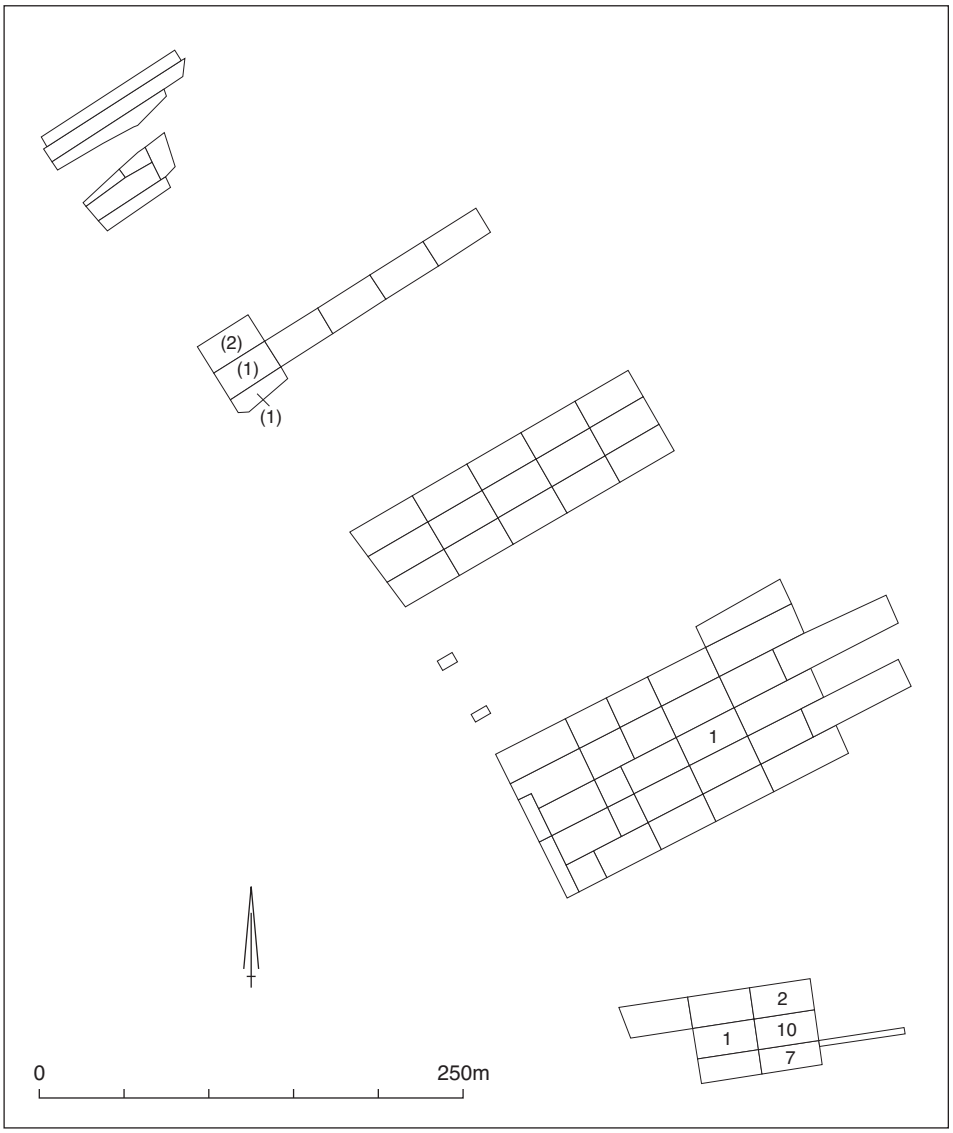


Fig. 165 Dorestad, Hoogstraat: numbers of rims type LM W ID (12th century). Numbers between brackets: determination uncertain.

The phases in the use of the riverbed complex can hardly be used as a dating factor for most of the metal objects. A catalogue now follows of metal objects whose function could be determined with some caution.

Gold

Pendant

Round pendant of thin gold leaf (fig. 166). The central part is slightly deepened and surrounded by a ridge. On either side of this ridge and on it is twisted gold wire. Braided gold wire is applied to the edge of the pendant. The central part and the edge zone are decorated with rolled gold wire figures. On the reverse side the ribbed suspension loop splits into two. Both plates are soldered to the pendant.
Similar pendants, though much smaller (diameter *c.* 2 cm), are known from various Merovingian cemeteries situated both in the Central Netherlands river area, the South Netherlands as well as the German Rhineland. They date from the second half of the 7th century; similar specimens from the north are slightly younger.[305]

305 Pirling 1974, 127–8, especially Stufe III, also slightly earlier and a little later. Items similar in size but made of silver are known from Scandinavia. They date from the second half of the 8th and beginning of the 9th century (cf. Birka).

Silver

Arm-ring
Complete open, decorated arm-ring with D-shaped cross-section (fig. 167). The inside length is 13.4 cm. On either side of the middle and at both ends is the same figurative decoration. This is bordered on both sides by a ridged groove decoration which is very worn. Inside it a more or less T-shaped decoration is visible, consisting of square impressions in which circles have been left blank. The object as a whole is suggestive of a snake's head becoming narrower towards both ends and the middle. At the side of the tapering decorated zone there is a zigzag groove decoration.
Open arm-rings with a D-shaped cross-section and stylized animal heads at the ends are dated from the second half of the 7th to the first half of the 8th century.[306]

Bronze

Dishes Four examples of bronze dishes were found in the Hoogstraat excavations. Three of them are from Hoogstraat II. They include a complete dish (fig. 168), with a lenticular base and a flat horizontal rim. It has no indications of a handle. The two other specimens, only fragments of which have been preserved, also had an everted rim. This merges into a flat handle with an upright rim (fig. 168). The Hoogstraat-0 excavation produced five rims of a shallow bronze basin with a short, horizontally

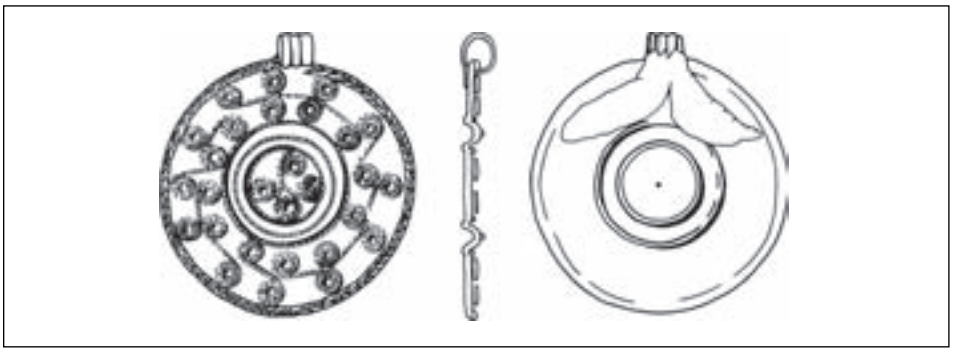


Fig. 166 Dorestad, Hoogstraat III: gold pendant; scale 1:1.

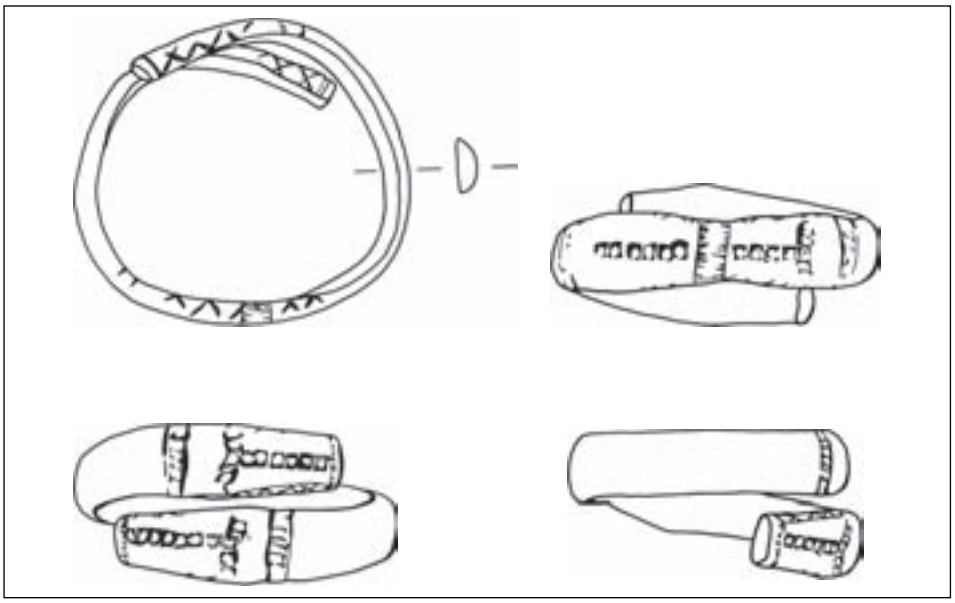


Fig. 167 Dorestad, Hoogstraat IV: silver arm-ring; scale 1:1.

306 Kleeman 1991, 65–6, Stufe II–IV. cf. Nerman 1969, Tafel 186: 1540.

Fig. 168 Dorestad, Hoogstraat II: bronze dish; scale 1:2.

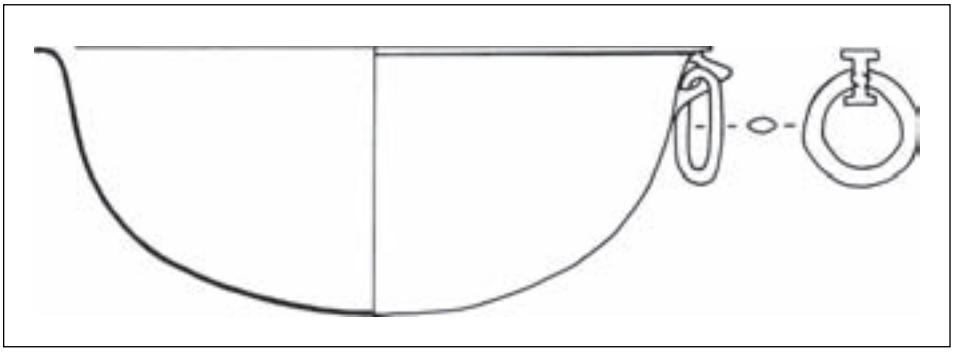


Fig. 169 Dorestad, Hoogstraat IV: bronze arm-ring; scale 1:1.

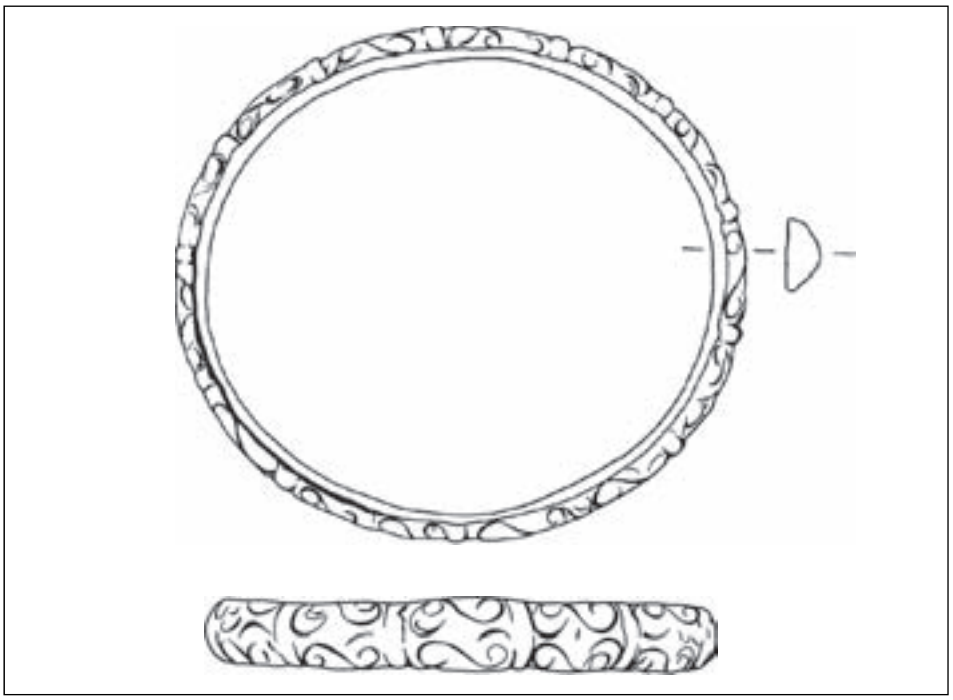
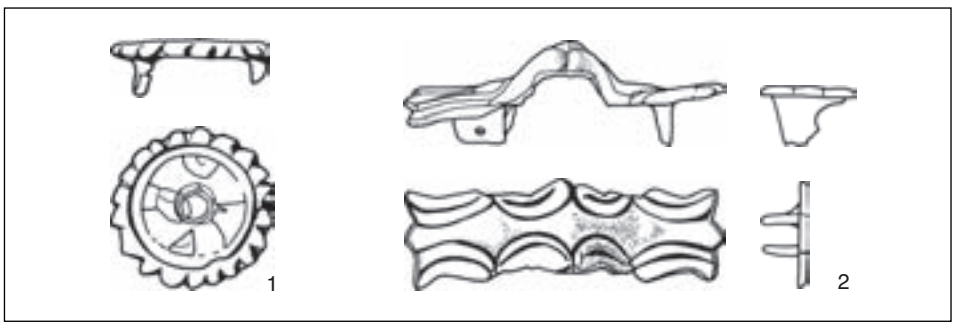


Fig. 170 Dorestad, Hoogstraat II-III: bronze fibulae; scale 1:1.



everted rim. Similar basins were discovered in the cemetery of Birka. They are thought to originate from the Frankish Rhineland.[307]

Arm-ring Complete closed, decorated bronze arm-ring with D-shaped cross-section (fig. 169). Decorated zone between transverse ridges which tapers slightly towards the ends. In the decorated zone a motif of S-shaped grooves occurs.
Closed arm-rings are dated in Kleemann Stufe III: 730/40–760/70. A similar arm-ring was discovered in grave 7 in the cemetery of Wijster, dating from the 8th century.[308]

307 Trotzig 1984, Gruppe B.
308 Kleeman 1991, 66–7, Stufe III; Van Es 1967, 413–5, 509–10, fig. 185.

Fig. 172 Dorestad, Hoogstraat II: bronze tweezers; scale 1:2.

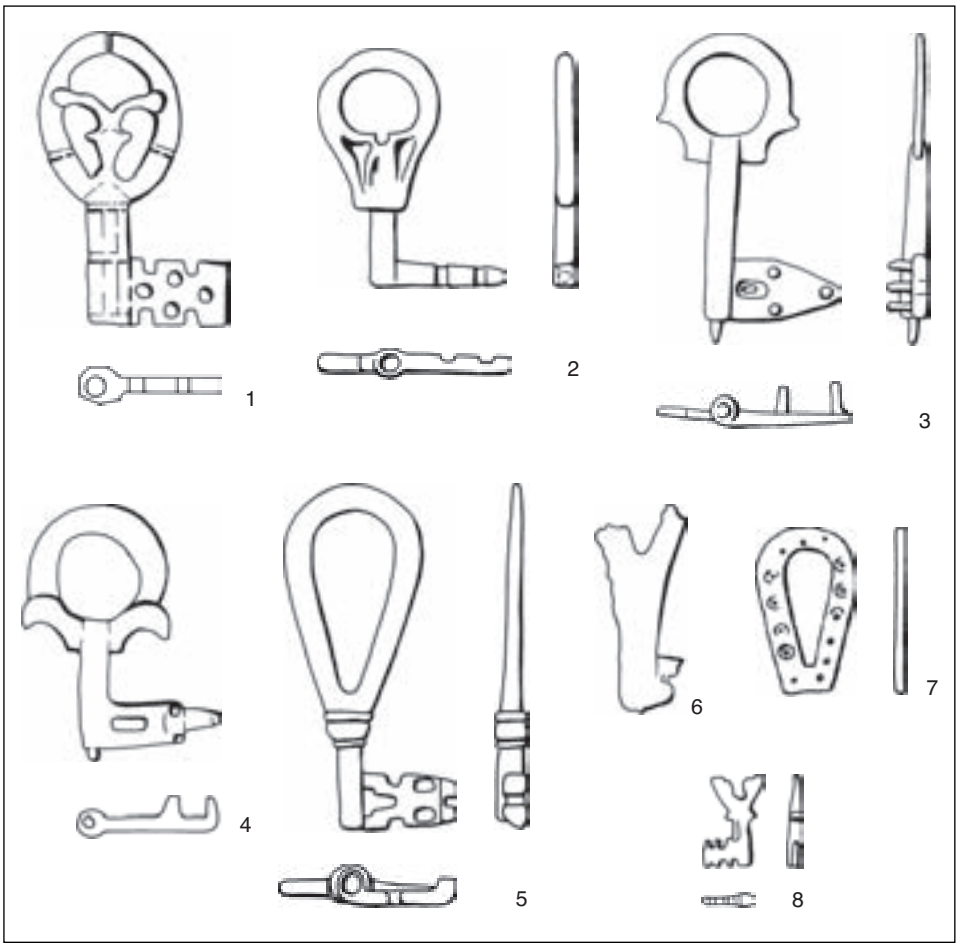


Fig. 171 Dorestad, Hoogstraat II-III: bronze keys; scale 1:2.

Brooch Disc brooch with bronze mounting and blue-white enamel (fig. 170: 1). Grave 24 in Goddelsheim, dated in the 8th century,[309] contained an exact parallel. Equal-armed brooch with *Kerbschnittverzierung* (fig. 170: 2). The decoration on the top of the bow is identical to that on the two ends. Brooches of this type were probably in use during the first half and third quarter of the 8th century.[310]

Keys Eight specimens, four of which are complete bit keys. Two keys have a round bow. The open shank of the key shown in figure 171: 1 has an angular cross-section. Bow and shank are decorated with grooves; inside the bow a bronze decoration has been applied. The specimen in figure 171: 2 has an open shank and a rectangular bit with two incisions. The keys in figures 171: 3–4, which are almost identical, ended in a small pin, and their bits were provided with a hole and three pins. The round bow of these specimens was worked on the outside. Bit keys with round bows are dated from the end of the 7th, and especially to the end of the 8th century.[311] One key had a loop-shaped bow, an open shank and a rectangular bit with several incisions (fig. 171: 5). A fragment of the loop-shaped bow of another key has been preserved (fig. 171: 6). This type is dated to the end of the 8th century.[312]
Dot and circle decoration was present on the loop-shaped bow of a broken key (fig. 171: 7). It was not possible to establish the shape of the decorated bow of a key with a closed shank (fig. 171: 8).

309 Stein 1967, 96–7, Tafel T 92A:6.
310 Van Bellingen 1988, type 3.3, 36–7, 52, 82, 92. Similar specimen from Domburg: Capelle 1976, 11, Tafel 3: 26–7; Kleeman 1991, 17–8.
311 Kleeman 1991, Typentafel 8, type 1a, 195–6: Stufe I–IV.
312 Kleeman 1991, Typentafel 8, type 3, 197–8: Stufe IV.

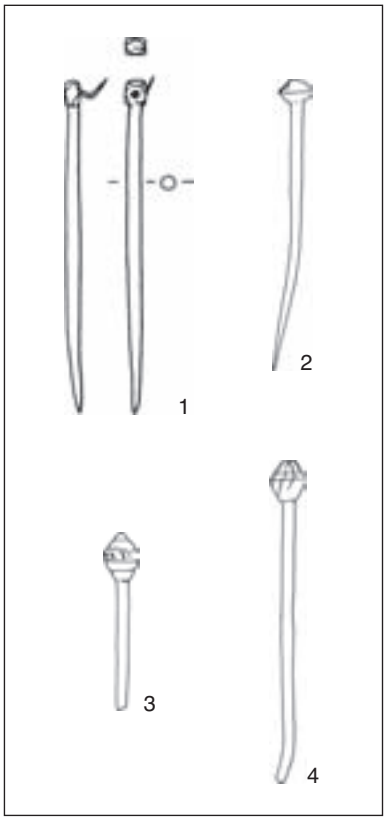


Fig. 174 Dorestad, Hoogstraat II-IV: bronze pins; scale 1:2.

Fig. 175 Dorestad, Hoogstraat II: bronze needle; scale 1:2.

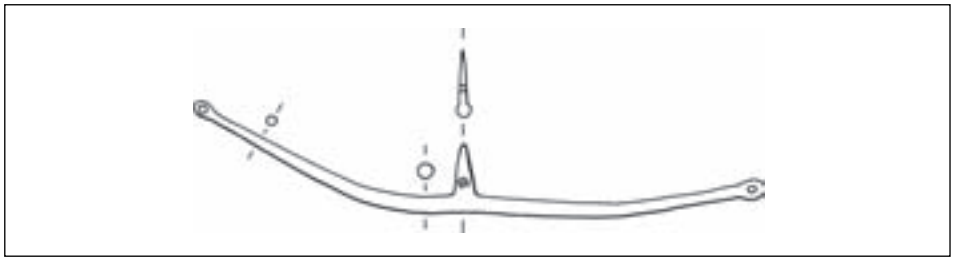


Fig. 173 Dorestad, Hoogstraat IV: bronze balance; scale 1:2.

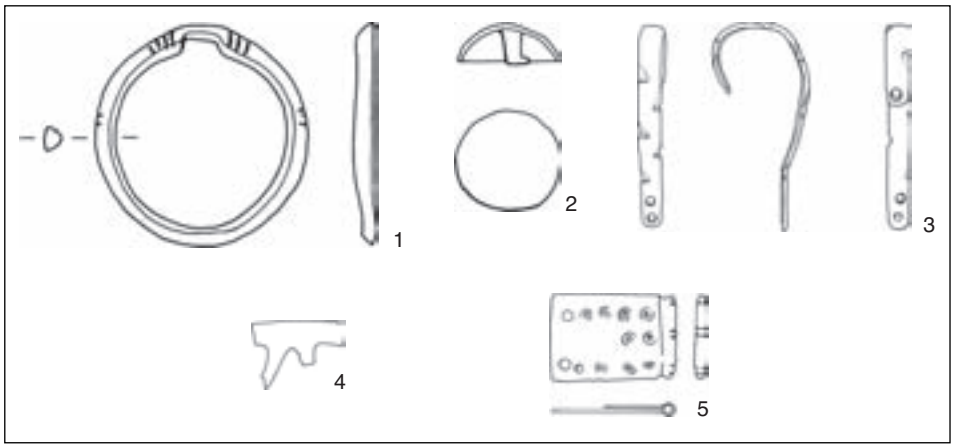


Fig. 176 Dorestad, Hoogstraat II-III: bronze, various; 1, 4 scale 1:1, 2, 3, 5 scale 1:2.

Tweezers Complete specimen (fig. 172). The upper side of the rectangular handle is decorated with grooved lines and circles.
Tweezers of this kind were in use in the 8th and the beginning of the 9th century.[313]

Balance Complete specimen (fig. 173); round cross-section; small hole at one end and in the needle.
Pins Nine specimens of which three fragmentarily preserved. One pin with facetted head, pierced by an iron wire (fig. 174: 1). This type is dated from 700 until into the 9th century.[314]
Five pins with thickened biconical, decorated heads (fig. 174: 2–4). This type of pin was used since the first half of the 8th century and continued to be used until the end of the same century.[315]
Needle One specimen with round eye. Length 6.5 cm; section 0.3 cm (fig. 175).
Socket or terminal Cylindrical specimen with round head with a hole in the middle. Just above the serrated edge at the bottom, four nail holes, nails still partly present on the inside (not illustrated). This specimen can be compared to the socket from Hoogstraat I.[316]

Miscellaneous Objects worth mentioning among the remaining bronze objects are: rings of different diameters (1.5–3.2 cm), a fragment of a round buckle with notch on top (fig. 176: 1), a mount, a rim of a bowl, and a knob (fig. 176: 2).
Also a small fitting with round ends, one of which had one hole in it, and the other two. On both the long sides notches had been made alternately (fig. 176: 3).
A flat decorated plate with spokes (fig. 176: 4). Finally, a small plate folded double, one side of which is decorated with dots and circles. A grooved decoration is applied to the widened fold which has the shape of an eye in cross-section (fig. 176: 5).

313 Kleeman 1991, Typentafel 19, type 2, 263, Stufe III–V.
314 Kleeman 1991, Typentafel 3, type 1, 55, Stufe II–V.
315 Kleeman 1991, Typentafel 3, type 5, 57-8, Stufe III–IV.
316 Van Es & Verwers 1980, 175, fig. 124: 4.

Iron

Carpenter's tools

Axes Five axes of different types. The specimen in figure 177: 1 has a rectangular shaft-hole. Its blade is more or less rectangular. A similar blade and an oval shaft-hole are shown in figure 177: 2. The shaft with its oval hole in figure 177: 3 is rather long, and this specimen has an oval blade. Axes of this type were used at the end of the 7th century.[317]
A so-called *Schaftlochaxt* with symmetrical, narrow body is represented by the specimens in figures 177: 4–5. A third *Schaftlochaxt* has a more or less parallel-sided body with a splayed edge. Wood remains were preserved in the oval shaft-hole of the Hoogstraat II specimen. This type of axe came into use in the second half of the 6th century and remained in use until into the Carolingian Period.[318]

Adzes Very long object with two cutting edges and oval shaft-hole in the middle (fig. 178: 1). Both sides end in a thin cutting edge, which had respectively a vertical and horizontal position in relation to the shaft-hole. This object may have had a double function: adze and axe. Adze with more or less triangular blade and oval shaft-hole, with bent wings (figure 178: 2). Flat blade of a third adze; the shaft was missing (fig. 178: 3).

Boring bits Five specimens, three of which are complete (fig. 179: 1–2). The length of the rectangular shanks varies from 8 to 14 cm.

*Hammer*s Five hammers, three of them T-shaped and with rectangular shaft (figs. 180: 1–3). Hitting surfaces are round or rectangular in section.[319]
A heavy hammer from Hoogstraat IV only has an oval blind hole for a shaft (fig. 180: 4). The shaft was attached to the hammer with a nail driven through a small hole at the top of the hammer. The iron object from Hoogstraat IV is also possibly a hammer. It has an angular section, the arms ending in a point. There may have been a shaft in the middle, now broken off (fig. 180: 5).

Saw Rectangular blade with straight upper- and serrated underside from Hoogstraat 0 (fig. 181). A small hole and a notch at one end, the other end broken off. This find is interpreted as a saw blade. Since it was found in the topsoil, the saw blade may date from after the Dorestad period.

Chisel Iron object with rectangular shank and the beginning of a blade from Hoogstraat IV. It is possibly the remains of a chisel (not illustrated).

Nails The Hoogstraat 0, and II–IV excavations yielded a total of 205 nails or fragments of nails, usually with round or lozenge-shaped heads. One complete specimen had a small head. It probably belongs to the Post-Dorestad period (fig. 182: 1). The usual Dorestad nails have larger lozenge-shaped heads like those found in the ship fragment (see chapter VI 3) or round heads (fig. 182: 2), sometimes with lozenge-shaped counter plates (fig. 182: 3).

Agricultural tools

Shovels Two specimens, of which one complete with wide, hollow blade (fig. 183). Split end with remains of a wooden handle. This specimen came from a late-medieval well in Hoogstraat III. The other shovel, also from Hoogstraat III, of which part of the blade was preserved (min. 18.6 cm long, min. 13.2 cm wide), belongs to the same type as the shovel found in Hoogstraat I,[320] with sides bent round the wooden handle.

317 Siegmund 1989, Phase 7: 585–605.
318 Siegmund 1989, Phase 6: 565–85; cf. Müller-Wille 1973, 26–8, Abb. 3.
319 Van Es & Verwers 1980, 175, fig. 125: 1–2.
320 Van Es & Verwers 1980, 177, fig. 130: 1.

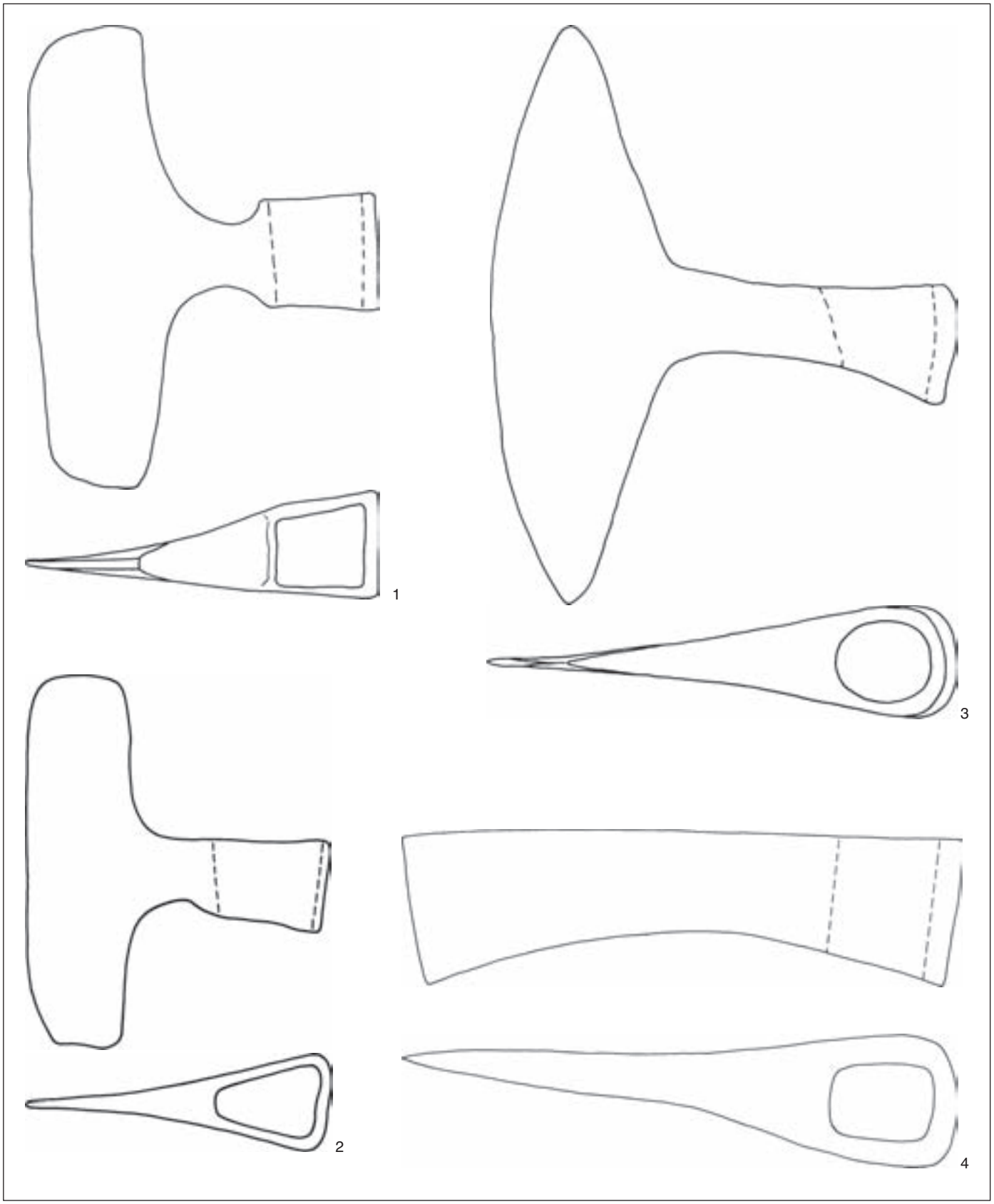


Fig. 177A Dorestad, Hoogstraat 0 and II: iron axes; scale 1:2.

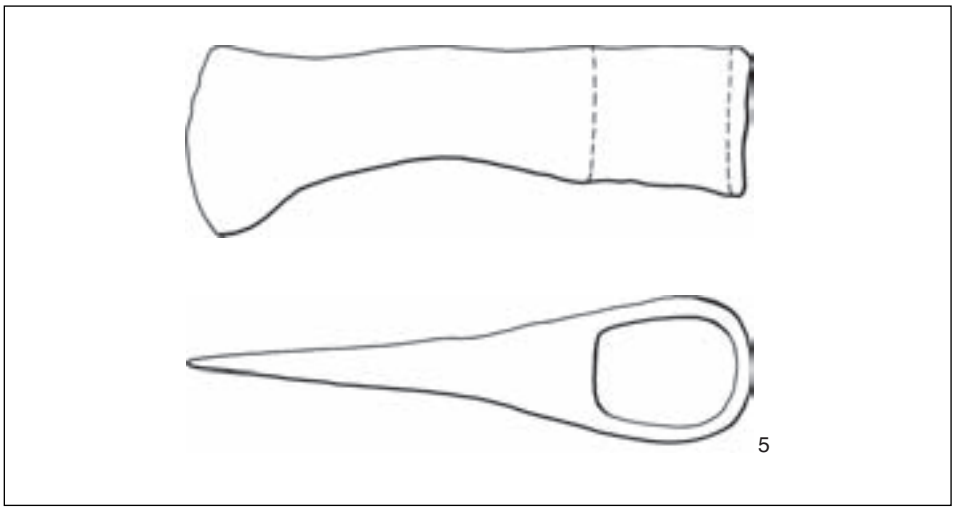


Fig. 177B Dorestad, Hoogstraat 0 and II: iron axes; scale 1:2. >>

Sickle One specimen with broken blade from Hoogstraat IV (fig. 184). A grooved decoration was present on the blade; completely preserved wooden handle.

Ploughshares Two specimens from Hoogstraat 0 and IV (fig. 185: 1–2). The body with round section consists of solid iron and ends in a point. The conical socket, with diameter similar to the Hoogstraat-I specimens,[321] ended in two overlapping wings. A hole for a wooden haft was present in the Hoogstraat-0 specimen.

Horse-gear, weapons and knives

Swords Six specimens, the blades of five of them incomplete. The width of the blades varies between 3.2–4.7 cm. Because of the poor and incomplete condition of these finds, nothing can be said about the shape of the swords (fig. 186: 1–3). There are possible traces of damascening on the blade of one specimen (not illustrated). The single more or less complete sword from Hoogstraat IV (fig. 186: 4) with damascened blade, was described by the late J. Ypey (ROB).
Iron sword, broken and highly corroded. Upper end of hilt missing. Length 46.6 cm; remaining blade-length 36.5 cm; width 4.8 cm. On both sides of the blade a double band of torsion damascening S-Z. On one side this is only faintly visible in a few places, but on the other side it can be observed over a large part of the length. The layer of damascening is very thin. Due to corrosion, the intermediate layer (core) can be seen in various places. After etching with diluted nitric acid the cuts became dark, which points to the presence of carbon, therefore steel cuts. No traces of hardening found.
The damascened strips were composed of 8 layers of iron and 7 layers of steel. This is remarkably more than the usual number of 4 layers of iron and 3 of steel. The blade is unusually short. The fact that the damascened strips converge in a point indicates that no shortening took place at the point of the blade, at any rate. Due to the complete corrosion of the hilt it is impossible to establish whether this was in fact a broken blade whose upper end was forged into a hilt so that it could still be used as a weapon.
Spearheads Four specimens of different types. The spearhead in figure 187: 1 has a relatively small blade with an angular transition to the facetted closed socket. The specimen in figure 187: 2 shows a fluent transition from the long blade to the round closed socket. Both specimens represent a type of spearhead which dates from the end of the 7th- and beginning of the 8th century.[322] Of the specimen from

321 Van Es & Verwers 1980, 178, fig. 131.
322 Kleeman 1991, Typentafel 14, type 3–4, 234–35, Stufe I–II; Siegmund 1989, Stufe 9–10: 640–705 AD.

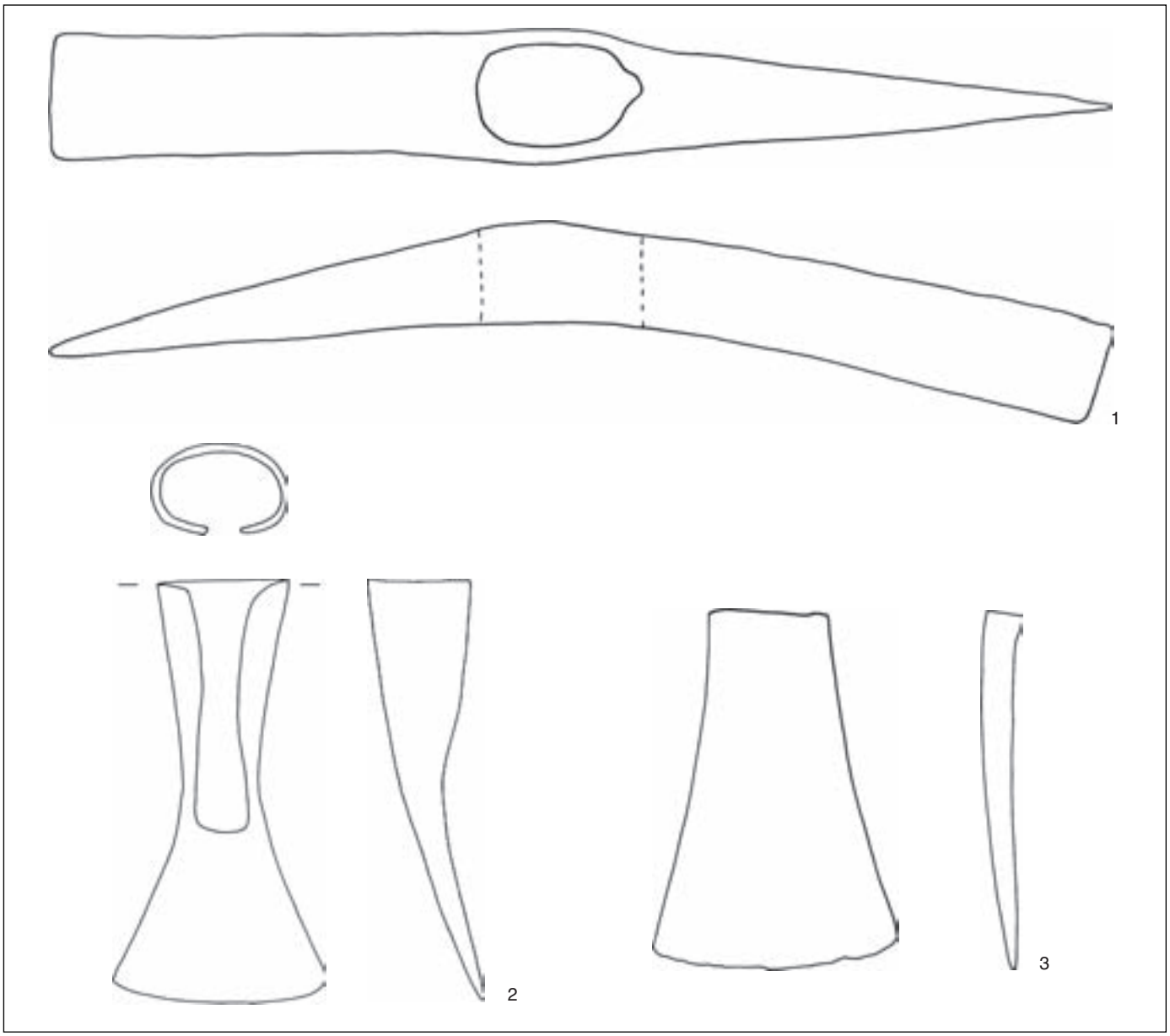


Fig. 178 Dorestad, Hoogstraat 0 and II: iron adzes; scale 1:2.

Hoogstraat 0 only the blade has been preserved (not illustrated). The transition to the socket appears to have a square cross-section. The winged lance type (*Flügellanz*) is represented by the specimen in figure 187: 3. The date of this spearhead with round *Tülle* is between 730/40–760/70.[323]

Saxes Bent fragment of a triangular-sectioned blade from Hoogstraat 0 (fig. 188: 1). The shape reminds one of the blade of a sax. Length at least 22.8 cm, width 3.8 cm. X-ray photographs reveal possible traces of damascening. A *Langsax*, discovered in Hoogstraat IV (fig. 188: 2), is 62.5 cm long, the width of the blade is 3.9 cm. In the middle of the blade a fragment of the scabbard remained. The bent sax showed a fluent transition from blade to grip. *Langsaxen* were in use from the end of the 7th century until the beginning of the 9th century.[324]

Shield bosses Fragment of a shield boss from the north profile of trench 383 in Hoogstraat II (fig. 189: 1). The narrow rim merges into a more or less vertical wall;

323 Kleeman 1991, Typentafel 15: type 6, 235–6, Stufe III.
324 Knol 1993, 74.

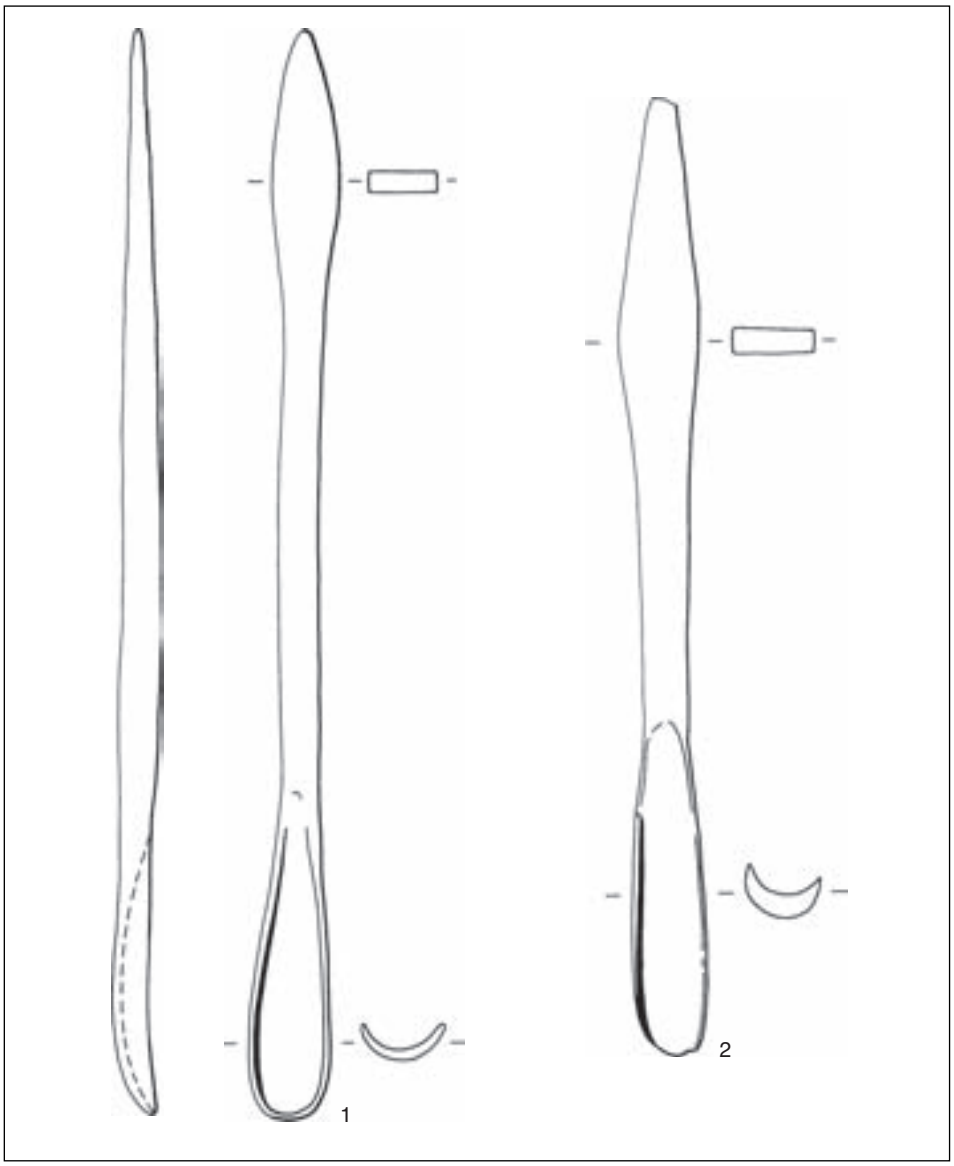


Fig. 179 Dorestad, Hoogstraat II and IV: iron boring-bits; scale 1:2.

there is no collar. Towards the top the wall bends inward, ending in a somewhat thickened point. These characteristics are typical of the Galgenberg type described by Stein,[325] which is dated between 700/10 and 760/70.[326]
An almost complete specimen of the same type and date was discovered in Hoogstraat III (fig. 189: 2).

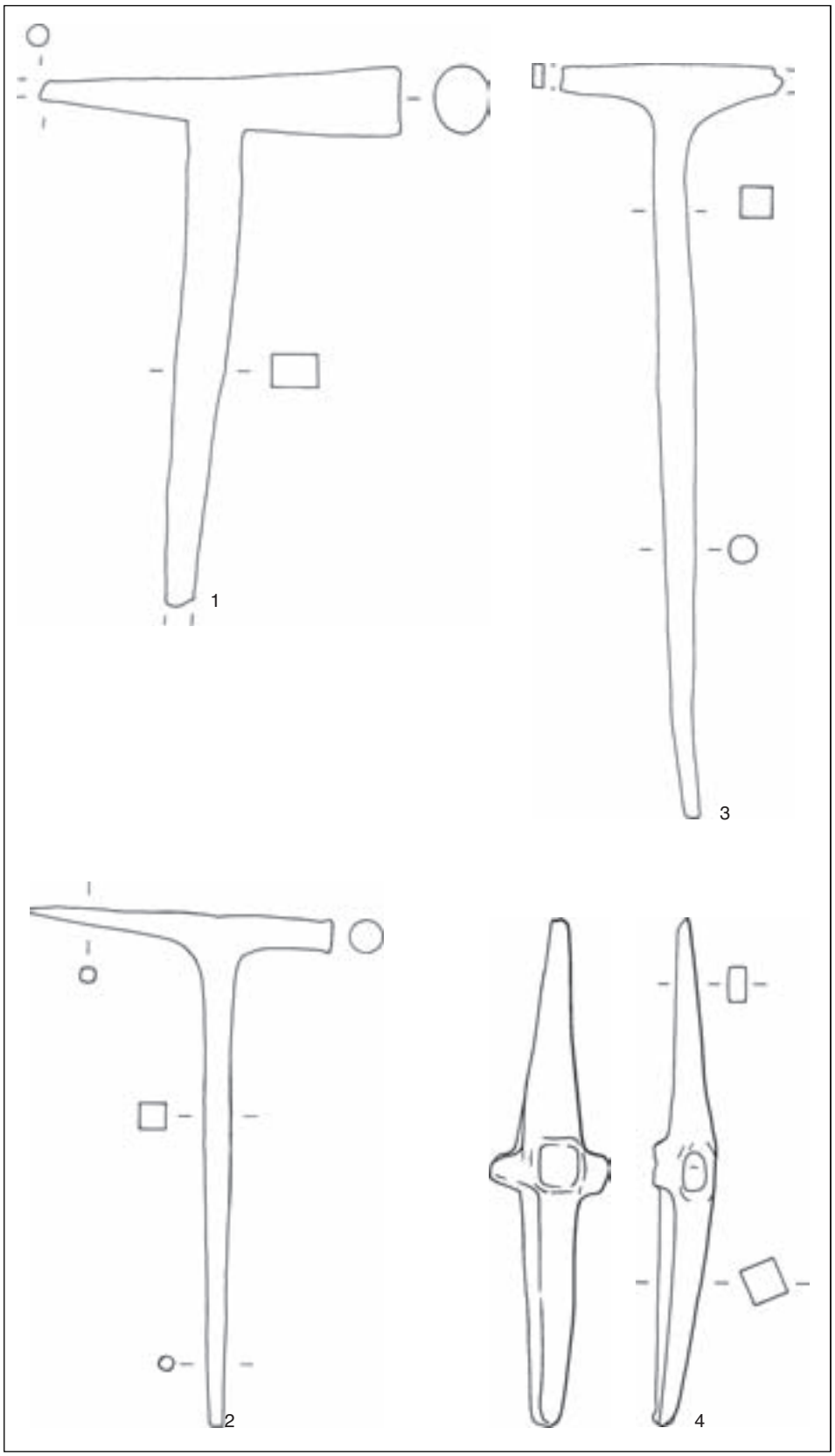
Arrow heads Two specimens from Hoogstraat IV, both incomplete (fig. 190: 1–2).

Spur One specimen with triangular cross-section from Hoogstraat III. Short prick, and unthickened oval eye for a leather strip at the end of the U-shaped arms. It belongs to the *Schlaufen* spur type (fig. 191), dated between 730/40 and 800/10.[327]

Knives Hoogstraat 0, II, III and IV produced 14, 38, 22 and 8 iron knives, respectively. They are mostly fragmentary or strongly corroded, so that the shapes can hardly be distinguished.

325 Stein 1967, 76–7.
326 Stein 1967, 90–2, 110; Kleeman 1991, Typentafel 16, type 2: Stufe II–III; Siegmund 1989, period 11 or later.
327 Kleemann 1991, Typentafel 17, type 1, 250–1, Stufe III–IV.

Fig. 180 Dorestad, Hoogstraat 0-IV: iron hammers; scale 1:2.



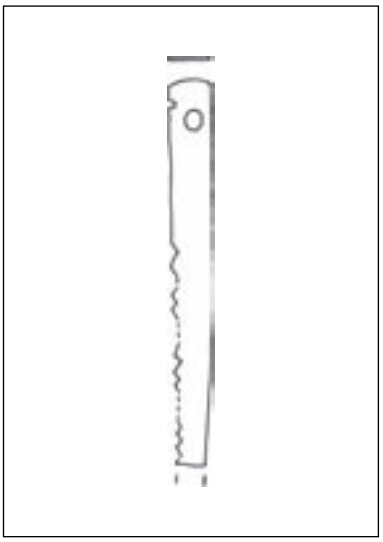


Fig. 181 Dorestad, Hoogstraat 0: iron saw; scale 1:2.

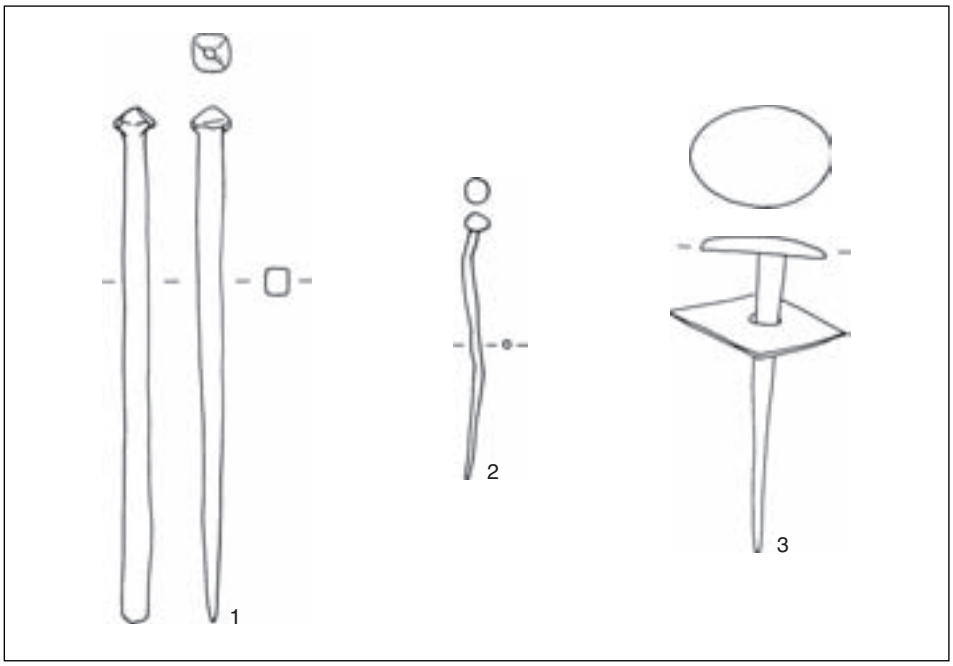


Fig. 182 Dorestad, Hoogstraat 0-IV: iron nails; scale 1:2.

Fig. 183 Dorestad, Hoogstraat III: iron shovel; scale 1:4.

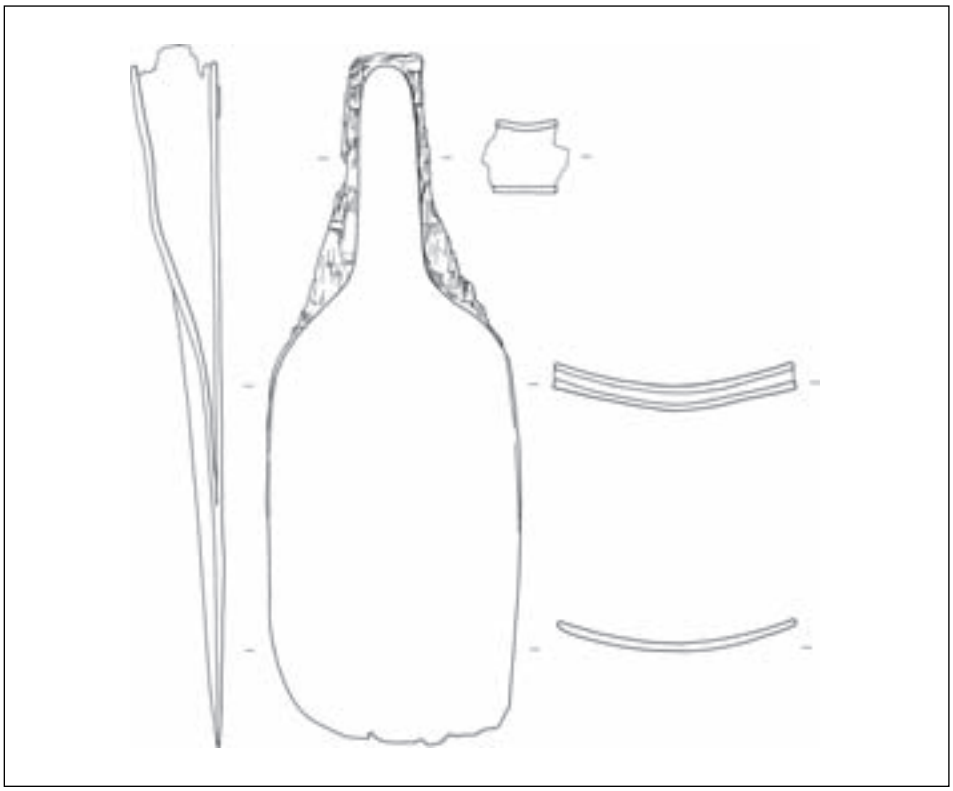
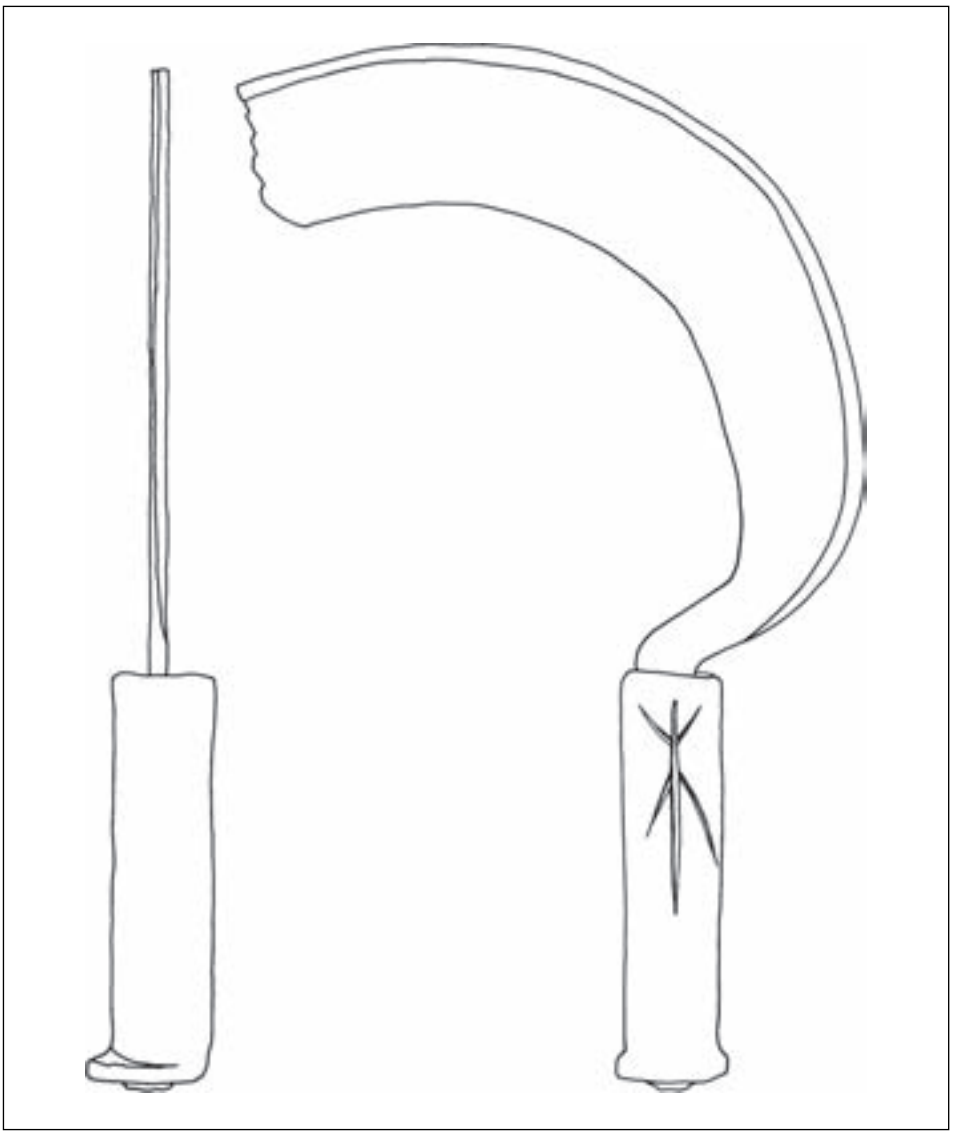


Fig. 184 Dorestad, Hoogstraat IV: iron sickle; scale 1:2.



X-ray photographs of the knives from Hoogstraat 0 reveal various types.
Knives with a:
a curved upper side (fig. 192: 1–2);
b straight upper side (fig. 192: 3–4, the latter with a markedly convex edge;
c stepped upper side; these have a straight under side (fig. 192: 5–8).

Knives of these shapes were in use from the second quarter of the 8th century until the 9th century, apart from type *a*, which occurred slightly earlier.[328] A knife from Hoogstraat 0, with straight upper side and curved end (type *b*), was fastened in a sheath (fig. 192: 3).
Folding knives date from the Carolingian Period.[329]

Shears A fragment of a triangular blade with one straight and one curved side came from Hoogstraat 0 (not illustrated). The curved side is thin and ends in a point, like a knife. The straight side is thickened, and curves slightly upward. The fragment is possibly part of a pair of shears.

328 Kleeman 1991, Typentafel 23, a type 1, b type 4, c type 2, 294–8.
329 cf. Van Es & Verwers 1980, 184, fig. 137: 8; Kleeman 1991, 269–70.

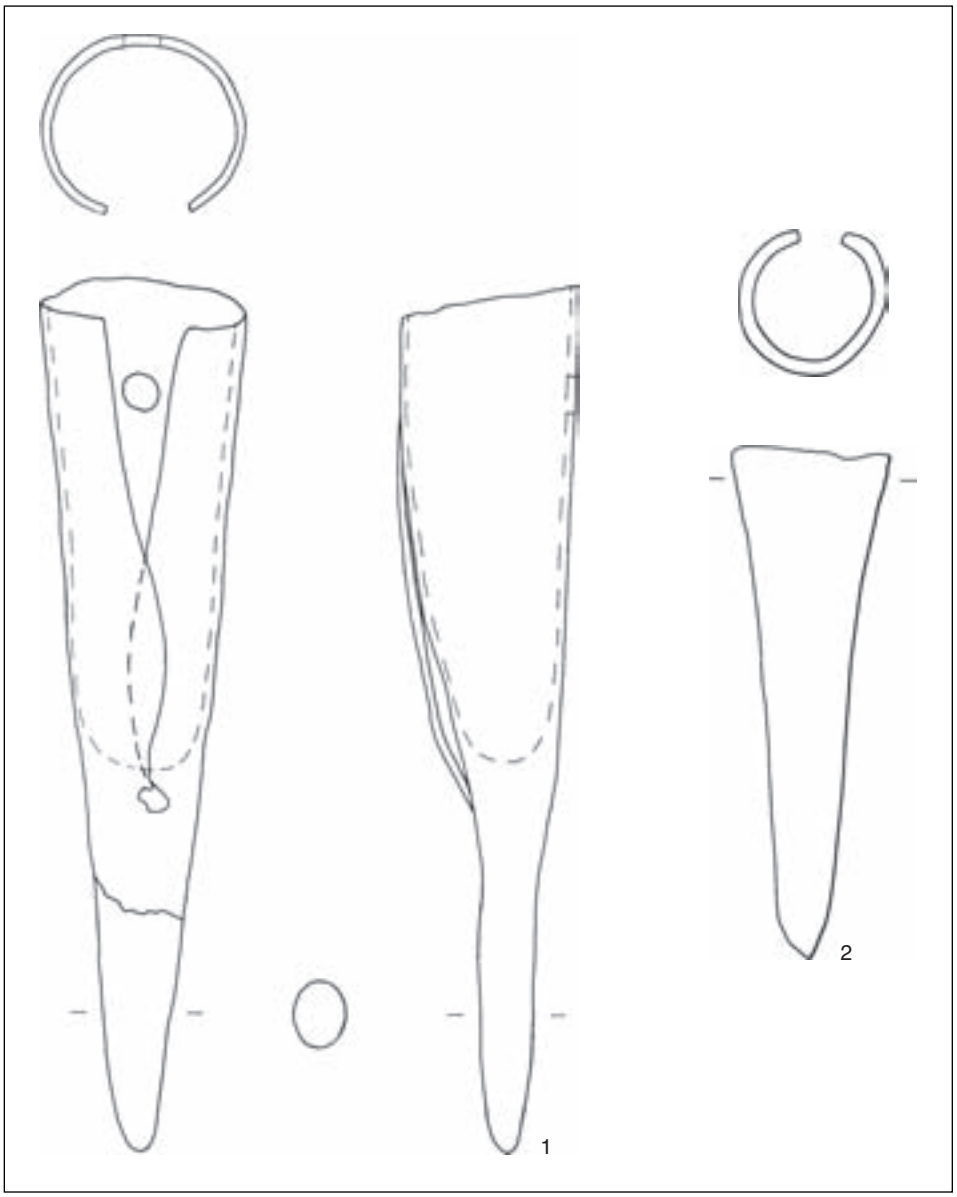


Fig. 185 Dorestad, Hoogstraat 0 and IV: iron plough points; scale 1:2.

Keys Ten specimens, eight more or less complete. Two iron keys came from Hoogstraat 0, seven from Hoogstraat II and one fragment from Hoogstraat IV.
- Bit keys Three bit keys with round handles (figs. 193: 1–2).[330] The shanks have a circular section with the exception of the key-shank in figure 193: 3, which is rectangular. The bits of the keys were on a level with the bow. Grooved decoration was present on the upper side of the open shank in figure 193:1.
Bit keys with round bows can be dated between the end of the 7th century and the transition from the 8th to the 9th century.[331]
Two bit keys with loop-shaped bow and round shanks. The bits of one specimen were not on a level with the bow (fig. 193: 4). This type of key was in use in the last quarter of the 8th century.[332]
- Hooked keys There are three keys of this type. One has a short double hook on one side of the shank, the end of which is bent over to form an eye (fig. 193: 5).[333] Another key has a hook on either side of the shank, the end of which is also bent into an eye (fig. 193: 6). The third specimen is a long hooked key with bent eye through

330 cf. Van Es & Verwers 1980, fig. 133: 1–2, 4–5.
331 Kleeman 1991, Typentafel 8, type 1, 195–6, Stufe I–IV.
332 Kleeman 1991, Typentafel 8, type 3, 197–8, Stufe IV.
333 cf. Van Es & Verwers 1980, fig. 133: 3.

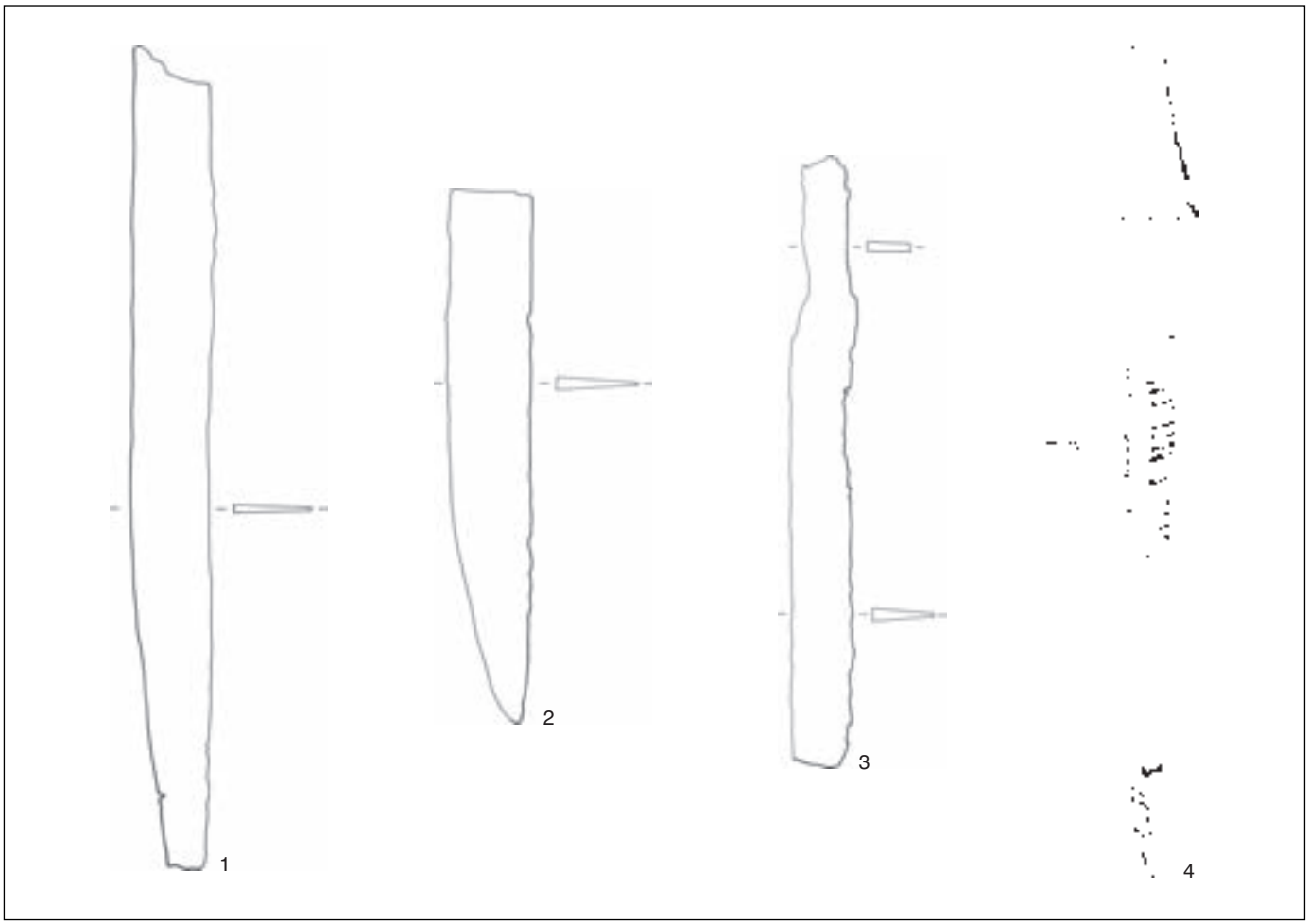


Fig. 186 Dorestad, Hoogstraat II-IV: iron swords; scale 1:4.

which an iron ring has been passed (fig. 193: 7). Its hook, which is on a level with the rectangular-sectioned shank, is split into two at the end. The shank had been broken in the middle and the two parts joined together with an iron nail.
Hooked keys were mainly used in the 8th century.[334]

Boat hooks The Hoogstraat excavations produced a total of 33 boat hooks, or fragments of them. Hoogstraat 0: 8; Hoogstraat II: 16; Hoogstraat III: 6; Hoogstraat IV: 3 specimens. Nearly all the specimens belong to the usual type *a*, with the V-shaped fork, found in Hoogstraat I (fig. 194: 1).[335] The prongs have a rectangular or square cross-section (figs. 194: 2–3), the odd one is multi-angular (figs. 194: 4–5). The ends of some prongs are bent (fig. 194: 1–2, 4–5),[336] others are straight (fig. 194: 3).[337] The boat hooks show slight differences in the position of the prongs. The prongs of these specimens are more or less U-shaped.[338]

Butt ferrules A total of 15 (fragments of) butt ferrules were discovered in the Hoogstraat 0, II–IV areas. Six specimens with solid conical body and narrow shaft, belong to the Hoogstraat-I type *a* (figs. 195: 1–3).[339] The X-ray photograph of a specimen from Hoogstraat III shows a conical iron collar, which held the rectangular stub of the butt ferrule in the wooden shaft (fig. 195: 4). Another butt ferrule from Hoogstraat III shows a similar attachment (fig. 195: 5).[340] A bronze ring with grooved decoration may serve to strengthen the connection between the butt ferrule and the

334 Kleeman 1991, Typentafel 9, type 8, 201–2, Stufe I–IV.
335 Van Es & Verwers 1980, 179–83.
336 cf. Van Es & Verwers 1980, fig. 134: 1–2.
337 cf. Van Es & Verwers 1980, fig. 134: 3.
338 cf. Van Es & Verwers 1980, fig. 134: 4–6.
339 Van Es & Verwers 1980, 184, fig. 135.
340 cf. Van Es & Verwers 1980, 184, fig. 135: 1.

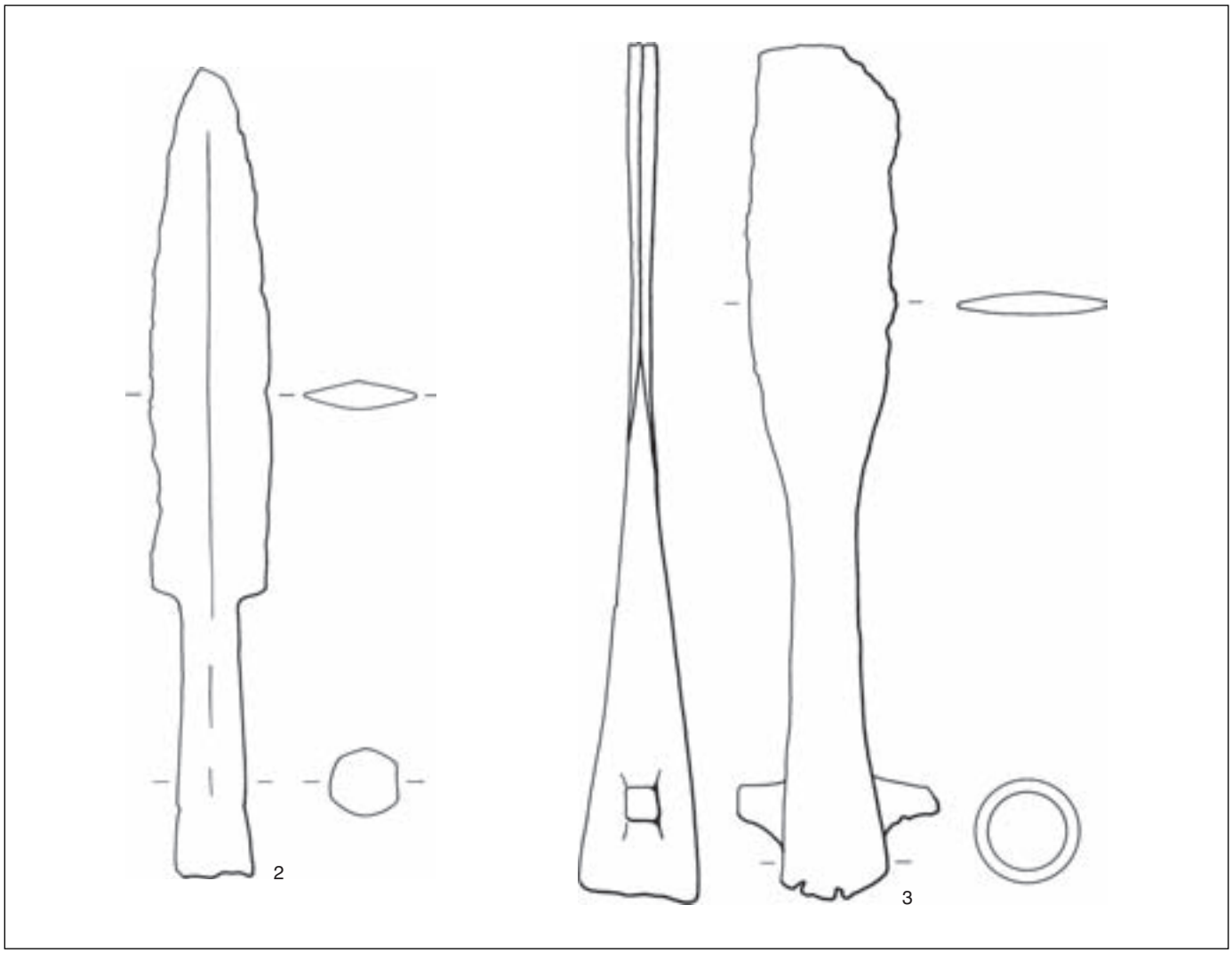


Fig. 187A Dorestad, Hoogstraat II and IV: iron spear-heads; scale 1:2.

wooden shaft of another butt ferrule from Hoogstraat III (fig. 195: 6). This specimen probably also belongs to Hoogstraat I type *a*, as does a butt ferrule from Hoogstraat 0 (fig. 195: 7). The latter is a small specimen with a solid conical body and rectangular shaft. The butt ferrule in figure 195: 3 is surrounded by an open cylindrical mount, whose function is uncertain. Butt ferrules (*Stabdorne*) were used during the Carolingian Period.[341]

The excavations at Hoogstraat 0, II–IV, yielded five butt-ferrules with hollow socket and solid point of Hoogstraat I type *b*. One, found at Hoogstraat II, had been preserved with its shaft (fig. 195: 8). This was 1.36 m long and made of *Taxus* wood (identification Dr L.I. Kooistra). The shaft had been attached to the butt ferrule with an iron nail. This ferrule, with angular point, was also decorated with grooves. The upper end of the wooden shaft had been decorated. This type of butt ferrule is typical of the 8th century.[342]

341 Kleeman 1991, Typentafel 20, type 1, 272-3, Stufe II–V.
342 Kleeman 1991, Typentafel 20, type 2, 273, Stufe II–IV.

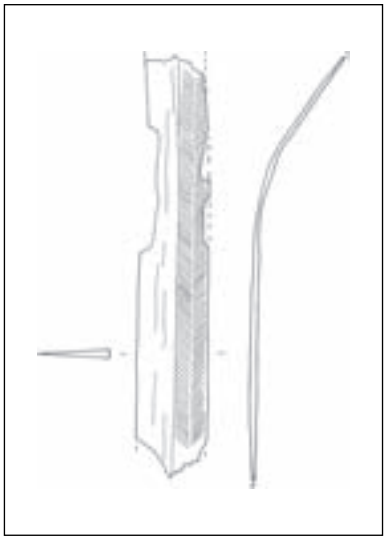


Fig. 188 Dorestad, Hoogstraat IV: iron sax; scale 1:4.

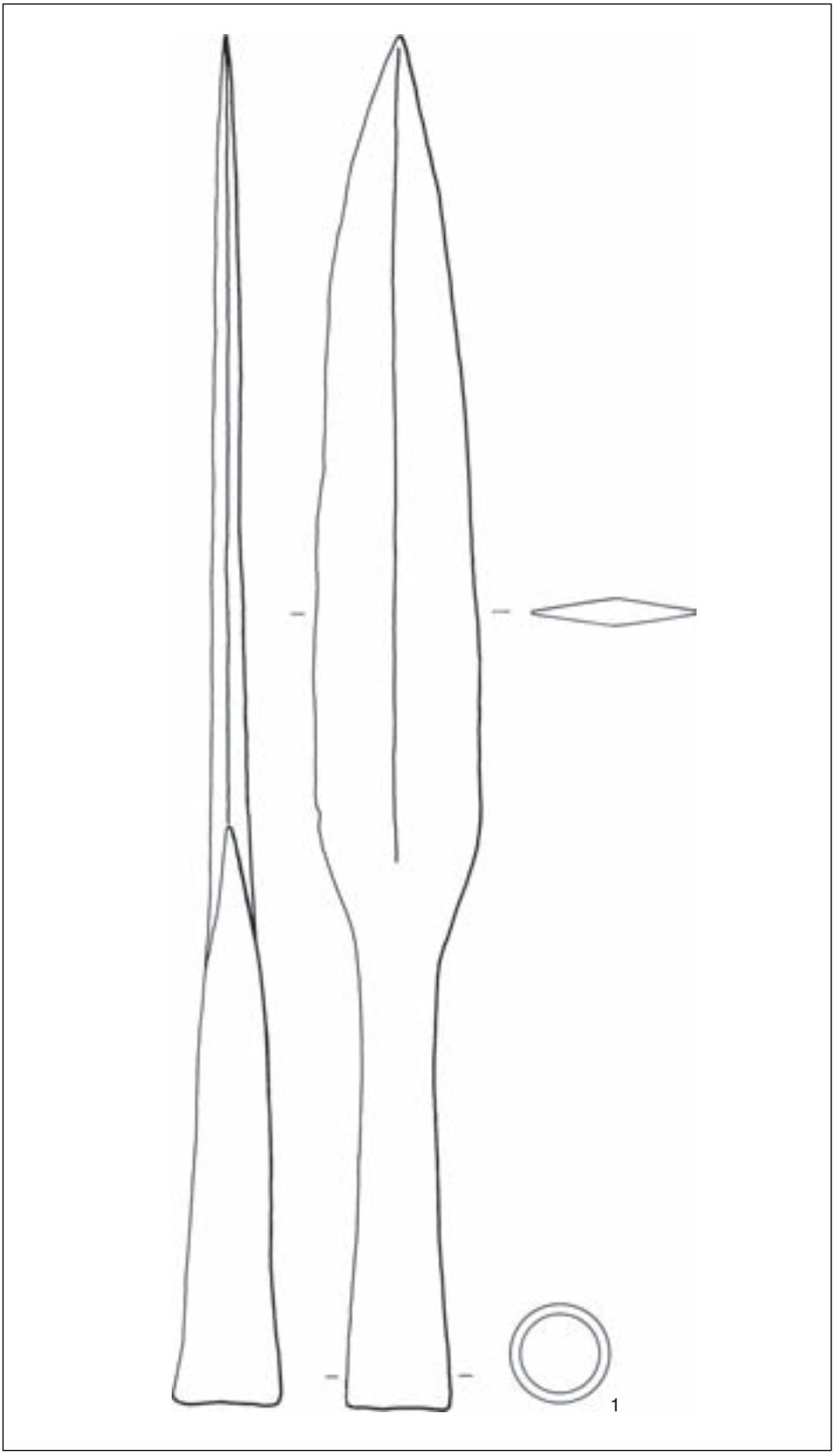
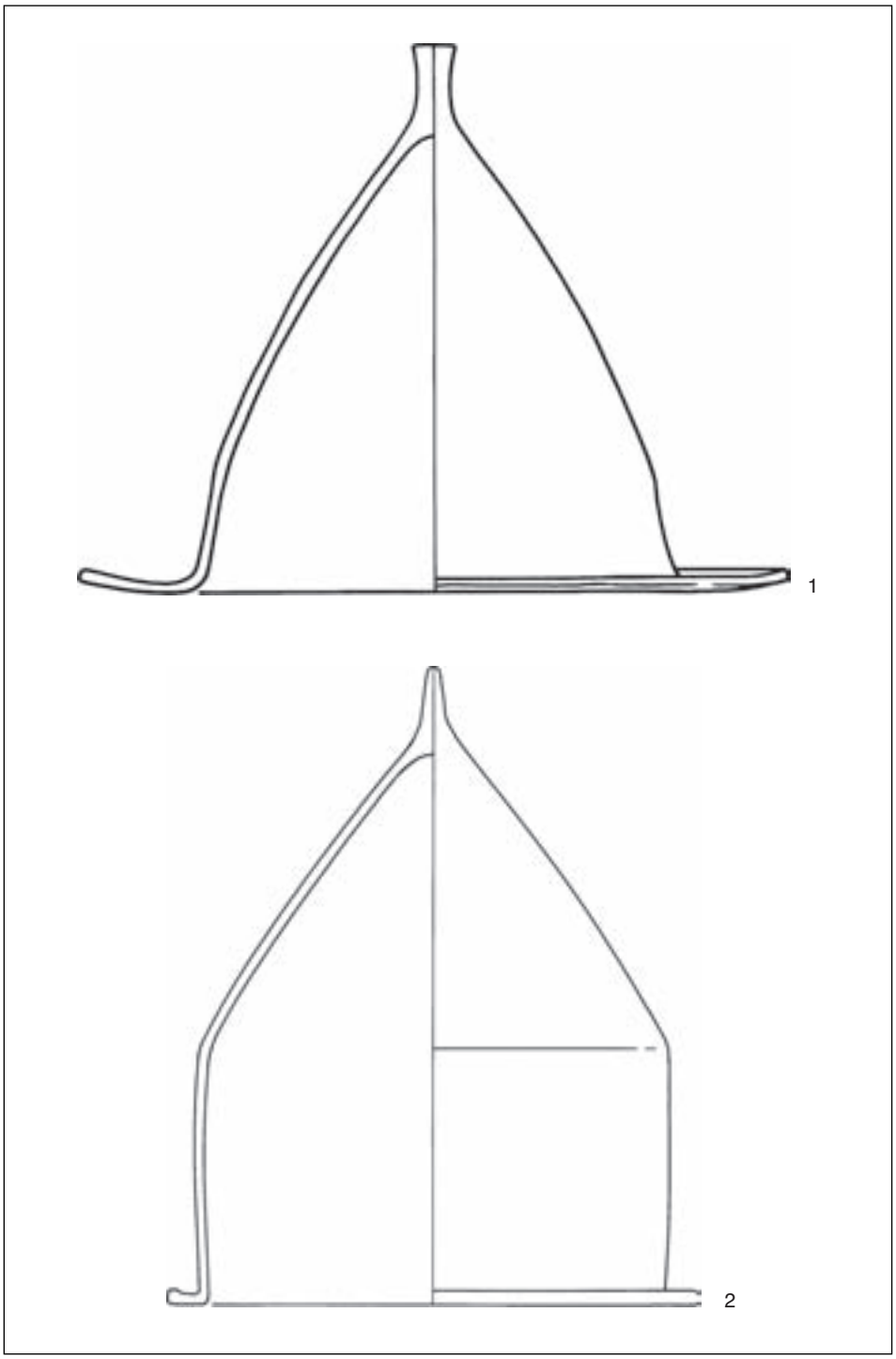


Fig. 187B Dorestad, Hoogstraat II and IV: iron spear-heads; scale 1:2.

Fig. 189 Dorestad, Hoogstraat II: iron shield-boss; scale 1:2.



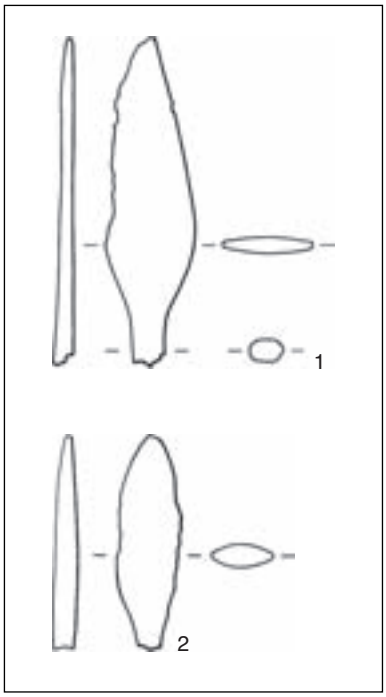


Fig. 190 Dorestad, Hoogstraat IV: iron arrow-heads; scale 1:2.

Miscellaneous objects

Bucket handles Nine specimens, of which the specimen from Hoogstraat III was almost complete. All the fragments are bent, some appear to be twisted. One specimen from Hoogstraat 0 is folded over at the end to form an eye (fig. 196: 1). The end of another is missing (fig. 196: 2). The diameter of the bucket which hung from the handle (diameter 4 mm) was approximately 14.5 cm.
The handle with rectangular section from Hoogstraat III is widened in the middle (fig. 197: 3). It has curved ends. The diameter of the bucket may have been *c.* 29 cm. Because this handle came from a late-medieval well, a 12th-century date is as good as certain.
The handle depicted in figure 196: 4, is rectangular at the top, becoming rounder towards the ends.
A handle and an iron band, both belonging to a wooden bucket, come from Hoogstraat IV.

Buckle One rectangular specimen, from Hoogstraat IV, the tongue of which is folded round the loop (fig. 197: 1). A second buckle, discovered in Hoogstraat 0, probably also had a rectangular loop (fig. 197: 2).
Again from Hoogstraat 0 came a round buckle, whose folded tongue has also been preserved (fig. 197: 3). This specimen was found in the highest excavation level and showed no relation to any feature.

Mountings Four specimens. A broken rectangular plate with a rounded end in which there are two square holes (fig. 198: 1). A broken rectangular plate with a hole for a nail, probably ending in an eye that has been broken off (fig. 198: 2). Finally, two narrow, rectangular, bent mountings (of a chest?; one illustrated, fig. 198: 3) with on one side a hole for a nail.

Chain Three fragments. In Hoogstraat 0 part of a chain was discovered consisting of at least two links (diameter *c.* 5 cm). One of these is folded double, the other is round (fig. 199: 1).
Two eyes bent together were possibly also part of a chain (fig. 199: 2, see also under: *Other*).

Pins Two specimens ending in a point. Length max. 11.6 cm, section at upper side 0.5 cm.

Trivet In Hoogstraat II an iron trivet came to light. It was discovered at a depth of *c.* 3 m NAP among the natural deposits of the Rhine bed. The find context points to an early-medieval date, although the shape of the object gives the impression of being recent (fig. 200).

Other Bipartite object ending in an eye. It possibly belonged to the chain in figure 199: 2. Both objects have the same finds numbers.

Lead

Two weights. A conical, octagonal weight comes from Hoogstraat II; a bronze eye was present on top of the weight (fig. 201: 1; 334 gr). The second one from Hoogstraat III was flat and round with grooves on the upper side (fig. 201: 2; 162.5 gr.).

Fig. 191 Dorestad, Hoogstraat III: iron spur; scale 1:2.

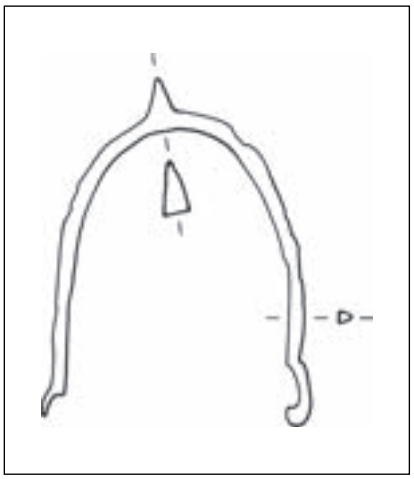
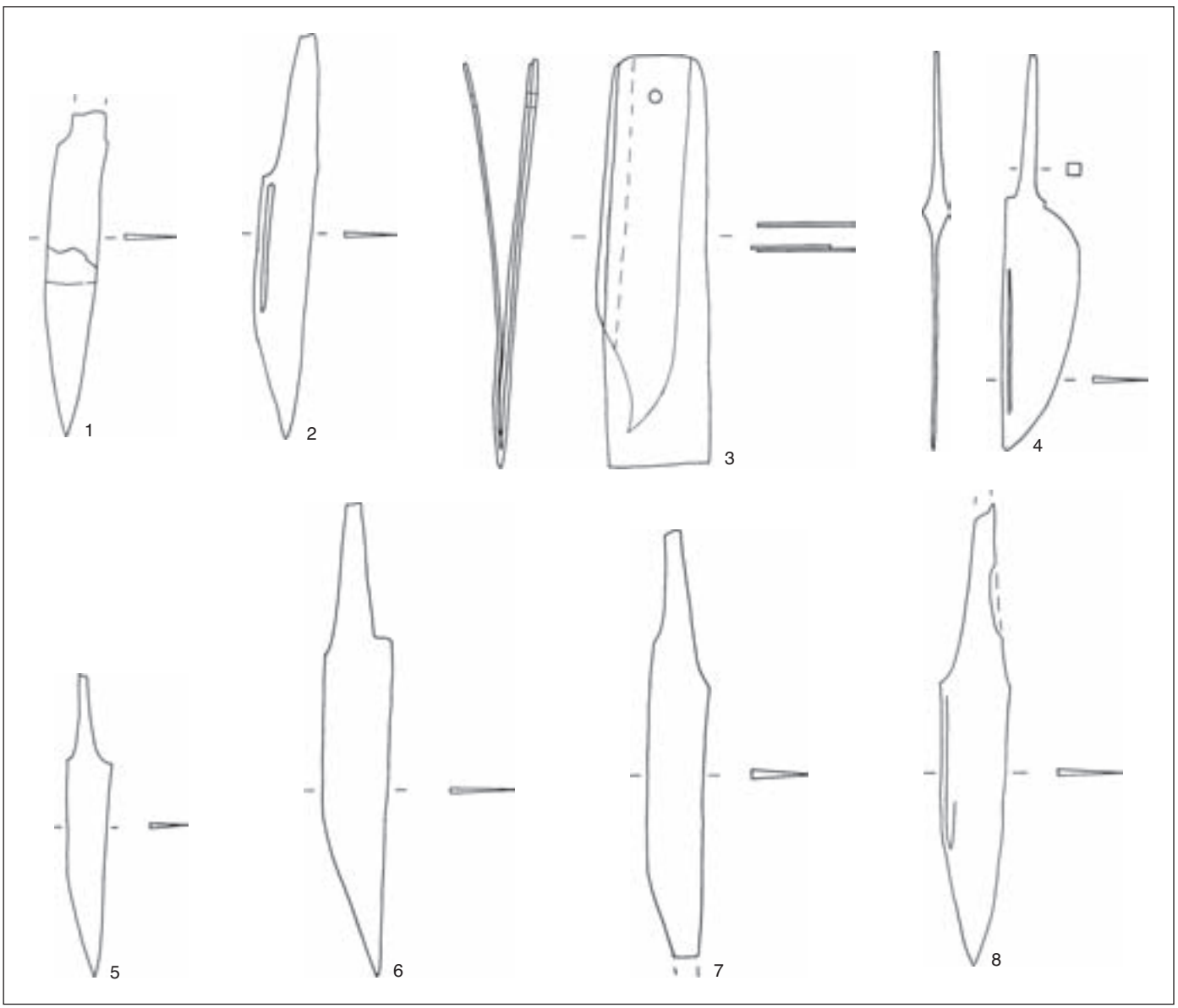


Fig. 192 Dorestad, Hoogstraat 0-IV: iron knives; scale 1:2.



