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Herausgegeben von Claus von Carnap-Bornheim, Falko Daim, Peter Ettel und Ursula Warnke

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Peter Ettel · Ursula Warnke (eds)

HARBOURS AS OBJECTS OF INTERDISCIPLINARY RESEARCH – ARCHAEOLOGY + HISTORY + GEOSCIENCES

International Conference »Harbours as objects of interdisciplinary research – Archaeology + History + Geosciences« at the Christian-Albrechts-University in Kiel, 30.9.-3.10.2015, within the framework of the Special Research Programme (DFG-SPP 1630) »Harbours from the Roman Period to the Middle Ages«

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FOREWORD

The Priority Programme 1630 »Harbours from the Roman Period to the Middle Ages« funded by the German Research Foundation (Deutsche Forschungsgemeinschaft) in the years 2011-2018 has made it its priority to unite and connect multidimensional approaches to harbour research within the vast research area of the North Atlantic to the Mediterranean. Modern research of the last three to four decades has particularly shown how the integration of geophysical and geoarchaeological methods has brought new insights into interdisciplinary and interpretational approaches. Thus the logical consequence was to dedicate the first international conference on the framework of the Priority Programme to this approach and its wide discussion. It took place from 30 September to 3 October 2015 with the title »Harbours as objects of interdisciplinary research – Archaeology + History + Geosciences«. About 130 participants from 15 nations with 70 lectures presented their work approaches and results within the five sections of the conference: »Plenum keynote-lectures«, »Geophysics and Field Research: Developing methods«, »Geoarchaeology: Changing Harbour Environments«, »Archaeological Features: Harbour Facilities and Infrastructure«, »Written and Iconographic Sources: Complementing the Material Evidence«. The ceremonial address of the evening was given by Sabine Ladstätter (Vienna) on the harbour of Ephesos. On the last day of the conference the participants visited the Viking Museum Haithabu as well as exhibitions at the Schleswig-Holsteinisches Landesmuseum Schloss Gottorf in Schleswig.

Subsequent to the conference in Kiel, the initiators of the Priority Programme decided on what at first glance appears to be an unusual publication strategy in which the predominantly archaeologically and historically oriented papers are being published in the present volume, whereas some mainly geophysical and geoarchaeological papers will be published in Quaternary International Special Issue »Integrated geophysical and (geo)archaeological explorations in wetlands« (guest editors: Christoph Zielhofer, Wolfgang Rabbel, Stefanie Berg-Hobohm, Tina Wunderlich), thereby reaching different milieus, which are, however, interconnected by their interdisciplinary research on harbours. Consequently, the thematic structure of the present volume will differ from the actual conference and the submitted contributions are arranged regionally as well as topically.

Our thanks go especially to Ilka E. Rau, who was both responsible for organising the conference as well as for the editorial responsibilities of this volume. Moreover, our thanks go to the editorial team of the RGZM in Mainz.

The initiators of the SPP 1630 »Harbours from the Roman Period to the Middle Ages«
Claus von Carnap-Bornheim
Falko Daim
Peter Ettel
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MARK DRIESSEN

THE LOGISTIC FUNCTION OF THE RHINE-MEUSE DELTA IN THE ROMAN PERIOD: THE HARBOUR TOWN OF VOORBURG-ARENTSBURG AS A CASE-STUDY

»*Nederland Transportland*« has been a popular slogan for decades as well as the other catchphrase »*Nederland Waterland*«. They both appeal to the maritime and riverine tradition of the Netherlands. The mentality of the people living in our coastal delta is formed by the delicate balance between the threats and the benefits of the sea, the coastal and riverine areas over centuries and is illustrative of our maritime-riverine tradition and culture. The geographical destiny of the Low Countries, with an average of two major floods each century over the last millennium, left the people with a legacy and a strong determination to transform the landscape. This resulted in the saying that »God created the earth, but the Dutch made Holland«. Our geographical location also brought prosperity through the extensive use of water transport, trade and worldwide interactions, and maritime industries. The origins of our maritime-riverine legacy and traditions are historically always associated with the late medieval period and our Golden Age. In this paper I would like to show that the unique geographical position and the logistic potential of our coastal delta, at the confluence of several important northern European waterways, was already recognized and actively exploited in the Roman period.

WATERFRONT INSTALLATIONS, HARBOURS AND PORTS

Typical of the Low Countries is the continuous reshaping by uncontrolled meandering and anastomosing river systems. These swampy wetlands and river levees lacked potential for large-scale agricultural surplus production and were not rich in natural resources. The Roman authorities were not interested in these marshlands because of their intrinsic economic potential, but most probably because of their maritime-riverine geographical location. Here the waterways of the Rhine, Meuse and Scheldt merged, a confluence that could be used as a logistic hub in the military and civilian provisioning between the inland provinces and the North Sea. The persistent efforts to establish, maintain and man the riverine and coastal military frontier zone, the use of innovative techniques to transform the dynamic and unpredictable wetland conditions to specific needs, and the ongoing attempts to maintain Roman authority in this territory were linked with the strategic importance of the transit routes for the entire north-western section of the empire. Examples of such technological adaptations to the dynamics of our waterland were retrieved during excavations of several Roman waterfront installations.

