The International Journal of
NAUTICAL ARCHAEOLOGY

The International Journal of Nautical Archaeology (2014) ••.••: ••–••
doi: 10.1111/1095-9270.12061

A Late Roman Quay in the River Meuse near Cuijk, Netherlands

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The detection of the waterlogged remains of massive oak foundation piles in the river Meuse near the Dutch city of Cuijk led to the discovery of a unique Late Roman site. The piles, driven into the river-bed, had protected vast layers of organic material containing all kind of artefacts against erosion by the river. Increased erosion during recent decades has uncovered much of the structure and artefacts, which have been meticulously recorded and collected by divers of the Dutch foundation Mergor in Mosam. Analysis of all data retrieved over the past 20 years has provided much information about the environment and life in *Ceuclum*, the Roman city of Cuijk.

Key words: Roman, Cuijk, quay, pile, botanic, demography, environment, *vicus*.

In advance of a project to excavate the Late Roman bridge in the river Meuse near Cuijk, Netherlands, in 1989, a new waterlogged site was discovered nearby, known as Gebied-6000 (Goudswaard *et al.*, 2000). It consisted of a cluster of about 120 massive oak piles driven into the river-bed. The piles, that covered an area of 15 x 35 m^2, had protected vast layers of organic material from river erosion. The organic layers consisted of botanic material mixed with all kinds of artefacts. Dating the piles, the organic material and the artefacts suggested the site to be of Late Roman origin.

Canalization of the river, which started in 1930 to improve its navigability, increased its flow-rate, so the overlying sediments that had protected the site, including a layer of clay and rubble that was deposited in 1963, were being washed away and the organic layers were eroding. Although Late Roman waterlogged sites containing organic material and wooden constructions are very rare in the Netherlands, little was done to protect the site. Four survey projects (Goudswaard *et al.*, 2000; Stassen, 2002; Roessingh, 2008; Manders, 2009) and one coring survey (Van Breda, 2011), were carried out to establish the archaeological value of the site. In 2006, an area of 10 x 20 m^2 (50%) of the remains were protected with geotextile and a *c.*0.5 m-thick layer of clay deposited, with the aim of establishing anaerobic conditions for the organic layers (Manders, 2009: 19–26). In parallel with these projects, divers of the Dutch foundation Mergor in Mosam have very regularly inspected the erosion boundary, recording and salvaging artefacts on the brink of being washed out of the layers. This paper describes and discusses the results of this that has been work carried out by the amateur underwater archaeology group over the past 20 years (Seinen and van den Besselaar, 2013; www.mergorinmosam.nl).

Location and history

The site is located on the western shore of the river Meuse at Cuijk (Fig. 1, no. 13), between the Meuse and the plateau of Cuijk. This plateau is the remainder of a high terrace of sand and gravel that was formed in the early Saalien (126,000–136,000 BC). A layer of dense river clay, deposited during the late Boreal period (8630–7210 BC) in an ancient gully of the Meuse between the river and the plateau, fixes the river-bed and significantly limits erosion of the plateau (Goudswaard *et al.*, 2000: 502).

The plateau, therefore, has been occupied almost continuously from prehistoric times till now (Van Enckevort and Thijssen, 2001: 15). The strategic value of the plateau, that rose about 4 m above its surroundings, was recognized by the Romans conquerors, who are believed to have built a small *castellum* in the 1st century AD. To supply the inhabitants of the *castellum* with necessities a *vicus* arose on the

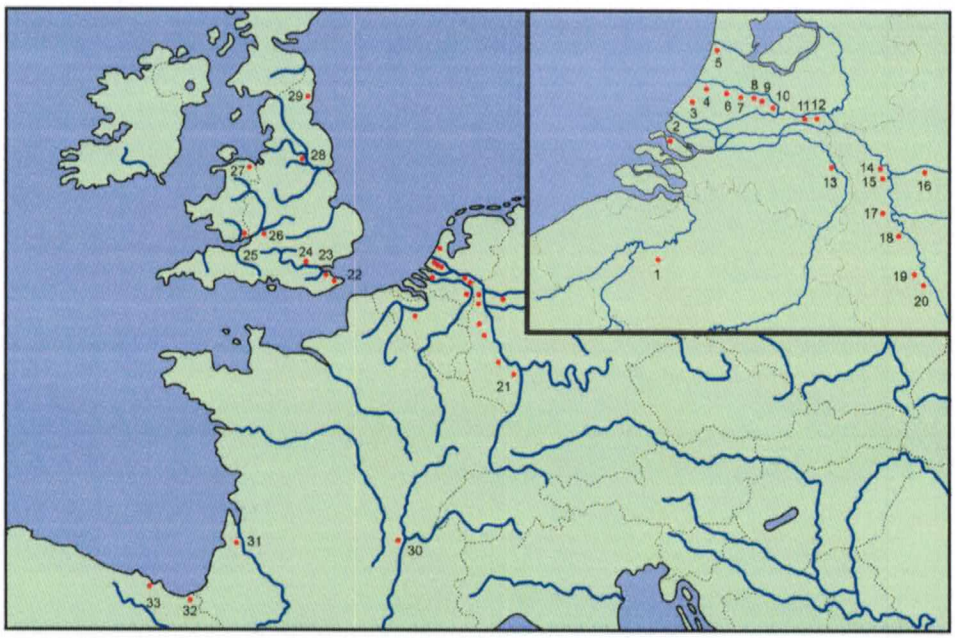

Figure 1. Location of well-documented Roman ports in NW-Europe; Cuijk is no. 13., see Table 1. (P. A. Seinen)

same plateau in the 1st century AD as well, and grew steadily long after the *castellum* was abandoned. During the reign of Emperor Trajan (AD 98–117), the *vicus* may have gained the status of *civitas*, in the sense of a regional centre, and flourished until the mid 3rd century, when it is believed to have been largely abandoned as a result of German-induced unrest, culminating in the first Frankish invasion in AD 275. Emperor Diocletian (AD 284–305) succeeded in reorganizing the *limes* defences in the late 3rd century and he, or his successor Constantine the Great (AD 306–337), erected a wooden *castellum* on the plateau in the early 4th century which was replaced by a stone *castellum* in the course of this century. The main purpose of the *castellum*, thought to be *Ceuclum* on the 4th-century Peutinger map, is believed to have been to defend the Roman bridge over the river Meuse, built in the mid 4th century (Goudswaard *et al.*, 2000: 482), which carried the road from Nijmegen (*Noviomagus*) to Tongeren (*Atuaca*). In the late 4th century the bridge was restored twice, but within a few decades, in AD 406, Frankish invaders urged the Romans to leave the area for the last time, abandoning *Ceuclum* to Frankish rule (Van Enckevort and Thijssen, 2001: 42–83).