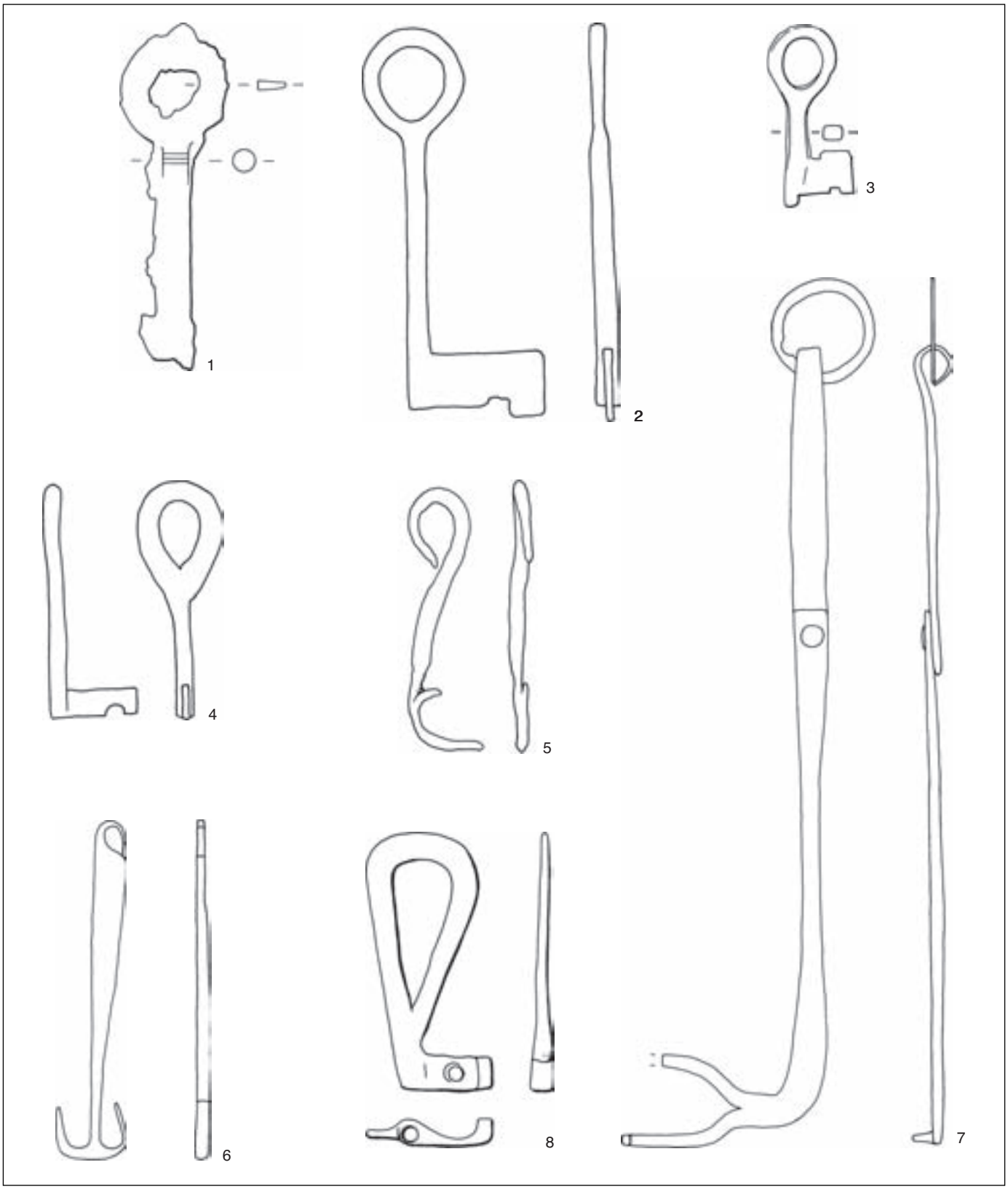


Fig. 193 Dorestad, Hoogstraat 0-IV: iron keys; scale 1:2.

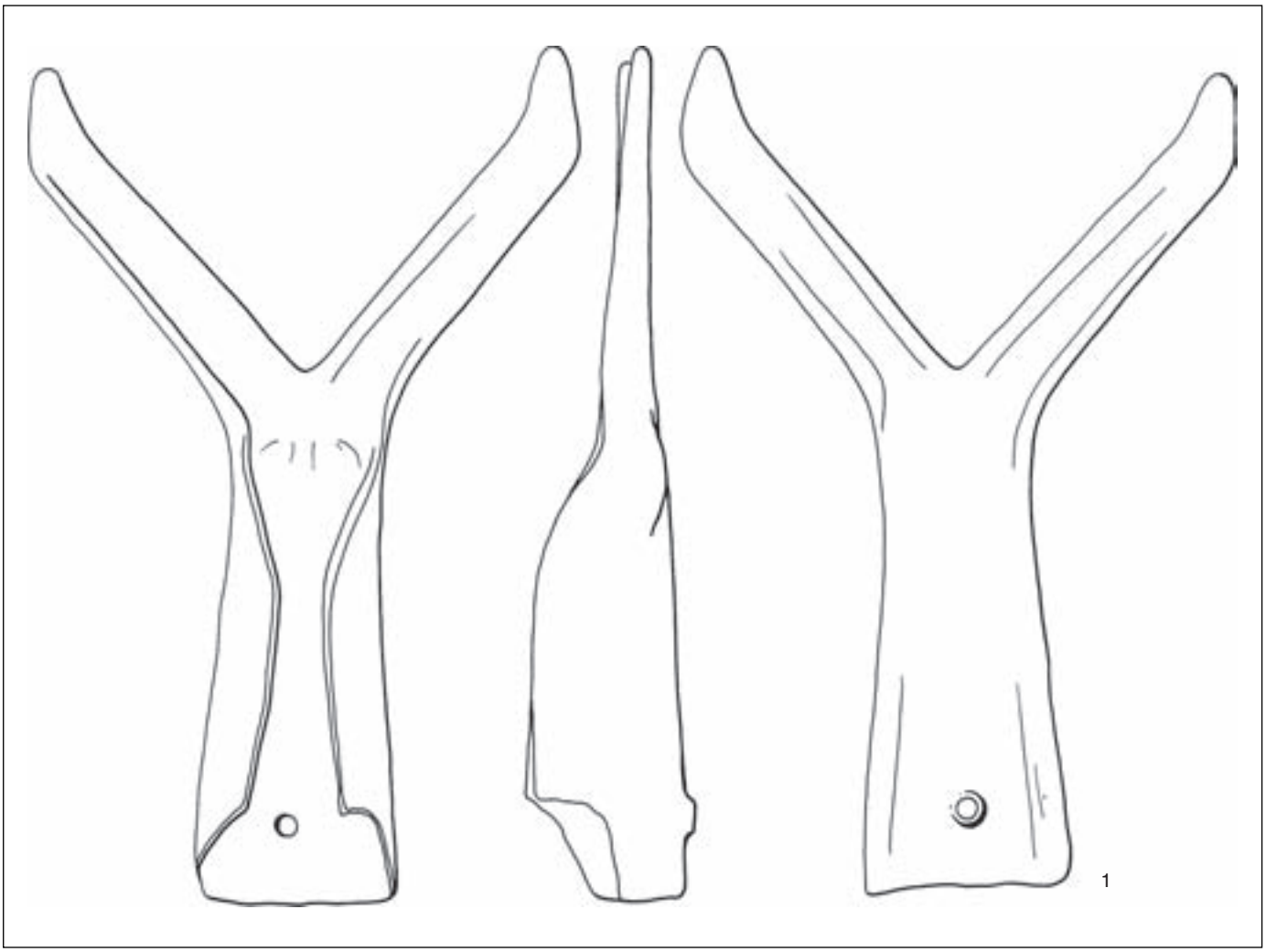


Fig. 194A Dorestad, Hoogstraat 0-IV:
iron boat hooks; scale 1:2.

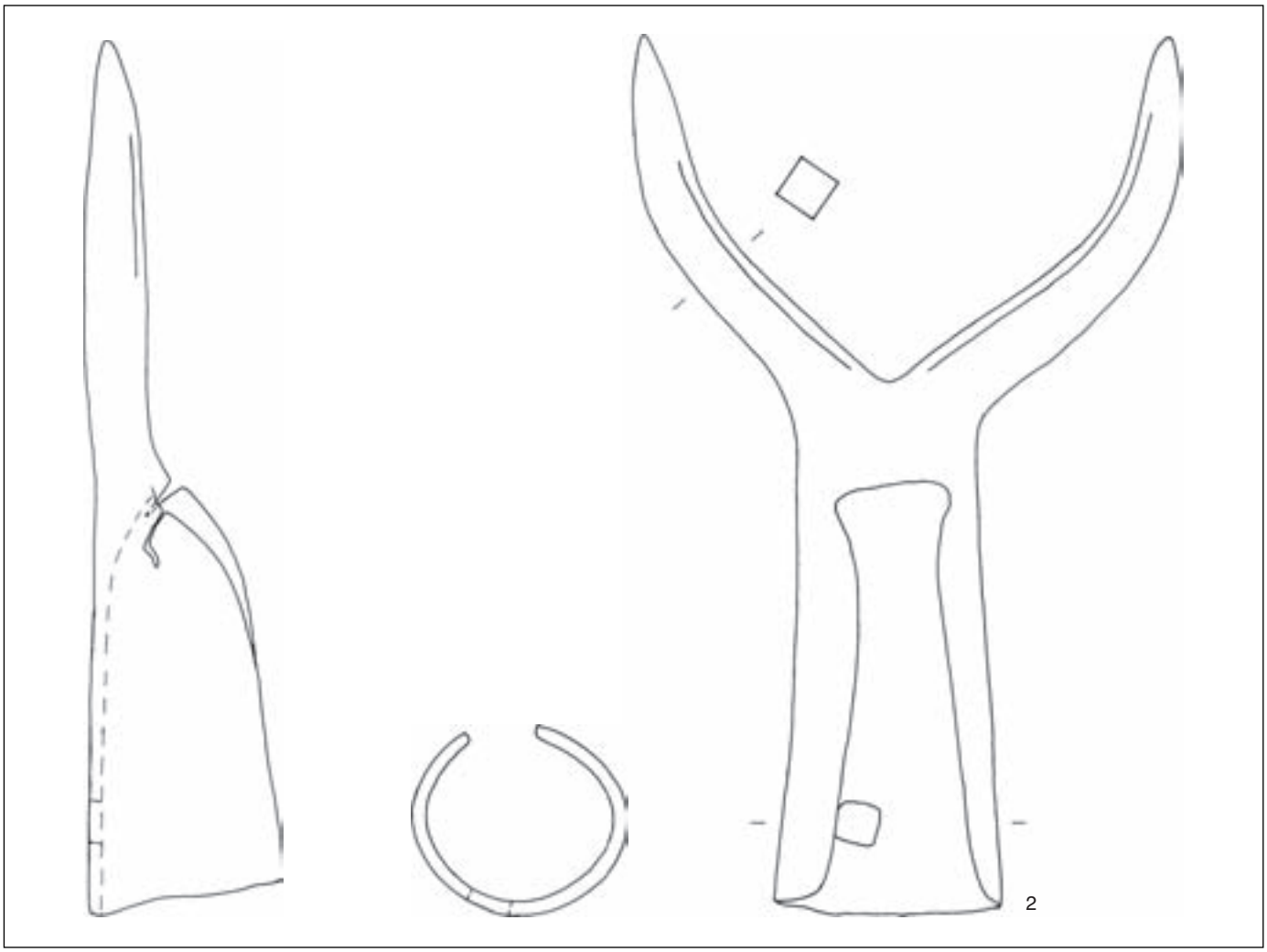


Fig. 194B Dorestad, Hoogstraat 0-IV:
iron boat hooks; scale 1:2.

Fig. 194C Dorestad, Hoogstraat 0-IV: iron boat hooks; scale 1:2.

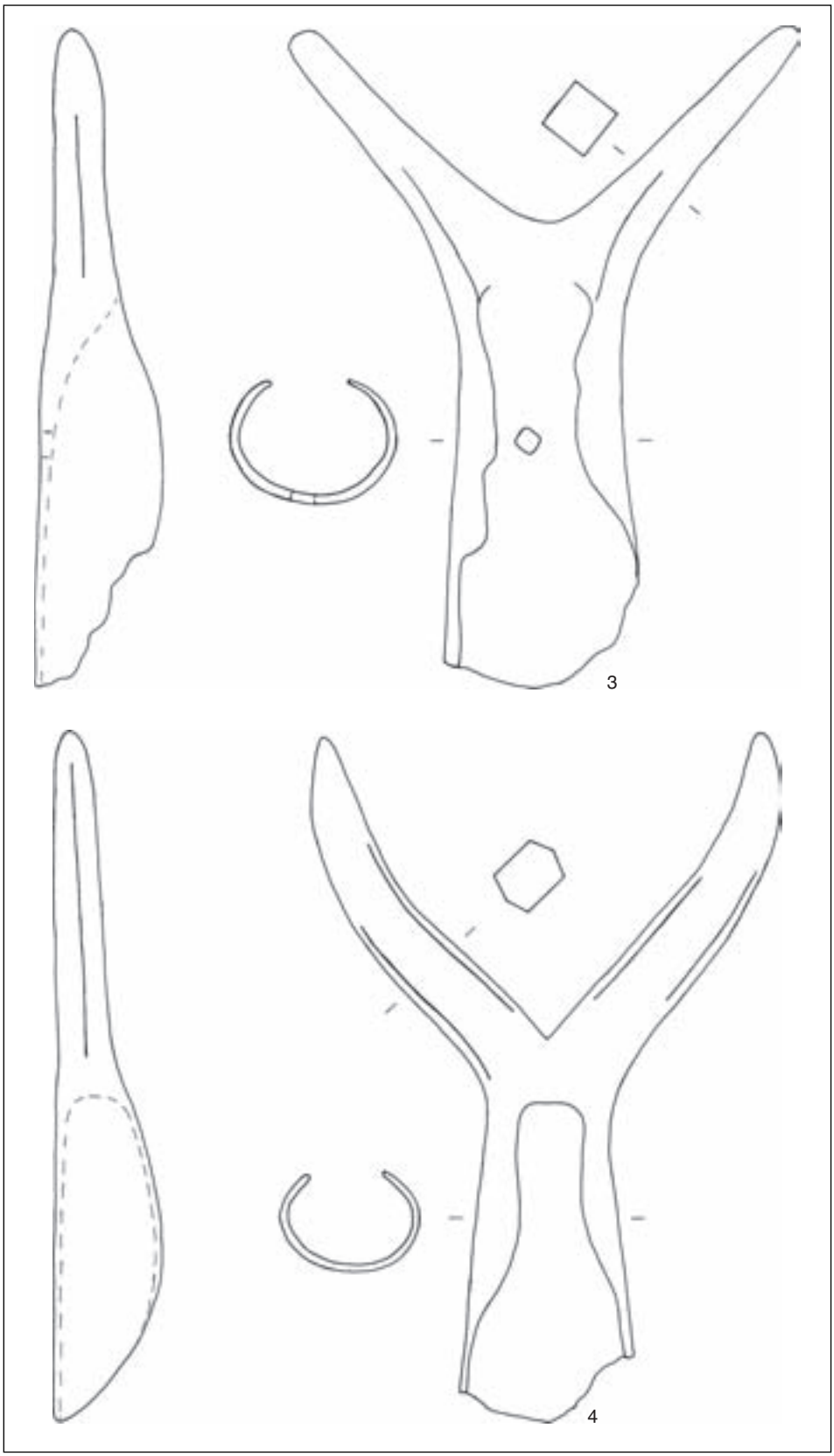


Fig. 194D Dorestad, Hoogstraat 0-IV: iron boat hooks; scale 1:2.

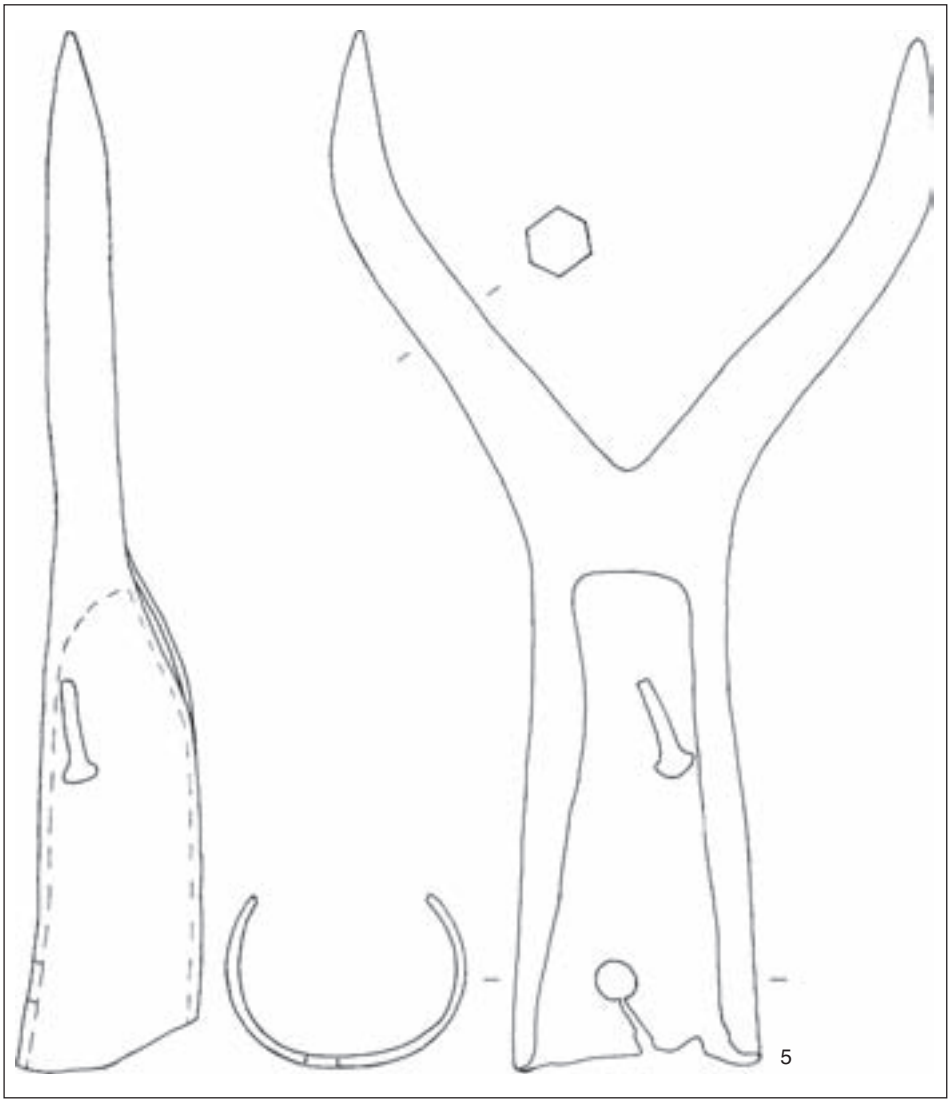


Fig. 195A Dorestad, Hoogstraat 0-III: iron butt-ferrules; scale 1:2; no. 8a scale 1:2, no. 8b (photograph) scale ca 1:8.

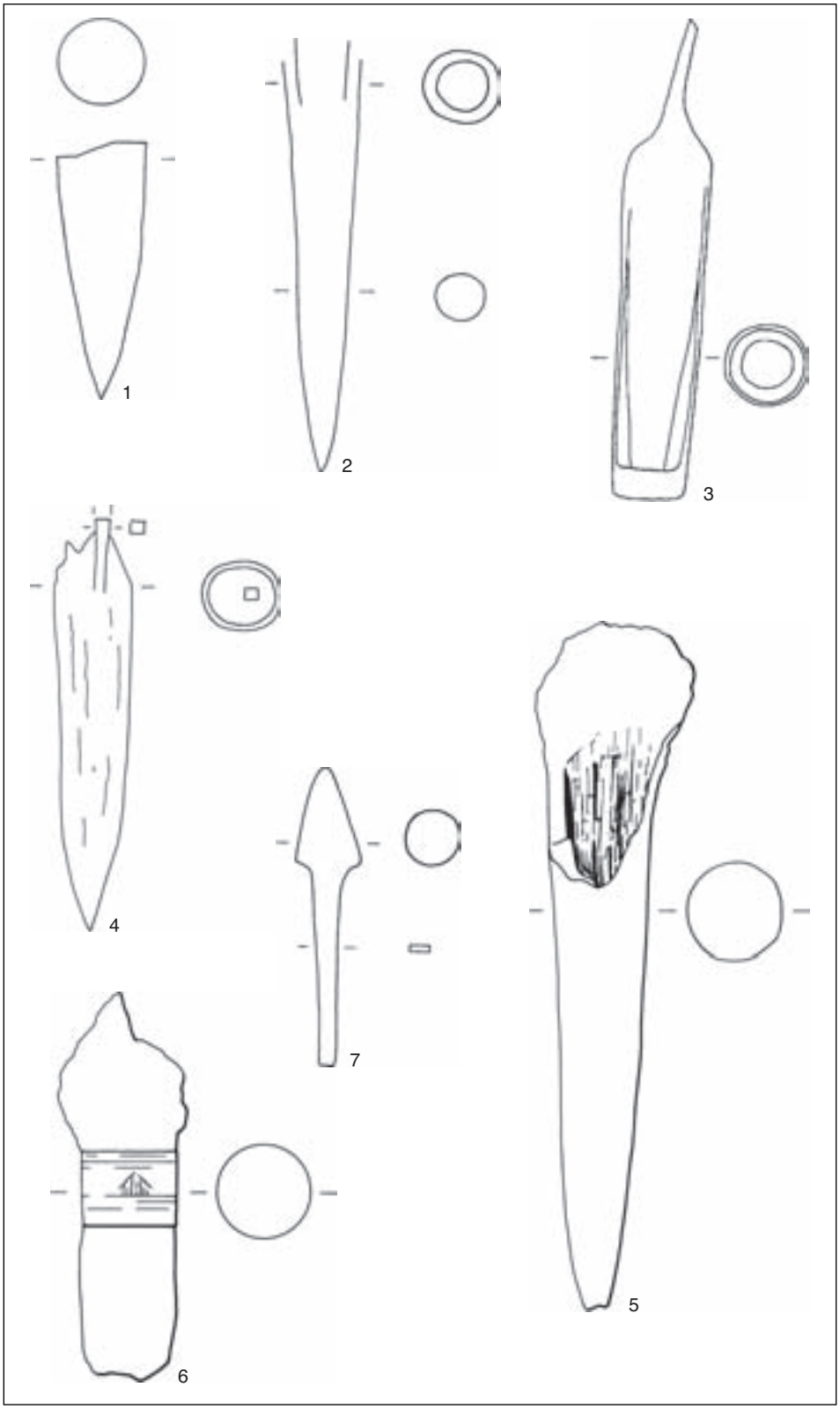
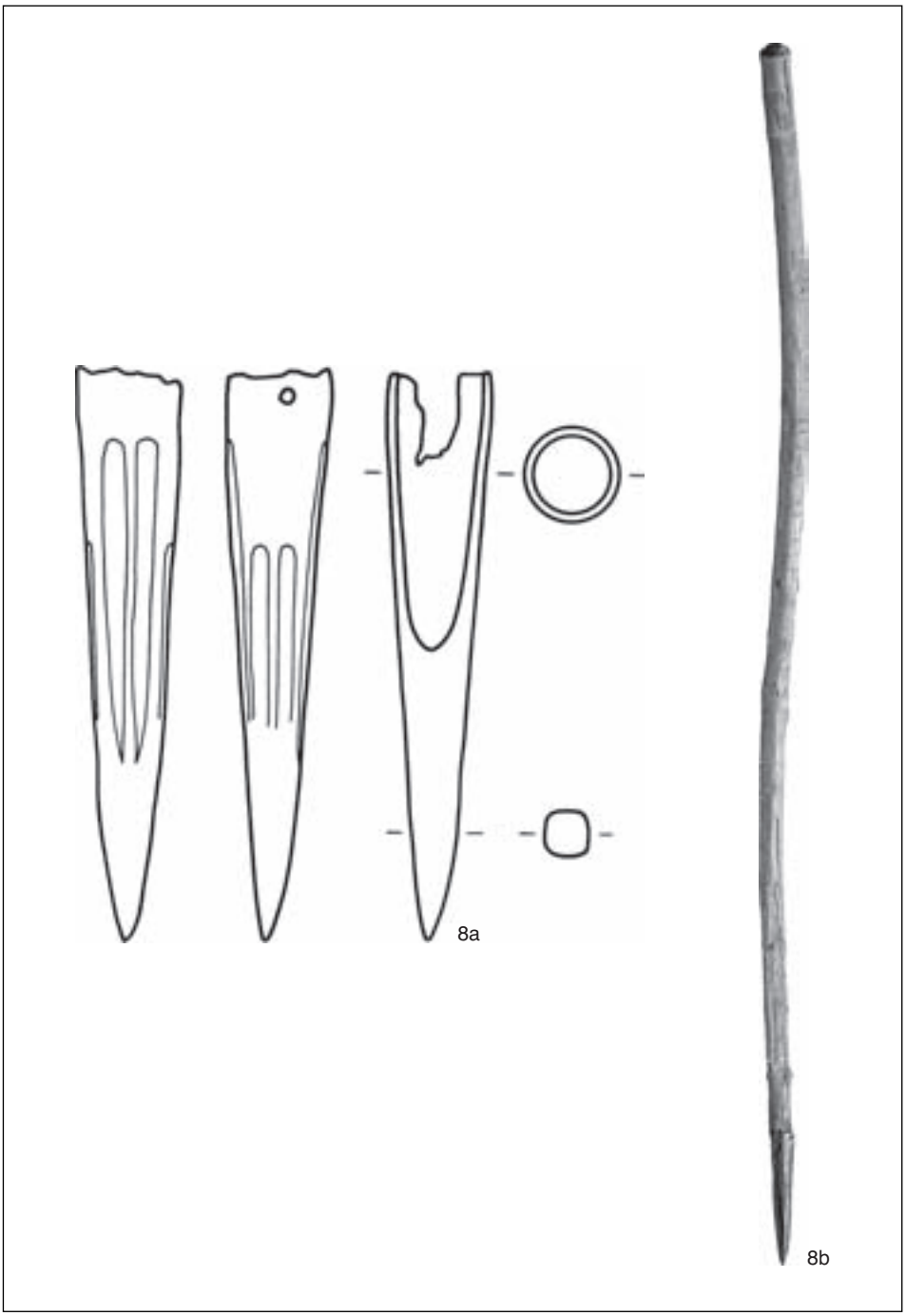


Fig. 195B Dorestad, Hoogstraat 0-III: iron butt-ferrules; scale 1:2; no. 8a scale 1:2, no. 8b (photograph) scale ca 1:8.



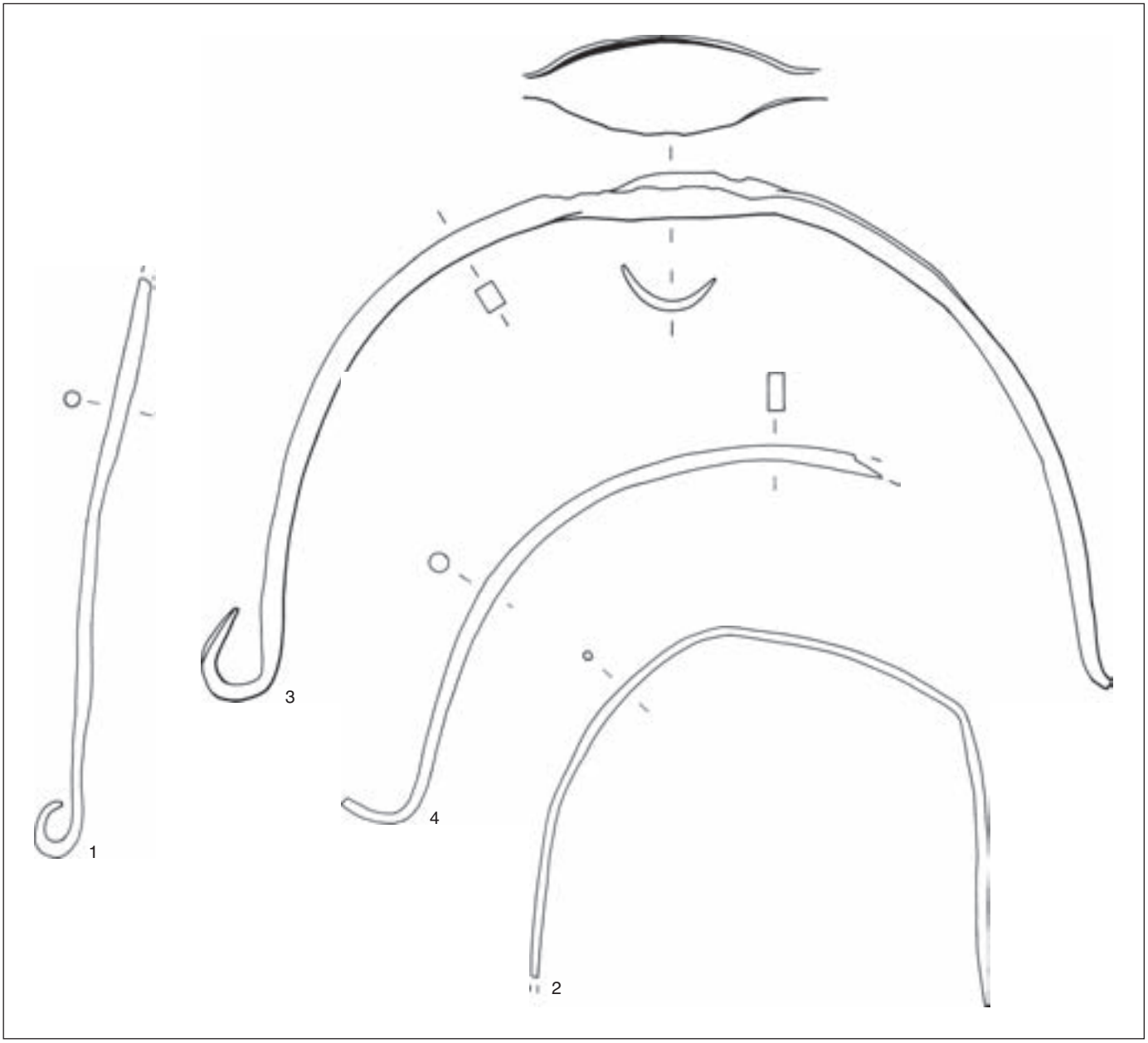


Fig. 196 Dorestad, Hoogstraat 0 and III: iron bucket handles; scale 1:2.

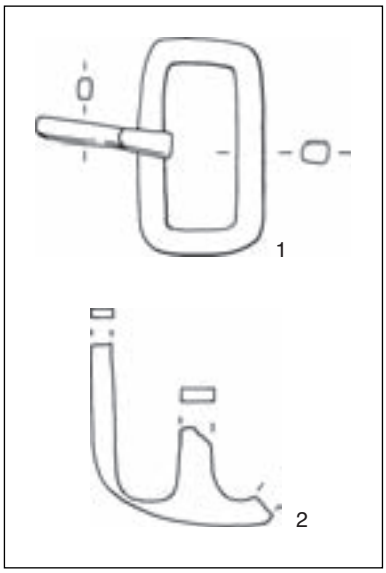


Fig. 197 Dorestad, Hoogstraat 0-IV: iron buckles; scale 1:2.

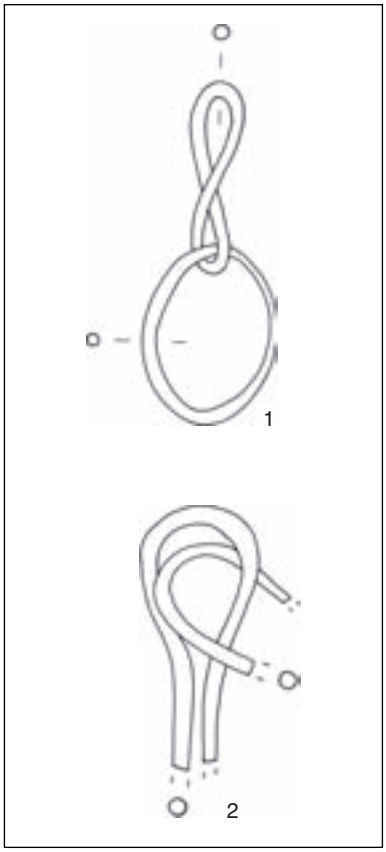


Fig. 199 Dorestad, Hoogstraat 0 and IV: iron chain; scale 1:2.

Fig. 201 Dorestad, Hoogstraat II and III: lead weights; scale 1:2. >>

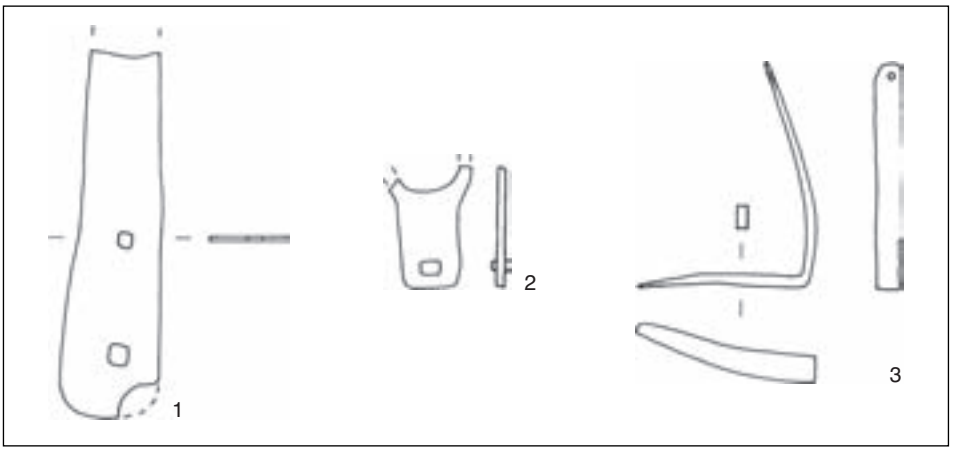


Fig. 198 Dorestad, Hoogstraat 0: iron mountings; scale 1:2.

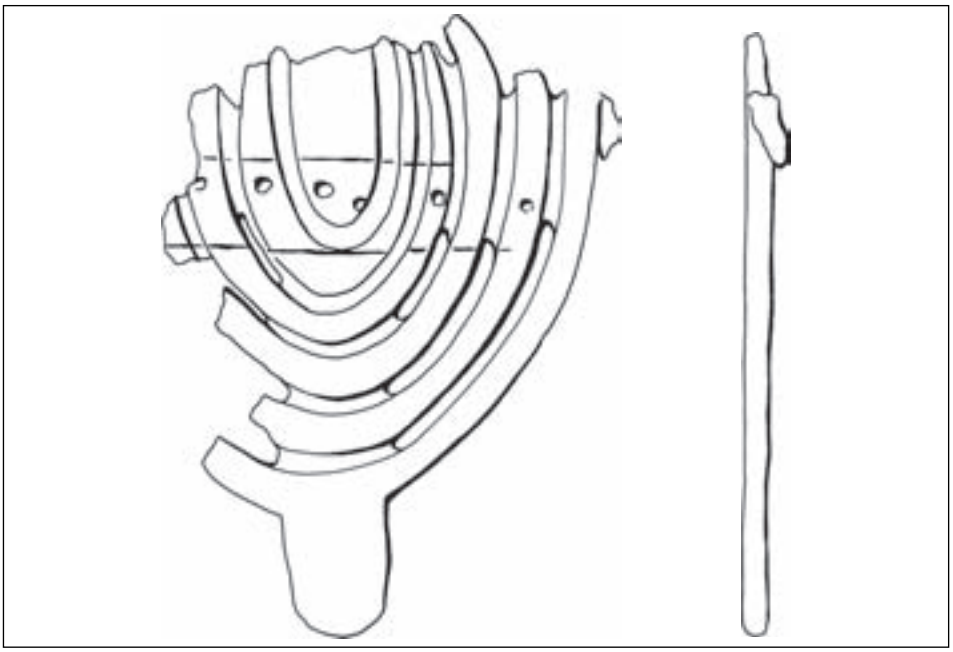


Fig. 200 Dorestad, Hoogstraat II: iron trivet; scale 1:2.

3 Wood

Creel

Two creels were found, both incomplete, one of which was inside a wattle enclosure (figs. 202–3, resp. fig. 16*, Hoogstraat II, squares F/G-7 and F-15).
The first had a rectangular frame measuring 1.70 x 1.45 m, that of the second was 2.10 x 1.40 m, each consisting of four beams or planks. Between the long sides were horizontal rods, around which wickerwork had been wound. The frame was held in place by vertical rods.
In one specimen (fig. 202) the plank of the short side (9 x 3 cm) tapered at the ends; at this point the short plank was inserted into the long one. The other end of the long beam rested in the short one, or what was left of it. The planks and beams were perforated at more or less regular intervals of 20 cm in two directions at right angles to each other. The horizontal holes held the rods with the wickerwork made of willow. This wickerwork formed the base of the creel. Between the vertical rods the upright walls had also been woven, but these have not been preserved. The wattle was of *Salix*. The frame itself consisted of *Quercus*, *Malus* and possibly *Salix*.[343]
This creel was probably secondarily placed inside a closed oval wattle enclosure. As far as it was possible to recover the wood from which it was constructed, the vertical stakes appeared to have been made of different types of wood: *Acer*, *Betula*, *Malus*, *Rhamnus* and *Salix*. The wickerwork, on the other hand, consisted exclusively of *Salix*. The creel was discovered at a depth of between *c.* 2.55 and 2.28 m NAP, among natural sediments.
Only the base of the other creel was preserved (fig. 203). Its construction was similar to that of the creel described above. The long horizontal beams, which were made of *Quercus*, had horizontal and vertical perforations. These were intended for the rods, which were of *Salix*. There was no enclosure around it. This creel was also embedded in natural sediments, and lay at a depth of between 2.45 and 2.15 m NAP (fig. 203).

Fykes

The remains of two fykes were found in Hoogstraat IV (fig. 204; fig. 18*, squares C/D-5/6). They lay more or less in a line and were oriented northwest-southeast. Hardly anything remained of the upper part of the fykes. The lower side, embedded in a natural clay layer, was visible at a depth of between 1.67 and 2.26 m NAP. Both fyke-nets dipped towards the west. The difference between both sides varies between 10 and 20 cm. The fykes consisted of a funnel-shaped wicker basket, held together by a wicker mouth and hoops. The length of the fykes was 3.30 (fyke 1) and 5 m (fyke 2), respectively.
The basket consisted of long osiers of *Betula* with a diameter of *c.* 0.5 cm; the length of the osiers is unknown. At the end of the fykes, the osiers were wound together.

The fykes were held in place by vertical stakes (fig. 204:1). In fyke 1 this was a 3 cm-thick stake of *Salix*, which had been preserved over a length of 40 cm. Another stake which was hewn on five sides, possibly had the same function. Its angular cross-section varied between *c.* 17 and 25 cm; nothing is known about its length. Fyke 2 was held in place on either side of the opening by two squarely lopped stakes with diameters of 8 x 8 and 12 x 12 cm respectively. The thinnest post had been driven through a horizontal, pointed post (length 250 cm; diameter 10 cm). Another small thick stake had been driven through this horizontal beam (length 20 cm; diameter 4 cm). Whether the horizontal beam and the latter stake were part of the fyke attachment is uncertain.
The widest part of the fykes was the opening, whose diameter varied from 0.95 to 1.07 m in fyke 1, and 0.95 to 1.27 m in fyke 2. The mouth was formed by a bundle of 5–8 interwoven twigs of *Betula*. The bundle had a diameter of 7 cm, that of the twigs was 1–1.8 cm.

343 All the wood samples discussed in this chapter were identified by Dr W. Casparie and J.E.J. Swarts (BAI).
344 Ellmers 1972, abb. 15.

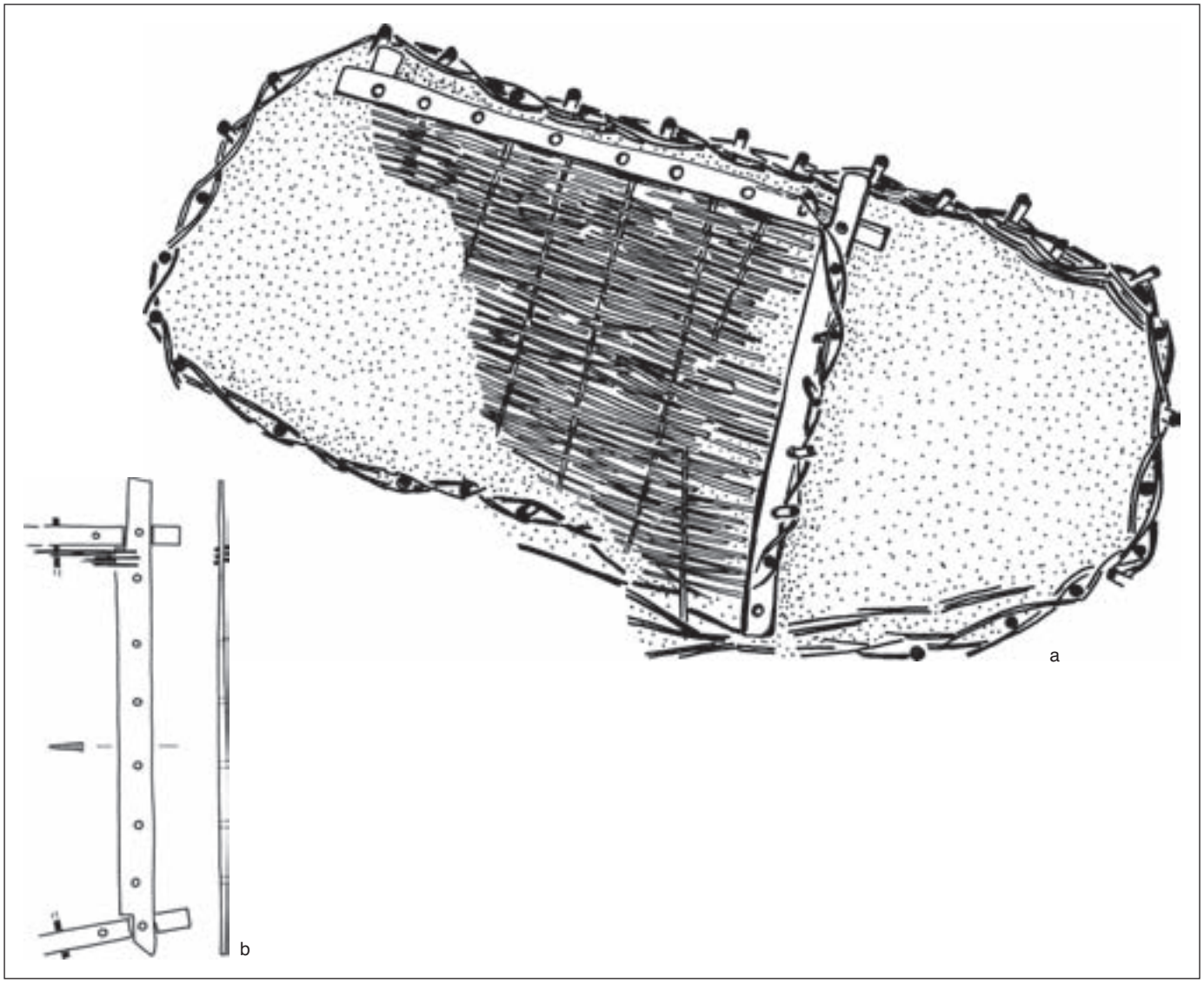


Fig. 202A Dorestad, Hoogstraat II: creel (no. 383.4.96-113). Scale 1:20.
Legend:
a plan;
b view from above and cross- section;
c reconstruction.

In the smallest fyke, the number of hoops was 8, and the largest had 11. The space between varied from 30–50 cm. Almost all the hoops were made of 2 or 3 twigs of *Salix*. In one hoop (fyke 1) *Betula* wood was used, and another (fyke 2) contained a twig of a type of *Malus*. About one-third length from the end of both fykes there was a thicker winding. This was in both cases a bundle of 4 or 5 twigs; the diameter of these twigs was 1–1.8 cm. In fyke 1 this bundle consisted of material from a *Prunus* type, and in fyke 2 this was *Betula*.

Wicker basket

Among the ship remains in Hoogstraat II the remnants of a wicker basket were found (figs. 16* and 207–8, squares D/E-11. The diameter of this basket was *c.* 50 cm; upper and lower side had decayed. The remains of the more or less basin-shaped basket could be seen over a depth of *c.* 40 cm, and emerged several decimetres under the level at which the ship remains were found. The contents consisted of unworked bone fragments and stones.

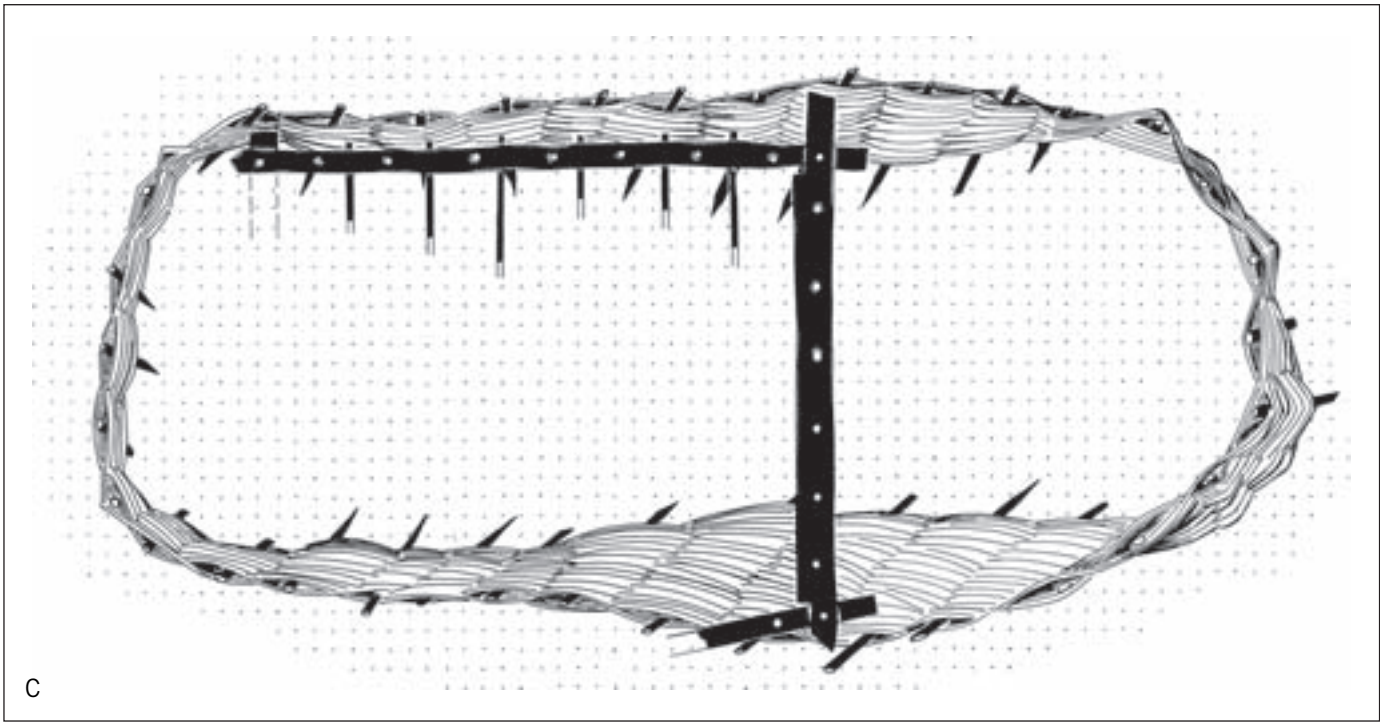


Fig. 202B Dorestad, Hoogstraat II: creel (no. 383.4.96-113).
Legend:
see fig. 202A.

Bucket
This find consists of the base and six staves of a wooden bucket, with the remains of iron hoops and an iron handle (fig. 205; fig. 18*, square D-6). The lower side of the base, which was 21.8 cm in diameter, was flat and the edge was bevelled on the upper side. The planks of the base were joined together by means of plugs (fig. 205). At the bottom on the inside of the staves was a groove into which the base was fitted. Of the fourteen original staves, six had been preserved. They more or less tapered towards the top and were *c.* 25 cm long. One stave was longer, *c.* 27.5 cm, and had a more or less roof-shaped top. In it a hole *c.* 1.5 cm in diameter had been made, through which the handle was fastened. Around the hole on the inside an iron plate had been fitted as a reinforcement, and this was attached to the stave with four nails (fig. 205). Two iron hoops held the staves in place.

Plank with perforations
In Hoogstraat III, just east of posts (see fig. 17*, squares E-12/13), a fragment of a curved plank was recovered (fig. 206). The plank had three perforations along the axis on the upperside with varying gaps in between. The holes had not been made parallel to each other, but more or less followed the radius of the curve of the plank. This gave the impression that it was a fragment of a spoked wheel, possibly some 100 cm in diameter. The plank which was made of *Abies* and was found at a depth of *c.* 2.70 m NAP, lay horizontally and was more or less north-south oriented.

Ship remains
In trenches 386 and 387 of Hoogstraat II (figs. 207–8; fig. 16*, squares C/F-10/12), and scattered over a distance of about 30 m and more or less in a north-south oriented line, lay the remains probably of one ship. They lay at a depth of *c.* 2.70 m NAP and consisted of separate planks, pieces of ship's side and part of a rib.

Rib The rib part was more or less square in cross-section, though rectangular in the middle (fig. 209). In two places, *c.* 35 cm apart, holes had been bored so that the

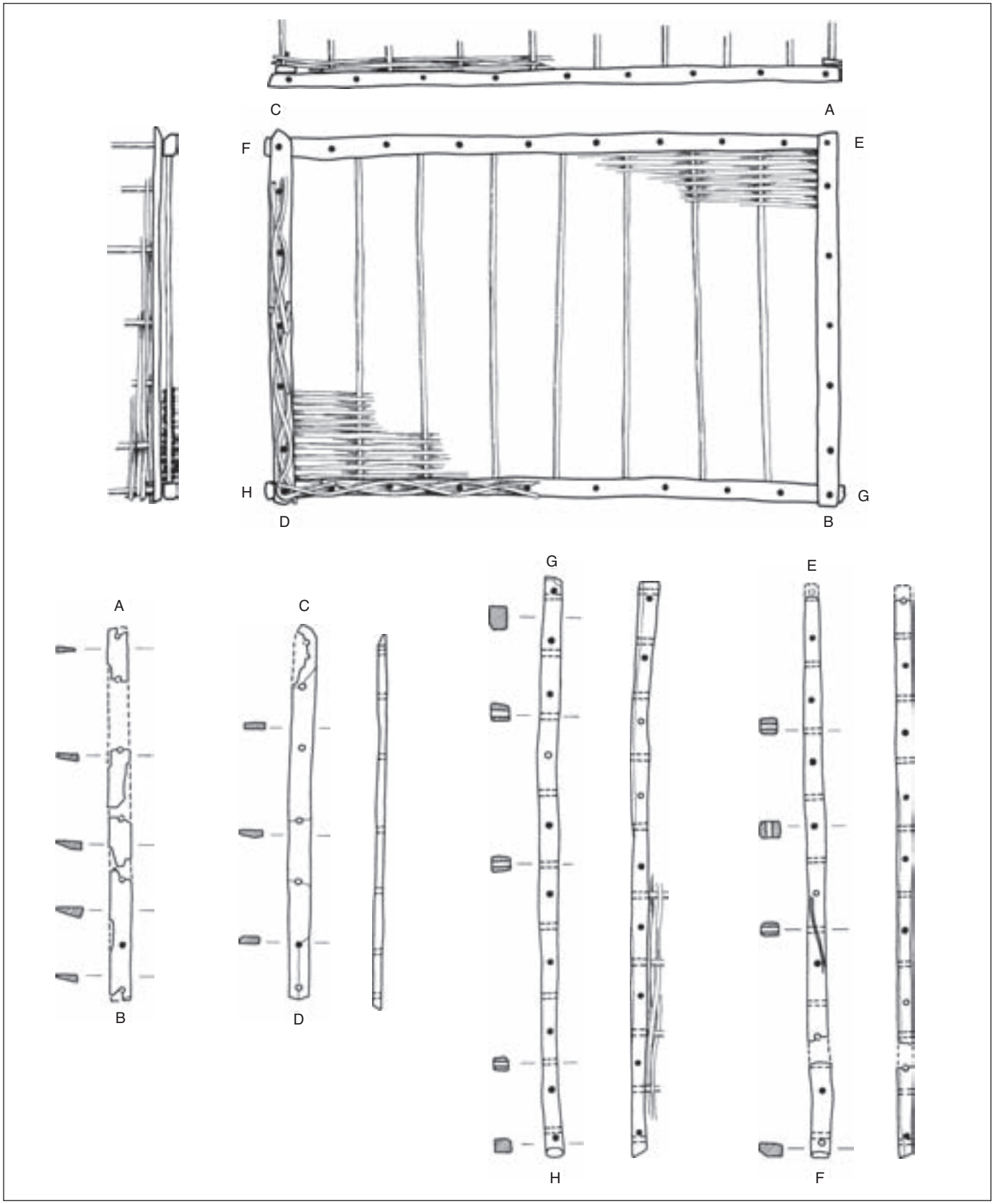


Fig. 203A Dorestad, Hoogstraat II: creel (no. 390.5.27). Plan and views from side and above. Scale 1:20.

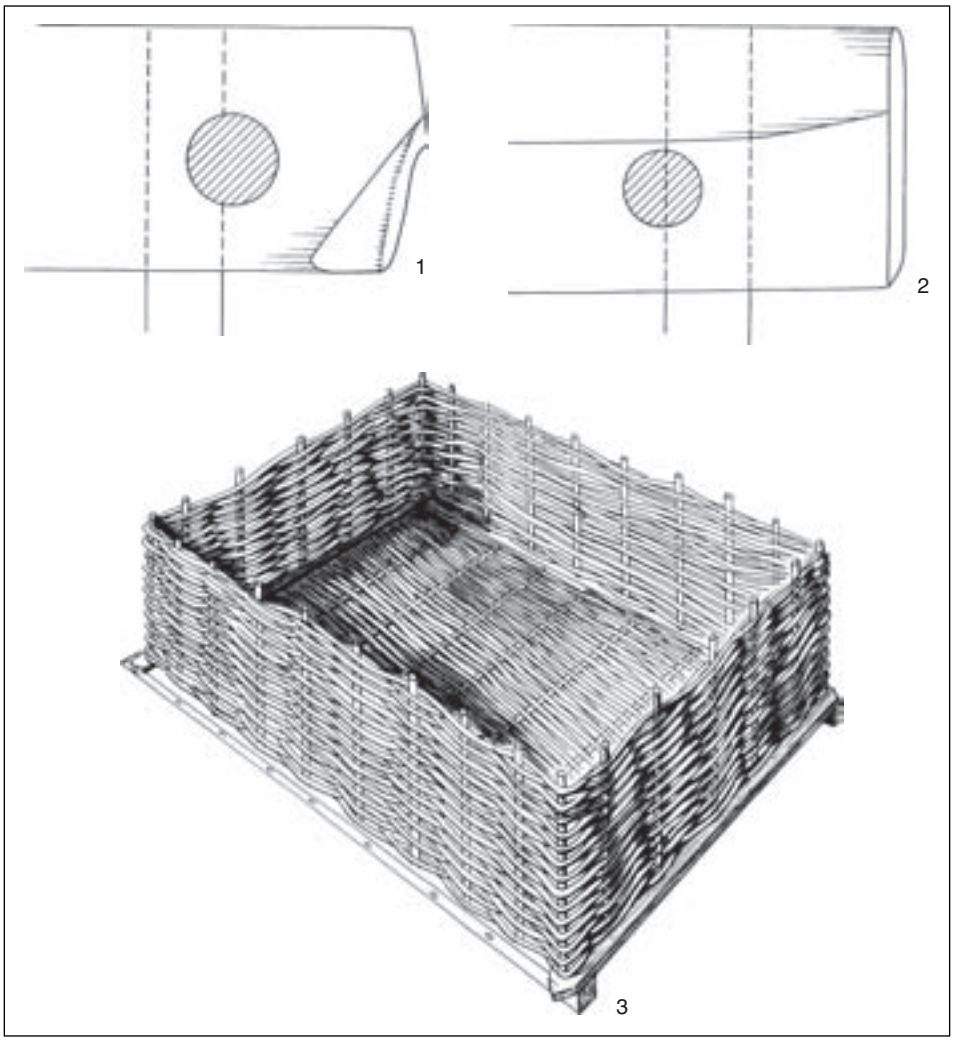


Fig. 203B Dorestad, Hoogstraat II: creel (no. 390.5.27). Details and reconstruction.
Legend:
1-2 details of beam at G (scale 1:10);
3 reconstruction.

ship's side could be fastened to the rib with wooden pins or iron nails. However, no connection has been found between the rib and the remains of the ship's sides found. A notch appears to have been cut in the under side of the rib so that it could be attached to the keel plank, although this may partly have developed as a result of rot. On the basis of the size of the notch, it is assumed that the rib must have come from the middle of a ship.[344] The rib was made of *Alnus*.
About 2 m south of the rib two planks emerged (fig. 210). One of them was 113 cm long, and they were between 2.0–5.5 cm thick. One had three holes and was tapering in section, the other end had decayed. The plank was more or less triangular in cross-section. The type of wood is unknown.

Ship's hull fragments There are four fragments of ship's hull, consisting of planks joined together with iron nails. One side of the planks was cut or sawn straight, the other side was somewhat rounded. The number of planks joined together was between 2 and 5. The greatest length observed was *c.* 175 cm (fig. 211), and this fragment was also the widest: 74 cm. Since most of the planks were damaged, the width could only be established in a few cases. A clear indication was the distance between the two rows of iron nails (along both edges of the planks), which varied from 16–20 cm. If another *c.* 2–3 cm-wide strip of wood was added on either side, the width would then be between 20 and 25 cm. The planks were 2–3 cm thick. The

345 Ellmers 1972, 31 etc.

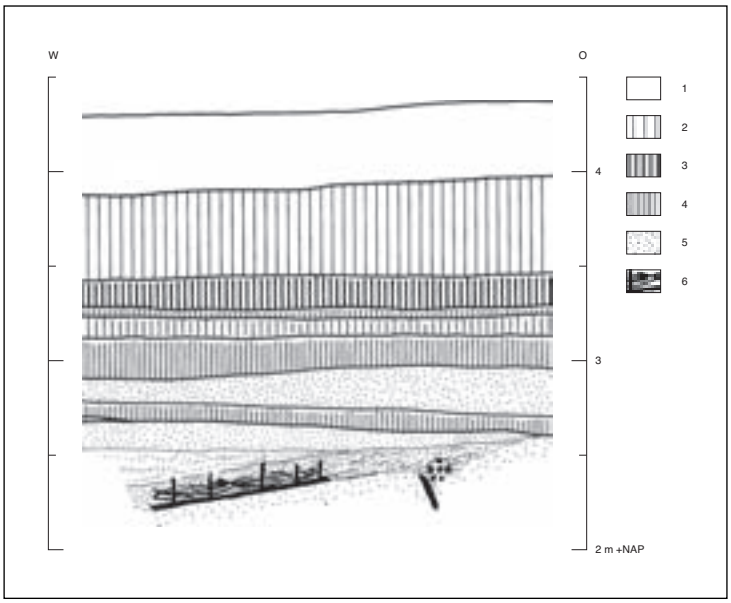


Fig. 203C Dorestad, Hoogstraat II: creel (no. 390.5.27). Position of the fyke in the profile. Scale 1:40
Legend:
1 topsoil, 2 reddish-brown clay with shells, 3 grey clay, 4 (greyish-) blue clay, 5 sand, 6 wood.

fragment shown in figure 212 was an exception: the plank was not only thicker, 5.6 cm at the most, but also wider. On the basis of the gap between the two rows of nails along both edges (*c.* 25 cm), it may be assumed that the total breadth must have been at least 29 cm. In all these ship remains, the distance between the individual nails was 15–18 cm. However, an exception was observed in the fragment shown in figure 212, where the gap was 24 cm.
One plank (fig. 213) appeared to be broken in the length. The width of the plank was *c.* 37 cm, on the basis of the gap between the rows of nails. The nails were hammered in at approximately 16 cm intervals. The thickness in cross-section varied from 2.4 cm on one side to 5 cm. A thin plank (9.2 cm wide; 1.4 cm thick) had been fastened across the break by means of iron nails. A second repair had possibly also been made to one end of this fragment. Shape, size, presence of nails plus the nature of the plank make it reasonable to assume that this remnant was also part of a ship's hull.
In four planks (figs. 214–7) neither the length nor the breadth had been completely preserved. The length varied from 58 to 130 cm, the breadth was at least 13 cm, and at most 20.6 cm. Apart from one very thin plank (0.6 cm), the planks were between 2 and 2.4 cm thick.

Fig. 204 Dorestad, Hoogstraat IV: fykes. 1 (middle and under) and 2 (above). Scale 1:50.

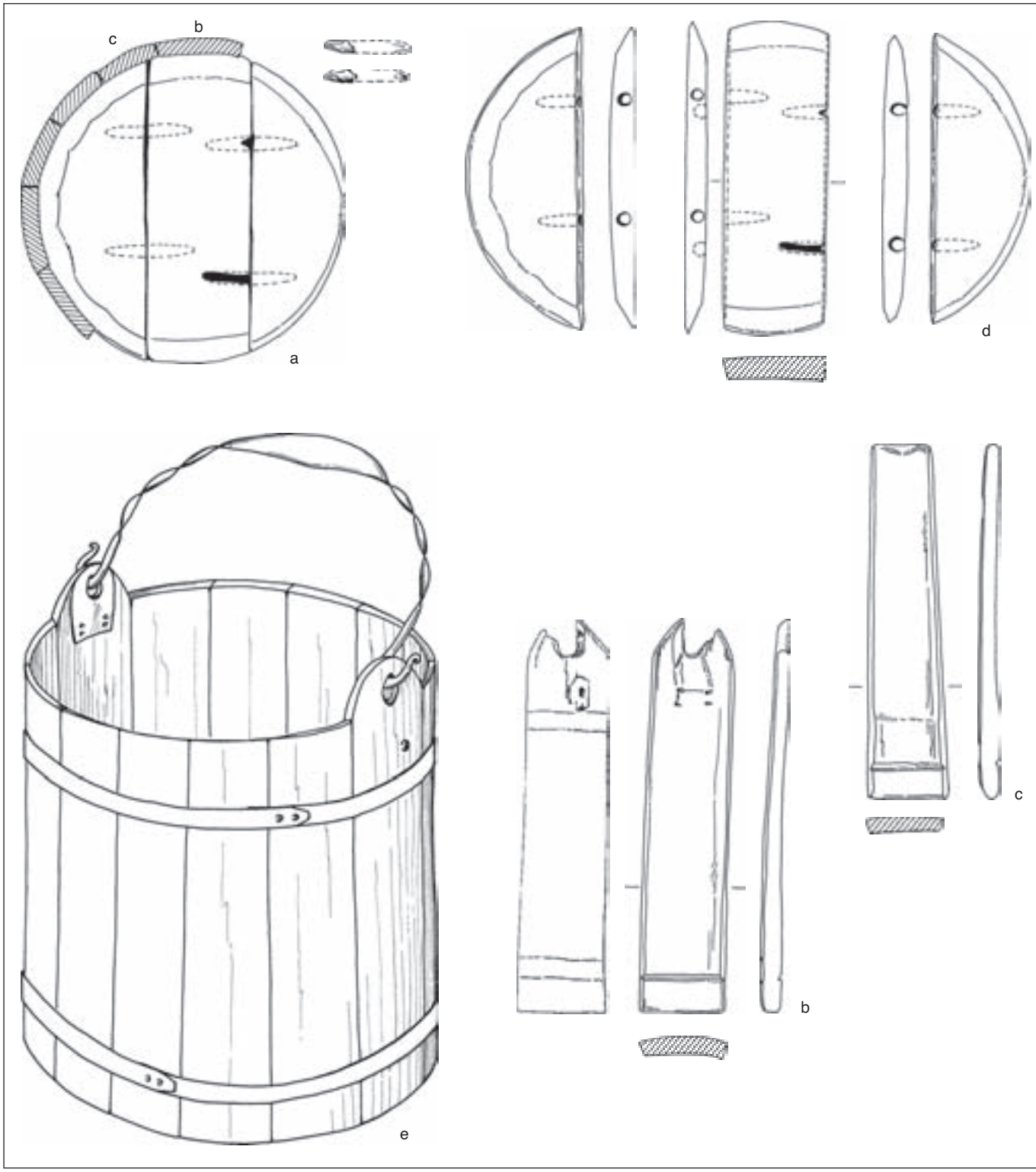

c
b
a
d
e
b
c

Fig. 205 Dorestad, Hoogstraat IV: wooden bucket.
Legend:
a view from above;
b-c staves;
d base;
e reconstruction (scale 1:4).
<<

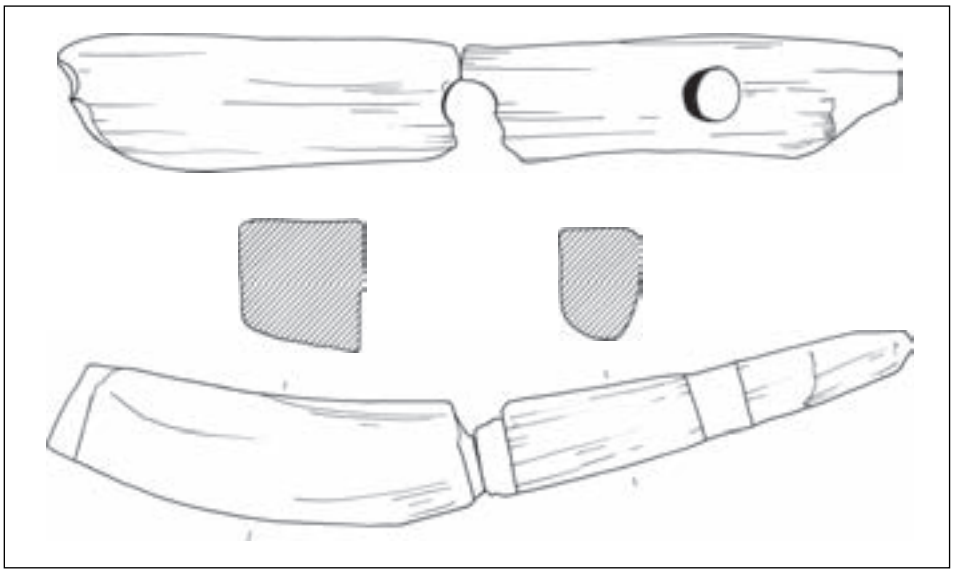


Fig. 206 Dorestad, Hoogstraat III: plank with perforations: views from side and above; scale 1:10.

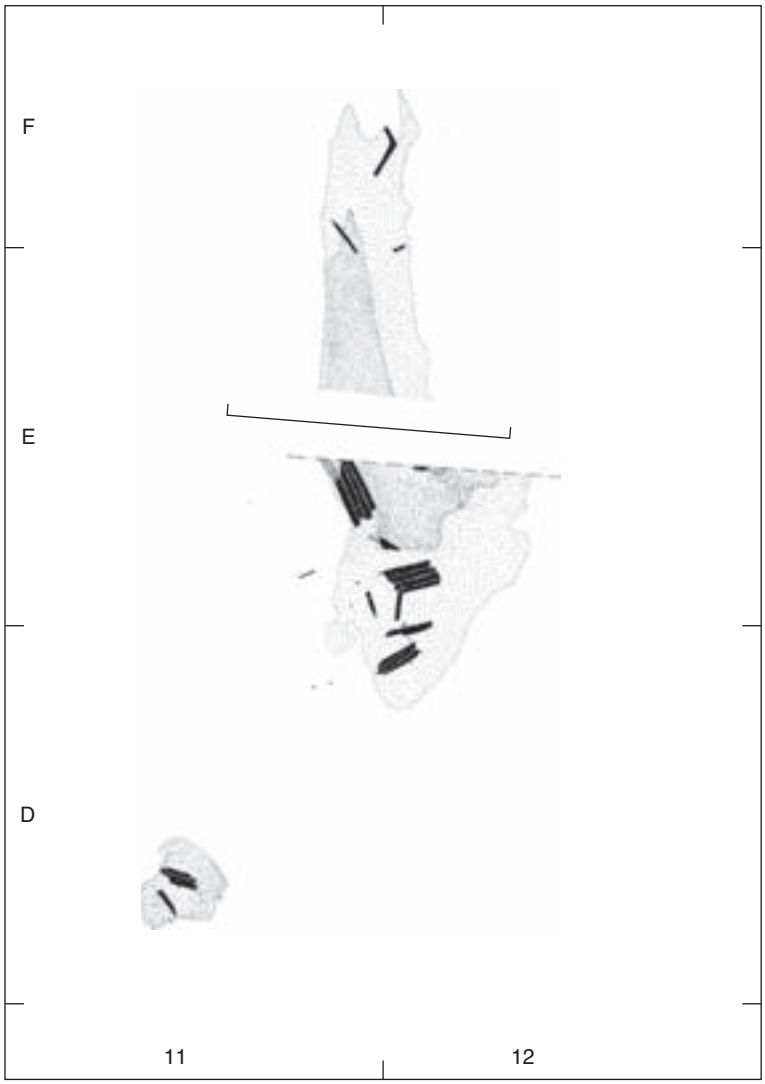


Fig. 207 Dorestad, Hoogstraat II: position of the ship remains and the section (see also fig. 208). Scale 1:200.

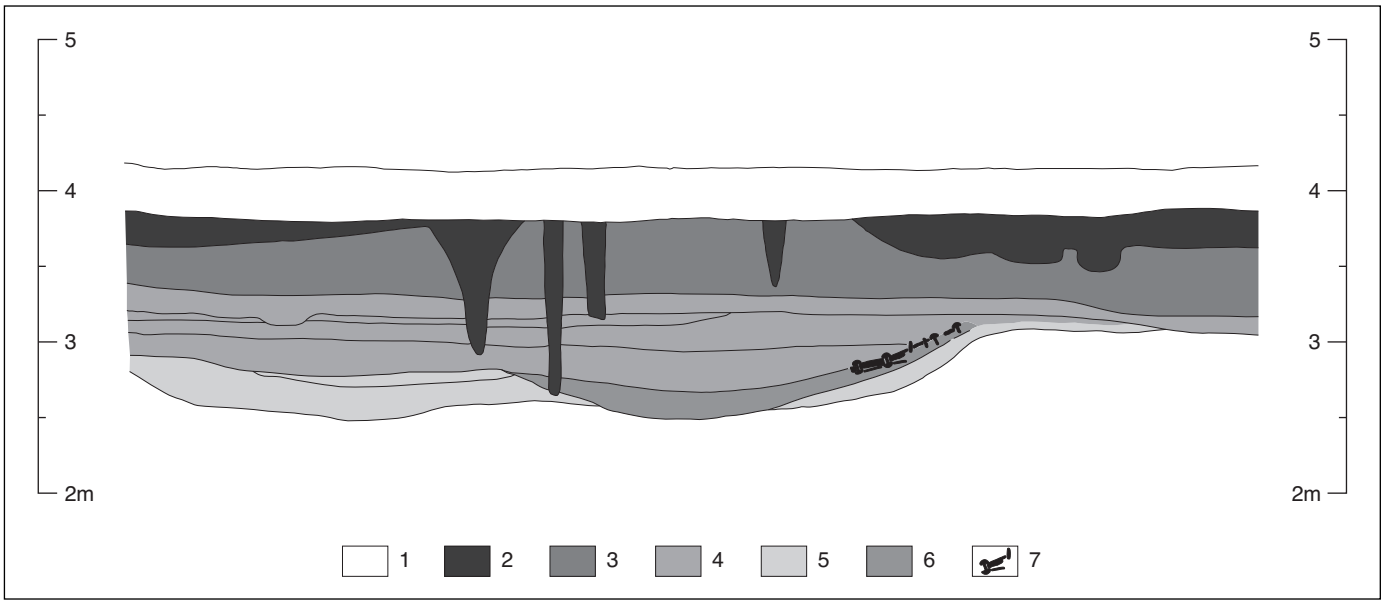
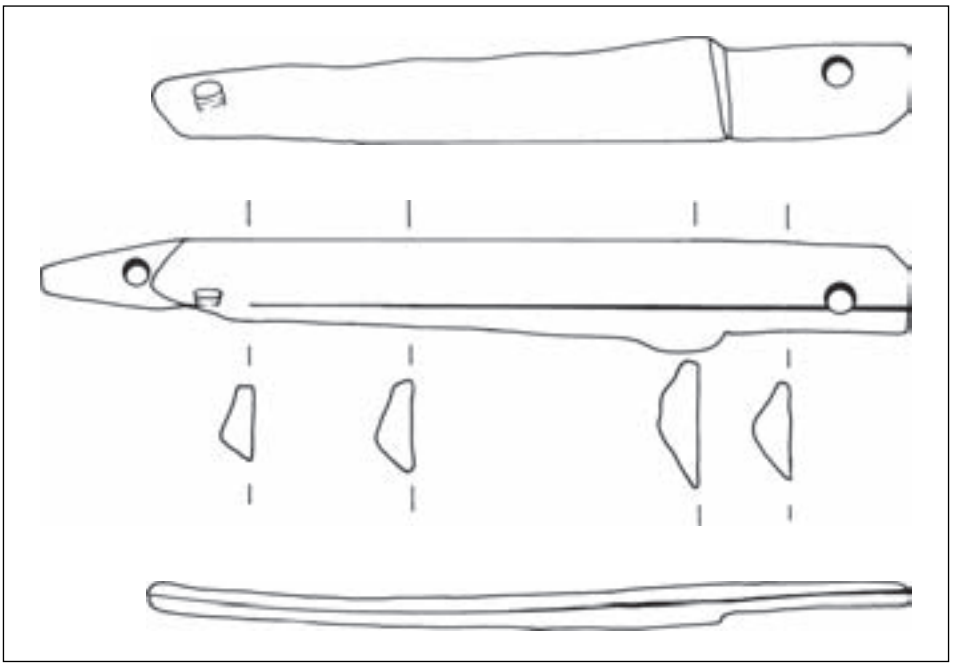


Fig. 208 Dorestad, Hoogstraat II: position of the ship remains in the section. Scale 1:50.
Legend:
1 topsoil;
2 polluted soil;
3 sandy clay;
4 clayey sand;
5 sand;
6 clay and sand, washed into ship remains;
7 ship remains.

Fig. 209 Dorestad, Hoogstraat II: rib; scale 1:10 (top of rib on left).

Fig. 210 Dorestad, Hoogstraat II: ship's side; scale 1:10.



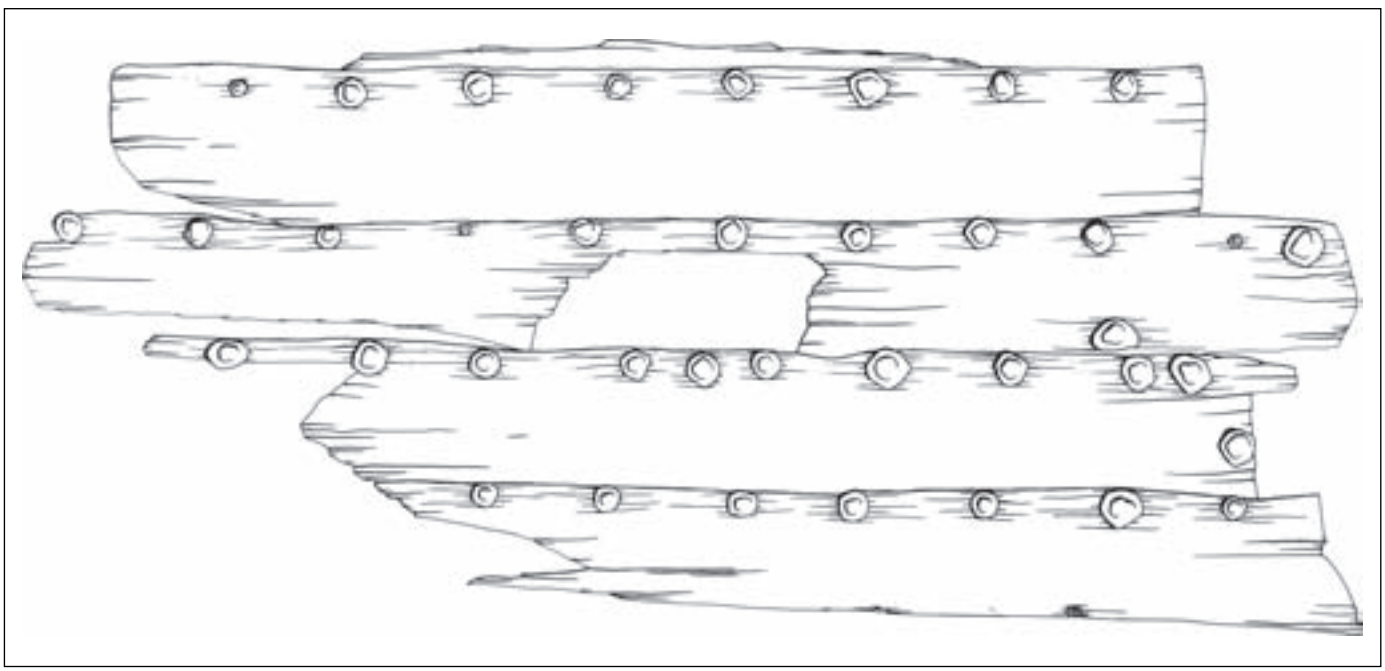


Fig. 211 Dorestad, Hoogstraat II: ship's side; scale 1:10.

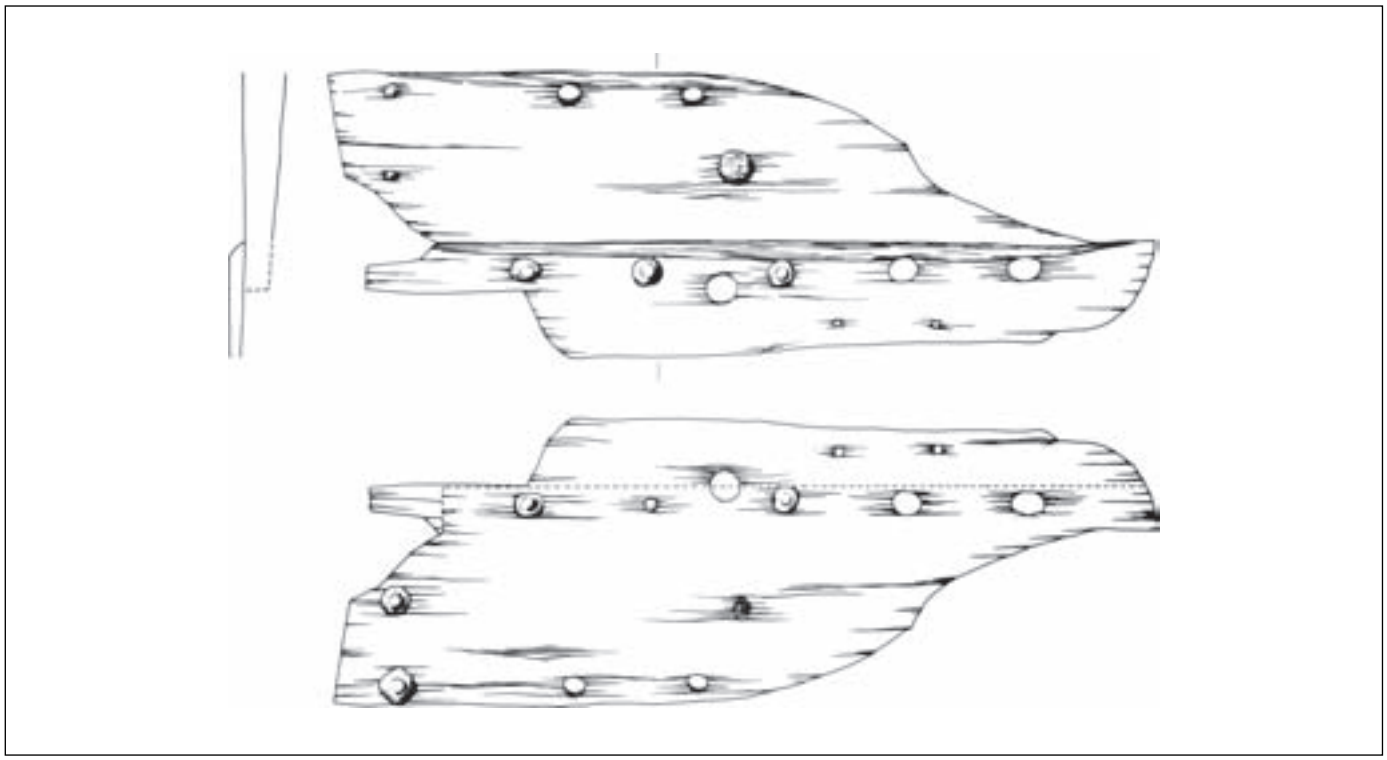


Fig. 212 Dorestad, Hoogstraat II: ship's side; scale 1:10.

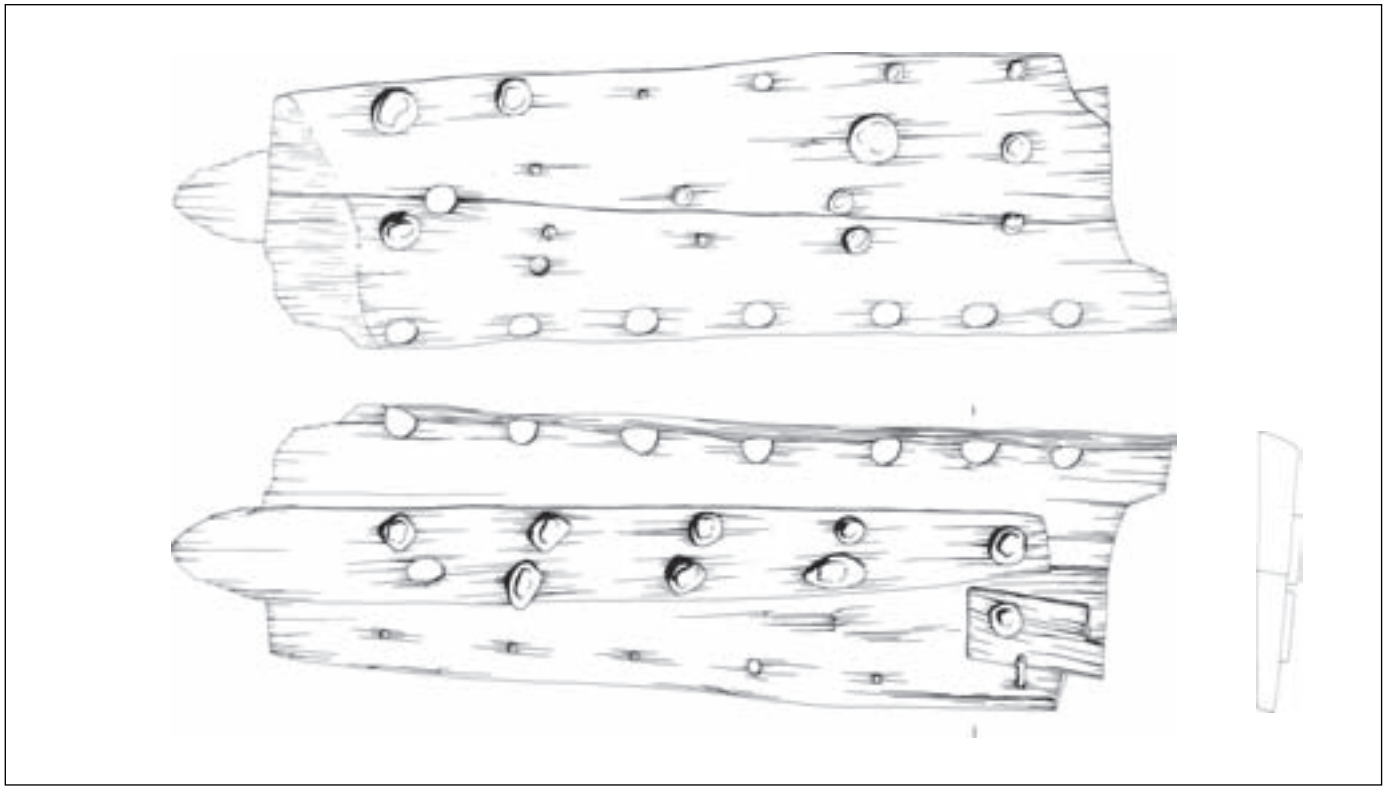


Fig. 213 Dorestad, Hoogstraat II: ship's side; scale 1:10.

Fig. 214 Dorestad, Hoogstraat II: ship's side; scale 1:10.

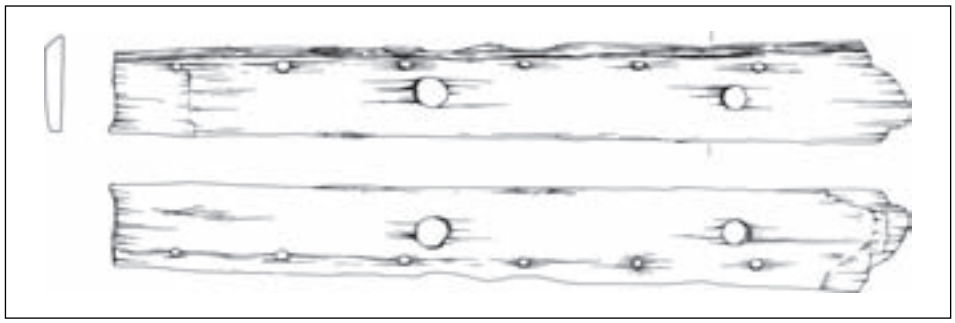
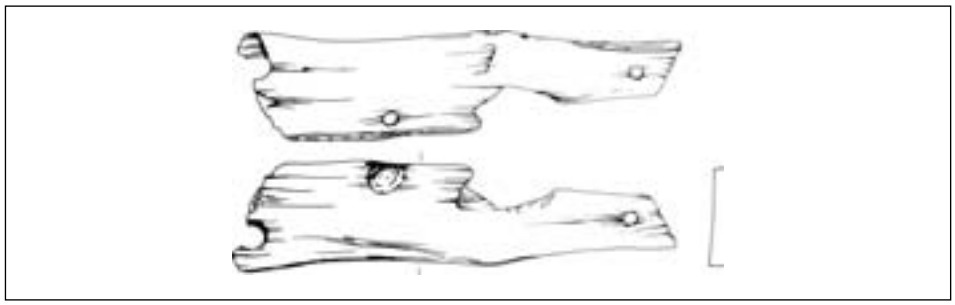


Fig. 215 Dorestad, Hoogstraat II: ship's side; scale 1:10.



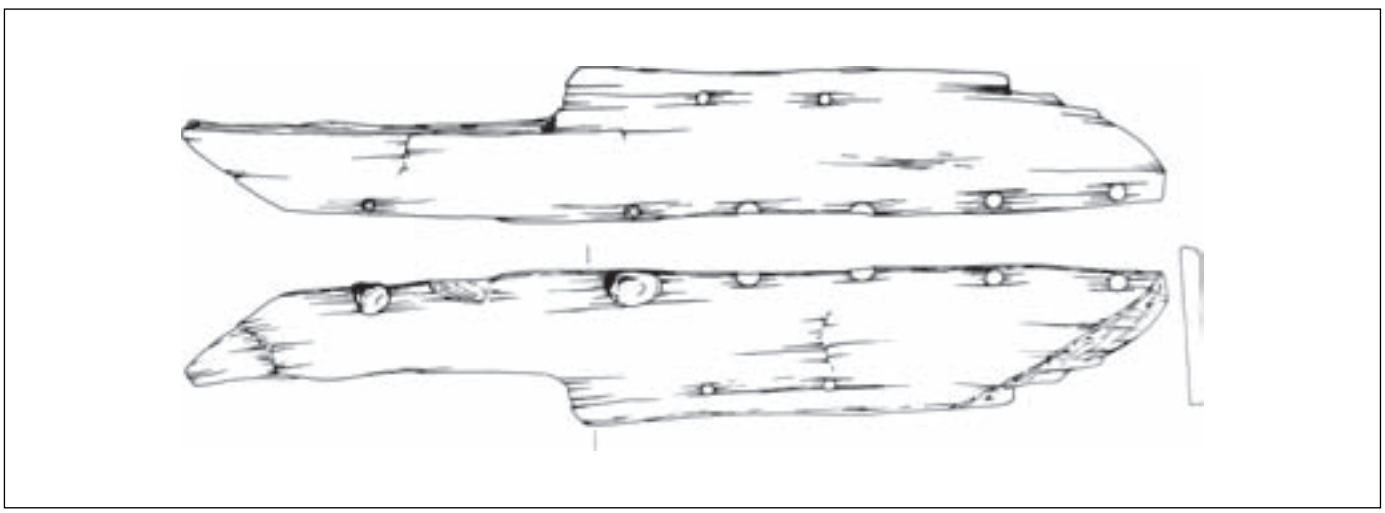


Fig. 216 Dorestad, Hoogstraat II: ship's side; scale 1:10.