A well-known example is the historically documented Corbulo canal that was constructed to create an inland connection between Meuse and Rhine, and had most probably a logistic role in the provisioning of the Claudian conquest of Britannia[1]. In the central river area near present-day Utrecht a diked road was constructed to traverse the »Old Rhine«[2], and several transformations and dredgings of the military harbour of Velsen I show the enhanced knowledge of water management that was achieved in a short period of time[3]. Excavations in the Holocene fluvial flood basin and marine salt marshes areas in our coastal delta

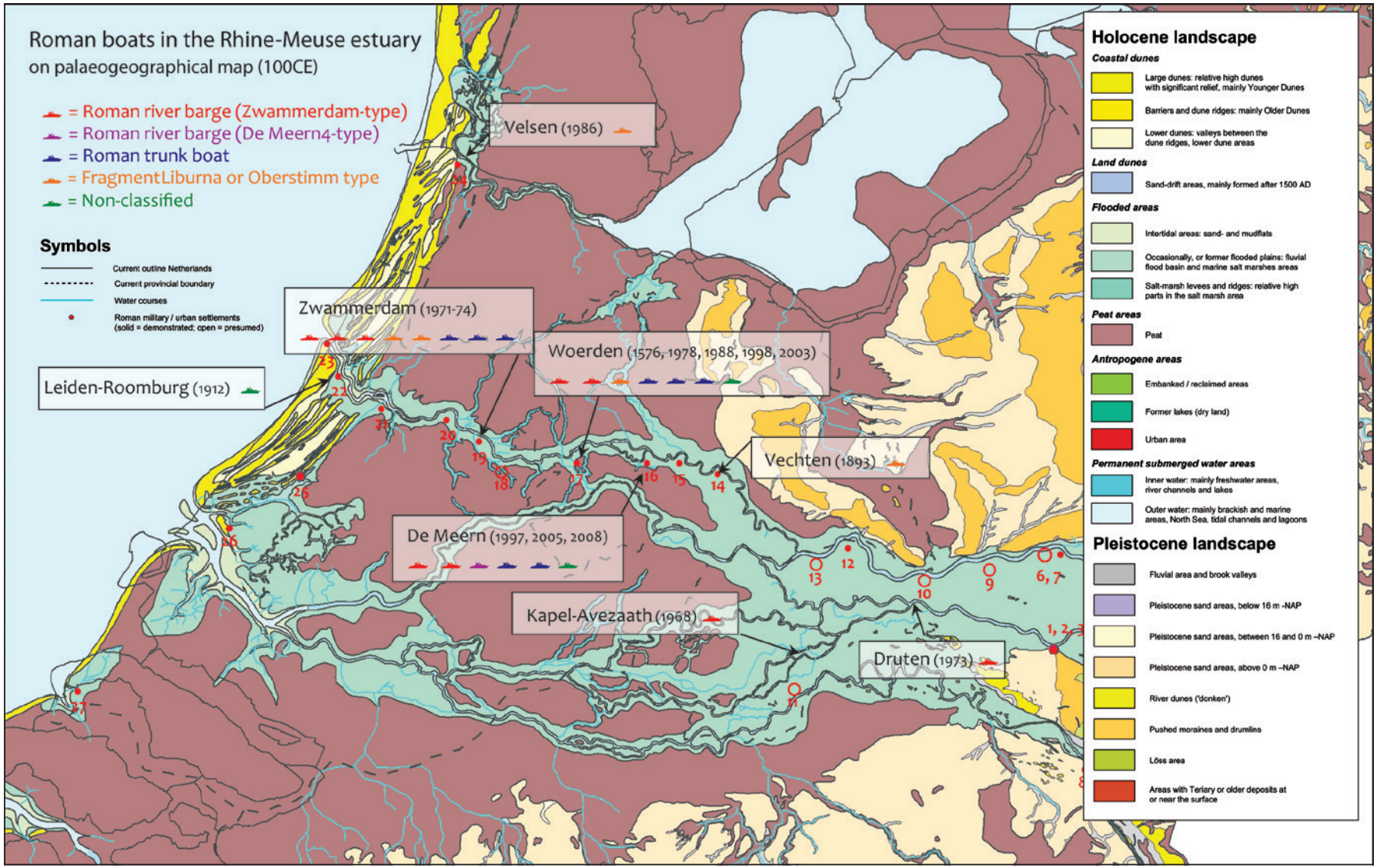

Fig. 1 Map of the Roman military-civilian settlements and boats in the Rhine-Meuse estuary, projected on the palaeogeographical map of the western part of the Netherlands. Settlements: **1-3** Nijmegen (Ulpia, Hunnerberg, Kops Plateau). – **4** Herwen-Bijland. – **5** Loowaard. – **6** Driel. – **7** Arnhem-Meinerswijk. – **8** Cuijk. – **9** Randwijk. – **10** Kesteren. – **11** Rossum. – **12** Maurik. – **13** Rijswijk. – **14** Vechten. – **15** Utrecht. – **16** De Meern. – **17** Woerden. – **18** Bodegraven. – **19** Zwammerdam. – **20** Alphen a/d Rijn. – **21** Leiden-Roomburg. – **22** Valkenburg. – **23** Brittenburg-Katwijk. – **24** Velsen I. – **25** Voorburg-Arentsburg. – **26** Naaldwijk. – **27** Goedereede. – • = certain; ○ = possible. – (Base map: Palaeogeographical map of the Netherlands c. AD 100; Vos/De Vries 2013; drawing Archol).

have revealed a unique assembly of Roman river barges (**fig. 1**). The construction and technical alterations of these ships illustrate that they were developed and optimized for professional transport on the rivers and streams of north-west Europe[4]. Even the drainage of wetland fields, which is so characteristic of the Netherlands of the last centuries, was already practised during the Roman period. A first century wooden culvert with a one-way valve retrieved under a dike near Vlaardingen and a sudden increase in the number of ditches laid out during wet periods in the Midden-Delfland are illustrative of this[5]. We hope more examples of such adaptations to waterland conditions are to be discovered, but we must also realize that many have vanished as a result of human activity and the abrasive effect of the meandering and anastomosing rivers and streams in later periods[6].