Methods

As erosion between 1993 and 2006 (when the clay capping was added) could not be prevented, the Mergor in Mosam team set out to preserve this valuable archaeological information by recording as much as possible through regular diver surveys: these were carried out twice a month and add up to some 420 hours underwater. The surveys included visually scanning the area for obvious changes in the site, due to erosion of the layers, and collecting artefacts in the area, both as stray finds or within large lumps of the organic material that had broken free (or almost free) as a result of erosion. When their original location *in situ* could be recognized, their spatial positions were recorded with respect to piles with known positions. This paper only discusses the analysis of artefacts that are known to relate to the layers (in the lumps), or that are determined to be of Roman date. Each pile was labelled and their positions were measured: of 120 piles once observed, the positions of 88 piles were measured using a total station, 20 using trilateration (with respect to other piles), while 12 were washed away before they could be measured.

Samples for botanical analysis were collected in the course of the surveys carried out by the professional archaeological groups (Goudswaard *et al.*, 2000; Manders, 2009; Van Breda, 2011). The absolute dating, dendrochronology and radiocarbon analyses were carried out at the Dutch Foundation Ring (Amersfoort), the State University Groningen, and at Beta Analytics (London) respectively. All artefacts were archived and when necessary conserved according to the present state of the art and are now housed at Museum Ceuclum in Cuijk and the MIM depot in Beers. The artefacts were analysed and dated by leading experts in their fields (see acknowledgments). The report and databases have and will be published on the Dutch AWN website, section LWAOW (AWN, 2013).

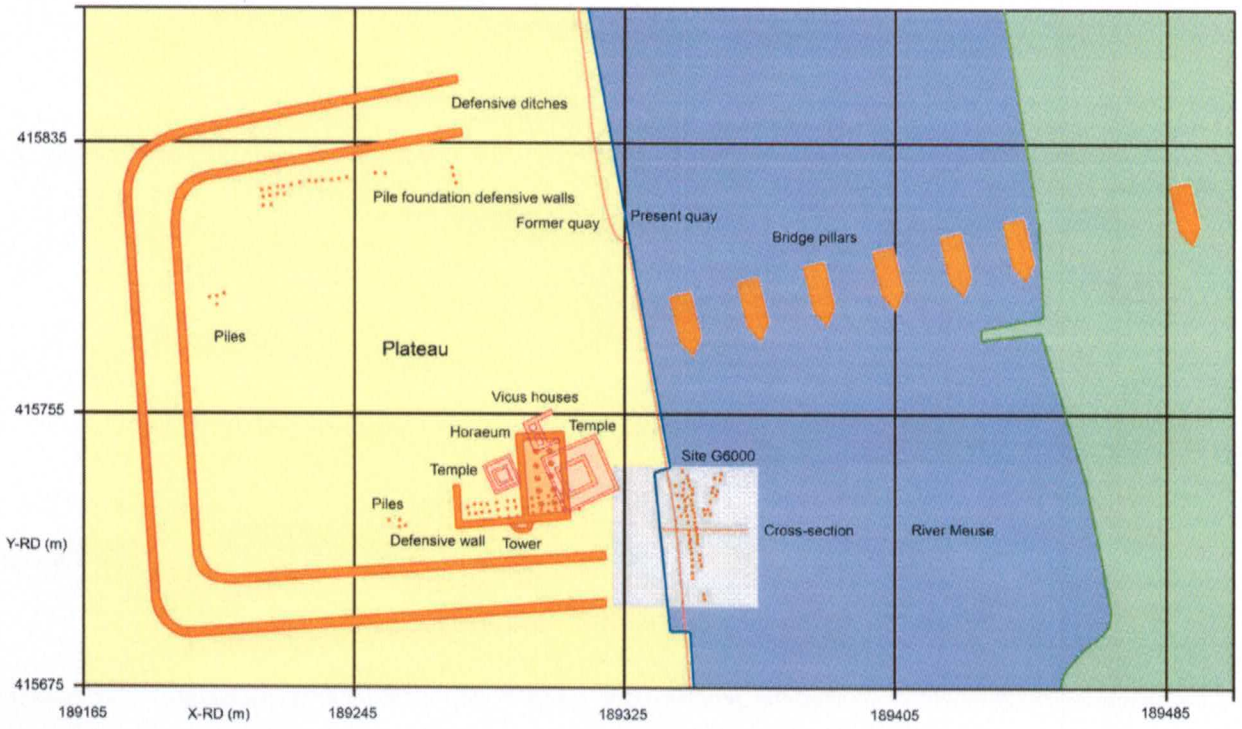

Figure 2. Part of the Cuijk plateau with Late Roman archaeology (*castellum, horraeum*, houses and bridge), the site is highlighted in the grey square. (P. A. Seinen)

Description and discussion

The site comprises three major elements: remains of foundation piles, layers of organic material, and a rich assemblage of artefacts from these layers. The description and subsequent discussion will therefore be split according to these categories.

The foundation piles

The Late Roman river site lies next to the plateau, with its remains of the 2nd–3rd-century *vicus* (temples and houses), the 4th-century *castellum* (ditches, walls, towers, granary) and the bridge (piers) of the same period (Van Enckevort and Thijssen, 2001) (Fig. 2). The site now comprises 88 squared and pointed oak piles that have been driven vertically and now stand 0.5 m above the river-bed. The present position of the often heavily eroded pile tops ranges from 3.4–5.4 m above Amsterdam Ordnance Datum (AOD). The water-level in Roman times is believed to have ranged from 4.2–7.2 m above AOD (Goudswaard *et al.*, 2000: 505). Assuming the quay construction was built above the highest possible water-level, the working surface is likely to have been at around 7.5 m. Therefore, at least 2 m of the foundation piles is missing, probably eroded. However, some skewed saw marks suggest that some were also demolished deliberately in ancient times (Van Campenhout, 2010: 11). Between some of these piles loosely lying horizontal beams were found.

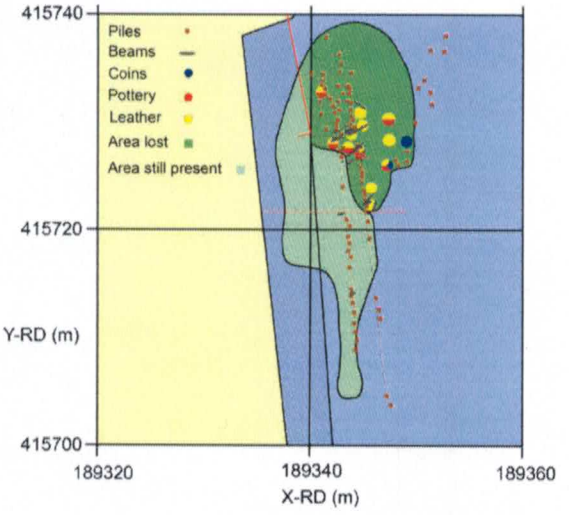

Figure 3. Details of the site, showing the distribution of piles, beams, the organic layers and artefact findspots. (P. A. Seinen)

The spatial distribution of the piles and beams can be divided into three sections (Fig. 3). From the south, two more-or-less parallel rows run parallel to the river-bank and into an area to the north that appears to consist of three less-well-defined rows of piles, also parallel to the bank. To the east of this area, and

running approximately SW-NE, the remains of four distinct pile clusters at more-or-less equal distances can be recognized, although the pattern is not clear; this may be due to some piles being missing, making an interpretation difficult.