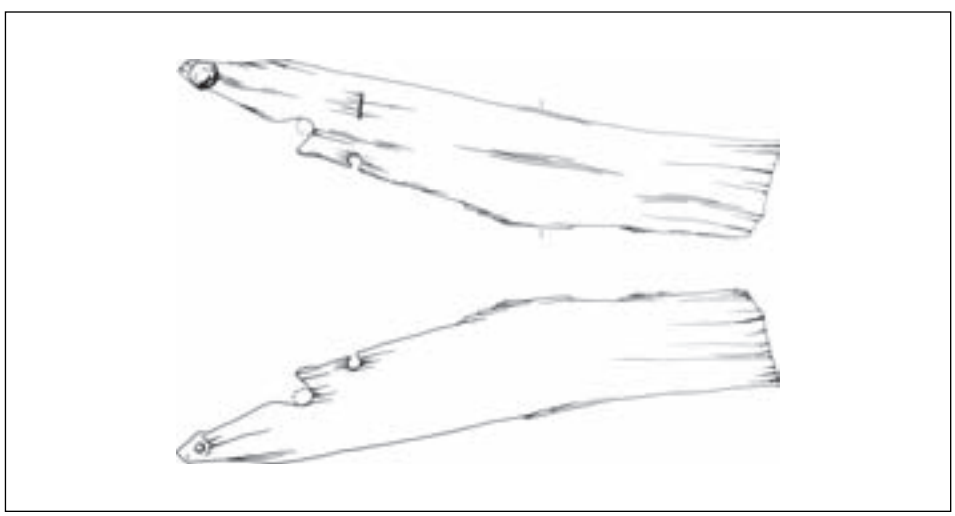


Fig. 217 Dorestad, Hoogstraat II: ship's side; scale 1:10.

Fig. 218 Dorestad, Hoogstraat II: ship's side; scale 1:10.

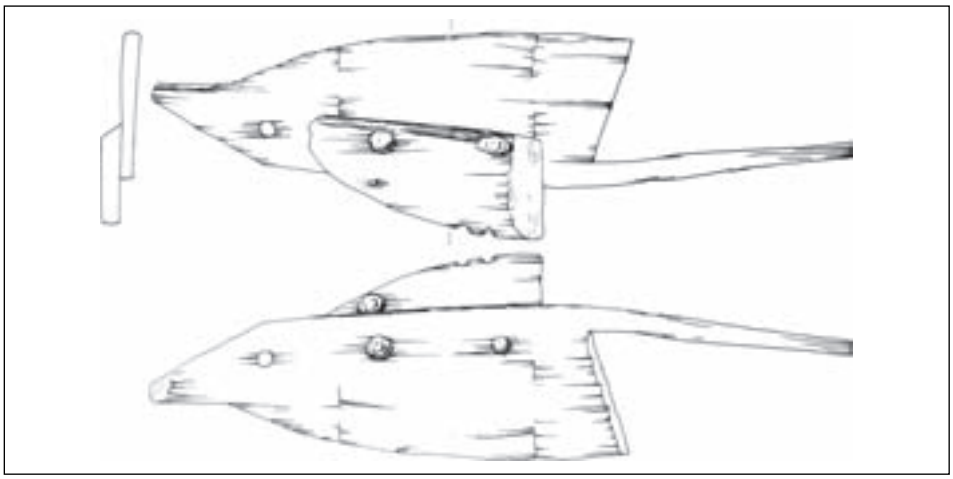


Fig. 219 Dorestad, Hoogstraat II: ship's side; scale 1:10.

4 Coins

H. Enno van Gelder †

From these areas 23 coins were recovered, 19 of them single finds; only 4 coins of Pippin (nos. 11–14) were found in a little pile corroded together.

A 3 Roman coins:	nos. 1, 4, 19.
B 5 Pre-Carolingian coins:	
sceattas from Northern Gaul	nos. 5, 20–21;
sceattas from Frisia	nos. 6, 22.
C 14 Carolingian coins:	
Pippin (754–768)	nos. 2, 11–4;
Charlemagne (768–814)	nos. 3, 7–8, 15;
Louis the Pious (814–840)	nos. 9–10, 16–7;
Lothaire I (840–855)	no. 18.
D 1 Modern coin of 1767:	no. 23.

Hoogstraat 0

Roman coin

- 1 Emperor Domitian (81–94), *sestertius*; rev. illegible; holed, 18.84 g (no. 11696).

Carolingian coins

- 2 Pippin, Dorestad.

Obv. three letters (retrograde PR-?), above a battleaxe, below a cross; rev. R.F, above a stroke, below a cross, to left three pellets (Morrison -); 0.98 g (no. 12455).

Tentatively ascribed to Pippin (similar reverses: Morrison 25 *et al.*) and Dorestad (axe on obverse). A comparable coin occurred in the 1972 I hoard (Van Gelder 1980, 215, no. 24, ill. 23).

- 3 Charlemagne, Milan.

Obv. cross, +CARLVSREXFR; rev. monogram, MEDIOL.
Morrison 212, 1.67 g (no. 11966).

Hoogstraat II

Roman coin

- 4 Antoninianus, second half of 3rd century.

Damaged and heavily corroded (no. 382.2.2b).

Pre-Carolingian coins

- 5 *Sceatta*, so-called 'Maastricht type'.

Obv. deformed head to left; rev. four curved lines forming a cross, dots in corners.
De Belfort 5993, Op den Velde 28; 0.33 g (no. 380.5.41).

- 6 *Sceatta*, porcupine type.

Obv. deformed head; rev. quadrangle with four crosses.
BMC type 5, Op den Velde 11; 0.41 g (no. 382.2.2a).

Carolingian coins
- 7 Charlemagne, Dorestad.
Obv. monogram, ...ESTADO; rev. cross, +CAR....REX.
Morrison 100; two fragments (no. 385.1.10).
- 8 Charlemagne, Mayence.
Obv. monogram, +CARLVSREXFR; rev. letter P, +MOGONTIA.
Morrison 93; 1.42 g (no. 388.3.13).
- 9 Louis the Pious, no mint place given.
Obv. cross with four dots, +HLVDOVVICVSIIIP; rev. temple, XPISTIANARELIGIO.
Morrison 472; 1.29 g (no. 394.4.1a).
- 10 As no. 9, but on obv. +HLVDOVVICVS-IMP.
Morrison 472; 1.45 g (no. 394.4.1b).

Hoogstraat III

Carolingian coins
- 11 Pippin, Dorestad.
Obv. in field IIPIPI, above a cross, below a battleaxe; rev. R.F, right leg of R ending in a cross, above a stroke.
Morrison 25; slightly damaged 1.18 g (no. 405.4.5c).
- 12 As no. 11.
Edge broken, 1.06 g (no.405.4.5b).
- 13 Probably type as no. 11.
Many small fragments (no. 405.4.5d).
- 14 Pippin, Dorestad.
Obv. in field IIPIP, above a cross, below a battleaxe; rev. R P, above a stroke, to left vertically -.
Morrison -, Völckers 1965, 129, no. II, 5; 1.01 g (no. 405.4.5a).
- 15 Charlemagne, Dorestad (first period).
Obv. in two lines CARO LVS; rev. in two lines DOR STAD, below a battleaxe.
Morrison 99; 0.94 g (no. 405.3.3).
- 16 Louis the Pious, probably Dorestad.
Obv. bust (?), HLUDOVV....; rev. ship, legend effaced.
Morrison 330; heavily corroded (no. 405.3.2).
- 17 Louis the Pious, no mint place given.
Obv. cross with four dots, +HLVDOVVICVSIMP; rev. temple, XPISTIANARELIGIO.
Morrison 472; 1.10 g (no. 405.2.29).
- 18 Lothaire I, Dorestad.
Obv. cross with four dots, +IOTAMVSIPNEIRAT; rev. temple, DORESTATVSMON.
Morrison 530; 1.71 g (no. 401.0.0).

Hoogstraat IV

Roman coin
- 19 Emperor Marcus Aurelius, copper as.
Portrait of Lucilla.
RIC 1729 sq. (no. 453.3.1a).

Pre-Carolingian coins
- 20 *Sceatta*, so-called 'Maastricht type'.
As no. HS-II 5, 1.12 g (no. 453.4.10).
- 21 *Sceatta*, so-called 'Herstal type'.

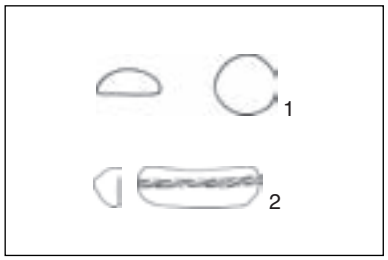


Fig. 220 Dorestad, Hoogstraat III:
1 Roman glass, game piece;
2 glass bracelet, Iron Age; scale 1:2.

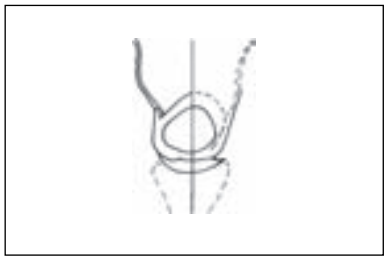


Fig. 221 Dorestad, Hoogstraat IV: Merovingian glass; scale 1:2.

Obv. two superimposed triangles, cross in centre; rev. cross, pseudo legend.
De Belfort 5743, Op den Velde 29; 0.95 g (no. 449.5.1).
- 22 *Sceatta* (?), copper.
Obv. head D (?); rev. serpent (?).
BMC type 32a/b; heavily corroded, 0.27 g (no. 453.3.1b).

Modern coin
- 23 City of Utrecht, doit 1767. Copper (no. 450.1.1).

5 Glass

C. Isings

Introduction

Although these groups are not as large as the one from Hoogstraat I, they will complete the picture of the total of glass found at the river sites and may provide additional information on glass used and traded at Dorestad. In this way what was said about the whole of the excavation results applies also to the glass.[346]
Our knowledge of early-medieval glass is still incomplete, but as more sites are excavated and finds and results of current research in this field are published some of the gaps may be filled in – although more questions will arise. The growing interest in medieval glass resulted in two important exhibitions, the catalogues of which have summarized and discussed what is now known and published in this field.[347]
As on other occupation sites the Dorestad finds consist mainly of fragments, some of them belonging to vessels which could be restored, others recognisable as having been part of the well-known types such as palm cups, funnel beakers, bowls and jars, as well as the non-vessel glass: the linen smoothers. New here are fragments of possibly Carolingian windoW-glass. As a whole the finds may be compared to those from elsewhere in Western Europe as well as to the complete vessels known from Scandinavian burials and in a few instances parallels in northern Italy may be seen. Where decorated fragments are present, these also are well comparable to what is known from other sites. As at Hoogstraat I some fragments date from earlier periods and some others are Post-Carolingian

I *Roman Period*

Whereas at Hoogstraat I three fragments of Roman glass came to light,[348] there was one at Hoogstraat II: a base fragment of a square bottle (HS-II/35e). At Hoogstraat III two fragments may be of Roman date (HS-III/6a and HS-III/5a). A fragment of a broad pushed-in foot of a dark blue vessel might be also Roman (HS-III/18a). A glass game-piece was also found on this site (fig. 220: 1, HS-III/1). An interesting find from Hoogstraat III is the fragment of a Romano-British bangle decorated with a horizontal *reticella* trail (HS-III/24, fig. 220: 2), which is comparable to one found at the site of the Roman auxiliary fort of Valkenburg (ZH) from a layer dated to *c.* AD 47–69.[349] These two are as yet the only ones known from continental sites. Three fragments of a beaker or a jug (HS-III/19a) may be of Late-Roman date, possibly 3rd century.[350]

II *Early Middle Ages*

Among the fragments thought to be of Merovingian date at the Hoogstraat I site, there were three which now appear to be Carolingian and will be discussed below.[351] At Hoogstraat IV an interesting fragment of a variety of the stemmed goblet came to light (fig. 221, HS-IV/11), comparable to one from Aquileia thought to be of 4th to 5th century date,[352] but which may be seen as a variety of Merovingian stemmed goblets, either those with a conical cup or the somewhat later ones as produced at Torcello.[353]

346 Van Es & Verwers 1980, 17.
347 Baumgartner & Krueger 1988 (58–94, 9th–11th centuries); Foy & Sennequier 1989 (chapter on Merovingian glass by P. Périn, and on Carolingian glass by V. Evison, 137–44).
348 Isings 1980, 225.
349 Van Lith 1977, 130–4.
350 cf. e.g. Isings 1957, forms 109 and 120.
351 Isings 1980, 226, nos. 2, 5 and 6.
352 Calvi 1968, 127–73, no. 346, Tav. 27; Isings 1987.
353 Leciejewicz, Tabaczynskaja & Tabaszynski 1963–64, fig.13; Foy 1989, 135–6.

A *Palm cups and funnel beakers*

Among the glass vessels from the 7th to 9th centuries AD these drinking vessels (and sometimes also lamps) predominate. Of the palm cups the shallow variety is represented as also the deeper cup which developed into the funnel beaker.[354] At Hoogstraat III the complete everted rim of a probably shallow cup was found (fig. 222: 1, HS-III/50), which is datable to the 7th or early 8th century AD.[355] A wall fragment from Hoogstraat II (HS-II/52) may have belonged to a similar cup.

Deep palm cups were known from the Hoogstraat-I site,[356] and *c.* 3/4 of one was discovered at Hoogstraat IV (fig. 222: 2, HS-IV/1). It belongs to a type of which moulded specimens are also known.[357] A fragment with an inverted rim from Hoogstraat II (fig. 222: 3, HS-II/12), may have been part of a similar palm cup. Two other fragments from Hoogstraat IV (fig. 222: 4, HS-IV/22 and fig. 222: 5, HS-IV/28a), have cavity rims. A fragment with a more splayed cavity rim (fig. 222: 6, HS-IV/32), represents a more developed variety of the type. There is as yet no proof that rim types of palm cups and funnel beakers developed here the in same way as in Britain.[358] There is one mould-blown fragment of a deep palm cup, which may have a cross on its base similar to some other mould-blown palm cups.[359] On the lower side of a deep palm cup a mould-blown pattern consisting of vertical ribbing and a row of knobs was present (fig. 222: 7, HS-II/7b).

A variety of the deep palm cup and the funnel beaker has a horizontal hollow moulding on its side. Fragments of such vessels may be mistaken for lower wall-fragments of Merovingian bell-beakers as erroneously published with the Hoogstraat-I glass.[360] A complete example is known from Ferwerd and fragments of similar beakers from Helgö.[361] As said, the type was represented by three fragments at Hoogstraat I, at Hoogstraat II fragments of five such beakers were found (fig. 222: 12, HS-II/17; fig. 222: 13, HS-II/28; fig. 222: 11, HS-II/29b; fig. 222: 8, HS-II/37). About three-quarters of one of them (HS-II/37) was preserved and has now been restored. At Hoogstraat III there were four fragments (fig. 222: 10, HS-III/15a; fig. 222: 9, HS-III/27; HS-III/32c; fig. 222: 1, HS-III/50). A large fragment from Hoogstraat 0 (fig. 222: 15, HS-0/6) shows that the type also occurred among the fully developed funnel-beaker. It appears to be a rather common type of vessel, though whether it was a lamp to be put into a stand or not is still uncertain.[362]

Of the fully developed types of funnel beakers those with the test-tube-shaped lower sides are slightly more numerous than those with straight sides. The simple rounded rims (fig. 223: 1–11) occur side by side with the inverted ones (fig. 223: 12–29). Whether different rims indicated different uses remains uncertain. A rounded rim may be easier to drink from, whereas the inverted one may prevent spilling.

As at Hoogstraat I, where it was represented by six fragments, the applied rim in blue or green glass was also present among the finds of Hoogstraat II (fig. 224: 1, HS-II/4a; fig. 224: 2, HS-II/41a; fig. 224: 3, HS-II/50), with a simple applied rim and one with a kind of insertion: first a bluish rim was applied, then a self-coloured one on top of it and finally a green rim on top of the latter (fig. 224: 4, HS-II/35a), for which I have not yet found a parallel. One fragment from Hoogstraat IV may have had an applied rim as well as a somewhat strange insertion: two greenish parts on top of each other, the upper one with a bluish streak and the whole apparently moulded afterwards with the oblique corrugations which go on without interruptions (fig. 224: 5, HS-IV/33).

Some of the palm cups and funnel beakers were plain, apart from the applications just mentioned other decorations were present on some fragments. At Hoogstraat I a fragment with vertical mould-blown ribs was mentioned.[363] Mould-blown corrugations are present on one fragment from Hoogstraat 0 (fig. 224: 6, HS-0/2) and on two from Hoogstraat II (fig. 222: 12, HS-II/17 and fig. 223: 35, HS-II/35d) as well as on five from Hoogstraat III (HS-III/6g; HS-III/20b; fig. 223: 47, HS-III/35; HS-III/36b; fig. 223: 46, HS-III/38) and on four from Hoogstraat IV, including the above-mentioned fragment with application (HS-IV/7; HS-IV/19b; fig. 222: 5, HS-IV/28a; fig. 224: 5, HS-IV/33).

354 Ypey 1962–63, 145, fig. 40.
355 Périn 1970, 140, type V.6; Périn 1989, 135, no. 58a, type 4.3c.
356 Isings 1980, 230, no. 25 and 231, no. 38.
357 Ypey 1962–63, fig. 40, nos. 2–6; Périn 1970, type V.5; Cabart 1991, 231.
358 Hunter 1980, 68–70.
359 See note 214.
360 See note 209.
361 Boeles 1951, 534, pl. XXXIX: 5; Arbman 1937, 76; Holmquist 1964, fig. 123.
362 Baumgartner & Krueger 1988, 62–3, no. 3.
363 Isings 1980, 231, fig. 153: 7.

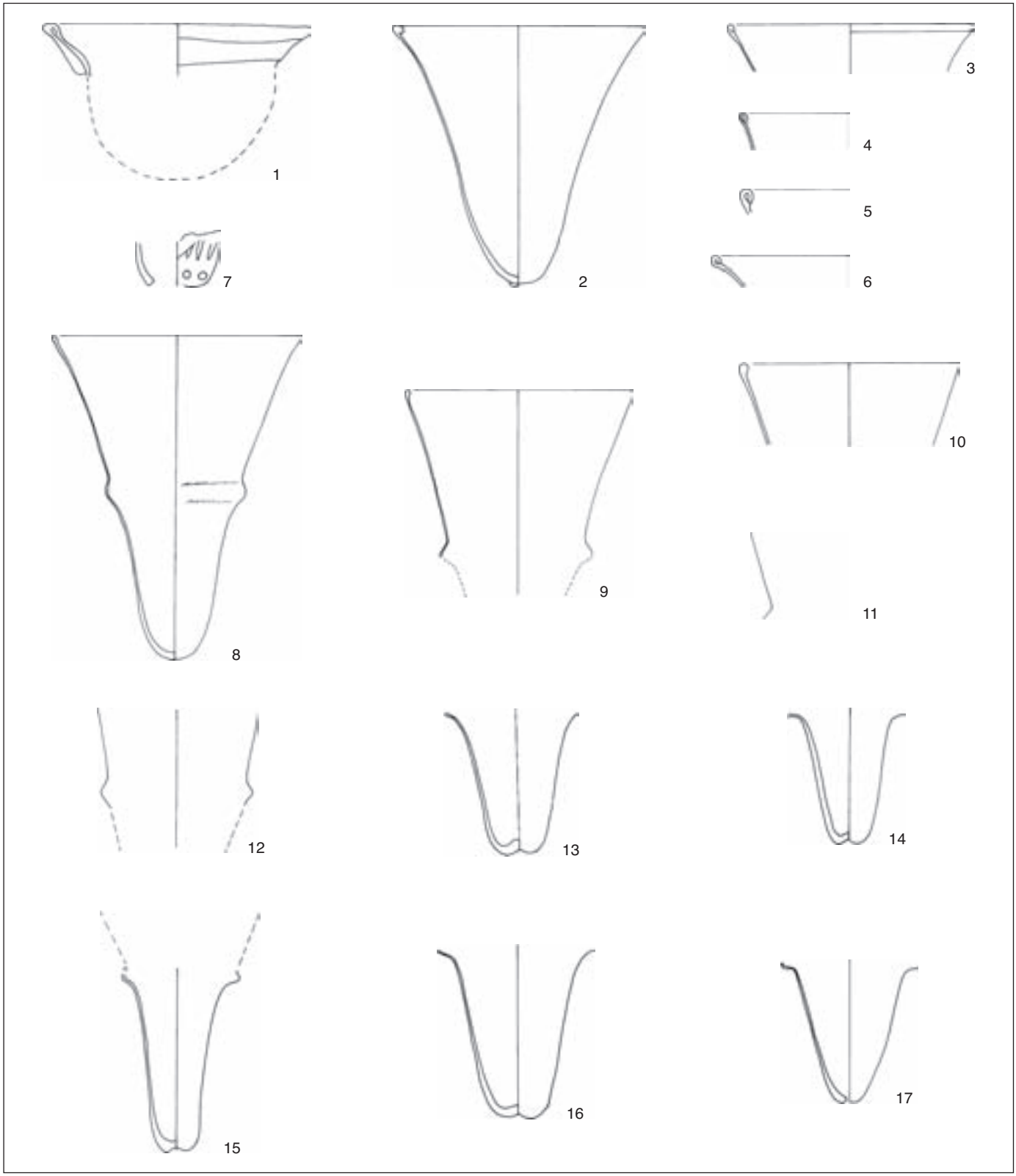


Fig. 222 Dorestad, Hoogstraat 0-IV:
Carolingian glass, palm cups; scale 1:2.

Fig. 223 Dorestad, Hoogstraat 0-IV:
Carolingian glass, funnel beakers; scale 1:2 >>.

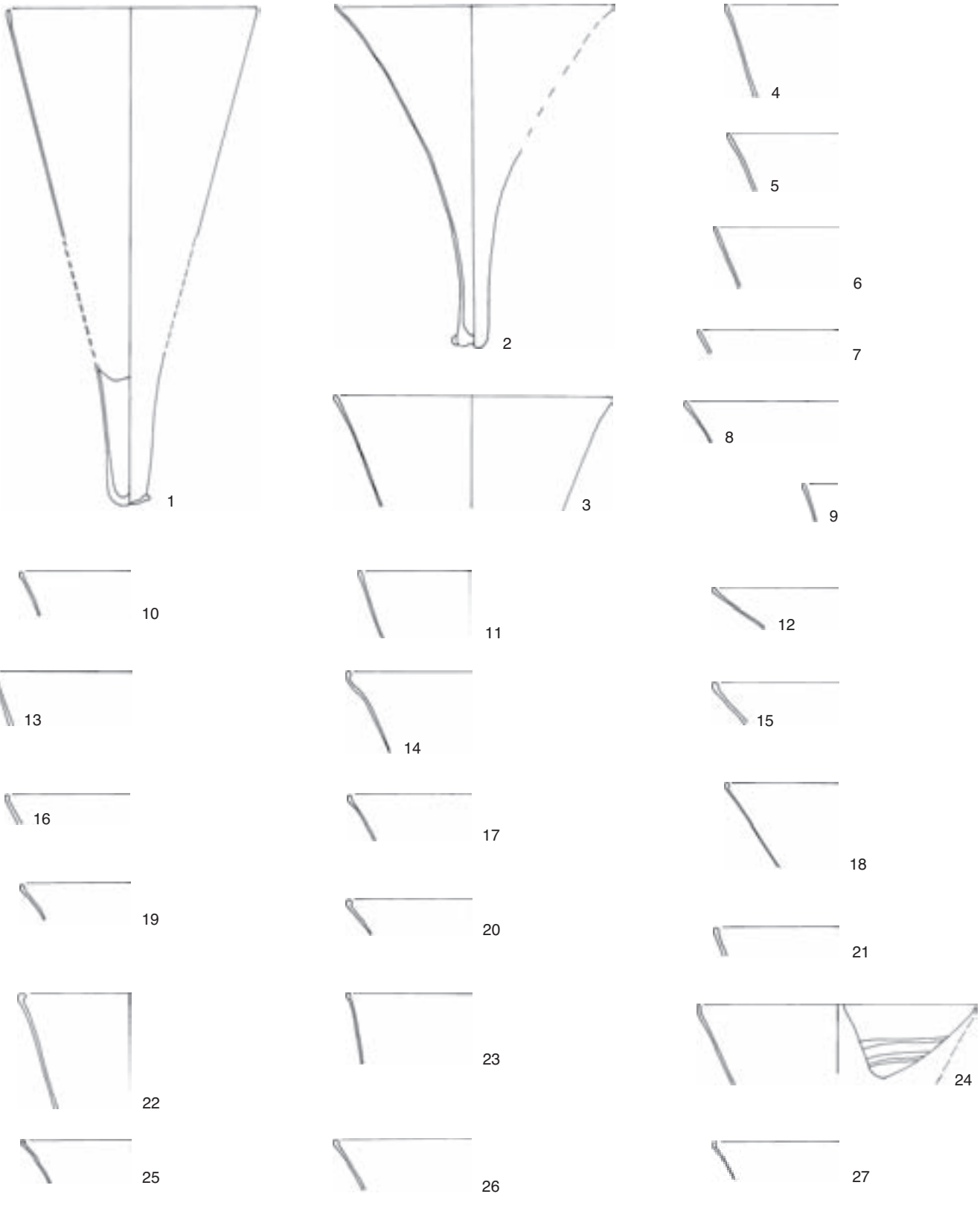

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Fig. 224 Dorestad, Hoogstraat 0-IV: Carolingian glass, funnel beakers; scale 1:2.

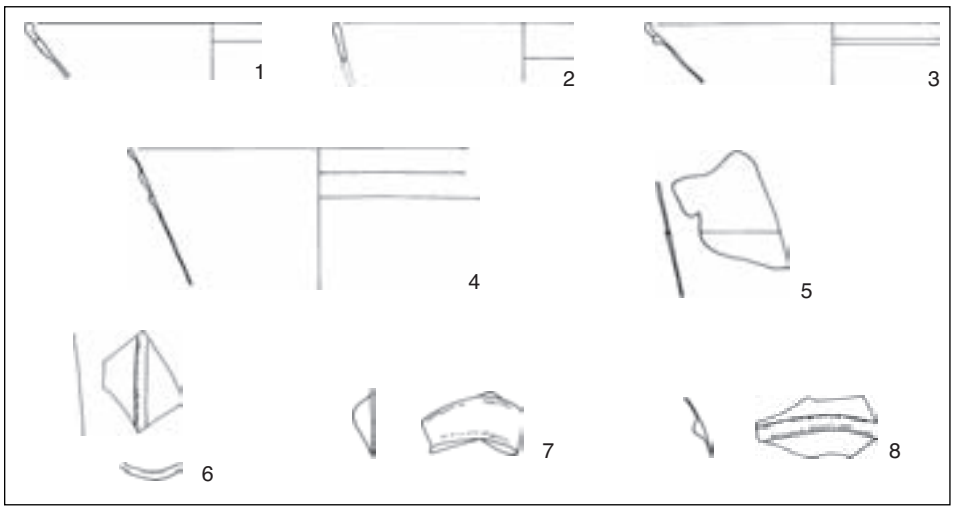
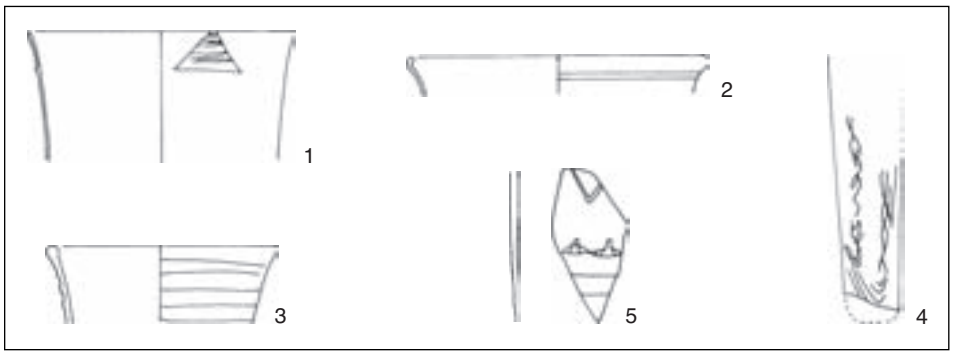


Fig. 225 Dorestad, Hoogstraat 0-IV: Carolingian glass, decorated funnel beakers; scale 1:2.



Arcaded trails may occur on deep palm cups as well as on funnel beakers, but the fragments from the Hoogstraat sites are too small to decide the type. Thick trails were seen on a fragment from Hoogstraat I,[364] as well as on one from Hoogstraat III (fig. 224: 7, HS-III/31). A fragment with a thin trail comes from Hoogstraat IV (fig. 224: 8, HS-IV/26), this may be compared to a funnel beaker from Pingjum,[365] to fragments from Helgö,[366] and (with the exception of the spiral trail) to a fragment from Medemblik.[367]

An arcaded trail, partly thick and partly thin, was also found at Southampton on a later form of palm cup.[368]

Opaque white spiral trails below the rim are known from Merovingian glass and may also occur occasionally on Carolingian vessel. When used on bowls or squat jars there may be a pattern of *reticella* trails below this zone. A fragment of a funnel beaker with spiral trail was found at Hoogstraat II (fig. 225: 1, HS-II/36c). Marvered yellow trails occur on squat jars and on bowls,[369] but as an inverted rim is more common on funnel beakers, a rim fragment from Hoogstraat II (fig. 225: 2, HS-II/2) might have belonged to a funnel beaker. It has a yellow marvered trail below the rim and it also has dark-red streaking which may have been flame-like or the start of a covering of the lower side, as it occurs on fragments of a jar and a bowl from Hoogstraat I.[370] Pale-blue streaking was seen on a fragment from Hoogstraat III (fig. 225: 3, HS-III/56) and on one – already mentioned – from Hoogstraat IV (fig. 224: 5, HS-IV/33).

Another decoration which jars, bowls and palm cups or funnel beakers may have in common, are applied *reticella* trails. These may consist of simple twists or of twists with a more complicated pattern as on a fragment of Hoogstraat I.[371] A simple bi-coloured twist has already been mentioned in connection with Hoogstraat I[372] and another one, also on a fragment of a funnel beakers, comes from Hoogstraat II (fig. 225: 4, HS-II/54).

364 Isings 1980, 231, no. 38.
365 Ypey 1962–63, fig. 40: 11.
366 Holmquist 1964, figs. 120–2.
367 Besteman 1974, 96, fig. 36.
368 Hunter 1980, 59, GL2, fig. 11: 1.
369 Evison 1988b, 216.
370 Isings 1980, 231, no. 5, fig. 154: 6 and no. 6, fig. 154: 3; Baumgartner & Krueger 1988, 71, no. 14 and 72, no. 16. cf. For discussion of flame-like streaking: Evison 1983, 15 etc.
371 Isings 1980, 231, fig. 154: 3. cf. For reticella trails: Haevernick 1979, 158 and Näsman 1986, 76–82.
372 Isings 1980, 231, fig. 154: 2.

It was apparently applied before the vessel was finished and the trails are now flush with the surface. A fragment of a funnel beaker from another Dorestad site shows how much skill existed in the making of a more sophisticated pattern in *reticella*.[373]
Among the luxury vessels of this period some were decorated with a pattern in gold leaf. Some of them may be funnel beakers, but other shapes are suggested also.[374] The sites where they were found do not indicate a special use: apparently they were either rich dwelling sites or trade centres and one abbey. They may have been just luxury glass, but a liturgical use cannot be completely excluded.
The production site or sites appear to have been somewhere in the Rhineland. Lorsch is a possibility and perhaps Paderborn also.[375] In most cases the ornaments consist of patterns of triangles and diamonds, and this was also the case with the fragment from Hoogstraat I.[376] At Hoogstraat III a rather thick-walled wall fragment was found with part of the gold leaf still adhering (fig. 225: 5, HS-III/52).[377] Its shape is uncertain, but it may have been part of the lower side of a funnel beaker. During the Dorestad excavations two other fragments came to light on other sites, one being part of a blue vessel, comparable to fragments found at Liège, Paderborn, Helgö, and the abbey of Niedermünster.[378] The other is a rim fragment of colourless glass with a more intricate pattern, in which the common triangles and diamonds are included.[379] An intricate pattern may also be seen on a Helgö fragment with pointed arches.
A thick-walled fragment of dark blue glass with white feather-pattern included among the beads of Hoogstraat I,[380] might be part of the lower side of a funnel beaker.[381] In this case a rather unique one with a horizontal band of gold leaf on the side, thus making a total of four with this type of decoration from Dorestad.

B *Bowls and squat jars*

Bowls and squat jars were less common than funnel beakers. Most of them were decorated in some way, the finest ones having trails of *reticella* as some from Hoogstraat I.[382] Two rim fragments found at Hoogstraat III may have belonged to jars. One of them has a marvered horizontal trail on its rim (fig. 226: 1, HS-III/2), the other one has a yellow spiral trail on its rim and neck (HS-III/55a). Whether they had *reticella* trails as well, remains uncertain.
A base fragment with part of a marvered yellow wavy line, may have belonged either to a small bowl or to a jar with a combed pattern similar to one from Hoogstraat I,[383] or to a fragment from Southampton, for which Hunter has suggested that it might have been the work of Lombard houses (fig. 226: 2, HS-III/22).[384]
There are two fragments from bowls with *reticella* trails, one from Hoogstraat III (fig. 226: 3, HS-III/11) with opaque white and self-coloured trails, and another one from Hoogstraat IV with opaque yellow and self-coloured trails (fig. 226: 4, HS-IV/9), which may have been comparable to the Valsgärde bowl.[385]
There is one small fragment, either belonging to a jar or to a bowl, with a rather interesting combed marvered pattern in red and opaque white between two layers of colourless glass (fig. 226: 5, HS-II/5). Combed patterns in red and white are known from several sites, unfortunately mostly in fragments.[386]

C *Beads*

In comparison to the numerous beads found at Hoogstraat I, there are only a few beads from the other Hoogstraat sites: four from Hoogstraat III and two from Hoogstraat IV. Whereas there were more monochrome beads than polychrome ones at Hoogstraat I, the polychrome ones predominated at the other sites. At Hoogstraat III a tiny annular blue bead was found (fig. 227: 3, HS-III/6j). An almost barrel-shaped bead of apparently black glass has a yellow zigzag trail between two horizontal trails (fig. 227: 1, HS-III/17), and is comparable to Callmer's bead-group Bc, dated to BP IV–VIII (*c.* 860–950).[387] A globular translucent bead has a marvered white trail around its middle with white circles on either side (fig. 227: 2, HS-III/23). It may be related to the eye-beads, but I have not yet encountered an exact parallel.

373 Isings 1978, 261, fig. 4; Baumgartner & Krueger 1988, 74, no. 18.
374 Lundström 1971, 52 etc. and Evison 1988b, 216–8, have suggested liturgical use. Contra: Baumgartner & Krueger 1988, 65.
375 Evison 1988b, 218. A production centre dating from the 9th to 11th centuries AD has been found at Corvey: Stephan 1988, 298.
376 Isings 1980, 230, no. 27, fig. 153: 26.
377 Baumgartner & Krueger 1988, 67, no. 9.
378 Baumgartner & Krueger 1988, 68, no 10; Salch 1971, 47, fig. 53; Evison 1988b, 217 and note 23.
379 Baumgartner & Krueger 1988, 66, no 8.
380 Isings 1980, 234, no. 7, fig. 157: 7.
381 Evison 1988b, 217 rightly suggests a funnel beaker.
382 Isings 1980, 231.
383 Isings 1980, 233, III, fig. 155; Evison 1988a, 219; Isings 1980, 230, no. 29, fig. 153: 27.
384 Hunter 1980, 71.
385 Baumgartner & Krueger 1988, 71, no. 13; Valsgärde bowl: Baumgartner & Krueger 1988, 70.
386 Evison 1988a, 218–9; Baumgartner & Krueger 1988, 81, no. 30a, this picture has to be turned with the combed pattern running vertically.
387 Callmer 1977, 82.

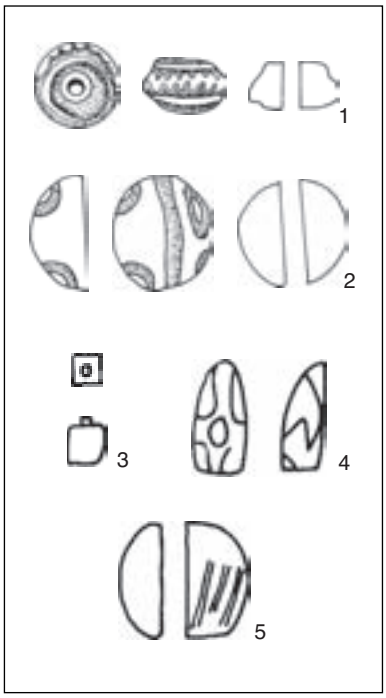


Fig. 227 Dorestad, Hoogstraat 0-IV: Carolingian glass, beads; scale 1:1.

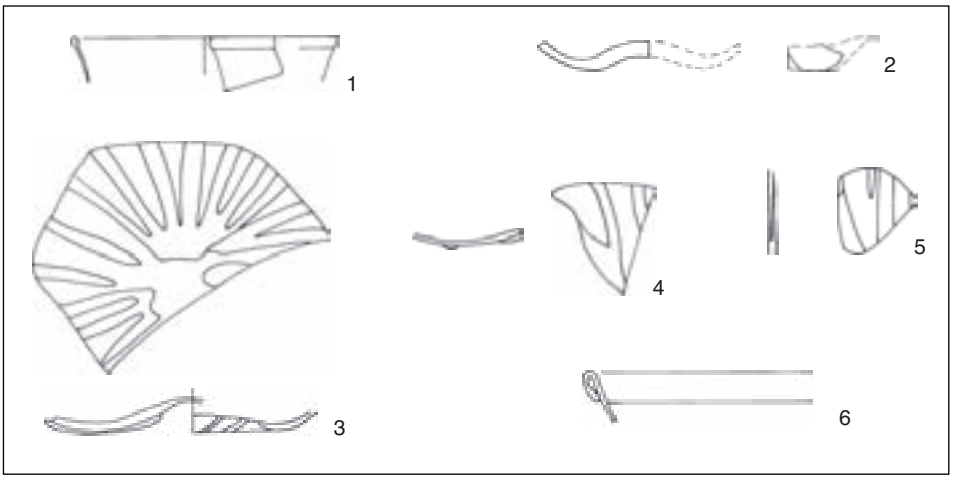


Fig. 226 Dorestad, Hoogstraat 0-IV: Carolingian glass, bowls and squat jars; scale 1:2.

There is one mosaic bead of a kind known in several varieties, its main colour being opaque bright-green with yellow lines and floral insertions (fig. 227: 4, HS-III/33g), which belongs to Callmer's bead-group J.[388] Of the two beads from Hoogstraat IV one is a small cylindrical almost globular opaque green bead of a rather long-lived type (HS-IV/10) comparable to Callmer's bead-group Aq.[389] The other bead was not made of glass but of so-called Egyptian faience. It was a ribbed melon-shaped one, already known in Roman times and still in use in the Early Middle Ages.[390]

D *Linen smoothers*

For a discussion about linen smoothers see the Hoogstraat-I finds.[391] They have been found at the other Hoogstraat sites as well and appear to have been a widely-used object. At Hoogstraat II fragments of seven linen smoothers came to light (HS-II/15; fig. 228: 1, HS-II/21a; fig. 228: 2, HS-II/21b; HS-II/26; HS-II/45b; fig. 228: 3, HS-II/47; HS-II/48) and there were four at Hoogstraat III (fig. 228: 4, HS-III/20a; fig. 228: 5, HS-III/43; fig. 228: 6, HS-III/49; fig. 228: 7, HS-III/55b), and one at Hoogstraat IV (HS-IV/23).

E *Window glass*

Window glass from the Carolingian Period is known from several sites and includes the earliest examples of leaded window glass known so far.[392] The majority of the fragments published has grozed edges, but rounded edges may occur also.[393] Of the window glass from the Hoogstraat sites one fragment came from a layer which contained no later material.[394] The fragment is very thin, no edge is preserved and it is covered with an iridescent layer (HS-II/58). Although another fragment came from a find complex including a fragment of a 17th-century wine-bottle (HS-II/4c) as well as one of a Carolingian funnel beaker, its grozed edges look rather similar to those found elsewhere and the fragment may be of early-medieval date (HS-II/4b). Of another fragment from Hoogstraat II no edges are preserved (HS-II/24b), and its finds number includes a fragment of a funnel beaker. There is one fragment of thin glass with a rounded edge which might be early-medieval or of later date, having been found with a fragment of a funnel beaker and with one from a wine-bottle (HS-II/45c). At Hoogstraat III one fragment was too small to be certain whether it came from a window (HS-III/33f) and another fragment is of uncertain date (HS-III/47). Other fragments from this site were part of large windows and might be of Post-Carolingian date. The same applies to the fragments found at Hoogstraat IV (fig. 229, HS-III/7a; HS-IV/6a and HS-IV/8).

388 Callmer 1977, 90.
389 Callmer 1977, 80.
390 Guido 1978, 100; Callmer 1977, 90, bead group Ra. Also one from Hoogstraat I: Isings 1980, 233, fig. 157: 5.
391 Isings 1980, 233, IV.
392 Harden 1959; Cramp 1970 and 1975; Evison 1988b, 215; Henderson 1991, 124–5.
393 e.g. Harden 1959, fig. 9f; Harden 1978, 8, fig. 3,a,A and B,a; Henderson 1991, 126, no. 239 and fig. 100; Cramp 1968, 16, figs. 1A and 2A.
394 Information from W.J.H. Verwers.

Fig. 228 Dorestad, Hoogstraat 0-IV: Carolingian glass, linen-smoothers; scale 1:2.

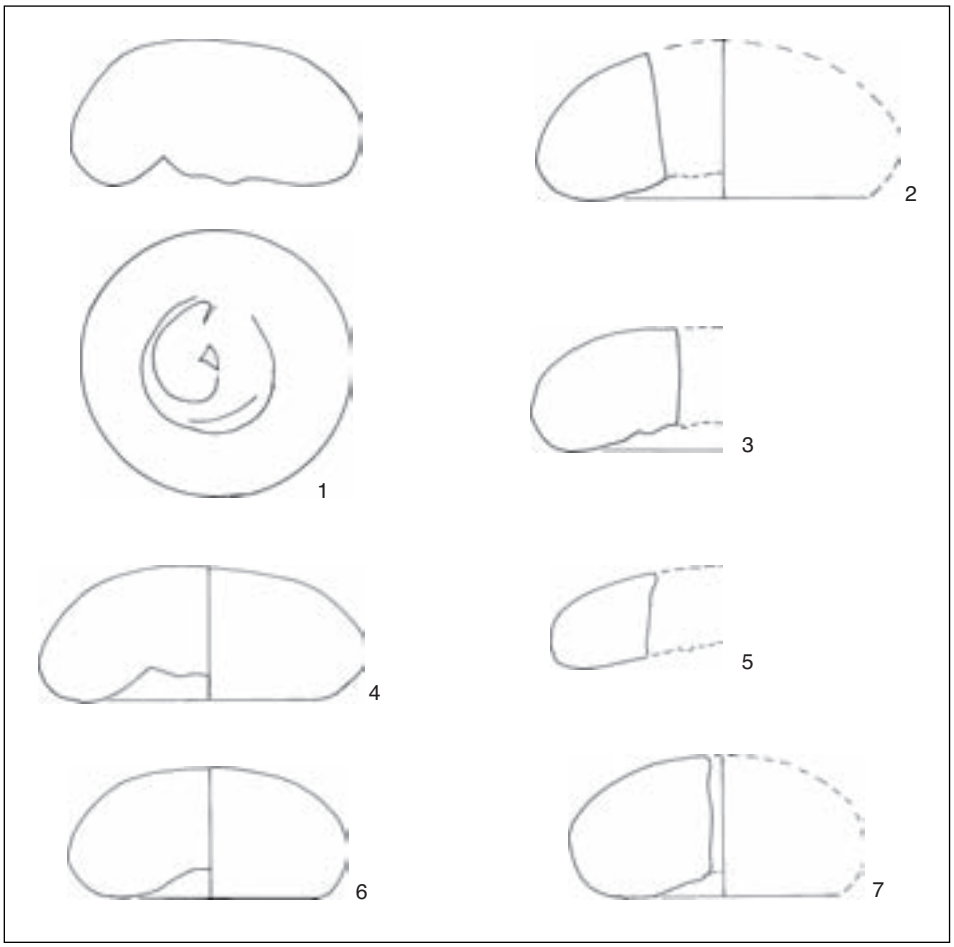
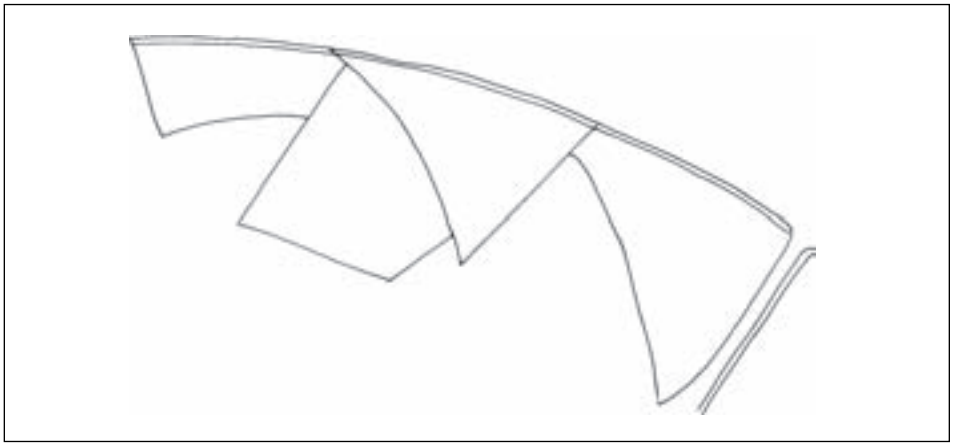


Fig. 229 Dorestad, Hoogstraat 0-IV: Carolingian glass, window glass; scale 1:2.



III *Recent glass*
This includes fragments of wine-bottles, among which one of prismatic shape. There was one fragment of an apothecary's bottle.

Catalogue

Hoogstraat 0

Eight glass fragments have been discovered on this site (find nos. 11816, 11817, 11887, 11964, 12248 (two fragments), 12352 and 13082). Six of them had belonged to funnel beakers, one to a deep palm cup with applied twisted rods and one to a funnel beaker with a horizontal moulding. There was one undeterminable fragment.

0/1 11816 Wall fragment. Bluish-green to green tinge, numerous bubbles. From the lower part of a funnel beaker. Extant diameter *c.* 3 cm; thickness 0.3 cm.

0/2 11817 Wall fragment. Bluish-green tinge, numerous bubbles. Mould-blown vertical ribbing. From lower part of a funnel beaker. Extant diameter *c.* 3.5 cm; thickness 0.19–0.25 cm (fig. 224: 6).

0/3 11887 Wall fragment. Moss-green tinge, numerous large bubbles. Flask or bowl of undeterminable type and date. Extant diameter *c.* 8 cm; thickness 0.17–0.19 cm.

0/4 11964 Fragments of lower side and base. Bluish-green to green tinge, numerous bubbles, some dulling. Base with a pontil mark. Funnel beaker or deep palm cup. Diameter of base 1.1 cm; thickness 0.23–0.27 cm.

0/5 12248 Two fragments found, both funnel beakers.

a Base with fragment of lower side. Green, numerous bubbles, two white streaks of weathering on the inside. Base with pontil wad still attached. Funnel beaker. Diameter of base 1.8 cm; thickness 0.1–0.2 cm.

b Wall fragment. Bright green ting, numerous bubbles. Funnel beaker. Extant diameter of side *c.* 6 cm; thickness 0.06–0.07 cm.

0/6 12352 Lower side and base. Bluish-green tinge, numerous bubbles, some streaks. Dulling and iridescence. Base with pontil mark. Horizontal moulding between upper and lower side. Funnel beaker. Diameter of base 1.3 cm; thickness 0.05 cm (fig. 222: 15).

0/7 13083 Fragment of lower side and base. bluish-green tinge. Twisted rods of self-coloured and yellow glass applied vertically. Numerous bubbles. Some dulling. Base with pontil mark. Deep palm cup. Diameter of base *c.* 1.5 cm; thickness 0.2–0.23 cm.

Hoogstraat II

Of the fragments found in the excavation trenches 380 to 394 and 463, forty-three belonged to either deep palm cups or funnel beakers. They include a fragment with a spiral trail, a base fragment with applied twisted rods, three rim fragments with applied blue rims and one fragment with a blue insertion. Five funnel beakers had a horizontal moulding half-way their side, one of them having a faint moulded ribbing. A rim fragment with a yellow trail on it may have been part of a jar. There is one bowl fragment.

An interesting wall fragment has a decoration of red and white marvered festoons on colourless glass.

Of the window glass found some may be of Carolingian date, others are probably from a later period as are the fragments of wine-bottles.

II/1 380.3.9 Wall fragment, bluish-green. From the lower side of a funnel beaker. Extant diameter *c.* 3.5 cm; thickness 0.19 cm.

II/2 381.2.2 Fragment of rim and side. Bluish-green tinge. Numerous bubbles. Inverted rim with a marvered yellow trail below it. Red streaking on the side. Probably a funnel beaker. Diameter of rim *c.* 8 cm; thickness 0.1 cm (fig. 225: 2).

II/3 381.2.3. Wall fragment, slightly greenish to colourless. Probably a funnel beaker. Extant diameter *c.* 7–8 cm; thickness 0.12 cm.

II/4 381.3.0. Three fragments.
a Fragment of rim and side, bluish-green tinge. Applied rim, dark bluish-green with inverted edge. Funnel beaker, the slope of the side suggests one with a test-tube-shaped base. Diameter of rim *c.* 10 cm; thickness 0.25 cm (fig. 224: 1).
b Fragment of window glass. Bluish-green. Grozed edge on the corner. Probably Carolingian. Thickness 0.25 cm.
c Fragment of lower side of a dark green square wine-bottle (17th–19th century). Width 9 x 9 cm.

II/5 381.4.17 Wall fragment of a bowl or jar, double layered colourless glass. On the inner layer festoons in white and red, marvered flush with the surface, the whole covered with an outer layer of colourless glass. Thickness 0.26 cm (fig. 226: 5).

II/6 382.2.0 Wall fragment of a wine-bottle. Dark green with a layer of iridescent weathering (17th–18th century). Diameter *c.* 9 cm.

II/7 382.2.6 Two fragments: a funnel beaker and a deep palm cup.
a fragment of rim and side. Almost colourless, slightly greenish. Dull weathering in undulating layers. Numerous bubbles. Rim rounded and slightly inverted. Funnel beaker. Diameter of rim *c.* 9 cm; thickness 0.1 cm.
b Fragment of lower side of a deep palm cup. Mould-blown pattern consisting of vertical ribbing and a row of knobs. Thickness 0.2 cm (fig. 222: 7).

II/8 382.2.8 Test-tube-shaped base of a funnel beaker. Green glass with numerous bubbles. Base with pontil mark. Diameter of base 1.21 cm; thickness 0.15 cm (fig. 223: 52).

II/9 382.3.0 Base fragment of a wine-bottle. Moss green glass with a brown layer of weathering on top of an iridescent one.

II/10 382.3.20 Base fragment of a wine-bottle. Green with a heavy brown layer of weathering.

II/11 382.3.22 Fragment of rim and side. Almost colourless, slightly greenish. Numerous bubbles. Some iridescence. Dull weathering in undulating layers. Funnel beaker, similar to but not identical with II/7a. Diameter *c.* 9 cm; thickness 0.13 cm (fig. 223: 17).

II/12 382.5.0 Fragment of rim and side. Bluish-green. Numerous bubbles. Inverted rim. Probably deep palm cup similar to one from Hilversum.[395] Diameter *c.* 9 cm; thickness 0.13 cm (fig. 222 :3).

II/13 383.1.16 Wall fragment of a wine-bottle. Moss-green. Iridescent layer of weathering. Diameter *c.* 10 cm.

II/14 383.1.20 Fragment of rim and side. Bluish-green tinge. Streaks and bubbles. Rounded rim. Probably deep palm cup similar to one from Hilversum.[396] Diameter of rim *c.* 8 cm; thickness 0.1 cm (fig. 223: 10).

II/15 383.2.2 Fragment of a linen smoother. Dark green. Dulled surface.

II/16 383.2.4 Two joining fragments of lower side and base. Green tinge. Numerous bubbles and some streaks. Base with pontil mark. Probably straight-sided funnel beaker. Diameter of base *c.* 1.6 cm; thickness 0.15 cm.

II/17 383.2.6 Fragment of side. Pale bluish-green tinge. Numerous bubbles. Some iridescence. Faint mould-blown vertical corrugated ribbing. Horizontal moulding between upper and lower side. Extant diameter *c.* 5–6 cm; thickness 0.1 cm (fig. 222: 12).

II/18 383.3.7 Fragment of lower side. Dark-green tinge. Blob on the lower side near the base is probably accidental. Dulled with iridescence on the inside. Probably deep palm cup. Diameter of base *c.* 2.5 cm; thickness 0.22–0.5 cm.

II/19 383.2.22 Base fragment from a wine-bottle. Green, dull weathering.

II/20 384.2.11 Base, test-tube-shaped. Green tinge. When the pontil wad was cut off part of the base's surface was cut-off as well. Funnel beaker. Diameter of base *c.* 1.35 cm; thickness 0.2 cm (fig. 223: 30).

395 *Ypey 1962–3, Abb. 40: 9.*
396 *Ypey 1962–3, Abb. 40: 9.*

II/21 384.2.13 Linen-smoother and fragment of one.
a Linen smoother. Dark green. Brown and dull weathering. Height 4.1 cm; diameter 7.7–7.82 cm (fig. 228: 1).
b Fragment of a linen-smoother. Dark-green very impure glass. Diameter *c.* 8 cm (fig. 228: 2).

II/22 384.2.17 Base. test-tube-shaped. Dark-green tinge. Base with pontil mark. Funnel beaker. Diameter of base *c.* 1.2 cm; thickness 0.16 cm (fig. 223: 31).

II/23 384.3.13 Base of a wine-bottle. Dark green. Heavy layer of weathering. Diameter *c.* 10 cm.

II/24 384.3.26 Two fragments, one funnel beaker, the other window glass.
a Fragment of rim and side. Pale greenish to bluish-green tinge. Numerous bubbles. Heavy metallic layer of weathering, mostly on the inside it was flaked off on the outside. Rim rounded and slightly incurved. Unusual heavy weathering among the finds from this site. Probably funnel beaker. Diameter of rim *c.* 8 cm; thickness 0.1 cm (fig. 223: 19).
b Fragment of window glass. Pale greenish. Thickness 0.11 cm.

II/25 384.4.0 Fragment of rim and side. Bluish-green tinge. Some bubbles. Inverted rim. Funnel beaker. Diameter of rim *c.* 9 cm; thickness 0.1 cm (fig. 223: 20).

II/26 384.4.8 Fragment of a linen smoother. Dark green. Diameter *c.* 7.5–8 cm.

II/27 384.4.20 Fragment of lower side with base (7 joining fragments). Greenish tinge. Numerous bubbles. Base with pontil mark. Part of horizontal moulding between upper and lower side. Funnel beaker. Diameter of base 1.5 cm; thickness 0.14 cm (fig. 222: 16).

II/28 384.5.10 Slightly distorted fragment of lower side with base (restored from fragments). Greenish tinge. Streaks and bubbles. Base with pontil mark. Part of horizontal moulding between upper and lower side. Funnel beaker. Diameter of base 1.5 cm; thickness 0.14 cm (fig. 222: 13).

II/29 384.5.11 Two fragments, possibly from the same beaker.
a Fragment of rim and side. Almost colourless, slightly greenish. Inverted rim. Diameter of rim *c.* 9 cm; thickness 0.1 cm.
b Wall fragment with part of horizontal moulding. Slightly greenish, almost colourless. Funnel beaker. Thickness 0.1 cm (fig. 222: 11).

II/30 385.1.2 Fragment of a test-tube-shaped base. Dark bluish-green. Numerous bubbles. Funnel beaker. Diameter of base 1.2 cm; thickness 0.2 cm (fig. 223: 32).

II/31 385.1.3 Wall fragment. Dark green. Wine-bottle.

II/32 385.1.13 Fragment of rim and side. Bluish-green tinge. Numerous bubbles; dulled. Inverted rim. Funnel beaker. Diameter of rim *c.* 9 cm; thickness 0.07 cm (fig. 223: 23).

II/33 385.2.0 Fragment of lower side with base. Green tinge. Numerous pin-prick bubbles. Base with pontil mark. Funnel beaker, probably a straight-sided one. Diameter of base 1.2 cm; thickness 0.12 cm (fig. 223: 33).

II/34 385.2.6 Fragment of rim and side. Pale greenish tinge. Numerous bubbles; dulled. Rounded rim. Straight-sided funnel beaker. Diameter of rim *c.* 8 cm; thickness 0.09 cm (fig. 223: 4).

II/35 385.2.8 Five fragments, one Roman, the others from funnel beakers.
a Fragment of rim and side. Pale greenish tinge. A few bubbles. Two-fold applied rim: first a dark bluish-green one and on top of this first a pale greenish rim and last a green one, thus producing a bluish-green insertion. Diameter of rim *c.* 10 cm; thickness 0.08 cm (fig. 224: 4).
b Fragment of rim and side. Greyish-green tinge. Numerous bubbles, streaks. White spots of weathering. Rounded rim. Straight-sided funnel beaker. Diameter of rim *c.* 9 cm; thickness 0.08 cm (fig. 223: 1).

c Lower side and base. bluish-green tinge. Numerous bubbles. Base with pontil mark. Probably the same funnel beaker as II/35b. Diameter of base 1.25 cm; thickness 0.1 cm.

d Fragment of lower side with base. Green tinge. Mould-blown oblique corrugations. Numerous bubbles; dulled. Funnel beaker. Diameter of base 1.46 cm; thickness 0.1 cm (fig. 223: 35).

e Base fragment of square bottle. Bluish-green. Base mark: one circle in relief with part of a St. Andrew's cross in the centre. Width *c.* 5 x 5 cm.[397]

II/36 385.3.0 Fragments of three beakers, one being a deep palm cup, the others funnel beakers.

a Two joining fragments of rim and side and wall-fragment of the same beaker. Green. Inverted rim and splayed side. Probably funnel beaker with a test-tube-shaped base. Diameter of rim *c.* 10 cm; thickness 0.1 cm (fig. 223: 25).

b Fragment of rim and side. Pale bluish-green tinge. Inverted rim. Possibly deep palm cup similar of Hilversum type.[398] Diameter of rim *c.* 8 cm; thickness 0.07 cm.

c Three wall fragments. Greenish tinge, almost colourless. Numerous bubbles. On one fragment part of an opaque white spiral trail. Funnel beaker. Extant diameter of side *c.* 7 cm; thickness 0.05–0.09 cm (fig. 225: 1).

II/37 385.3.9 Circa 3/4 of a deep palm cup, restored from fragments. Bluish-green. Numerous bubbles. A horizontal moulding half-way across the side. Rim rounded and inverted. Base with pontil mark. The beaker is comparable to the one from Ferwerd and is a variety of one from Hilversum.[399] Diameter of rim 9 cm; height 11.8 cm; thickness 0.1 cm (fig. 222: 8).

II/38 385.4.9 Fragment of rim and side and two wall-fragments. Dark bluish-green to emerald green. Rounded rim. Straight-sided funnel beaker. Diameter of rim *c.* 9 cm; thickness 0.15 cm (fig. 223: 5).

II/39 385.5.7 Fragment of rim and side. Bluish-green tinge. Marvered yellow trail on rim and side. Everted rim. Bowl, comparable to *e.g.* one from Valsgärde. Diameter of rim *c.* 12 cm; thickness 0.11 cm (fig. 226: 6).

II/40 386.1.2 Two joining fragments of lower side. Greenish tinge. Funnel beaker with test-tube-shaped base. Extant lower diameter 1.4–*c.* 2 cm; thickness 0.9–0.32 cm (fig. 223: 36).

II/41 386.1.11 Two fragments, both from funnel beakers.

a Fragments of an applied rim. Emerald green. A few bubbles. Diameter of rim *c.* 10 cm; thickness 0.15 cm (fig. 224: 2).

b Fragment of lower side with base. Bluish-green tinge. Base with pontil mark. Test-tube-shaped base. Diameter of base *c.* 1 cm; thickness 0.09 cm (fig. 223: 37).

II/42 387.1.1 Fragment of lower side with base. Pale greenish tinge. Numerous bubbles. Base with pontil mark. Funnel beaker with test-tube-shaped base. Diameter of base 1.1 cm; thickness 0.15 cm (fig. 223: 38).

II/43 387.1.12 Wall fragment. Greenish to bluish-green. Numerous bubbles. Funnel beaker. Extant diameter *c.* 9 cm; thickness 0.2 cm.

II/44 387.2.0 Fragment of rim and side. Pale bluish-green tinge. Numerous bubbles. Slightly inverted rim. Funnel beaker, slope of the side suggests one with a test-tube-shaped base. Diameter of rim *c.* 9 cm; thickness 0.1 cm (fig. 223: 12).

II/45 388.1.1 Four fragments: a funnel beaker, a linen smoother, window glass and a wine-bottle.

a Wall fragment. Bluish-green, a few bubbles. Probably funnel beaker. Extant diameter *c.* 5 cm; thickness 0.1 cm.

397 Isings 1957, form 50; Charlesworth 1966, 34, fig. 12.
398 Ypey 1962–3, Abb. 40: 9.
399 Ypey 1962–3, Abb. 40: 9.

b Fragment of a linen smoother. Dark green. Brown weathering. Diameter *c.* 8 cm.

c Rim fragment of window glass with rounded rim. Uncertain date. Thickness 0.15 cm.

d Wall fragment of a wine-bottle.

II/46 388.2.1 Fragment of rim and side. Bluish-green. Numerous bubbles. Rim somewhat misshapen, possibly a small spout was meant (?). Jug or funnel beaker. Thickness 0.07 cm.

II/47 388.2.1 Rim fragment of a linen smoother. Dark green, dulled. Diameter *c.* 8 cm (fig. 228: 3).

II/48 388.2.3 Rim fragment and small body-fragment of a linen smoother. Dark green. Diameter *c.* 7 cm.

II/49 388.3.4 Two fragments, one of a deep palm cup, the other of a funnel beaker.

a Fragment of lower side with base. Bluish-green tinge. Iridescence and yellow weathering. Pontil mark on the base. Deep palm cup. Extant diameter of lower side 2.5 cm; thickness 0.05 cm.

b Fragment of lower side with base. Green tinge. Numerous bubbles; cracked. Base with pontil mark. Funnel beaker with test-tube-shaped base. Diameter of base 1.17 cm; thickness 0.12 cm (fig. 223: 41).

II/50 388.3.10 Fragment of rim and side. Bluish-green tinge. Applied dark green rim, inverted. Few bubbles. Funnel beaker. The slope of the side suggests one with a test-tube-shaped base. Diameter of rim *c.* 10 cm; thickness 0.8 cm (fig. 224: 3).

II/51 388.3.11 Fragment of lower side with base. Pale green tinge. Numerous bubbles. Base with pontil mark. Funnel beaker. Diameter of base 1.3 cm; thickness 0.11 cm (fig. 223: 34).

II/52 388.4.1 Wall fragment. Dark bluish-green. Numerous bubbles. Possibly a palm cup. Extant diameter *c.* 8 cm; thickness 0.15–0.3 cm.

II/53 389.1.0 Wall fragment of a wine-bottle. Dark green; dulled.

II/54 389.1.1 Fragment of lower side: five joining and one other fragment. Bluish-green. Vertically applied twisted rods of self-coloured and white, probably applied before the vessel was finished as they are now flush with the surface. Funnel beaker with test-tube-shaped base. Extant diameter *c.* 2 cm; thickness 0.16–0.35 cm (fig. 225: 4).

II/55 390.1.1 Fragment of rim and side, and wall fragment. Bluish-green tinge. Numerous bubbles. Rim slightly inverted. Straight-sided funnel beaker. Diameter of rim *c.* 11 cm; thickness 0.07 cm (fig. 223: 8).

II/56 390.5.24 Two fragments, possibly both funnel beakers.

a Fragment of rim and side. Bluish-green tinge. Numerous bubbles. Inverted rim. Funnel beaker. Diameter of rim *c.* 9 cm; thickness 0.06 cm (fig. 223: 14).

b Two wall fragments, joining. Colourless; iridescence. Possibly from lower side of a funnel beaker. Extant diameter *c.* 2.5 cm; thickness 0.09 cm.

II/57 391.1.1 Fragment of rim and side. Green tinge. Numerous bubbles. Rounded and slightly inverted rim. Straight-sided funnel beaker. Diameter of rim *c.* 10 cm; thickness 0.2 cm (fig. 223: 13).

II/58 391.3.3 Fragment of window glass. Completely covered with an iridescent layer of weathering. Thickness 0.09 cm.

II/59 463.0.0 a Fragment of rim and side. Slight greenish tinge. Streaks and numerous bubbles. Rim rounded and slightly inverted. Some iridescence. Funnel beaker, probably a straight-sided one. Diameter of rim *c.* 9 cm; thickness 0.12 cm (fig. 223: 28).

b Bead, melon-shaped. Bluish-green 'Egyptian faience'. Damaged. The type was in use from the Roman Period onwards to the Viking Period. Height 1.55–1.66 cm; max. diameter 1.9 cm (fig. 227: 5).

Hoogstraat III

Glass fragments came from excavation trenches 401 up to 407. As at the other sites most of them belonged to either deep palm cups or to funnel beakers, including a fragment with applied gold-leaf and five fragments with a horizontal moulding. There were four fragments of either bowls or jars, four beads, fragments of three linen smoothers and a fragment of a Roman bangle. Three fragments are possibly Roman and two are Merovingian, one of them an interesting type of goblet. There was one Roman game piece. The window glass found at the site is mainly Post-Carolingian, two fragments might be Carolingian. There were two fragments of wine-bottles.

III/1 401.0.6 Game piece. Opaque pale blue; dulled. Height 0.62 cm; diameter 1.6 cm (fig. 220: 1).

III/2 401.0.3 Fragment of rim and side. Bluish-green tinge. Numerous bubbles. Rounded rim with marvered yellow trail. Possibly jar. Diameter of rim *c.* 7 cm; thickness 0.09 cm (fig. 226: 1).

III/3 401.1.0 Fragment of rim and side. Pale bluish-green tinge. Numerous bubbles and some iridescence. Rim rounded and slightly inverted. The slope of the side suggests a funnel beaker with test-tube-shaped base. Diameter of rim *c.* 9 cm; thickness 0.15 cm (fig. 223: 15).

III/4 401.3.13 Two fragments, both funnel beakers.

a Fragment of lower side and base. Pale bluish green tinge. Numerous bubbles. Base with pontil mark. Straight-sided funnel beaker. Diameter of base *c.* 1.5 cm; thickness 0.28 cm (fig. 223: 43).

b Fragment of base. Pale bluish-green tinge; dulled. Base with pontil mark. Probably funnel beaker with a test-tube-shaped base. Diameter of base 1.2 cm; thickness 0.2 cm (fig. 223: 51).

III/5 401.4.21 Two fragments of blue glass.

a Fragment of a cut-out base. Transparent cobalt-blue glass. Numerous bubbles. Either a beaker (goblet) or jug. Might be Late Roman, but an early medieval date is also possible. Diameter of base *c.* 6 cm; thickness 0.35 cm.

b Fragment of thick-walled cylindrical object. Dark blue. Dulled with some iridescence. Uncertain type and date (lower side fragment of a funnel beaker?). Diameter *c.* 3.5 cm; thickness 1.14 cm.

III/6 402.1.10 Numerous small fragments, part of them funnel beakers.

a Neck fragment. Green tinge; dulled. Wall fragment, probably of the same vessel. Probably a Roman bottle. Diameter of neck *c.* 2.5 cm; thickness 0.53 cm.

b Fragment of rim and side, 3 fragments of side. Bluish-green tinge. Numerous bubbles. Rounded rim. Funnel beaker, probably straight-sided. Diameter of rim *c.* 9 cm; thickness 0.06 cm.

c Small fragment of rim and side. Bluish-green tinge. From a straight sided funnel beaker. Thickness 0.1 cm.

d Small fragment of rim and side. Bluish-green tinge. Rounded and slightly inverted rim. Funnel beaker. Thickness 0.1 cm (fig. 223: 10).

e Five wall fragments. Bluish-green. Thickness 0.07 cm.

f Nine small fragments. Colourless. Thickness 0.06 cm.

g Wall fragment. Colourless. Mould-blown corrugations. Thickness 0.06 cm.

h Twenty-one wall fragments. Bluish-green.

i Eight wall fragments. Greenish.

j Tiny blue globular bead. Opaque; dulled. Height 0.2 cm; diameter 0.3 cm (fig. 227: 3).

III/7 402.2.0 Fragment of three different windows.

a Eight fragments, five of them rim fragments and part of them joining. Moss green; yellowish layer of weathering. Straight edge cut by 'diamond' scoring with a sharp instrument. A dulled line near the edge indicates where the frame or leading ended. Thickness 0.14–0.28 cm (fig. 229).

b Seven fragments, four of them joining, from window glass with a rounded edge. Olive green; some iridescence. Large window, either a round one or one with a semicircular end. Thickness 0.19–0.32 cm.

c Sixteen fragments, two of them with a rounded edge. Bluish-green tinge. Thickness 0.07–0.2 cm.

III/8 402.2.47 Fragment of rim and side. Bluish-green tinge. Numerous bubbles. Rounded and slightly inverted rim. Straight-sided funnel beaker. Diameter of rim *c.* 9 cm; thickness 0.14 cm (fig. 223: 16).

III/9 402.2.39 Fragment of lower side. Pale bluish-green tinge. Numerous bubbles. Funnel beaker. Extant diameter *c.* 4 cm; thickness 0.14 cm.

III/10 402.2.41 Fragment of lower side. Green tinge. Numerous bubbles. Funnel beaker. Extant diameter *c.* 4 cm; thickness 0.15 cm.

III/11 402.4.14 Fragment of base. Bluish-green tinge, applied self-coloured and yellow twisted rods. Slightly concave base with pontil mark. Probably from a bowl comparable to the one from Valsgärde. Diameter of base *c.* 6–7 cm; thickness 0.18 cm (fig. 226: 3).

III/12 403.1.1 Base fragment of a bottle. Green. Apothecary bottle.

III/13 403.2.0 Fragment of lower side with base. Pale green tinge. Base with pontil-mark. Funnel beaker with a test-tube-shaped base. Diameter of base 1.2 cm; thickness 0.15 cm (fig. 223: 40).

III/14 403.3.1 Wall (?) fragment. Green tinge. Slightly distorted by fire. Shape and date uncertain. Thickness 0.2–0.37 cm.

III/15 403.3.5 Three fragments, all funnel beakers.

a Fragment of rim and side. Greyish-green tinge. Numerous bubbles. Some iridescence. Thick rounded rim, slightly inverted. Either a deep palm cup or a straight-sided funnel beaker. Diameter of rim *c.* 8 cm; thickness 0.1 cm (fig. 222: 10).

b Fragment of rim and side. bluish-green tinge. A few bubbles. Rounded rim. Straight-sided funnel beaker. Diameter of rim *c.* 11 cm; thickness 0.1 cm.

c Fragment of lower side with base. Dark bluish-green tinge. Numerous bubbles. Base with pontil mark. Probably straight-sided funnel beaker. Diameter of base *c.* 1 cm; thickness 0.15 cm.

III/16 403.4.12 Five fragments, joining, of side and one fragment of lower side and base. Bluish-green tinge. A few bubbles. Funnel beaker with a horizontal moulding. Diameter at the moulding *c.* 5 cm; thickness 0.1–0.41 cm (fig. 222: 17).

III/17 404.3.0 Annular bead. Transparent, green. Yellow zigzag trail between two horizontal ones. Callmer's bead-group Bc of the Middle Viking Period. Height 0.64 cm; diameter 1.12 cm (fig. 227: 1).

III/18 404.3.7 Two fragments, both funnel beakers.

a Fragment of lower side. Green tinge. Extant diameter *c.* 4.5 cm; thickness 0.15 cm.

b Fragment of lower side. Bluish-green tinge. A few bubbles. Extant diameter *c.* 5 cm; thickness 0.11 cm.

III/19 404.3.8 Four fragments, one Roman, the others funnel beakers.

a Three fragments, two of them joining of base and foot. Greenish tinge. Badly cracked. Cut-out foot. Late-Roman, possibly a 3rd to 4th-century beaker or jug.[400] Diameter of foot *c.* 5.5 cm; thickness 0.3–0.5 cm.
b Fragment of rim and side. Pale greenish tinge. Numerous bubbles. Rounded rim. Straight-sided funnel beaker. Diameter of rim *c.* 9 cm; thickness 0.1 cm (fig. 223: 6).
c Fragment of rim and side. Slightly greenish, pure glass. Rounded and inverted rim. Probably a funnel beaker with a test-tube-shaped base. Diameter of rim *c.* 9 cm; thickness 0.12 cm (fig. 223: 29).
d Fragment of rim and side. Green tinge. Rounded rim. Straight-sided funnel beaker. Diameter of rim *c.* 10 cm; thickness 0.1 cm (fig. 223: 7).

III/20 405.1.10 Two fragments, one a linen-smoother, the other of uncertain type.
a Circa 3/4 of a linen-smoother. Dark green; dulled. Maximum height 3.6 cm; diameter 8.55 cm (fig. 228: 4).
b Fragment of a concave base with pontil mark. Probably greenish. Covered with a layer of iridescent weathering. Type and date uncertain. Thickness 0.2–0.44 cm.

III/21 405.1.13 Three fragments, all funnel beakers.
a Fragment of rim and side and fragment of side with base, joining (complete profile of beaker). Bluish-green tinge. Numerous bubbles. Vertical mould-blown corrugations. Base with pontil mark. Funnel beaker with test-tube-shaped base. Diameter of rim *c.* 10 cm; height *c.* 12.1 cm (fig. 223: 2).
b Fragment of lower side with base. Green tinge. Funnel beaker with a test-tube-shaped base. Diameter of base 1.2 cm; thickness 0.15 cm (fig. 223: 44).
c Wall fragment. Bluish-green tinge. Numerous bubbles. Thickness 0.07 cm.

III/22 405.2.17 Fragment of lower side and base. Bluish-green. Base concave with pontil mark. On the side part of yellow marvered wavy line(s). Bowl or jar. Diameter of base *c.* 3.5 cm; thickness 0.2 cm (fig. 226: 2).

III/23 405.2.22 Half of a globular bead. Translucent cobalt blue. Iridescence. White marvered circles on both sides of a white marvered horizontal trail. Diameter 1.45–1.50 cm; height 1.4 cm (fig. 227: 2).

III/24 405.2.28 Fragment of a bangle. Blue with a blue and white twisted rod applied lengthwise around its middle. Imported British-Roman. D-shaped cross-section (1 cm). Diameter 4 cm (fig. 220: 2).

III/25 405.2.33 Fragment of lower side with base. Pale greenish tinge. Test-tube-shaped base of funnel beaker. Diameter of base *c.* 1 cm; thickness 0.1 cm (fig. 223: 42).

III/26 405.2.40 Wall fragment. Pale greenish tinge. Numerous bubbles. Horizontal moulding halfway on the side. Rounded and inverted rim. Funnel beaker. Extant diameter *c.* 6 cm; thickness 0.09 cm.

III/27 405.2.41 Fragment of rim and side. Pale greenish tinge. Numerous bubbles. Horizontal moulding halfway on the side. Rounded and inverted rim. Funnel beaker. Diameter of rim *c.* 8.2 cm; thickness 0.09 cm (fig. 222: 9).

III/28 405.3.7 Three fragments, all funnel beakers.
a Fragment of rim and side. Pale bluish-green tinge. Numerous bubbles. Rim rounded and inverted. Straight-sided funnel beaker. Diameter of rim *c.* 8 cm; thickness 0.07 cm (fig. 223: 22).
b Fragment of rim and side. Pale bluish-green tinge. Numerous bubbles. Rounded rim. Possibly funnel beaker with test-tube-shaped base. Diameter of rim *c.* 8 cm; thickness 0.05 cm.
c Fragment of rim and side. Bluish tinge. Numerous bubbles. Thick rounded and inverted rim. Funnel beaker. Diameter of rim *c.* 9 cm; thickness 0.07 cm.

400 cf. e.g. Isings 1957, forms 109 and 120.

III/29 405.3.12 Fragment of rim and side. Green tinge. Numerous bubbles. Rounded and slightly inverted rim. Slope of the side suggest a funnel beaker with test-tube-shaped base. Diameter of rim *c.* 10 cm; thickness 0.08 cm.

III/30 405.3.16 Two fragments, both funnel beakers.

a Fragment of lower side with base. Bluish-green. Numerous bubbles. Base with pontil mark. Probably a straight-sided funnel beaker. Diameter of base 1.35 cm; thickness 0.1 cm (fig. 223: 45).

b Wall fragment. Green to bluish-green tinge. Numerous bubbles. Extant diameter *c.* 6 cm.

III/31 405.3.26 Wall fragment. Bluish-green. Decorated with self-coloured arcaded trail. Diameter uncertain: may have been a deep palm cup; thickness 0.06 cm (fig. 224: 7).

III/32 405.3.27 Fragment of lower side. Bluish-green tinge. Numerous bubbles. Funnel beaker. Extant diameter *c.* 1.5 cm; thickness 0.23–0.4 cm.

III/33 405.5.14 Fragments of eight objects, three of them funnel beakers, one bead and one possibly window glass.

a Three fragments, two of them joining, of rim and side. Colourless with a very slight greenish tinge. Streaks of white weathering. Rim rounded and inverted. Funnel beaker. Diameter of rim *c.* 8 cm; thickness 0.09 cm (fig. 223: 18).

b Fragment of rim and side. Greenish tinge. Applied blue rounded rim. Funnel beaker. Diameter of rim *c.* 9 cm; thickness 0.19 cm.

c Wall fragment. Bluish-green tinge. From the horizontal moulding of a funnel beaker. Thickness 0.1 cm.

d Wall fragment. Colourless. Cracked and scratched. A few bubbles. Type and date uncertain. Extant diameter *c.* 5 cm; thickness 0.25–0.35 cm.

e Two wall fragments, one a bluish-green, the other pale greenish with iridescence. Thickness 0.1 cm.

f Fragment of flat glass, probably window glass. Green tinge; dulled. Probably Carolingian, as the other finds date from this period.

g Circa 2/3 of a bead. Green matrix, mosaic bead with pale yellow wavy lines crossing, and at the points of intersection a pale blue mosaic inlay containing a white rosette with a bright red heart. At one side of the bead this inlay became distorted by the fashioning of the bead from a mosaic blank. Callmer's bead-group J (posterior to AD 820). Maximum diameter 0.69 cm (fig. 227: 4).

III/34 406.3.3 Fragment of lower side and base. Pale bluish-green tinge. Convex base with pontil mark. Deep palm cup comparable to one from Hilversum.[401] Thickness 0.1 cm.

III/35 406.3.9 Fragment of lower side and base. Green tinge. Numerous bubbles. Base with pontil mark. Funnel beaker with a test-tube-shaped base. Diameter of base 1.2 cm; thickness 0.1 cm (fig. 223: 47).

III/36 406.4.1 Two fragments, one a funnel beaker, the other of uncertain type.

a Fragment of lower side and base. Bluish-green tinge. Numerous bubbles. Base with pontil mark. Mould-blown vertical corrugations. Funnel beaker. Diameter of base 1 cm; thickness 0.2 cm (fig. 223: 48).

b Wall fragment. Bluish-green tinge. Numerous bubbles. Type uncertain may have been a palm cup. Some iridescence. Extant diameter between 5 and 6 cm; thickness 0.14–0.28 cm.

III/37 406.4.14 Fragment of rim and side. Bluish-green tinge. Numerous bubbles. Rounded rim. Mould-blown more or less vertical ribbing which might have become spiral ribbing on the lower side. Straight-sided funnel beaker. Diameter of rim *c.* 10 cm; thickness 0.05 cm (fig. 223: 3).

401 Ypey 1962–3, Abb. 40: 9.

III/38 406.5.0 Fragment of lower side with base. Emerald-green tinge. Numerous bubbles. Base with pontil mark. Straight-sided funnel beaker. Diameter of base 1.22 cm; thickness 0.1 cm (fig. 223: 46).

III/39 406.5.23 Fragment of lower side with base. Emerald-green tinge. Numerous bubbles. Mould-blown vertical corrugations only slightly visible. Funnel beaker with test-tube-shaped base (fig. 223: 50).

III/40 406.6.8 Fragment of lower side with base. Green tinge. Remains of pontil wad at the junction of side and base. Funnel beaker, probably with a test-tube-shaped base. Diameter of base 1.2 cm; thickness 0.12 cm (fig. 223: 49).

III/41 407.1.6 Fragment of lower side. Pale bluish-green tinge. Funnel beaker. Extant diameter *c.* 2 cm; thickness 0.14 cm.

III/42 407.2.9 Fragment of bluish-green glass, distorted by fire.

III/43 407.2.11 Rim fragment of a linen smoother. Dark green; dulled. Diameter *c.* 9 cm (fig. 228: 5).

III/44 407.2.16 Base fragment of a wine-bottle. Dark green.

III/45 407.2.20 Fragment of lower side and base. Dark bluish-green. Numerous bubbles. Base with a pointed kick. Straight-sided funnel beaker. Diameter of base 1.2 cm; thickness 0.15 cm.

III/46 407.2.23 Wall fragment. Bluish-green tinge; iridescence. Funnel beaker. Thickness 0.1 cm.

III/47 407.2.26 Rim fragment of window glass. Green tinge; iridescent layer of weathering. Uncertain date. Thickness 0.15 cm.

III/48 407.3.1 Wall fragment. Almost colourless with a bright green tinge on the thicker parts; dulled. Probably funnel beaker. Extant diameter *c.* 7.5 cm; thickness 0.12 cm.

III/49 407.3.5 Fragment of a linen smoother. Dark green; dulled. Diameter *c.* 7.5 cm; height 3.6 cm (fig. 228: 6).

III/50 407.3.8 Complete rim with tiny parts of side. Bluish-green tinge. Numerous bubbles. Broad everted rim. Palm cup. Slight iridescence. Maximum diameter of rim 9.8 cm; thickness 0.11 cm (fig. 222: 1).

III/51 407.3.16 Six joining fragments of lower side and base. Bluish-green tinge. Horizontal moulding between upper and lower side. Funnel beaker. Diameter of base 1 cm; thickness 0.1–0.2 cm (fig. 222: 14).

III/52 407.5.0 Wall fragments. Pale bluish-green tinge. Applied gold-leaf on a surface roughened by scratching. Part of the gold-leaf still adheres. Of the decoration part of a large triangle and a row of small truncated cones crowned by rectangles remains. Funnel beaker, probably a straight-sided one. Extant diameter *c.* 9 cm; thickness 0.21–0.25 cm (fig. 225: 5).

III/53 407.6.8 Wall fragment of a wine-bottle. Dark olive-green; white weathering.

III/54 407.6.11 Two fragments, both funnel beakers.

a Fragment of rim and side. Bluish-green tinge. Numerous bubbles. Rounded and inverted rim. Funnel beaker. Diameter of rim *c.* 9 cm; thickness 0.11 cm (fig. 223: 27).

b Fragment of rim and side. Bluish-green tinge. Numerous bubbles. Rounded rim, only slightly inverted. Diameter of rim *c.* 10 cm; thickness 0.1 cm (fig. 223: 26).

III/55 407.5.4 Two fragments, one a deep palm cup, the other a linen-smoother.

a Fragment of lower side with base. Bluish-green. Numerous bubbles. Flaking layer of whitish weathering. Convex base. Deep palm cup of Hilversum type.[402] Thickness 0.13 cm.

b Rim fragment of a linen smoother. Dark green; yellowish-white weathering. Diameter *c.* 7.5 cm (fig. 228: 7).

III/56 407.7.2 Fragment of rim and side. Bluish-green tinge. Thick rounded rim which may have been everted originally and pressed afterwards. Thin yellow spiral trail on rim and neck. Jar. Diameter of rim *c.* 6 cm; thickness 0.12 cm (fig. 225: 3).

402 Ypey 1962–3, Abb. 40: 9.

III/57 407.7.8 Wall fragment. Pale greenish tinge with a pale blue streak. Numerous bubbles and streaky weathering. Funnel beaker. Extant diameter *c.* 6 cm; thickness 0.11 cm.

Hoogstraat IV

Finds in this group come from excavation trenches 448 up to 454. Again the majority consists of deep palm cups and funnel beakers. An interesting Merovingian fragment is one of a rare type of stemmed goblet. There is one fragment of a bowl or jar, a fragment of a linen-smoother and 3 beads. Two mosaic *tesserae* may be of Roman date, there is as yet no proof of glass industry on the site for which *tesserae* might have been used as scrap material. The window glass found is possibly Post-Carolingian, of recent date are also three fragments of wine-bottles.

IV/1 448.4.1 Circa 3/4 of a deep palm cup, put together from fragments. Bluish-green tinge. Numerous streaks and bubbles. Dulling and iridescence. Rim inverted. Convex base with pontil mark. Height 9.4 cm; maximum diameter 9.2 cm; thickness 0.12 cm (fig. 222: 2).

IV/2 448.5.0 Three fragments, one of them possibly a funnel beaker, one from a wine-bottle.

a Wall fragment. Bluish-green tinge. Numerous bubbles. Possibly funnel beaker. Extant diameter *c.* 5 cm; thickness 0.1 cm.

b Wall fragment. Bluish-green. Numerous bubbles. Uncertain type. Thickness 0.2 cm.

c Wall fragment of a wine-bottle. Olive-green.

IV/3 449.0.16 Two fire-damaged fragments. Bluish-green.

IV/4 449.1.0 Base fragment of a wine-bottle. Olive-green with an iridescent and metallic layer of weathering.

IV/5 449.1.36 Fragment of rim and side. Pale green tinge. Numerous bubbles. Rounded rim, splayed. The slope of the side suggests a funnel beaker with a test-tube-shaped base. Diameter of rim *c.* 11 cm; thickness 0.1 cm.

IV/6 449.2.0 Fragments of two objects: one a windoW-glass fragment, the other a wine-bottle, both Post-Carolingian.

a Two joining fragments of window glass. Bluish-green. Numerous bubbles. Scratches and pitted. Iridescent with parts of a metallic layer of weathering. Rounded edge. Thickness 0.28–0.4 cm.

b Wall fragment of a wine-bottle. Olive-green with part of a metallic layer of weathering.

IV/7 449.2.5 Fragment of lower side. Pale greenish tinge; some iridescence. Numerous bubbles. Hardly visible mould-blown vertical corrugations. Funnel beaker, probably one with a test-tube-shaped base. Extant diameter 1.4–2.1 cm; thickness 0.1–0.2 cm.

IV/8 449.2.10 Fragment of window glass. Bluish-green. Numerous bubbles. Iridescence and part of a metallic layer of weathering. Cracks and scratches. May have been part of the same window as no. IV/6a. Thickness 0.3 cm.

IV/9 449.2.13 Base fragment. Bluish-green. Concave base with applied twisted rods of self-coloured and white. Few bubbles. Probably a bowl. Thickness 0.13–0.2 cm (fig. 226: 4).

IV/10 449.2.17 Cylindrical bead. Opaque greyish-green. Belongs to a long-lived type. Height 0.6–0.65 cm; diameter 0.87 cm.

IV/11 449.2.19 Fragment of lower side and stem. Bluish-green tinge. Numerous bubbles. Bowl and stem made separately: four small stems were first drawn from the bowls base, these were bent thus as to make their ends meet in the middle. A hollow stem was attached to them, possibly by blowing a small tube against it. From the latter the stem and base were then fashioned. Goblet,

probably imported from Northern Italy. Merovingian. Extant lower diameter of bowl *c.* 2.5 cm; thickness 0.1–0.2 cm (fig. 221).

IV/12 449.2.28 Fragment of rim and side. Almost colourless with a very slight yellowish-green tinge. Numerous bubbles. Streaky dull white weathering and some iridescence. Rim rounded and inverted. Funnel beaker, probably a straight-sided one. Diameter of rim *c.* 10 cm; thickness 0.15 cm (fig. 223: 24).

IV/13 449.2.33 Fragment of lower side with base. Dark bluish-green; dulled on the inside. Numerous bubbles. Base with pontil mark. Funnel beaker. Diameter of base 1.4 cm; thickness 0.15 cm.

IV/14 449.3.40 Fragment of lower side and base. Bluish-green. Numerous bubbles. Base with pontil mark. Funnel beaker, probably a straight-sided one. Diameter of base 1.2 cm; thickness 0.1–0.4 cm (fig. 222: 39).

IV/15 449.3.44 Base fragment. Emerald green. Numerous bubbles. Convex base, only slightly flattened in its centre. Pointed kick on the inside which does not correspond with any indentation on the outside. Its top is broken off. Dulled and scratched by usage on the outside of the base. Uncertain type, possibly a palm cup. Thickness 0.4 cm.

IV/16 449.3.48 Fragment of lower side and base. Green tinge. Numerous bubbles. Some streaks. Funnel beaker. Diameter of base 1 cm; thickness 0.1 cm.

IV/17 449.4.0 Fragment of side. Bluish-green tinge. Numerous bubbles. Some streaks. Fashioning marks and elongated bubbles indicate a place near the rim. Probably a funnel beaker. Uncertain diameter (*c.* 9–10 cm?); thickness 0.09 cm.

IV/18 449.4.68 Fragment of side. Bluish-green tinge. Numerous bubbles and streaks. Funnel beaker. Extant diameter *c.* 5 cm; thickness 0.1 cm.

IV/19 449.5.0 Four fragments, two of which may have belonged to the same funnel beaker. The fourth fragment is from a wine-bottle.

a Fragment of rim and side. Bluish-green tinge. Numerous bubbles. Rim rounded and slightly inverted. Funnel beaker. Diameter of rim *c.* 8 cm; thickness 0.07–0.1 cm.

b Wall fragment. Bluish-green tinge similar to IV/19a and possibly from the same beaker. Mould-blown vertical corrugations. Extant diameter *c.* 7 cm; thickness 0.1 cm.

c Wall fragment. Greenish tinge. Numerous bubbles. Funnel beaker. Extant diameter *c.* 3 cm; thickness 0.1 cm.

d Base fragment of a wine-bottle. Olive-green with iridescence.

IV/20 450.2.11 Fragment of lower side with base. Bluish-green tinge. Numerous bubbles. Base with pontil mark and part of pontil wad. Funnel beaker with a test-tube-shaped base. Diameter of base 1.4 cm; thickness 0.1 cm.

IV/21 450.2.21 Wall fragment of a wine-bottle. Olive-green; iridescent layer of weathering.