Noticeable examples of waterfront installations with a logistic function are loading platforms, portages, harbours and ports. In archaeological literature a tendency can be observed that most of the excavated waterfront installations with quays and/or embankments are indiscriminately described as being harbours, but we must ask ourselves: do all of them qualify as such? For the conceptualization of waterfront installations, we should be aware of the inter-changeability between the terminology of these installations. Different meanings and purposes are attributed to, for instance, embankments, landing places, loading platforms, jetties, piers, moles, harbours and ports in many languages[7]. This significant difference in functions and purpose should be taken into consideration before these terms are applied to archaeologically retrieved structures[8].

According to Rogers[9], a harbour can be defined as an artificial structure constructed with jetties, sea walls or breakwaters, or as a natural place where vessels can seek shelter or be stored. Harbours are also more permanent and elaborate structures than loading platforms. A physical distinction can be made between loading platforms and harbours, whereby harbours consist at least in multiple loading quays. Harbours as being more permanent structures can also be distinguished from loading platforms by means of the investment of great effort and ingenuity, and applied maintenance. The first can be observed archaeologically by adaptations and innovative changes in waterfront installations to changing environmental conditions, and the last, for instance, by structural periodic dredging. A harbour is dredged if navigability becomes an issue as a result of relative changes in the water level or sedimentation. Harbours are the physical waterfront structures related to a larger ensemble with a more institutionalised character. From a socio-economic perspective harbours can be seen as artificial waterfront constructions near the shore of a sea, lake or waterway where loading, transhipment and/or unloading of vessels takes place, and which occupies a pivotal role in (supra)regional and/or military connectivity. When these harbours are part of larger urban or military settlements, this ensemble is defined as a port. The concept of connectivity is introduced by Horden/Purcell[10] and is described by them as »the various ways in which micro-regions cohere, both internally and also one with another – in aggregates that may range in size from small clusters to something approaching the whole Mediterranean«. Morris[11] defines connectivity in a practical and simpler way as »the transfer of materials and/or people from one place to another, such that a connection is established between those places and the people who occupy them. In essence this refers to exchange and the associated connections between places created through exchanges.«

It is not only these differences in physical appearances and socio-economic purposes that archaeologists should take in consideration, but also the social impact these waterfront installations had on the waterscapes and people involved[12]. Such structures established in a riverine-coastal landscape are not only logistic and transportation installations, but are also landmarks of power and control and mark borders of cognitive zones[13]. The territorial markers in Roman infrastructure are monumentalized by the construction of waterfront installations and also by the placement of more than life-size statues[14]. These landmarks – with waterfront installations and statues – may be regarded on the one hand as representatives of »political monumentality« to accentuate the central authority's position of power[15]. On the other hand they may also

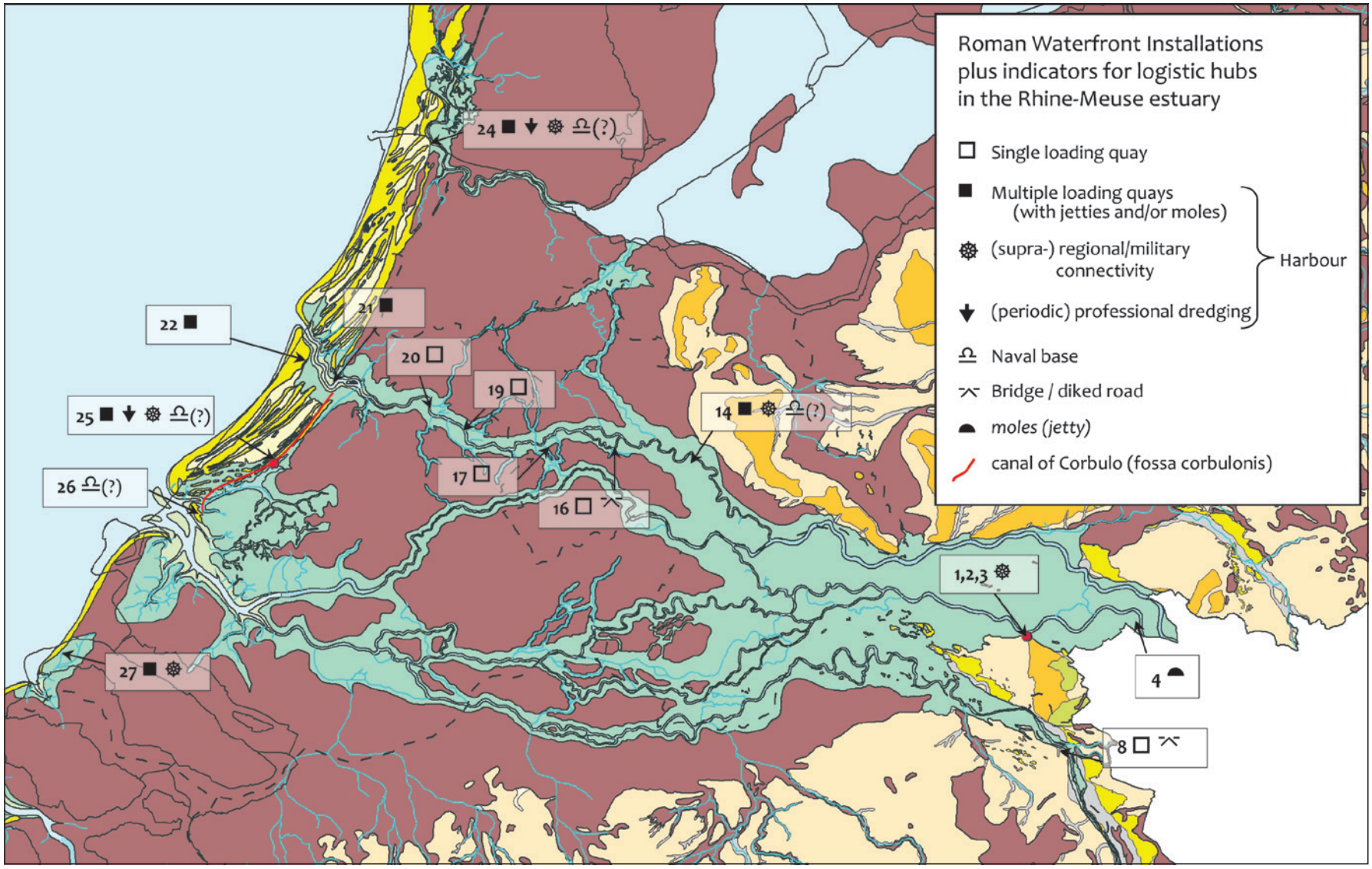

Fig. 2 Roman waterfront installations plus indicators for logistic hubs in the Rhine-Meuse estuary; projected on the palaeogeographical map of the western part of the Netherlands. For settlement names see **fig. 1**. – (Base map: Palaeogeographical map of the Netherlands c. AD 100; Vos/De Vries 2013; drawing Archol).