The distance between piles in apparently undisturbed parts of the rows is, on average, 0.5–0.75 m, and the distance between the rows ranges from 1.4–2.2 m. These measurements do not clearly fit any Roman measure, such as the *pes monetalis* (0.296 m), as has been noted elsewhere (Morel, 1988: 25). The average diameter of the top-most surviving part of each pile is 0.25 m. This measurement is close to that of the piles used for building the Roman bridge, which are 0.27 m on average (Goudswaard *et al.*, 2000: 556–8), suggesting some standardization. Fifteen piles have been extracted and, based on this limited data, the present length of the piles ranges from 1–3 m (Van Campenhout, 2010: 14; Seinen and Van den Besselaar, 2013: 10). Those nearest to the shore are the shortest and those furthest into the river the longest, reflecting the slope of the river-bed towards the river-bank. None of the extracted piles were equipped with a steel pile-shoe (Van Campenhout, 2010: 14), as an aid for driving them into the bottom, whereas about a quarter of the piles of the bridge had a shoe (Goudswaard *et al.*, 2000: 461). The type of soil, or the depth to which the piles were required to be driven, may have rendered a shoe unnecessary. None of the piles or beams showed any signs of carving that could be related to joints of any kind that would give a clue as to the form of the original construction.

All 20 recorded beams, except one that was salvaged during the coring survey, were severely eroded, having lost all carving marks and original dimensions (present dimensions 0.1–0.2 m diameter and 0.5–2 m length). The salvaged beam still had its original dimensions (diameter 0.25 m) and shows clear tool marks at both ends. With a length of 3.6 m it is the largest beam seen to date, and its dating suggests it is almost certainly a part of the quay construction (Van Campenhout, 2010: 12). Unfortunately its orientation with respect to the piles is not certain, but it probably lay parallel to both rows of piles.

The oak trees required for making the piles for this quay, as well as for the bridge, were likely felled in the northern Meuse basin, possibly near Cuijk (Goudswaard *et al.*, 2000: 460; Manders, 2009: 32).

Interpretation and reconstruction

From the layout of the structure near the river-bank, and the distribution of the pile heads (Fig. 3), it can be assumed that it represents some kind of quay construction. An alternative interpretation is that the piles form the foundation of the eastern part of the defensive wall of the *castellum* (Goudswaard *et al.*, 2000: 525). This interpretation was based on the original discovery of a limited number of piles, since which the discovery of more piles, has made it unconvincing. An overview of quay constructions of the Roman period in Western Europe and Britain is given here in order to place the Cuijk remains in their wider context and enable as accurate a reconstruction as possible. Quay constructions in Roman river ports are fairly abundant in Western Europe and Britain (Cleere, 1978: 36; Marsden, 1994; Konen, 2000; Cattrysse, 2010), and this study is confined to wooden constructions (Table 1, Fig. 1), leaving out those constructed of stone, such as at Rouen (Halbout, 1979: 40–3), or those constructed of both stone and wood, for example at Rézé (Arthuis *et al.*, 2010: 26–35).

Besides elements such as wharfs, boathouses, storehouses and lighthouses, all of the ports studied have some form of closed or open quay (with or without revetment respectively) that runs parallel to the river-bank, or a closed or open jetty (with or without revetment respectively), which extends into the river. The construction of quays varies widely, depending on their purposes including the type and sizes of mooring ships, the environmental conditions such as river-flow, geological conditions, the availability of building material and economics—minimizing effort and use of material. Although there are no two identical constructions, they can be classified according to general principles (Table 1).

The main purpose of a quay is to provide access to ships from the river-bank, enabling the easy transfer of passengers and goods. The working surface should extend to a point with sufficient depth for ships to moor, while allowing those charging or unloading the boats to keep their feet dry. The simplest construction is an open quay, with a row of foundation piles and horizontally mounted support-beams, topped by planking forming a working surface. It has a single row of piles with a support-beam that supports one end of the planking, the other end being supported on the bank (Fig. 4a), as has been found at Pommeroeul (De Boe and Hubert, 1977: 5–22). When local conditions, such as very shallow riverbanks, require the quay to extend further into the river, multiple rows can be employed (Fig. 4b), either with or without support from the river-bank. The link to the river-bank might not be constructed over the entire length of the quay, such as at Voorburg (Driessen, forthcoming).

A more complex construction is a closed quay with a revetment, which is required when the river-bank is prone to erosion. Filling the revetment might provide a solid working surface that could be reinforced with turf, clay, wattle-work or narrow beams or planks. A properly closed quay should prevent the filling material from being washed out. This type of construction has a wide variety of forms; the simplest comprising of a row of closely placed piles, leaving no space between them for the filling material to be washed out (Fig. 4c), as has been recorded at Goedereede (De Bruin, 2012: 37–42, 130–3). Increasing the distance between piles requires some kind of revetment to fill the gaps between them. The simplest solution is wattle-work