IV/22 450.2.22 Fragment of rim and side. Bluish-green tinge. Numerous bubbles. Inverted cavity-rim. Deep palm cup. Diameter of rim *c.* 9 cm; thickness 0.15 cm (fig. 222: 4).

IV/23 450.3.4 Fragment of a linen smoother. Dark green; brown patches of weathering.

IV/24 451.4.0 Wall fragment of a wine-bottle. Olive-green.

IV/25 453.0.5 White mosaic *tessera*. Height 0.87 cm; maximum width 0.9 cm.

IV/26 453.1.10 Wall fragment. Bluish-green tinge. Numerous bubbles. Applied arcaded trail. From a funnel beaker. Extant diameter *c.* 10 cm; thickness 0.09 cm (fig. 224: 8).

IV/27 453.1.19 Five fragments, one of them distorted by heat. Probably all from funnel beakers .

a Fragment of lower side and base. Bluish-green tinge. Numerous bubbles; dulling. Base with pontil mark. Either deep palm cup or straight-sided funnel beaker. Diameter of base *c.* 0.9 cm; thickness 0.1 cm.

b Wall fragment. Bluish-green tinge; some iridescence. From lower side of a funnel beaker. Extant diameter *c.* 2 cm; thickness 0.25 cm.
c–d Two wall fragments. Pale bluish-green tinge; iridescence. Numerous bubbles. Probably funnel beaker(s). Thickness 0.09 cm.
e Wall fragment. Bluish-green tinge. Distorted by fire.

IV/28 453.2.9 Ten fragments, one of them probably a (deep) palm cup, the others probably funnel beakers .
a Fragment of rim and side. Bluish-green tinge; some iridescence. Numerous bubbles. Inverted cavity-rim. Palm cup. Diameter of rim *c.* 8 cm; thickness 0.12 cm (fig. 222: 5).
b–c Two wall fragments, both fire-damaged. One of lower side, the other of lower side and base. Bluish-green. Funnel beaker(s). Thickness 0.2–0.3 cm.
d Wall fragment. Bluish-green. Numerous bubbles. Mould-blown vertical corrugations. Funnel beaker. Extant diameter *c.* 4.5 cm; thickness 0.13 cm.
e Wall fragment. Pale bluish-green tinge. Numerous bubbles. Traces of mould-blown vertical corrugations. Might be part of a beaker. Thickness 0.15 cm.
f Wall fragment. Bluish-green tinge. Streaks and numerous bubbles. Possibly funnel beaker. Thickness 0.15–0.25 cm.
g–h Two wall fragments. Bluish-green tinge. Numerous bubbles. Thickness 0.1 cm.
i–j Two wall fragments. Slightly greenish tinge. Thickness 0.09 cm.

IV/29 453.2.10 Two fragments, both funnel beakers .
a Fragment of rim and side. Bluish-green tinge; dulling. Numerous bubbles. Rim rounded and inverted. Funnel beaker. Diameter uncertain; thickness 0.12 cm (fig. 223: 21).
b Wall fragment. Pale bluish-green tinge; iridescence. Numerous bubbles. Funnel beaker. Extant diameter *c.* 3.5 cm; thickness 0.12 cm.

IV/30 453.3.0 Fragment of rim and side. Pale greenish tinge; some iridescence. Numerous bubbles. Rounded rim. Straight-sided funnel beaker. Diameter of rim *c.* 9 cm; thickness 0.07 cm (fig. 223: 11).

IV/31 453.3.14 Fragmentary mosaic tessera. Cobalt-blue; some iridescence.

IV/32 453.4.11 Fragment of rim and side. Bluish-green tinge. Numerous bubbles. Inverted cavity-rim, splayed. Deep palm cup. Diameter of rim *c.* 10 cm; thickness 0.1 cm (fig. 222: 6).

IV/33 453.5.1 Wall fragment, consisting of two parts fused together on top of one of them, the way applied rims were made. Basic colour a very slight greenish tinge, one part has a pale blue streak near the 'seam'. Mould-blown vertical corrugations continuing without a break in both parts. Numerous bubbles. Probably funnel beaker. Extant diameter *c.* 6 cm; thickness 0.1–0.15 cm (fig. 224: 5).

IV/34 454.3.3 Fragment of rim and side. Bluish-green; some iridescence. Numerous bubbles. Rim rounded and inverted. Funnel beaker. Diameter of rim *c.* 9 cm; thickness 0.09 cm.

IV/35 454.3.5 Fragment of lower side. Bluish-green. Streaks and numerous bubbles. Funnel beaker. Extant diameter *c.* 2.5–3 cm; thickness 0.2 cm.

IV/36 454.3.7 Rim fragment. Bluish-green. Inverted rim. Probably funnel beaker or deep palm cup. Diameter *c.* 9 cm.

IV/37 454.1.0 Base fragment of a wine-bottle. Olive-green. Metallic layer of weathering and iridescence.
17th–18th century.

6 Worked bone

The Hoogstraat II excavation yielded two fragments of bone combs. Both specimens are made from two connecting plates which held a plate with teeth. The connecting plates are straight at the bottom and slightly curved at the top (fig. 230). There is a grooved decoration along the edges of the connecting plate, ending in a point on either side. Within these grooved lines there are horizontal rows of dot-circle decoration. On the connecting plates of one specimen oblique rows of dot-circle decoration are visible, sometimes accompanied by two grooves on either side. This type of comb was made at any rate from the end of the 8th century until into the 9th century. Evidence is known from the North Netherlands which points to production from the beginning of the 8th century.[403]

403 cf. Roes 1965, pl. 18: 4; Knol 1993, 83.

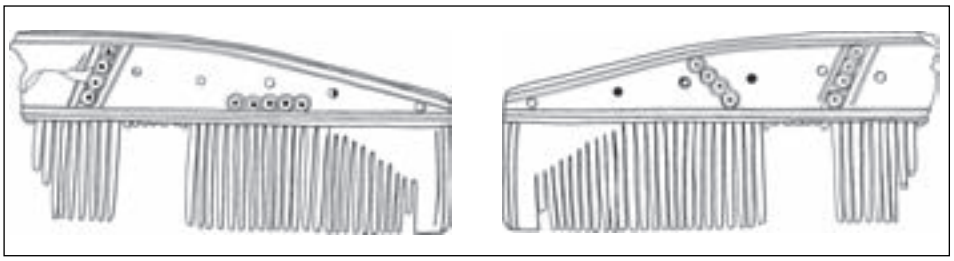


Fig. 230 Dorestad, Hoogstraat II: bone comb; scale 1:2.

VII The chronology of the riverbed area

1 Introduction

The starting-point in this chapter is the chronology that was worked out in 1980 for the Hoogstraat-I excavation.[404] The main conclusion at that time was that the complex of structures in the riverbed developed between *c.* 675 and 825 AD. After 800/825 AD little or no building work was done on the dams, and economic decline set in, which resulted in Dorestad ceasing to exist as an international trading port in the second half of the 9th century. No traces of habitation dating from before the end of the 7th century were found. However, the possibility that the Hoogstraat-I site was re-used to some extent during the 10th or 11th centuries was taken into consideration, although this re-occupation did not appear to have been very intensive. The time-span of approximately one-and-a-half centuries, during which building activities in the riverbed took place, has in Hoogstraat I been divided into two periods which succeeded each other without interruption around the first quarter of the 8th century (700/725).
The widely differing scale of the Hoogstraat excavations makes it difficult for them to be compared. It is particularly difficult to establish to what degree the division in the complex of dams also occurred outside Hoogstraat I. The difference between periods 1 and 2 in Hoogstraat I was based on differences in the way the dams were built. About 60–70 m from the original bank (roughly at the division between squares 9 and 10) something appeared to change: the dams appeared to be more regularly built. The posts – referred to in the Hoogstraat I book as 'inner posts' – attracted particular attention because they were set in regular rows which continued for quite some distance. These inner posts were assumed to have served as supports for the platform covering the dams. Consequently we imagined that the dams from period 2 were originally extended by large sections at a time. On the basis of similar differences in the plan of the dams, period 1 was subdivided into two (1A and B) and period 2 into three sub-phases (2A–C).
In our present approach, we lay the emphasis on the end revetments far more than on the side revetments, which was formerly the case. Moreover, there is a tendency to interpret every row of inner posts as an end revetment (see chapter III), which would blur the difference between periods 1 and 2. Incidentally, the difference was not always clearly visible in Hoogstraat I either. At the southern edge of this excavation area there appeared to be an unusual degree of continuity, also in building method, especially in dam HS-I 10, and to a lesser extent in HS-I 8 and 9. On the basis of the information on these dams alone, one would not immediately think of a division, but we consider this to be justified in the rest of Hoogstraat I. The division between both periods later appeared to coincide with a re-allotment of parcels HS-I 1B7 (see chapter V, fig. 78). From the Hoogstraat-I data it is not clear whether the division was applicable to the entire excavation area, or whether it was a local, not a general, phenomenon.
This hypothesis could no longer be verified in Hoogstraat III. The zone in which one would assume the beginning of the features from period 2 to be located, if in fact they did begin at about the same distance from the bank as in Hoogstraat I, was almost completely eroded. The remaining part, however, did suggest a strong similarity to the

404 *Van Es & Verwers 1980, 303.*

picture revealed by the period 1 zone in Hoogstraat I: relatively regularly built dams at the beginning against the bank, followed by a zone in which the dam plans became obscure (see especially fig. 17, the basic plan of Hoogstraat III, 1:400).
In the general plan of Hoogstraat II, the transition from period 1 to period 2 is similar to that of Hoogstraat I. However, it is situated slightly closer to the bank, at about 50 m from it, roughly on the dividing line between squares 7 and 8 (fig. 16, basic plan of Hoogstraat II, 1:400). The division was not always clear in Hoogstraat II either. It was mainly observable on the south, *i.e.* on the Hoogstraat-I side, which was separated from Hoogstraat II by an unexcavated zone of not much more than 100 m. In the two or three northern dams, HS-II 2–4, the continuity in method of building outweighed the differences. The zone belonging to period 1 basically corresponds to that of Hoogstraat I, apart from the fact that there were fewer posts, particularly at the beginning against the bank. Hoogstraat II was characterized, as was Hoogstraat I, by a rather 'vague' zone at the transition between the areas belonging to periods 1 and 2 (in squares 7 and 8), but the dams in the period 1 area were often clearly recognizable despite the relatively few revetment posts because the lighter cores of the dams stood out against the polluted (dark) spaces in between them (see chapter V, fig. 74). This fine picture was possibly the result of more careful excavation: during the Hoogstraat II investigation the experiences gained from Hoogstraat I were at our disposal. Probably, though, the features were better preserved than in Hoogstraat II, because, unlike Hoogstraat I (and III) they had suffered less from later activities. A very striking difference between Hoogstraat I and II was that only a small part of the area belonging to period 2 in the latter excavation proved to have been built up. There was, in fact, only one dam, HS-II 9, on the south side which had been extended over the entire length (in other words as far as the dams in Hoogstraat I). Elsewhere in Hoogstraat II the 'multi-post' dam construction came to a halt only a short distance from the division between the areas belonging to periods 1 and 2. Dams HS-II 2–7 did not extend any further than some 100 m from the bank, hardly more than half the total length of the dams in Hoogstraat I. The parcellation remained visible up to *c.* 180 m from the bank. Here and there, especially on the south side, rows of posts still continued (almost) to the end of the dam plans, but the number of wooden posts was substantially less than in the area belonging to periods 2B and C in Hoogstraat I.
The Hoogstraat IV excavation was too narrow to be judged adequately, but it gave the impression that the situation was very similar to that of the northern part of Hoogstraat II. The multi-post extension of the dams was no more than 80–90 m here too. The only dam to be completely excavated, HS-IV 4, could be compared in all respects with, for example, dam HS-II 2; the distance between the two was almost 150 m.
In Hoogstraat 0 only a small section of the zone immediately in front of the bank was excavated. As usual, the dams here were often sturdily constructed. How far the dams extended is unknown: but at least 40 m. Changes in direction of the dams may also have made re-allotment here necessary. However, as long as we have no information as to how far the dams extended into the riverbed, it remains questionable whether this was ever the case.

The above leads to the conclusion that the dams were not extended equally far everywhere, at least, not in the same way. In Hoogstraat I they remained plentifully equipped with posts over the entire length of almost 200 m, and were generally sturdily constructed. This was probably also the case in a strip 100 m or slightly more in length, between Hoogstraat I and II. North of the southernmost dam in Hoogstraat II the picture changed: 80–100 m from the bank the abundant use of posts stopped. Further east, the parcellation was apparently retained, but considerably less wood was used in the development of the parcels. In Hoogstraat IV we encountered the same situation and this probably did not change further

northward in Hoogstraat 0. Due to the incomplete picture in Hoogstraat III, it was no longer possible to trace the development of the complex of riverbed structures in this area.
The period 2 area therefore was not built up in the same way throughout the riverbed area. Nevertheless, the division between periods 1 and 2 appears to be a more or less common phenomenon. The dividing line between both periods could not be observed in Hoogstraat 0 due to the small scale of the excavation, but elsewhere it was more or less clearly recognizable: it was clear in Hoogstraat I and II, and with a little good will in Hoogstraat IV too (at *c.* 40 m from the bank, on the line between squares 8 and 9). In Hoogstraat III it was just perceptible in the northeast (though indistinctly) at a point *c.* 50 m from the bank (roughly on the dividing line between squares 9 and 10) where the beginning of a zone with – apparently – a larger quantity of posts was situated. Everywhere a situation was observed which was related to period 1, with dams clearly recognizable over a length of 30 m, after which they became faint. Period 2 started a little further on, with structures which were characterized by a greater use of wood. The vague zone (period 1B, from Hoogstraat I) appeared in Hoogstraat I to be *c.* 20 m wider than elsewhere, but it was difficult to draw the line, especially in Hoogstraat I, where we have to take into account the intensive re-use of the period 1 area.

2 ^{14}C-dating

2.1 Introduction

A total of 61 ^{14}C-dates are available for the riverbed area, 24 of which are from the Hoogstraat-I excavation. The last of these have already been published,[405] but are again taken into consideration here since they have now been calibrated in a somewhat different way. This method of calibration has been published by Stuiver and Van der Plicht.[406]
The administrative data from the ^{14}C-dates are shown in table 34. Figure 231 shows the time-spans covered after calibration. In general, the dates are not very accurate. Even with a 1σ deviation, most of them span a period of approximately one century, though often with interruptions. With 2σ deviation (about 95 % probability) the periods generally become considerably longer. Short dates are by far the minority, and belong to the earliest: for instance 37, 52, 55, 58 and 68, which, with 1σ deviation, have a precision of about 20 years.

The samples for analysis were, with one exception, taken from thin stakes with no more than *c.* 50 rings. The one exception is date 6, which is from wattle remains from the old revetment in Hoogstraat II. With the thin wattle twigs one does not have to allow for missing tree-rings. In the case of stakes, one does: the last 10 to 15 rings will have been lost with the soft sapwood. This was the main reason for correcting the dates from Hoogstraat I in 1980 by 15–25 years. This correction has not been included here in figure 231, though it was taken into account during the interpretation of the dates. The samples were taken in pairs, as far as possible, *i.e.* in every case they were taken from two posts close together. The expectation that the two dates from a pair of samples would prove more or less the same – neighbouring posts were probably placed at about the same time, unless repairs had been carried out – was almost always met. That some pairs differ as much as, for example, 55 and 56, 63 and 64, or

405 Mook & Casparie 1980, 262–92.
406 R.H. van Heeringen (ROB) has calibrated the old 14C-figures for us according to the new 14C-curve: Stuiver & Van der Plicht 1998.

Fig. 231 Dorestad, Hoogstraat 0-IV: C14 dates after calibration. Legend: black (1σ) ca 67 % probability; white (2σ) ca 95 % probability. >>

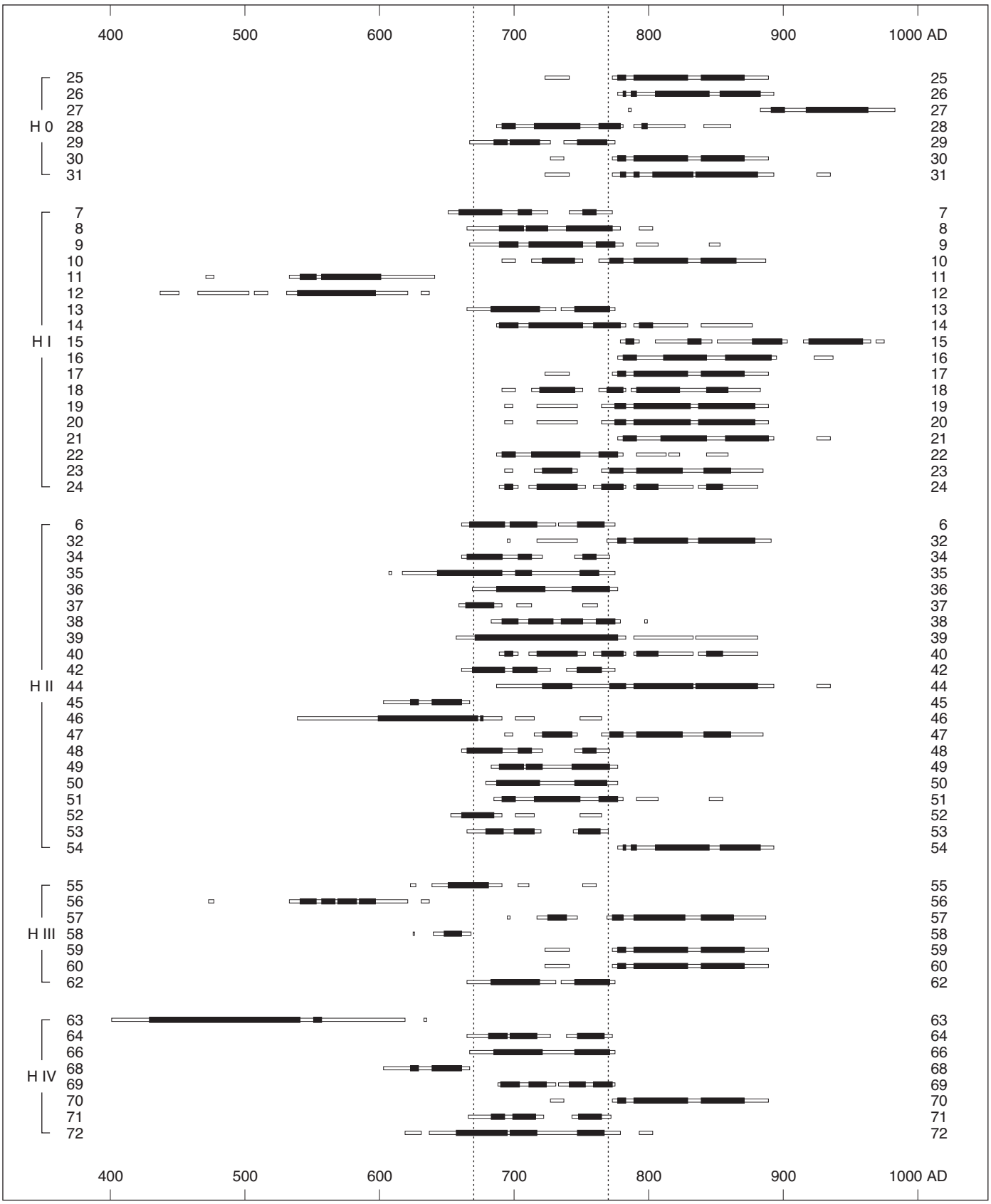

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TABLE 34 Dorestad, Hoogstraat 0–IV
^{14}C dates, adminstrative data.

			conventional ^{14}C age		calibrated ^{14}C age	
Specimen no.	GrN	finds no.	in years BP	in years AD	1 σ	2 σ
7	7727	366.4.82	1330 ± 35	620 ± 35	659-691 703-713 751-761	651-725 741-773
8	7728	366.4.102	1275 ± 30	675 ± 30	689-707 709-725 739-773	665-779 793-803
9	7729	354.8.4	1270 ± 30	680 ± 30	689-703 711-751 761-775	667-781 791-807 845-853
10	7730	354.8.10	1230 ± 30	720 ± 30	721-745 771-781 789-829 839-865	691-701 713-751 763-887
11	7731	365.2.14	1495 ± 30	455 ± 30	541-553 557-601	471-477 533-641
12	7732	365.2.16	1510 ± 30	440 ± 30	539-597	437-451 465-503 507-517 531-621 631-637
13	7733	361.6.13	1295 ± 30	655 ± 30	683-719 745-771	665-731 735-775
14	7734	361.6.22	1250 ± 30	700 ± 30	689-703 711-751 759-779 793-803	687-783 789-829 839-877
15	7735	371.4.123	1155 ± 25	795 ± 25	783-789 829-839 877-899 919-959	779-793 805-847 851-903 915-965 969-975
16	7736	371.4.126	1180 ± 25	770 ± 25	781-791 811-843 857-891	777-895 923-937
17	8029	367.4.41	1215 ± 25	735 ± 25	777-783 789-829 839-871	723-741 773-889
18	8030	367.4.44	1235 ± 25	715 ± 25	719-745 769-781 791-823 843-859	691-701 713-751 763-783 787-883
19	8031	376.5.95	1220 ± 30	730 ± 30	775-783 789-831 837-879	693-699 717-747 765-889
20	8032	376.5.99	1220 ± 30	730 ± 30	775-783 789-831 837-879	693-699 717-747 765-889
21	8033	359.5.10	1185 ± 25	765 ± 25	781-791 809-843 857-889	777-893 925-935
22	8034	359.5.11	1255 ± 25	695 ± 25	691-701 713-749 763-777	687-781 791-813 815-823 843-859
23	8035	372.6.185	1230 ± 25	720 ± 25	721-743 771-781 791-825 841-861	693-699 715-747 765-885

TABLE 34 Dorestad, Hoogstraat 0–IV
^{14}C dates, adminstrative data (continued).

			conventional ^{14}C age		calibrated ^{14}C age	
Specimen no.	GrN	finds no.	in years BP	in years AD	1 σ	2 σ
24	8036	372.6.204	1240 ± 25	710 ± 25	693-699 717-747 765-781 791-807 843-855	689-703 711-753 759-783 789-833 837-881
25	8037	363.1.32	1215 ± 25	735 ± 25	777-783 789-829 839-871	723-741 773-889
26	8038	363.1.66	1195 ± 25	755 ± 25	781-783 787-791 805-845 853-883	777-893
27	8039	376.5.111	1130 ± 25	820 ± 25	891-901 917-963	785-787 883-983
28	8040	376.5.115	1250 ± 25	700 ± 25	691-701 715-749 763-779 795-799	687-781 789-827 841-861
29	8041	369.5.63	1295 ± 25	655 ± 25	685-695 697-719 747-769	667-727 737-775
30	8042	369.5.75	1210 ± 25	740 ± 25	777-783 789-829 839-871	727-737 773-889
31	10640	261.8.12008	1200 ± 30	750 ± 30	779-783 789-793 803-833 835-881	723-741 773-893 925-935
32	11069	261.8.12038	1215 ± 30	735 ± 30	777-783 789-829 837-879	695-697 717-747 769-891
34	10642	268.7.13338	1315 ± 25	635 ± 25	665-691 703-713 751-761	661-721 745-771
35	10643	268.7.13346	1350 ± 50	600 ± 50	643-691 701-713 749-763	607-609 617-775
36	11070	268.7.13531	1285 ± 30	665 ± 30	687-723 743-771	669-777
37	10644	268.7.13369	1330 ± 20	620 ± 20	664-685	659-691 702-713 751-762
38	11071	268.7.13520	1270 ± 25	680 ± 25	691-703 711-729 735-751 761-775	683-779 797-799
39	10753	380.5.48	1285 ± 55	665 ± 55	671-777	657-783 789-833 835-881
40	11072	380.5.18	1240 ± 25	710 ± 25	693-699 717-747 765-781 791-807 843-855	689-703 711-753 759-783 789-833 837-881
42	11073	380.5.24	1305 ± 30	645 ± 30	669-693 699-717 747-765	661-727 739-775

TABLE 34 Dorestad, Hoogstraat 0–IV
^{14}C dates, adminstrative data (continued).

			conventional ^{14}C age		calibrated ^{14}C age	
Specimen no.	GrN	finds no.	in years BP	in years AD	1 σ	2 σ
44	11074	380.5.44	1225 ± 45	725 ± 45	721-743 771-783 789-833 835-881	687-893 925-935
45	10647	382.5.21	1400 ± 30	550 ± 30	623-629 639-661	603-667
46	11075	382.5.22	1405 ± 55	545 ± 55	599-673 675-677	539-691 701-715 749-765
47	10648	383.4.52	1230 ± 25	720 ± 25	721-743 771-781 791-825 841-861	693-699 715-747 765-885
48	11076	383.4.53	1315 ± 25	635 ± 25	665-691 703-713 751-761	661-721 745-771
49	10649	385.6.255	1280 ± 25	670 ± 25	689-707 709-721 743-771	683-777
50	11077	385.6.251	1285 ± 25	665 ± 25	687-719 745-769	679-777
51	10650	387.4.5	1260 ± 25	690 ± 25	691-701 715-749 763-777	685-781 791-807 845-855
52	11078	387.4.8	1340 ± 25	610 ± 25	661-685	653-691 701-715 749-765
53	10651	394.6.10	1305 ± 20	645 ± 20	679-692 700-715 748-764	665-720 744-770
54	11079	394.6.17	1195 ± 25	755 ± 25	781-783 787-791 805-845 853-883	777-893
6	7447	?	1305 ± 35	645 ± 35	667-693 697-717 747-767	661-731 733-775
55	10652	403.5.53	1365 ± 30	585 ± 30	651-681	623-627 639-691 703-711 751-761
56	11080	403.5.54	1505 ± 25	445 ± 25	541-553 557-567 569-583 585-597	473-477 533-621 631-637
57	10653	405.6.20	1225 ± 25	725 ± 25	725-739 773-781 789-827 839-863	695-697 717-747 769-887
58	11081	405.6.21	1385 ± 20	565 ± 20	648-661	625-626 640-668
59	10654	405.6.118	1215 ± 25	735 ± 25	777-783 789-829 839-871	723-741 773-889

TABLE 34 Dorestad, Hoogstraat 0–IV
^{14}C dates, adminstrative data (continued).

			conventional ^{14}C age		calibrated ^{14}C age	
Specimen no.	GrN	finds no.	in years BP	in years AD	1 σ	2 σ
60	11082	405.6.119	1215 ± 25	735 ± 25	777-783 789-829 839-871	723-741 773-889
62	11083	405.6.316	1295 ± 30	655 ± 30	683-719 745-771	665-731 735-775
63	10656	448.6.15	1560 ± 55	390 ± 55	429-541 551-557	401-619 633-635
64	11084	448.6.26	1300 ± 25	650 ± 25	681-695 697-717 747-767	665-727 739-773
66	11085	449.5.306	1290 ± 30	660 ± 30	685-721 745-771	667-775
68	11086	449.5.356	1400 ± 30	550 ± 30	623-629 639-661	603-667
69	10659	450.5.33	1275 ± 20	675 ± 20	690-704 711-724 741-753 759-773	688-731 733-775
70	11087	450.5.29	1210 ± 25	740 ± 25	777-783 789-829 839-871	727-737 773-889
71	10660	450.5.44	1300 ± 20	650 ± 20	683-693 699-716 748-765	666-722 743-772
72	11088	450.5.45	1330 ± 50	620 ± 50	657-695 697-717 747-767	619-631 637-779 793-803

TABLE 34A Dorestad, Hoogstraat 0–IV
^{14}C-dates in groups per site, A *before* ca 670, B 660–> 800, B/C 675–800, C 675–780/800, D 690–900, E 690–780, F 720–900, G 780–> 900.

date	A	B	B/C	C	D	E	F	G	total
HS-I	2	4		1	9		3	5	24
HS-0		1	1	2	1	1	1		7
HS-II	1	1	2	3	4	3		1	15
HS-III	2	1		1	1		2		7
HS-IV	2	1		3		1	1		8
total	7	8	3	10	15	5	7	6	61

TABLE 34B Dorestad, Hoogstraat 0–IV
^{14}C-dates in clusters per site (see table 34A).

cluster	A	B, B/C, C, E	D, F, G
HS-I	2	5	17
HS-0		5	2
HS-II	1	9	5
HS-III	2	2	3
HS-IV	2	5	1
total	7	26	28

53 and 54, is exceptional, but it is just as exceptional when they are absolutely identical, such as pairs 19 and 20, and 49 and 50. In by far the most cases, dates from posts which are close together correspond well, and it is likely that together they represent the time-span in which they overlap each other.
In figure 232–6* the ^{14}C-dates have been shown on the plans. Their distribution over the riverbed structures largely meets the expectations. The early dates are usually from the front area of the original bank (A: legend 1 in figs. 232–6*), and the

youngest figures from after 780/800, with the sole exception (21), come from the final section of the complex (G: legend 8 in figs. 232–6*). It is remarkable that these 'legend 8' dates are almost all from Hoogstraat I and only one is from elsewhere, in this case from Hoogstraat II. Over a third of the other dates is between *c.* 650 and 800 (legend 3–5 in figs. 232–6*). In Hoogstraat I the samples with these dates were located between the old posts at the front, and between the young posts at the back of the complex. There was no such tendency in Hoogstraat III; in Hoogstraat 0 they were encountered at the beginning. In Hoogstraat IV dates from this group occurred almost exclusively. In Hoogstraat II posts with this date (approximately one-third of the total) were found only in the south. A second large group of dates, also about a third, are between *c.* 690/720 and 900 (legend 6–7 in figs. 232–6*). Most of them come from almost the entire excavation, except for the oldest – the foremost – section. In Hoogstraat IV only one post with this date was found.
In the following, the ^{14}C-dates per excavation are subjected to a detailed analysis based on 2σ dates.

2.2 Hoogstraat I

The pair of dates 11 and 12 must originate from an early building phase of dam HS-I 5. In the 1980 calibration, their combined time-span extends from 460 to 570 AD. It was assumed that this was old material which had been re-used. This is indicated by the fact that the posts in question differed from the rest: they were radially split oak beams instead of the usual stakes. However, the gap between the ^{14}C-dates and the moment of re-use, estimated to be in the second half/last quarter of the 7th century, remained large. This gap has been almost completely filled as a result of the new calibration. The joint time-span of 11 and 12 now ends in *c.* 635 AD (2σ), to which another 25–35 years may be added to compensate for missing growth rings, among other things. This makes a felling-date of around 660/670 for the tree from which the posts were cut quite feasible. It implies that the posts were possibly used somewhere else for a maximum of one generation, before being put to new use in a dam towards the end of the 7th century. The primary use may have been in or near a farm on the De Geer site, in the immediate surroundings, where settlement traces from this period were discovered. Naturally, such an assumption is *possible* on the basis of these ^{14}C-dates, though it need not necessarily have been the case. The result of pair 11 and 12 would even permit a much earlier beginning of the building of dam HS-I 5: as early as the second half of the 5th century. A date (long) before the middle of the 7th century would, however, conflict with the remaining ^{14}C-dates from Hoogstraat I, none of which begins before *c.* 660 AD (the earliest is 7, with a starting-date of 651 with 2σ). Dates 21 and 22 came from samples which were also relatively near the front of the complex of wooden structures. Together, however, they certainly do not indicate an early stage of building, since their joint time-span does not begin until after 777 AD. Date 22 already begins at the end of the 7th century and thus theoretically fits in with an expected date of *c.* 700 AD. Date 21 would then have to represent a repair from the late 8th or 9th century.
Six ^{14}C-dated posts are roughly the same age from the point of view of horizontal stratigraphy (7 and 8, 9 and 10, 13 and 14). Their dates should roughly mark the beginning of period 2; their actual age may be within the time-span in which they all overlap: *c.* 690–775 AD. This corresponds, or at least does not conflict with an expected date in the second quarter or in the middle of the 8th century. Two posts (14 and 10) may refer to (much) younger repairs, since their dates continue until *c.* 880 AD. Four dates (17 and 18, 29 and 30) are younger with regard to horizontal stratigraphy than the previous six, though probably not much, in view of their proximity. In combination, three of the four (except for 29) overlap a time-span of *c.* 725–735 AD, which appears to be rather early. The date of 29 begins even earlier, at the end of the 7th century, and continues until 775. The overlap of the other three

dates lies between *c.* 775 and 785 AD. This latter time-span forms a *terminus ante quem* for the following group. The possibility cannot, incidentally, be excluded that date 29 refers to the re-use of an older post.
Six dates (15 and 16, 25 and 26, 27 and 28) mark the end of the complex. The beginning of four of these dates (15 and 16, 26 and 27) is in the last quarter of the 8th century; the end is shortly before 900 or (well) after. The two other dates are similar, although 28 does not continue after 861. The beginning of both dates is well before that of the other four: 687 and 723. The continuing time-span of both dates fits in well with those of the other four, which corresponds with an expected final date of the complex at the end of the 8th or beginning of the 9th century. The distance from the previous group in the complex is so short that a late-9th-century date for the end of the building activities becomes unlikely.
Four dates remain (19 and 20, 23 and 24) which are in between the last and the second last group, regarding horizontal stratigraphy. This is quite possible from the chronological aspect, too, given their overlap between *c.* 690 and 890 AD. However, these dates are so long that they are of no use in specifying an exact final date. A date for the end of the building activities of well into the 9th century must also be considered improbable here.

All in all, the 24 ^{14}C-dates from Hoogstraat I could be tied in well with the chronological diagram drawn up in 1980, even after the new calibration. Only in the case of a few posts was it necessary to assume that they had been secondarily used.

2.3 Hoogstraat II
The starting-point is date 6, which refers to the old revetment because it represents a point in time which pre-dates the construction of the dams. Whether this date marks the beginning of all the activities in this part of the riverbank area is uncertain, but it is stratigraphically older than all traces of activity in the riverbed. The construction of the old revetment cannot have taken place earlier than 661 AD. Two dates (42 and 46) from the beginning of dams HS-II 2 and 7 slightly overlap the old revetment in the time-span 660–690 AD. This suggests that the construction of the revetment and the beginning of the dam-building took place in quick succession. The construction of the revetment may have taken place not long after the middle of the 7th century, and dam-building may have started in the last quarter of that century. Date 45, which begins shortly after 600 and ends after the middle of the 7th century, possibly points to the secondary use of an old post.
Three dates (39, 40, and 44), which are close together and also to 42, do not conflict with this. Although the beginning of 39 is shortly after the middle of the 7th century, making it the earliest of the three, they overlap each other in the long time-span between *c.* 690 and 880 AD, and could consequently date from the end of the 7th or beginning of the 8th century. Theoretically, these samples may also have come from later repairs, but there is no evidence for this.
Six dates (47 and 48, 49 and 50, 51 and 52) refer to the beginning, or to an early stage of period 2. Pair 49 and 50, has a joint time-span between *c.* 680 and 775. Pairs 47-48 and 51-52 overlap in about 690–695 and 710–720. Two of these dates, (48 and 52) show an interruption between *c.* 720 and 750 AD. Subsequently, there is an overlap for each pair between 765 and 771, and between 749 and 765 AD, respectively. Because a *c.* 700 date appears too early, given the distance from the previous group, the beginning of the building activities in this phase is most probably after the middle of the 8th century. The date of sample 47, continuing well into the 9th century, may indicate a repair.
Finally, two dates (53 and 54) mark the end of the development in its mature form, which was only observable in the southernmost dams. Their overlap is very short: from *c.* 780–795 AD (with an addition in the case of 53, which with 2σ deviation ends

in 770 AD). Without the addition, the possibility of re-use must be taken into account. Another theoretical possibility is that date 54 refers to a repair, although this is unlikely because of the distance from the previous group.
A final date for the complex of Hoogstraat II of *c.* 800 AD, corresponds to the date found for Hoogstraat I. The extension appears to have been halted earlier than this in most of the dams in Hoogstraat II (2 to 6), namely in the second half of the 8th century.

2.4 Hoogstraat III

Dates 55 and 56 appear to form a pair. It is conceivable that the samples in question may have come from a relatively late stage in the development of period 1. Based on this assumption, if one compares them with the results obtained for Hoogstraat I and II, one would expect their date to be at the beginning or in the first half of the 8th century. Only date 55 meets this expectation: with 2σ deviation it ends in 761 AD. Date 56 is rather earlier than expected: there is hardly any overlap with 55, from *c.* 620 to 635 AD. The possibility that old wood was re-used here may have to be considered.
The three dates 59 and 60 and 62 are not much further away in the complex and should not therefore be much younger than the previous two. They may, moreover, mark the beginning of period 2, leading one to expect a date in the first half of the 8th century. This expectation was not disappointed: the three dates roughly overlap a time-span from *c.* 720 to 740, then again between 770 and 795 AD (with an addition for 62, which with 2σ deviation ends in 775). A theoretical possibility is that these dates may indicate a difference in time with regard to the extension of the dams. The extension of the one dam may have taken place earlier than that of the other.
From the horizontal-stratigraphical aspect, dates 57 and 58 – which appear to form a pair – should not be much younger than the previous three. Only 57 is able to meet this condition, but it produces an extremely long time-span: *c.* 695–885 AD. As a pair, 57 and 58 are certainly not of use, for they only just overlap *c.* 690 AD (with an addition for 58), and such an early date is out of the question here. Date 58 is too early, so it may qualify for the 're-use of old wood hypothesis'.
Summing up, we may state that the ^{14}Cdates for Hoogstraat III cannot with certainty be attributed to a certain building phase of the complex of wooden structures; the samples of pair 57 and 58 even came from the erosion zone; two dates (56 and 58) are difficult to fit in; the re-use of old wood cannot be excluded.

2.5 Hoogstraat IV

Unfortunately, the two dates (63 and 64) which refer to the beginning of dam HS-IV 4 are not a usable pair, since date 63 – even after the addition of missing growth rings – does not overlap 64. The next two dates for the same dam (66 and 68) must be slightly younger on the basis of the horizontal stratigraphy, while they cannot differ much in age from 63 and 64. The overlap of 64 with 66 and 68 is at the end of the 7th century: *c.* 670–695 AD (with an addition for 68, which, with 2σ deviation, ends in 667 AD). This suggests that the beginning of the construction of the dam was possibly in the last quarter of the 7th century. Date 63, which is too early, could be explained by the use of old wood. An interesting fact in this respect is that this date comes from an oak sapling that grew remarkably slowly and regularly, and, for this reason, possibly came from beyond the immediate vicinity. If it was used in the dam not too long after the middle of the 7th century, *c.* 50 growth rings would be missing – possibly the 'import' was delayed because the stake had first been used elsewhere. If there is no addition to date 68, this may well point to secondary usage. Another possibility is that the actual age of date 68 was outside 2σ deviation. If one accepts that the actual age of 66 and 68 lay within the time-span 670–695 AD, the dam must already have been some 25 m long at the end of the 7th century.
Further still in the same dam, the paired dates 69 and 70 possibly indicate the approximate beginning of period 2, while again their age cannot differ very much

from that of 66 and 68. They hardly overlap at all: a few years in the second quarter of the 8th century and then more between *c.* 770 and 800 AD (with an addition in the case of 69, which, with 2σ deviation ends in 775 AD). The first period is fully in keeping with the expectations, and also links up well with the previous dates. The second period is undoubtedly too young for this location. If there is no addition to date 69 and the young date 70 is accepted, the latter could only refer to a repair.
The pair of dates 71 and 72 roughly indicates the end of the dam-building in Hoogstraat IV. Unfortunately, they do not provide an exact date, since they too cover a long joint time-span: from *c.* 665–770 AD. A date for the end of the Hoogstraat-IV complex in about the middle of the 8th century is, in combination with the previous dates and in comparison with, for example, those of Hoogstraat II (47-48, 49-50 and 51-52), very likely.
In the above interpretation, it is only probable in the case of one date (63) that the actual age is outside a 2σ deviation.

2.6 Hoogstraat 0

The paired dates 34 and 37 appear to mark the beginning of dam HS-0 4, though this is not absolutely certain. They roughly overlap a time-span from *c.* 660 to 760 AD, with the emphasis on the second half of the 7th century and the beginning and middle of the 8th century.
The three samples from the riverbank area which produced dates 35, 36 and 38 appear to be linked with the side revetments of a through road, which – we assume – ran along the bank through a hollow at this spot (the gap in the bank). The ^{14}C-dates cannot tell us when this road was built, since the revetments were probably not installed in a short space of time. They will have been repeatedly replaced. The road was probably used in the period in which the three dates overlap: *c.* 680–775 AD (on the basis of 35 alone, almost the entire 7th and 8th centuries would be eligible).
Dates 31 and 32 are so close together that they may be considered a pair. Their starting date is later than that of the other Hoogstraat 0 dates: at the end of the 7th century. These dates probably mark an early stage in the development of dam HS-0 2, at the beginning of phase 2. An expected date in the first half of the 8th century would then be a possibility. The time-spans, however, are extremely long and also cover the rest of the 8th and the whole of the 9th century, so one might consider the possibility of later repairs.

2.7 Conclusion

The ^{14}C-data do not conflict with the existing chronology of the complex of riverbed structures: the beginning in the second half (last quarter) of the 7th century; a new start at the beginning of period 2 in the first half (second quarter) of the 8th century; the end around or not long after 800 AD.
The ^{14}C-dates refer to the construction of the dams. Whether the use of the riverbed continued for a long time after *c.* 800 AD, cannot be unequivocally established from the data available. It is conceivable that building was halted at a certain point in time and that the use of the complex continued.
A similar problem was also observed at the beginning near the riverbank. There is only a single date (6, from the old revetment in Hoogstraat II) which provides a *terminus post quem* for the construction of the dams. Construction cannot have begun before 660 AD. Theoretically, however, activities may well have taken place in the riverbank area – not in the riverbed – at an earlier stage, without any wooden remains from them being preserved, and therefore no ^{14}C-dates. Whether this was, in fact, the case will have to be shown by the finds.
The 61 ^{14}C-dates for the riverbed area are a coherent whole. Apart from some early dates, by far the most show an overlap between 660/680 and 780 AD. This was apparently the period in which the complex of wooden structures was realized. On the distribution maps, these are groups B, C, D, E and F. Of the total number of ^{14}C-dates,

almost half end before 800. A third of the dates begin after 690 and continue until *c.* 900 or slightly later. As far as Hoogstraat I is concerned, this group predominates. The reverse is the case in the Hoogstraat 0, II and IV excavations. Finally, group G, dating after 780 and covering at least the 9th century, was found, almost exclusively in Hoogstraat I. A possible explanation for this conclusion is that the building of the complex in Hoogstraat I took longer than in the three other complexes. An exception may be the southern half of Hoogstraat II, where late dates also came from the end of the complex. Conversely, there are only few dates from the beginning of the complex (11, 12, 45, 56, 58, 63, and 68), which end before 660/680 AD. Most of these – with a little effort – can be fitted in with the help of an addition for the missing growth rings. It is remarkable that two of the three dates which appear completely 'out of place' (56, 63; the third is 27), belong to the early group. It looks as if the early dates are systematically on the early side or are simply *too* early, which can perhaps be explained by the use of old wood. For that matter, two or three dates whose actual age must be assumed to lie outside a 2σ deviation, out of a total of 61 is still below the statistical expectation. On the other hand, there are also dates which differ only slightly from the age expected. The posts which are too young may indicate repairs.

3 The finds

3.1 Introduction

From the numerical point of view, pottery sherds are by far the most important element of the finds complex. They are also the most practicable for chronological purposes. The number of metal finds with a dating value, including coins, is limited. The glass artefacts, mainly sherds of glassware, play a supplementary role.
The numbers of pottery sherds vary considerably per excavation, not only in absolute numbers, but also in proportion to the size of the areas excavated (table 35). From the Hoogstraat I excavation the average per 1000 m^2 is remarkably low, but from Hoogstraat III it is five times as high. If one ignores the sherds from the late-medieval phase of occupation, which was only well-represented there, it still amounts to four times as high. This can partly be explained by the differences in intensity with which the finds were collected during the excavation. It is conceivable that this is the reason for the small number of sherds from Hoogstraat I and the relatively few sherds from Hoogstraat 0. After all, Hoogstraat I and 0 were the first excavations in the riverbed area, and inexperience was perhaps a factor here. On the other hand, the average number of sherds from the whole of Hoogstraat 0 (*i.e.* riverbank area *and* riverbed) is very large. Irregular collecting will certainly have played a part, but to what extent can, unfortunately, no longer be established. At any rate, it does not appear to be the only cause of the differences observed.
The very large number of sherds from Hoogstraat III can perhaps (partly) be explained by the fact that erosion of the riverbed structures took place at this spot. Possibly during this erosion, pottery sherds which were originally spread over a larger area were swept together. The number of sherds from Hoogstraat 0, which was also relatively large, may be due to the fact that only the beginning of the zone containing wooden structures, situated in the riverbed, was excavated here. This area was usually rich in finds, as was the case, for example, in Hoogstraat IV and II. The average numbers per 1000 m^2 for Hoogstraat IV and II are lower, because hardly any finds, or relatively very few, were found on the east side of these areas. If the total number of sherds from Hoogstraat I were combined in the zone comparable to the western areas of Hoogstraat II and IV, where the finds were mainly found, the average for Hoogstraat I (2037 per 1000 m^2) would be between that of Hoogstraat II and IV. During the Hoogstraat I excavation there appeared to be differences in the quantities of finds yielded by the separate parcels within the same excavation. In narrower excavation sites, such as Hoogstraat II and

excavation	HS-0	HS-I	HS-II	HS-III	HS-IV
Area in m²	*c.* 4000	*c.* 20 850	*c.* 12 200	*c.* 5260	*c.* 5260
no. of sherds (without LME)	10 436	21 623	27 156	27 235 (21 672)	9333
average no. sherds per 1000 m²	2609	1036	2226	5177 (4120)	1774
no. of sherds in pits	719				1921
average no. sherds per pit	10.4				40.0

TABLE 35 Dorestad, Hoogstraat 0–IV
Numbers of sherds per excavation.

especially IV, such differences can hardly be traced, though the density of finds per excavation may well be influenced by them.
All in all, it is reasonable to assume that the differences in the density of finds observed were influenced by various factors. Precisely for this reason it is impossible to establish for certain to what extent these differences are the result of the excavation or whether they reflect the Carolingian situation. A direct link between the density of finds and the intensity of the activities in the Dorestad period cannot, unfortunately, be made.
The starting-point in the following sections is the typological classification and the chronology drawn up for the pottery from Hoogstraat I.[407] The pottery types from Hoogstraat I are divided into two series, one of which is wheel-thrown and the other handmade. The wheel-thrown series is referred to as 'W' (wheel-thrown pottery) and, in the case of Hoogstraat I, has been divided into thirteen main types, which have been further subdivided on the basis of the rim profiles: W I, I/II, II–XII; W XIII refers to the group 'miscellaneous'. After the analysis of the other Dorestad excavations, the 'type' W XIV, with Merovingian and Walsum pottery, was added. This series of fifteen main types is used in this book. No changes have been made to the series of handmade types since the publication of Hoogstraat I. This series consists, as before, of the five main types 'H' (handmade pottery) I–V, with a 'miscellaneous' group included under H VI.
From the investigation in Hoogstraat I it appeared that the Late-Merovingian and Carolingian pottery-types found there could be divided into two groups: early and late. The early group includes: W V–VII, IX, X, and now also XIV, as well as H III. The late group comprises: W I, I/II, II–IV, VIII and H I, II, and IV (a few types such as W XI and W XII are very rarely found and have therefore not been included). Flat bases are characteristic of the early group; lenticular bases mainly belong to the late group, though not exclusively.
The Hoogstraat-I excavation had already made it clear that a simple division into two groups would be too schematic. The distribution of the various pottery types over the excavation area suggested more differentiated dates, and a subdivision for both groups was advisable.
There are genuinely early types and there are types which appear somewhat later in the early period. Similarly, types occur which can be placed at the beginning of the late group, and others which can be placed later in the late period. Table 36 reflects our views on the dating of the Late-Merovingian and Carolingian pottery-types from Dorestad, but here too, the picture is probably still too schematic. Clearly, the table can be no more than an indication, especially as far as the absolute dates are concerned.
In the following section, the composition of the pottery complexes from the Hoogstraat excavations will first be discussed. Starting from the pottery from the pits which were located on the riverbank in Hoogstraat 0 and IV, we have attempted to interpret chronologically the differences in the composition of the complexes. Subsequently, the distribution of the pottery types which are of chronological value is dealt with. In addition, the distribution of several other dating finds in the area excavated is examined. This exhausts the arsenal of dating possibilities so that finally we can take stock.

407 Van Es & Verwers 1980, chapters 6, 7 and 11.

TABLE 36 Dorestad, Hoogstraat 0–IV
Dates of the Late-Merovingian and Carolingian pottery types.

period	pottery type W	pottery type H	date
early (early)	W V W VI W IX W X W XIV flat bs	H III	AD 650/675
early (late)	W IID? W IIIC/D W V W VII flat bs		725
late (early)	W I W II (C) W IIIA/B W IV convex bs	H I-1 H II H IV	750/775
late (late)	W I W II (A/B) W I/II W IV W VIII ws roulette convex bs	H I-2	800

3.2 The pottery from the pits in the riverbank areas of Hoogstraat 0 and IV

Only in the riverbank areas of Hoogstraat 0 and IV were sufficient pits excavated to be taken into consideration. Their function has already been discussed in chapter V 4.2, and the issue here is their dating with the help of the pottery. Table 37 gives a survey of the pottery from the pits, and also links up the composition of the pottery complex of Hoogstraat I in terms of percentage, and the contents of the pits. It is evident that there is a systematic difference between the two. The early types are over-represented both in Hoogstraat 0 and IV in comparison to those of Hoogstraat I, and in most cases, are even seriously over-represented (indicated by + and ++ respectively). The only, and inexplicable anomaly in this respect is the absence of type W VI in both pit complexes.[408] The situation concerning W XIV is not altogether clear. This type had not yet been determined when identifying the finds from Hoogstraat I (perhaps it was not always considered during the identification of the sherds from the pits). On the other hand, the late types from the pits are clearly under-represented. The well-represented type W III, which in its entirety is not particularly early- or late-dated, had a kind of midway position in the pits: it was over-represented, but not extremely so in Hoogstraat 0, and it was slightly under-represented in Hoogstraat IV. We regard the relatively very few sherds of Post-Carolingian pottery as intrusions in pits which functioned in the Dorestad period. These pits were connected with habitation. They occurred on the house sites and marked on the riverbank the beginning of the parcels in the riverbed. The pits have been divided into two groups: an early and a late group, with early and (also) late pottery-types, respectively. There was no question of a clear spatial segregation: both groups were found at both locations, at the houses and along the bank. In Hoogstraat 0 the later pits on the southern house sites seem to withdraw from the bank and only occurred at the west ends of the house sites. In Hoogstraat IV the pits which also contained late finds were in the minority.

The date of the pits cannot perhaps simply be equated with the duration of occupation, or, more generally, with that of the activities in the riverbank areas of Hoogstraat 0 and IV. It is theoretically possible that pits ceased to be dug while occupation was

408 The absence of this numerically poor type must be due to chance. It is represented by (a few) wall- and base-sherds.

excavation		HS-O		HS-IV		HS-I		relation to HS-I	
pottery types		N	%	N	%	N	%	HS-0	HS-IV
rim sherds	W I	1	0.9	4	1.6	97	3.6	--	--
	II	18	15.8	22	8.7	695	26.1	--	--
	I/II	-	-	1	0.4	42	1.6	--	--
	III	55	48.2	81	32.1	933	35.1	+	±
	IV	3	2.6	1	0.4	94	3.5	-	--
	V	10	8.8	33	13.1	64	2.4	++	++
	VI	-	-	-	-	31	1.2	--	--
	VII	2	1.6	2	0.8	11	0.4	++	++
	VIII	-	-	2	0.8	24	0.9	--	±
	IX	9	7.9	30	11.9	34	1.3	++	++
	X	6	5.3	16	6.3	26	1.0	++	++
	XII	-	-	2	0.8	7	0.3	--	++
	XIII	6	5.3	4	1.6	30*	1.1	++	±
	XIV	?		9	3.6	-		?	++
	H I	4	3.5	40	15.9	475**	17.9	--	±
	II&III	-	-	5	2.0	96	3.6	--	--
Total		114	100	252	100	2659	100		
ws and bs W I		8	1.4	19	1.3	458	2.5	--	--
W I/II		1	0.2	2	0.1	67	0.4	--	--
roulette		56	9.5	83	5.7	2700	14.8	-	--
other decoration		3	0.5	8	0.5	268	1.4	--	--
undecorated sherds		388	65.7	980	66.8	11081	60.8	±	±
base sherds flat		26	4.4	63	4.3	168	0.9	++	++
base sherds convex		52	8.8	116	7.9	1350	7.4	±	±
wall sherds H		57	9.6	197	13.4	2144	11.8	-	±
Total		591	100	1468	100	18236	100		
rs, ws, bs LME		4		25					

* including W XI, ** including H IV, H V and H VI.

TABLE 37 Dorestad, Hoogstraat 0–IV
Pottery in the pits of the riverbank area compared with Hoogstraat I, numbers and percentages.
Legend:
-- few;
- less;
± average;
+ more;
++ many;
? unknown.

continued. Another possibility is that, before or after the period in which there were houses here, activities took place which did not require pits nor permanent buildings. However, these possibilities are probably not very realistic, since the tendency which emerged from the sherds found in the pits was also observed in a wider context. This can be seen in tables 38–40, which are discussed in the next section.

3.3 Comparison of the pottery complexes from the Hoogstraat excavations

The pottery complexes of Hoogstraat 0 and IV differ from those of Hoogstraat I in the same way as the pottery from the pits in the riverbank area. In table 38 one finds roughly the same over-representation of early types and under-representation of late types in Hoogstraat 0 and IV as in the pits. This is particularly clear in table 39, which gives a summary of table 38. One gets the impression on several points that the picture formed by the contents of the pits is even clearer than that of the total complexes of Hoogstraat 0 and IV, for example, in the case of type W I and of W V, IX and X. It is questionable whether much importance should be attached to this fact, in view of the relatively small number of sherds from the pits. Occasionally something is noticed which is inconsistent with a markedly early character of the pits, for instance, the 'too high' percentages of W II and to a lesser extent – due to the small numbers – of W VII in the Hoogstraat-0 pits. Similar cases are the high percentages of H I and W VIII in the Hoogstraat IV pits. The lower percentages of W III in the pits, however, would fit, if one assumed that the pits reflected an earlier pottery spectrum than the complexes of Hoogstraat 0 and IV in their entirety. We do not consider this to be altogether convincing, but the differences observed could form an indication that the pits only reflect part, and probably only an early part of the activities in Hoogstraat 0 and IV.

excavation	HS-0	HS-0 pits	HS-IV	HS-IV pits	HS-II	HS-I	HS-III
rim sherds	N 1182	N 114	N 1423	N 252	N 4195	N 2659	N 2922
pottery types							
W I	2.6	0.9	2.9	1.6	3.6	3.6	2.1
W II	11.1	15.8	11.9	8.7	19.6	26.1	24.3
W I/II	0.4	-	0.3	0.4	0.3	1.6	0.7
W III	52.7	48.2	40.8	32.1	42.3	35.1	39.0
W IIIC	[2.7]		[3.0]		[1.0]	[0.8]	[2.7]
W IIID	[2.1]		[5.3]		[3.6]	[3.0]	[3.1]
W IV	2.0	2.6	2.3	0.4	2.7	3.5	2.4
W V	5.1	8.8	6.2	13.1	1.6	2.4	5.8
W VI	1.2	-	1.9	-	1.0	1.2	1.8
W VII	0.7	1.6	0.6	0.8	0.7	0.4	0.6
W VIII	0.2	-	0.4	0.8	0.9	0.9	1.5
W IX	4.0	7.9	6.0	11.9	0.9	1.3	3.0
W X	3.5	5.3	3.0	6.3	1.7	1.0	1.7
W XI	-	-	0.1	-	-	0.1	0.03
W XII	0.6	-	0.2	0.8	0.2	0.3	0.1
W XIII	1.1	5.3	1.6	1.6	0.4	} 1.0	0.6
W XIV	0.8	?	1.0	3.6	0.6	}	1.1
H I	12.4	3.5	17.4	15.9	21.8	17.9	13.6
H II	0.1	-	0.3	} 2.0	0.5	1.3	0.4
H III	0.8	-	1.4	}	1.0	1.6	0.9
H IV	0.1	-	0.1	-	0.1	0.4	0.1
H V	-	-	-	-	-	-	0.06
H VI	-	-	-	-	0.1	0.3	0.2
Total	100	100	100	100	100	100	100

TABLE 38 Dorestad, Hoogstraat 0–IV Composition in terms of percentages of the Late-Merovingian and Carolingian part of the pottery complexes.

excavation	HS-0	HS-0 pits	HS-IV	HS-IV pits	HS-II	HS-III
pottery types rim sherds						
W V	++	++	++	++	-	++
W VI	±	--	+	--	±	+
W IX	++	++	++	++	-	++
W X	++	++	++	++	+	+
W XIV	+	-	++	++	±?	+
W IIIC	++		++		±	++
W IIID	-		++		±	±
W VII	+	++	+	++	+	+
W IIIA-G	(+)+	+	+	±	+	±
H I	-	--	±	±	+	-
H II & III	--	--	-	--	-	--
W I	-	--	-	--	±	-
W II	--	--	--	--	-	±
W I/II	--	--	--	--	--	--

TABLE 39 Dorestad, Hoogstraat 0–IV Over- or underrepresentation of sections of the pottery complexes of Hoogstraat 0, II, III and IV in relation to Hoogstraat I.

The distribution of the handmade pottery-types over the excavation sites is also interesting (table 40). Type H III is the only one to be placed in the early group of pottery types. However, it is numerically unimportant and, moreover, is difficult to distinguish from H IA, which is why we shall not discuss it further here. The remaining handmade types belong to the late group. These are mainly H IA, -B and -

C, *i.e.* the *Kugeltöpfe,* since the *Kugeltopf* skillet H II, the bowl H IV and the small crucible H V can be disregarded due to their small number. The results of the Hoogstraat I investigation suggested that the dates of the three *Kugeltopf* types differed to some extent.[409] The H IA type (with rounded off rim) which is not very specific could be the oldest, provided that it appeared first and continued to occur alongside the other two types. Type H IC, which mainly occurs in fabric H-1 (grit tempering), is also relatively old: it has a remarkably 'early' distribution pattern. Type H IB, which is characterized by fabric H-2 (shell-grit tempering), has a relatively late date. Fabric H-2 is also of a later date, generally speaking, than fabric H-1. In terms of absolute chronology this could roughly mean the following: H IA-1 already appeared in the first half of the 8th century, and was joined by H IC-1 in the second half or around the middle of the same century; H IB-2 did not make its appearance until the end of the 8th century, when H IC-1 fell into disuse, but H IA-1 was still present and could also be made in fabric H-2.
In the Hoogstraat 0 and IV excavations, the late *Kugeltöpfe* type B and also fabric H-2 were under-represented. The same applies to *Kugeltopf* A, which appeared early on but remained in production longer. By contrast, the *Kugeltopf* with C rim, which probably occurred fairly early on and which was not in circulation for very long, is over-represented. This state of affairs implies that the deposition of *Kugeltopf* sherds in the Hoogstraat 0 and IV areas was prematurely halted: *Kugeltöpfe* b and a did not get the opportunity to reach full strength.
Much of what applies to the pottery complexes of Hoogstraat 0 and IV also applies to those of Hoogstraat III. *Kugeltopf* B and fabric H-2 are even more under-represented here. Of the wheel-thrown types, those of the early group from Hoogstraat III are more or less equally over-represented as those from Hoogstraat 0 and IV. Of the types belonging to the late group, only W II, with a deviant and remarkably high percentage (almost as high as that of H I), is represented in the Hoogstraat III excavation.

The finds complex from the Hoogstraat II excavation comes closest to that of Hoogstraat I. The differences between the two are generally not great, (far) less than those between Hoogstraat I and the other complexes. Moreover, the differences are not consistent: both the early and the late groups from Hoogstraat II tend to be slightly under-represented.

TABLE 40 Dorestad, Hoogstraat 0–IV
The proportions of hand-made pottery types in the Late-Merovingian and Carolingian section of the pottery complexes from the Hoogstraat excavations.
Legend:
rs rim sherd;
ws wall sherd.

excavation	**HS-0**	**HS-IV**	**HS-II**	**HS-I**	**HS-III**
pottery types and number	N 159	N 277	N 958	N 564	N 448
rs H IA	6.3	9.8	12.1	12.0	9.3
rs H IB	2.1	3.0	7.2	3.9	1.4
rs H IC	4.1	4.9	1.8	2.0	2.8
rs H II	0.1	0.4	0.5	1.3	0.4
rs H III	0.8	1.4	1.0	1.7	0.9
rs H IV, V, VI	0.1	0.1	0.2	0.4	0.4
ws H-1	9.7	15.2	11.2	11.0	12.5
ws H-2	3.7	4.3	11.7	10.2	2.9
rs H IA	--	-	±		-
rs H IB	-	-	+		--
rs H IC	++	++	±		+
rs H II	--	--	--		--
rs H III	--	±	-		-
ws H-1	±	+	±		±
ws H-2	--	--	±		--

409 Van Es & Verwers 1980, 159; table 22; figs. 102, 109, 110, and 113.

Basically, the complexes to the left and right of Hoogstraat I and II reveal early characteristics in comparison to these two. In Hoogstraat I and (the adjoining southern part of) Hoogstraat II, the structures in the riverbed had been extended to the maximum length. Because of erosion, it can no longer be established whether they were just as long in Hoogstraat III. It does not appear very likely, but the part that has disappeared is at any rate the latest part. This could explain the relatively early character of the finds complex: only the earliest part of the structures remained. A similar kind of explanation might be imagined to apply to the situation at Hoogstraat 0. There, only part of the complex, the earliest part, was excavated. However, in this case this option is unlikely, since in Hoogstraat II (northern part) and -IV it was obvious that the structures here had been extended considerably less far than in Hoogstraat I and II (southern part). This makes it very improbable that the structures in Hoogstraat 0 would have been as long as in Hoogstraat I and II. It looks as if the structures north of Hoogstraat II (southern part) did not attain their 'full' size. In combination with the early character of the finds complexes in question, this fact leads one to suspect that the activities in the northern part of the riverbed continued for a shorter time, or were at least less intensive than in Hoogstraat I and II (southern part).
This conclusion must be approached cautiously, since the distribution of the finds was not only influenced by the time factor. One can imagine all kinds of 'chance' factors which were also influential and which can possibly provide an explanation for some of the deviations in the otherwise consistent picture. To give an example: the relatively high percentage of *Kugeltöpfe* H IB from Hoogstraat II (in accordance with the high percentage of wall sherds in fabric H-2) is difficult to specify chronologically. There are no further indications that the activities in question in the Hoogstraat II area continued for a longer period than in Hoogstraat I. A possible explanation might be that the users of the Hoogstraat II area were at the time specialized in the sale (or manufacture?) of *Kugeltöpfe*, type B. This kind of anomaly is, however, rare. We assume that time was the key factor in the distribution of the sherds, and that the composition of the pottery complexes therefore primarily provides information on the duration of use of the riverbed areas concerned (and, in the case of Hoogstraat 0 and IV, also the areas on the edge of the bank). To be specific, the beginning of the Hoogstraat excavations was (about) the same everywhere, but in the central area between Hoogstraat I and II (southern part) the complex of finds was able to develop longer, which explains the differences in composition between the Hoogstraat I and II complexes, on the one hand, and those of Hoogstraat 0 and IV on the other; nothing can be said in this respect about Hoogstraat III.
The moment at which the development of the various parts of the riverbed area began to diverge, cannot be precisely determined. It must have been in the period of the late pottery types, since these were encountered everywhere. In other words, the second half of the 8th century is the earliest possibility, but, on the basis of the pottery dates it may have been around AD 800 or even later. What actually happened is certainly not 'told' by the sherds. Questions remain unanswered: did the activities in the riverbed area north of Hoogstraat II (southern part) stop altogether before the end of the 8th century, or did they just (significantly) decrease in intensity; and did the decline in the area on the riverbank perhaps set in a little earlier, as was suggested at the beginning of this section on the basis of the pit contents?

3.4 The distribution of pottery types and several other categories of finds

3.4.1 Pottery: introduction

Figure 237 gives a general survey of a large part of the pottery complex. It includes (almost) all the wall and base sherds of wheel-thrown pottery. The number is substantial – over 59 000 sherds – and it is assumed that this group is more or less representative of the entire complex, since there is a roughly average distribution over the excavation

area. It could not, of course, be expected that more or less the same number of sherds would be found in all periods. Judging by the rim sherds, the fragments of late pottery types predominate: the rim sherds of types W I, II, and I/II are over twice as numerous as those of W V, VI, IX, X, and IIIC together. Consequently, the picture shown by figure 237 is probably influenced more by the late than by the early types.
In figure 237 the number of fragments per 1000 m^2 has been calculated for each excavation trench. These numbers were then divided into six classes or grades, which may be described as follows:
1 very few to hardly any;
2 few, or well below average;
3 still below average;
4 above average;
5 many, or well above average;
6 very many (there is actually a seventh class/grade: 0, none at all).[410]

In figure 238 the picture is simplified even further, because the frequencies of the pottery types per 1000 m^2 are now not calculated per excavation trench, but per zone. The method of calculation and the classification into grades remains the same. The location of the zones in the various Hoogstraat excavations is shown in figure 239. Zones 1 appear to be reasonably well comparable: only in Hoogstraat 0 is zone 1 limited exclusively to the area on the riverbank, in the other sites zone 1 also includes a small section of the beginning of the riverbed structures. Zones 2 and 3 are generally also comparable, as far as their location is concerned: only in Hoogstraat III do zones 2 and 3 both lie within what is elsewhere zone 2.
The zonal distribution pattern presents a broader – and therefore more regular – picture than the pattern of distribution per excavation trench. Figure 237 shows that substantial differences in frequency can occur 'horizontally' *i.e.* between the various parcels. In Hoogstraat I, for instance, the southernmost row of excavation trenches was very rich in finds, as was the case in Hoogstraat II. There is no hard and fast explanation for this phenomenon. One possibility is that the riverbed parcels in question were used more intensively, or for a longer duration. However, it is also possible that the differences may (partly) be a result of the excavation: the division into excavation trenches is not directly linked with the original parcellation, and consequently, a trench could contain material which in actual fact originated from a neighbouring parcel. The latter was not the case at the ends of the parcels on the south side of Hoogstraat II. Neighbouring structures were lacking on the north side there. Nevertheless, it is conceivable that the adjacent parcels on the north side did remain in use for the same length of time, even though the structures here had been extended less far than on the southern parcels. In view of these uncertainties, there is no objection to 'horizontal' differences being ironed out by the zonal pattern. The 'longitudinal' differences, however, are even more clearly apparent, and in our opinion have chronological implications.

3.4.2 Pottery: comparison of the zonal distribution patterns
There is no complete correspondence between the distribution pattern of a pottery type with that of the control group in figure 238. Only in the case of type W IIIA is this situation almost achieved: there is only one deviation in zone 1 of Hoogstraat I (fig. 240). This is a type with a midway position, chronologically, since it has neither a distinctly early nor a distinctly late date. With early pottery types the differences are very great, and also with the late types there are more or less clear differences. To illustrate this, we show the zonal distribution patterns of W V (fig. 241) and -IX (fig. 242) on the one hand, and of H IA (fig. 243), W II (fig. 244) and wall sherds with roulette decoration (fig. 245) on the other hand.
It would be going too far to illustrate the zonal distribution patterns of all the possible types and to discuss them in detail. We have therefore restricted ourselves to the most

410 The grades were calculated as follows:
1 < 1/6 of average;
2 1–50 % of < 1/6 of average–average;
3 51–100 % of < 1/6 of average– < average;
4 1–50 % of < average–halfway between the two highest values,
5 51–100 % of < average–halfway between the two highest values;
6 more than grade 5.

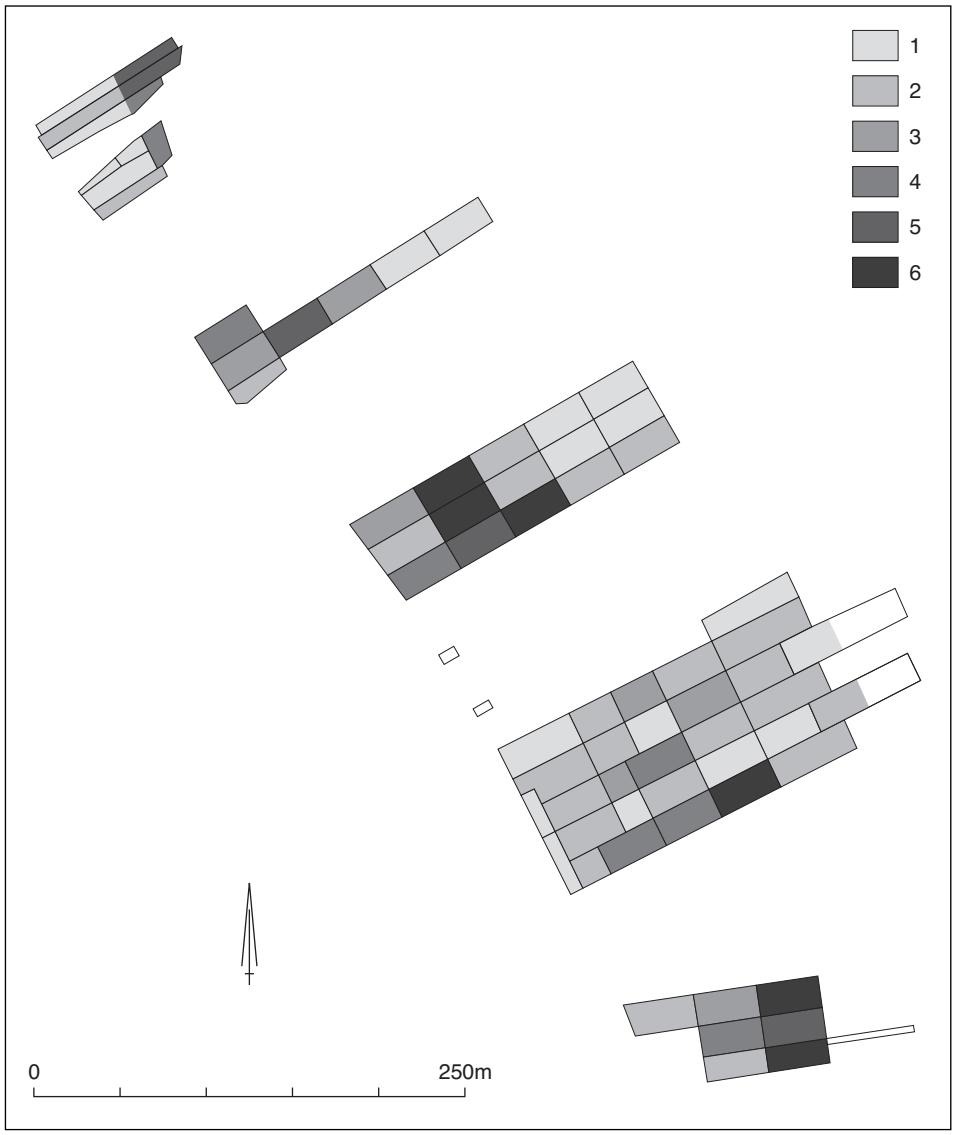


Fig. 237 Dorestad, Hoogstraat 0-IV: frequency of wall sherds of Carolingian wheel-thrown pottery per excavation trench; N=59202 items, average per trench 1244.4.
Legend:
1 < 207.4;
2 207.4-1244.4;
3 725.7-1244.4;
4 1244.4-4318.0;
5 2781.2-4318.0;
6 > 4318.0.

important ones, and have summarized the data concerned in two tables. The first of these (table 41) contains the 'absolute' data, indicating with plus and minus signs what is shown by shading in the illustrations. One could call table 41 the direct translation of the distribution patterns: the frequency grades are indicated by one or more plus or minus signs; a circle marks the zone in which a pottery type reached its highest frequency (largest number per 1000 m^2). The second table (table 42) summarizes the differences between the various distribution patterns with regard to the control group. The plus and minus signs here serve to measure the degree of difference.
From the two tables it is obvious that the early and late pottery types show systematically different behaviour compared to the control group. The optimum of the early pottery types is also often found in zone 1, that of the late types never is. However, the optimum or a relatively high value of the late types is sometimes, and then only in Hoogstraat I, found in zone 3. Deviations above the norm in zone 1 are only found on a large scale in the early types. In zone 2, deviations below the norm are much more frequent in the early types than in the late ones. The upward deviations there do not differ much, but the late types in zone 2 correspond more often in intensity with the control group than the early types. Table 43 gives a survey

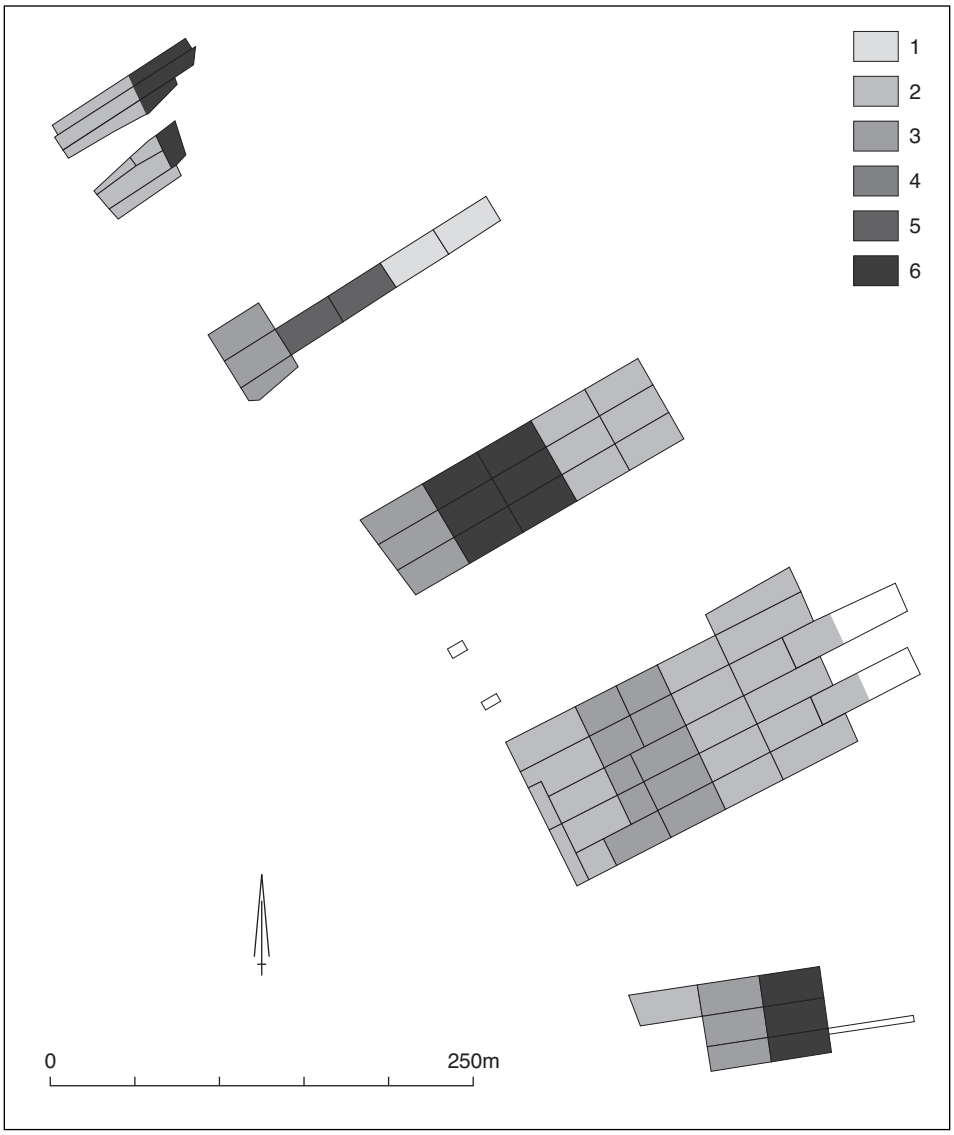


Fig. 238 Dorestad, Hoogstraat 0-IV: frequency of wall sherds of Carolingian wheel-thrown pottery per zone; N=59202 items, average per trench 1244.4.
Legend:
1 < 207.4;
2 207.4-1244.4;
3 725.7-1244.4;
4 1244.4-2665.1;
5 1954.7-2665.1;
6 > 2665.1.

in percentages of the deviations per group for each zone (the percentages are calculated on the basis of the score of the signs in the columns of table 42; signs in brackets count as 1/2).

Conclusions which may be drawn from the data presented here are as follows.

1 The early pottery types belong to the settlement area on the riverbank and to the beginning of the structures in the riverbed. By the time the structures in Hoogstraat I and II had been extended into zone 3, their term of use was already (completely or partly) over.
2 The late types were also found in the riverbed area and in zone 2, but were often under-represented there (25 % deviations below the norm in both zones, according to table 42). They occurred frequently in zone 2, however, and largely determined the pottery situation there, in other words, zone 2 was being intensively exploited at the time they were in use. In the riverbed area (zone 1) the activities may have decreased since the appearance of the late types.
3 It remains a problem whether zone 2 continued to function in Hoogstraat IV and II when in Hoogstraat I (and the south part of II) the activities also began to extend over zone 3. In other words, did the activities in Hoogstraat IV and II (and 0 and

possibly III) go on as long as in Hoogstraat I? The distribution patterns of distinctly late types such as w ii and the wall sherds with roulette decoration suggest that this was not the case, at least, not in Hoogstraat IV (and 0). In Hoogstraat IV both the rim and the wall sherds of W II were extremely under-represented in comparison with the control group (figs. 244 and 245, compared to 238). This was far less so with the Badorf group (W II and wall sherds with rouletting) in Hoogstraat II. This could be due to the fact that the total of pottery in zone 2 of Hoogstraat II was substantially influenced by the wealth of finds in the south row of excavation trenches. It remains conceivable that the shorter extension of the structures in Hoogstraat IV, (0) and II, corresponds to a shorter period of use of the terrain segments in question. In Hoogstraat I (and in the sector between Hoogstraat II and I; possibly also in those between Hoogstraat I and III) the activities may have continued longer, thus resulting in a greater length of the riverbed structures.

3.4.3 Distribution of the coins, weapons and ornaments

The distribution of the coins corresponds to the conclusions which can be drawn from the pottery finds (fig. 246).[411] This confirms the chronological value of the pottery, since, in the case of coins, one can always be more or less certain that their distribution is mainly connected with the time factor: after all, the coins we find were successively lost. Hoards, in fact, are also lost coins. They may have been

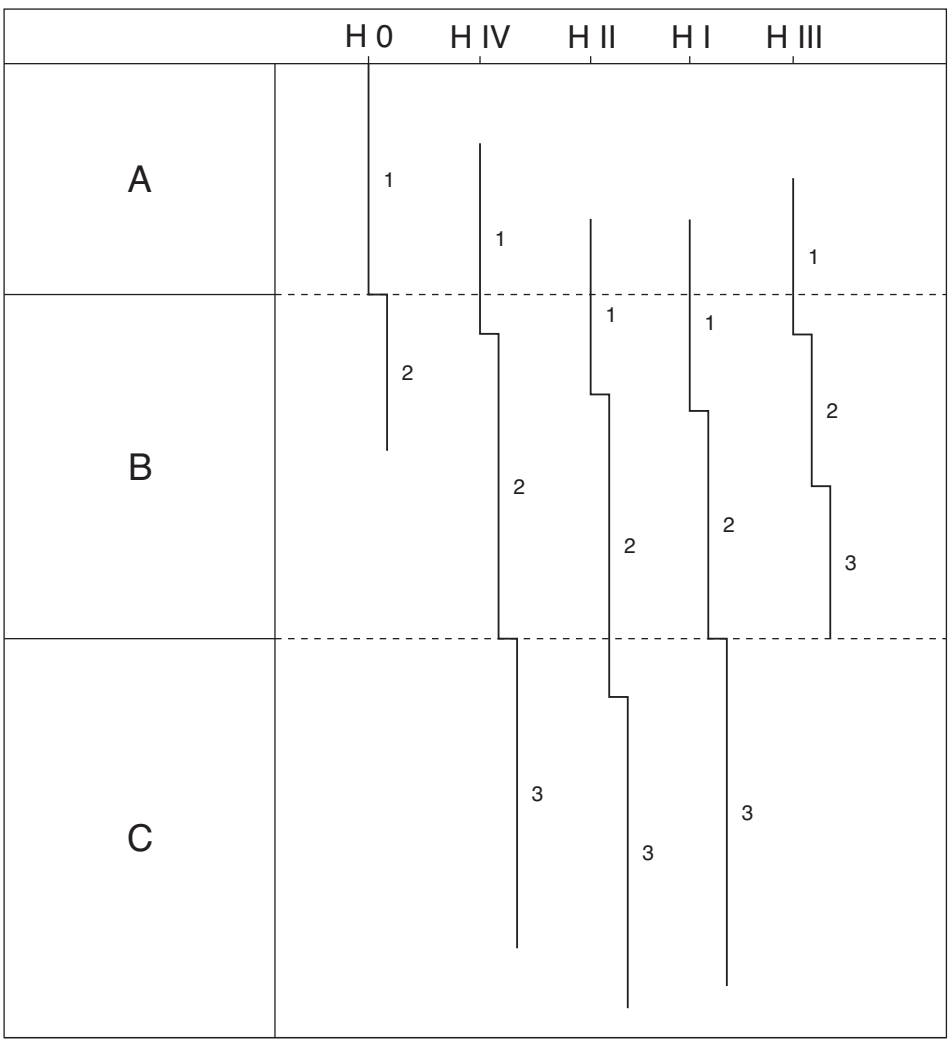


Fig. 239 Dorestad, Hoogstraat 0-IV: location of the three zones.
Legend:
A riverbank area;
B 90 m into riverbed Hoogstraat I, zone period 1 and beginning of period 2;
C 200 m into riverbed Hoogstraat I, rest of zone period 2.

411 For an analysis of the coins from the riverbank in Hoogstraat I: see Van Gelder 1980, 212–24 and in this book, chapter VI 4.

Fig. 240 Dorestad, Hoogstraat 0-IV: frequency of rim sherds of pottery type W IIIA per zone; N=3092 items, average per trench 65.0.
Legend:
1 < 10.8;
2 10.8-65.0;
3 37.9-65.0;
4 65.0-199.6;
5 92.3-199.6;
6 > 199.6.

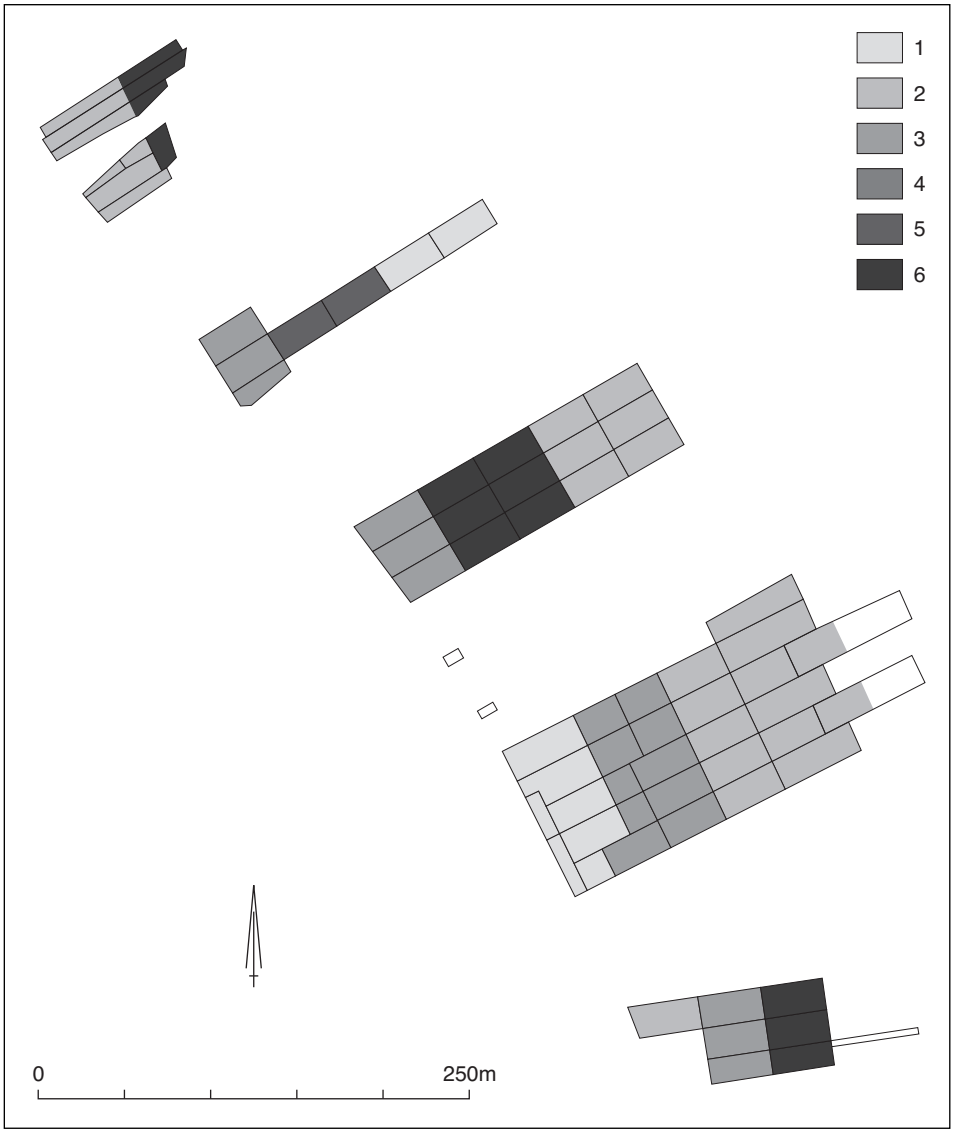


Fig. 241 Dorestad, Hoogstraat 0-IV: frequency of rim sherds of pottery type W V per zone; N=453 items, average per trench 9.5.
Legend:
1 < 1.6;
2 1.6-9.5;
3 5.5-9.5;
4 9.5-27.0;
5 18.2-27.0;
6 > 27.0.

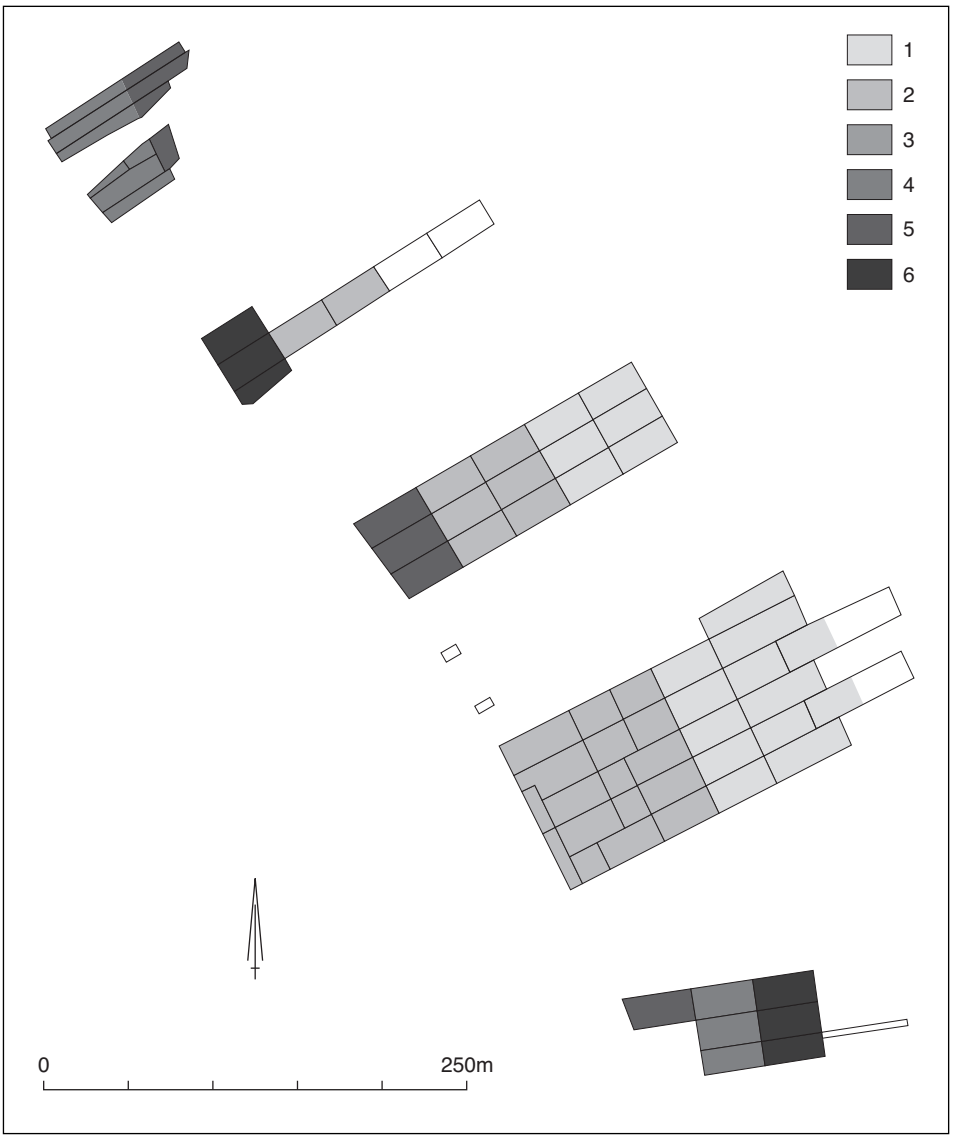


Fig. 242 Dorestad, Hoogstraat 0-IV: frequency of rim sherds of pottery type W IX per zone; N=290 items, average per trench 6.1.
Legend:
1 < 1;
2 1-6.1;
3 3.5-6.1;
4 6.1-17;
5 11.5-17;
6 > 17.