be seen as territorial markers of the infrastructural adjustments and innovations within the scope of the »monumentality of tamed nature«. The Roman transformation of the landscape not only had a practical purpose but, furthermore, demonstrated that the Roman Empire had conquered the world technologically as well, an aspect from which its subjects could also benefit[16].

ROMAN HARBOUR SITES IN THE NETHERLANDS

At present, numerous Roman sites with waterfront installations are known in the Netherlands, not all of them yet publicized (fig. 2). These already emphasize the strategic and logistical importance of the transit routes along which they are established for and beyond the north-western provinces of the Roman Empire. Although they might all have a pivotal role in the control and establishment of the supply lines, only a few can be characterized – or expected – as harbour sites according to the above criteria.

The Roman naval base of Vechten

The oldest site is the early Roman naval base and harbour of Vechten near present-day Utrecht, which dates to the first decades of our era. Polak[17] resumes a long-lasting debate on the role of early Vechten as a naval base initiated by a publication of Holwerda in 1915. For his reviews, Polak analyses some of the basic finds and arguments and also incorporates new evidence retrieved from old excavations. The remnants of a variety of loading quays, landing stages and other bank revetments were retrieved with a length of more than 500 m[18]. No observations were made on the dredging of the harbour basin of Vechten, but this might have been due to the difficult excavation conditions and the fact that this publication is based on old research, sometimes dating from the 19th century with of course other research aims and methodologies. The archaeological finds underline the function of Vechten as a logistical base for military connectivity. Polak[19] suggests that Vechten played a role as a predecessor of the Roman military harbour base of Velsen I on the one hand, but might on the other hand have served as a Claudian supply base for small military installations further along the Rhine, which were established to safeguard the military transports to Britain.

The early Roman fort and harbour of Velsen I

The Roman outpost and naval base of Velsen I are also part of the Roman military reorientation after the Varus Battle. The waterfront installations of Velsen I initially consisted of four pier-like structures, of which the two largest sheet-piled quay moles (45 m and 54 m) were connected to a revetted trapezoid platform (24 m × 24 m). The next phase of the waterfront installations consist of four open quay jetties and newly erected revetments established as adaptations to the abrasive effects of the Oer-IJ river, next to which Velsen I is situated (fig. 3). These new embankments were not the only adjustments to the dynamics of the stream, but subsequent dredging operations were carried out to keep the river and harbour navigable. Two boathouses – comparable to the ones from Hofestatt-Haltern – were retrieved; the largest one was most probably big enough to house two small galleys[20]. A portion of the huge corpus of Roman wheel-thrown pottery bears limited traces of wear, use and fragmentation. Some of the smooth ware jugs even contained intact wooden stoppers. These were most probably damaged during transport and as a result discarded in the harbour basin when the cargo loads were unloaded and/or transhipped. No ships have been excavated