Table 1. *Overview of Roman ports with documented remains*

Number	Country	Toponyms			Date	Type	Observed components			Reference
		Current	Roman	River			Foundation	Revetment	Surface	
1	Belgium	Pommeroeul	—	Haine	AD 150–200	Open quay	Single row piles	—	Planks	De Boe and Hubert, 1977: 5–22
1	Belgium	Pommeroeul	—	Haine	AD 150–200	Closed quay	Double-row piles	Planks	—	De Boe and Hubert, 1977: 5–22
2	Netherlands	Goedereede	—	An ancient creek	AD 75–225	Closed quay	Double-row piles	Closely placed piles	Planks	De Bruin, 2012: 37–42, 130–3
3	Netherlands	Voorburg	Forum Hadriana	Corbulo's canal	AD 150–175	Open quay	Double-row piles	—	—	Driessen, forthcoming
3	Netherlands	Voorburg	Forum Hadriana	Corbulo's canal	AD 200–225	Open quay	Triple-row piles	Planks	—	Driessen, forthcoming
4	Netherlands	Valkenburg-Marktveld	Praetorium Agrippina	Rijn	AD 0–225	Closed quay	Single row piles	Closely placed piles	Planks	Bult, 1987: 1–8, 43–50
4	Netherlands	Valkenburg-Marktveld	Praetorium Agrippina	Rijn	AD 0–225	Closed quay	Single row piles	Wattle work	—	Bult, 1987: 1–8, 43–50
4	Netherlands	Valkenburg-De Woerd	Praetorium Agrippina	Rijn	AD 100–150	—	Single row piles	—	—	Van Dierendonck *et al.*, 1993: 14–17
5	Netherlands	Velsen	Flevum	Oer-IJ	AD 0–25	Closed quay	Single row piles	—	Clay	Morel, 1988: 124–38
5	Netherlands	Velsen	Flevum	Oer-IJ	AD 0–25	Open jetty	Double-row	—	—	Morel, 1988: 121–3
5	Netherlands	Velsen	Flevum	Oer-IJ	AD 0–25	Closed jetty	Double-row	—	Wattle	Morel, 1988: 139–60
6	Netherlands	Leiden-Roomburg	Matilo	Corbulo's canal	AD 25–150	Closed quay	Single row	Closely placed piles	—	Bogaers, 1962: 191–5
6	Netherlands	Leiden-Roomburg	Matilo	Corbulo's canal	AD 100–150	Closed quay	Single row	—	Turf	Bogaers, 1962: 191–5
6	Netherlands	Leiden-Roomburg	Matilo	Corbulo's canal	AD 100–125	Open quay	Double-row	—	—	Bogaers, 1962, 191–5
7	Netherlands	Alphen aan den Rijn	Albanianum	Oude Rijn	AD 25–125	—	Single row with brace	—	—	Polak, 2004: 113–20
8	Netherlands	Zwammerdam	Nigrum Pullum	Oude Rijn	AD 25–225	—	Single row	—	—	Haalebos, 1977: 41–6
9	Netherlands	Bodegraven	—	Oude Bodegrave	AD 0–50	Closed quay	Single row	Planks	Beams	Van den Kooij, 2005: 286–93
9	Netherlands	Bodegraven	—	Oude Bodegrave	AD 50–100	Closed quay	Single row	Closely placed piles	—	Van den Kooij, 2005: 286–93
10	Netherlands	Woerden-Jozefpensionaat	Laurium	Oude Rijn	AD 75–100	—	Single row with brace	—	Wattle	Bogaers, 1983: 302–9
10	Netherlands	Woerden-Kruittorenweg	Laurium	Oude Rijn	AD 75–100	Closed quay	Single row	—	Beams	Bogaers, 1983: 302–9
10	Netherlands	Woerden-Gasfabriek	Laurium	Oude Rijn	AD 100–175	Closed quay	Single row	—	Beams	Beunder, 1988: 57–67
10	Netherlands	Woerden-Havenstraat	Laurium	Oude Rijn	AD 50–100	—	Single row	—	—	Beunder, 1990: 61–3
11	Netherlands	Vechten	Fectio	Kromme Rijn	AD 0–25	Open quay	Double-row	—	Planks	Polak, 1991: 125–56
11	Netherlands	Vechten	Fectio	Kromme Rijn	AD 0–25	Closed quay	Single row	Planks	—	Polak, 1991: 125–56
12	Netherlands	Hoge Woerd	—	Leidsche Rijn	AD 75–125	Closed quay	Single row	—	—	Graafstal, 2002: 2–27
12	Netherlands	Veldhuizen	—	Heldammer stroom	AD 75–125	Closed quay	Single row	Planks	—	Graafstal, 2002: 2–27
12	Netherlands	Veldhuizen	—	Heldammer stroom	AD 75–100	Open quay	Double-row	—	—	Graafstal, 2002: 2–27
13	Netherlands	Cuijk	Ceuclum	Maas	AD 325–375	Open quay	Double/triple-row	—	—	Seinen and Van den Besselaar, 2013: 27–8
14	Germany	Xanten	Colonia Ulpia Trajana	Rhein	AD 50–150	Closed quay	Single row with brace	Beams	Planks	Mueller *et al.*, 2008: 447–69
15	Germany	Buederich	—	Rhein	AD 0–100	—	Single row	—	—	Boecking, 1974: 14
16	Germany	Haltern-Hofestatt	—	Lippe	AD 0–100	—	Single row	—	—	Konen, 2000: 288–94
17	Germany	Moers-Asberg	Asciburgium	Rhein	AD 50–100	—	Single row	—	—	Bechert, 2011: 12–15, 103
18	Germany	Krefeld-Gellep	Gelduba	Rhein	AD 150–200	—	Single row	—	—	Konen, 2000: 251
21	Germany	Mainz-Dimesser-Ort	Mogontiacum	Rhein	AD 0–100	—	Single row	—	—	Lindenschmit, 1883: 142
21	Germany	Mainz-Am Brand	—	Rhein	AD 0–200	—	Single row	—	—	Hoeckmann, 1986
22	Britain	Dover	Dubris	Dour	AD 75–125	Box	Horizontal beams	Beams	—	Rigold, 1969: 78–100
24	Britain	London-Landing stage	Londinium	Thames	AD 50–75	Box	Single row	Beams	—	Milne, 1985: 55–67
24	Britain	London-Pudding Lane	Londinium	Thames	AD 50–75	Closed quay	Single row with brace	Beams	—	Milne, 1985: 55–67
24	Britain	London-Miles Lane	Londinium	Thames	AD 25–50	Box	Single row	Beams	—	Milne, 1985: 55–67
24	Britain	London-Custom-house	Londinium	Thames	AD 150–200	Box	Single row	Beams	Clay	Miller *et al.*, 1986: 2–11, 25–74
24	Britain	London-New-Fresh-Wharf	Londinium	Thames	AD 200–250	Closed quay	Single row with brace	Planks	—	Miller *et al.*, 1986: 2–11, 25–74
24	Britain	London-New-Fresh-Wharf	Londinium	Thames	AD 200–250	Closed quay	Beames with brace	Beams	—	Miller *et al.*, 1986: 2–11, 25–74
25	Britain	Gloucester	Glevum Colonia	Severn	AD 50–100	—	Single row	—	Clay	Green, 1942: 39–53
26	Britain	Carlaeon	Isca Augusta	Usk	AD 175–275	Open quay	Double-row	—	—	Boon, 1978: 1–23
27	Britain	Chester-Roodeye	Deva	Dee	AD 50–100	—	Single row	—	—	Shrubsole, 1887: 76–90
28	Britain	York	Eboracum	Ouse	AD 275–350	—	Single row	—	—	Richardson, 1959: 54–6
29	Britain	Newcastle	—	Tyne	AD 50–100	—	Single row	—	—	Bruce, 1885: 1–11
30	France	Bordeaux-Saint-Remi	Burdigala	Garonne	AD 75–200	Box	Single row	Beams	—	Gerber, 2010: 83–103
30	France	Bordeaux-Bourse-Nord	Burdigala	Garonne	AD 75–325	Closed quay	Single (?) row	Closely placed piles	—	Gerber, 2010: 83–103
31	France	Lyon-Parc-Saint-George	Lugdunum	Saone	AD 75–100	Open quay	Double (?) row	—	—	Ayala, 2007: 153–85
32	Spain	Irun-Santiago	Oiasso	Biscay	AD 50–125	Slipway	Horizontal beams	—	—	Artigas *et al.*, 2005: 85–106
33	Spain	Santander-Magdalena	Victoriae Iuliobrigensium	La Bahai	AD 0–400	Open quay	Double row	Closely placed piles	—	Artigas *et al.*, 2005: 107–22