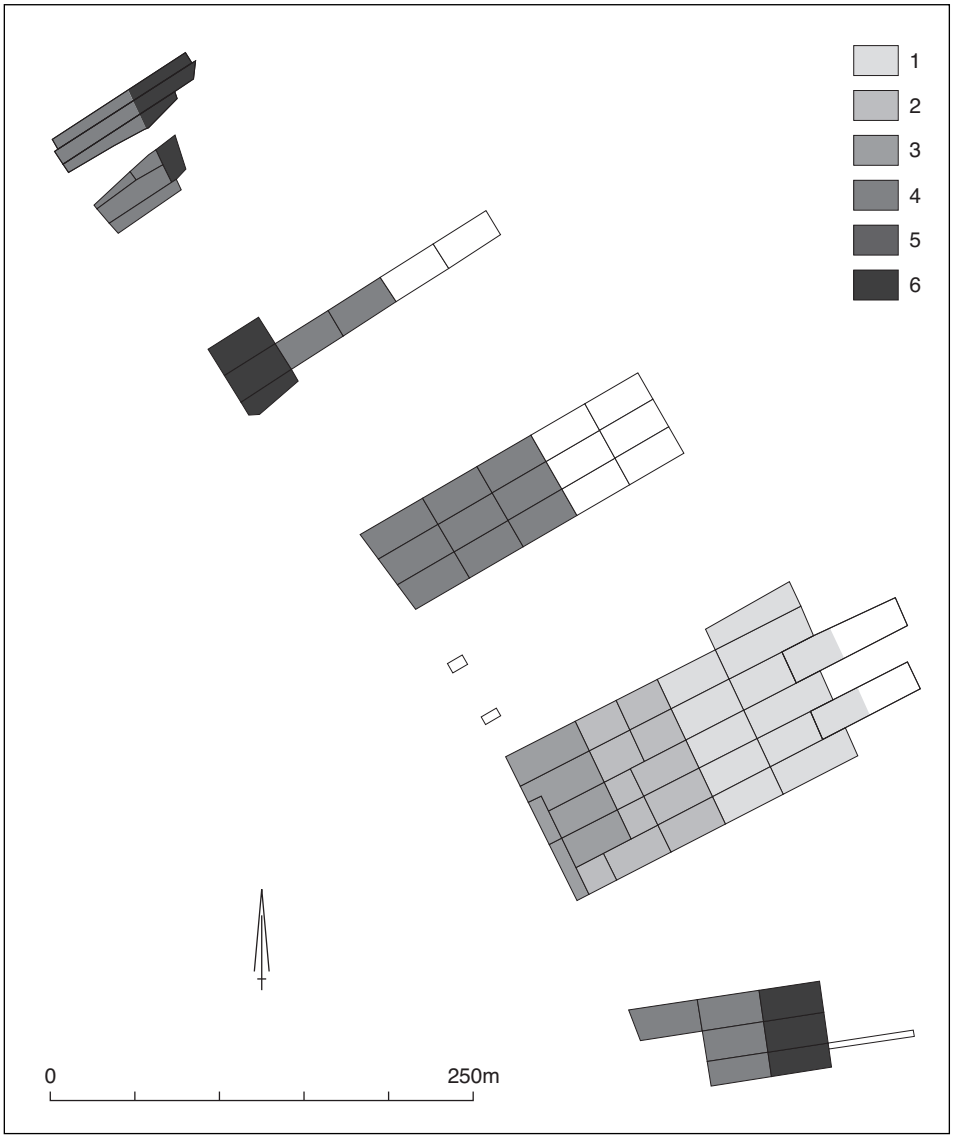


Fig. 243 Dorestad, Hoogstraat 0-IV: frequency of rim sherds of pottery type H IA per zone; N=1315 items, average per trench 29.6.
Legend:
1 < 4.9;
2 4.9-29.6;
3 17.2-29.6;
4 29.6-45.1;
5 37.4-45.1;
6 > 45.1.

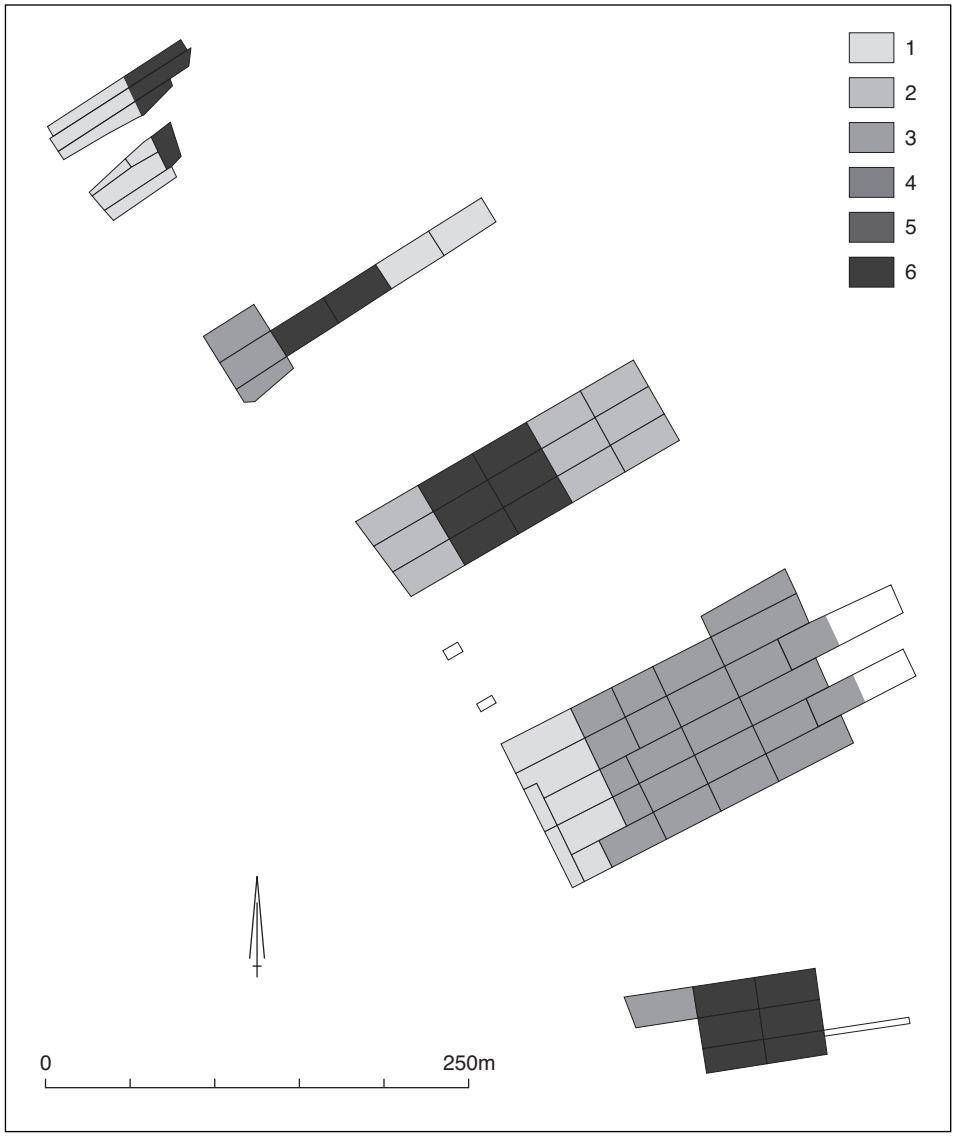


Fig. 244 Dorestad, Hoogstraat 0-IV: frequency of rim sherds of pottery type W IIA-F per zone; N=2510 items, average per trench 52.8.
Legend:
1 < 8.8;
2 8.8-52.8;
3 30.8-52.8;
4 52.8-134.1;
5 93.5-134.1;
6 > 134.1.

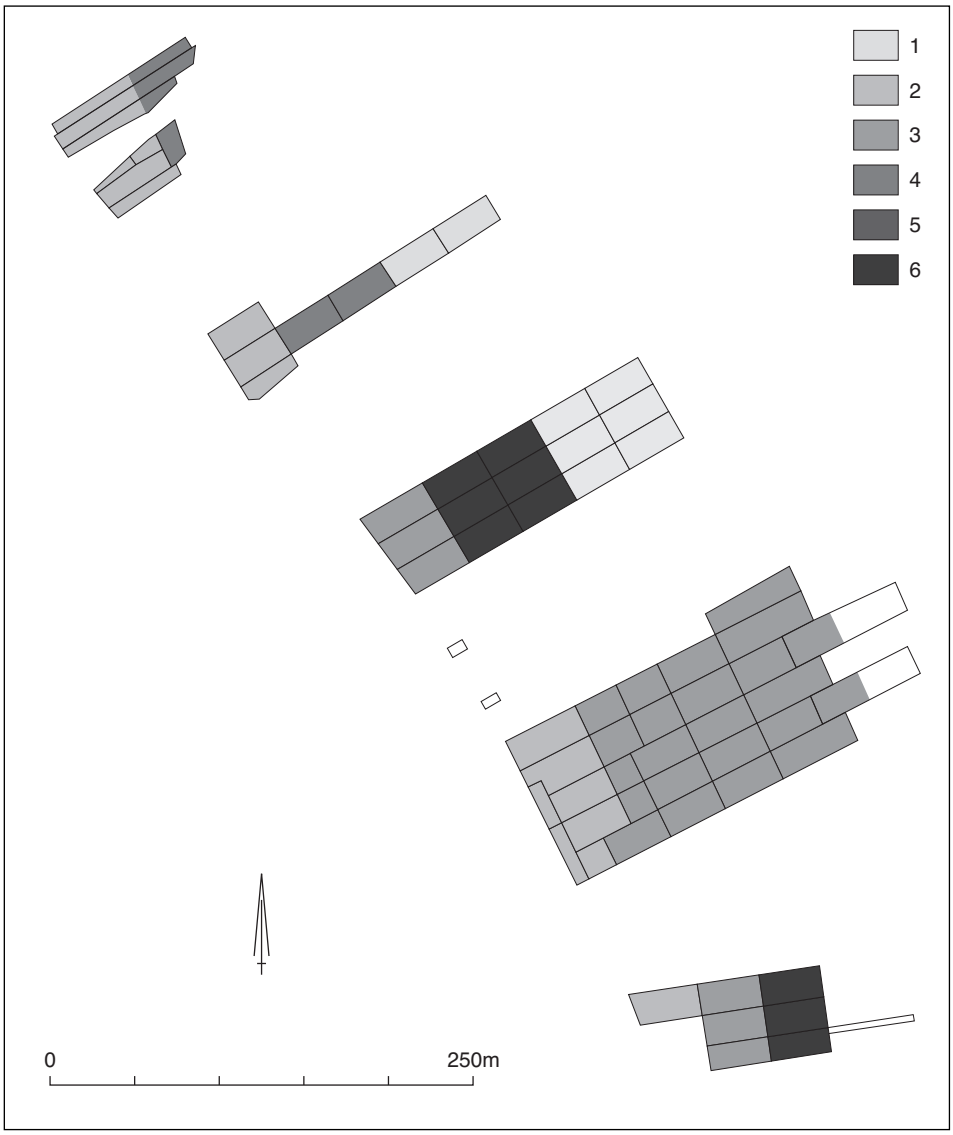


Fig. 245 Dorestad, Hoogstraat 0-IV: frequency of wall sherds of Carolingian wheel-thrown pottery with roulette decoration per zone; N=8677 items, average per trench 185.5.
Legend:
1 < 30.8;
2 30.8-185.5;
3 108.2-185.5;
4 185.5-667.5;
5 426.5-667.5;
6 > 667.5.

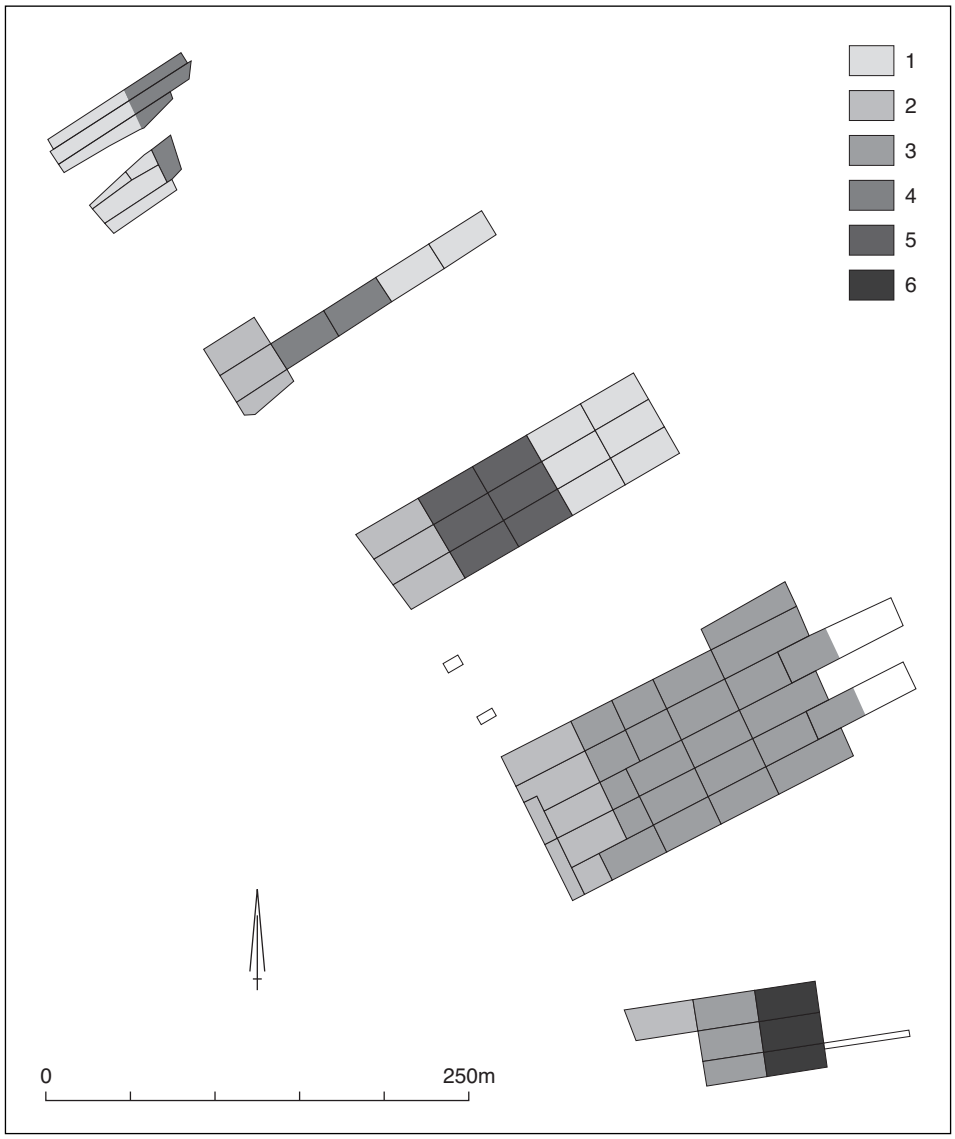


TABLE 41 Dorestad, Hoogstraat 0–IV
Frequencies of the types of Carolingian wheel-thrown pottery per zone.
Legend:
rs rim sherd;
ws wall sherd;
ovs undecorated;
O step 0;
-- step 1;
- step 2;
(-) step 3;
(+) step 4;
+ step 5;
++ step 6;
the circle indicates the highest value per type >>

TABLE 42 Dorestad, Hoogstraat 0–IV
Deviations in the distribution patterns of separate Carolingian pottery types from that of the control group.
Legend:
rs rim sherd;
ws wall sherd;
= equal to control group;
(-) one step lower;
- two steps lower;
-- three steps lower;
(+) one step higher;
+ two steps higher;
++ three steps higher.
>>

excavation		HS-0	HS-IV	HS-II	HS-I	HS-III	HS-0	HS-IV	HS-II	HS-I	HS-III	HS-III	HS-IV	HS-II	HS-I
zone		1	1	1	1	1	2	2	2	2	2	3	3	3	3
pottery type															
ws W-13, 14, 15/16 ovs/roulette		-	(-)	(-)	-	-	++	+	++	(-)	(-)	++	--	-	-
rs W V	e	(+)	++	+	-	+	+	-	-	-	(+)	++	0	--	--
rs W VI	a	--	(+)	(+)	-	(+)	++	++	+	(-)	+	++	0	--	--
rs W IX	r	(+)	++	(+)	(-)	(+)	++	(+)	(+)	-	(+)	++	0	0	--
rs W X	l	-	++	(+)	(-)	(+)	++	(+)	(+)	-	-	++	0	0	--
rs W IIIC	y	(-)	++	(+)	-	+	++	+	(-)	--	(+)	++	0	--	--
rs H III		-	(-)	++	(-)	++	++	++	++	(+)	+	++	0	--	-
rs W IIIA		-	(-)	(-)	--	-	++	+	++	(-)	(-)	++	--	-	-
rs W IIIB		-	(+)	(-)	--	-	++	+	+	-	(-)	++	--	--	-
rs H IA	l	--	(-)	-	--	(-)	++	++	++	(-)	++	++	--	-	(-)
rs H IB	a	-	-	(+)	--	0	+	+	++	(-)	(-)	(+)	--	-	-
rs H IC	t	--	(+)	(-)	-	-	++	++	(+)	(-)	+	++	0	--	-
rs W I	e	--	(-)	(-)	-	(-)	++	++	++	(-)	(+)	++	0	--	-
ws W I		-	(-)	(-)	-	-	++	++	++	(-)	(+)	++	--	--	-
rs W IIA-F	t	-	-	(-)	-	-	(+)	(+)	++	(-)	(-)	++	--	--	(-)
rs W IIC	y	-	-	(-)	-	-	+	(+)	+	(-)	(+)	++	--	-	(-)
rs + ws H I/II	p	--	-	-	-	(-)	(+)	(-)	(+)	(+)	-	++	0	(-)	(+)
ws roulette	e	--	-	-	-	-	(+)	(+)	+	(-)	(-)	++	--	--	(-)

TABLE 41 Dorestad, Hoogstraat 0–IV Frequencies of the types of Carolingian wheel-thrown pottery per zone (for legend see page 309).

excavation			HS-0	HS-IV	HS-II	HS-I	HS-III	HS-0	HS-IV	HS-II	HS-I	HS-III	HS-III	HS-IV	HS-II	HS-I
zone			1	1	1	1	1	2	2	2	2	2	3	3	3	3
control group (see fig. 238)			-	(-)	(-)	-	-	++	+	++	(-)	(-)	++	--	-	-
rs	W V	e	+	++	+	=	++	(-)	-	--	(-)	(+)	=	(-)	(-)	(-)
	W VI	a	(-)	(+)	(+)	=	+	=	(+)	(-)	=	+	=	(-)	(-)	(-)
	W IX	r	+	++	(+)	(+)	+	=	(-)	-	(-)	(+)	=	(-)	-	(-)
	W X	l	=	++	(+)	(+)	+	=	(-)	-	(-)	(-)	=	(-)	-	(-)
	W IIIC	y	(+)	++	(+)	=	+	=	=	--	--	(+)	=	(-)	(-)	(-)
	H III		=	=	++	(-)	++	=	(+)	=	(+)	+	=	(-)	(-)	=
rs	W IIIA		=	=	=	(-)	=	=	=	=	=	=	=	=	=	=
	W IIIB		=	(+)	=	(-)	=	=	=	(-)	(-)	=	=	=	(-)	=
rs	H IA	l	(-)	=	(-)	(-)	(+)	=	(-)	=	=	++	=	=	=	(+)
	H IB	a	=	(-)	(+)	(-)	-	-	(-)	=	=	=	-	=	=	=
	H IC	t	(-)	(+)	=	=	=	=	(+)	-	=	+	=	(-)	(-)	=
	W I	e	(-)	=	=	=	(+)	=	(+)	=	=	(+)	=	(-)	(-)	=
ws	W I		=	=	=	=	=	=	(+)	=	=	(+)	=	=	(-)	=
rs	W IIA-F	t	=	(-)	=	=	=	-	(-)	=	=	=	=	=	(-)	(+)
	W IIC	y	=	(-)	=	=	=	(-)	(-)	(-)	=	(+)	=	=	=	(+)
rs+ws	W I/II	p	(-)	(-)	-	=	(+)	-	-	-	(+)	(-)	=	(-)	=	+
ws roulette		e	(-)	(-)	(-)	=	=	-	(-)	(-)	=	=	=	=	(-)	(+)
rs	W VIII	s	-	(-)	--	-	(+)	-	-	-	=	(+)	=	=	-	(+)

TABLE 42 Dorestad, Hoogstraat 0–IV Deviations in the distribution patterns of separate Carolingian pottery types from that of the control group (for legend see page 309).

TABLE 43 Dorestad, Hoogstraat 0–IV
Deviations of groups of Carolingian pottery types from the control group in percentages.

zone	pottery group	downward deviations	upward deviations	equal
1	early	3.1	78.1	18.8
	middle	11.8	5.9	82.4
	late	25.4	7.0	67.6
2	early	40.6	15.6	43.8
	middle	9.1	0	90.9
	late	25.0	14.1	60.9
3	early	90.5	0	9.5
	middle	9.1	0	90.9
	late	19.0	14.3	66.7

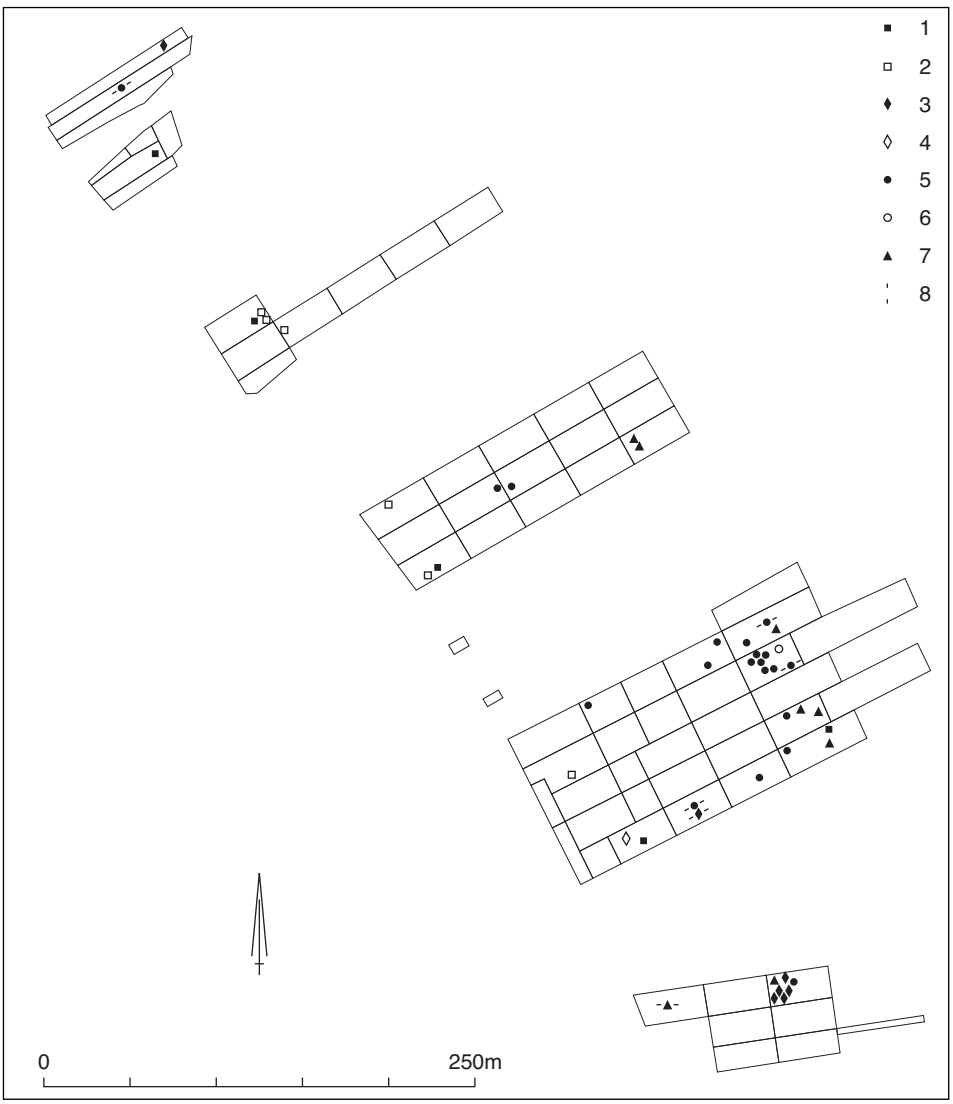


Fig. 246 Dorestad, Hoogstraat 0-IV: distribution of the coins.
Legend:
1 Roman coin;
2 sceatta;
3 denarius of Pippin III or Charlemagne (period 1) ca 752-793;
4 hoard find HS-I 1972 I;
5 denarius of Charlemagne (period 2) or Louis the Pious (initial period) ca 793-820;
6 hoard find HS-I 1972 II;
7 denarius of Louis the Pious (Christiana Religio) or Lotharius ca 820-840;
8 position in excavation trench uncertain, but within the trench.

deliberately hidden at the time, it is true, but the fact that we find them shows that, for the original owner, they were lost. In a situation such as that of the Hoogstraat excavations, coins are eminently suitable for establishing a 'horizontal chronology', all the more so because they are relatively precisely dated.
The oldest coins, *sceattas*, were only discovered in the settlement area on the riverbank.[412] *Sceattas* appeared in the course of the 7th century (or in the late 7th

412 In figure 246 the location of the coins has been indicated as accurately as possible.

century) and were (probably) minted until (well?) after the middle of the 8th century. Remarkably, four of the five Roman coins from the Hoogstraat excavations also came from the area on the riverbank. The coins date from the 2nd and 3rd centuries, though it is possible that they were still in circulation in the Late Merovingian Period. The earliest Carolingian *denarii*, those of Pippin III and those of Charlemagne's first coin period (before 793 AD), were found at the front of the riverbed: period 1/ beginning 2. The later *denarii* of Charlemagne (second coin period), and those from the beginning of Louis the Pious' reign were found in zone 2 and in Hoogstraat I, especially in zone 3. These coins, which were minted between *c.* 793 and 820 AD, therefore belong to period 2, possibly mainly to the end of this period. The distribution of coins belonging to this group in Hoogstraat I was probably strongly influenced by a hoard which had become scattered. In our opinion, it is reasonable to assume that the coins found separately in the vicinity of hoard 1972II, belonged to that hoard.

Finally, the youngest *denarii,* which were minted between *c.* 820 and 840 AD (Lotharius I and the *Christiana religio* coins of Louis the Pious), marked the end of the development in Hoogstraat I and II. One specimen from this group, which was found in zone 3 of Hoogstraat III, could be an indication that the structures in the riverbed did not extend much further here, but this is uncertain; the coin was found amidst older *denarii.* The Lotharius *denarius*, which was discovered in the riverbank area of Hoogstraat III, shows that there was still traffic there at any rate until the end of the development; it does not, in itself, provide evidence for settlement. It is interesting to note that the youngest coins were lacking in the area north of the southernmost part of Hoogstraat II.

Conclusion: in the sector comprising the southern part of Hoogstraat II-Hoogstraat I-Hoogstraat III, occupation continued until (at least) the first half of the 9th century. That the activities in the sector to the north of this may have been halted earlier does not conflict with the distribution of the coins provided that this took place no earlier than the beginning of the 9th century. The *sceattas* suggest that the settlement activities in the area on the riverbank reached a peak between the end of the 7th century and the (first half of) the 8th century. The completion of the majority of the structures in the riverbed area must have occurred during the 8th century.

Figure 247 refers to the relatively few metal objects which can be dated 'with some precision', but the degree of precision is not very high. The dates span about half a century, sometimes slightly less, but also somewhat longer. The objects can be divided into three groups on the basis of their dates:

a objects from the end of the 7th and beginning of the 8th century;

b - from (the middle of) the 8th century;

c - from the end of the 8th and first half of the 9th century. Their distribution pattern confirms the results achieved so far. The earliest objects (group *a*) were found at the front of the area. An exception was spear-head no. 5 found in Hoogstraat IV well to the rear in the section of the riverbed which was no longer raised: had it fallen into the water from a ship? The 'probably late-medieval' gold ring no. 2 was found at an early location. The late objects (group *c*) on the contrary, were at the rear. The iron key no.7 found there was something of an exception. It is a key with a loop bow and belongs to a type which appears to be mainly late 8th-century. Most of the bronze or iron keys found in Dorestad cannot be dated more closely than to the 8th century and a little later. Their distribution in the riverbed area (see fig. 247) corresponds with this dating: they were generally found in the middle and at the back, and in a few cases right at the front. The majority of closely dated metal objects belonging to middle group *b* of the closely dated metal objects was also found in an intermediate location.

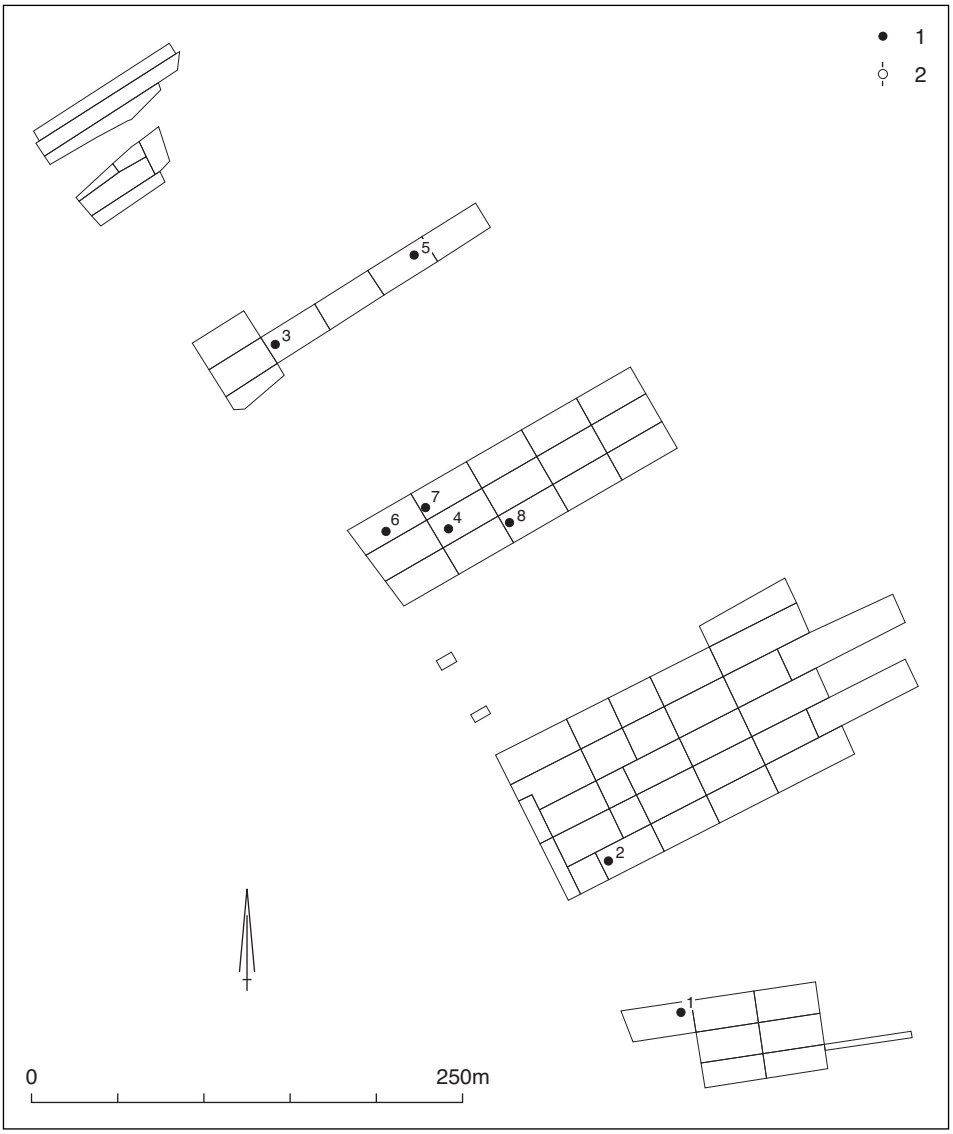


Fig. 247A Dorestad, Hoogstraat 0-IV: 'sharply' datable metal objects: group a (dating last quarter 7th century / 1st quarter 8th century):
1 gold pendant (HS-III 401.4.1);
2 gold ring (HS-0 15767);
3 silver arm-ring (HS-IV 449.1.30);
4 lance point (HS-II 384.3.25);
5 lance point (HS-IV 451.3.4);
6 axe (HS-II 380.4.23);
7 axe (HS-II 383.4.8);
8 axe (HS-II 388.2.1).
Legend:
1 metal object;
2 metal object, position within trench unknown.

3.4.4 Distribution of the glassware

The final category of finds to be discussed in this chapter is the glassware. Its usefulness for a chronological analysis is limited. It is difficult to recognize the forms from the fragmentary material, in addition to which the types can only be dated within wide margins. For the dates used here we have made grateful use of Isings' work.[413] The glass finds from the Hoogstraat area consist mainly of fragments of glassware. A small number of these date from the Roman Period; also from this period are a glass game counter and an interesting Romano-British bangle. The Merovingian Period is represented by a 6th-century spindle whorl, three 6–7th-century bell beakers and a goblet, probably North-Italian. The two shallow palm cups could perhaps be Late-Merovingian (late 7th/early 8th century). The deep palm cups, which are considerably more numerous (about 26 specimens), date from the late 7th to early 8th century. The cups or beakers with horizontal moulding, probably lamps (*c.* 12 items), either belong to the palm cups or to the funnel beakers. The latter category is by far the most numerous: it comprises at least 165 specimens. This familiar Carolingian type of glass also occurs in a decorated form. The riverbed area of Dorestad has yielded a small number of fragments of decorated funnel beakers,

413 Isings 1980, 225–37; in this book chapter VI 5.

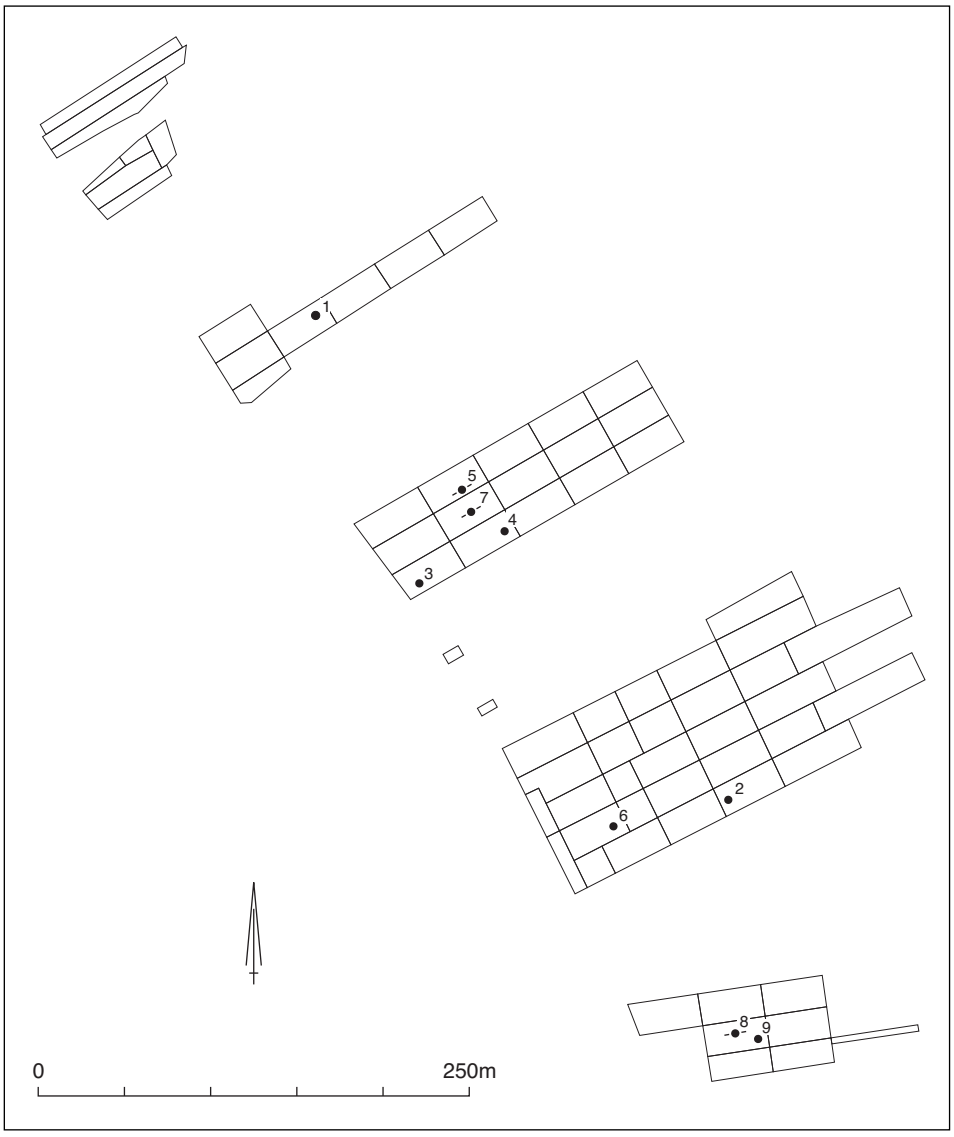


Fig. 247B Dorestad, Hoogstraat 0-IV: 'sharply' datable metal objects: group b (dating 2nd/3rd quarter 8th century):
1 bronze arm-ring (HS-IV 449.2.40);
2 equal-armed brooch (HS-I 16074);
3 enamel disc brooch (HS-II 382.2.2);
4 winged lance point (HS-II 385.2.9);
5 umbo (HS-II 383.0.1);
6 belt fitting (HS-I 359.3.1);
7 pin with biconical head (HS-II 384.1.0);
8 as 7 (HS-III 403.1.1);
9 as 7 (HS-III 403.3.4).
Legend see fig. 247A.

including a few with applied gold foil decoration. Funnel beakers are thought to have been produced from the late 8th to the 10th century. A subdivision of the type on the basis of differences in the shape of the rim, wall and base is possible, but the chronological implications are not very clear. The inverted rim could well point to an early type: late 8th/early 9th century. Compared to the funnel beakers, the jars (*c.* 10 specimens) and the bowls (4 specimens) are few in number. Their date is not altogether clear. Most are probably 'late', *i.e.* not older than the funnel beakers, but some could be older. One of the jugs from Hoogstraat III (Isings III/26) could be Late-Roman. Apart from glassware dating from the Carolingian Period there are also linen smoothers (26 specimens), two *tesserae* (one white, one blue), and a number of fragments (probably) of window glass. *All* the sherds were included when counting the specimens, and not only the rim sherds, as was the case with the pottery.

An overall[414] survey of the glass finds shows a distribution which is basically similar to that of the pottery and the coins: the latest types in Hoogstraat I and II penetrate further east than the earliest (fig. 248). The Merovingian glasses and the palm cups are characteristic of zones 1 and 2. In Hoogstraat I they reach as far as the

414 The symbols do not indicate the exact find-spot, but are grouped per excavation trench.

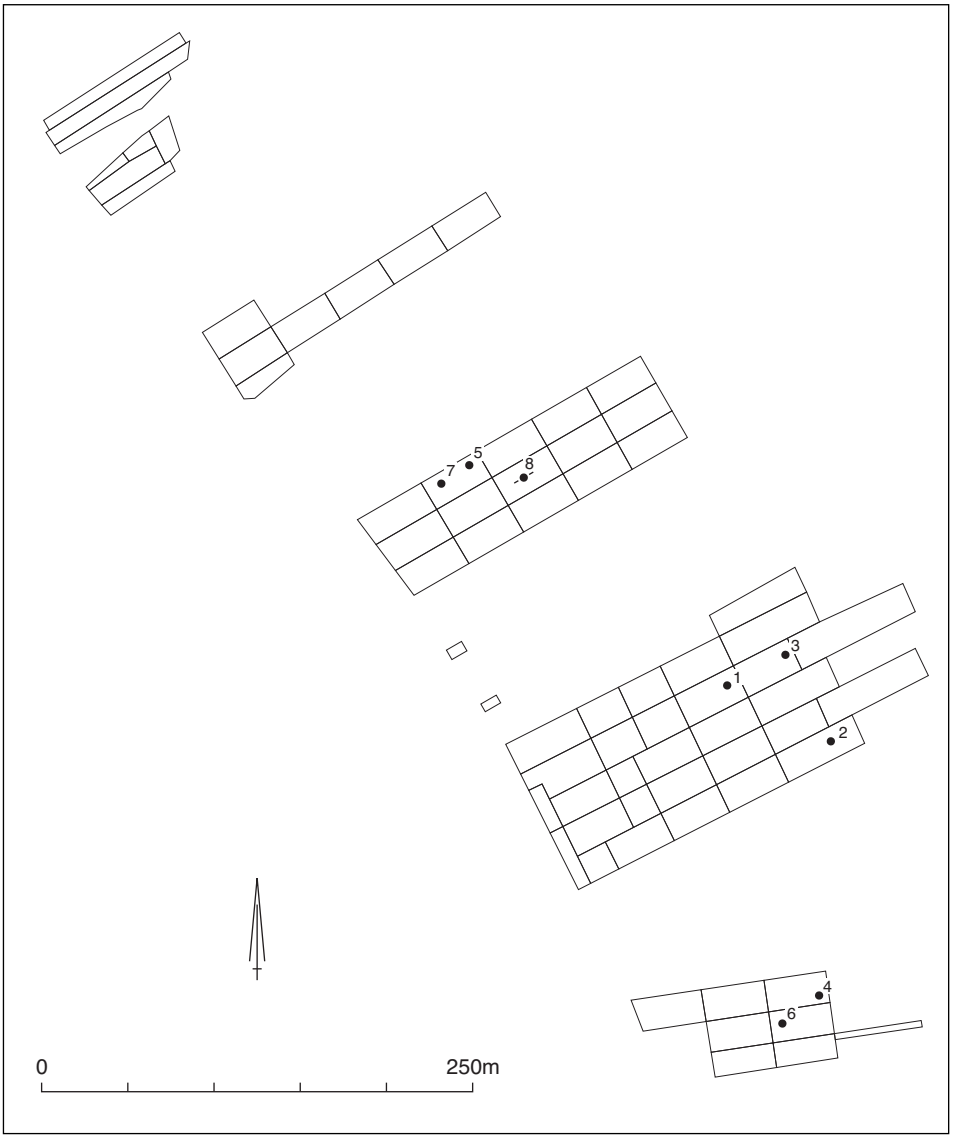


Fig. 247C Dorestad, Hoogstraat 0-IV: 'sharply' datable metal objects: group c (dating last quarter 8th century / 1st half 9th century):
1 pseudo-cameo brooch (HS-I 358.1.6);
2 spatha (HS-I 372.4.11);
3 pair of bronze spurs and strap fittings (HS-I 357.7.3-5, 357.8.216);
4 spur (HS-III 405.6.1);
5 key with loop-shaped bow, bronze (HS-II 383.1.22);
6 as 5 (HS-III 406.4.16);
7 as 5, iron (HS-II 383.2.1);
8 as 7 (HS-II 387.4.64).
Legend see fig. 247A.

beginning of zone 3. The same applies to the lamps (cups and beakers with horizontal moulding). This fact again confirms the 8th-century origin of zone 2. It is remarkable that the Roman finds have an 'early' distribution, as do the coins: the area on the riverbank and the beginning of the riverbed. Here too, the question of whether the Roman material was still in circulation in the 7th and 8th centuries is apt.
Funnel beakers were numerous throughout zone 2, except for Hoogstraat 0, though this may be coincidental. In addition, the funnel beaker was also well represented in zone 3, especially in Hoogstraat I. The explanation for this would appear to be that zone 2 probably remained in use everywhere until the 9th century, but only in Hoogstraat I and adjacent sectors were the structures extended in this area in the 9th century. The inverted rim was found relatively often in funnel beakers from the Hoogstraat area. In fact, these beakers occurred everywhere there, except once again for Hoogstraat 0, where no rims of funnel beakers were found. This may be an indication that the Dorestad funnel beakers should not be dated late: to the late 8th (last quarter?) and 9th century (first half or third quarter) rather than to the (late 9th and) 10th century. An argument to demonstrate that the activities in the Hoogstraat I area (and adjacent sectors) possibly continued longer than in the

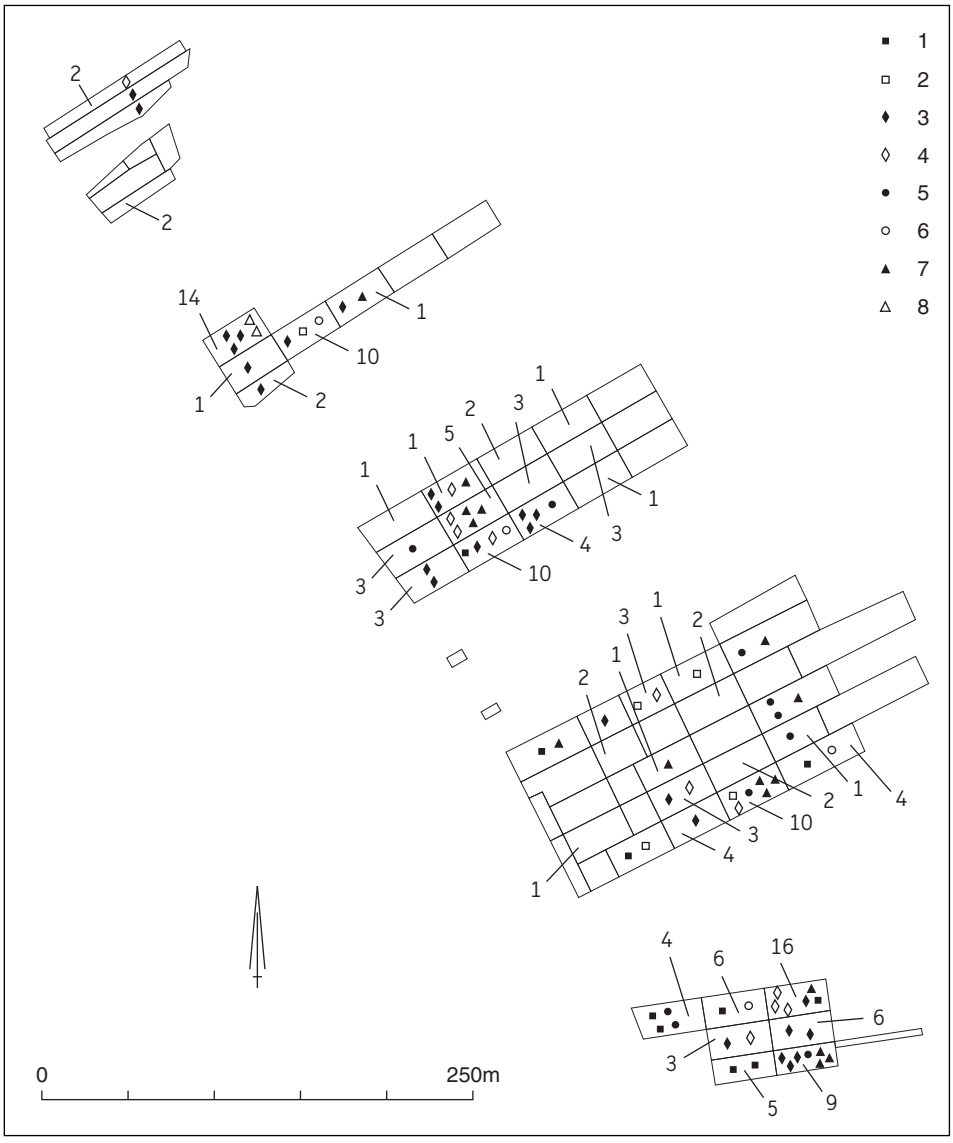


Fig. 248 Dorestad, Hoogstraat 0-IV: overall distribution of the glass finds.
Legend:
1 Roman;
2 Merovingian;
3 palm cups;
4 palm cup or funnel beaker, horizontal moulding;
5 jars;
6 bowls;
7 smoothers;
8 tesserae.
Arabic numerals indicate the number of funnel beakers per trench.

sector north of the southern part of Hoogstraat II, is the fact that the end of the development in Hoogstraat I was surprisingly clearly marked by the (late) jars. The zonal distribution-pattern of the funnel beakers shows, on the one hand, a degree of similarity with late pottery types such as W II and roulette decoration, which was to be expected in view of the date (fig. 249). On the other hand, the picture of the zone on the riverbank (zone 1) is deviant. In the case of Hoogstraat IV, II and III, the frequency of occurrence of the funnel beakers corresponds more to that of early pottery types, whereas in Hoogstraat 0 and I it corresponds more to the 'late' types. These differences are possibly connected with differences in function of glass and pottery. Pottery sherds may be production waste, but (with the exception perhaps of handmade pottery) this was not the case in the Dorestad area. By far the majority of pottery sherds there clearly belonged to the settlement refuse, which was of no further value and therefore probably remained near the place where the pottery had been used and was broken. This is why pottery sherds generally indicate habitation, and often provide indications for the duration or intensity of occupation at a certain spot. Broken glass, on the other hand, has more value: it can be re-used for the production of glass objects. A concentration of glass fragments may

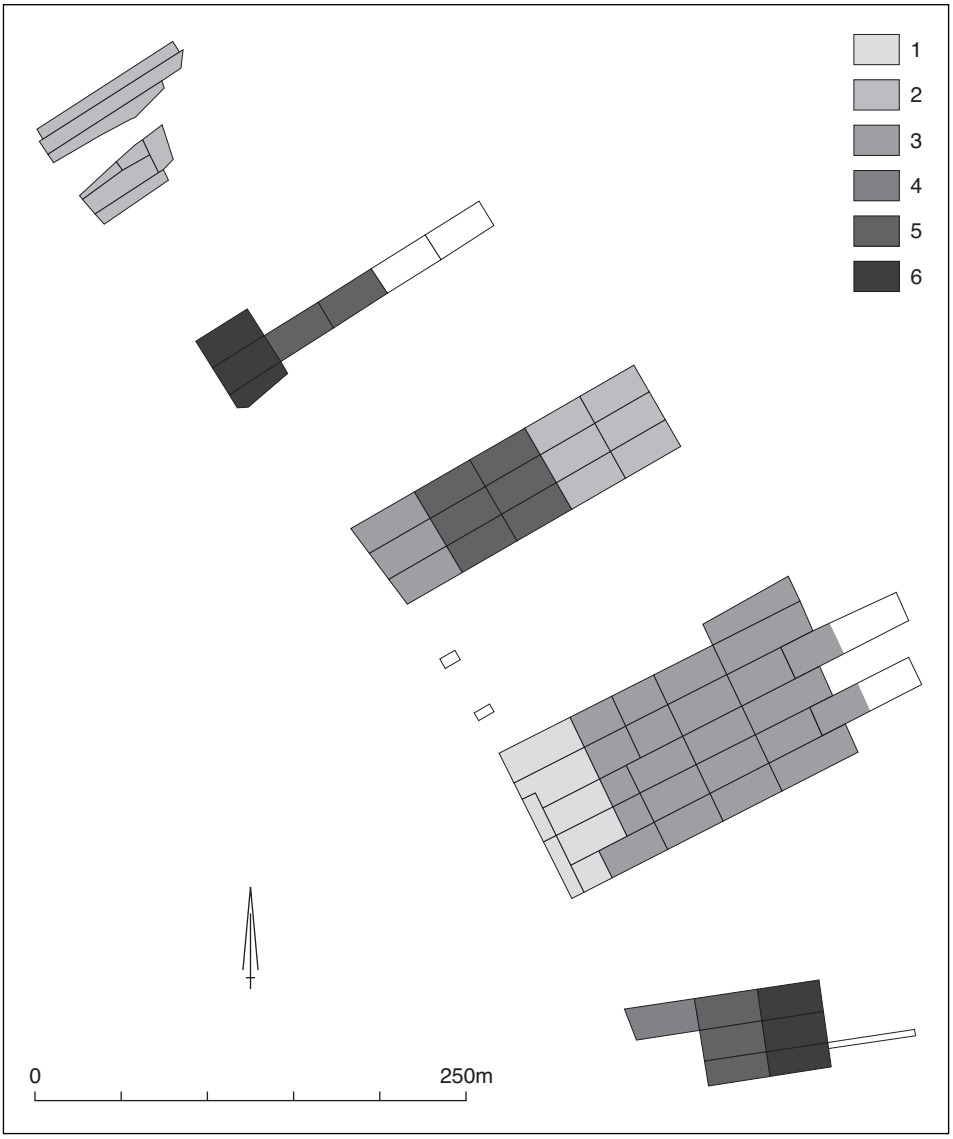


Fig. 249 Dorestad, Hoogstraat 0-IV: frequency of glass funnel beakers per zone; N=*c.* 165 items, average per trench 3.3.
Legend:
1 < 0.5;
2 0.5-3.3;
3 1.9-3.3;
4 3.3-7.1;
5 5.2-7.1;
6 > 7.1.

therefore point to a specific form of occupation: the remains of a glass workshop, for instance. Glassworkers= workshops would have been of a temporary nature, and were undoubtedly less regularly distributed than 'ordinary' houses. Thinking along these lines, we may have to consider the presence of glassworkers in, for example, the riverbank area of Hoogstraat IV with its high frequency of glass finds, over a (short?) period: at the end of the 8th or in the (early) 9th century. It is perhaps not just due to coincidence that the only two *tesserae* originated from the riverbank area of Hoogstraat IV. The possible presence – we will never be sure – of glass producers at one or more places in the riverbank area in the 9th century must prevent us from drawing any (premature) conclusions about this zone on the basis of the pottery finds from the pits (see chapter VII 3.2).

VIII The exploitation of the bed of the Rhine along Hoogstraat at the time of Dorestad

1 The development of the meander east of Hoogstraat

The Rhine meander east of Hoogstraat started to develop at the time of Dorestad. Whereas the left bank of the Rhine still ran directly along and partly even under the present Hoogstraat in the 7th century, by the 9th century it had shifted some 200 m eastward at the site of the Hoogstraat I and -II excavations. Nor did it stay there: within a relatively short period the river shifted another 500 m eastward, creating the wide bend still present in a fossilized form in the landscape. The fossilization was the result of the damming up of the river Kromme Rijn at Wijk bij Duurstede in 1122.[415] Afterwards, the course of this river only changed as a result of human intervention.

The formation of the meander at Hoogstraat was one of several radical changes in the courses of the river at the point where the most northerly branch of the Rhine, the Lower Rhine, split into the Kromme Rijn and the Lek. The latter branch of the Rhine is generally assumed to have existed in the Roman Period. Since then, the Lek became increasingly important, and after the Dorestad period, it took over from the Kromme Rijn the function of draining water from the Lower Rhine. The volume of the Kromme Rijn must have decreased so much that it became possible to dam it. An attempt has been made to outline the whole process in figure 250. It is obvious how hypothetical in many respects this reconstruction is. The courses of the rivers Rhine and Lek have been indicated at the time of Dorestad and at the beginning of the 12th century, when damming up had taken place. In addition, a section of the course of the Kromme Rijn has been shown from the final phase of Dorestad, around 900 AD. Only the reconstruction of the Hoogstraat area offers any certainty. The starting-point and intermediate stage there are known from the excavations, and the final stage at the beginning of the 12th century has remained unchanged. Immediately south of Hoogstraat, traces of the development have largely been obliterated, among other things by the development of the town of Wijk bij Duurstede at this spot. Nevertheless, excavations at the western edge of the medieval town centre have revealed part of the latest, 12th-century course of the Kromme Rijn.[416] For the rest, figure 250 is based entirely on hypothesis. The location of the *castellum*, though based on archaeological data,[417] is not certain either. The figure may help to explain the essence of this natural process of change.

The meander at Hoogstraat must have been the mirror image of an adjoining bend in the river to the south which broadened westward instead of eastward. The two curves in the Rhine were situated a short distance from the fork of the Kromme Rijn and the Lek, at the precise spot where the Kromme Rijn branched off to the northwest. At that turning-point there were two so-called point bar areas (areas within a meander loop) which probably both developed in the Late Merovingian Period. The north point bar area was brought into use in the Dorestad period, when it was in the first stage of its development. We do not know what happened in the south point bar area at the same time, but we assume that there was settlement on

415 Dekker 1980 and 1983, 98-117.
416 So far, only preliminary reports on the excavations in the town centre of Wijk have been published: see, for example, Verwers 1994, 234-8 and Van Doesburg 1994, 239-41.
417 Van Es 1984.

the left bank of the Kromme Rijn during the Dorestad period: *i.e.* beyond the point bar area, and on the bank which was being eroded by the developing south meander. Only when this process of development had been concluded did conditions become favourable enough for the town of Wijk to grow up. By then, the north point bar area had already been largely abandoned, except for the southernmost part – around Hoogstraat III and further south – where occupation continued until the second half of the 12th century, with or without interruptions.
The development of the two meanders at the turning-point of the Kromme Rijn went hand in hand, we assume, with a westward shift of the fork of the Kromme Rijn and the Lek. The development of both curves shortly after the bifurcation had a negative influence on the drainage capacity of the Kromme Rijn, causing the Lek to increase in volume. A result of this was that the latter shifted the fork downstream (in a westerly direction). The local Roman frontier fort of Levefanum probably fell victim to this development. When this took place is unknown: but it would undoubtedly have been after the Dorestad period, so not before the late 9th or the 10th century. In our reconstruction we have allowed the *castellum* to be engulfed by the Lek before 1122, but it is possible that this occurred at a later date.
If we confine ourselves to the Dorestad period, we observe a positive development in the Hoogstraat area: land accretion in the north point bar area. In the south point bar area, however, a negative development from the point of view of Dorestad probably took place. At any rate, land there was lost through erosion on the left bank of the Kromme Rijn – in an area that was possibly inhabited. If this assumption is correct, the balance for the inhabitants of Dorestad was roughly nil. The accretion in the north point bar area was not pure gain, but it could compensate the loss in the south point bar area.

2 Aim and use of the structures in the riverbed

2.1 Introduction

In the book on the Hoogstraat-I excavation, published in 1980, we assumed that the structures in the riverbed were mainly, if not exclusively, to be explained by Dorestad's function as a harbour. We regarded them as dams made of earth and wood, not as jetties in the true sense of the word. According to this view, they were rather roads which had been raised due to the damp subsoil in the riverbed, and which – possibly paved with wood – served to ensure a good connection between the

Fig. 250 Dorestad: reconstruction of the changes in the courses of the rivers Rhine and Lek; scale 1:50 000.
Legend:
1 (presumed) wooden construction in the riverbed;
2 presumed location of Roman castle;
3 (presumed) courses of the rivers Rhine and Lek at the time of Dorestad;
4 idem *c.* 900 AD;
5 idem *c.* 1122.

settlement on the left bank of the Rhine and the river beach on which the ships landed, and which was constantly shifting further away. It was assumed that one or two of these dams belonged to each house situated directly on the riverside of the settlement, becoming as it were a kind of private property: a platform between house and harbour which could be used to reach the moored ships to load and unload them. The question whether the ships could only moor at the heads of the dams or also alongside them could not be clearly answered. Goods could be temporarily stored on the platforms, possibly in sheds where passing merchants could perhaps also lodge for a while. We did not consider it likely that accommodation would have been available for longer periods – let alone permanently occupied houses – since we assumed that the relatively loW-lying point bar area regularly had to struggle with flooding or floating ice. Succinctly formulated, in earlier publications we regarded the section of the point bar area along Hoogstraat which was exploited by the inhabitants of Dorestad as a traffic area and not as a settlement area.
The line of thought referred to above was in fact based on more or less implicit hypotheses. Now that the data from the other Hoogstraat excavations are available in addition to those of Hoogstraat I, it is advisable to carefully reconsider the function of the riverbed structures. This will be done in the following sections on the basis of considerations relating to the riverbed area and on the basis of the finds.

2.2 The riverbed area: a separate unit in the settlement

Analysis of the settlement traces in the riverbank area of Hoogstraat 0 and IV has shown that the parcellation of the bank continued into the riverbed, though not without interruption (see chapter V 3.2). The edge of the riverbed was marked by a row of pits, possibly accompanied by a road on the land side. This row of pits is comparable to the row of pits discovered along the sides of the house plots. It may also have formed part of a parcel boundary which, in this case, ran from north to south and was at right angles to the house plots. In other words, the terrain in the riverbed was separated from the house plots on the bank by a parcel boundary, which in turn implies that the occupied area in the riverbed was a separate unit within the settlement. The parcels in the riverbed, therefore, need not necessarily have belonged to the house sites which were situated at the front of the bank. Consequently, it is less likely that both had the same owners or users. The previously assumed function of connecting roads between the river beach and houses on the 'original' riverbank now appears far less probable.
The building and digging activities in the Carolingian part of the Rhine point bar area east of Hoogstraat could be described as a system of land improvement by means of – partial – soil raising. Comparable methods of artificial land raising in or along beds of the Rhine were already employed in the Netherlands by the Romans. We shall discuss below three examples from the immediate vicinity of Roman frontier forts.
- The first example is De Woerd, part of the *castellum* complex of Valkenburg (ZH) which is identified with Praetorium Agrippinae on the Peutinger map.[418] The core of De Woerd – the name refers to an (artificial) hillock – is formed by an artificial mound dating from the middle of the 1st century AD. This core developed in the fork of a bed of the Oude Rijn and a tributary. According to the excavator: … *the work of heightening was preceded by the building of a series of wattle-fenced enclosures. Subsequently, every enclosure was filled with sods of sandy clay up to the required level*. This basically corresponds to our picture of the structures in the riverbed at Dorestad. The height of the enclosures in De Woerd is not mentioned, but they cannot have been high since they linked up with a *low dike*, which served as a road along the bank. In the trenches along this road, *long rows of revetment stakes* were found. The raised terrain was over 1 ha in size, and served as a vast quay at a landing-stage. Originally the quay had a number of granaries on it, and after a substantial expansion, even a complete settlement.

418 *Sarfatij 1977, 161.*

- What took place at the Roman frontier fort of Zwammerdam, the Nigrum Pullum on the Peutinger map, is far less clear.[419] There, a more than 600 m-long section of the bank of the Oude Rijn in front of the fort is said to have been shifted forward over a distance of (far?) more than 20 m as a result of artificially filling up the riverbed. This heightening amounted to at least 1–2 m. It is assumed that it took place in a 40–50 m-wide side branch of the river, not in the main bed. In the raising process, which, according to the excavator, was meant to create quays, pointed wooden stakes were used, the same size as those used in the riverbed at Dorestad. Wicker mats laid horizontally were also used there – did they serve as paving to reinforce the surface, as we assume was done in Dorestad? No further details about the wooden structures in the riverbed are known from Zwammerdam. It has been suggested that the filling up of the riverbed there took place in strips parallel to the riverbank. However, the excavation data are too scanty to exclude the possibility that compartments were also employed in Zwammerdam.
- In our third example, referring to (an arm of) the Kromme Rijn at the *limes* fort Vechten, or Fectio on the Tabula Peutingeriana, the compartments were certainly used.[420] On various occasions discoveries were made of: … *upright and horizontal posts and stakes in association with layers of debris. They were arranged in rows bending at right angles, running perpendicular to and parallel with the bank. …. the structures formed by them cannot have served as landing-stages or quays for the mooring of ships. … The structures discovered probably had the function of containing the soil used for filling up the riverbed. …. These operations should be regarded as an intentional extension of the south bank, carried out systematically and possibly parcel by parcel, which eventually resulted in the river being dammed completely…. Land hunger (in the civilian settlement near the castellum?) will undoubtedly have been an important factor. Military considerations and the possibility of more adequate water-control may also have played a part*. In this case too, it probably concerned one of the Rhine beds, not the only one. During recent excavations over 200 m east of the site described above near the fort, similar features were observed.[421] The raising of a Rhine bed had therefore already reached a large scale in Roman Vechten. Hardly any details of the excavations at Vechten have yet been published, but even so, the similarity to what later took place in the riverbed at Dorestad is evident.

How old this system of heightening was, is unknown. Theoretically, it could be earlier than the Roman Period, since it is an obvious method. Nevertheless, the degree of organization of the indigenous society prior to the arrival of the Romans would have been too primitive for this kind of work to have been carried out on a large scale, and no older examples are known. It will certainly not have been coincidental that the examples known are all from the *limes* zone: the Roman army had the required know-how and labour force. Moreover, there was much low-lying land along the *limes* river, and it is not unlikely that this method of soil improvement was introduced into the Netherlands by the Roman army. The scale on which it was employed in the *limes* territory of Lower Germany cannot be precisely ascertained. In Valkenburg-De Woerd and Vechten, it concerned areas of several hectares. The works in the northern part of Dorestad were on a similar scale, covering a surface area of at least 10 ha. The exact size has not been established, but it may have been much in excess of the 10 ha mentioned. It would appear that, in certain aspects, the Dorestad complex had a different structure, for instance: the extremely systematic parcellation, the soil extraction within the area which was to be raised, and – possibly also – the abundant quantities of wood used. It is clear that the raising of the terrain involved an enormous investment, which makes the question of the purpose of this enterprise all the more weighty.

419 Haalebos 1977.
420 Van Tent 1973 (quotation on p. 129).
421 Polak & Wynia 1991, plate 1: east of E.

2.3 The nature of the finds from the riverbed area

2.3.1 Introduction

This section deals with what the finds tell us about the activities on the raised terrain in the point bar area bordering Hoogstraat. The finds have already been divided into three categories (chapter V 4.3.2). The first category comprises refuse from ordinary household activities: pottery, slaughtering debris, and glassware (*cf.* chapter VII 3.4.4). The second consists of waste from industrial processes: loom weights and spindle whorls, slag, worked bone and fragments of amber. The remaining category combines all objects which may originate from the first or the second category: lumps of softly fired clay and daub, unworked stones, all finished objects of metal, stone or bone in contrast to rough-outs, which belong to the second category. This classification is only a rough approach, although it suggests a high level of accuracy. Even with the finds belonging to the first two categories, it is by no means always certain which activities they refer to, nor is the list of activities exhaustive. In the case of areas situated directly on the river, activities connected with water, such as shipping, transport and fishing, would certainly be involved. Pottery sherds found there could indicate both settlement (domestic refuse) and shipping or transport (refuse from skippers' household utensils or remains of broken cargo). Basically, the indications shown by the finds with regard to the activities at a certain location are always more or less ambiguous.

There is an additional problem with the raised area in the riverbed. It is not altogether certain that the material found there actually came from local activities. In our book on Hoogstraat I, we assumed that this was not the case. At the time we thought that the riverbed had served as a refuse dump for the settlement, and that (almost) everything found there must have originated from the actual settlement area on the riverbank. This hypothesis requires modification, to say the least. It did not arise from an analysis of the finds, but was connected with our basic assumption that the dams in the riverbed – one might also say: the raised parts of the parcels in the riverbed – were not used for occupation. As stated above, this hypothesis is, in our view, no longer tenable, at least, not in this form.

2.3.2 Loom-weights and stone finds

The function of the area west of Hoogstraat on the left bank of the Rhine has been established. The features excavated, such as wells and house plans, show that this was a settlement area. Comparison of the finds from this area with those from the riverbed is not possible for the majority of types as long as the bulk of the finds from the settlement on the riverbank have not been analysed. However, thanks to the work of Kars, we can compare the loom-weights and stone artefacts (including amber objects).[422]

The distribution of the loom-weights over the excavation trenches shows that the density of finds in the riverbed corresponds well with the front part of the settlement on the riverbank.[423] In the north of the excavation site this front section was about 150 m wide (measured from the original riverbank) increasing to about 300 m in the south. West of this strip, *i.e.* at the rear of the settlement, the density of finds dropped fairly abruptly, except for the south part of the excavation area which was situated behind Hoogstraat I. As far as was investigated, the settlement there reached its widest point, while the density of finds remained constant up to a distance of over 400 m from the riverbed. This part of the settlement may have been of more than average importance, though the details are not yet known. In the riverbed area (see also fig. 251) concentrations of loom-weights were found in Hoogstraat 0, IV and II, at the front of zone 2, in other words, the raised area. In Hoogstraat I, where the raised part was roughly twice as wide, they were distributed more regularly and less densely over zones 2 and 3. A possible explanation for this

422 *Kars 1984.*
423 *Kars 1984, fig. 35.*

phenomenon is that the process of deposition in Hoogstraat 0–II continued for a longer time in zone 2 than in Hoogstraat I. The density of these loom-weights in Hoogstraat III zone 3 is moderate compared to that of other finds. It probably means that this type of loom-weight was no longer used after the Carolingian Period (the later occupation observed here did not cause a disproportionate frequency of finds). Finally, the loom-weights also proved to be relatively well represented in zone 1, which is the foremost section of the settlement on the bank.
The similarity in density of loom-weight finds in the riverbed and in the eastern part of the settlement on the riverbank is an indication that the finds in the riverbed are probably not refuse from elsewhere in the settlement area. One might expect this refuse to originate particularly from settlement areas situated close to the river. In the foremost part of the area on the riverbank, the find frequencies are roughly as high as in the riverbed, and only at the rear are low frequencies encountered. However, this is more likely to be due to a less intensive use of the loom-weights there, than to refuse being specially brought to the river from the farthest part of the settlement.
There is another indication that the loom-weights from the riverbed can be related to certain local activities. Kars states that almost 10 % of the loom-weights from Hoogstraat I were discovered intact; the rest consisted of large or small fragments. A ratio of 1:10 between complete and broken specimens would appear to be above rather than below average for the entire excavation. One would not expect this to be the case if the loom-weights in the riverbed originated from elsewhere. These artefacts of softly fired clay are rather fragile, so a relatively high percentage would have been broken if they were moved.
The loom-weights form a large group with a total of over 2000 finds. According to Kars, approximately 40 % came from the riverbed, where we counted *c.* 950 specimens (fragments and complete items together). Loom-weights point irrefutably to craft activities. However, it is likely that the textile industry in Dorestad was not, or at any rate, not yet purely the work of specialists, practised exclusively in special workshops in separate parts of a settlement. There may have been a certain degree of specialization, for instance in the production of finer materials. This cannot be established due to the lack of sufficient textile finds. In addition, cloth would also, or mainly, have been manufactured in the home, for example, on a farm. The latter is generally accepted in the case of 'Frisian cloth-weaving'. That this also applied to Dorestad is apparent from the uninterrupted distribution of loom-weights throughout the entire settlement area. They were apparently connected with an activity which occurred everywhere, and probably also on the raised area in the point bar of the Rhine in front of the original bank. Compared to the foremost half of the settlement site on the bank, the loom-weights here were certainly not under-represented, but were a very common feature here too.
It is quite probable that the pattern of pottery distribution over the riverbed and bank largely corresponds to that of the loom-weights. At any rate, the zonal distribution of the loom-weights in the riverbed and riverbank areas, as shown in figure 251, does not differ much from that of the control group as shown in figures 237 and 238, which consists of pottery sherds. Only in the riverbank area did the loom-weights tend to be clearly over-represented. The pattern in zones 2 and 3 is very similar. It looks as if there cannot have been a significant difference in the way in which the loom-weights and the pottery were deposited in the raised area east of Hoogstraat.
Up to now, the stone weights are the only worked finds which show a clear difference in distribution between the riverbed and the bank areas.[424] They form a small group – the complete specimens amount to less than 60 altogether – but it can hardly be coincidental that the stone weights were found everywhere in the riverbed, while in the settlement area on the bank they only occurred on the northern edge and mainly in the broad southern section. The weights appear to have been made from very different

424 Kars 1984, fig. 33.

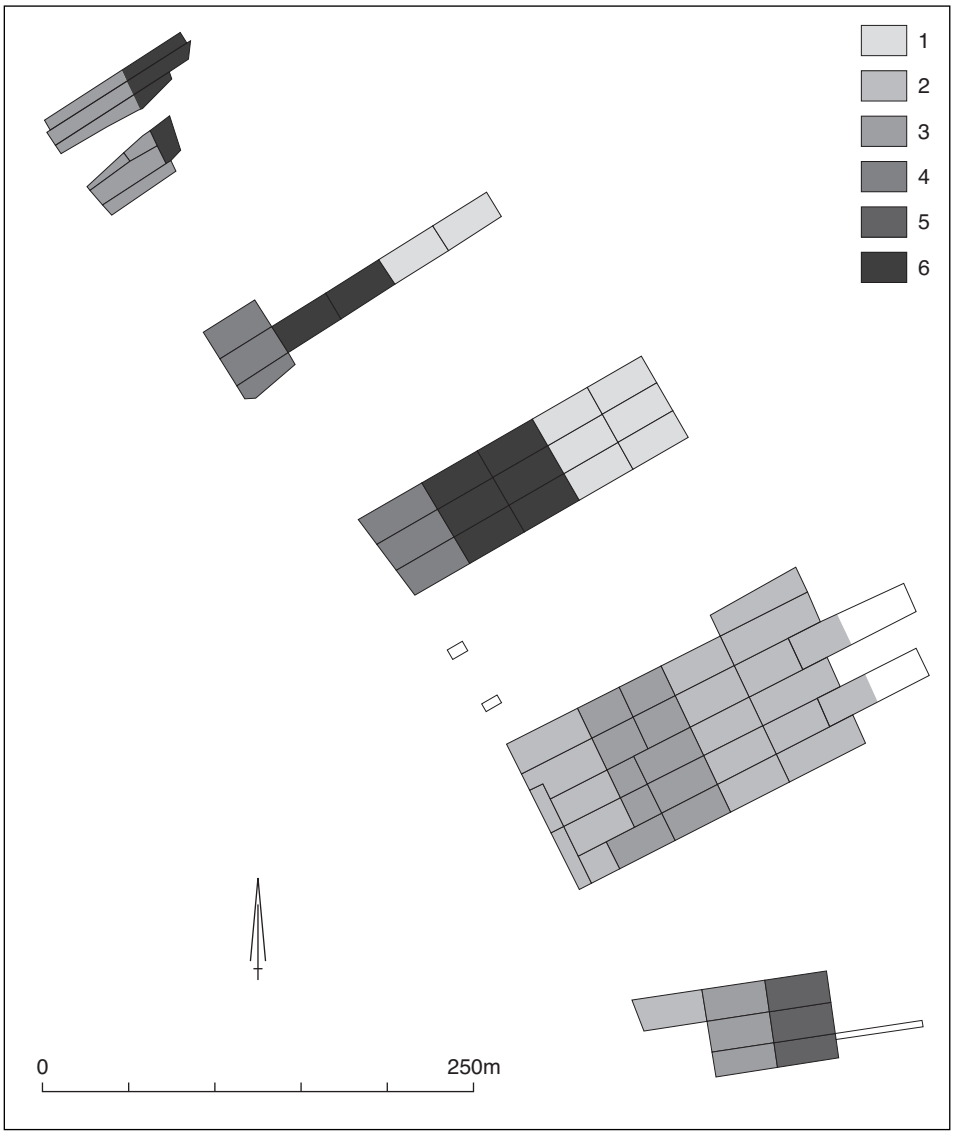


Fig. 251 Dorestad, Hoogstraat 0-IV: frequency of loomweights per zone; N=947 items, average per trench 19.9.
Legend:
1 < 3.3;
2 3.3-19.9;
3 11.1-19.9;
4 19.9-41.5;
5 30.7-41.5;
6 > 41.5.

types of soft stone and often from older artefacts, such as Roman building stones and early-medieval mortars, querns and even a sarcophagus. From these data, Kars has concluded that the weights must have been made locally; whether this refers to do-it-yourself activities of the inhabitants or to a more specialized production is uncertain. Specialized skills would hardly have been required for the manufacture of these simple objects, but their production may well have been a sideline for stonemasons who were mainly engaged in finishing querns or making mortars.
The function of the weights has been convincingly demonstrated by Kars: they were used in fishing, as sinkers of a so-called seine net or as weights at the end of a heaving-line. The fact that by far the most were found intact brings Kars to the conclusion that this was not just *ordinary refuse*, but that one has to assume *a close relationship between use and (find) location*. Various explanations are feasible for the deviant distribution pattern. The over-representation of weights on the raised part of the riverbed cannot have been caused by anything other than fishing. Both sea and freshwater fish were certainly eaten in Dorestad, although determining the quantities consumed is still largely guesswork.[425] It is quite possible that fish was an important constituent of the diet at the time. It is even possible that people already

425 Prummel 1983, chapter 6, particularly tables 110 and 111.

knew how to preserve fish by salting it; in which case, there may even have been a 'fish-processing industry' there.
At any rate, fishermen certainly formed part of the local population, either as professional fishermen or as people who fished as a sideline. One can almost envisage them operating from the raised parts of the parcels in the riverbed. The little boats with which they sailed upriver could be moored in the open parts of the dug out 'ditches' between the raised parts of the parcels. However, the activities of the fishermen on the parcels in the riverbed do not necessarily imply a long stay: it is possible that they lived on the bank. The finds in the southern part of the settlement behind Hoogstraat I may imply that fishermen who made their own net weights lived in this area. A striking fact, however, is that there was also a concentration of finds situated right at the back of the settlement. Did fishermen living there have to be able to reach the watercourses in the hinterland quickly, or did the concentration of finds reflect a 'specialist' workshop producing weights for fishermen? The stone weights at any rate show that the finds in the riverbed should not be regarded just as refuse from elsewhere.

The situation also requires some thought in the case of the quern finds. Their numbers are considerable: the fragments found, which amount to over 1000, may derive from some 500 specimens.[426] In an in-depth analysis, Kars has established that *c.* 70 % of these come from hand-mills worn out in domestic use (household refuse) and the rest from new specimens which had not yet been brought into circulation. The latter point to trade – in which case the stones would have been broken during storage or transport – or to stone-cutting – in which case the fragments would have originated during the finishing of rough-outs. New stones or fragments of them can be distinguished from the old, useless hand-mills by their thickness.
The distribution of the quern fragments reminds one very much of that of the loom-weights: these were found almost everywhere in the riverbed and in the adjacent front part of the settlement area on the bank (with the possible chance exception of the extreme northern part of the riverbank zone). The southern part of the distribution area behind Hoogstraat I stood out in this case too for its greater width. Querns were apparently often used in Dorestad: it is assumed that every family had one. This is possibly also linked with Dorestad's function as a trade and craft centre. At any rate, these functions are accentuated by the rough-outs and thick fragments discovered. They probably occurred more frequently on the raised part of the riverbed than on the bank: of the 14 rough-outs found, 11 are from the riverbed area. Thick fragments from the riverbed are over-represented (thickness coefficient 0.62, as opposed to 0.43 of those from the settlement area on the bank), but this difference is not considered significant. However, it is significant in the case of the thickness coefficient for the finds from Hoogstraat IV (4.85), where fragments of used specimens appeared to be almost completely lacking, and also in Hoogstraat I used fragments would be under-represented. On the basis of these differences Kars states: *Quern refuse was probably dumped near the place of employment*. This is again an indication that one should not automatically assume that the finds from the riverbed are refuse brought in from elsewhere.
The commercial or craft function is not exclusively linked with the area in the point bar. The cause of the difference in composition of the material from Hoogstraat IV was mainly due to an extremely high concentration of finds, right at the transition from riverbank to riverbed. This must imply the proximity of a trader's warehouse where querns had been broken during loading or unloading, or there may have been a stone-mason's workshop nearby. In the latter case, which seems more probable, the finds could be interpreted as refuse from stone-cutting or as the remains of a supply of unfinished querns. This workshop may have been located either on the bank or at the front of the riverbed. Another very high concentration of finds in Hoogstraat III did not yield much reliable information, since it could have been

426 Kars 1984, fig. 3.

caused by later habitation. The third high concentration was situated in the middle of the settlement on the bank behind Hoogstraat I, and only in this case is Kars completely convinced of the presence of a workshop. The processing of querns therefore certainly took place in the settlement on the bank. That it also occurred on the raised area in the point bar is possible, but no work- or storage places could be localized with absolute certainty. Incidentally, a concentration of the second category of finds was discovered in Hoogstraat II, as was another one in the riverbank area of Hoogstraat III, and a few more in the south on the bank.
The presence of tephrite fragments without any trace of processing is shown separately on Kars' distribution map in his figure 3. Tephrite is the lava rock quarried in the Eifel from which the querns were made. It is, therefore, reasonable to assume that these fragments also come from querns. Kars remarks that: *.... the finishing of rough-outs at Dorestad could have produced some 'unworked' fragments*. Fragments without traces of processing may therefore originate from industrial or commercial activities; most of them, however, did not. If we consider them to be fragments of *used* querns which were too worn or too small to reveal traces of working, part of this 'unworked' material may be regarded as household waste, thus constituting an indication for normal occupation. It is unfortunate that here too the functions are again confused, for the distribution is remarkable. With one exception, in Hoogstraat 0, the 'unworked' items were only found in Hoogstraat I (plus the southeast corner of Hoogstraat II) and in the part of the settlement area on the bank behind, right up to the rear (west side). As to what this signifies, there is no straightforward answer. Were the industrial or commercial activities concentrated in this sector of the settlement, and were they also found on the bank and in the point bar area? Was occupation in this sector more intensive and more prosperous, and/or did the activities in question continue longer? At any rate, it is remarkable that the Hoogstraat I–II sector in the riverbed showed a clear similarity to the sector behind it on the bank with regard to one detail of the distribution of finds. In our view, there is no reason to interpret this pattern of distribution as a sign of refuse dumping in the riverbed. It points rather to the fact that, in both sectors, the deposition of finds was affected by the same factors, or, more concretely: it indicates that the activities on the riverbank and in the riverbed did not fundamentally differ.

The distribution pattern of the stone mortars does not provide any new perspectives for answering the central issue in this section, namely: was the find material in the riverbed refuse brought in from elsewhere?[427] The mortars represent both the commercial and the production aspect as well as private use (habitation), as do the querns. These stone products were manufactured locally from used material, especially limestone and, to a lesser extent, sandstone, which had already been imported and used in the Roman Period. The great variety of sizes and forms would indicate a considerable production of the various workshops in Dorestad. The distribution pattern of the finds does not clearly show exactly where these workshops were situated. Only that of Hoogstraat 0 stands out for its relatively high density of finds. The density is low everywhere else, and moreover, the finds were fairly regularly distributed over the excavated area. There do not appear to be any important differences between the area in the riverbed and that on the riverbank. Due to the rather small quantity of finds – *c.* 200 finds indicating *c.* 100 specimens, six of which are still intact – the distribution pattern shows quite a number of gaps. Conspicuous gaps were observed at the northern end, apart from Hoogstraat 0, and especially the western part of the settlement behind Hoogstraat I. Also remarkable was the fact that the sandstone mortars were irregularly distributed. They mainly occurred in the far north and south of the excavated area. These phenomena possibly have a partly chronological cause.

427 Kars 1984, fig. 72.

Over 80 % of the mortars are of limestone. Kars assumes that they were used in the kitchen as mixing bowls, *e.g.* for making sauces. The use of mortars for this purpose – elsewhere wooden bowls would have been used – is typical of the high standard of living in Dorestad; they were probably prestige objects. From their numbers and from their patchy distribution over the excavation area they do not appear to have belonged to every kitchen in Dorestad either. For that matter, the population of Dorestad was possibly the assumed local workshops' own best customer. The mortars do not appear to have been a major export article: similar specimens are unknown elsewhere, apart from Deventer. Consequently, it is questionable whether production of these artefacts in Dorestad was indeed extensive. It is conceivable that it was mainly a local initiative: possibly imitations of mortaria, which were made elsewhere of a different type of stone (for instance, sandstone?). Perhaps the local production did not last very long, and people became dependent again on the import of sandstone mortars. This – entirely speculative – model may explain an early and a late presence of relatively few sandstone mortars, with an intervening period of prosperity of the relatively cheap local mixing bowl. The manufacture of this type of product from Roman limestone fragments will have required a certain knoW-how and technical skill. The fact alone that these were to be found in Dorestad points to the special position of this town in the field of crafts and trade, even if production was not very extensive. If one looks for production centres inside the distribution pattern of the stone mortars, one need not expect any high concentrations. On the basis of the fact that such remains have been found there in a large continuous area, the front part of the settlement area on the bank, which is situated behind Hoogstraat I, could be considered a likely candidate. Other types of finds from this area indicate the possible existence of one or more workshops. Another continuous area of limestone mortar finds was Hoogstraat II zone 2, *i.e.* the front section of the raised terrain in the riverbed. Actually, Hoogstraat III (zones 2 and 3) was another such area.

The approximately 400 grindstones or whetstones were scattered over the entire excavation site,[428] so it is almost certain that every household possessed at least one. This, of course, only refers to the type most commonly found: the naturally formed grindstones which could be encountered ready made among the river boulders used in Roman walls. This common type must have been easily obtainable and was therefore probably a cheap article. Far more rare (*c.* 15 % of the total) were the artificially fashioned grindstones of stone which originated from usually distant quarries situated in, for example, Kent, Eidsborg (Norway), other locations in Norway or Sweden, and finally, possibly the Ardennes. These were probably high-quality tools for professional use. It is likely that these – expensive – grindstones were used in Dorestad. On the basis of the find of two rough-outs it may be concluded that this type of grindstone was made, or at least finished here. There are various possibilities for interpreting them in terms of activities: as a smith's tools and/or a grindstone-maker's supply – possibly both these craftsmen had come to Dorestad from distant parts. One might also consider these objects to be the tools of foreign ship's crews. Kars has analogously explained the three or four fragments of soapstone vessels as the remains of cooking-pots from Scandinavian ships. The export of soapstone vessels to Dorestad would not have been very attractive at the time because of fierce competition with the wheel-thrown pottery from Badorf and Mayen. Judging from the distribution pattern of soapstone – in Hoogstraat III and at one spot in the settlement even further to the south (on the corner of Steenstraat) – it is possible that the deposition of the soapstone fragments took place after the Dorestad period.
The professional grindstones were relatively very well-represented in the raised section of the riverbed.[429] They were about three times as numerous there as in the foremost strip of the settlement area on the bank. Characteristic were the very

428 Kars 1984, fig. 119.
429 Kars 1984, fig. 120.

striking concentrations of these finds in the Hoogstraat II, I (southern part), and Hoogstraat III excavations. The latter concentration perhaps partly consisted of *Post*-Dorestad specimens. The other two undoubtedly all dated from the Dorestad period. In both of them a rough-out was found, and in the Hoogstraat I concentration also two *tuyères* (one of which was of soapstone). The Hoogstraat II concentration included two rotating grindstones, which were probably professional tools. Specimens of this kind of grindstone were also found elsewhere: one in Hoogstraat III, and five more in the front part of the settlement, usually close to a concentration of grindstones. The concentrations in the riverbed area were almost always accompanied by high concentrations of slag (fig. 252). The sole exception was the Hoogstraat I area, possibly due to the less intensive collection of this type of find. As we have observed, the professional grindstones here were relatively numerous. Until the slags have been analysed further, their significance is limited, although they do include specimens which at any rate indicate metalworking. All in all, with the grindstones, *tuyères* and slag we have a complex of finds which provides clear evidence for craft and/or trade activities.
Similar finds complexes were in fact found throughout the riverbed.

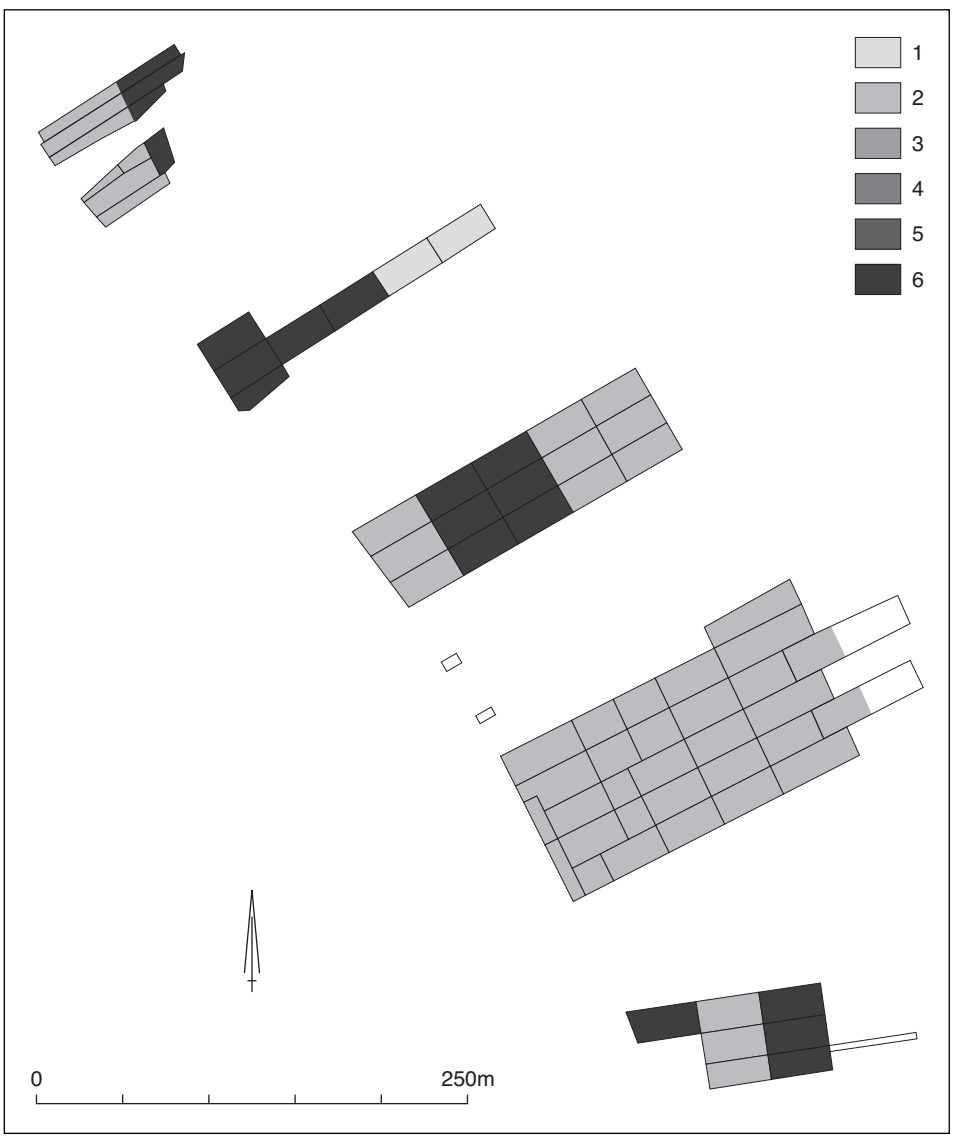


Fig. 252 Dorestad, Hoogstraat 0-IV: frequency of slag per zone; N=858 items, average per trench 18.0.
Legend:
1 < 3.0;
2 3.0-18.0;
3 10.5-18.0;
4 18.0-36.2;
5 27.1-36.2;
6 > 36.2.