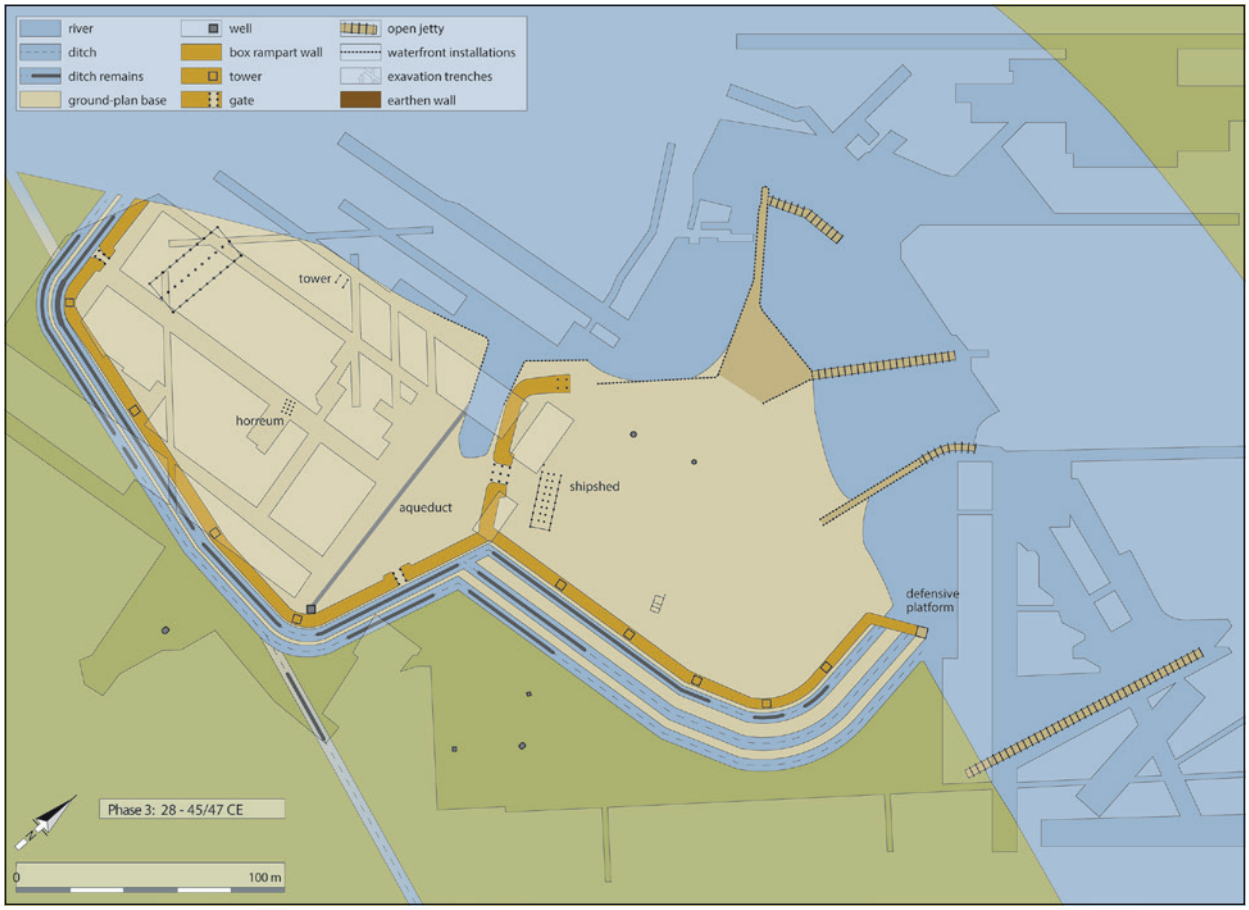

Fig. 3 Phase 3 of the military outpost and harbour of Velsen (28-45/47 AD). – (Drawing J. Kaarsemaker).

in the harbour of Velsen I, but other nautical wooden artefacts such as pulleys, cleats, blocks and paddles have been found. Other evidence for the presence of seafaring ships comes from an often neglected find group: lead strips. Such strips with nail holes – which were applied to the ship's hull to improve water tightness and to prevent the hull from biofouling – are found on shipwrecks and near waterfront installations at about 50 Roman archaeological sites in the Mediterranean[21]. The lead strips from Velsen have the same dimensions, and also the size of the nail holes and the impressions of the nail heads in these strips are comparable to the ones found at many Mediterranean waterfront sites[22].

The Roman military outpost and harbour of Velsen I was constructed around 16 AD and remained in use until the second half of the 40s. This naval base most probably played a role in safeguarding the region and the logistical organisation of military campaigns in the north.

The military logistic hub of Flavian-Trajanic Nijmegen

A military settlement complex was re-established on the Nijmegen push moraine after the civil wars and nativist rebellions of 69-70 AD. The Flavian-Trajanic legionary fortress at Nijmegen functioned on the one hand as a defensive control centre. The Legio X Gemina was permanently housed here on a key logistic position connected to different »channels« of communication in order to respond quickly to possible regional threats[23]. These *castra* formed in conjunction with its *canabae legionis,* also a logistical bridgehead, to fa-

Fig. 4 Location of the Flavian-Trajanic legionary fortress and *canabae legionis* on Nijmegen moraine. – (Drawing A. Jansen).

cilitate the movement and distribution of supplies, equipment, troops and information[24]. There was a need for such a logistical central place after the Batavian revolt. The Roman armies were confronted with major logistical problems after losing control over the Rhine, the main transport artery, and thus were no longer able to supply the troops involved in operations along this river in the years 69-70 AD[25]. It is quite obvious that after this breakdown a logistical reorganization was considered of utmost importance. A harbour site is pivotal for the functioning of this logistical hub, but where are these waterfront installations situated? It has always been assumed that this harbour site was based at the foot of the modern city of Nijmegen, which would have resulted in an overland transport of about 2 km for all military equipment, food and building materials in order to reach the military »cities«. The extramural structures north-east of the legionary camp on the steep edge of the Nijmegen lateral moraine, 30-40 m above the river landscape, are interpreted as the foundations of a crane or derrick and a roller conveyer[26]. The above arguments together with the consultation of palaeogeographic studies and 17th-18th-century maps concerning older sidearms and stream channels of the River Waal resulted in the hypothesis that the location of the harbour of this military settlement complex is to be expected at the foot of the steep edge of the Nijmegen moraine, just under the north-eastern corner of the fortress (**fig. 4**)[27]. Corings carried out here to locate the harbour between 2008 and 2013 looked promising, but test trenches excavated in 2015 however failed to recover any signs of these waterfront installations.

The trade settlement and harbour of Goedereede

A Roman settlement with multiple loading quays was found near Goedereede, in the Dutch province of Zeeland (**fig. 2**). It was excavated in the 1950s and 1980s, but not published until 2012[28]. This settlement

dates from the 80s of the first century until approximately 225 AD. The waterfront installations consist of several revetments and multiple loading quays laid out alongside a stream. The find assemblages point out that the settlement played a role in a (supra)regional trading network, although it remains unclear to what waterways the stream was connected[29]. No Roman waterways are known yet between the mouths of the Scheldt and the Meuse (Helinium), as large parts of the landscape around Goedereede were eroded in the post-Roman periods. An important indication that these waterways did exist are the inscriptions on the Nehalennia altars which were found near Domburg and Colijnsplaat, also in the Dutch province of Zeeland, and a palaeogeographical reconstruction indicates that Goedereede might have been connected to the Helinium via northern streams[30].

The Roman land- and waterscape hubs briefly described above are essential elements of the logistic chains for the specific regions and periods in the Low Countries. The remaining part of this paper will focus on a harbour site excavated near the modern city of The Hague: Voorburg-Arentsburg.