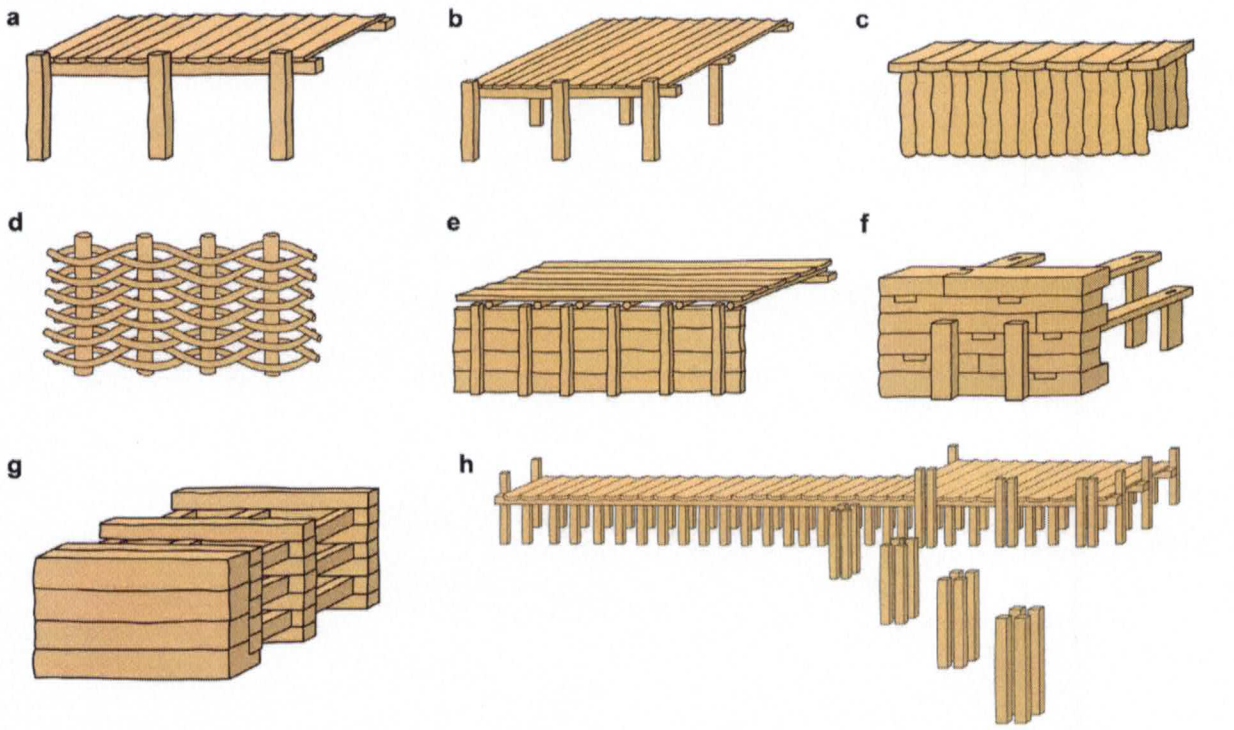

Figure 4. *a)* open quay of single-row piles; *b)* open quay of double-row piles; *c)* closed quay of closely placed piles; *d)* closed quay of wattle-work; *e)* closed quay of campshot planks supported by piles; *f)* closed quay of beams supported by piles and braces; *g)* box of beams in a frame; *h)* tentative reconstruction of the Late Roman open quay at Cuijk. (P. A. Seinen)

(Fig. 4d) or planks (Fig. 4e), as seen, for example, at Valkenburg (Bult, 1987: 1–8, 43–50) and Veldhuizen (Graafstal, 2002, 2–27). To withstand the inevitable forces exerted by the filling material on the revetment, braces are also often employed, which also show a wide variety of constructions. However, all consist of horizontally placed planks or beams, attached at one end to the revetment structure and to piles at the other end which are anchored in the embankment. Various solutions are known with the braces, with those at Xanten (Mueller *et al.*, 2008: 453) and London (Miller *et al.*, 1986: 66) being the best documented examples. When the relatively light campshot planks are replaced by heavier beams and the number of piles are decreased (Fig. 4f), stability relies more on the use of braces, as seen at Xanten (Mueller *et al.*, 2008: 447–69). Alternatively, piles and braces can be integrated into a box-like structure, as found at the Custom House site, London (Miller *et al.*, 1986: 2–11, 25–74) (Fig. 4g). Piles applied at the front of such structures do not generally have a supporting function, but protect the construction from impacts from heavily laden ships.

This short overview of quay constructions may suggest a development over time from very simple to fairly complicated structures, but this is not supported by current dating (Table 1). The choice for a specific construction seems to have been determined by the variety of considerations discussed above.

The construction at Cuijk has produced no evidence of revetment material, and, had it existed, it might have been expected to survive at least as traces embedded in the organic material. Therefore, it was probably an open structure consisting of a long double-row quay to the south, connected to a multi-row (at least 3 rows) platform to the north, with a series of four mooring posts stretching out to the north-east (Fig. 4h).

The robustness of the construction, expressed by the diameter and distribution of the piles (respectively 0.25 m and 1.3–2 piles/m) is fairly high. The constructions at Voorburg consist of an open quay built of piles with a very similar diameter 0.23 m to those at Cuijk, but the open quay at Cuijk is much more robust. The Voorburg open quay has an average of only 0.5 piles/m (Driessen, forthcoming). Explanations for the solidity of the construction at Cuijk could be that it was built to withstand floating ice during winter, the impact of large or heavily laden ships, or that it required greater resistance to river current than the Voorburg quay.

The layers with organic remains

At the time of the discovery of the organic layers they were covered by layers of clay and rubble that had been applied in 1963 in an attempt to prevent erosion of the river-bank (Fig. 5). Four phases have been reconstructed from the stratigraphy to explain the

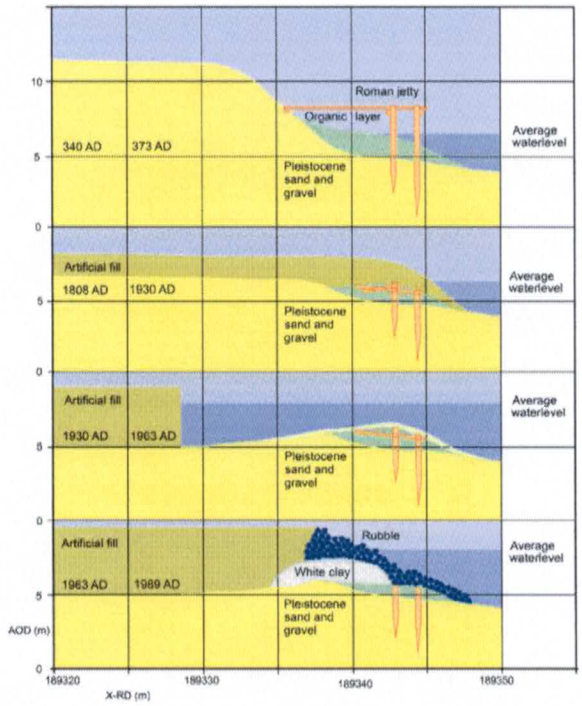

Figure 5. Cross section at Y-RD 415722 m through the ages. (P. A. Seinen)

preservation of the site. In the late 4th century, the natural sand and gravel river-bottom near the bank was covered by the organic layers. The shallow river would have covered these layers with sand and gravel very rapidly. In 1808 an artificial river-bank was made covering a large part of the site. In 1930, most of this river-bank was removed for building a new quay, leaving the site virtually unprotected. In 1963, the river-bank was restored to its late 4th-century location using heavy grey clay, later to be covered by rubble, to protect it against erosion.