They also occur in the front part of the settlement, judging from the rotating grindstones, professional whetstones, and high concentrations of 'ordinary' whetstones found there. Metalworking undoubtedly took place there, on the bank; why should this not have been the case on the raised part of the riverbed? On the other hand, the distribution of the grindstones does not provide absolute evidence to support such a hypothesis. The possibility remains that all the workshop refuse was transported from the settlement to the area in the riverbed, though it requires a good deal of imagination to envisage this situation. In view of the location, the remarkable concentration of 'professional' grindstones – including a relatively large number of Scandinavian (?) greenish quartz phyllite – in the southwest part of the excavation area behind Hoogstraat III, could be a late feature from the Post-Dorestad period. The distribution of the largely or entirely late-medieval roof-shingles of shale also revealed a remarkable concentration in the same area.[430]
The unworked stones constitute a very large group of finds: *c.* 4800 items. They were undoubtedly salvaged from Roman walls and were found throughout the excavated area. They produced the familiar picture of dense concentration in the riverbed, in the adjacent strip of the settlement on the bank and in the broad section of the settlement behind Hoogstraat I.[431] The fact that these finds were relatively numerous in the southern part of the settlement near Steenstraat makes one suspect that they were used over a long period, possibly in house floors or hearths, and even as street paving. Kars assumes that: … *they were mostly used for drainage of wet areas in the settlement as well as in the harbour area. It is also possible that some of these stones were used in fireplaces, or that they were used as foundations for such installations as 'forges' in smithies*. The unworked stones may therefore be linked with normal occupation as well as with craft activities. Their use as paving for damp surfaces would correspond well with their abundant presence in the riverbed. The stones were apparently necessary there at that time, and were probably deliberately brought there for use, and not, therefore as settlement rubble.

Perhaps the fragments of Roman roof tiles were used for the same purposes as the stones. The zonal distribution frequencies of tile fragments in the riverbed are shown in figure 253. The distribution over the site on the riverbank is not yet known. The number of tile fragments found in the point bar area is not inconsiderable, even though they are somewhat under-represented in zone 2 (fig. 253).
Amber finds are also very numerous, with over 5000 fragments. This total amounts to even more than that of the unworked stone finds, which makes their distribution pattern all the more remarkable.[432] Eighty percent of the amber finds were concentrated in Hoogstraat I and the broad section of the settlement behind it. Amber is a clear indication of commercial or craft activities. Among the *c.* 20 worked items there are several rough-outs. The rest of the finds consist of generally small fragments, which must be regarded as inferior material or production waste from objects such as beads, spindles, pendants and bridges of stringed musical instruments. A similarity in the distribution of finds between Hoogstraat I and the area behind it on the bank can also be observed with the querns (p. 322-3). If amber was worked exclusively in the sector of the settlement area on the bank concerned, the refuse from Hoogstraat I must originate from these activities. In that case, it would be surprising that so much refuse was left behind at the place of production. It is, therefore, more logical to assume that the refuse in Hoogstraat I came from activities in the immediate vicinity, in other words from the area in the riverbed itself.

2.3.3 Animal skeletal remains

Animal bone material constitutes an enormous group of finds. The actual size of the group is not known, but an estimate of the finds from the riverbed provides an indication. The number of finds numbers containing bone amounts to some 1500.

430 Kars 1984, fig. 135.
431 Kars 1984, figs. 133 and 134.
432 Kars 1984, fig. 140.

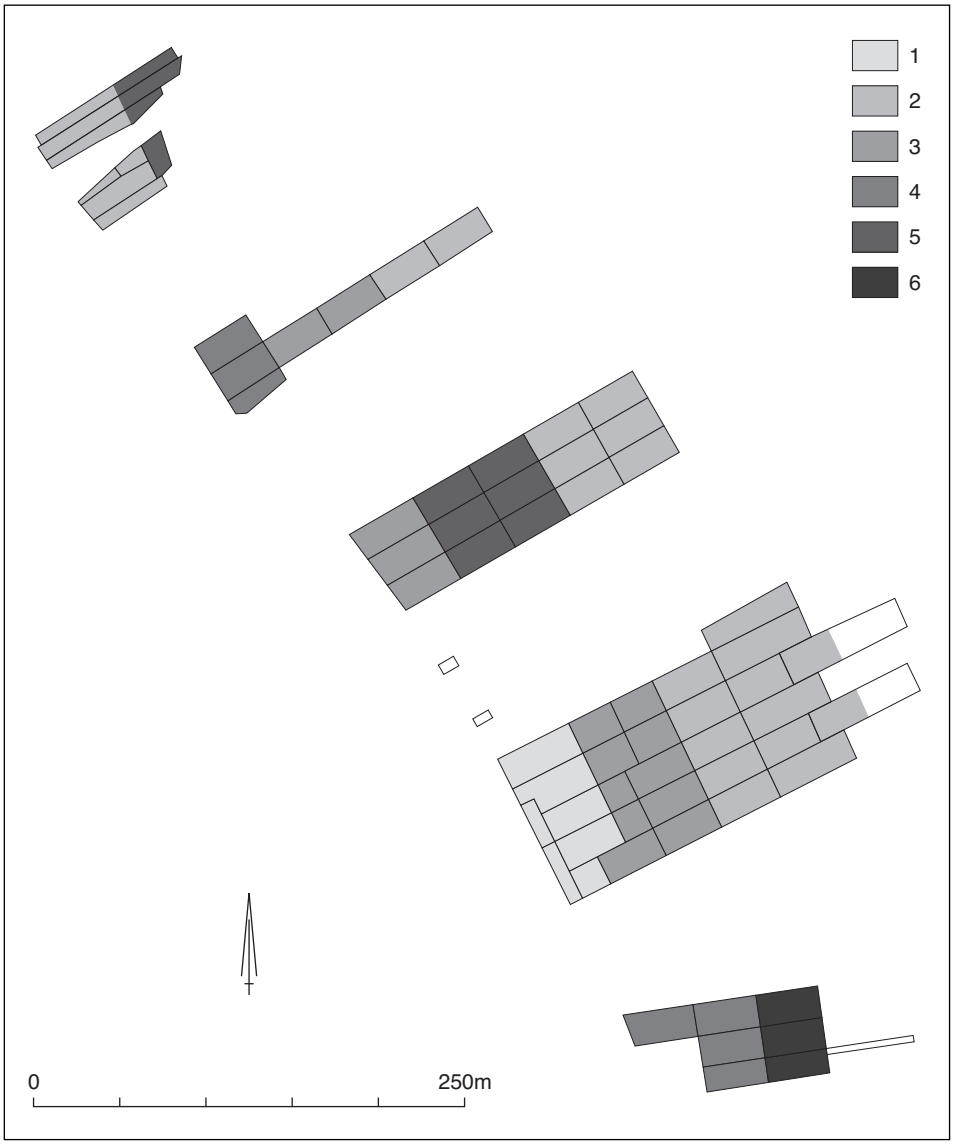


Fig. 253 Dorestad, Hoogstraat 0-IV: frequency of Roman roof tiles per zone; N=800 items, average per trench 16.8.
Legend:
1 < 2.8;
2 2.8-16.8;
3 9.8-16.8;
4 16.8-43.2;
5 30.0-43.2;
6 > 43.2.

Each of them includes one or more, but often dozens and in some cases hundreds of bones or bone fragments. An average of 20 items per finds number, which is probably a conservative estimate, would bring the total to 30 000 items, roughly half as much as the pottery. The bone finds from the site on the riverbank are probably less numerous per surface unit, but the area excavated there was much larger, so the total for that area will probably not differ much from that from the riverbed. Altogether, this means at least 60 000 bone fragments. In her doctoral thesis, Prummel has studied a random sample of *c.* 10 % of these fragments.[433] The sample covered the Hoogstraat-I area and thirteen smaller areas (together measuring *c.* 4 ha) which were regularly distributed over the settlement site on the bank. Among other things, Prummel investigated to what extent differences occurred in the composition of the finds complexes of the riverbed area and those of the settlement area.
A very small proportion of the material – probably no more than 1 % – is evidence of bone-working. These indications of craft activities consist of refuse, several rough-outs, and a number of obvious artefacts. Clason's publication on the worked bone from Hoogstraat I shows a wide range of objects.[434] It is not certain whether these objects were all manufactured in Dorestad, but it is possible. It has been established

433 Prummel 1983.
434 Clason 1980.

that Dorestad had a bone-working industry, which produced combs, among other things. This was a specialism, for which antlers were also used as well as bone. The former were obtained in the immediate surroundings, Prummel assumes. Apart from combs, runners of horse- and cow bone, needles, spindles and bone ornaments would probably have been made.

Comb-making waste was more plentiful in the Hoogstraat-I area than in all the thirteen test areas on the bank together. In only one of the thirteen areas (IV) was it more or less as well represented, relatively speaking, as in Hoogstraat I. This fact led Prummel to the following conclusion: *The antler-craftsmen, who presumably worked in the part of the settlement bordering on Hoogstraat I, deposited their waste in this part of the riverbed. There was, perhaps, a concentration of antler-craftsmen at this spot in comparison with the numbers of antler-craftsmen elsewhere in the settlement… It is likely that a relatively large quantity of antler was worked in trench group IV*.[435] She drew a similar conclusion from yet another indication of craft activities in the bone material. She observed a slight over-representation in Hoogstraat I of horn cores of sheep and/or goat, and this … *may be explained by assuming that the skins of sheep killed in the settlement, complete with horns, were tanned in the Hoogstraat I part of the strip of land alongside the harbour*.[436]
Prummel clearly assumed that the refuse from both these craft activities was not produced in Hoogstraat I itself – *i.e.* not in the riverbed – but in the adjoining bank zone. This was the current view at the time. For the finds connected with comb-making, we now have an overview of all the excavations in the riverbed area (fig. 254).[437] The remains of comb-making in zone 1 – therefore still on the bank – appeared to be only slightly less well represented than in zone 2 in the riverbed; and in Hoogstraat II and IV they were even relatively more plentiful. This naturally does not prove that the refuse in zone 2 could not have come from the adjacent part of the settlement on the bank, but neither does it prove that it did. Why would one have dumped part of the refuse in the riverbed and left just as much behind?
The bulk of the bone material must be regarded as offal. Possibly, there was some connection with craft or commercial activities, for it is conceivable that the finds of unworked bone, often with traces of slaughtering, consist of refuse from export slaughterhouses as well as domestic kitchen waste. Perhaps smoked or salted meat was sold to ship's crews, though this is only a theoretical possibility. The majority of bones was undoubtedly linked with local consumption. Prummel has compared the bone material from the settlement area with that from Hoogstraat I in this respect too, and in her opinion, there are no significant differences. We quote her once again: *It is plausible to conclude that scarcely any evidence was found which points to any difference in eating habits between the harbour area and the settlement*. Perhaps in the case of 'harbour area' Prummel was mainly thinking of the riverbank area – our zone 1. Nevertheless, the quotation contains a hint that the finds in the riverbed are the result of local activities, in fact of occupation. This notion is not expressed in so many words in her book, but it is implied in the cover drawing which shows buildings also on the raised site in front of the original riverbank.
The zonal distribution frequencies of unworked bone in the Hoogstraat excavations are shown in figure 255. The pattern is similar to that of the 'average' pottery finds (*cf.* fig. 238). There are differences: the main one being the relatively higher frequency of bone in zone 1. This may be due to the fact that finds *numbers* were counted in figure 255 instead of finds units. Because of the many pits in zone 1, which could each have yielded one or more finds numbers, the zonal distribution-frequency there is probably exaggerated. The overall correspondence between pottery and bone confirms the similarity of their nature: they are, for the most part, just settlement refuse. In the same way that a small

435 Prummel 1983, 260.
436 Prummel 1983, 261.
437 It should be noted that figure 254 does not show the distribution of the finds units found, but the finds numbers with the remains of comb-making. If the finds units are counted – which is not yet possible at the present state of analysis – the preponderance of zone 2 will probably increase.

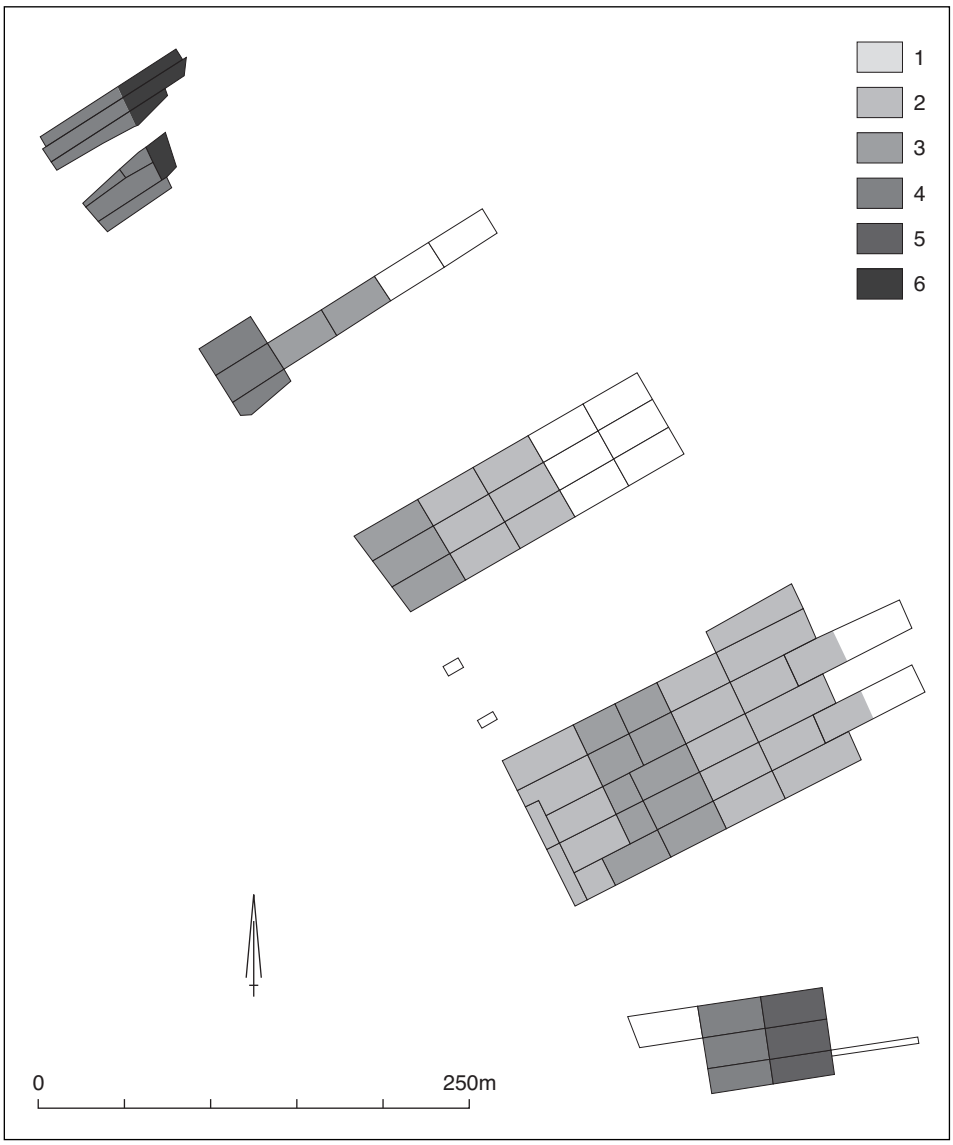


Fig. 254 Dorestad, Hoogstraat 0-IV: frequency of finds numbers with waste products from combmaking per zone; N=60 items, average per trench 1.3.
Legend:
1 < 0.2;
2 0.2-1.3;
3 0.7-1.3;
4 1.3-5.6;
5 3.5-5.6;
6 > 5.6.

proportion of the bones from the Hoogstraat excavations can be attributed to craft activities, a small proportion of the pottery finds can also be linked with local commercial activities at the time: goods broken during loading and unloading. Nevertheless, the majority of the material must be of domestic origin. If one assumes that the bone material is no more than settlement refuse, the same must also apply to the pottery.
Finally, the runners, which are the only kind of bone artefact frequently found. Prummel mentions a total of 35 from the areas excavated by her on the bank. Of these, 19 come from the part of the settlement behind, *i.e.* west of Hoogstraat.[438] Fourteen of them were found at different locations in the front part of the excavated area closest to Hoogstraat, and five at the rear of the broad section of the settlement behind Hoogstraat I. A similar distribution was also observed with most of the types of stone finds. What particularly interests us here is the relatively small number of runners compared to the finds from the point bar area: Hoogstraat 0–IV yielded a total of about 130 runners (fig. 256). The excavated area in the riverbed does not differ much in size from the site investigated by Prummel in the settlement area behind it. This means that the distribution frequency of runners in the point bar area

438 Sixteen specimens were found south of Steenstraat and these no longer belong to the northern unit within the Dorestad area.

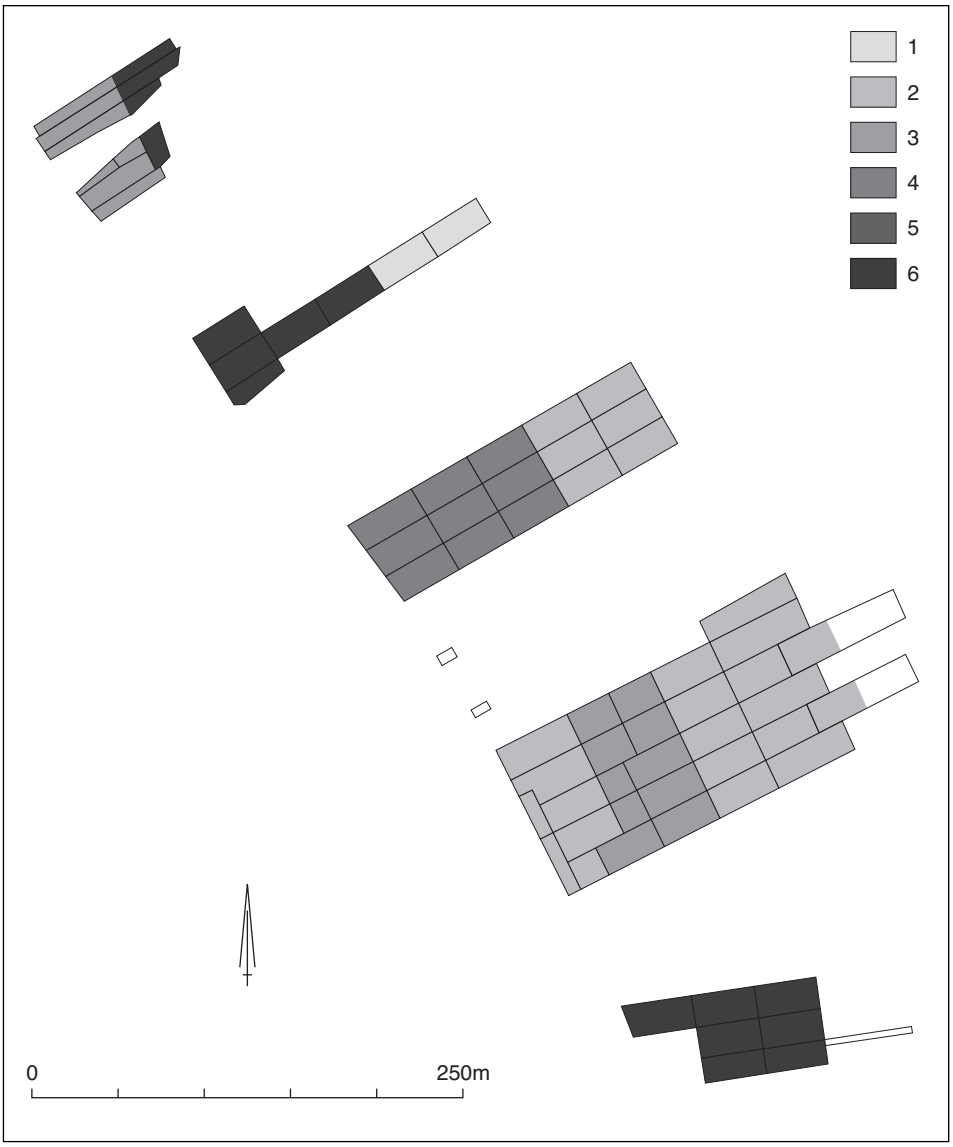


Fig. 255 Dorestad, Hoogstraat 0-IV: frequency of finds numbers with unworked animal bone per zone; N=1474 items, average per trench 31.6.
Legend:
1 < 5.3;
2 5.3-31.6;
3 18.4-31.6;
4 31.6-52.8;
5 42.2-52.8;
6 > 52.8.

is about six times as much as that on the bank. It is possible that differences in the preservation conditions and chance of being found may have played a part, but the discrepancy appears too great for this to be the only explanation. A likelier assumption is that the function of the runners had a special connection with site conditions in the point bar area at that time.
Prummel and Clason are in agreement as to this function insofar that they both consider the runners to be transport components: they were attached underneath sledges (and/or under the foot as a type of skate?). Opinions conflict as to whether these means of transport were exclusively used on ice, or whether they were also used on – damp – terrain,[439] in addition to which it is not altogether clear whether this transport involved people or goods. The iron butt-ferrules, many of which were discovered in the riverbed (fig. 257), may have belonged to prickers used to propel a sledge or a skater forward. One such pricker of yew, complete with iron point, was found in Hoogstraat II (fig. 195: 8). Despite the uncertainties, it is obvious that this possible use of the runners fits in well with the relatively damp site in the point bar area close to the river. In our view, it is difficult to establish whether the runners found there are evidence of 'habitation', a long stay, commercial activities or even

439 Prummel opts for use on ice. In her view, use on soil would have resulted in different patterns of wear: Prummel 1983, 260; cf. Clason 1980, 245–6.

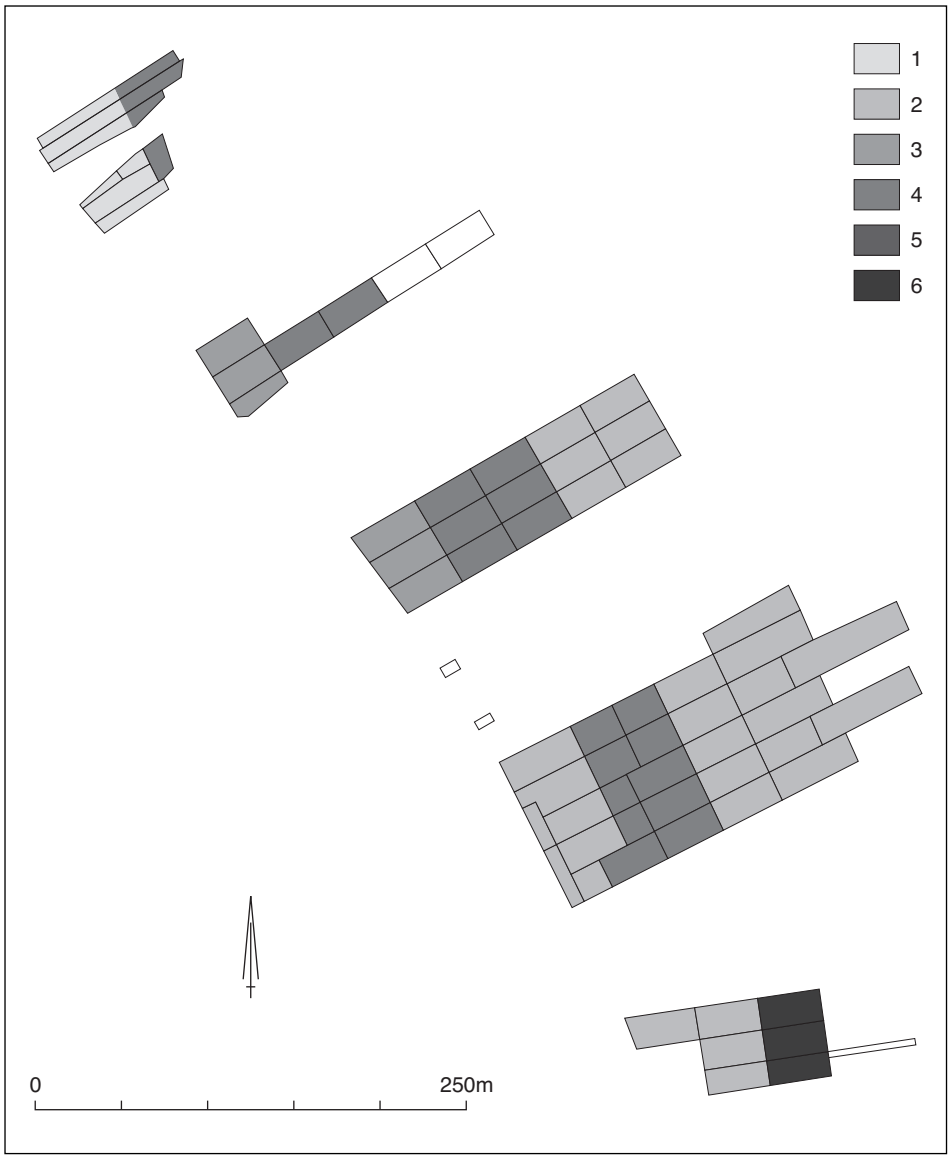


Fig. 256 Dorestad, Hoogstraat 0-IV: frequency of runners; N=127 items, average per trench 2.7.
Legend:
1 < 0.4;
2 0.4-2.7;
3 1.5-2.7;
4 2.7-9.9;
5 6.3-9.9;
6 > 9.9.

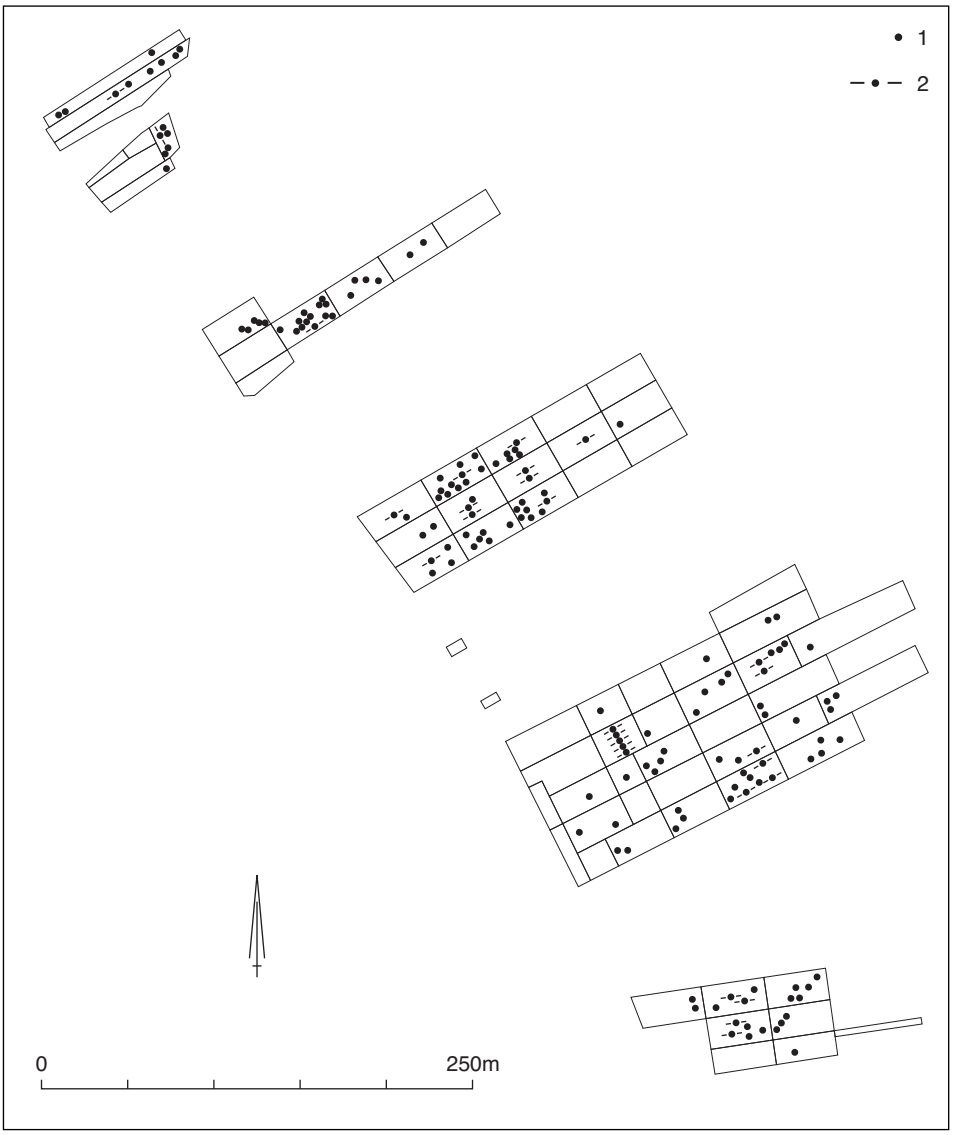
craft activities (the production of runners). However, the large numbers in which they occurred in the riverbed are a sign that the finds complex encountered there reflects local activities and conditions.

2.3.4 Metal objects

Table 44 gives a survey of the metal objects from the riverbed area. Their number is quite substantial: even if one excludes the iron nails, there are still *c.* 350–400 recognizable objects, most of iron, about forty of bronze, ten small lead weights and three precious metal ornaments. Apart from the odd exception, they are not valuable, and they probably do not include any deliberately hidden hoards. The number of ornaments is remarkably small: less than ten. Clothing accessories were hardly found either: no more than eleven, including only two bronze belt fittings, the rest being buckles and iron fittings.

The majority of these objects consists of tools in the widest sense of the word, including in the first place weapons – also a kind of tool. There are about twenty of these, most of them swords, but also several spear-heads, arrow-heads, one or two umbos, three spurs (two of which form a pair and were found together with parts of

Fig. 257 Dorestad, Hoogstraat 0-IV: distribution of the metal objects.
Legend:
1 metal object;
2 metal object, position within trench unknown (excluded: iron nails, knives, boat hooks and butt ferrules).



Type of object	No. of objects					
	HS-0	HS-I	HS-II	HS-III	HS-IV	total
finger-ring, gold		1				1
pendant, gold				1		1
arm-ring, silver					1	1
arm-ring, bronze					1	1
dish, bronze	5 rs (1 spec.)		3			4
brooch, bronze		2	1	1?	1?	5(3)
key, bronze			4	3		7
key, iron	2	5	7		1	15
lock spring, iron		1				1
balance, bronze					1	1
weight, lead		8	1	1		10
tweezers, bronze		1	1			2
pin, bronze			4	2	1	7
nailbox, bronze		1				1
needle, bronze		1	1			2
spur, bronze		2+fittings				2
spur, iron				1		1
stirrup, iron		1				1
(belt) mount, iron	2			1	1	4
buckle, iron	2	1		1	1	5
sword, iron		1	1	2	3	7
sax, iron	1					1
spear-head, iron	1		2		1	4
arroW-head, iron		1			2	3
shield boss, iron			1	1		2
knife, iron	14	29	38	22	8	111
scissors, iron	1	1?				2(1)
belt-mount, bronze		2				2
axe, iron	1	3	4			8
adze, iron	1	2	3		1	7
hammer, iron	1	5		1	3(4)	10(11)
boring-bits, iron		2	4		1	7
chisel, iron					1	1
saw, iron	1?					1(0)
shovel, iron		1?		2?		3(0)
point of plough, iron	1	4			1	6
sickle, iron		1			1	2
hackle, iron		1				1
boat hook, iron	8	15	16	6	3	48
butt ferrule, iron	2	22	7	6		37
chain, iron	2	1			1?	4(3)
suspension-gear, iron		6?				6(0)
bucket handle, iron	4	2		3?	2	11(8)
trivet, iron			1			1
fire-iron, iron		1				1
hook, iron		1				1
rivet, iron		6	many		1	>7
nail, iron (bronze)	x	32	x	x	x	238
staples		4				4
terminal, bronze		1				1
pin, iron		2	2			4
undefined	-	-	-	-	-	-
total ca	45	130*	100*	120*	50*	606

* number not including iron nails

TABLE 44 Dorestad, Hoogstraat 0–IV Metal objects.

their strap fittings) and a stirrup. The group is heterogeneous and, in fact, very small in proportion to the total.
Craftsmen's tools are better represented than those of the warrior. Craft tools, such as hammers, adzes, axes, drills, chisels and saws, are represented by 35 specimens. This is a surprisingly large number, certainly if one considers how valuable and rare iron tools were prior to the industrial revolution. The tools discovered are mainly suitable for woodworking and carpentry, and, in the case of the hammers – which were the most numerous type of tool – possibly also for metalworking. Behind these tools we discern not only the carpenter, but also perhaps the shipwright. The iron ship's rivets (large nails with a lozenge-shaped head and counter-plate are not certain evidence that the latter actually practised his trade there. Their number is limited, and in Hoogstraat II they proved to have come from wreckage. As was suggested earlier, the craft tools may also have belonged to a smith. The countless ordinary iron nails remind one of a smith as well as a carpenter: they must have been made by the former and may have been used by the latter. Incidentally, nails were not such ordinary objects in the Early Middle Ages. They only became common at a much later date, when nails were manufactured industrially.
Agricultural tools, six plough-shoes and two sickles, are poorly represented. To these can perhaps be added the only hackle, although one might also consider linen weaving. The glass 'linen smoothers' (see chapters VI 5 and VII 3.4.4) are also sometimes connected with this kind of industry. The three shovels are not specifically agricultural tools, moreover the shape of the one found in Hoogstraat I is uncertain, as is the date of the other two from Hoogstraat III. In the case of objects from the latter excavation which cannot be precisely dated, there is always the possibility that they may be linked with Post-Dorestad habitation.
By far the largest group of tools consists of boathooks and iron butt-ferrules: 85 items altogether. These artefacts are connected with transport across water, and partly also over land (see previous section), and therefore evoke a picture of the skipper and/or trader. The few weights and the one balance point in the same direction. Possibly the three touchstones from Hoogstraat I also belong here, though they may have been used by gold or silversmiths as well as by traders. The three or four (fragments of) iron chain would not be out of place on board a ship. With the six fragments of kettle hooks they may have been the mobile cooking utensils of a ship's crew, though this need not have been the case. They could just as well have hung over a landlubber's hearth. Their date, for that matter, is uncertain, because they were found in topsoil which had been disturbed until recent times.
Finally, there are objects which may have been used by anybody and for various purposes. These are: buckets made of staves with iron handles, the iron trivet and fire strike-a-light, keys, and over a hundred knives, including cleavers.
Summing up, we may conclude that the complex of metal objects from the riverbed area is clearly linked with craft and transport (over water) or trade. Unfortunately, it is not yet possible to compare the composition of this complex with the metal objects from the settlement area on the riverbank behind the riverbed. There – as far as we know at this moment – not one boathook has been found, which cannot only be explained by the fact that the preservation conditions for iron objects were more unfavourable in that area. We shall finally consider the distribution of the metal objects in the riverbed area.
Figure 257 shows the distribution of the metal objects *without* the nails, knives, boathooks and butt ferrules. This distribution pattern may be considered representative of the total complex. The clear link with the raised part of the riverbed is characteristic. There are hardly any finds from the eastern two, respectively six excavation trenches of Hoogstraat IV and II, where no heightening had taken place. This indicates that these finds point to activities connected with the use of the 'inhabited' part of the riverbed.

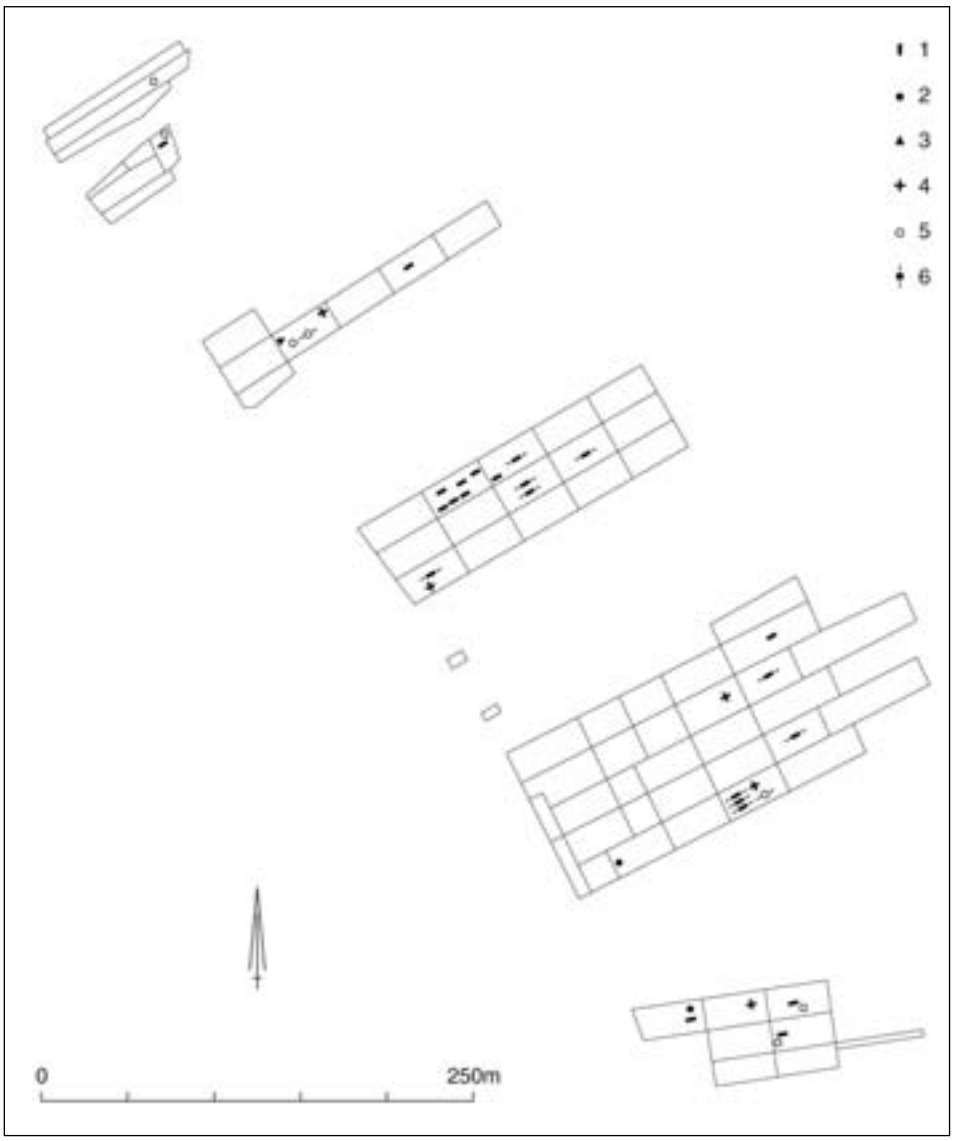


Fig. 258 Dorestad, Hoogstraat 0-IV: distribution of selected metal objects. Legend:
1 iron and bronze keys;
2 gold ring or pendant;
3 silver arm-ring;
4 bronze arm-ring or brooch;
5 iron bucket handle;
6 metal object, position within trench unknown.

This conclusion is possibly confirmed by the distribution pattern of the boathooks and butt ferrules (figs. 257 and 258). They were clearly over-represented in the easternmost zone of Hoogstraat I. Furthermore, there was a remarkable number of finds, relatively speaking, from the eastern excavation trenches of Hoogstraat II and IV. The most reasonable explanation for this deviant distribution, in our view, appears to be that these ship's tools were used most frequently at the rear of this area (the part closest to the river). In this case the distribution of boathooks and butt ferrules was at least partly determined by the transport and concomitant trade activities in the riverbed area. However, their distribution pattern can also be explained chronologically, namely by assuming that these were relatively late artefacts which were therefore used in the zone which was raised last.

Nor can craft activities be demonstrated with absolute certainty in the area where the finds in question occurred. Again the problem presents itself that these objects may have been tools used on the spot (or craft products manufactured on the spot) or goods produced elsewhere. If one assumes that both possibilities occurred, the matter becomes even more complicated. To our mind, the clustering observed here

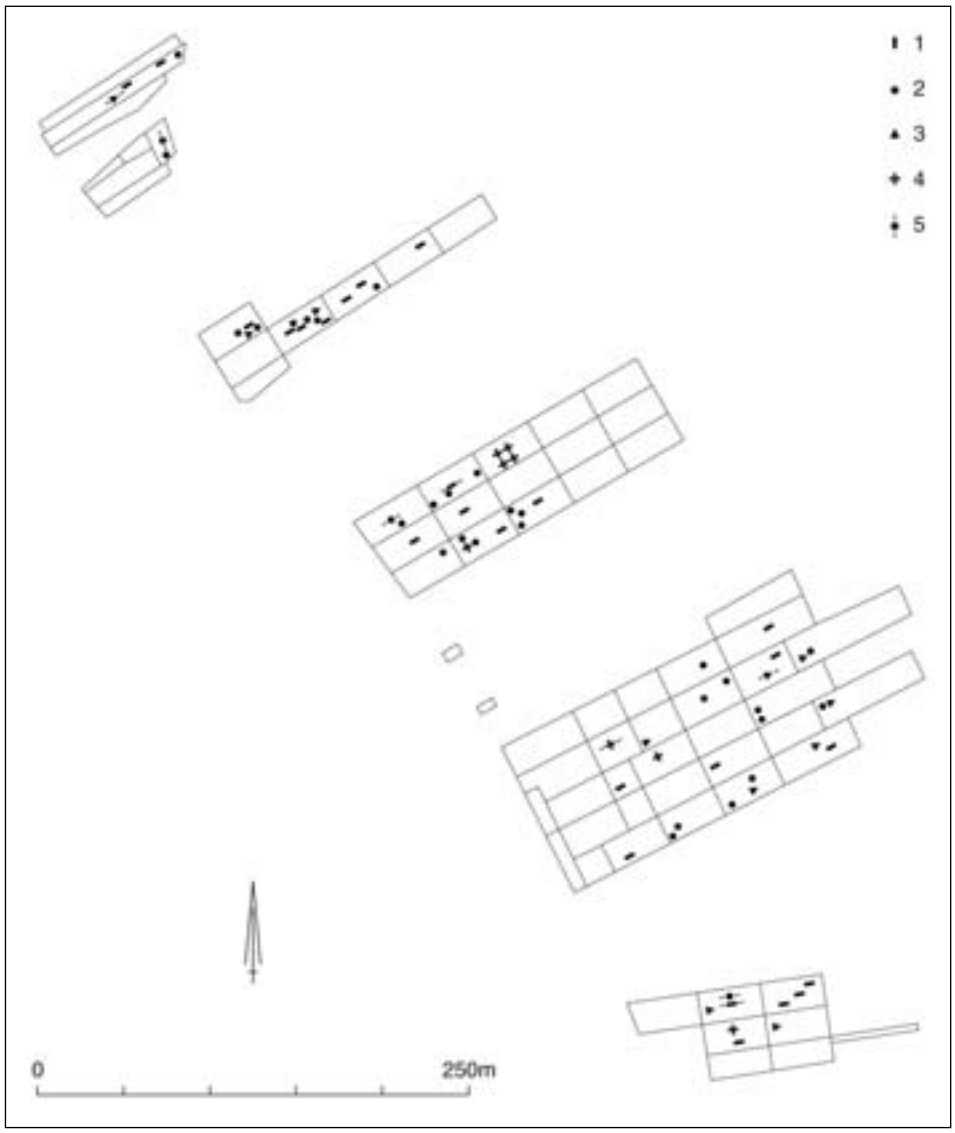


Fig. 259 Dorestad, Hoogstraat 0-IV: distribution of selected metal objects.
Legend:
1 weapons;
2 craft tools;
3 agricultural tools, including hackle and shovels;
4 ship's nails;
5 metal object, position within trench unknown.

and there with some types of object is an indication of local production. If this is true, a key specialist must have worked in Hoogstraat II, trench 383, and possibly also in Hoogstraat I, trench 354 (fig. 258). In Hoogstraat IV an armourer may have been active, while the heaps of tools in Hoogstraat II, trenches 380/383 and 382/385/388, were possibly connected with the activities of woodworkers and/or smiths (fig. 259). Boathooks may also have been manufactured in the latter workshops (*cf.* fig. 260). A concentration of boathooks in Hoogstraat 0, trench 267, could lead to a similar conclusion. There was a concentration of small weights and touchstones roughly in the middle of the Hoogstraat I excavation (fig. 260): were producers or traders established there? The only balance found came from Hoogstraat IV.

In short, the results remain rather ambiguous, as was the case in the preceding sections. Nevertheless, the predominant impression is that the finds from the riverbed area are connected with local activities which included craft production, transport and trade.

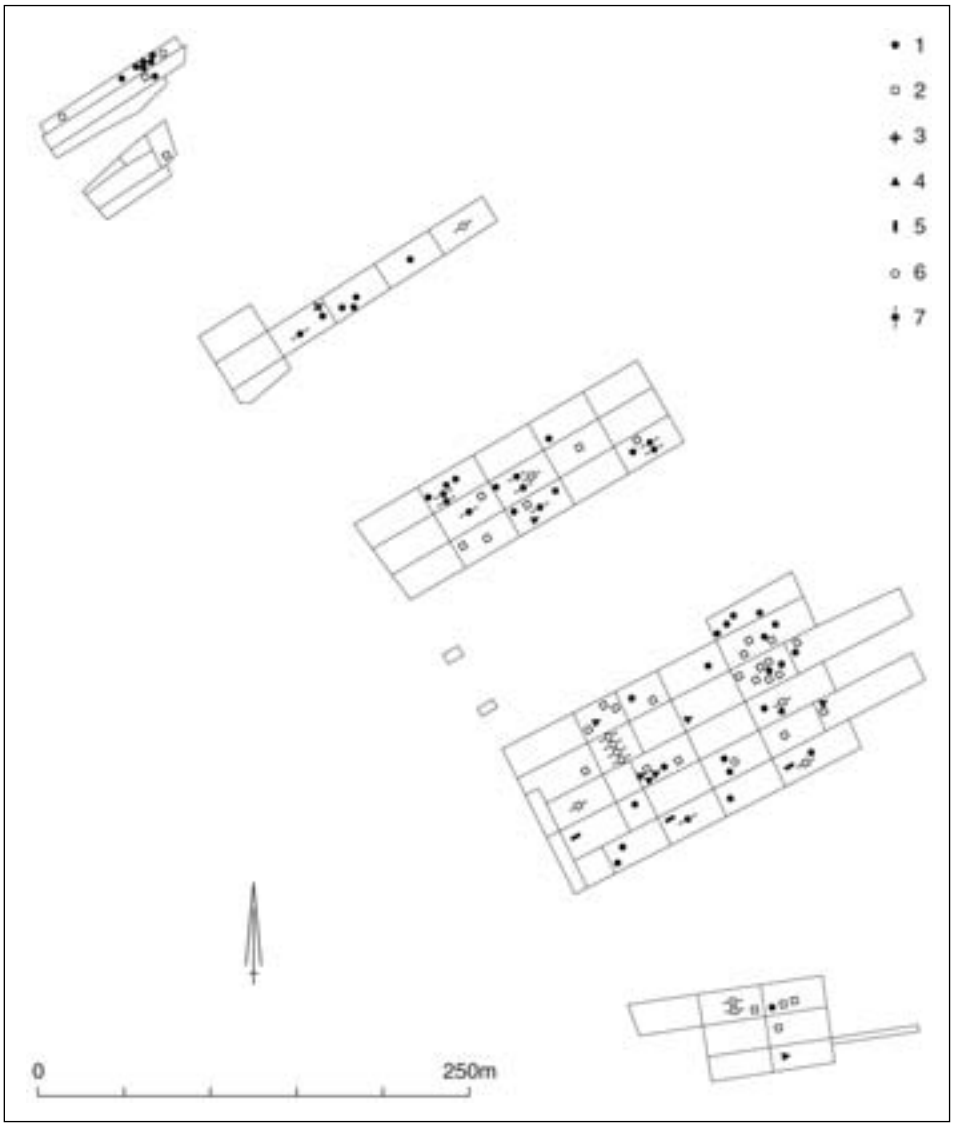


Fig. 260 Dorestad, Hoogstraat 0-IV: distribution of selected metal objects and touchstones.
Legend:
1 boat hooks;
2 butt ferrules;
3 balance;
4 weights;
5 touchstones;
6 chains;
7 metal object, position within trench unknown.

2.3.5 Final considerations and conclusion

In the preceding sections of this chapter, the main issue was whether the raised area in the riverbed east of Hoogstraat was exclusively reserved for traffic, or whether it was also used for settlement. We have attempted to discover what information is revealed by the finds on this matter. That they are the residue of all kinds of activities, such as occupation, craft production, transport, fishing and trade, is clear. However, this does not answer the question definitively, because it is difficult to establish for certain that the finds were evidence of local activities. In several cases it appears more or less certain, for instance in the case of the runners and the net weights. These reflect activities which one would expect to find on or near the river. However, for the bulk of the finds we cannot prove that they were left behind at the place where they were used. The possibility cannot be entirely excluded that they were dumped in the riverbed only after they had been used elsewhere – the most likely area being the corresponding part of the settlement behind the riverbed. In our view, the analysis of the various types of finds provides indications that this possibility is not very probable. We get the impression that the finds from the 'harbour', or at any rate most of them, came from local activities. In the following,

we shall add several more or less general considerations which point in the same direction.
To start with: if the structures in the riverbed area were exclusively intended for the purpose of crossing dry-shod from the bank to the river beach – where the ships landed – would such an enormous amount of wood and labour have been spent on them? Far simpler solutions would have sufficed, such as jetties and narrower dams. An example of the latter was probably encountered in Hoogstraat II. The last part of parcel HS-II 6 appears to have consisted of a 1 to 2 m-wide dam which was reinforced on both sides by a revetment (fig. 16*, Hoogstraat II, squares C-17/20). It looked as if the little dam linked up with the central axis of the parcel, though this was not altogether clear. It may have been some 30 to 35 m long, and appeared to have been built in one go. Apparently, at some stage the user of the parcel (HS-II 6) no longer considered it worthwhile to heighten his land across the usual breadth, although he did still appreciate easy access to the river.

Another point of consideration is that the operation of heightening was halted 'midway' in Hoogstraat II and IV, and probably also in Hoogstraat 0. Actually, this is not the proper way of putting it. In Hoogstraat II and IV it could clearly be observed that the parcellation remained unaltered in zone 3 as well. At various spots there, side- and end revetments were found. These were often simple, indicating few or no repairs, but their presence suggests that heightening did still take place. Judging from the data available, this was done in large sections at a time: long compartments. The soil required for this may have been extracted locally from pits dug at right angles to the longitudinal axis of the parcels, and especially from the 4 m-wide 'ditches' which remained open between the raised sections of the parcels. Ditches of this kind were prominently present in zone 3 of Hoogstraat II and IV. In Hoogstraat IV a layer of clay had been deposited which stood out for its colour and composition. Zone 3 therefore did not lack the heightening and the parcellation, but it did lack the abundance of posts and finds so characteristic of zone 2. Only in Hoogstraat I – and in the southern part of Hoogstraat II – were the latter two elements found in zone 3.
We should probably visualize the situation as follows: an abundance of posts and also to a certain extent of finds apparently belong together and point to the intensive use (settlement) of the raised parcels. In Hoogstraat II and IV this intensive use remained limited to zone 2. The 'impoldered' area in front of it was left vacant, in contrast to the Hoogstraat-I area: few or no activities took place here. The length of the raised, though not very much used area was between *c.* 40 and 60 m. The reason for this low intensity of use is unknown. Perhaps it was intended for more intensive use, but that never happened. It is even possible that it was customary to first raise a parcel over a certain length before starting to live on it. Another possibility is that the heightening at the end of Hoogstraat II and IV was intended from the start to ensure easy access to the river. The 'ditches' which had silted up mainly with 'clean' clay at the end of these complexes may have served as drainage. It is clear that the situation in zone 3 of Hoogstraat II and IV was an exception. In other areas of the riverbed, the far greater amount of wood in the structures, together with a greater abundance of finds, pointed to a more intensive, or at any rate, longer and probably also different type of use.
It is perhaps no coincidence that the wooden fragments of a riveted ship's skin were found in Hoogstraat II laying across the 'ditch' between parcels Hoogstraat II 4 and Hoogstraat II 5. Moreover, this was roughly at the transition from the intensively used zone 2 to the 'empty' zone 3 (Hoogstraat II, squares E/D-11/12; fig. 207–8, photograph fragments). In chapter II 3.6 it was assumed that the fragments were the remains of a ship that had sunk or been dismantled at that spot. There now appears to be another possible explanation: perhaps the pieces of wreckage were used

secondarily as a kind of quay wall crosswise over the 'ditch'. The secondary usage of ship's timber in revetments and quays has frequently been observed in ports.
The third consideration concerns Hoogstraat III, where a Post-Dorestad phase of use of the site in the riverbed was observed. Dating from this later phase are (large) pits, trenches and several wells, as well as large quantities of pottery sherds. Two barrel wells date from the first half of the 12th century. Several stone wells may even be slightly younger: recent sherds were found in them. Mainly because of the wells, we have never doubted that there must have been 'ordinary settlement' here, even though no convincing traces of houses have been found. This habitation was apparently a short distance from the course of the Rhine at the time since it proved to have been partly eroded when the river changed course off Hoogstraat III, back in a westerly direction. If prolonged occupation did prove possible on the raised area in the riverbed in the centuries after Dorestad, it is not easy to see why this would have been out of the question in the Dorestad period. Moreover, it is not inconceivable that the 10th-century and later use of the Hoogstraat III area linked up without interruption with its earlier use in the Carolingian Period. In that case it is likely that its function also remained fundamentally unchanged.

Wells from the Carolingian Period in the riverbed area are extremely rare, whereas they occurred in large numbers in the settlement on the bank. Wells in the riverbed were almost entirely lacking, except for the Hoogstraat-I area, where three certain and three 'uncertain' specimens were found only in the front part of the site.[440] Two of the certain wells were situated right at the front of parcels HS-I 5 and HS-I 7, the third was a little further away, exactly on the parcel boundary between HS-I 7 and HS-I 8. The three 'uncertain' wells were situated about the same distance from the original bank (*c.* 12–20 m). One of them was approximately on the division between parcels HS-I 1 and 2, and the other two were roughly in the middle of parcel HS-I 2. In contrast to our previous views, we no longer have any objection to regarding these wells as an integrated element of the 'dams' in question. In our opinion, they may be regarded as an indication of 'occupation'. The other Hoogstraat excavations did not produce any evident wells. Some round pits on the 'land abutments' in zone 1 of Hoogstraat II reminded us of them, but the pits were not really deep enough to be wells, with the possible exception of the two more or less round pits on either side of the 'land abutment' on parcel HS-II 7 (squares A/B-3). Roughly in the middle of zone 2 in Hoogstraat II, *c.* 50 m from the bank, a large pit was discovered containing (at the bottom?) traces of a trapezoid (originally roughly square?) frame of beams (Hoogstraat II, square D-7). This was visible in level 6, at a depth of *c.* 2.50 m NAP. These features probably did not originate from a well but from a wooden creel, as was also found in Hoogstraat II, square F/G-7 (fig. 202).[441] In that case it could have been dug into the northern edge of the dam on parcel HS-II 5, on the side of the 'ditch' between HS-II 5 and 4. It is more probable, though, that the placing of the creel preceded the construction of the dam.
Wells also appeared to have been scarce in the bank zone. One was found belonging to house 5 or 6 in Hoogstraat IV, not far from the original bank. The shortage of wells in the riverbank area and in the riverbed area itself may have been due to various causes. The most probable of these, in our view, is that at these spots one had easy access to the river for water. Another explanation may also be the possibly less permanent, less intensive or different type of 'habitation' than in the settlement further away from the riverbank.

With the fourth and last consideration we return to the finds. The question here is whether the deposition in the riverbed area of refuse produced elsewhere could have led to the distribution of finds which was observed in the Hoogstraat excavations. Pottery constituted by far the largest proportion of the finds complex, in addition to

440 Van Es & Verwers 1980, 30–2, fig. 19–20.
441 Van Es 1974.

which it could be relatively precisely dated. Early and later pottery types showed a remarkable difference in distribution: compare, for example, figures 242 and 245. The density of finds of the early pottery forms was highest in the riverbank area (zone 1), and in the front half of the raised area in the riverbed (zone 2). With the late types, the distribution frequency decreased in zone 1. The highest density of these finds was now exclusively in zone 2, while in Hoogstraat I, zone 3 was well supplied. This basically means that the pottery lay scattered over the riverbank area and the point bar area in chronological order: early forms were to be found at the front, and later forms further back. It is difficult to imagine that such a pattern developed by dumping settlement refuse brought in from elsewhere. In this case the refuse would have to have been deposited further and further into the point bar area, at the same time ensuring that old and young material did not get mixed up. Moreover, a large amount of refuse was found in the settlement area behind Hoogstraat itself, so apparently people did not mind leaving the refuse where it was. Why then, would they have transported some of it to another spot?
Summing up, we conclude that it is very probable that the finds from the Hoogstraat excavations indicate local activities. We no longer see a reason to interpret the finds complex from the riverbed area differently than the one originating from the evident settlement site west of Hoogstraat. In other words: we must assume that the raised parcels in the point bar area were also 'occupied'. With this assumption, we approach the viewpoint already described in 1985 in his thesis by Gustav Milne.[442]
Milne started from our report of the Hoogstraat I excavation,[443] but rejected … *the concept of a system of contiguous, infilled but otherwise undeveloped 'causeways' extending for lengths of up to 200 m just to provide access to and from the river and buildings on the bank… If access was the primary need, then narrow open-work jetties, ramps or slipways etc. would have been quite adequate and easier to erect and maintain. Rather than constructing such elaborate roadways simply for access it would have been easier to move the buildings closer to the river, a solution which in this writer's estimation, was adopted by the Carolingian inhabitants.*[444] He proposed that the raised areas in the point bar be regarded as … *deliberate reclamations at the expense of the river…* and to assume … *that the newly-won land contained buildings, landing places and access routes in addition to wells and pits. As such it formed the expanding 'merchant quarter' of the town, a discrete and distinctive part of the settlement.*[445] *In conclusion, it may be said that while the 7th and 8th century extensions at Dorestad may well have been partially motivated by the need to overcome the problems of silting/ river movement, the desire to win land to accommodate the increasing size of buildings and warehouses played a prominent part. Rather than displaying Dorestad's 'almost pathetic struggle for life',*[446] *the energetic waterfront expansion could be seen as the physical manifestation of the very vitality of the port.*[447]

2.4 Buildings in the crevass splay

The above considerations make it reasonable to assume that buildings also stood on the raised parts of the parcels in the riverbed area. The question is where, and what did they look like. So far, only the large 'boat-shaped' house-plans from Dorestad have been described in detail.[448] These were found in the settlement area behind the point bar area, but they certainly did not occur in the point bar area itself. Not only would we have noticed such remarkable plans, often with curved long walls (sometimes marked by double rows of postholes), but their dimensions do not fit the pattern of parcellation in the riverbed. Their width of 8–9 m is too great for the raised strips of land which were seldom broader than 7 m. The absence of this type of building in the riverbed area becomes understandable when one accepts that it was mainly in use as a farmhouse, and possibly also as an – elite – hall.
However, the boat-shaped house was not the only house type in Dorestad. Smaller,

442 On 27-09 1988 Milne sent us the pages from his thesis which referred to Dorestad: pp. 36–40 (text), 207–11 (figures). As far as we know, this is a still unpublished thesis, containing a survey of medieval waterfront development in northern Europe.
443 Van Es & Verwers 1980.
444 Milne, thesis 1985, 38.
445 Milne, thesis 1985, 37.
446 Van Es & Verwers 1981, 76.
447 Milne, thesis 1985, 40.
448 Van Es & Verwers 1995.

rectangular buildings are known from the settlement area behind the riverbed, some 10–15 m long and 5–6 m wide. We excavated a few traces of the foremost row of buildings on the 'original' bank in Hoogstraat 0 and IV (see chapter IV 2 and -3), but they also occurred further to the rear of the settlement. At the present stage of the analysis of the excavation data, no further details on these houses are available. One should probably visualize these rectangular buildings as the reconstructed house at Haithabu, although it is not certain whether the Dorestad buildings were (always) provided with shores placed outside the walls.[449] Apparently, this was not the case in Haithabu either.[450] Rectangular buildings of the size mentioned would fit very well into the parcellation of the riverbed area. For that matter, the plans concerned have so far not been recognized there either. This would not, in itself, be easy, as the wall posts of such buildings would be difficult to distinguish from the revetment stakes of the dam compartments. The most likely explanation for the absence of recognizable house-plans in the riverbed area, however, is that it was not possible to build directly on the soil there: the damp condition of the soil would probably have made it necessary to give any buildings there a substructure. In this case the vertical (wall) posts of the buildings did not extend down to the bottom of the river, which is why they were not found during excavation. Houses on piles do not leave normal plans, and what is found is a plan of the substructure and not of the house itself.

Traces of a substructure were visible at many places in the riverbed area in the form of regular patterns of posts. These were part of the dams and formed a contrast to the 'empty' compartments, which were only enclosed by side revetments. The posthole patterns filled the entire breadth of the dam; two rows of posts followed the sides and one, two or three rows ran in-between. After the data on the types of wood used were available, the posts in the patterns proved, almost without exception, to be oak, in contrast to the revetment stakes which were ash. These posthole patterns were in fact the 'interior posts' of the 1980 publication on Hoogstraat I. They are the posts which we then assumed supported a platform. The phenomenon of the posthole patterns has already been mentioned in chapter III. We described them there as successions of transverse rows, and pointed out that it is difficult to distinguish clearly between the transverse rows of the posthole patterns and the end revetments of dam compartments. Both functions need not have excluded the other entirely.
In figures 261–5* we have attempted to indicate the locations of the posthole patterns. The result still has some uncertainties. The shortage of reliable data on Hoogstraat 0 and IV can mainly be explained from the small scale of the excavations. The plan of the structures in the riverbed area of Hoogstraat III is always rather unreliable due to more recent activities. Within the Hoogstraat-I area, the uncertainty was greatest at the front of the riverbed, in the period-1 area. This part of the Hoogstraat I site was in use the longest, and was where alterations in the parcellation took place, making it more difficult to recognize the patterns. All in all, the comprehensiveness of the figures cannot be guaranteed. It remains uncertain whether all the patterns, and therefore all the potential building sites, have been recognized. It is even theoretically possible that there were buildings on the dams which have left absolutely no traces. One would then have to assume that they had been founded on horizontal beams which were anchored, for example, on or to the side revetments. However, in our view, this possibility is purely hypothetical, so we shall no longer take it into consideration.
Figure 266* gives a survey of the most clearly recognizable posthole patterns. There is a considerable variety. The number of posts in the transverse rows from which the patterns were built up varied from three to four or five. The differences in length were substantial. The shortest consisted of three or four transverse rows – which we previously called 'initial platforms' – and were mainly found against the 'original' bank. Further on in the riverbed the patterns were (much) longer, and could include

449 Elsner 1989, 25B34.
450 Elsner 1989, reconstruction drawing on p. 111.

dozens of transverse rows. A good example is the pattern from Hoogstraat I, 5A (F-G/10–14; fig. 266*: 17). That this was built in one go is highly unlikely: the pattern clearly falls apart into at least two parts. It is, however, possible, that the shorter patterns were also realized in several phases.

The shorter patterns in particular showed an unmistakable similarity to the 'plans' of granaries. Granaries were a kind of storehouse on piles, in which valuable possessions, mainly agricultural products, were stored. The floor was raised to protect the products from rising damp and from being eaten into by vermin. In this area of Dorestad the former aspect of raising the floor above ground level would probably have been the main reason. In the point bar area it would have been very important, especially in winter, to literally keep the floor above water. Since the raised floor of a (wooden) granary had to be able to carry a heavy load, support by a group of closely set posts was essential. This is why in agrarian settlements a posthole pattern forms a reliable criterion for identifying a pile-building as a granary, even though the rest of its form remains largely unknown. Moreover, in many cases the settlement context showed that these are granaries.

In figure 267* examples of granary-plans have been brought together. These occurred in a large area extending from the Central Netherlands as far as the North-German coast, and dated from a lengthy period from the Middle Iron Age up to and including the Early Middle Ages. All the granaries illustrated functioned in the context of agrarian settlements and were probably mainly intended for storing corn. In table 45 the dimensions of these granaries have been compared to those of the posthole patterns from Dorestad. This table also includes the measurements of three wooden Roman *horrea* from a military context. Not included are the small square to rectangular plans of four to six posts which are also often regarded as buildings used – among other things – for storage, and are therefore often labelled granaries. It is quite possible that they were partly provided with a raised floor, though one can never be entirely sure of this. The only example of these frequently occurring 'granaries' which has so far been recognized in Dorestad was found in Hoogstraat II (fig. 57). The small building stood on the edge of the bank at the site of the old revetment, and probably consisted of seven posts, five of which were in *quincunx* formation (see also chapter IV). The latter feature could point to a (partly) raised floor. An interpretation of this building as a granary or storehouse is attractive, but by no means certain.

The oldest unmistakable granaries found in the North Sea coastal area so far date from the Iron Age. On the island of Texel, the nine-post granary originated from the end of the Early Iron Age.[451] This type of granary, which leaves behind the smallest possible posthole-pattern, was granted a long life, because it still occurred a thousand years later in Dalem (Germany). In the second half of the Roman Period a variant developed, examples of which have been found on either side of the Lower Rhine, in Wijster and in Lent near Nijmegen. This variant was in fact a nine-post granary, extended with a fourth row of three posts placed a short distance from the other rows, at least as far as the Wijster specimens were concerned. The granary in Lent has rows of four instead of three posts, which could indicate Roman provincial influence. More or less comparable are the twelve-post granaries from Feddersen Wierde and Flögeln (fig. 267*: 1–12). The 'extra' row (placed close to the other posts) there probably represents a loading platform which may or may not have been covered. Another possibility is that there were stairs in the shorter part leading to a second floor, so that the building might be referred to as a tower granary. Twelve-post granaries, whose posts are more or less regularly divided over a square pattern, were found for example in Paddepoel, at the transition from the Iron Age to the Roman Period, but they remain exceptional. Certainly in the Roman Period the nine-post granary remained the common type, outside provincial Roman territory, that is. Granaries from provincial Roman settlements may reveal larger posthole-patterns, probably following the example of the *horrea*, as in Rijswijk, Oss-Ussen, and De Horden (fig. 267*: 31, 33, 35-40).

451 *Woltering 2000-1.*

Zimmermann discovered a new type of granary in Flögeln, which he called *zaunparallele Pfostenrost* (posthole pattern parallel to a plot boundary; figs. 267*: 1-3 and 268: 4-7). It apparently developed in the 4th century from older phases, for instance from a row of smaller granaries located along a fence.[452] He regards them as large (two-aisled) barns on posts.[453] These barns are thought to have been storage buildings (*Vorratsgebäude*) whose function did not fundamentally differ from that of the granaries. Their length varied in Flögeln from 12 to over 30 m. The shortest (PR4) consisted of four rows of three posts, and the longest, (PR9), of ten. Similar posthole-patterns were still found in Dalem in the 7th century, though their maximum length there was 20 m (fig. 268: 1-2, 5, 8). Zimmermann also regards these as granaries. As a result of these large storehouses, the total storage capacity in early-medieval Dalem would well have exceeded local demand. This leads to the assumption that, in the Early Middle Ages, Dalem was a depot.[454] It is obvious that the large granary from Dorestad (trench 9), shows great similarity to the Dalem *Speicher* (granaries, fig. 268: 3). So far, it is the only plan from the settlement site of Dorestad, which, with a reasonable amount of certainty, can be considered to be a granary plan; and this too is certainly of early-medieval origin. The date of a second posthole-pattern from the settlement area of Dorestad, trench 101, is uncertain: probably Carolingian. Nor is it certain whether this pattern was completely excavated. As it now appears, one might interpret it as two granaries, each of 3 x 4 posts, joined together in the middle (fig. 268: 6).

From table 45 one can see that the measurements of the granaries did not alter much for a long time. In the Iron Age, the surface area of the nine-post granaries on Texel varied from *c.* 4.5 to 7 m^2. In Paddepoel, it was not much more, despite the 12 posts. In the Roman Period, the surface area of the granaries (9-, 12-, and 16-post) in the Germania Libera territory did increase, though not drastically: Texel's maximum now became the minimum, and the maximum increased to twice or sometimes three times as much. On provincial Roman territory the granaries were often (much) bigger, but in the agrarian 'native' settlements in the border zone they hardly differed. In Oss-Ussen, where nine-post granaries from the Iron Age and from the Roman Period were found, the whole sequence of development could be traced at one spot. A striking expansion took place in the north at the end of the Roman Period, with the introduction of the large barns on posts in Flögeln and Dalem.

The posthole patterns revealed the same tendency with regard to the spaces between the posts. Initially, these were small (Texel, Paddepoel): 0.80–1.40 m, both between, as well as in the rows. In Germania Libera, in the Roman Period, they became larger: generally 1.40–2.00 m, sometimes even exceeding this (maximum 2.50 m). In the patterns of Flögeln and Dalem the distances between the rows were usually over 3 and even 4 m, and in the rows between 2 and 3 m. Consistent with this is the established decrease in the number of posts per m^2: from 1–2 in Texel, via (usually) 0.5–1 at the time of the Roman emperors, to 0.18–0.27 in Flögeln and Dalem. The granary from Dorestad (trench 9) fits this pattern perfectly with 0.25 posts per m^2. A remarkable feature is that the Roman military wooden *horrea* scored lower in this respect than the Roman provincial' and Germanic granaries: 0.41–0.58 posts per m^2.

The significance of all this is not immediately evident. This is because various factors may have influenced the development. For example, the availability of suitable building timber may have varied per region. This might explain why at Paddepoel, where no heavy building timber was available locally, there were more thinner posts and smaller spaces in the substructure than elsewhere. However, the most important factors were probably changes in the construction of the superstructure. What the actual granaries or storehouses on the platforms looked like cannot be deduced in detail from the plan of the posthole patterns. In general, the square or slightly rectangular granaries are visualized as single-story buildings with wattle walls and a saddle roof. In the case of

452 Zimmermann 1992, 261. For a row of granaries as a preliminary/early stage of a zaunparallele Pfostenrost, see also: Van Es 1967, fig. 40: 1.
453 Reconstruction in Zimmermann 1992, Abb. 204.
454 Zimmermann 1991, 39.

Findspot	further details	no. of posts	length (m)*	width (m)*	surface area (m^2)	distance between rows (m)	distance between posts in rows (m)	no. of posts per m^2
Dorestad HS-I	parcel 5 (G-3/5)	7x3	10.4	6(?)	62.4(?)	1–2	3	0.34
HS-II	parcel 6 (B/C-3/4)	3x3	3.5	5.4	18.9	18	2.5–2.9	0.48
HS-III	parcel 1 (F/G-5/6)	10x3	15–15.4	5	76	0.8–2	2.4–2.8	0.39
	parcel 7 (A/B-6/7)	6x3	10–10.8	5.4	58.2	1.6–2.6	2.6–2.8	0.31
	parcel 7 (A/B-6/7)	7x3	10.8	6.2	67	1.6–1.9	3–3.2	0.31
HS-IV	parcel 4 (C/4-5)	4x3	5.6	5	28	1.8	25	0.43
HS-0	parcel 2 (H/J-8)	4x4	6	5.6	33.6	2	1.6–2	0.48
	parcel 7 (C/D-7/8)	6x4	7.4	5.4–6	407	1–2	1.6–2	0.59
	parcel 8 (C-7/8)	4x4	5	59	295	1.4–2	1.8–2	0.55
HS-I	parcel 2 (J/K-4)	5x4	7.8	6	46.8	1.8–2.4	1.8–2	0.43
	parcel 6 (E/F-3/4)	5x4	8.2	5.2	42.6	1.6–2.2	1.6–1.8	0.47
HS-II	parcel 2 (F/G-3/4)	5x4	7	5.8–6	413	1.6–1.8	1.8–2	0.48
	parcel 4 (D/E-7/10)	13x4	23–23.6	72	169.9	1.6–2.4	2–2.8	0.31
	parcel 5 (C/D-3)	5x4	9.8	6	58.8	2.4–2.5	1.7–2	0.34
	parcel 7 (A/B-4/5)	4x4	6	6.6–6.8	449	2	2–2.6	0.36
HS-III	parcel 2 (E/F-5/6)	9x4	11.6–12	66	77.9	1–1.8	2–2.6	0.46
	parcel 5 (C/D-6/8)	7x4	124	6.2–7	81.8	1.6–2.4	2–2.4	0.34
HS-0	parcel 2 (H-10/12)	8x5	14	6–6.5	875	2	1.4–2	0.46
HS-I	parcel 2 (J/K-14/16)	8x5	14–14.4	76	1079	1.5–2.2	1.8–2.2	0.37
	parcel 3 (H/J-11/12)	10x5	13.4–14.4	8.4–9	1218	1.4–1.8	1.8–2.6	0.41
	parcel 5A(F/G-13/14)	8x5	17	72	1224	2–2.6	1.6–2	0.33
	parcel 5A(F/G-10/12)	16x5	19	7	133	1–1.6	1.6–2	0.60
HS-II	parcel 6 (C-8/10)	10x5	16.2–16.8	7	1148	1.4–2	1.2–2.2	0.44
	parcel 7(B-10)	4x5	5	6.6–7	34	1.6–1.8	1.4–2.2	0.59
HS-III	parcel 3/4(D/E-6/7)	4x5	7	9–9.2	637	2.2–2.6	2–2.8	0.31
HS-II	at level of old revetment	2x2 (+1)	3	3.4	10.2			0.49
	(D/E-2)	3x2 (+1)	6	3.4	20.4			0.34
settlement	trench 9	4x3	8.6	5.6	48.2	2.6 - 3.2	2.8	0.25
	trench 101	6x3+2	11.6–12	5.6	66.1	2.2–2.6	1.6–2	0.30
Dalem (BRD)[455]	Sp 5	3x3	6.2	5.4–5.6	34.1	2.6–3.4	2.6–2.8	0.26
	Sp 12	3x3	7.6–7.8	5	335	3.4–4.4	2.2–2.8	0.27
	Sp 7	4x3	10.4	48	499	3.2–3.8	2.2–2.6	0.24
	Sp 10	5x3	13	4.6–5	62.4	2.6–3.4	2–3.2	0.24
		7x3	17	4.5	76.5	2.5–3	22	0.27
Flögeln (BRD)[456]	PR4	4x3	11.8–12.4	44	532	3.6–4.6	2–2.2	0.23
	PR3	5x3	17.4–18.2	3.6–3.8	659	3.9–5.2	1.4–2.4	0.23
	PR5	7x3	25.6	4.2–4.9	1152	3.4–4.9	2–2.4	0.18
	PR6	7x3	25.8–26.2	4–5	114.4	3.4–5.4	2–2.6	0.18
	PR9	10x3	30.6–31	3.8–4.8	1324	2.6–4.2	0.9–2.6	0.23
	Sp 23	3x3	32	28	9	1.3–1.8	1.2–1.5	1.0
	Sp 25	4x3	3	3	9	1	1.4–1.6	1.0
	Sp 5	4x5	5.4	5	27	1.6–1.8	1–1.4	0.74
Feddersen Wierde	SH 5 Sp H16	3x3	3.8	3.8	14.5	1.8–2	1.8–2	0.83
(BRD)[457]	SH 3 Sp H13	3x3	3	2.6	7.8	1.4–1.6	1.2–1.4	1.2
	SH 1d Sp 15	3x4	2.5	3.4	8.5	1–1.5	1–1.2	1.4
	SH 1c Sp 5	4x4	7.4	5	37	2.4–2.6	1.4–1.8	0.43
	10 granaries	3x3	3–5	2.5–3.5	7.5–15			0.60 - 1.2 (aver. 0.83)
	2 granaries	3x4	4.5/6.8	3.5/3.5	15.8/23.8			0.50/0.76

455 Zimmermann 1992, Abb. 191; Zimmermann 1991, Abb. 4:3.
456 Zimmermann 1992, Abb. 191, 196–200.
457 Zimmerman 1992, Abb. 191; Haarnagel 1979, 149.

Findspot	further details	no. of posts	length (m)*	width (m)*	surface area (m^2)	distance between rows (m)	distance between posts in rows (m)	no. of posts per m^2
Texel, Den Burg[458]	47	3x3	26	2.6	6.8	1.1–1.4	1.2–1.4	1.3
	53	3x3	2.8	2–2.2	59	1.3–1.4	0.9–1.2	1.5
	58	3x3	2.8	23	64	1.2–1.5	1–1.2	1.4
	59	3x3	2.3	2	4.6	1–1.3	1	2.0
	60	3x3	2.8	2.2	6.2	1.2–1.6	1–1.2	1.5
	61	3x3	2.4	2.8–3	7	1–1.4	1.4–1.5	1.3
	68	3x3	2.5	22	5.5	1.1–1.3	1–1.2	1.6
	69	3x3	2	2.5	5	1	1.2–1.3	1.8
	70	3x3	2.6	2.5	6.5	1.2–1.4	1.2–1.3	1.4
	71	3x3	2	2.2	4.4	1	1.1–1.2	2.0
	74	3x3	2.1	2.2	4.6	0.9–1.1	1–1.2	2.0
Groningen, Paddepoel[459]	II (Ab/Ac-64/65)	3x4	2.8	2.9	8.1	1.2–1.6	1	1.5
	III (Z/Aa-13/14)	3x4	2.8	2.6	7.4	1.2–1.4	0.9	1.6
	(X/Y-22/24)	3x4	2.8	2.3	6.4	14	0.8	1.9
Wijster[460]	(Clm-40/1)	4x3	5.1	3.3	16.3	0.8–2.2	1.6–2	0.74 (0.63)
	(Dcf-26/7)	4x3	4.3	2.8	12	0.8–1.8	1.4–1.8	1.0 (0.89)
	(Cuv-36/7)	4x3	5.1	3.3	16.3	0.8–2.2	1.6–1.8	0.74 (0.63)
Lent[461]		4x4	5.2	3.2	16.4	1–2	1	0.98 (0.89)
Raalte, Heeten[462]		3x3	4	4.6	18.4	2	2.2–2.4	0.49
		3x3	3.6	4.4	15.8	1.8	22	0.57
Bennekom[463]	S1	3x3	5	5	25	2.2–2.6	24	0.36
	S2	3x3	3.5–3.7	3.5–3.7	13	1.5–2.1	1.6–2.1	0.69
	S3	3x3	4.2	3.5	14.7	2–2.1	18	0.61
	S4	3x3	4.5	4.5	20.3	2.2–2.4	2–2.4	0.44
Wijk, De Horden[464]	trench 529	4x5	6.6	5.2	34.3	2–2.7	1.1–1.4	0.58
Houten, Tielandt[465]		4x4	4.2	3.2	13.4	1–1.7	1–1.1	1.19
Rijswijk, De Bult[466]	building 28	8x3	4	6.3	25.2	2	0.8–1	0.95
Aalst[467]	LME	4x3	8	3.2	25.6	2	1.8	0.47
Baginton, The Lunt (UK)[468]		15x7	21	10	210	1.5	15	0.50
Hod Hill (UK)[469]		12x5	16.5	6.3	103.5	1.2–1.7	1.5–1.7	0.58
Haltern (BRD)[470]		18x9	29.7	13.5	401	1.6–1.7	1.6–1.7	0.40
Oss-Ussen[471]	S203	3x3	2.8	2	5.6	1.2–1.5	1	1.6
	S336	3x3	3.2	2.2	7	16	1–1.2	1.3
	S4	3x3	3.4–3.6	3–3.2	104	1.6–1.8	1.4–1.6	0.87
	S464	3x3	4.2–4.3	34	147	2–2.2	1.6–1.8	0.61
	S309	4x3	7–7.2	4–4.2	291	2.2–2.4	2–2.2	0.41

* measured centre to centre

TABLE 45 Dimensions of posthole patterns from Dorestad compared with those of posthole patterns from Western Europe.

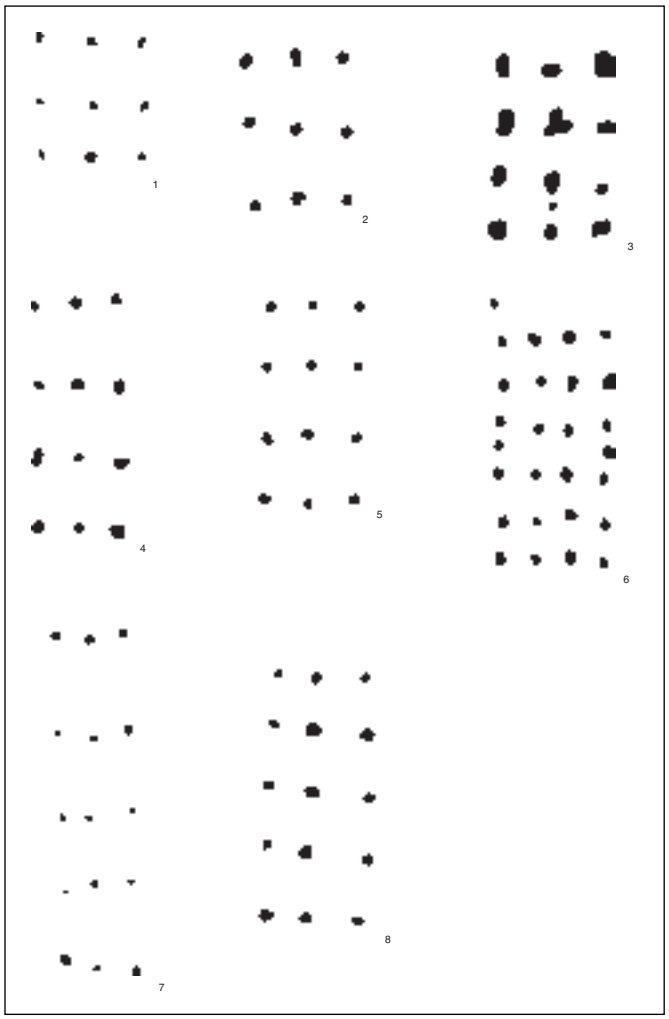
458 *Woltering 2001, 52–8.*
459 *Van Es 1968, fig.7, 11, 13.*
460 *Van Es 1967, fig.42.*
461 *Van Es & Hulst 1991, Abb. 26.*
462 *Verlinde & Erdrich 1998.*
463 *Van Es, Miedema & Wynia 1985, Abb. 21.*
464 *Excavation ROB 1977–86, granary no. 87 (Vos 2002, type 3, 50–1, 112).*
465 *Van Es & Hessing 1994, fig. 41.*
466 *Bloemers 1978, Abb. 62.*
467 *Verwers & Stoepker 2002, 103-4.*
468 *Hobley 1974, 276–80.*
469 *Rickman 1971, fig. 36.*
471 *Schinkel 1994, fig. 41–3.*
472 *Woltering, 2000-1.*
473 *Hobley 1974.*

Texel, Woltering suggests the possibility that the Iron Age and Roman Period granaries there were not true buildings but a kind of beehive-like structure of wattle and daub.[472] The wooden *horrea* of the Roman army are reconstructed as wooden sheds on a platform. The reconstructed granary at Lunt near Corbridge has one storey, but it is expressly mentioned that the roof also provides enormous storage space.[473] As stated above, the long rectangular posthole-patterns of Dalem and Flögeln are interpreted as long barns on posts, possibly with a storey. The striking drop in the number of supporting posts per m^2, especially in the Early Middle Ages, may be linked with an improvement in the timber constructions and/or the use of heavier wood, particularly for the horizontal beams of which the platform consisted. However, it is also conceivable that the floor of the barns was less heavily laden than that of the smaller granaries, for example, because they were used for a different purpose. In

Zimmermann's view, this was not the case: the large barns also apparently served as storage places for harvested products, especially cereals.
Posthole patterns of granaries do not therefore constitute true plans: they give little information about the way in which the actual storehouse on the posts was built. As far as the posthole patterns of Dorestad are concerned, there is an additional problem: their measurements cannot always be established with certainty. In figures 269–77 an attempt has been made to integrate a number of posthole patterns, by way of example, in the development of the dams in which they were incorporated. There often appear to be various possibilities of attributing the patterns to successive building phases. In figure 271 alternative solutions have been given for the patterns in dams HS-II 5 and 7, and this would have been possible in many other cases. Which of the solutions is preferable is difficult to say. However, it is evident that only short posthole-patterns occurred at the beginning of the dams (figs. 269–75). The buildings which sprang up at the beginning of the dams against the original bank appear to have been relatively small and short. The best examples of these were found in Hoogstraat I and II, but there too, it was difficult to trace what had actually taken place.
Dam HS-I 6 began with a rectangle of posts on the inside of which there was a wattle screen (fig. 269); in this case there was no question of a posthole pattern. We interpreted this first section of the dam as the first dam compartment: a caisson of wickerwork supported by posts and filled with soil. However, one might also see it as the plan of a small building, *c.* 5.5 x 3 m, which did not need to be set on a platform at this spot against the bank. The heavier posts would then have supported both floor and roof, and the wattle screen (indicated by the small postholes) would in that case have formed the walls. The two extra posts discovered on the west-side on either side of the central axis were possibly the doorposts, though they may also have been from a stairway bridging the gap between bank and dam. Similar initial elements were also found in other dams, though the plans were usually less clear (figs. 269–275). In some dams, such as HS-II 5 and 6, the first – recognizable – element was already a definite posthole-pattern (fig. 272). It is, therefore, not improbable that the development of the parcels in the riverbed began with the construction of a small building on or against the 'original' bank.
These initial buildings were, as we have seen, short. The initial pattern of HS-II 6 was 4 x 6 m and consisted of three rows of posts. In the adjacent parcel HS-II 5, the initial posthole-pattern was more or less as wide and long, or three times as long at the most. Elsewhere the patterns at the beginning of the dams did not appear to have been any longer either, and there are no indications that this changed during period 1 (AD 650/675-725/750). In the period-2 zone, roughly from the middle of the 8th century, the patterns in Hoogstraat I and II[474] appeared at first sight to have been much longer, though this was probably just imagination. Figures 276 and -277, suggest that these long patterns also developed over several building phases. The length of the separate elements did not exceed 10 m and was generally well below this. As far as the measurements of the patterns are concerned, there are no fundamental differences between the two periods. The lengths varied within the same limits. In period 2 the width increased a little: the number of posts in the rows now amounted to five, instead of three or four.
We assume that the dimensions of the posthole patterns (roughly) corresponded to the surface area of the buildings erected on the posthole patterns. How tall these buildings were is unknown. In the silhouettes, added to figures 269–71 as side-elevations, we assumed a wall height of 2 m and a ridge height of 4 m: *i.e.* single-storey buildings and a saddle roof. However, this is pure conjecture, which is why we also consider buildings with two storeys (under the saddle roof) to be possible. The supporting power of the Dorestad posthole-patterns, measured in the number of posts per m^2, compares favourably with that of the barns on posts from Dalem or the

474 In the other Hoogstraat I excavations the dams were (probably) extended less far eastward, and no new built up zone developed in period 2.

Fig. 268 Plans of granaries from Western Europe, dating from the Iron Age, Roman period and (Early) Middle Ages. Scale 1:200 (see also table 45). Legenda: see list of Illustrations, p. 378.



zaunparallele Pfostenreihen from Flögeln, and is generally not much below that of the wooden *horrea* of the Roman army (table 45). A second point of uncertainty is whether the building completely covered the posthole pattern. In the rear view of dam HS-I 5 two solutions have been proposed (fig. 269). In the first, the building does not completely cover the entire breadth, but the oblique shores against the outer wall obstruct the use of the sides of the platform. In the second solution, a *c.* 1 m-wide 'gangway' remains on either side of the building. It was not possible to deduce from the position of the post remains – or post traces – found which of these solutions is correct, although in our view the second possibility is preferable. The total breadth of the platform would then already be between 7 and 8 m at the beginning, which corresponds to the breadth of the posthole patterns from period 2 (*cf.* figs. 276 and 277). If one assumes that gangways were also left open on the latter platforms, the width of the buildings would be 5–6 m from beginning to end. The way in which the posthole patterns were incorporated in the dams which were then still being extended is difficult to fathom. We assume that a platform with a building on it was integrated in a dam compartment by surrounding it on three sides by side and end revetments. It seems logical that the posts of the pattern would first have been driven into the soil, then that the revetments were built and filled with soil, and that finally the building was erected. It looks as if the dam was generally extended a short distance past the building, creating a kind of loading platform which may very well have been covered. The empty space in front of the building increased as the dam

was extended. It is often difficult to establish whether the roof or the entire building was also extended. 'Empty' compartments such as those in dams HS-II 2, 5–7 at the beginning, and in HS-I 5/5A, 8 and 9 from period 2, suggest that this was certainly not the case everywhere. Apparently, parts of the dams remained vacant, in front of and between the buildings. On the other hand, the posthole patterns in other places succeeded each other without any large gaps. In those cases one might assume that long, shed-like buildings gradually developed out of separate building sections of 3 to 6 m in length – especially during period 2 in Hoogstraat I and II. However, it is also possible that what was built on to the front side of the building was demolished at the back, so that the building did 'creep' forward, but did not become much longer. This second hypothesis is less probable in our opinion. Sturdy oak buildings would certainly have lasted for two or three generations if well maintained, and neither of the two periods of use of the riverbed area lasted much longer.

Figures 261–5* give the impression that there were two or three rows of buildings behind each other, at least in Hoogstraat I and II. If the oldest buildings remained until the end of the development there, they would have been at least one and a half centuries old at that moment. This is perhaps not inconceivable, but in our view it does not seem very likely. However, pottery dating from after the middle of the 8th century was found in the period-1 zone, at the front of the riverbed. This indicates that, also in Hoogstraat I and II, this area remained in use in (part of) the second half of the 8th century. It possibly implies that the oldest buildings there still remained in use for a while after the foremost buildings had shifted to the period-2 zone. Even if this was the case, we do not know how for how long, but probably not until the end of Dorestad, around the middle of the 9th century or slightly later. In the other Hoogstraat excavations the expansion of the riverbed structures probably took place over a shorter distance, with the front shifting less far eastwards. In the built up area there must have been buildings present at least until the second half of the 8th century. On the basis of the finds it is probable that the exploitation of the riverbed area ended earlier in Hoogstraat 0 and IV, and possibly also in III, than in the central part of Hoogstraat I to II (see chapter VII 3.3).