THE HARBOUR TOWN OF VOORBURG-ARENTSBURG

Introduction

Excavations in Voorburg-Arentsburg carried out in the 19th century by Caspar Reuvens – the first professor of archaeology – and in the early 20th century by Jan Hendrik Holwerda have uncovered structures which are typical of a planned Roman settlement[31]. Holwerda[32] interpreted this settlement as a fleet station of the *classis Germanica*. Later on this hypothesis was rejected and the site was reinterpreted as the Roman town Forum Hadriani[33]. A number of milestones from the region show that this small Roman town – which served as the capital for the *civitas* of the Cananefatians – received a legal status as *municipium* before 151 AD and was most probably also known under the name of Municipium Aelium Cananefat(i)um[34].
Excavations carried out in three large trenches by the University of Amsterdam in 2007/2008 were undertaken in the expectation of examining two – possibly three – *insulae* of this Roman town. We were very surprised when the excavations in two trenches uncovered a river channel of at least 110 m in length with a width tapering from 41 m to 28 m (**fig. 5**). These widths are based on archaeological observations and corings carried out during and after the excavations. It is not clear how the harbour is connected to the Corbulo canal; because of present road surfacing and buildings it was not possible to perform corings south of trench 2 to clarify this.

The origins and early Roman use of the river channel

The genesis and dating of this channel are difficult to trace, partly due to later Roman civil engineering, but these are most probably connected with increasing marine influences that took place in the Middle Iron Age. Water entered the land from the Helinium – the Meuse estuary – and created the Gantel system. The many stream channels of the Gantel system are observed inland as far as Voorburg, Delft and Pijnacker (**fig. 6**), due to which the landscape changed drastically with an abrasive effect on the peat areas and depositions of clay[35]. The river channel of Voorburg, most probably one of the farthest inland branches of the Gantel system, might have owed its existence to a spring tide or some other burst of energy. Concentrations of rounded pebbles observed in undisturbed contact zones between the bottom of the channel and the

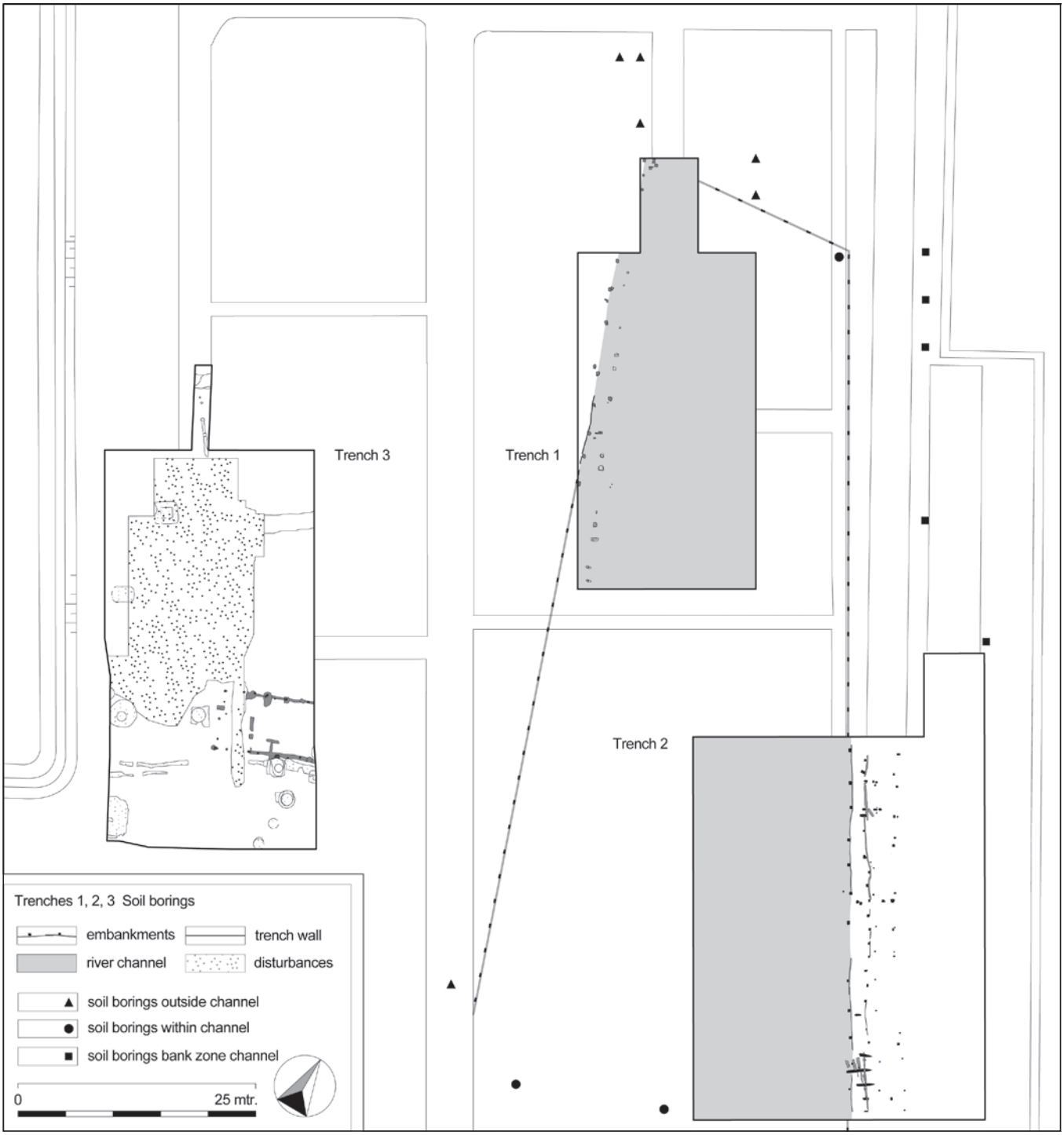

Fig. 5 Layout of the University of Amsterdam excavations of Voorburg-Arentsburg with soil drillings to locate the dimensions of the harbour basin. – (Drawing J. Kaarsemaker).

underlying beach barrier support this assumption. Many of these residual channels that originated in the Middle Iron Age silted up again in the course of the Late Iron Age, so it is questionable whether the channel was still open when it was put into use in the Roman period[36].