The distribution of the layers of organic remains over the site is shown in Figure 3. The darker green area indicates the part that has been washed away in the past 20 years, mainly by the propellers of mooring ships. The lighter area has been made evident by a soil coring survey (Van Breda, 2011). The total thickness of the layers, which vary widely in composition, ranges from a few centimetres to more than a metre. The extent of the layers seems to follow the distribution of the piles, as might be expected. In various locations the layers are separated by very thin sand-gravel layers. A recent survey carried out for Dutch Cultural Heritage (RCE) in 2013 (Opdebeeck, forthcoming) may give us a better insight into the genesis of the layers: for instance whether the material has been dumped over a short or longer timespan.

The organic layers consist of brown to black coloured peat-like material containing vegetable and animal remains such as leaves, twigs, seeds, kernels, pollen, wood chips, horse manure, bones and leather. These provide important information for reconstructing the type of environment and activities that took place on and around the plateau. The vegetable remains, extensively discussed in three previous reports (Bakels, 2006: 2–19; Manders, 2009: 16, 34–7; Van Breda, 2011: 23–32, 41–7), are summarized in Table 2, including the major landscape indicators. The natural landscape varies from a very wet to a dry environment: sphagnum indicates marshland; alder, birch and willow indicate wetlands; oak, elm, ash and maple indicate mixed deciduous forest; and heather indicates moorland. The cultivated landscape reflects various uses. White clover, tufted vetch, galium, rattle, plantain, stinging nettle, mugwort, as well as fungi, indicate meadowlands, likely for cattle breeding. Birds-foot-trefoil, orache, camomile, sheep's sorrel, hemlock, mellow, riccia and carnation indicate fields for growing crops such as emmer, spelt and possibly rye. Typical Roman ingredients including herbs, such as dill, coriander, fennel and savoury, mint, hemp, opium poppy, flax, and vegetables, such as carrot, chick pea and beet, indicate vegetable gardens. Apple, plum, cherry and walnut may indicate some manner of orchards.

Nightshade, henbane, common vervain and opium poppy may indicate that plants were gathered for medicinal purposes. Flax, hemp and kite can indicate textile production, including a yellow dye.

The use of typical Roman vegetables and the dominance of emmer and spelt over rye, which was hardly present, indicate a strong Romanization of the inhabitants (Bakels, 2006: 13).

Weeds which commonly grow in Belgian or French corn fields, such as white-lace flower, cow-basil, caucalis and corn cockle, which are often found mixed with imported corn, indicate that not all food was grown locally. Similarly, Roman specialities, such as olive pips, were likely imported from the Mediterranean area.

The animal finds (Seinen and Van den Besselaar, 2013: 12) provided very limited information. Most of the bone material was not found in context in the organic layers and therefore is not dated. Pieces of calcified material that could be related to the organic layers were determined as sheep, wild or domesticated pig and deer, the latter suggesting hunting activity.

Conspicuous is the absence of remains of fish, which might be expected so close to a river. A special find in this category, however, are the remains of lots of periostraca of Batavian river mussels, apparently the remains of a single meal (Van den Besselaar, 2004: 25–6). Single mussel shells have also been uncovered (Van Breda, 2011: 20–1).

The presence of horse manure, which was first recognized by its shape, was confirmed by further analysis (Zachariasse, 2003a).

Table 2. *Overview of botanic finds together with their indicators*

Group	Family	Name	Indicator
Natural vegetation	Moss	Sphagnum	Marshland
	Shrubs or trees	Alder, birch, willow	Wetlands
	Shrubs or trees	Oak, maple, elm, ash, elder, ivy	Mixed deciduous forest
	Shrubs or trees	Heather	Moor (sheep breeding)
	Weeds	Bracken	Sandy soil (burned)
	Weeds	Birds-foot-trefoil, orache, camomile, sheep's sorrel, hemlock, mellow	Agriculture
	Weeds	Hornwort	Agriculture
	Weeds	Riccia, carnation, fabaceae	Agriculture
	Weeds	White clover, tufted vetch, galium, rattle, stinging nettle, mugwort	Meadowland (cattle breeding)
	Weeds	Knapweed	Meadowland (cattle breeding)
	Weeds	Plantain	Grazing (cattle breeding)
	Weeds	White lace flower***, cow-basil***, caucalis***, corn cockle***	Import of grain (Belgium or France)*****
Cultivated vegetation	Grasses	Emmer wheat, spelt wheat	Local wheat production****
	Shrubs or trees	Walnut*, hazelnut	None
	Grasses	Rye	German food culture
	Herbs	Dill*, coriander*, fennel*, savory*, mint, hemp, opium poppy, flax	Roman food culture
	Vegetables	Carrot, chick pea*, beet*	Roman food culture
	Shrubs or trees	Apple, plum, cherry**	Roman food culture
	Shrubs or trees	Olive***	Roman food culture
	Herbs	Nightshade**, henbane**, saint john's wort, common vervain, opium poppy	Roman medicine
	Herbs	Flax, hemp, kite	Textile industry
	Herbs	Flax, opium poppy	Fine oil
Other	Fungi	Chaetomium, sordaria type, podospora type	Stable
	Insects	Weevil	Grain storage

* Roman introduction, ** Possible Roman introduction, *** Roman import, **** Samples of chaff, ***** Probably millet and barley.

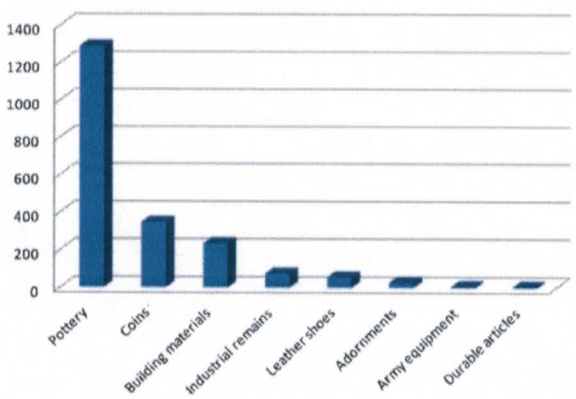

Figure 6. Distribution of numbers of all artefacts over the major find groups. (P. A. Seinen)

Table 3. *Overview of pottery types and forms*

Material	%	Form	%
Coarse ware	42	Bowl	23
Samian ware	26	Beaker	22
Colour-coated ware	14	Pot	18
Terra nigra	6	Mortar	13
Marbled ware	5	Dish	10
Smooth ware	3	Plate	7
Amphora ware	2	Amphora	3
—	—	Jar	2

Artefacts from the organic layers

Artefacts in the following categories have been retrieved: pottery, building materials, coins, leather material, adornments, military equipment, other durable articles and industrial remains (Fig. 6). Findspots for coins, pottery and leather with known locations, are shown in Figure 3. These findspots accounted for only about 20% of all finds, the rest of which were collected after they had been washed out of the organic layers at which point a precise location could no longer be ascertained.