What the waterfront of this part of the settlement looked like is difficult to describe exactly. It was, of course, determined by the façades of the buildings situated on the raised sections of the parcels in the riverbed. The buildings in various places there were built in pairs on contiguous dams, with no more than a narrow alleyway between them (see for example figs. 267* and 274). Nevertheless, the waterfront of this part of Dorestad certainly did not consist of an unbroken row of façades. In many cases there was a gap of at least four metres between two successive buildings: this was in the section of the parcels which had not been heightened systematically, where the soil for raising the dams had been extracted. Elsewhere the gaps were even greater because not every dam apparently had a building on it (see for example fig. 276). Whether this was a frequent occurrence and whether there was a system to the alternation of built up and vacant parcels cannot be established, due to the incomplete nature of the archaeological picture. The situation reflected in figure 276 was possibly an exception. At any rate, the impression is that (almost) all the parcels in the zone directly in front of the 'original' bank were built on. It is uncertain whether the façades of the buildings always had the same alignment: we suspect that they did not. Finally the height of the house façades is unknown, but it was probably not impressive. All in all, with the northern part of Dorestad in mind, one should not imagine the waterfront of a late-medieval trading port. That of Dorestad was probably far more irregular, and it was not characterized by slender storehouses but by shed-like buildings.

The buildings which we assume stood on the posthole patterns in the riverbed have, in the preceding pages, been included in the development of the granary in the coastal area of the North Sea. The main reason for this was the similarity in 'plan', and, if the

buildings in this part of Dorestad did in fact develop in phases from sections some 4 to 10 m long, as we assume, there is also a similarity in dimensions, in length at least, with the 'ordinary' granaries. In this case, the Dorestad buildings would only have attained measurements similar to those of the sheds on posts from Dalem in the second instance and in the course of time. Did these buildings also have the function of granaries or storehouses? Their floors were sturdy enough to support heavy loads. Nevertheless there are various arguments against the exclusive function as storehouses. The finds from the riverbed area indicate habitation in the most literal sense. In addition, there are clear indications of craft and commercial activities. The construction method of the buildings on the posthole patterns is unknown. However, it was possibly not very different from that of the smaller rectangular buildings in the zone on the bank behind the riverbed area. One may perhaps describe the buildings in the riverbed as a (shorter?) form on posts of the houses from the foremost zone of the settlement on the riverbank. Building on posts need not have been for exactly the same reasons as in the case of the granaries: the damp location may have been reason enough. The buildings in the riverbed probably did not only serve as storehouses, but were also used as dwellings and workshops. For that matter, in historical times the granary often had a mixed function. According to Zimmermann … *der Schlafplatz im Speicher* (was) *Europaweit verbreitet*.[475] The main reason for multiple use (as a treasure-house, among other things) was apparently that the granary was sturdily constructed, could be easily locked and often escaped being burnt.

As to the kind of inhabitants of the buildings in the riverbed area of Dorestad, we can only surmise. The location reminds one primarily of merchants, possibly living on a floor or loft above their wares. Perhaps they also practised their crafts in or near their buildings, or had this done by others. All this remains speculation. Nor is it absolutely certain that the buildings in the riverbed area were permanently occupied. One can imagine that they were empty in winter, out of the sailing season. We do not even know who the owners of the buildings were. They may not even have belonged to the people who used them.

475 Zimmermann 1992, 246.

Fig. 269 Dorestad, Hoogstraat I:
1 dam segment HS I 5 (G-3/5), with posthole pattern;
2 schematic front view;
3 schematic side view. Scale 1:400.

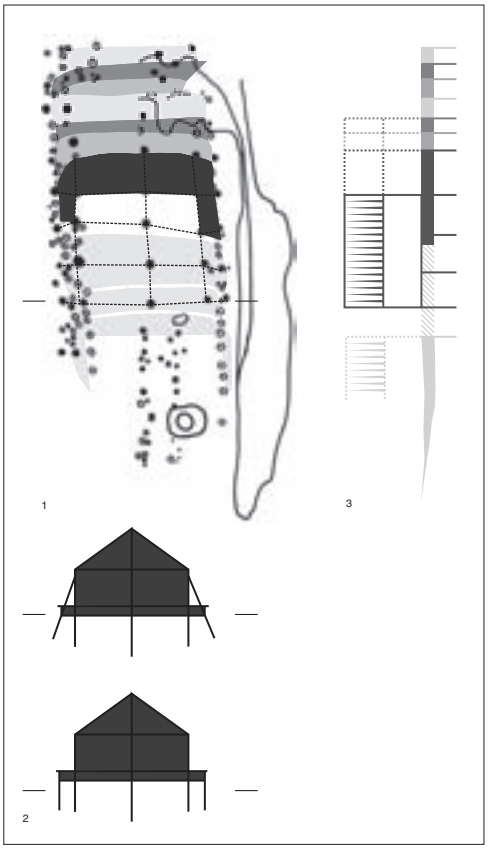


Fig. 270 Dorestad, Hoogstraat I:
1 dam segment HS I 6 (E/F-3/4), with posthole pattern;
2 schematic side view. Scale 1:400.

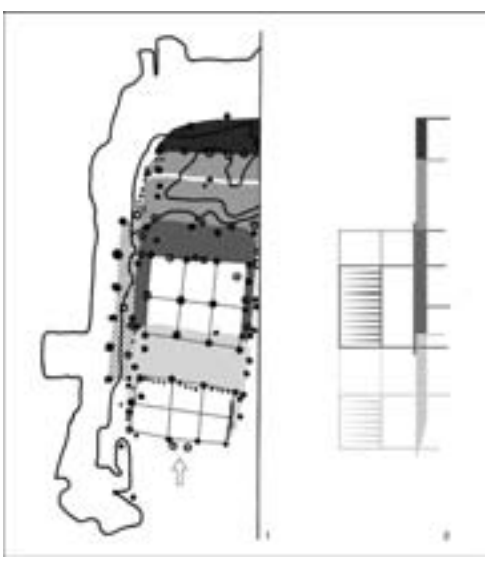
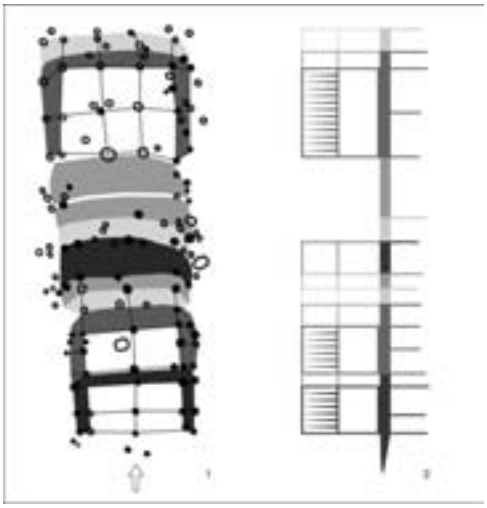


Fig. 271 Dorestad, Hoogstraat I:
1 dam segment with posthole pattern;
2 schematic side view. Scale 1:400.



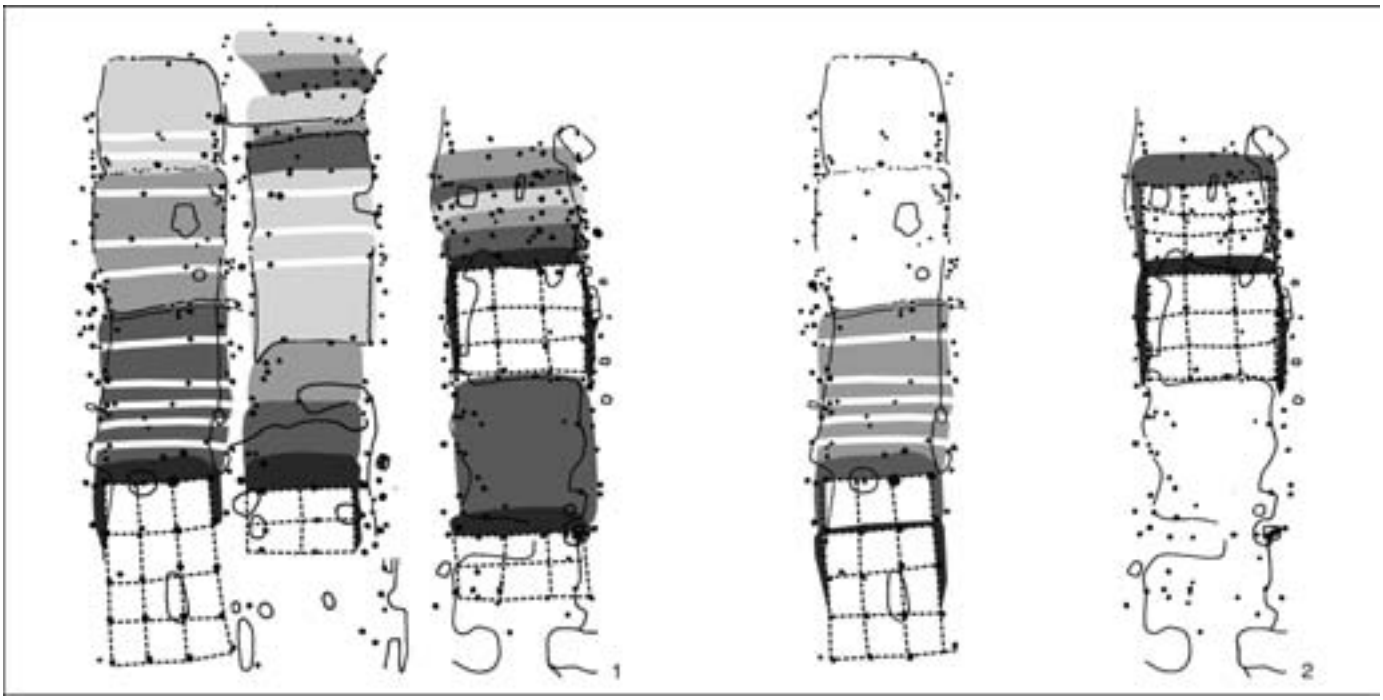


Fig. 272 Dorestad, Hoogstraat II: dam segments HS II 5/7 (A/C - 3/6) with posthole pattern;
1 and 2 different interpretations.
Scale 1:400.

Fig. 273 Dorestad, Hoogstraat II: dam segment HS II 2 (F/G-3/5) with posthole pattern; scale 1:400.

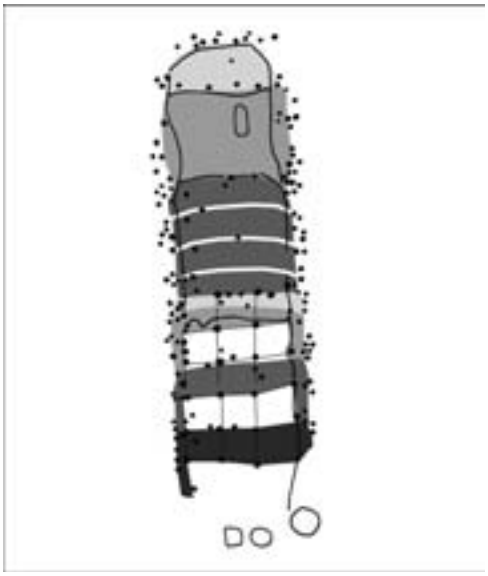


Fig. 274 Dorestad, Hoogstraat I: dam segment HS I 2/3 (J/K-3/5) with posthole pattern; scale 1:400.

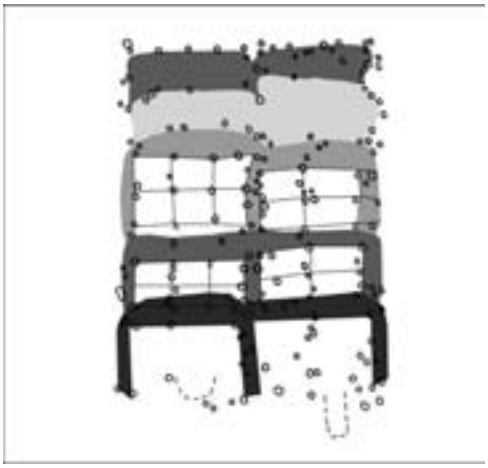


Fig. 275 Dorestad, Hoogstraat III: dam segment HS III 1/2 (E/G-4/6) with posthole pattern; scale 1:400.

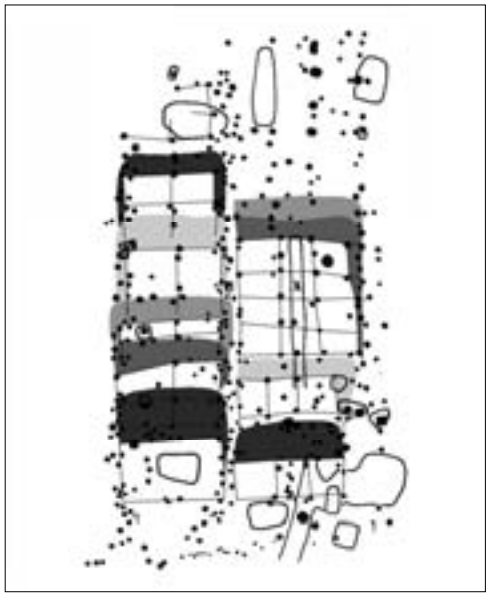


Fig. 276 Dorestad, Hoogstraat I: dam segment HS I 5/5A (G/F-10/16) with posthole pattern; scale 1:600.

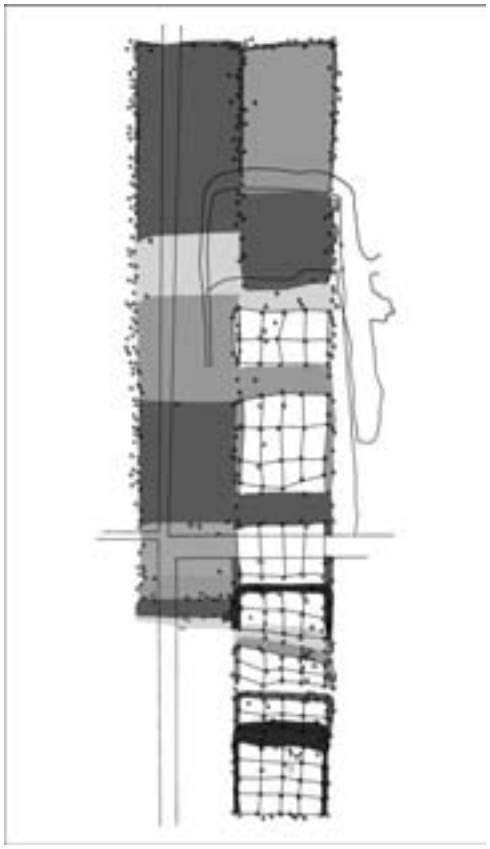
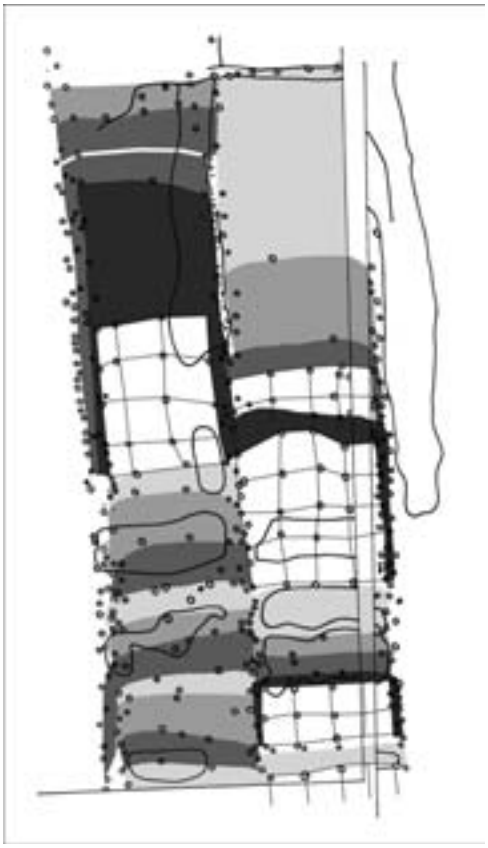


Fig. 277 Dorestad, Hoogstraat I: dam segment HS I 8/9 (C/D-13/16) with posthole pattern; scale 1:400.



References

Alders, G.P., 1988: Nieuwe dateringen van het vroegste steengoed, *Westerheem* 37, 306-12.

Arbman, H., 1937: *Schweden und das Karolingische Reich*, Stockholm (Kungl Vitterhets historie och akademiens handlingar, 4).

Bader, W., 1955: *St. Quirinus zu Neuss*, Ratingen.

Bader, W., 1962: Datierte Gefässe aus St. Viktor in Xanten. Mit einem anhang über Gefässe aus St. Martin in Emmerich, *Bonner Jarhbücher* 162, 188-230.

Bardet, A.C., 1995: Pottery Traded to Dorestad: some Exploratory Archaeometrical Analyses of Early Medieval Rhenish Wares, *BROB* 41, 187-230.

Bartels, M.H., *et al*. 1997: Duitsburgse waar uit ottoons Tiel, een keramische gidsfossiel voor de 10e eeuw?, *Westerheem* 46, 2-15.

Bartels, M. H., 1999: *Steden in scherven. Vondsten uit beerputten in Deventer, Dordrecht, Nijmegen en Tiel (1250-1900)*, Zwolle.

Baumgartner, E., & I. Krüger 1988: *Phoenix aus Sand und Asche*, Rheinisches Landesmuseum Bonn, 3.Mei-24.Juli, Basel 26.August - 28.September 1988.

Bayley, J., 1985: Viking Glassworking: the Evidence from York, *Annales du 10e congrès de l'Association Internationale pour l'Histoire du Verre*, Madrid-Segovie 23-28 septembre 1985, 245-54.

Beckmann, B., 1975: *Der Scherbenhügel in der Siegburger Aulgasse Bd. I: Die Formen der Keramik von ihren Anfängen bis zum Beginn der sogenannten Blütezeit (Perioden 1 bis 4)*, Bonn (Rheinische Ausgrabungen, 16).

Belfort, A. De, 1892-95: *Description générale des monnaies mérovingiennes*, Paris.

Bellingen, S. Van, 1987-1988: *Gelijkarmige fibulae uit de merovingische- en karolingische periode in België en in Noord-Frankrijk*, Brussel (thesis Vrije Universiteit).

Berendsen, H.J.A., 1982: *De genese van het landschap in het zuiden van de provincie Utrecht, een fysisch-geografisch onderzoek*, Utrecht (Utrechtse geografische studies, 25).

Berghaus, P., 1955/1956: Fünf Kölner Pfenninge von Wermelskirchen, Rhein-Wupper-Kreis, vergraben um 960, *Hamburger Beiträge zur Numismatik* III, Heft 9/10.

Besteman, J.C., 1974: Carolingian Medemblik, *BROB* 24, 43-106.

Besteman, J.C., 1989: The pre-urban development of Medemblik: From a early-medieval trading centre to a medieval town, in: H.A. Heidinga & H.H. van Regteren Altena (eds.), *Medemblik and Monickendam. Aspects of medieval urbanization in northern Holland*, Amsterdam (Cingula 11), 1-30.

Besteman, J.C., & A.J. Guiran 1986: De middeleeuwse bewoningsgeschiedenis van Noord-Holland boven het IJ en de ontginning van de veengebieden. Opgravingen in Assendelft in perspectief. In: M.C. van Trierum & H.E. Henkes (red.), A *contribution to prehistoric, roman and medieval archaeology*, Rotterdam, 183-212 (Rotterdam Papers V).

Binding, G., 1971: St. Johann Baptist in Hamborn, *Rheinische Ausgrabungen* 9, Düsseldorf, 88-110.

Binding, G., W. Janssen & F.K. Jungklaass 1970: *Burg und Stift Elten am Niederrhein. Archäologische Untersuchungen der Jahre 1964/65*, Düsseldorf.

Bit, R. G. Dehamende, J. Docquier & E. Lauwerijs 1985/86: Four de potier de la fin de XIe-debut du XII siècle decouvert a Huy, *Bulletin du Cercle archéologique Hesbaye-Cobdroz* 19, 169-77.

Bloemers, J.H.F., 1974: *Rijswijk (Z.H.), 'De Bult', Eine Siedlung der Cananefaten*, Amersfoort (Nederlandse Oudheden, 8).

BMC: *Catalogus of English Coins in the British Museum*, Anglo-Saxon Series I, London, 1887.

Boeles, P.C.J.A., 1951: *Friesland tot de elfde eeuw*, Den Haag (2nd ed.).

Bogaers, J.E., 1974: Troupes auxiliaires thraces dans la partie néerlandaise de la Germania Inferior, *Actes du IXe Congrès International d'études sur les frontières romaines*, Mamaïa, 6-13 septembre 1972, Köln/Wien, 445-63.

Böhner, K., 1958: *Die Fränkischen Altertümer des Trierer Landes*, Berlin (Germanische Denkmäler der Völkerwanderungszeit B1).

Borger, H., 1965: Die Anfänge der mittelalterlichen Stadt Neuss nach dem Ergebnissen der Ausgrabungen inde den Jahren 1959-1964 (Vorbericht), *Rheinische Ausgrabungen* 1. Bonner Jahrbücher, Beiheft 28, Keulen/Graz, 170-240.

Borremans, R., & R. Warginaire 1966: *La céramique d'Andenne. Recherches de 1956-1965*, Rotterdam.

Borremans, R, & W. Lassance 1987: Andenne, site A61. Fouilles de fours de potiers (1973-1976), *Vie Archéolique* 7: 26, 53-104.

Bos, J.M., 1986: Amsterdam: Poppendam. In: P.J. Woltering (red.), Archeologische Kroniek van Noord-Holland over 1985, *Holland* 18, 294.

Braat, W.C., 1937: Funde mittelalterlicher Keramik in Holland und ihre Datierung, *Bonner Jahrbücher* 142, 157-76.

Bruijn, A., 1960-1961: Die mitteralterliche keramische Industrie in Schinveld, *BROB* 10-11, 462-507.

Bruijn, A., 1962-1963: Die mittelalterliche keramische Industrie in Südlimburg, *BROB* 12-13, 356-459.

Bruijn, A, 1968: Zur Zeitbestimmung mittelalterlicher bemalter Keramik, *Chateau Gaillard* 4, Gent, 45-7.

Bult, E.J., 1994: Bijlage III: Laat-middeleeuws aardewerk, in: P.W. van den Broecke & J.-K.A. Hagers, *Gasleiding als aanleiding: Inventarisatie van archeologische waarden in het gasleidingtracé Monster-Gaag (Zuid-Holland)*, De Haag (Haagse Oudheidkundige Publicaties I), 72-3.

Cabart, H., 1991: Les gobelets mérovingiens à inscription du musée de Chalons-sur-Marne (France), *Annales du 12e congrès de l'Association Internationale pour l'Histoire du Verre*, Vienne-Wien 26-31 août 1991, 225-34.

Callmer, J., 1977: *Trade Beads and Bead Trade in Scandinavia ca 800 - 1000 AD*, Bonn (Acta Archaeologica Lundensia, Series in quatro, 11).

Calvi, M.C., 1968: *I vetri romani del museo di Aquileia*, Aquileia.

Capelle, T., 1976: *Die frühgeschichtlichen Metallfunde von Domburg auf Walcheren 1-2*, Amersfoort (Nederlandse Oudheden, 5).

Carmiggelt, A., & A.J. Guiran 1997: Pre-stedelijke bewoningssporen en vondsten in het tracé van de Willemsspoortunnel te Rotterdam: prehistorie, Romeinse Tijd en Middeleeuwen (vóór ca 1150), in: A. Carmiggelt, A.J. Guiran & M.C. van Trierum (red.), *BOOR-balans 3: Archeologisch onderzoek in het tracé van de Willemsspoortunnel te Rotterdam*, Rotterdam, 73-112.

Casparie, W.A., & J.E.J. Swarts 1980: Wood from Dorestad, Hoogstraat I, in: W.A. van Es & W.J.H. Verwers, *Excavations at Dorestad 1, The Harbour: Hoogstraat I*, 's-Gravenhage, 262-85 (Nederlandse Oudheden, 9).

Clarke, H., 1975: Andenne Pottery Found from Excavations at Staveren, Friesland, 1963-1964, *BROB* 25, 177-82.

Clason, A.T., 1980: Worked Bone and Antler Objects from Dorestad, Hoogstraat I, in: W.A. van Es & W.J.H. Verwers, *Excavations at Dorestad 1, The Harbour: Hoogstraat I*, 's-Gravenhage, 238-47 (Nederlandse Oudheden, 9).

Claussen, H., & U. Lobbedey 1989: Die karolingische Stiftkirche in Meschede. Kurzer Bericht über die Bauforschung 1965-1981, *Westfalen* 67, 116-26.

Cordfunke, E.H.P., 1979: Een bijzondere kan uit middeleeuws Alkmaar, *Kennemer contouren*, Zutphen (Alkmaarse historische reeks 3), 52-4.

Cordfunke, E.H.P., 1990a: Thirty Years of Archeological Investigation in Alkmaar's Town Centre, *BROB* 40, 333-87.

Cordfunke, E.H.P., 1990b: Alkmaar, een dorp op de geest wordt stad, in: H. Sarfatij (ed.), *Verborgen steden: Stadsarcheologie in Nederland*, Amsterdam, 78-82.

Dekker, C., 1980: De Dam bij Wijk, in: *Scrinum et scriptura, opstellen betreffende de Nederlandse geschiedenis, aangeboden aan Prof. dr. J.L. van der Gouw*, Groningen, 248-66 (Nederlands Archievenblad, 84).

Dekker, C., 1983: *Het Kromme Rijngebied in de middeleeuwen, een institutioneel-geografische studie* (Stichtse Historische Reeks, 9).

Döbken, A.B., 1988: Spijkenisse-Hartel-West 10-117, in: M.C. van Trierum, A.B. Döbken & A.J. Guiran (red.), *BOOR-balans 1: Archeologisch onderzoek in het Maasmondgebied 1976-1986*, Rotterdam, 63-5.

Doesburg, J., 1994: De begraven hofstad op De Geer, in: W.A. van Es & W.A.M. Hessing, *Romeinen, Friezen en Franken in het hart van Nederland. Van Traiectum tot Dorestad 50 v.C.-900 n.C.*, Utrecht/Amersfoort, 195-203.

Doesburg, J. van, 2000: What's in a name? De naam Wijk in relatie tot de ligging en de functie van de nederzetting, in: M.A. van Eerden-Vonk, J. Hauer & G.W.J. van Omme (red.), *Wijk bij Duurstede 700 jaar stad. Ruimtelijke structuur en bouwgeschiedenis*, 67-82.

Doesburg, J. van, & A.M. Bakker 1999: Archeologisch aanvullend onderzoek (AAO) in de binnenstad van Tiel. Vindplaats Tiel-Bleekveld, *Rapportage Archeologische Monumentenzorg* 72.

Dijkman, W., 1993: La Céramique du Haut Moyen Age à Maastricht: tradition et innovation, in: D. Piton (ed.), *Travaux du Groupe de Recherches et d'Etude sur la Céramique dans le Nord-Pas-de -Calais*, Actes du colloque d'Outreau, 10-12 avril 1992, la céramique du Ve au Xe siècle dans l'Europe du Nord-Ouest, Boulogne-sur-Mer, 217-25.

Dijkstra, J., 1998: Archeologisch onderzoek in de binnenstad van Tiel: De lokaties Koornmarkt en Tol-Zuid, juni t/m september 1996, *Rapportage Archeologische Monumentenzorg* 57.

Dirks, U., 1994: *Bleiglasierte Miniaturgefässe des augehenden hohen Mittelalters. Funde der Rathausgrabung und aus dem Altstadtgebiet Höxters* (Schriften des Weserrenaissance-Museums Schloss Brake Band 7), 229-37.

Ellmers, D., 1972: *Frühmittelalterliche Handelsschiffahrt in Mittel- und Nordeuropa*, Neumünster (Offa-Bücher, 29).

Elsner, H., 1989: *Wikinger Museum Haithabu: Schaufenster einer frühen Stadt*, Neumünster.

Es, W.A. van, 1967: *Wijster, a native village beyond the imperial frontier 150-425 A.D.*, Groningen.

Es, W.A. van, 1968: Archeologisch Nieuws in NKNOB, 30, Bennekom.

Es, W.A. van, 1974: Vis voor mijnheer Calkoen, *Westerheem* 23, 89-94.

Es, W.A. van, 1984: Romeinse helmen uit de Rijn bij Rijswijk, *Liber Amicorum aangeboden aan prof. dr. M.W. Heslinga*, Amsterdam, 255-91.

Es, W.A. van, 1990: Dorestad centred, in: J.C. Besteman *e.a.* (ed.), *Medieval Archaeology in the Netherlands. Studies presented to H.H. van Regteren Altena*, Assen/Maastricht, 151-82.

Es, W.A. van, & W.J.H. Verwers 1975: Céramique peinte d'époque carolingienne trouvée à Dorestad, *BROB* 25, 133-64.

Es, W.A. van, & W.J.H. Verwers 1980: *Excavations at Dorestad 1, The Harbour: Hoogstraat I*, 's-Gravenhage (Nederlandse Oudheden, 9).

Es, W.A. van, & W.J.H. Verwers 1985, Karolingisch draaischijfaardewerk uit Deventer, in: V.T. van Vilsteren & D.J. de Vries, *Van Beek en land en mensenhand*, Utrecht, 22-40.

Es, W.A. van, M. Miedema & S.L. Wijnia 1985: Eine Siedlung der römischen Kaiserzeit in Bennekom, Prov. Gelderland, *BROB* 35, 533-652.

Es, W.A. van, & R.S. Hulst 1991: *Das merowingische Gräberfeld von Lent*, Amersfoort (Nederlandse Oudheden, 14).

Es, W.A. van, & W.A.M. Hessing (red.) 1994: *Romeinen, Friezen en Franken in het hart van Nederland. Van Traiectum tot Dorestad 50 v.C.-900 n.C.*, Utrecht/Amersfoort.

Es, W.A. van, & W.J.H. Verwers 1995: House Plans from Dorestad, *BROB* 41, 173-86.

Evison, V.I., 1983: Bichrome Glass Vessels of the Seventh and Eighth Centuries, *Studien zur Sachsenforschung* 3, 7-21.

Evison, V.I., 1988a: Red Marbled Glass, Roman to Carolingian, *Annales du 11e congrès de l'Association Internationale pour l'Histoire du Verre*, Bâle, 29 août-3 septembre 1988, 217-28.

Evison, V.I., 1988b: Vieux Marché, Place Saint-Lambert, Liège. The Glass, in: M. Otte (ed.), *Les Fouilles de la Place Saint-Lambert à Liège 2. Le vieux marchè (ERAUL 23)*, Liège, 215-9.

Evison, V.I., 1989: Le verre carolingien, in: D. Foy & G. Sennequier (eds.), *A travers le verre du Moyen Age à la Renaissance*, Rouen, 137-44.

Foy, D., 1989: Verre à tige. VIIme siècle, in: D. Foy & G. Sennequier (eds.), *A travers le verre du Moyen Age à la Renaissance*, Rouen, 135-6, no. 59.

Foy, D., & G. Sennequier 1989: *A travers le verre du Moyen Age à la Renaissance*, Rouen (Musée départmental des antiquités).

Gelder, H.E. van, 1980: Coins from Dorestad, Hoogstraat I, in: W.A. van Es & W.J.H. Verwers, *Excavations at Dorestad 1, The Harbour: Hoogstraat I*, 's-Gravenhage, 212-24 (Nederlandse Oudheden, 9).

Giertz, W., 1996: Middle Meuse Valley Ceramics of Huy-type: a Preliminary Analysis, in: *Medieval Ceramics* 20, 33-61.

Gierz, W., 2001: Reliefbandamforen aus St. Quintin im kontext karolingischer Keramik, in: M. Tauch (Hrsg.), *Beiträge zur Heiligen-, Stifts- und Münstergeschichte*, Keulen, 222-406.

Gläser, M., 1989: Miniaturgefässe, in: J. Bracker (Hrsg.), *Hanse, Lebenswirklichkeit und Mythos,* Band 2. Zweibändiger Katalog zur Ausstellung des Museums für Hamburgische Geschichte, Hamburg, 557.

Glazema, P., 1951: Oudheidkundige onderzoekingen in de provincie Gelderland gedurende de jaren 1946 tot en met 1950, *Bijdragen en Mededelingen Gelre* dl. LI, 1-120.

Guido, M., 1978: *The Glass Beads of the Prehistoric and Roman Periods in Britain and Ireland*, London (Reports of the Research Committee of the Society of Antiquaries of London, 35).

Haalebos, J.K., 1977: *Zwammerdam - Nigrum Pullum. Ein Auxiliarkastell am Niedergermanischen Limes*, Amsterdam.

Haarnagel, W., 1979: *Die Grabung Feddersen Wierde*, Wiesbaden.
Haevernick, Th.E., 1979: Karolingisches Glas aus St. Dionysius in Esslingen, *Forschungen und Berichte der Archäologie des Mittelalters in Baden-Württemberg* Band 6, Stuttgart.

Halbertsma, H., 1953: Een onderzoek in de kerken van Eethen en Herpt, in 't land van Heusden (N. Brabant), *BROB* 4, 18-36.

Harden, D.B., 1959: New Light on Roman and early Medieval Window-glass, *Glastechnische Berichte*, 32K, Heft VIII, 8-16.

Harden, D.B., 1972: Ancient Glass, III: Post-Roman, *The Archaeological Journal* 128, 78-177.

Harden, D.B., 1978: Anglo-Saxon and Later Medieval Glass in Britain: Some Recent Developments, *Medieval Archaeology* 32, 1-24.

Heege, A., 1993: *Die Töpferei am Negenborner Weg, Einbecks ältester Gewerbetrieb* (Kleine Schriften des Städtlichen Museums Einbeck, Heft 1), Oldenburg.

Heege, A., 1995: Die Keramik des frühen und hohen Mittelalters aus dem Rheinland. Stand der Forschung - Typologie, Chronologie, Warenarten, *Archäologische Berichte* 5, Bonn, 1-101.

Heeringen, R.M. van, 1991: Verslag provinciaal archeoloog over 1990, *Jaarverslag ROB* 1990, 193.

Heeringen, R.M. van, 1992: Verslag provinciaal archeoloog over 1991, *Jaarverslag ROB* 1991, 57 en 173.

Heeringen, R.M. van, 1995: Het aardewerk, in: R.M. van Heeringen, P.A. Henderikx & A. Mars (red.) *Vroeg-Middeleeuwse ringwalburgen in Zeeland*, Goes/Amersfoort, 145-55.

Heeringen R.M. van, *et al.* 1995: *Vroeg-Middeleeuwse ringwalburgen in Zeeland*, Goes/Amersfoort.

Heidinga, H.A., 1987: The Hunneschans at Uddel reconsiderd: some ideas about the function of a medieval ringfort in the Central Netherlands, *Chateau Gaillard* XIII, 53-62.

Henderikx, P.A., 1980: De Lek en de Hollandse IJsel in de vroege middeleeuwen, in: *Scrinum et scriptura, opstellen betreffende de Nederlandse geschiedenis, aangeboden aan Prof. dr. J.L. van der Gouw*, Groningen, 229-47 (Nederlands Archievenblad, 84).

Henderson, J., 1991: The Glass, in: P. Armstrong, D. Tomlinson & D.H. Evans, *Excavation at Lurk Lane Beverley, 1979-82*, 124-257 (Sheffield Excavation Reports, 1).

Hobley, B., 1974: A Neronian-Vespasianic fort at 'The Lunt', Baginton, in: E. Birley, B. Dobson & M. Jarrett (eds.), *Roman Frontier Studies* 1969, Cardiff, 70-83.

Hollstein, E., 1968: Jahrringchronologische Untersuchungen von Holzproben aus der Motte bei Haus Meer, *Rheinische Ausgrabungen* 1, Keulen/Graz, 92-6.

Hollstein, E., 1980: Mitteleuropäische Eichenchronologie, *Trierer Grabungen und Forschungen* 11, Mainz.

Holmquist, W., 1964: Summaries Concerning Glass and Pottery from the Central Building Complex: the Glass, in: W. Holmquist & B. Arrhenius (eds.), *Excavations at Helgö, II: Report for 1957-1959*, Stockholm, 243-60.

Holwerda, J.H., 1923: *Arentsburg. Een Romeinsch militair vlootstation bij Voorburg, Leiden*.

Hübener, W., 1959: *Die Keramik von Haithabu*, Neumünster.

Hunter, J.R., 1980: The Glass, in: P. Holdsworth, *Excavations at Melbourne Street, Southampton, 1971-6* (CBA Research Report, 33).

Hussong, L., 1936: Frühmittelalterliche Keramik aus dem Trierer Bezirk, *Trierer Zeitschrift* 1, 75-89.

Hussong, L., 1939: Fränkisches Tongeschirr im Rheinland, *Rheinische Vorzeit in Wort und Bild* 2, 1, 70-5.

Isings, C., 1978: Een bijzonder drinkglas uit Dorestad, *Antiek* 21, no. 9, 495-7.

Isings, C., 1980: Glass Finds from Dorestad, Hoogstraat I, in: W.A. van Es & W.J.H. Verwers, *Excavations at Dorestad 1, The Harbour: Hoogstraat I*, 's-Gravenhage, 225-37 (Nederlandse Oudheden, 9).

Jaarverslag ROB, 1991, 42-50.

Janssen, H.L., 1983: Het middeleeuwse aardewerk; ca. 1200-ca. 1550, in: H.L. Janssen (red.), *Van Bos tot Stad: opgravingen in 's-Hertogenbosch*, Den Bosch, 188-222.

Janssen, H.L., 1988: The dating and typology of the earliest Siegburg stoneware in the Netherlands, in: D.R.M. Gaimster *e.a.* (eds.), *Zur Keramik des Mittelalters und der beginnenden Neuzeit im Rheinland* (BAR International series 440), Oxford, 311-33.

Janssen, W., 1970: Der Karolingische Töpferbezirk von Brühl-Eckdorf, Kr. Köln, *Neue Ausgrabungen in Niedersachsen* 6, 224-39.

Janssen, W., 1987: Die Importkeramik von Haithabu*, Die Ausgrabungen in Haithabu,* Band 9, Neumünster.

Janssen, W., & M. Müller-Wille 1968: Das Fundmaterial der Grabungen 1962-1964 auf der Niederungsburg bei Haus Meer, *Rheinische Ausgrabungen* 1, Keulen/Graz, 56-79.

Jelgersma, S., J. de Jong & W. Zagwijn *et al.* 1970: The coastal dunes in the western Netherlands: geology, vegitational history and archaeology, *Mededelingen Rijks Geologische Dienst* N.S. 21, 93-167.

Kars, H., 1984: *Early-medieval Dorestad, an archaeo-petrological study*, Amsterdam (also in *BROB* 30-33).

Keller, H., 1975: Reliquien, in Architekturteilen beigezetzt, in: Rüdiger Becksmann, Ulf-Dietrich Korn & Johannes Zahlten (Hrsg.), *Beiträge zur Kunst des Mittelalters*. Festschrift für Hans Wentzel, Berlin, 105-14.

Kleeman, J., 1991: *Grabfunde des 8. und 9. Jahrhunderts im nördlichen Randgebiet des Karolingerreiches*, Bonn.

Kleij, P., 2000: Aardewerk, in: J.W.M. Oudhof, J. Dijkstra & A.A.A. Verhoeven (red.), Archeologie in de Betuweroute. 'Huis Malburg' van spoor tot spoor. Een middeleeewse nederzetting in Kerk-Avezaath, *Rapportage Archeologische Monumentenzorg* 81, 97-138.

Kluge-Pinsker, A., 1988: *Die Entwicklung der Keramikproduction in Duisburg im 9. und 10. Jahrhundert*, Frankfurt am Main.

Knol, E., 1993: *De Noordnederlandse kustlanden in de Vroege Middeleeuwen*, Groningen.

Lanting, J.N., 1990: De ouderdom van de houten gebouwen onder de St.-Walburg en Martinikerk, in: J. W. Boersma, J.F.J. van den Borek, G.J.D. Offerman (red.), *Groningen 1040, Archeologie en de oudste geschiedenis van de stad Groningen,* Groningen, 145-74.

Leciejewicz, L., E. Tabaczynska & S. Tabaczynski 1963/64: Richerche archeolgiche a Torcello nel 1962, relazione provisoria, *Bolletino dell'Instituto di Storia Società e dello Stato veneziano* V-VII.

Leineweber, U., 1982: *Töpferei des Rheinhardswaldes vom 12. bis 20. Jahrhunderts,* Katalog zur Ausstellung des Hessischen Museumverbandes und der Staatlichen Kunstsammlungen Kassel, Kassel.

Linden, H. van der, 1982: Een nieuwe overheidsinstelling: het waterschap ca. 1100-1400, *AGN* III, Haarlem, 60-76.

Lith, S.M.E. van, 1977: A Romano-British Bangle from Valkenburg Z.H., in: B.L. van Beek, R.W. Brand & W. Groenman-van Waateringe (red.), *Ex Horreo* IPP 1951-1976, Amsterdam (Cingula, 4).

Lobbedey, U., 1968: Untersuchungen mittelalterlicher Keramik vornehmlich aus Süddeutschland, *Arbeiten zur Frühmittelalterforschung* 3, Berlin.

Lüdtke, H., 1988: Pingsdorfer Ware in Bergen, in: D.R.M. Gaimster, M. Redknap, H.-H. Wegner (Hrsg.), *Zur Keramik des Mittelalters und der beginnenden Neuzeit im Rheinland. Medieval and Later pottery from the Rhineland and its Markets*, Oxford (BAR. International series 440), 259-70.

Lüdtke, H., 1989: *The Bryggen pottery I. Introduction and Pingsdorf Ware*, Bergen (The Bryggen Papers Supplementary Series 4).

Lundström, A., 1971: Cuppa vitrea auro ornata, *Early Medieval Studies* 3, Stockholm, 52-68 (Antikvariskt arkiv, 40).

Lung, W., 1955: Töpferöfen der frühmittelalterichen Badorfware aus Badorf und Pingsdorf, Landkr. Köln, *Kölner Jahrbuch für Vor- und Frühgeschichte* 1, 54-70, Berlin.

Lung, W., 1956: Die Ausgrabungen nachkarolingischer Töpferöfen in Paffrath, Gem. Bergisch-Gladbach, *Bonner Jahrbücher* 155/156, 355-71.

Magdelijns, J.R.M., *et al.* (red.) 1996: *Het kapittel van Lebuinus in Deventer. Nalatenschap van een immuniteit in bodem, bebouwing en beschrijving*, Deventer.

Masden, P.K., 1991: Mittelalterliche bleiglazierte Miniaturgefässe aus Ribe, in: Töpfereiforschung - archäologisch, etnologisch, volkskundlich, in: Hartwig Lüdtke & Rüdiger Vossen (Hrsg.), *Beiträge des internationalen Kolloquiums 1987 in Schleswig*, Bonn, 430-7.

Milne, G., 1985: unpublished thesis on Medieval waterfront developments in northern Europe.

Moerman, J.D., 1959: Glazuur op Siegburger aardewerk, *Mededelingenblad van de Vrienden der Nederlandse Ceramiek* 16, 147-76.

Mook, W.G., & W.A. Casparie 1980: C-14 Datings from Dorestad, Hoogstraat I, in: W.A. van Es & W.J.H. Verwers, *Excavations at Dorestad 1, The Harbour: Hoogstraat I*, 's-Gravenhage, 286-91 (Nederlandse Oudheden, 9).

Morrison, K.F., & H. Grunthal 1967: *Carolingian Coinage*, New York.

Müller-Wille, M., 1973: *Eisengeräte aus Haithabu (Ausgrabung 1963-1964)* (Ausgrabungen in Haithabu, Bericht 6).

Näsman, U., 1984 (1986): Vendel Period Glass from Eketorp-II, Oland, Sweden. On Glass and Trade from the late 6th to the late 8th Centuries A.D., *Acta Archaelogica* 55, 55-116.

Nerman, B., 1969: *Die Vendelzeit Gotlands*, Stockholm.

Op den Velde, W., 1982: Sceatta's gevonden bij Maurik en Rijswijk, *Jaarboek voor Munt- en Penningkunde* 69, 1-19.

Oudhof, J.W., & M.H. Bartels 1996: De Middeleeuwse haven van Tiel, *Archeologie in Tiel* 3.

Périn, P., 1970: La vaisselle de terre, de verre et de bronze dans les Ardennes à l'époque mérovingienne d'après l'archéologie funéraire, *Actes du 93e Congrès National des Sociétés Savantes, Tours 1968*, Section d'Archéologie, Paris, 122-43.

Périn, P., 1989: Verre à tige. VIIe siècle, in: D. Foy & G. Sennequier, *A travers le verre du Moyen Age à la Renaissance*, Rouen, 135-136.

Piepers, W., 1981: Ausgrabungen an der alten Burg Lürken, *Rheinische Ausgrabungen* 21, Keulen.

Pirling, R., 1966: *Das Römisch-Fränkische Gräberfeld von Krefeld-Gellep*, Berlin.

Pirling, R., 1974: *Das Römisch-Fränkische Gräberfeld von Krefeld-Gellep 1960-1963*, Berlin.

Plumier, J., & C. Duhaut 1996: Un atelier de potiers médiévaux à Gesves/Mozet, *Cinq années d'archéologie en provence de Namur 1990-1995* (Etudes et Documents, fouilles 3), 63-6.

Polak, M., & S.L. Wynia 1991: The Roman forts at Vechten, a survey of the excavations 1829-1989, *OMROL* 71, 125-56.

Proos, R.H.P., 1996: Archeologisch onderzoek in en om Sandrasteeg 8, in: J.R.M. Magdelijns, H.J. Nalis, R.H.P. Proos & D.J. de Vries (red.), *Het kapittel van Lebuinus in Deventer. Nalatenschap van een immuniteit in bodem, bebouwing en beschrijving*, Deventer, 144-62.

Prummel, W., 1983: *Excavations at Dorestad 2; Early-Medieval Dorestad, an archaeozoological study*, Amersfoort (Nederlandse Oudheden, 11).

Reenen, P. van, 1992: Jydepotten in Nederland, *Westerheem* 41, 260-3.

Reenen, P. van, & V. Jensen 1995: Jydepotten en hun export naar Nederland, *Westerheem* 44, 1-16.

Renaud, J.G.N., 1968: Quelques remarques concernant le "Hunneschans" au Lac d'Uddel, *Chateau Gaillard* IV, 191-9.

Roman Imperial Coinage (RIC) III, London 1930.
Rickman, G., 1971:*Roman Granaries and Store Buildings,* Cambridge.

Roes, A., 1963: *Bone and antler objects from the frisian terp-mounds*, Haarlem.

Röber, R., 1990: *Hoch- und spätmittelalterliche Keramik aus der Klosteranlage tom Rhoden* (Ausgrabungen in tom Rhoden Band 1. Denkmalpfege und Forschung in Westfalen, Band 21), Bonn.

Salch, Charles-Laurent, 1971: Addenda verres des VIIIe au XIIIe siècles, *Communication artistiques et historiques, IX Congrès International du Verre*, Versailles 27 septembre-2 octobre, 147-54.

Sanke, M., 1999: "Wikingerschutt" aus Deventer und Zutphen. Zwei enddatierte Keramikkomplexe mit rheinischer Importware aus den Niederlanden, *Archäologie als Sozialgeschichte. Studien zu Siedlung, Wirtschaft und Gesellschaft im frühgeschichtlichen Mitteleuropa, Festschr. Heiko Steuer* (Internationale Archäologie, Studia honoraria 9), Rahden, 251-70.

Sanke, M., 2002: *Die mittelalterliche Keramikproduction in Brühl-Pingsdorf: Technologie – Typopogie – Chronologie* (Rheinische Ausgrabungen Band 50), Mainz.

Sarfatij 1977: Valkenburg (Z.H.), Excavations at De Woerd (Praetorium Agrippinae?) in 1972; a preliminary report, in: Studien zu den Militärgrenzen Roms, II: *Vorträge des 10. internationalen Limeskongresses in Germania Inferior*, Köln (*BJ*, Beiheft 38), 159-67.

Sarfatij, H., 1999: Tiel in succesion of Dorestad. Archaeology in a 10th- to 11th Century Commercial Centre in the Central River Area of the Netherlands, in: H. Sarfatij *et al.*, *In Discussion with the Past. Archaeological studies presented to W.A. van Es*, Zwolle, 243-52.

Schinkel, K., 1994: *Zwervende erven. Bewoningssporen in Oss-Ussen uit bronstijd, ijzertijd en Romeinse tijd; opgravingen 1976-1986*, Leiden.

Siegmund, F., 1989: *Fränkische Funde vom deutschen Niederrhein und der nördlichen Kölner Bucht*, Köln.

Speck, B., 1993: Römisches Spielzeug, Rasseln, Tiere, Puppen und Knöchelchen, in: *Spielzeug in der Grube lag und schlief. Archäologische Funde aus Römerziet und Mittelalter* (Katalog zur Ausstellung der stadtlichen Museen Heilbronn), Heilbronn.

Spitzers, Th. A., 1990: *'Port of trade' of vroege stad? De nederzettingsontwikkeling van Deventer in de vroege middeleeuwen archeologisch en historisch bekeken* (ongepubliceerde doctoraalscriptie), Amsterdam.

Spitzers, Th. A., 1996: De opgraving aan de Stromarkt (1966/1967), in: J.R.M. Magdelijns, H.J. Nalis, R.H.P. Proos & D.J. de Vries (red.), *Het kapittel van Lebuinus in Deventer. Nalatenschap van een immuniteit in bodem, bebouwing en beschrijving*, Deventer, 115-26.

Stampfuss, R., 1939: *Der Spät-fränkische Sippenfriedhof von Walsum*, Quellenschriften zur Westdeutschen Vor- und Frühgeschichte 1, Leipzig.

Stein, F., 1967: *Adelsgräber des achten Jahrhunderts in Deutschland*, Berlin (Germanische Denkmäler der Völkerwanderungszeit, serie A 9).

Stephan, H.G., 1981: *Coppengrave. Studien zur Töpferei des 13. bis 19. Jahrthunderts in Nordwest-deutschland* (Materialhefte zur Ur- und Frühgeschichte Niedersachsens, Heft 17), Hildesheim.

Stephan, H.G., 1986: Beiträge zur archäologischen Erforschung der materiellen Kultur des hohen und späten Mittelalters im Weserbergland. Funde aus zwei Kloaken in der Altstadt von Höxter, *Neue Ausgrabungen und Forschungen in Niedersachsen* 17, 219-308.

Stephan, H.G., 1987: *Grossalmerode. Ein Zentrum der Herstellung von technischer Keramik, Steinzeug und Irdenware in Hessen*, Glas- und Keramikmuseum Grossalmerode, Teil I, Melsungen.

Stephan, Hans-Georg, 1988: Mittelalterliche Glasproduktion in Hessen, Westfalen und Niedersachsen (800-1500), *Annales du 11e Congrès de l'Association Internationale pour l'Histoire du Verre*, Bâle 29 août - 3 septembre, 291-301.

Stilke, H., 1993: Die frühmittelalterliche Keramik von Oldorf, Gde. Wangerland, Ldkr. Friesland. In: *Nachrichten aus Niedersachsens Urgeschichte* 62, 135-68.

Stilke, H., A. Hein & H. Mommsen 1996: Results of Neutron Activation Analysis on Tating Ware and the Mayen Industry, *Medieval Ceramics* 20, 25-32.

Tent, W.J. van, 1973: Excavations along the Limes, *BROB* 23, 123-34.

Tholen, P.J., 1969: Fundberichte: Bergisch Gladbach, Rhein.-Berg. Kreis, 3. Paffrath, *Bonner Jahrbücher* 169, 511-2.

Tischler, F., 1950: Frühmittelalterliche Keramik aus Duisburg, *Germania* 1944-1950, 75-82.

Tischler, F., 1952: Zur datierung der Frühmittelalterlichen Tonware von Badorf, Ldkr. Köln, *Germania* 30, 194-200.

Treling, J.R., 1986: Lange Lauwersstraat 3-13, in: T.J. Hoekstra (red.), *Archeologisch-Bouwhistorische Kroniek van de gemeente Utrecht 1985* (maandblad Oud-Utrecht, 1981-11), 176-81.

Trimpe Burger, J.A., 1958: Onderzoekingen in vluchtbergen, Zeeland, *BROB* 8, 114-57.

Tromnau, G., 1979: Fortführung der Ausgrabung eines mittelalterliches Töpferofens in Duisburg, *Ausgrabungen im Rheinland* 78, 253-7.

Tromnau, G., 1983: Ein karolingerzeitlicher Töpfereibetrieb in Duisburgs Innenstadt, *Duisburg und die Wikinger, 1100 Jahre Duisburg*, 883-1983, 31-6.

Veen, M.M.A. van, 1992: Middeleeuwse houtbouw uit Spijkenisse- Hartel West, in: A.B. Döbken (red.), *BOOR-balans 2: bijdragen aan de bewoningsgeschiedenis van het Maasmondgebied*, Rotterdam, 236-51.

Verhaeghe, F., 1967: Het *plaatselijk geglazuurd aardewerk opgegraven te Antwerpen*, Gent.

Verhaeghe, F., 1995: V.2 Het vroeg-Middeleeuwse geglazuurde aardewerk uit Oost-Souburg, in: R.M. van Heeringen, P.A. Henderikx & A. Mars (red.), *Vroeg-Middeleeuwse ringwalburgen in Zeeland*, Goes/Amersfoort, 155-69.

Verhoeven, A.A.A., 1989: Middeleeuws aardewerk uit Bergeijk, in: A.A.A. Verhoeven & F. Theuws, *Het Kempen-project 3. De Middeleeuwen Centraal* (Bijdragen tot de studie van het Brabants Heem, 33), 217-43.

Verhoeven, A.A.A., 1990: Ceramics and economics in the Low Countries AD 1000-1300, in: J. C. Besteman *et al.* (red.), *Medieval Archaeology in the Netherlands. Studies presented to H.H. van Regteren Altena*, Assen/Maastricht, 265-82.

Verhoeven, A.A.A., 1996: *Handgemaakt aardewerk in Nederland (8ste-13de eeuw); enkele studies over middeleeuwse kogelpotten*, Amsterdam.

Verhoeven, A.A.A., 1998: *Middeleeuws gebruiksaardewerk in Nederland (8ste-13de eeuw)*, Amsterdam Archaeological Studies 3, Amsterdam.

Verlinde, A.D., & M. Erdrich 1998: Eine germanische Siedlung der späten Kaiserzeit mit umwehrter Anlage und umfangreicher Eisenindustrie in Heeten, Provinz Overijssel, Niederlande, *Germania* 76, 2. Halbband, 693-719.

Verwers, W.J.H., 1994: Wijk bij Duurstede-Dorestad, in: W.A. van Es & W.A.M. Hessing (red.), *Romeinen, Friezen en Franken in het hart van Nederland. Van Traiectum tot Dorestad 50 v.C.-900 n.C.*, Utrecht/Amersfoort, 234-8.

Verwers, W.J.H., 1998: *North Brabant in Roman and Early Medieval Times*, V: Habitation History, Amersfoort.

Verwers, W.J.H., & A.E. Botman 1999: Absolute dating of Early Medieval wells in Wijk bij Duurstede, in: H. Sarfatij *et al.*, *In Discussion with the past. Archaeological studies presented to W.A. van Es*, Zwolle, 243-52.

Verwers, W.J.H., & H. Stoepker 2002: De houten Kerken in Brabant, in: P.J. Woltering, W.J.H. Verwers & G.H. Scheepstra, *Middeleeuwse Toestanden. Archeologie, geschiedenis en monumentenzorg,* Amersfoort, 93-117.

Vlierman, K., 1996: Kleine bootjes en middeleeuws scheepshout met constructiedetails, *Scheepsarcheologie* II (Flevobericht 404), NISA/ROB, Amersfoort.

Vlierman, K., 2002: Scheeps- en stadsarcheologie. De betekenis van scheeps(houtvondsten in Nederlandse middeleeuwse steden, in: P.J. Woltering, W.J.H. Verwers & G.H. Scheepstra, *Middeleeuwse Toestanden. Archeologie, geschiedenis en monumentenzorg,* Amersfoort, 119-48.

Völckers, H.H., 1965: *Karolingische Münzfunde der Frühzeit (751-800)*, Göttingen.

Vos, W.K., 2002: *De inheems-Romeinse huisplattegronden van De Horden te Wijk bij Duurstede*, Amersfoort (Rapportage Archeologische Monumentenzorg, 96).

Waterbolk, H.T., 1990: Het houten gebouw onder de St.-Walburgkerk te Groningen, in: J. W. Boersma, J.F.J. van den Broek & G.J.D. Offerman (red.), *Groningen 1040, Archeologie en de oudste geschiedenis van de stad Groningen*, Groningen, 145-74.

Winkelmann, W., 1975: Alles Hohle klingt besser, karolingische Schallgefäße aus der Kirche St. Walburga in Meschede, *Kölner Römer-Illustrierte* 2, 233-4.

Woltering, P.J., 2000/01: Occupation History of Texel, IV Middle Bronze Age-Late Iron Age, *BROB* 44, 9-396.

Ypey, J., 1962/63: Die Funde aus dem frühmittelalterlichen Gräberfeld Huinerveld bei Putten im Museum Nairac in Barneveld, *BROB* 12-3, 99-152.

Zimmermann, W.H., 1991: Die früh- bis hochmittelalterliche Wüstung Dalem, Gem. Langen-Neuenwalde, Kr. Cuxhaven. Archäologische Untersuchungen in einem Dorf des 7.-14. Jh. n. Chr., in: H.W. Böhme (Hrsg.), *Siedlungen und Landesausbau zur Salierzeit 1. In den nördlichen Landschaften des Reiches*, 37-46, Sigmaringen (Monographien RGZM Mainz, 27).

Zimmermann, W.H., 1992: *Die Siedlungen des 1. bis 6. Jahrhunderts nach Christus von Flögeln-Eekhöltjen, Niedersachsen: Die Bauformen und ihre Funktionen*, Wilhelmshaven (Probleme der Küstenforschung im südlichen Nordseegebiet, Bd. 19).

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List of abbrevations

AGN	*Algemene Geschiedenis van Nederland*
BAI	Biologisch-Archaeologisch Instituut, Rijksuniversiteit, Groningen
BAR	*British Archaeological Reports*
BJ	*Bonner Jahrbücher*
BMC	British Coins
BROB	*Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek*
ERAUL	Études et Recherches Archéologiques de l'Université de Liège
IPP	Instituut voor Prae- en Protohistorische Archeologie Albert Egges van Giffen, Amsterdam
JROB	*Jaarverslag van de Rijksdienst voor het Oudheidkundig Bodemonderzoek*
NAP	above Normal Amsterdam Peil (Dutch Datum Level)
-NAP	under Normal Amsterdam Peil (Dutch Datum Level)
NISA	Nederlands Instituut voor Scheeps- en Onderwater Archeologie, Lelystad/ Amersfoort
NKNOB	*Nieuwbulletin van de Koninklijke Nederlandse Oudheidkundige Bond*
OMROL	*Oudheidkundige Mededelingen uit het Rijksmuseum van Oudheden te Leiden*
RAM	Rapportage Archeologische Monumentenzorg
RGZM	Römisch-Germanischen Zentralmuseum Mainz
ROB	Rijksdienst voor het Oudheidkundig Bodemonderzoek
VU	Vrije Universiteit van Amsterdam

Fig. 8 Dorestad, Hoogstraat 0: west-east section AA-BB; north profile trench 267. Scale 1:400 (length), 1:80 (height). Legend:
1 settlement refuse, usually in pits or trenches;
2 polluted sandy clay;
3 sandy clay;
4 fine or coarse sand;
5 fine or coarse gravel;
6 topsoil;
7 postholes;
8 sand extraction pits.

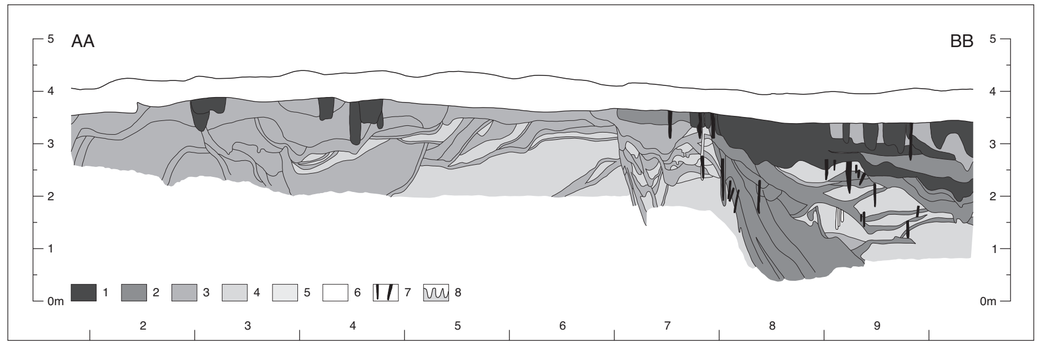


Fig. 9 Dorestad, Hoogstraat 0: west-east section CC-DD; north profile trench 261. Scale (length) 1:400, (height) 1:80. Legend: see fig. 8.

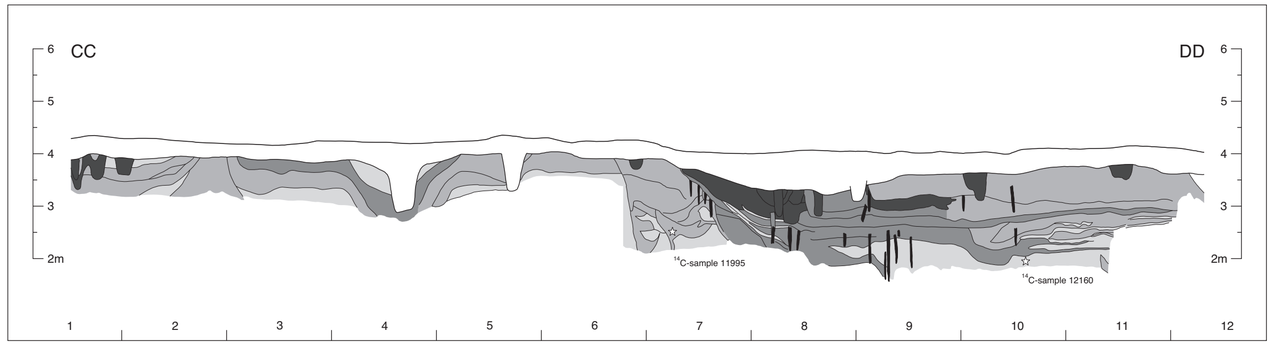


Fig. 10 Dorestad, Hoogstraat 0: west-east section EE-FF; north profile trench 262. Scale (length) 1:400, (height) 1:80. Legend: see fig. 8.

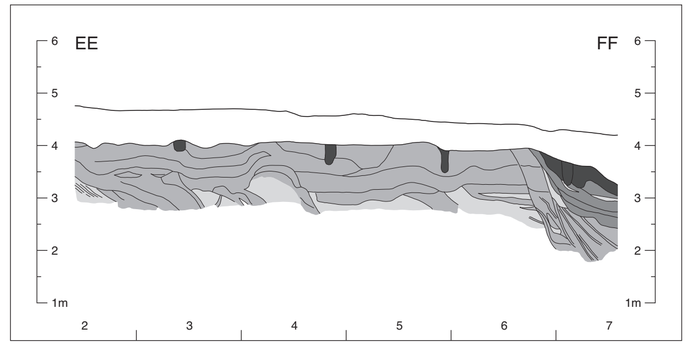


Fig. 11 Dorestad, Hoogstraat IV: west-east section GG-HH; north profile trenches 448-452. Scale (length) 1:400, (height) 1:80. Legend: see fig. 8. Arrow indicates position of fykes (see fig. 204).

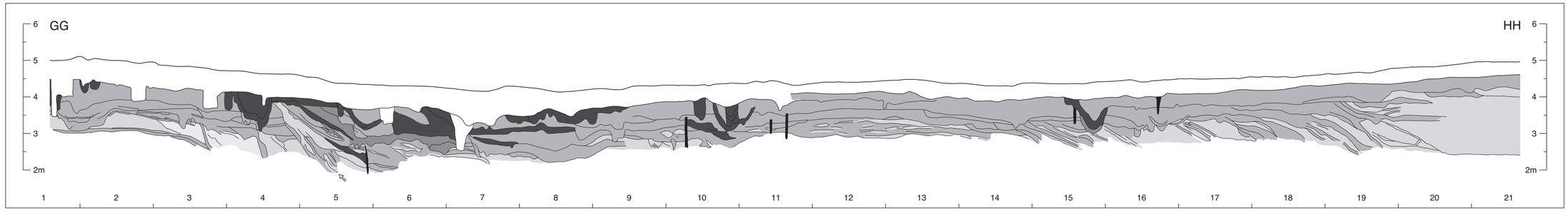


Fig. 13 Dorestad, Hoogstraat III: west-east section KK-LL; north profile trenches 403, 407, 408. Scale (length) 1:400, (height) 1:80. Legend: see fig. 8.

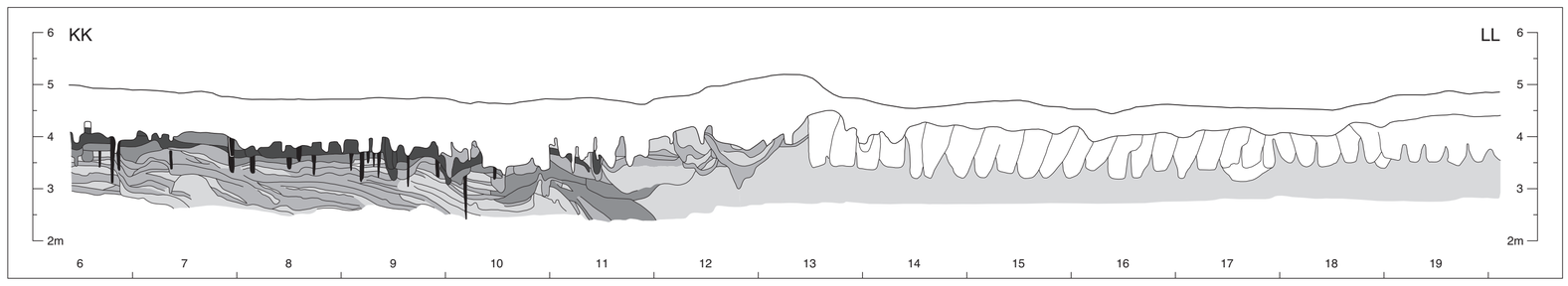


Fig. 15 Dorestad, Hoogstraat 0: excavation plan; scale 1:400.
Legend:
1 polluted soil in riverbed in lowest excavation level;
2 post or post-ghost, present in the lowest excavation level;
3 remaining post or post-ghost.

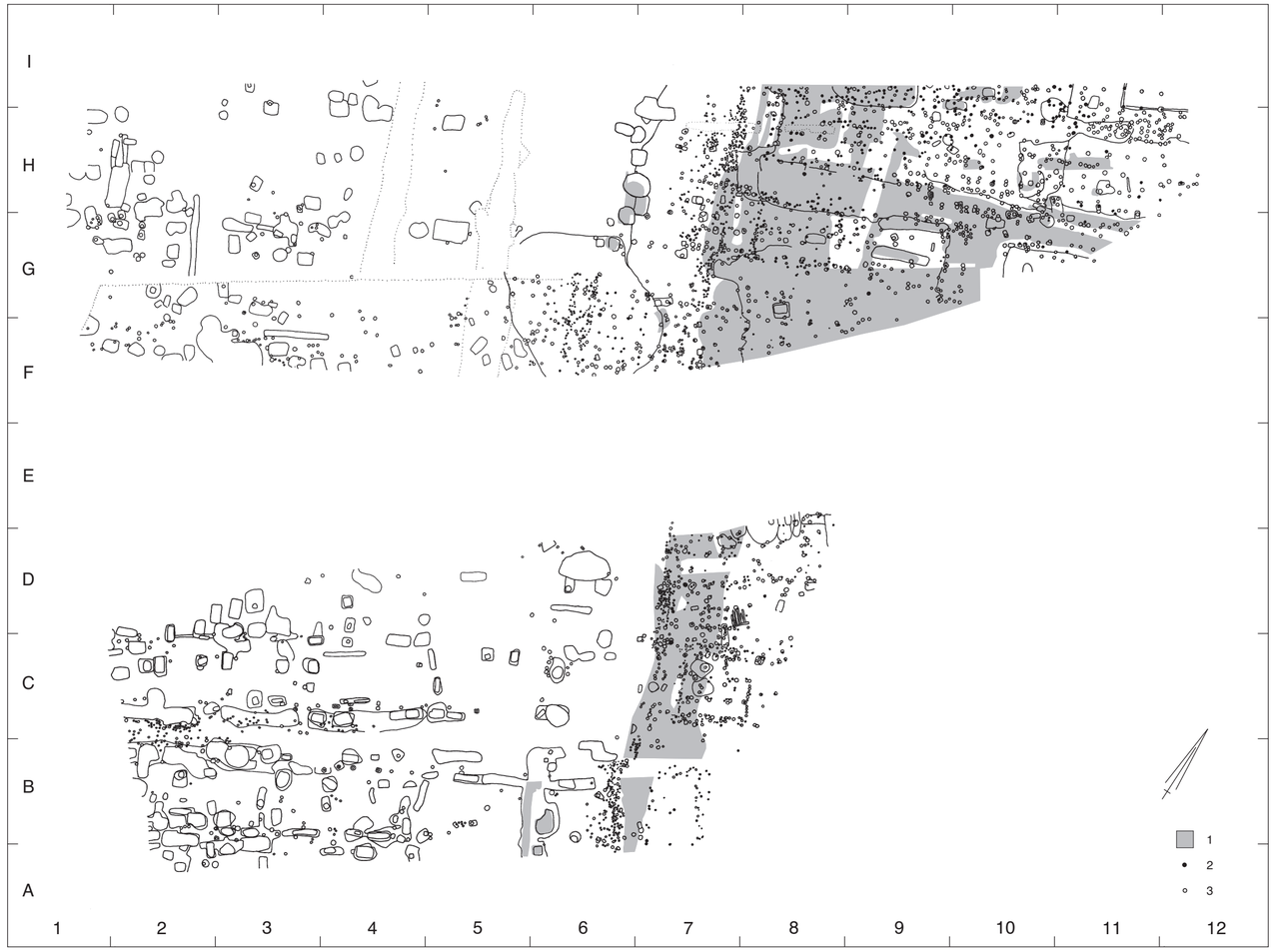


Fig. 16 Dorestad, Hoogstraat II: excavation plan; scale 1:400. Legend: see fig. 15.

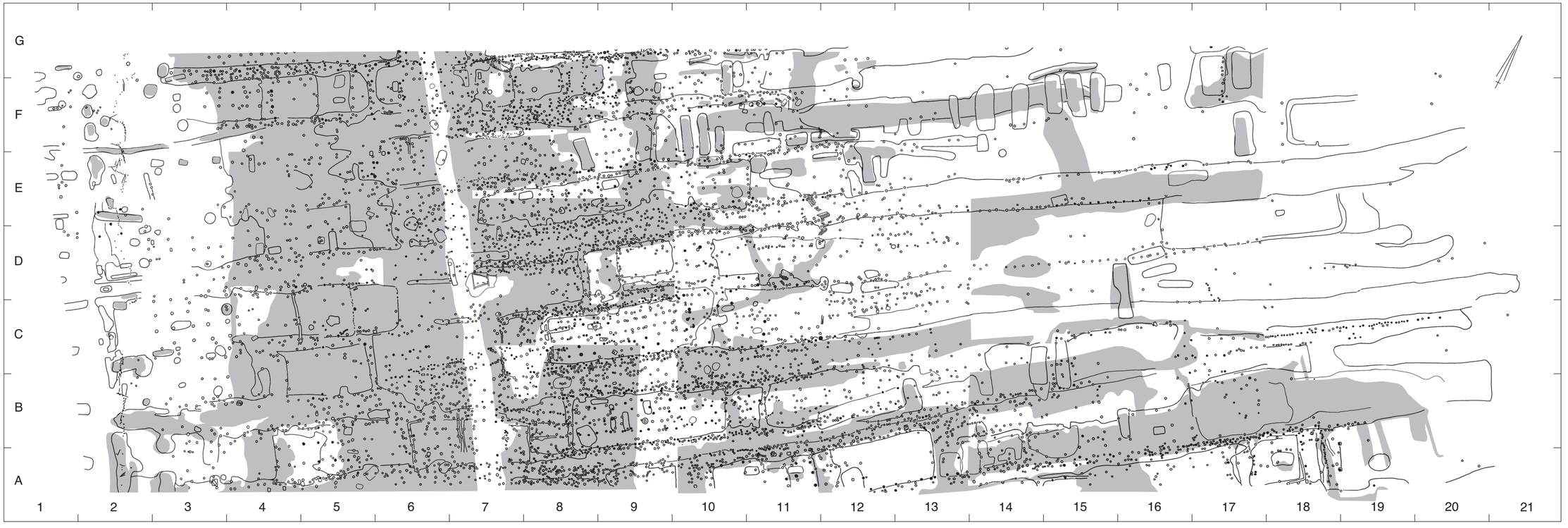


Fig. 17 Dorestad, Hoogstraat III: excavation plan; scale 1:400. Legend: see fig. 15.

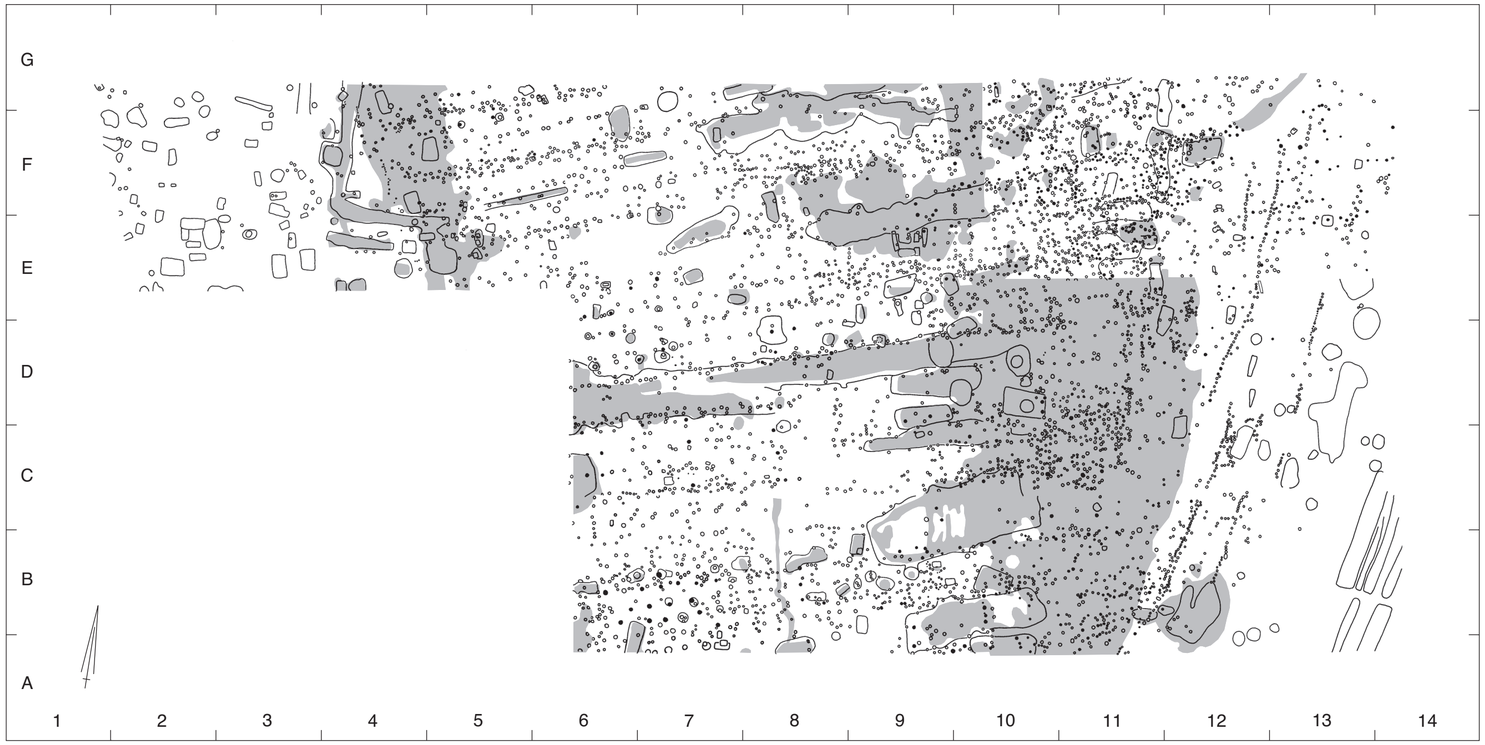


Fig. 53 Dorestad, Hoogstraat IV: location of house sites Legend: 1 house sites; 2 parcel numbers; scale 1:400.

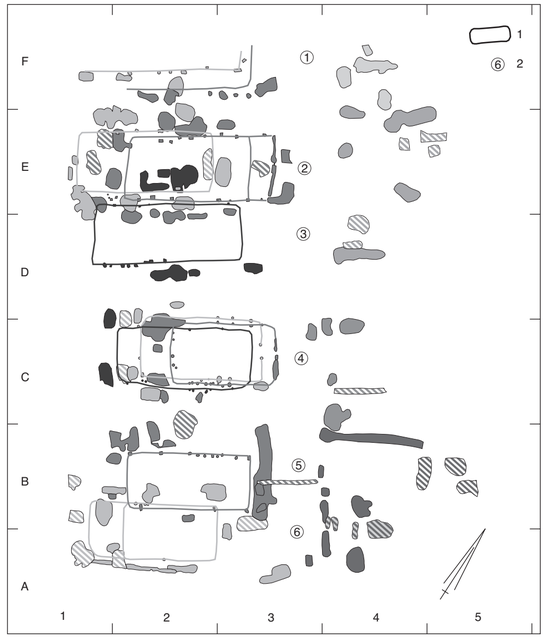


Fig. 18 Dorestad, Hoogstraat IV: excavation plan; scale 1:400.
Legend: see fig. 15.

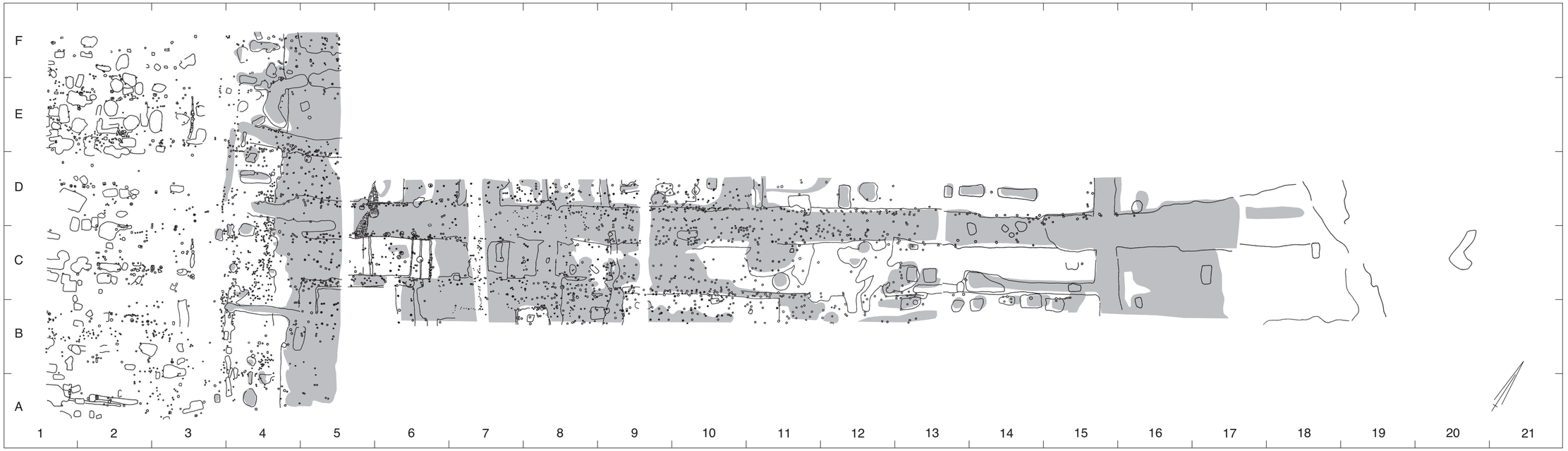


Fig. 50 Dorestad, Hoogstraat 0, southern part: parcels with "indoor pits" indicated by concentrations of pits.
Legend:
1 indoor pits;
2 parcel numbers; scale 1:400.

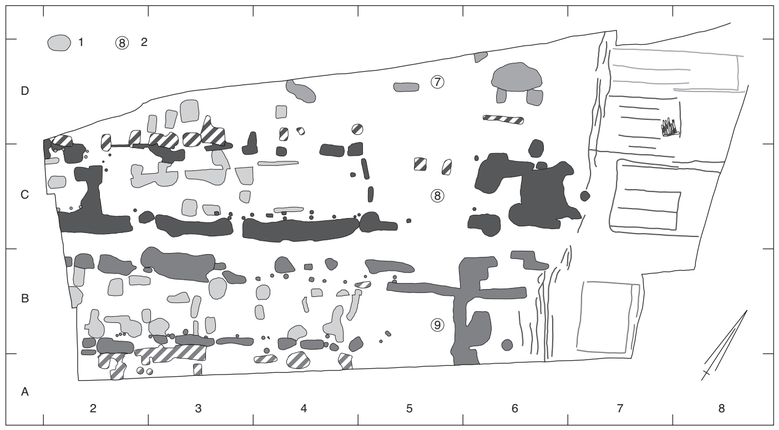


Fig. 51 Dorestad, Hoogstraat 0, southern part: location of house sites.
Legend:
1 (presumed) house sites;
2 parcel numbers; scale 1:400.

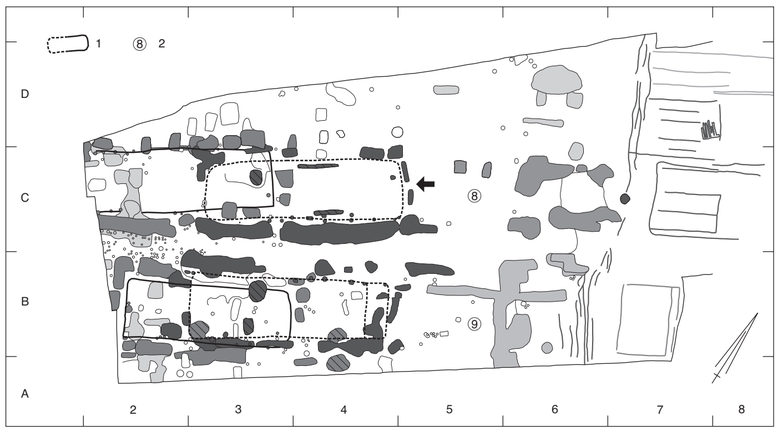


Fig. 52 Dorestad, Hoogstraat 0, northern part: location of house sites. Legend: see fig. 51; scale: 1:400.

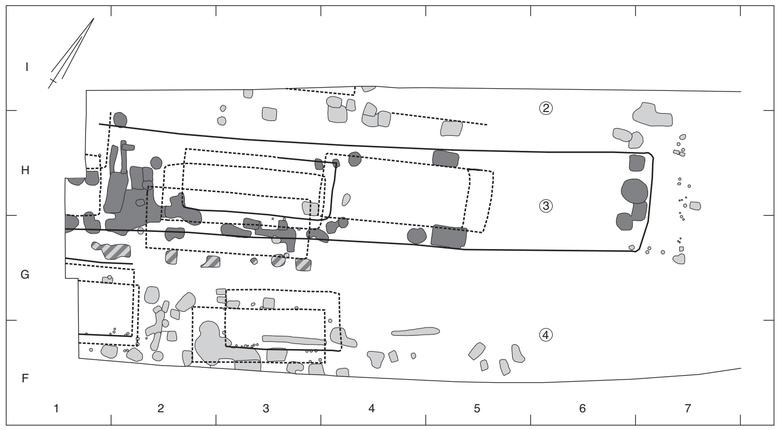


Fig. 56 Dorestad, Hoogstraat II: use of wood in the revetment; scale 1:200.
Legend:
1 Fraxinus post;
2 Alnus post;
3 Salix post;
4 Alnus wickerwork;
5 Salix wickerwork.

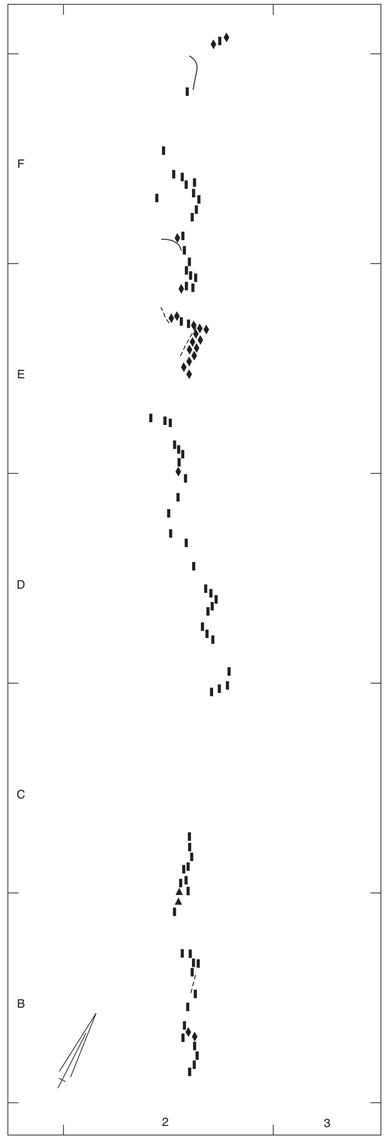


Fig. 62 Dorestad, Hoogstraat 0: schematic plan of the house sites in the riverbank area and of the dams in the riverbed; scale 1:400.
Legend:
1 (presumed) house sites;
2 pits;
3 (presumed) phase in dam;
4 dam;
5 parcel number.

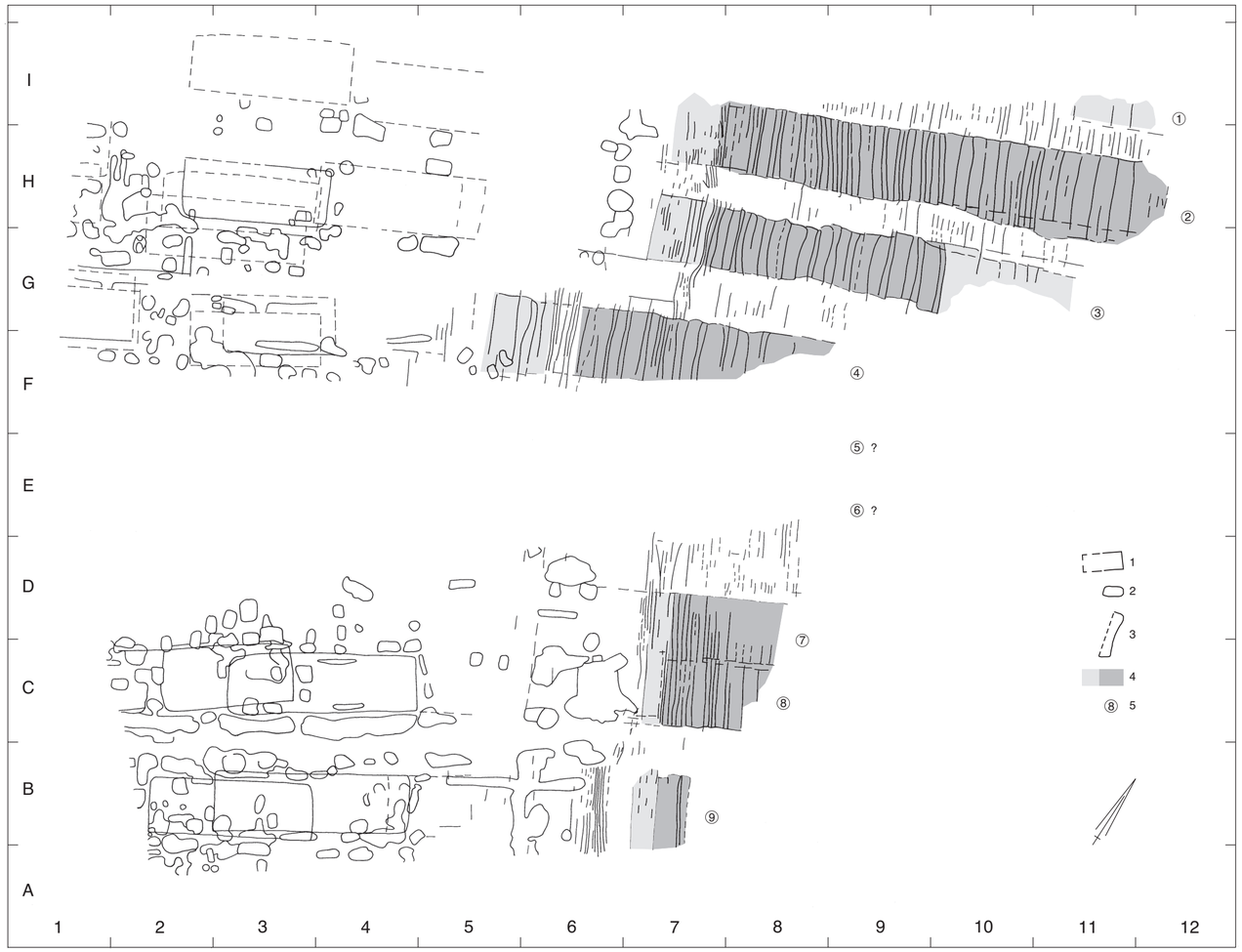


Fig. 63 Dorestad, Hoogstraat IV: schematic plan of the house sites in the riverbank area and of the dams in the riverbed; scale 1:400. Legend: see fig. 62.