Micromorphological research into the transition zone between the bottom of the channel and the underlying beach barrier shows that it was water-bearing prior to the first harbour phase, but it is uncertain

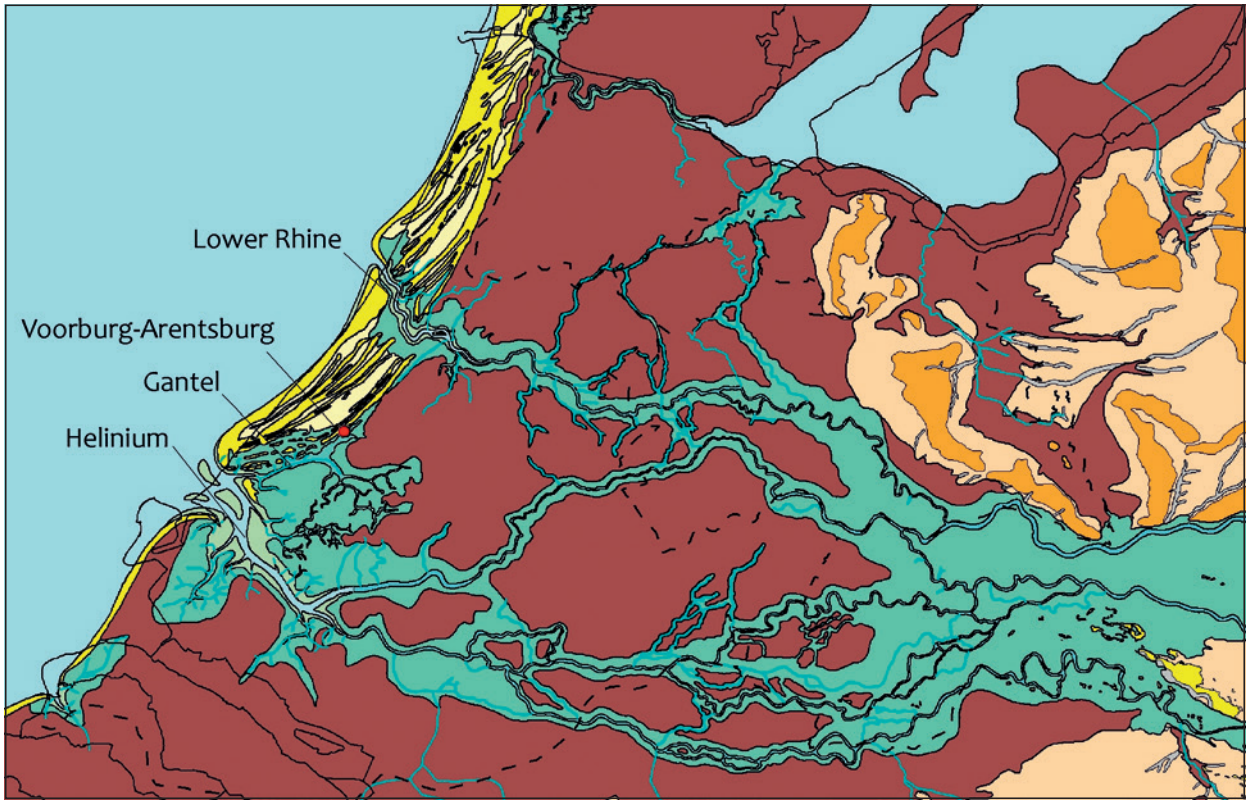

Fig. 6 Palaeogeographical map of the coastal river delta in The Netherlands (around 100 AD). – (After Vos/De Vries 2013).

whether it was used as a harbour[37]. Any remaining traces of possible earlier Roman uses preceding the phase in which the first quay structures were built and the first dredging operation took place will have largely disappeared as a result of this systematic dredging. Older pockets containing dumped material had been preserved underneath this first dredging. The material dates these pockets to the Roman period, but is older than the first harbour phase. The pottery spectrum from these older and related features consists predominantly of handmade pottery, the regionally produced Low Lands Ware and imports from the Rhineland and corresponds largely to that from rural settlements in the region[38]. That some interesting »Roman« activities took place here can be deduced from the top of a Cretan amphora[39] with intact wooden stopper. Such predominantly 1st-century amphorae are rare in the north-western part of the empire[40] and show that unusual imports reached the settlement in the 1st or early 2nd century.

Harbour construction and maintenance

The felling date of the posts for the oldest phase of the waterfront installations is dendrochronologically dated to around 160 AD[41]. The eastern quays in trench 2 consist of a double row of driven-in posts. The standing posts of all retrieved quays consist of pointed and straightened oak posts with a width and thickness of 0.3 m. For the construction of the quays, these originally about 4-m long posts were most probably hoisted up with a derrick and driven in with a piledriver. This process is observed at all waterfront structures in the Voorburg harbour. The posts from the first phase have a provenance from the southern part of the Netherlands as well as from southern Germany[42]. The imported timbers could relate to a local scarcity of required dimensions for this period. The Roman armies based in the Netherlands for more than one and a

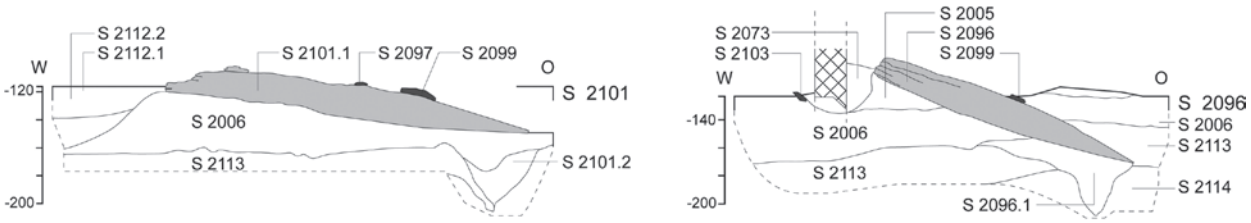

Fig. 7 Two collapsed posts of the 160-210 AD quay works of the harbour of Voorburg-Arentsburg. The posts had been pulled out of their piling holes after which they subsided. – (Drawing J. Kaarsemaker).

half centuries had a high impact on the natural resources of these areas[43]. The imported timbers have tree ring patterns indicating slower growth in closed canopies. This resulted in higher trunks, which could be processed into two posts as was observed through dendrochronological research. The local timbers were only processed into single posts and show the irregular tree ring patterns of the fast-growing and less straight trees grown under favourable conditions in more open landscapes[44].