The Roman pottery spectrum, analysed by Jan Thijssen (Table 3), shows a very high percentage of samian ware, as might be expected from a Romanized context and represents land rather than harbour debris (Thijssen, 2011: 174). The very low percentage of amphora and *dolia* sherds (Table 3) is striking and may suggest that these particular sherds were collected

Figure 7. Fragment of a Roman rooftile with inscription. (P. A. Seinen)

separately, as in Rome on the Monte Testaccio, a huge dump of more than 50 million amphora sherds (Dressel, 1878). A similar dump in Cuijk has not as yet been found.

The coin assemblage (346 coins), analysed by Rob Reijnen, consists almost entirely of bronze *folles* and a significant number of *antonianini* coins which had little value at the time of their loss (Reijnen, pers. comm.). Of the 99 coins that could be traced back to their place of production, 66 were minted in Trier, as might be expected. A significant part of the assemblage consists of barbarian imitations, a common practice to relieve the shortage of coins. These imitations could have been minted locally, as evidence of bronze casting has also been identified on the site.

The building materials assemblage was analysed by Harry van Enckevort and Henk Kars and contained materials typical for Roman building practices: mainly tuff, sandstone, *tegulae*, *imbrices* and Roman concrete. A few *hypocaust* tiles and *tubuli* may be associated with the late 2nd-century baths (Van Enckevort and Thijssen, 2001: 40). One *tegula* fragment showed a stamp CTEC, from a well-known 2nd-century manufacturer near Maastricht (De Poorter, 1989: 45). Another *tegula* fragment showed elements of engraved text (Fig. 7). Unfortunately, the fragment was too small to for it to be deciphered.

The industrial remains were analysed by Van Enckevort and Thijssen, and are a varied mix of the waste products of various crafts, including shoemaking, lead and bronze casting, iron production and possibly smithing (Seinen and Van den Besselaar, 2013: 16), pottery production and gold-smithing (Table 4). Two crucibles may have been the tools for the latter. Small glass nuggets suggest glass production for bracelets. Linen production and dyeing is suggested from the plant remains (flax, hemp and kite, see Table 1). Besides manufacturing new products, worn and broken objects were also repaired as seen on some

Table 4. *Overview of remains of industrial activities*

Material	Form	Date	Number
Leather	Off-cuts	AD 325–350	54
Lead	Pour channels	AD 325–350	2
Bronze	Pour channels	AD 325–350	2
Bronze	Droplet	AD 325–350	1
Gold	Droplet, thread, sheet	AD 325–350	3
Glass (green, black)	Nugget	AD 325–350	2
Ironslag	Iron-production	AD 325–350	6
Cinder	Oven-lining	AD 325–350	2
Ceramics	Crucible	AD 325–350	2

Table 5. *Overview of types and designs of shoes and remains*

Type	Design	Complete	Fragments
Sandals	Roman	6	0
Nail shoes	Roman	0	7
Slippers	Roman	1	3
Laced shoes (fixed lace)	Roman	2	3
Laced shoes (separate lace)	Roman	8	5
Shoes	German	4	6

leather shoes and in the lead-plugs used to mend cracked pottery. The wooden chips, mostly oak, clearly the remains of woodworking, might be related to the construction of the quay, or at least another significant construction activity. Coal, found deep within the layers and thus unlikely to be a later contamination, (Van Breda, 2011: 19) is likely to have been used for heating, either domestic or for specific industrial processes.

The leather remains were analysed by Carol van Driel-Murray. Those remains that could be categorized were exclusively related to shoes. No less than 45 complete or partial shoes could be identified, with various types and designs of both Roman and German fashion (Table 5). Their sizes also vary and include shoes made for children, women and men. All these remains were firmly related to the organic layers and are thus dated. The Roman designs coincide neatly with the known fashion of the late 3rd to early 4th century Empire (Van Driel-Murray, 2007: 133–41) (Fig. 8).

Very close to the leather finds, fragments of hemp rope were found, which may also have been of local manufacture.

The adornments were analysed by Van Enckevort and Thijssen (Table 6). Though small, the assemblage includes hairpins and *fibulae* made of bronze (Seinen and Van den Besselaar, 2013: 16), bracelets of black coloured glass and jet, and beads of green and blue coloured glass and jet. Hairpins and bracelets underline the presence of women on the plateau. A few

Figure 8. A complete Roman sandal made of leather. (J. A. van den Besselaar)

Table 6. *Overview and dates of adornments*

Type	Material	Date	Number
Hairpins	Bronze	AD 325–350	3
Bracelets	Glass (black)	AD 325–350	9
Bracelets	Jet	AD 325–350	1
Bracelets	Bronze	AD 0–400	1
Crossbow fibula	Bronze	AD 250–400	2
Ring fibula	Bronze	AD 100–300	1
Hinge fibula	Bronze	AD 200–250	1
Crossbow fibula	Bronze	AD 300–350	1
Beads	Glass (black, green, blue)	AD 0–400	6
Beads	Jet	AD 325–350	1

of the bracelets are of a particularly small size and were probably for children. A resurgence in the fashion for glass bracelets is known to have occurred in the Late Roman Empire (Van Driel-Murray, 2007: 140).

The collection of military equipment, analysed by Van Enckevort, is very small and contains cavalry-related fragments of ornaments, a single *lamella* of body armour and a crossbow *fibula*, the only find clearly related to a military presence in the early 4th century.

Other durable articles recovered were analysed by Van Enckevort. They were few, and therefore are prized finds. They include a bronze curry-comb—another hint of the presence of horses—and a rare fine-toothed comb made of box-tree wood (Fig. 9). As box-tree of this size would have been hard to find this far north, it is probably a Roman import, either as raw material but more likely as a finished product (Zachariasse, 2003b: 11). The fine-toothed comb was inspected for the remains of parasites, such lice or fleas, but none were found. Rare bronze remains such as a spoon, key and the hook of a steelyard are clearly Roman introductions, although possibly locally made. The steelyard may be linked to trade within the alleged Late Roman *vicus*.

Dating

In order to put dates on the activities discussed, the layers and some of the artefacts contained within it have been dated using: dendrochronology for the oak piles and a beam; radiocarbon-dating of organic

Figure 9. Remains of an almost-complete comb made of box-tree wood. (J. A. van den Besselaar)

remains; and seriation of Roman coins and pottery. Other datable artefacts were too few in number to provide reliable statistics and most could only be dated with wide margins. The dating results of the coins and pottery should be interpreted with caution as the relation between some of this material and the layers is not always clear. This is most obvious for the dating data for the pottery. All non-Roman material, as well as some Roman material, originates from building and subsequent repair of quays in the early 19th and late 20th century, for which quarried soil from all over Cuijk was used. The non-Roman material will be left out of this analysis.