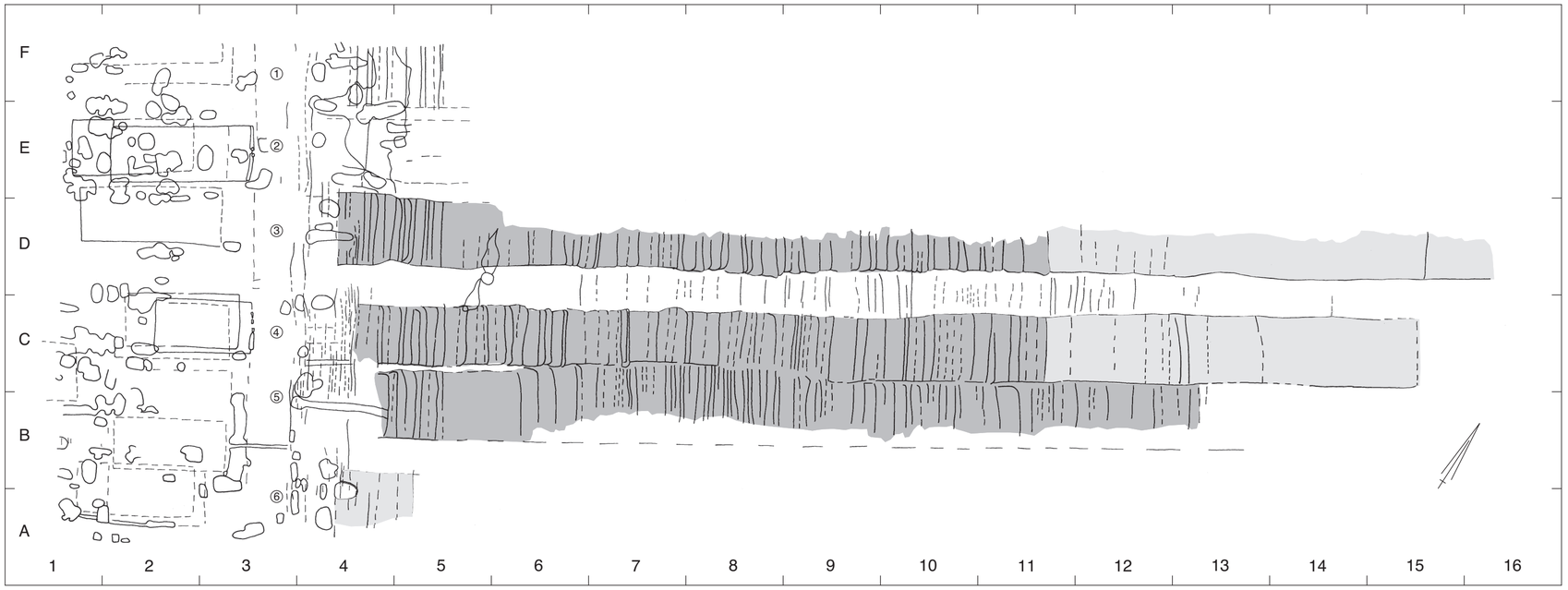


Fig. 64 Dorestad, Hoogstraat II: schematic plan of the dams in the riverbed; scale 1:400. Legend: see fig. 62.

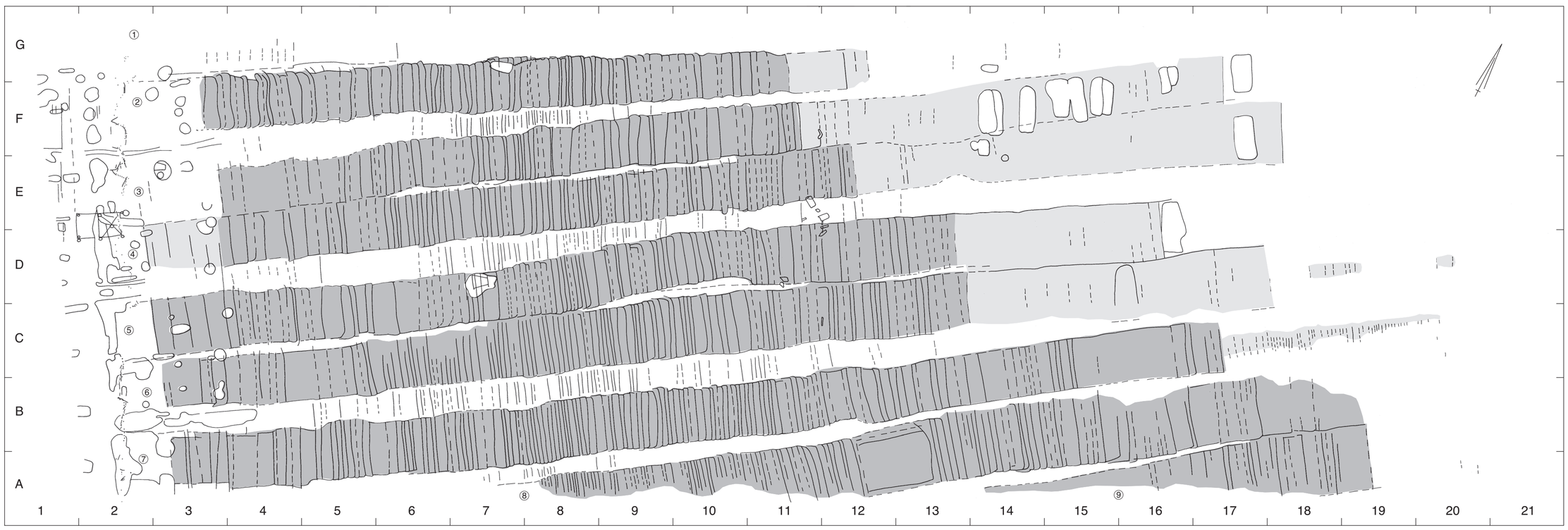


Fig. 66 Dorestad, Hoogstraat III: schematic plan of the dams in the riverbed; scale 1:400.
Legend:
1 (presumed) phase in dam;
2 (presumed) dam;
3 parcel number.

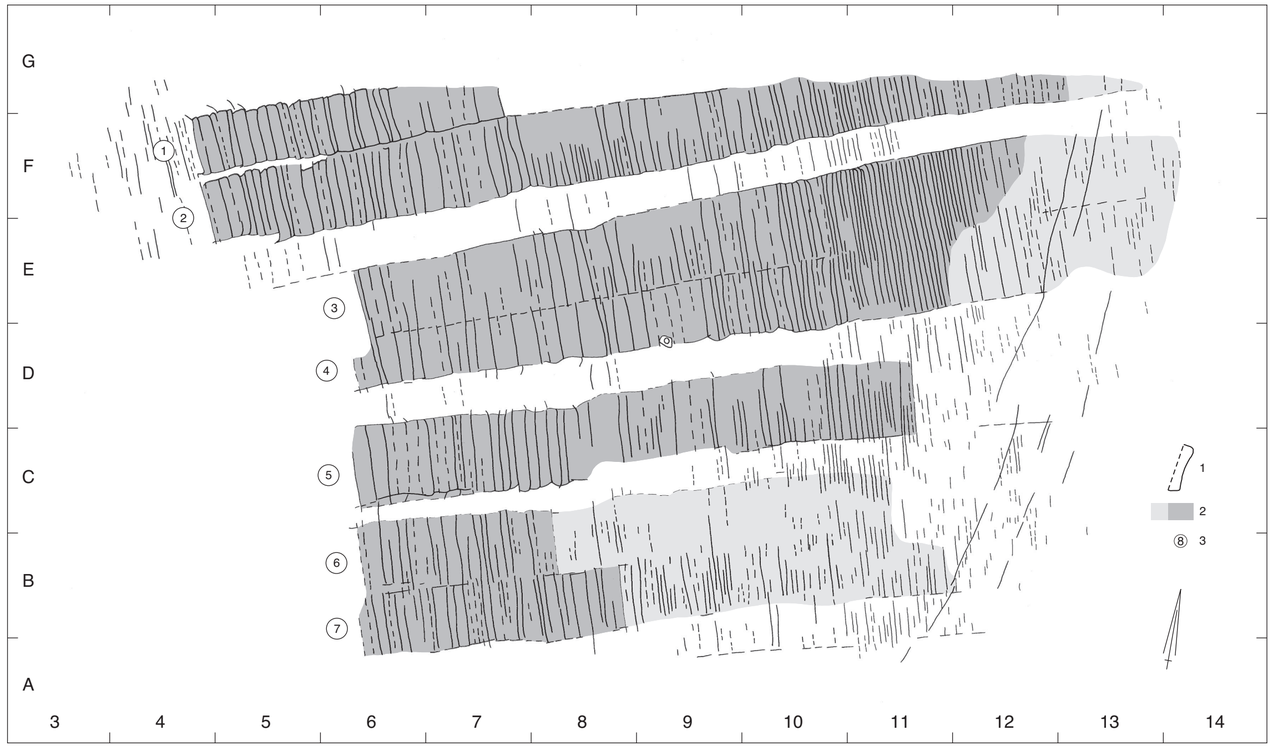


Fig. 67 Dorestad, Hoogstraat 0: house parcels in the riverbank area and dam parcels in the riverbed; scale 1:400.
Legend:
1 (presumed) house site;
2 pits;
3 dam;
4 (presumed) phase in dam;
5 parcel boundary;
6 parcel number;
7 paved road;
8 ditch and dam.

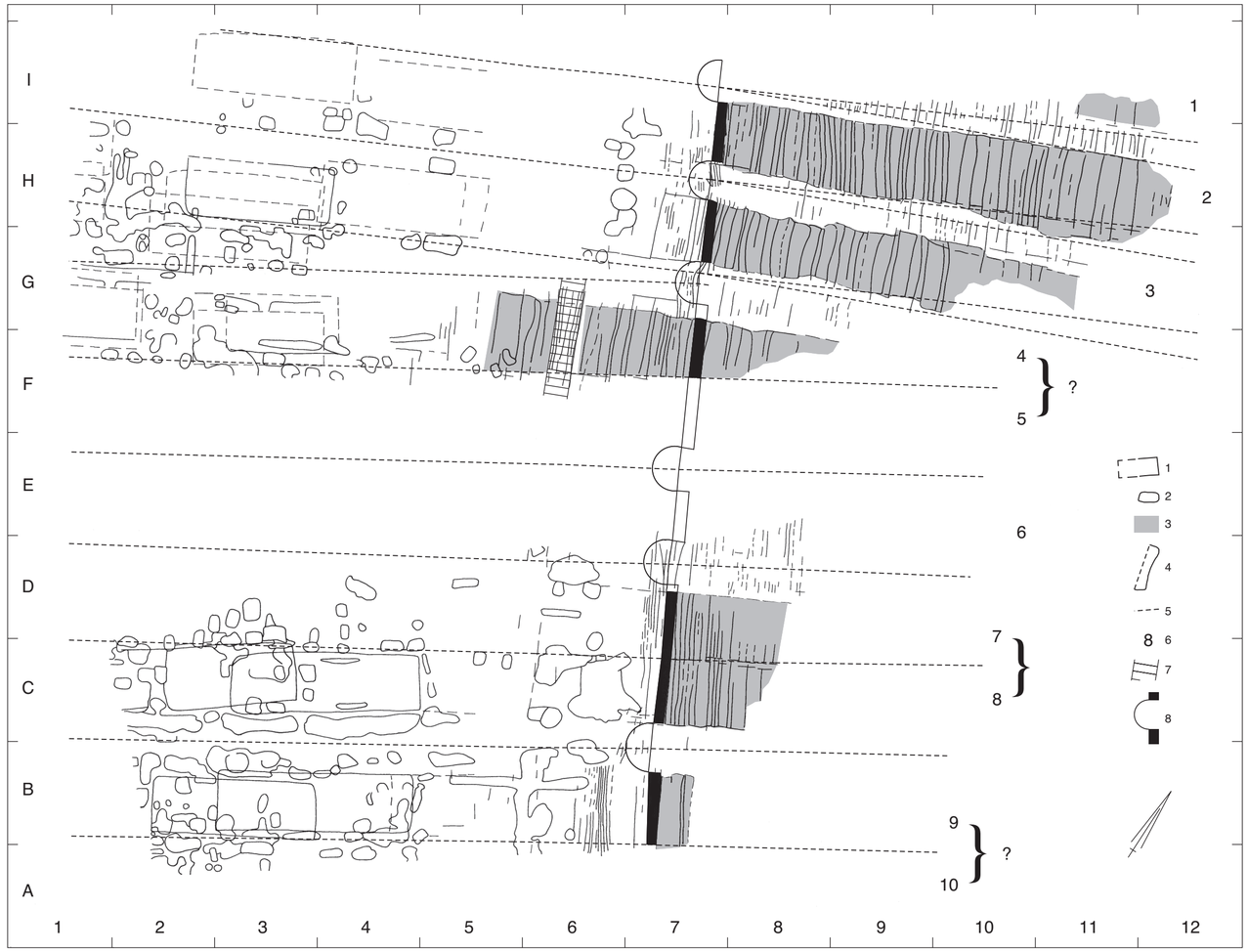


Fig. 68 Dorestad, Hoogstraat IV: house parcels in the riverbank area and dam parcels in the riverbed; scale 1:400.
Legend:
1 (presumed) house site;
2 pit;
3 (presumed) dam;
4 (presumed) phase in dam;
5 parcel boundary;
6 parcel number;
7 ditch and dam.

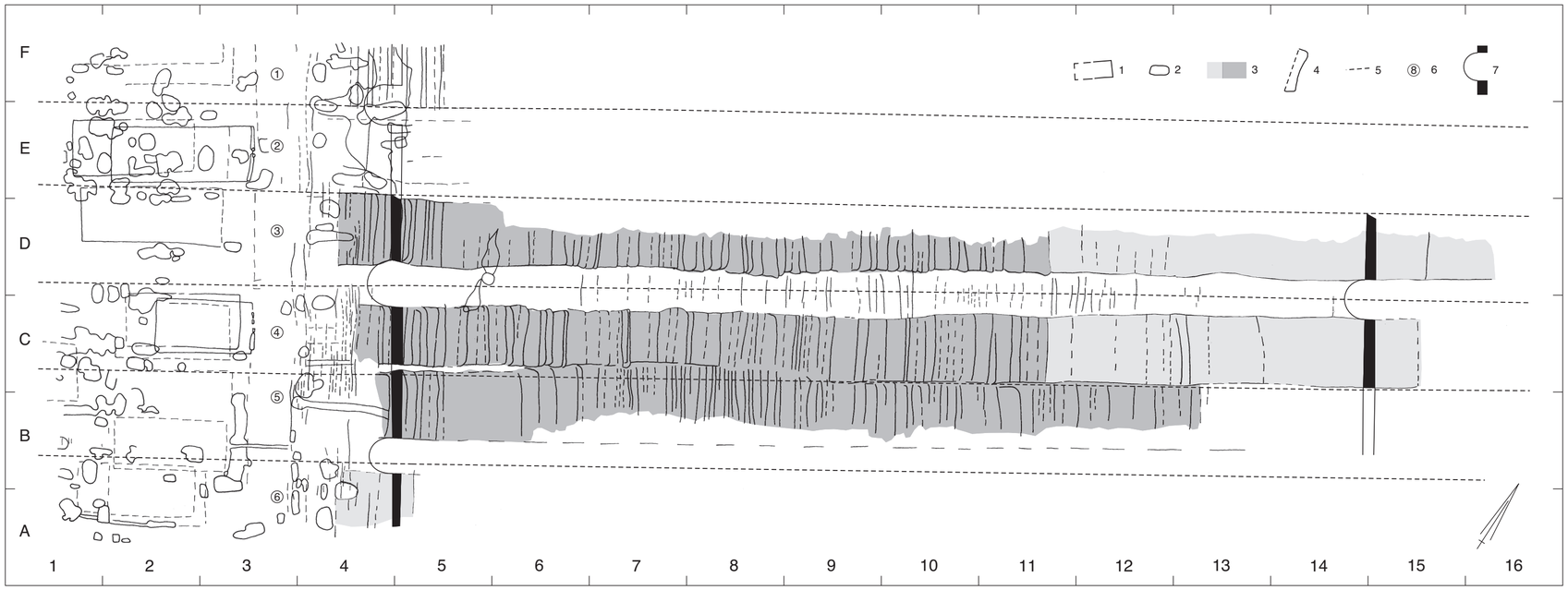


Fig. 69 Dorestad, Hoogstraat II: house parcels in the riverbank area and dam parcels in the riverbed; scale 1:400.
Legend: see fig. 68.

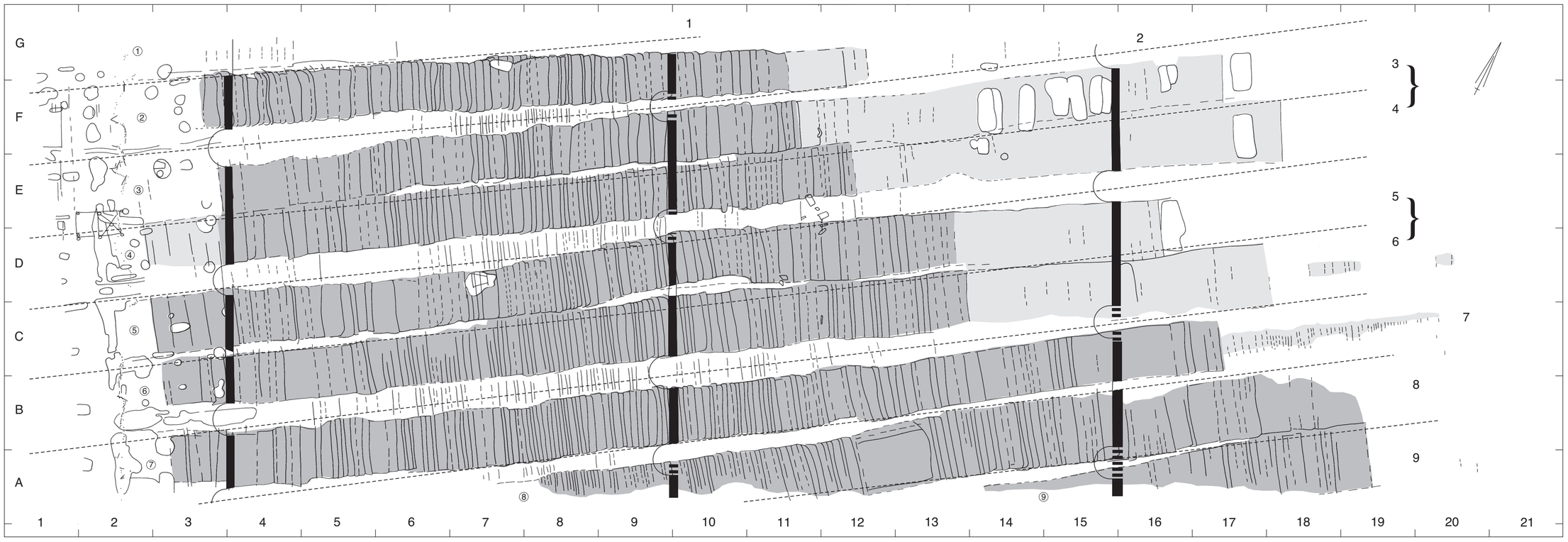


Fig. 232 Dorestad, Hoogstraat I: distribution of C14 dates over the structures in the riverbed; scale 1:400.
Legend:
1 before 660/680;
2 probably before 660/680, possibly also 660/680-760/780;
3 660/680-760/780;
4 probably 660/680-760/780, possibly also before 660/680;
5 probably 660/680-760/780, possibly also after 760/780;
6 660/680- after 760/780;
7 probably after 760/780, possibly also 660/680-760/780;
8 after 760/780.

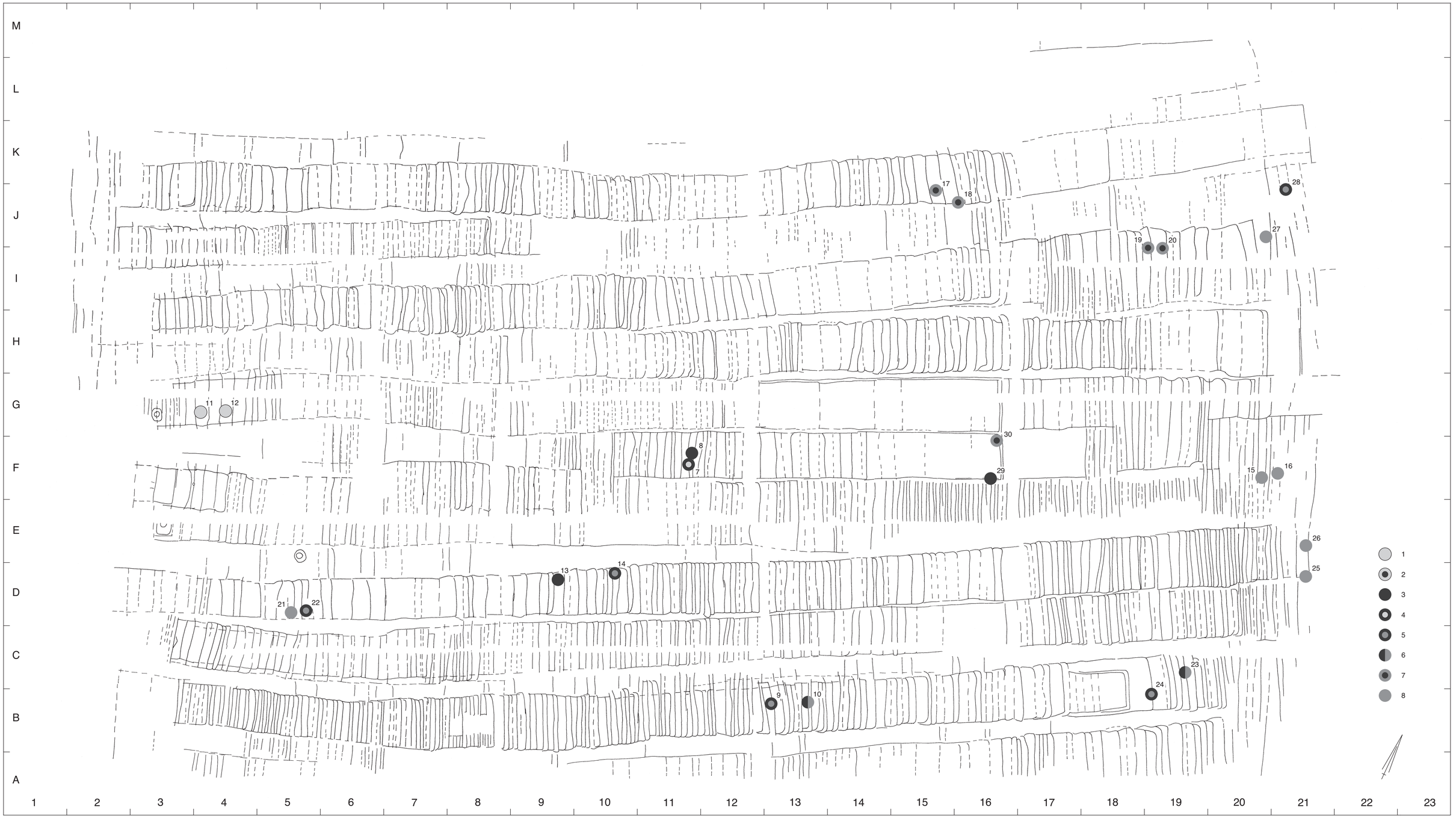


Fig. 233 Dorestad, Hoogstraat II: distribution of C14 dates over the structures in the riverbed; scale 1:400.
Legend:
1 before 660/680;
2 probably before 660/680, possibly also 660/680-760/780;
3 660/680-760/780;
4 probably 660/680-760/780, possibly also before 660/680;
5 probably 660/680-760/780, possibly also after 760/780;
6 660/680- after 760/780;
7 probably after 760/780, possibly also 660/680-760/780;
8 after 760/780.

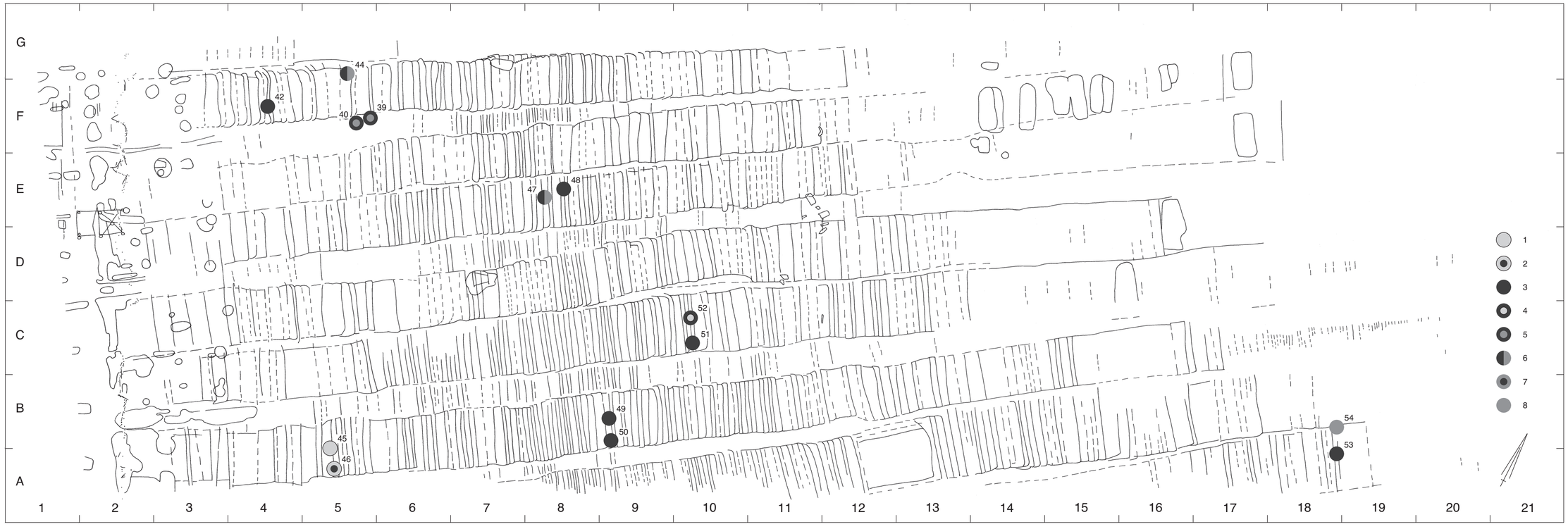


Fig. 234 Dorestad, Hoogstraat III: distribution of C14 dates over the structures in the riverbed.
Legend:
1 before 660/680;
2 probably before 660/680, possibly also 660/680-760/780;
3 660/680-760/780;
4 probably 660/680-760/780, possibly also before 660/680;
5 probably 660/680-760/780, possibly also after 760/780;
6 660/680- after 760/780;
7 probably after 760/780, possibly also 660/680-760/780;
8 after 760/780.

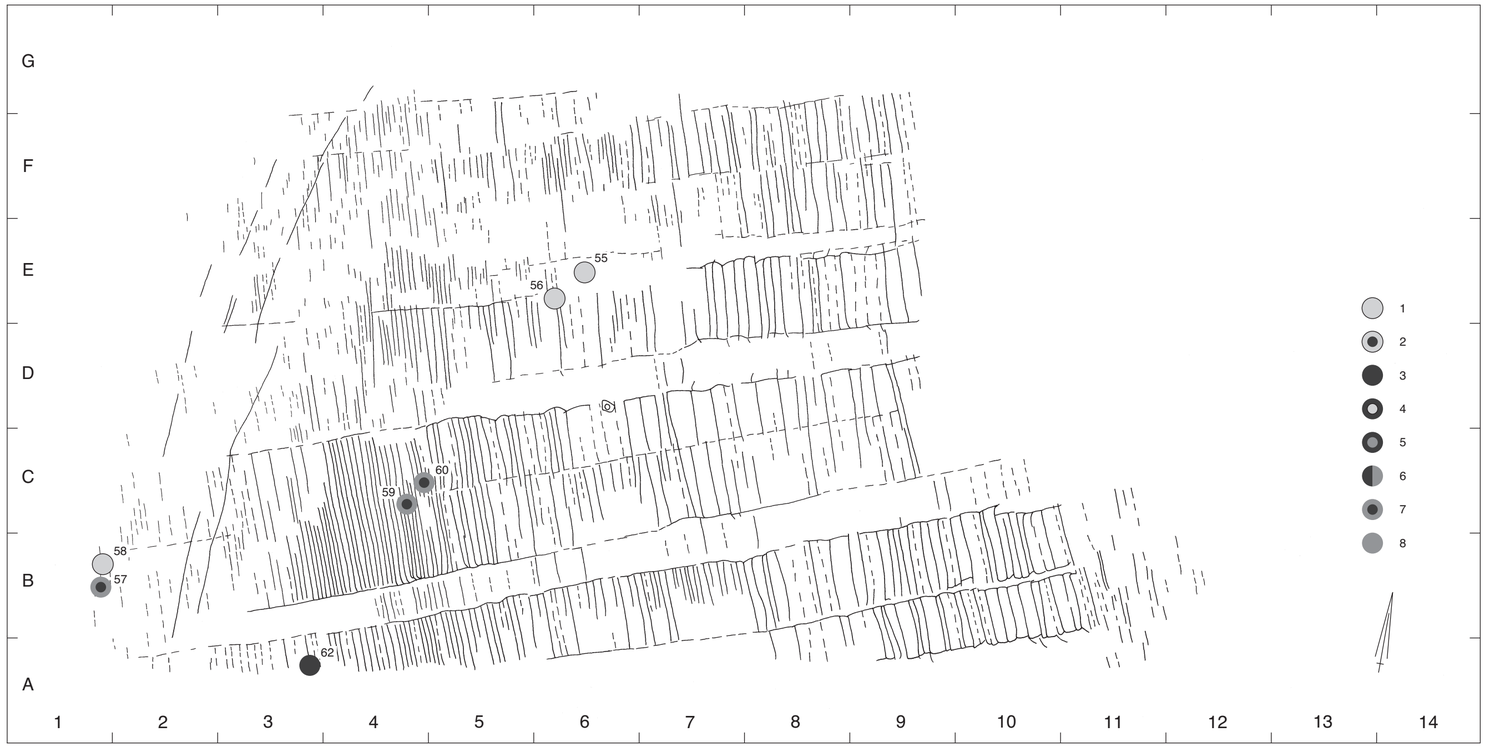


Fig. 235 Dorestad, Hoogstraat IV: distribution of C14 dates over the structures in the riverbed; scale 1:400.
Legend:
1 before 660/680;
2 probably before 660/680, possibly also 660/680-760/780;
3 660/680-760/780;
4 probably 660/680-760/780, possibly also before 660/680;
5 probably 660/680-760/780, possibly also after 760/780;
6 660/680- after 760/780;
7 probably after 760/780, possibly also 660/680-760/780;
8 after 760/780.

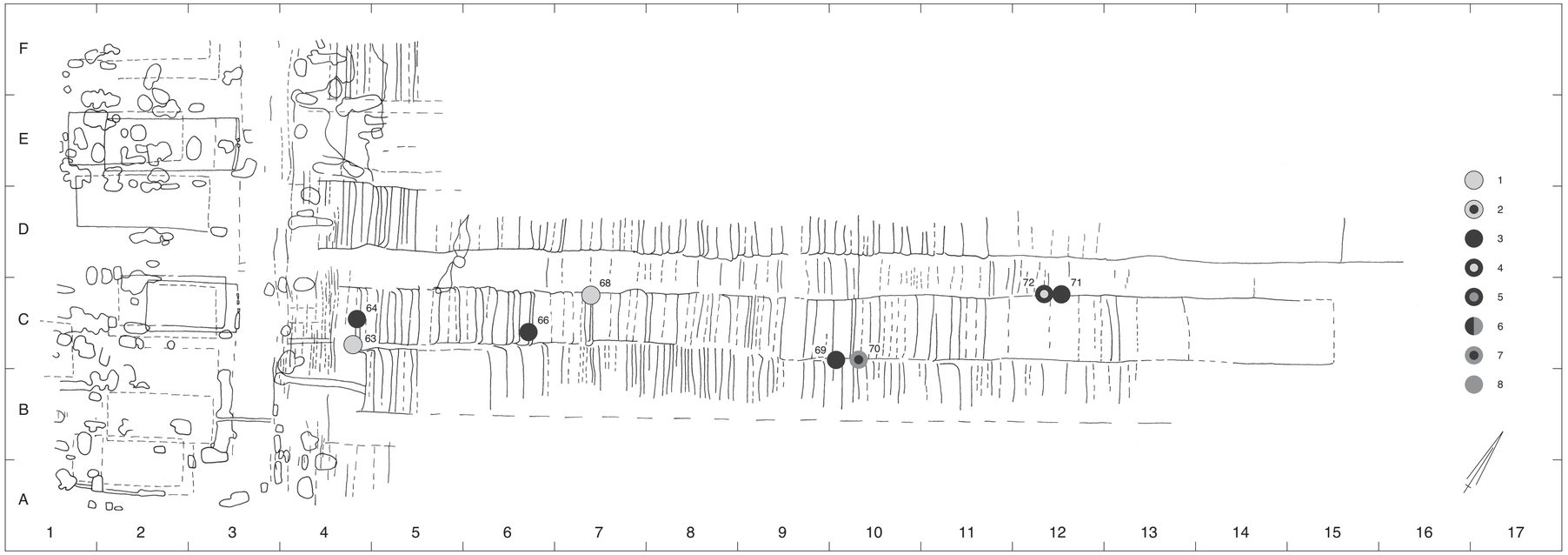


Fig. 236 Dorestad, Hoogstraat 0: distribution of C14 dates over the structures in the riverbed; scale 1:400.
Legend:
1 before 660/680;
2 probably before 660/680, possibly also 660/680-760/780;
3 660/680-760/780;
4 probably 660/680-760/780, possibly also before 660/680;
5 probably 660/680-760/780, possibly also after 760/780;
6 660/680- after 760/780;
7 probably after 760/780, possibly also 660/680-760/780;
8 after 760/780.

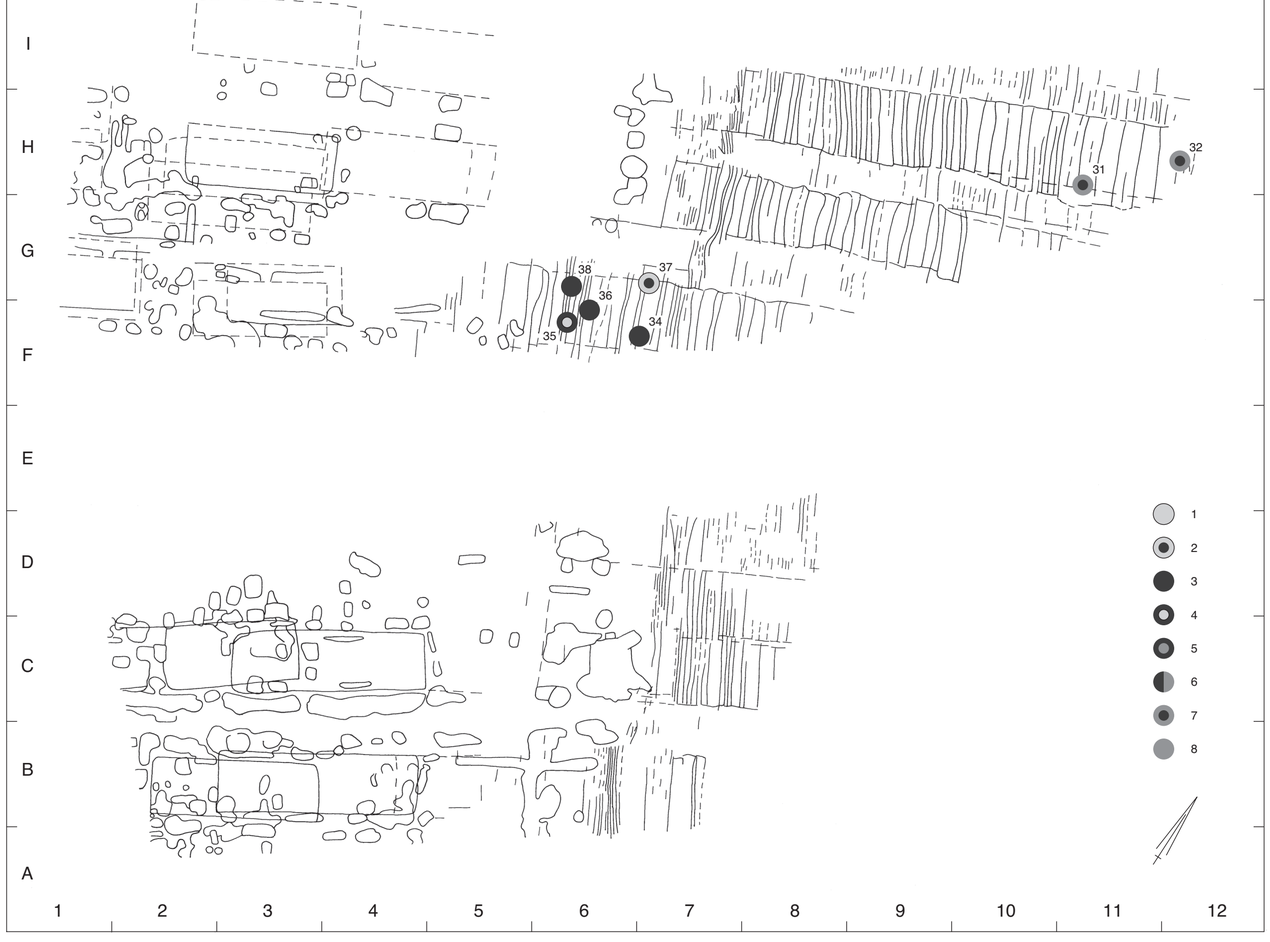


Fig. 261 Dorestad, Hoogstraat 0: location of posthole patterns; scale 1:400.
Legend:
1 certain;
2 possible.

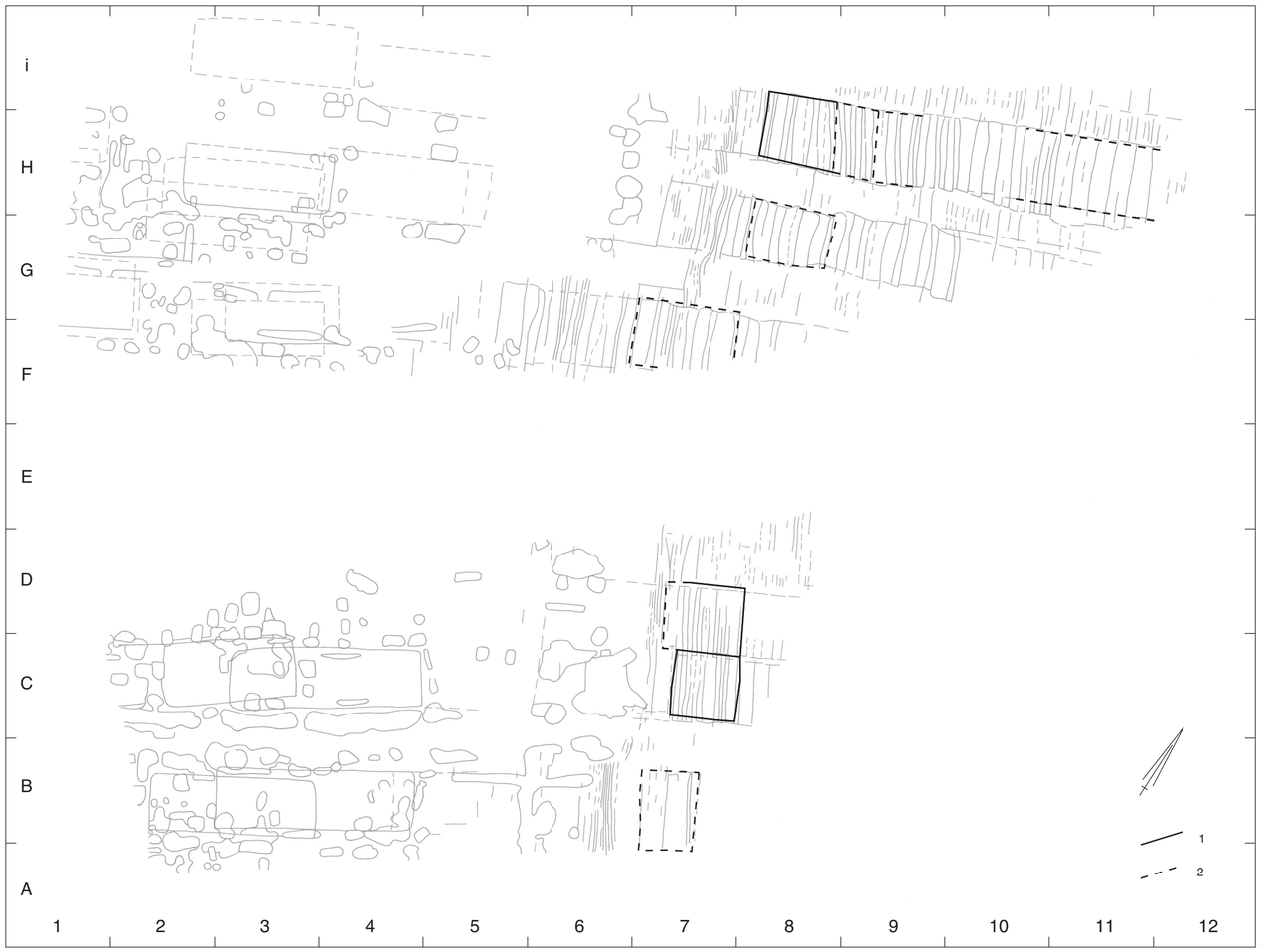


Fig. 262 Dorestad, Hoogstraat IV: location of posthole patterns; scale 1:400.
Legend: see fig. 261.

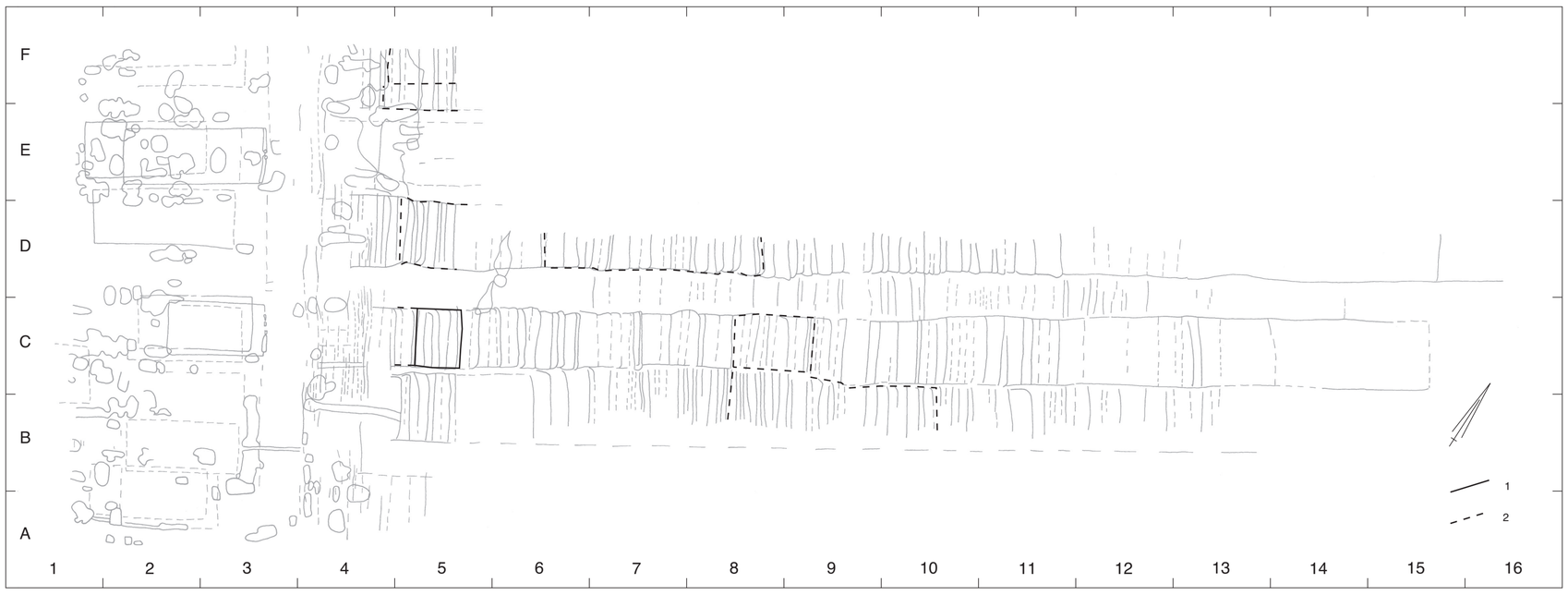
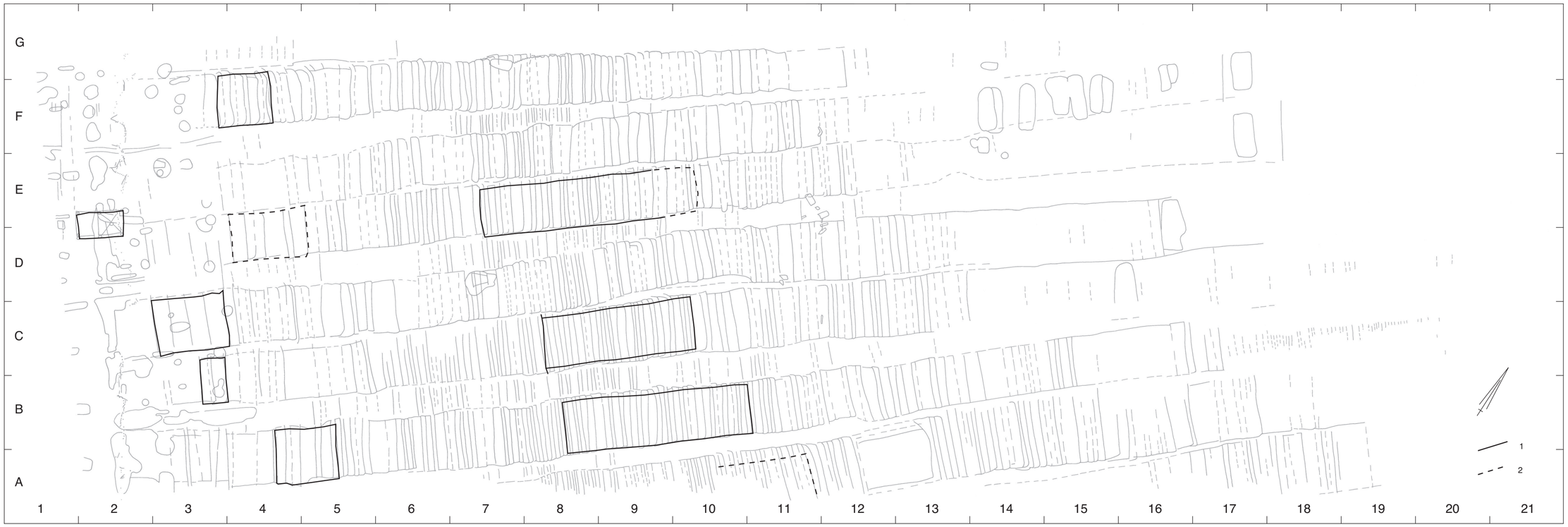


Fig. 263 Dorestad, Hoogstraat II: location of posthole patterns; scale 1:400.
Legend: see fig. 261.



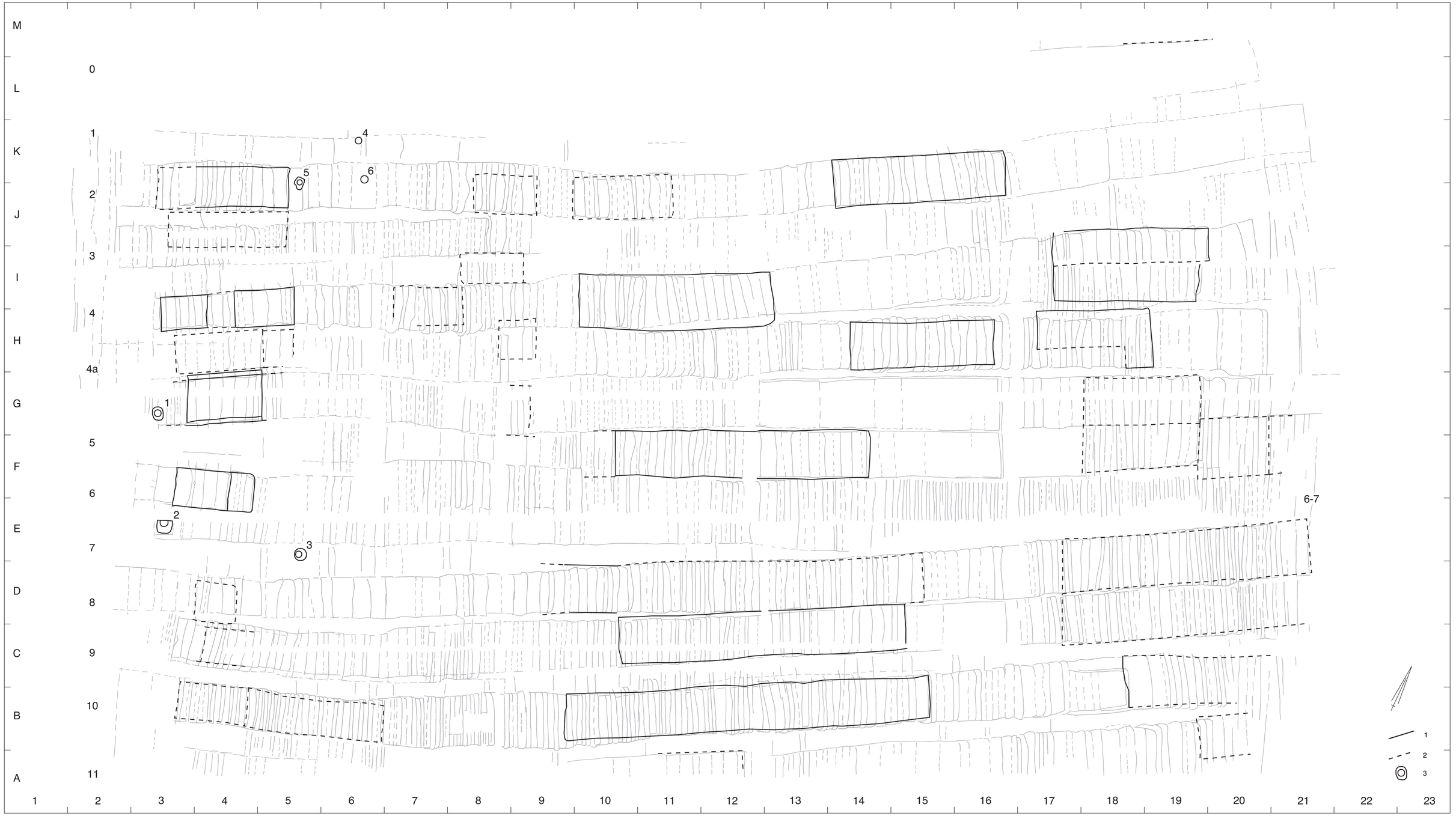


Fig. 264 Dorestad, Hoogstraat I: location of posthole patterns; scale 1:400.
Legend:
1 certain;
2 possible;
3 well.

Fig. 265 Dorestad, Hoogstraat III: location of posthole patterns; scale 1:400.
Legend: see fig. 261.

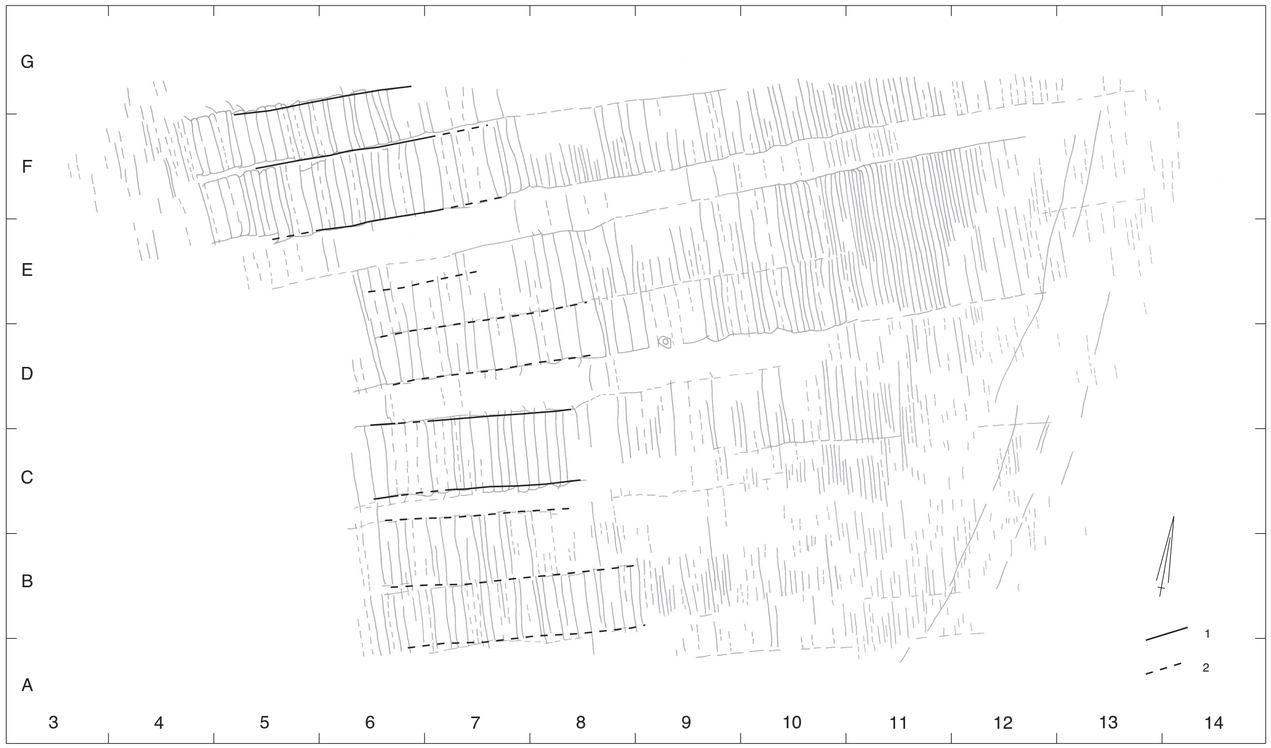


Fig. 266 Dorestad, Hoogstraat 0-IV: posthole patterns; scale 1:200 (see also table 45).
Legenda: see list of Illustrations, p. 376.

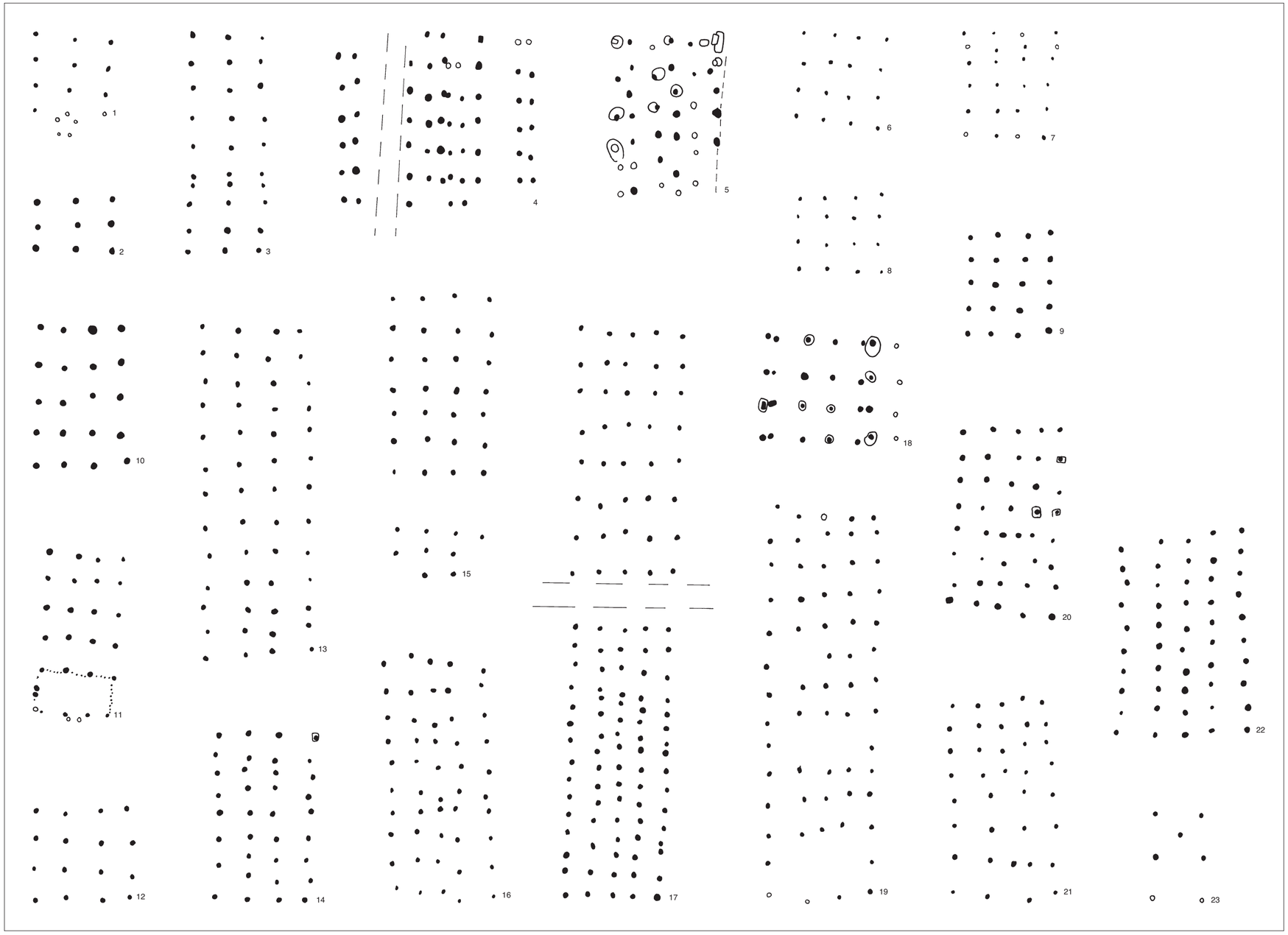


Fig. 267 Plans of granaries from Western Europe, dating from the Iron Age, Roman period and (Early) Middle Ages. Scale 1:200 (see also table 45).

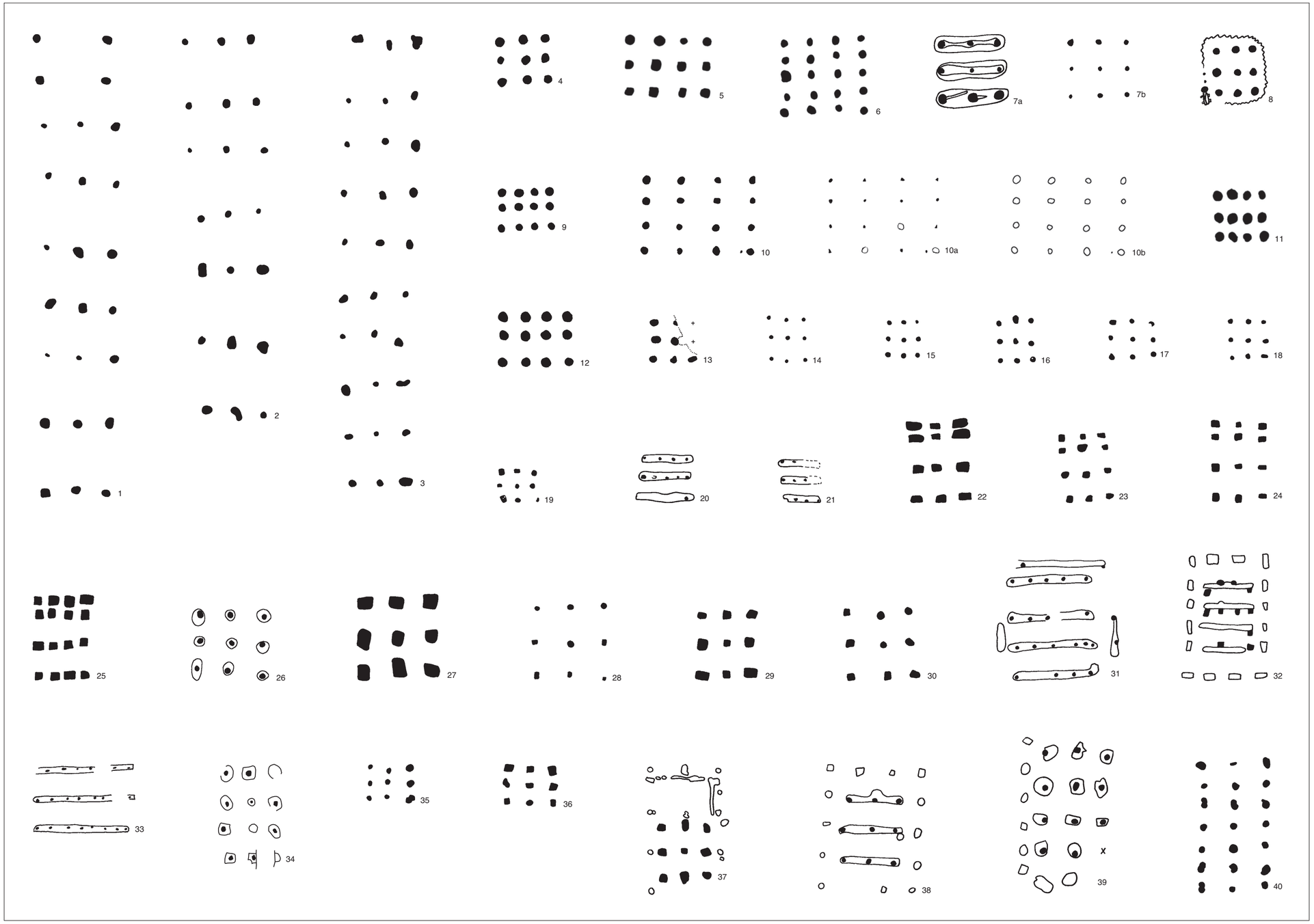


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Fig. 12 Dorestad, Hoogstraat II: west-east section II-JJ; profile trenches 382, 385, 388, 391, 394, 463. Scale (length) 1:400, (height) 1:80. Legend: see fig. 8. Arrow indicates position of wickerwork.

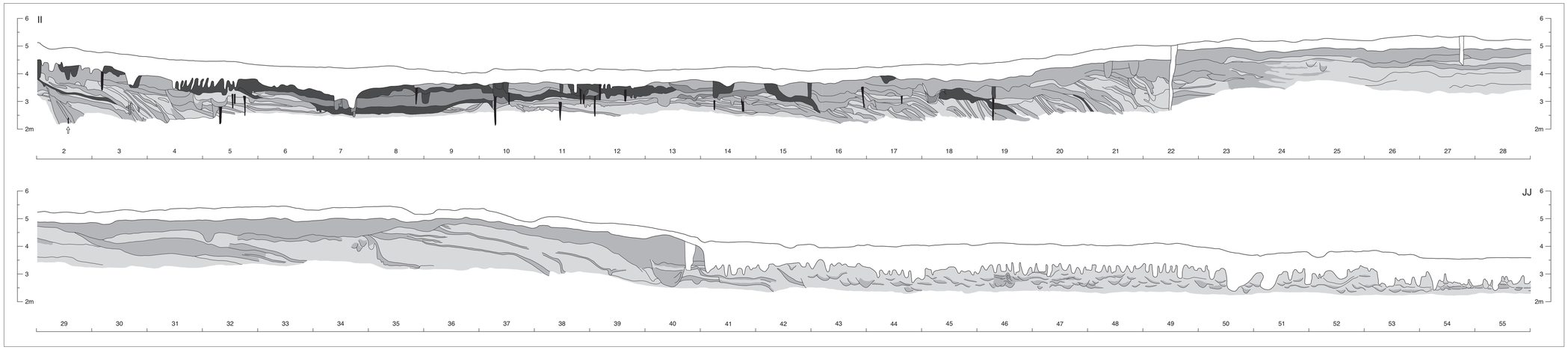

Fig. 65 Dorestad, Hoogstraat I: schematic plan of the dams in the riverbed; scale 1:400.
Legend:
1 (presumed) phase in dam;
2 (presumed) dam;
3 extra dam;
4 well;
5 parcel number.

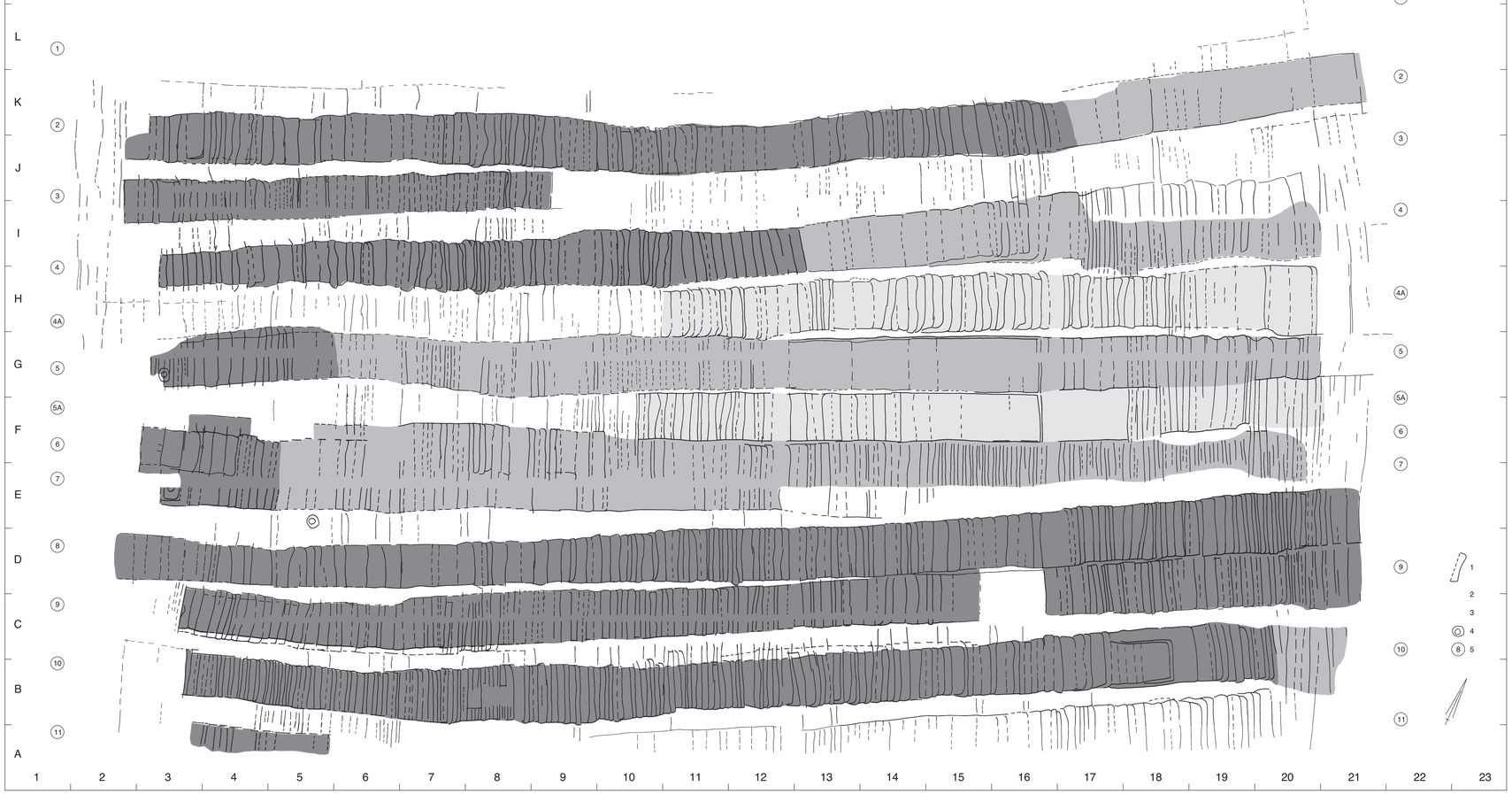

Fig. 70 Dorestad, Hoogstraat I: dam parcels in the riverbed; scale 1:400.
Legend:
1 (presumed) dam;
2 (presumed) phase in dam;
3 parcel boundary 1;
4 parcel boundary 2;
5 parcel number;
6 ditch and dam.
Arrow shows starting-point central axis of trench.

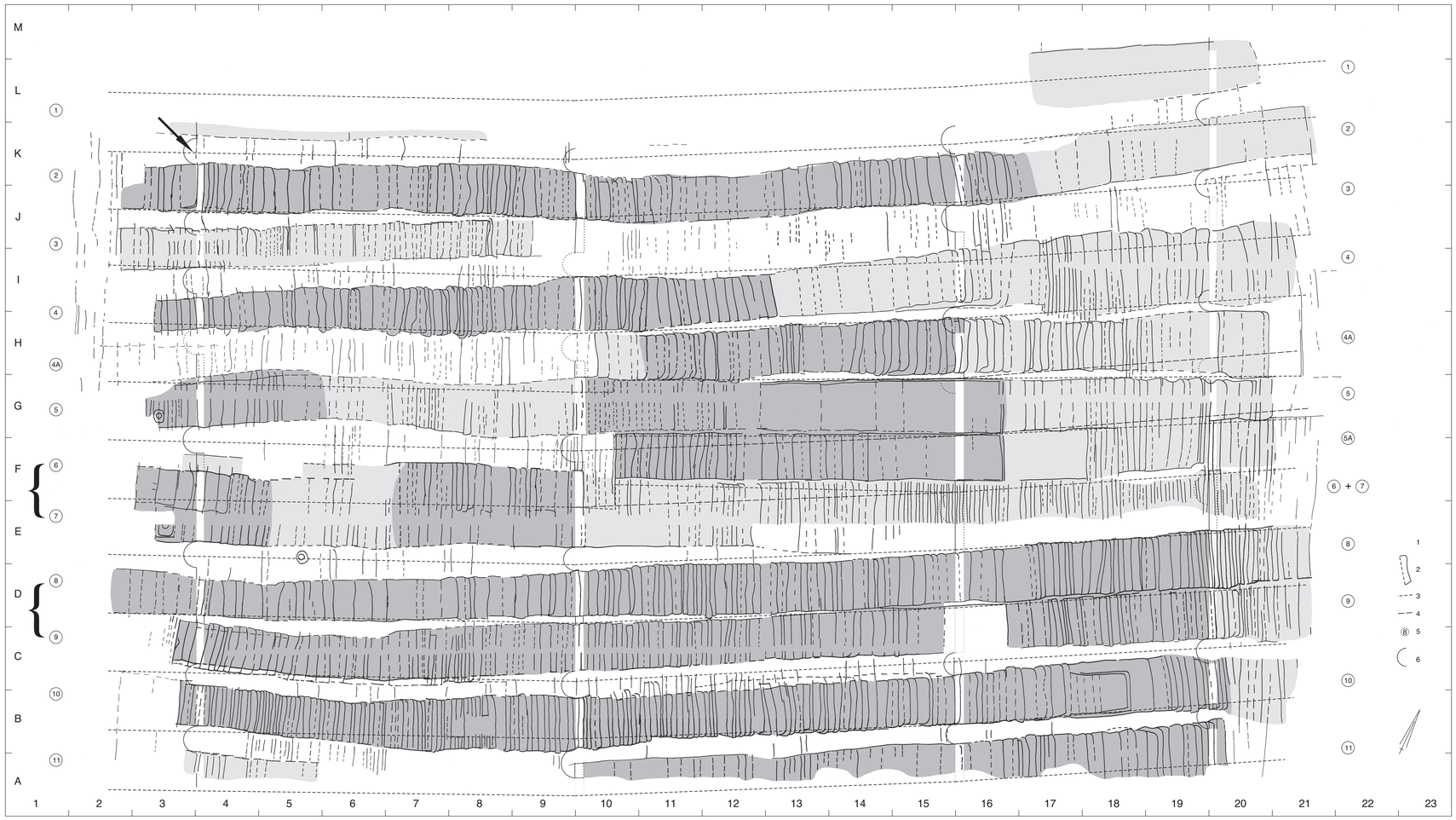

Fig. 71 Dorestad, Hoogstraat III: dam parcels in the riverbed; scale 1:400.
Legend: see fig. 68.

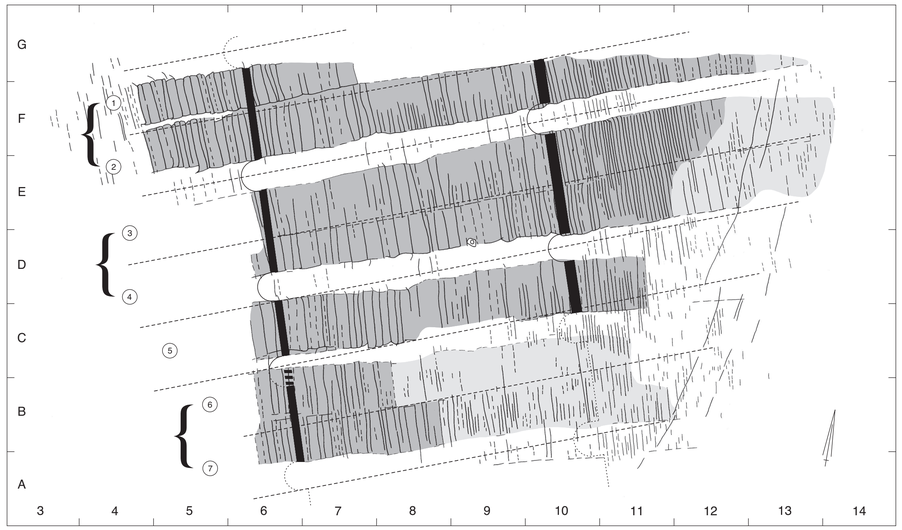

Fig. 72 Dorestad, Hoogstraat 0: pollution of the riverbed; scale 1:400.
Legend:
1 un- or hardly polluted;
2 polluted;
3 heavily polluted;
4 parcel boundary;
5 parcel number;
6 ditch and dam;
7 paved road.

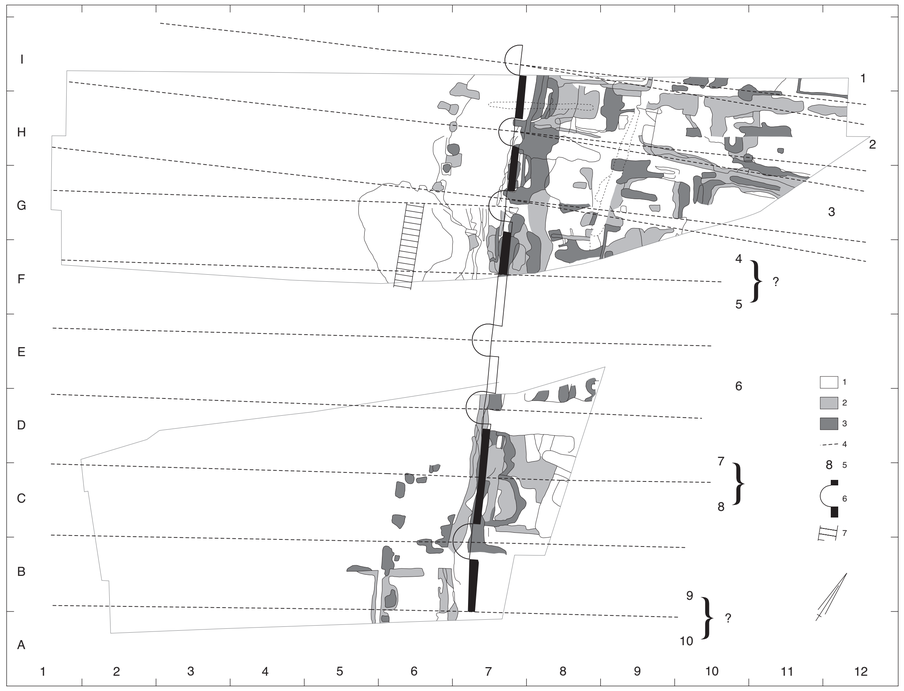

Fig. 73 Dorestad, Hoogstraat IV: pollution of the riverbed; scale 1:400. Legend: see fig. 72.

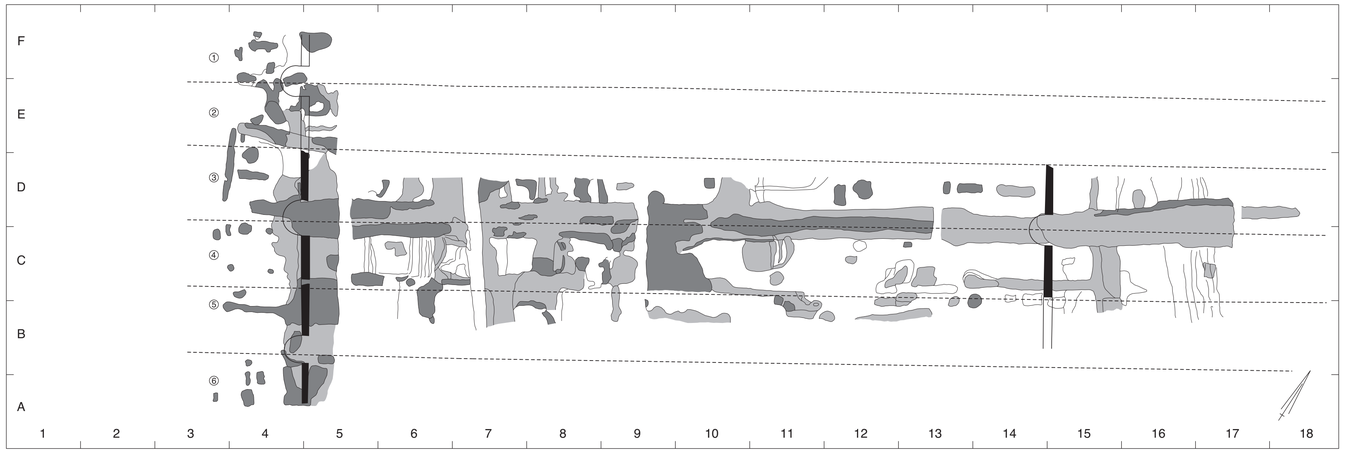

Fig. 74 Dorestad, Hoogstraat II: pollution of the riverbed; scale 1:400. Legend: see fig. 72.

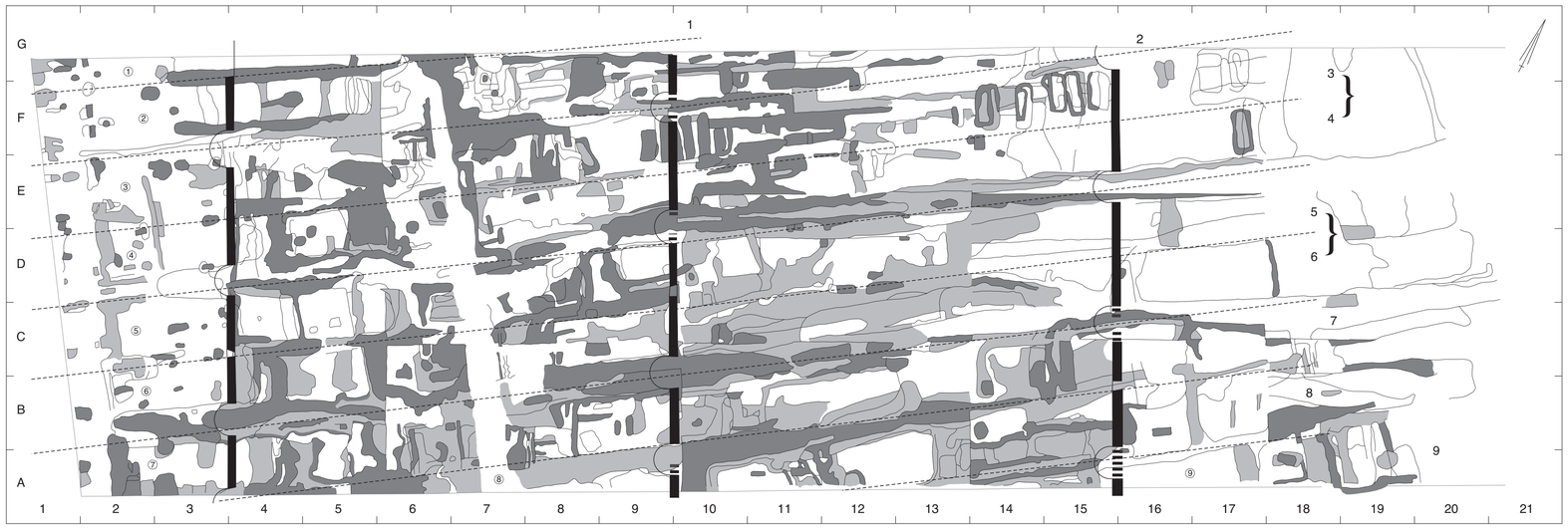

Fig. 75 Dorestad, Hoogstraat I: pollution of the riverbed; scale 1:400.
Legend:
1 un- or hardly polluted;
2 polluted;
3 heavily polluted;
4 parcel boundary 1;
5 parcel boundary 2;
6 parcel number;
7 ditch and dam.

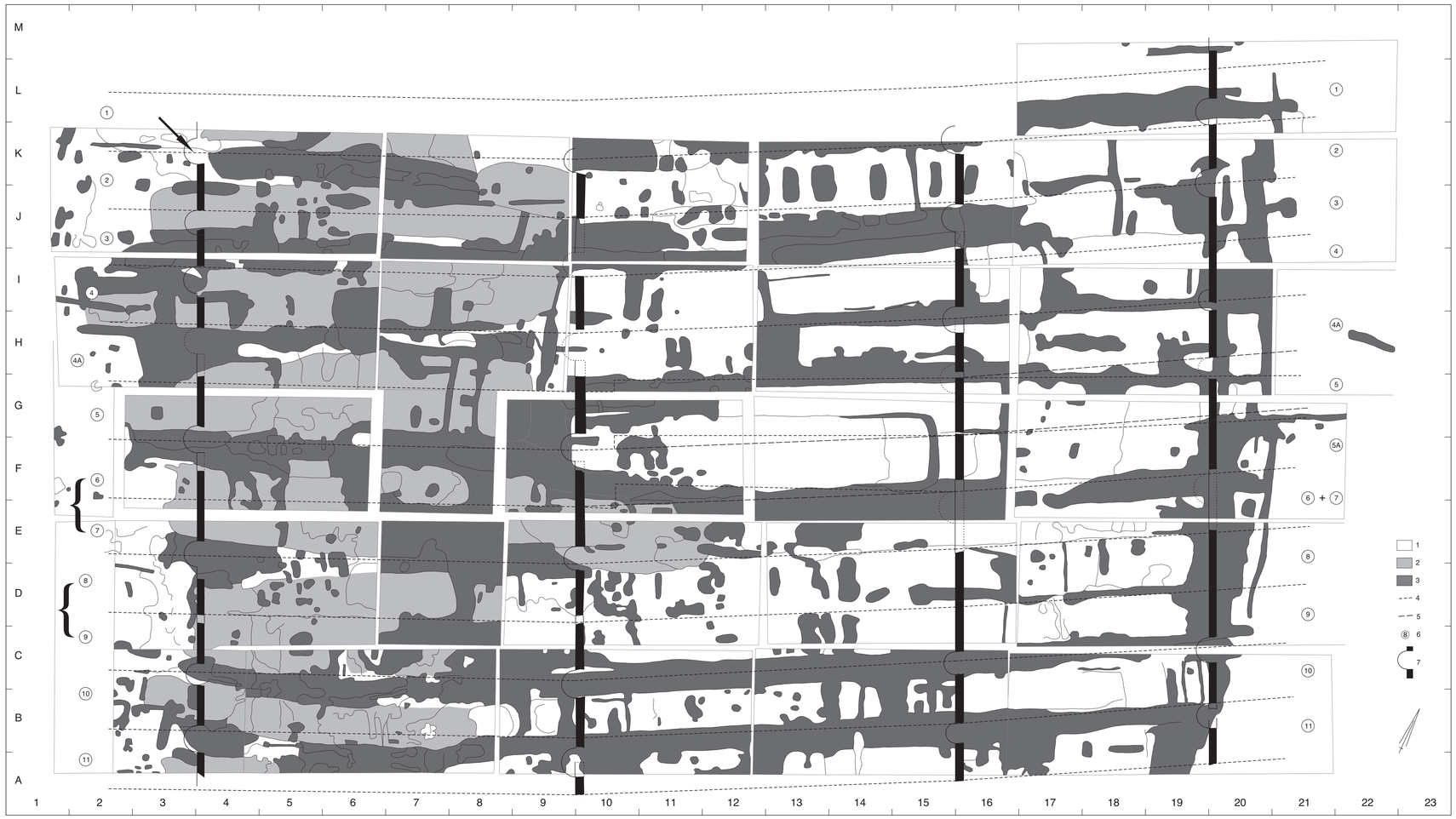

Fig. 76 Dorestad, Hoogstraat III: pollution of the riverbed; scale 1:400.
Legend: see fig. 72.

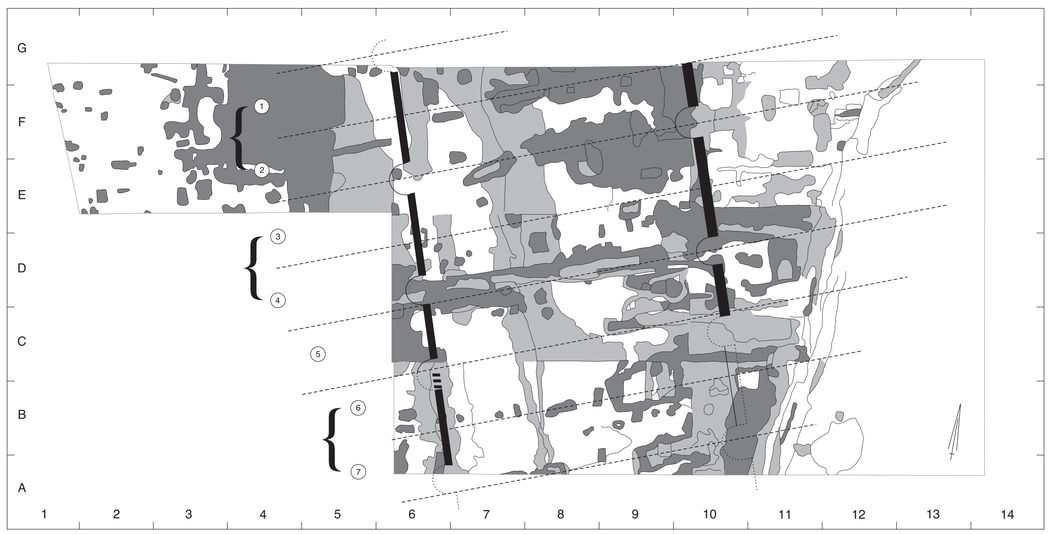

Fig. 77 Dorestad, Hoogstraat I: pollution of the riverbed; scale 1:400.
Legend:
1 un- or hardly polluted (dams);
2 slightly polluted;
3 heavily polluted (ditches and ends of growth phases);
4 parcel boundary 1;
5 parcel boundary 2;
6 parcel number.

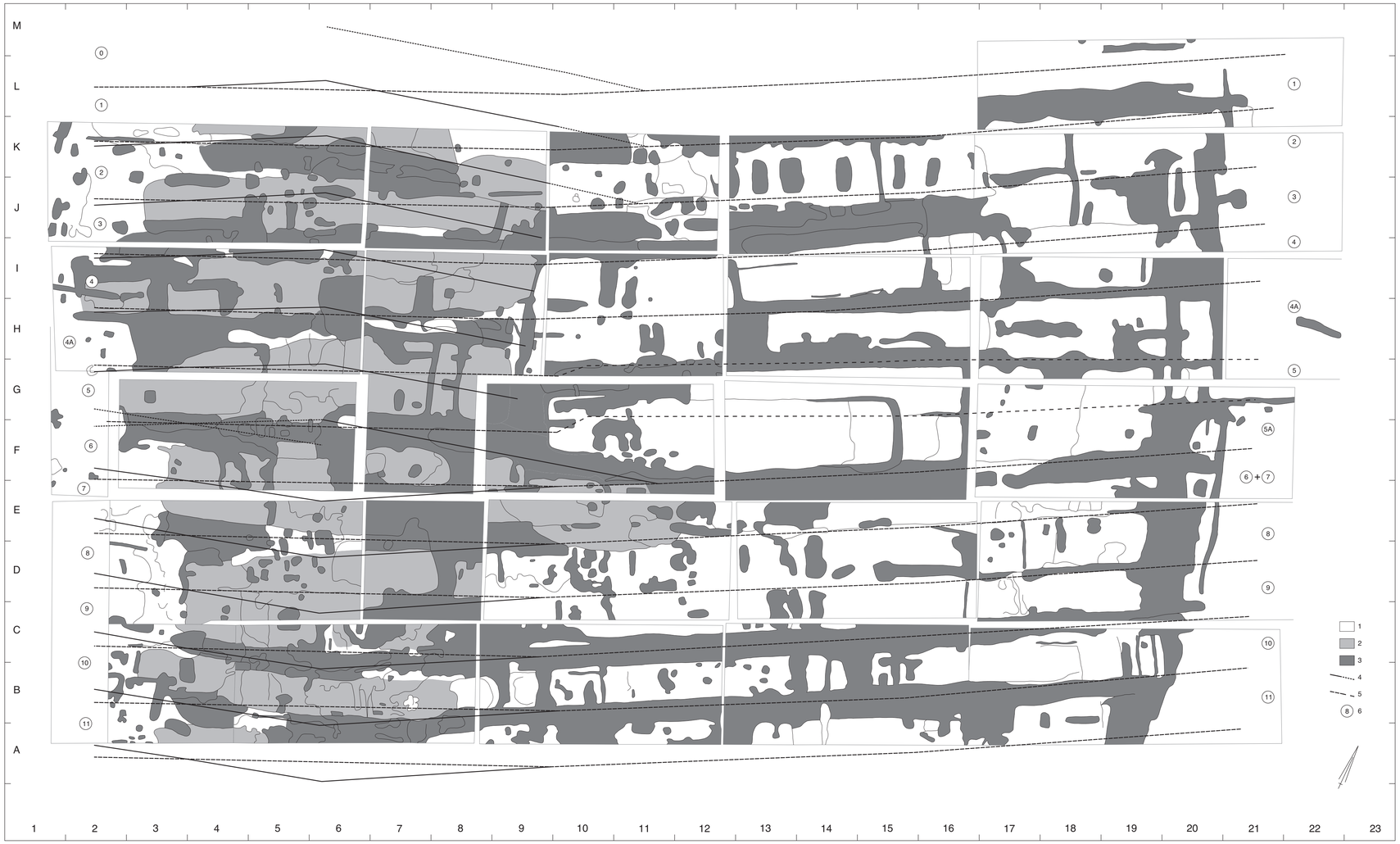

Fig. 78 Dorestad, Hoogstraat I: reconstruction of the parcellation in the riverbed, two periods; scale 1:400. Legend:
1 dams period 1;
2 dams period 2;
3 dams transition period 1 to 2;
4 corrected revised parcel boundary;
5 parcel boundary as in fig. 75;
6 vanishing point parcel 5A (period 1);
7 parcel number.