The dendrochronology of 19 piles and one beam (Goudswaard *et al.*, 2000: 558–9; Manders, 2009: 32; Van Campenhout, 2010: 41) provides two equally large groups of precise and distinct dates: AD 325–326 for the probable construction of the quay, including the beam, and AD 372–373 for the probable replacement of damaged piles. Although these dates represent the felling of the trees and the actual use may be some years later, it is assumed that the trees were processed shortly after the felling as was common practice in Roman engineering (Hollstein, 1965: 12–27). Moreover, no cracks as a result of prolonged storage were observed, which suggests the timbers were used shortly after felling (Driessen, forthcoming).

Samples of a leaf, a twig, a chunk of charcoal and an oak chip were taken from three cores for radiocarbon analysis (Goudswaard *et al.*, 2000, 484–5). Radiocarbon data of the leaf, twig and charcoal (State University Groningen) and the chip (Beta Analytics) is fairly consistent (statistically no significant differences), but due to an unfortunate wiggle in the calibration curve, it provides two fairly extensive date ranges, either between AD 130–260 or AD 270–335. The former range, although possible, provides an unlikely gap with the dating of the artefacts in the layers (Goudswaard *et al.*, 2000, 484–5; Seinen and Van den Besselaar, 2013).

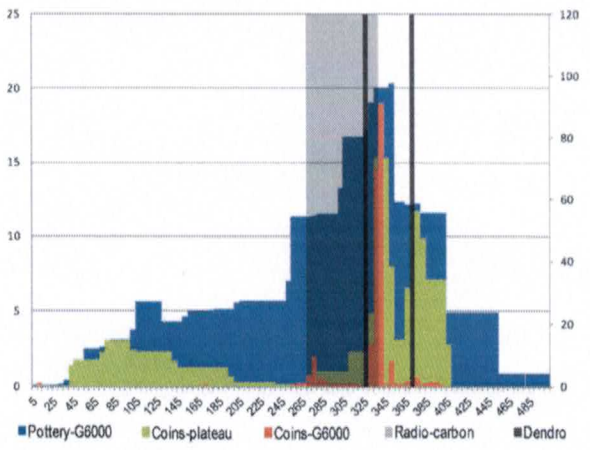

Figure 10. Overview of the dating distributions of pottery, coins, organic material and piles. (P. A. Seinen)

The 346 coins, both genuine and imitation, by their sheer number provide useful statistics. The 290 genuine coins have a fairly confined date distribution, 257 falling between AD 330 and AD 350, supplemented with 22 coins of earlier date, AD 250–300, and 11 coins of later date, AD 365–395 (Fig. 10). Most of the imitations provide only a *terminus post quem* of AD 330. More than 80% of all the coins provide a *terminus post quem* of AD 335.

The Roman pottery also provides impressive statistics (1286 pieces). The date distribution (Fig. 10) shows a peak at AD 340, too. It could be interpreted as suggesting continuous habitation between AD 40 and AD 405, and even beyond that date, but this continuity is largely caused by the large margin of dates for some sherds. For example only a few pieces fill the gap between AD 250 and AD 300, when the plateau was believed to be unpopulated.

The summary of all dating results (Fig. 10) shows some interesting features. Comparing the coins from the river site with those found on the plateau, both from excavations and metal detectorists (Van Enckevort and Thijssen, 2001: 73–9) shows marked differences in the date distributions. The distribution of coins from the plateau shows two major clusters at AD 40–200 and AD 270–405, the latter cluster having two distinct peaks at AD 340 and AD 370. The distribution of coins from the river site shows one peak at AD 340. It seems that the period in which organic waste was collected and dumped on the river-bank was limited to AD 330–350.

The date distribution of the pottery also shows a maximum around AD 340, which fits with both coin distributions. It has already been pointed out that the distribution of the pottery extends well into the 20th century, explained by the early 19th and late 20th century infilling. It is possible that this soil contained Roman sherds but few coins as the modern population of Cuijk has started to collect coins and other metal artefacts.

The radiocarbon data match that of both distributions for coins and pottery at their upper boundary of AD 335. The period of collecting and dumping the material therefore is most likely AD 330–340.

Comparing these with that of the dendro-data for the piles (AD 325–326 and AD 372–373) reveals no meaningful correlation. Establishing the sequence of events in building the quay and dumping the organic material, by excavating one or more of the piles, could provide welcome insight.

Synthesis

After the reorganization of the defensive *limes* by Emperor Diocletian in the late 3rd century (a new paradigm in blocking German invaders), followed by the building of a *castellum* in the late 3rd to early 4th century, the *vicus* started to flourish again.

Environmental evidence suggests that the surrounding landscape was a mix of natural and cultivated areas. The natural areas varied from the very wet river valley, marshland, wetlands, and a dryer mixed deciduous forest, to moorland. The cultivated areas varied from meadowlands likely for cattle breeding, and fields for growing emmer and spelt, to vegetable gardens and orchards that provided vegetables, herbs, fruit and nuts, medicinal plants and other commodities.

The demography showed women, men and children with a mix of Romans, Romanized locals or Germans.

The food supply of meat, corn, vegetables and herbs, some for medicinal purposes, was probably largely local, but a part of the corn and specific Roman specialities, such as olives that could not be grown locally, were imported. Besides agricultural activities, there are hints of shell fishing and hunting. Other inhabitants were involved in various crafts such as iron production, gold-smithing, bronze and lead-casting, pottery and glass production, shoemaking and textile production.

In AD 325–326 a wooden construction, probably an open quay with a broad platform, and mooring posts further into the river were built on the bank of the Meuse. Its robustness makes it suitable for unloading the heavy building materials that have been found on the plateau. However, its construction date matches neither that of the bridge in AD 347–349, nor the erection of the stone *castellum* in AD 334 or 369 (Van Enckevort and Thijssen, 2001: 87).

A few decades after the last recorded repairs in AD 372–373, which are close in date to repairs of the bridge in AD 368–369 and the (possible) erection of the stone *castellum* in AD 369 (Van Enckevort and Thijssen, 2001: 87), the Romans left the area. This may coincide with the partial demolition of the quay construction. Erosion of the river removed a good part of the soil around the site, which became a shallow bank in the river. Reclaiming this eroded territory by the construction of a new quay in the mid 20th century resulted in

the unintentional protection of the site with layers of clay and rubble.

The future for the site does not look so bright, however, as a large area is now exposed. A recent survey, conducted by the Dutch Cultural Heritage (RCE) to find the best way to protect the site *in* or *ex situ*, will be reported at the end of 2014 (Opdebeeck, forthcoming). Until the site is protected properly, Mergor in Mosam will continue to conduct regular surveys.

Acknowledgments

The authors are indebted to the efforts of members of the operational group of the foundation Mergor in Mosam, for analysing and dating the organic material and the artefacts: Corrie Bakels and Wim Kuipers (botanics), Caroll van Driel-Murray (leather), Fiona Zachariasse (horse manure), Theo de Jong (bones), Jan Thijssen (pottery), Harry van Enckevort (building materials and small metal artefacts), Stijn Heeren (*fibulae*), Henk Kars (minerals and stone), Rob Reijnen (coins), Patrice de Rijke (iron-slag) and Sander Laurant and Linders Meten en Peilen (terrestrial measurements).

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