Around 160 AD the first observed dredging operation deepened the channel to a level of minus 1.80 m to minus 2.10 m ASL[45], with most readings around 1.90 m below our main water level. The harbour was dredged in an efficient and expert way by an experienced team, as the deviation in dredging depth over the vast navigable part of the harbour is only around 20 cm over an area of hundreds of square metres. The micromorphological analysis – by which the archaeologically observed dredgings could be further analysed – shows that prior to the dredging the channel was largely laid dry. During the dredging operation washed-in layers of clay at the bottom of the channel were removed with some obliquely cut edges which can relate to the use of a shovel or hoe-like tools for this operation[46]. After this first dredging, the harbour gradually silted up with a layer of marine light sandy clay, whereby a micromorphologically observed stirring or mixing that took place in this layer is probably the result of shipping activities.

At the end of the 2nd or at the start of the 3rd century a second dredging operation is observed in trench 2 only. This part of the harbour is closer to the inflowing waterway(s), probably resulting in more currents, more shipping activities and possibly more discipline in keeping the harbour clean than in the northern part that gradually silted up in this period. It is quite possible that this second dredging was performed too thoroughly near the quay works in the southern part of the harbour. This dredging, probably in combination with tidal activities, could have undermined the foundation of these quays, which subsequently subsided. Almost all the posts were largely pulled out of their piling holes before they subsided in the direction of the harbour (**fig. 7**). The initial action that caused this collapse was a sudden lateral pull possibly caused by moored ships, followed by a more gradual further subsiding of these posts (**fig. 8**). The process of the gradual collapse of the quays may have taken a matter of years or even months. Because it is not logical that the second dredging was carried out in front of already collapsed waterfront structures, it is assumed that these were still standing when this took place at the end of the 2nd to early 3rd century.

The harbour was equipped with new or partially new quays around or shortly after 205 AD (**fig. 9**). The subsided eastern quay was completely replaced by new quays. The processes that led to the collapse of the initial quay probably provided insights which were applied in the next harbour phase. The new quay was extended further into the harbour, namely over 2 m more to the west than the oldest phase. Two other adjustments were made to prevent future subsidence. Posts with longer points were driven in considerably more deeply (on average to minus 3.27 m ASL vs minus 2.45 m ASL for the previous phase) and two extra rows of »supporting posts« were added alongside the row of quay posts for the new quays. The posts from this second phase were all made of timber from a single stand of long-lived oaks (*c.* 300 years) originating

Fig. 8 Collapsed post of the 160-210 AD quay works of the harbour of Voorburg-Arentsburg. – (Photo Amsterdam Archaeological Centre).

from central Germany and/or the Mosel area[47]. As with the southern German posts from the first phase, it is observed that some trunks were processed into two posts. The quays on the north and west sides of the harbour, which had not subsided, were partly provided with new quay posts most probably to replace poor or weaker specimens of the oldest phase. An interesting phenomenon was observed near the western quays. About 1.5 m east of the posts of these quays, a parallel row of empty postholes was found (**fig. 10**). The sections of these postholes show that the dimensions were similar to the wooden posts and most of them were pulled out in a perpendicular direction. We realized that these posts were not part of another quay phase when the levels of these postholes were compared with those of the quay posts. The bottom levels of the emptied postholes were between 1.0 and 1.5 m higher than those of the posts, and these did not penetrate the solid beach barrier as was the case with the posts. The idea is that these postholes were part of a preparatory work process, for which they are placed in a row parallel to the intended locations before they were hoisted up with a crane, placed in the desired positions and driven in with a piledriver. During the excavation, we made other observations of the antique work processes carried out in order to establish the quays. The shaping of the timbers to the required size and shape might have taken place on site: this can be deduced from the woodchips of mainly oak which were retrieved near the quay posts[48]. Long staging planks were found both at the western and the eastern quay posts. Because there are no joints or cross planks it is unclear – for the younger as well as the older quay structures – what the construction of the top of the quay structures with scaffolding and platforms and/or foot planks was like.

Around 205 AD a third dredging operation took place. This was carried out in the northern as well as in the southern part of the harbour. The second and third dredgings are only noticed because they took place at a higher level than the initial one. Possible other dredgings could of course have been executed, but remain imperceptible to us when performed at a deeper level than an initial dredging. The third dredging is located between minus 1.26 m and minus 1.56 m ASL, with most readings around minus 1.40 m ASL. Due to this, the harbour appears to become half a metre shallower than after the dredging operation performed approximately 50 years earlier. Evidently, this was not a problem for the desired navigable depth, else it would have been executed otherwise.

The first harbour establishment took place during the last years of Antoninus Pius. Under his reign many (provincial) building programmes – initiated by Hadrian – were further continued and completed. Judging by the

Fig. 9 Frontal view of the replaced quay works at the eastern side of the harbour of Voorburg-Arentsburg (210-230 AD) as retrieved in trench 2. – (Drawing J. Kaarsemaker; photos Amsterdam Archaeological Centre).

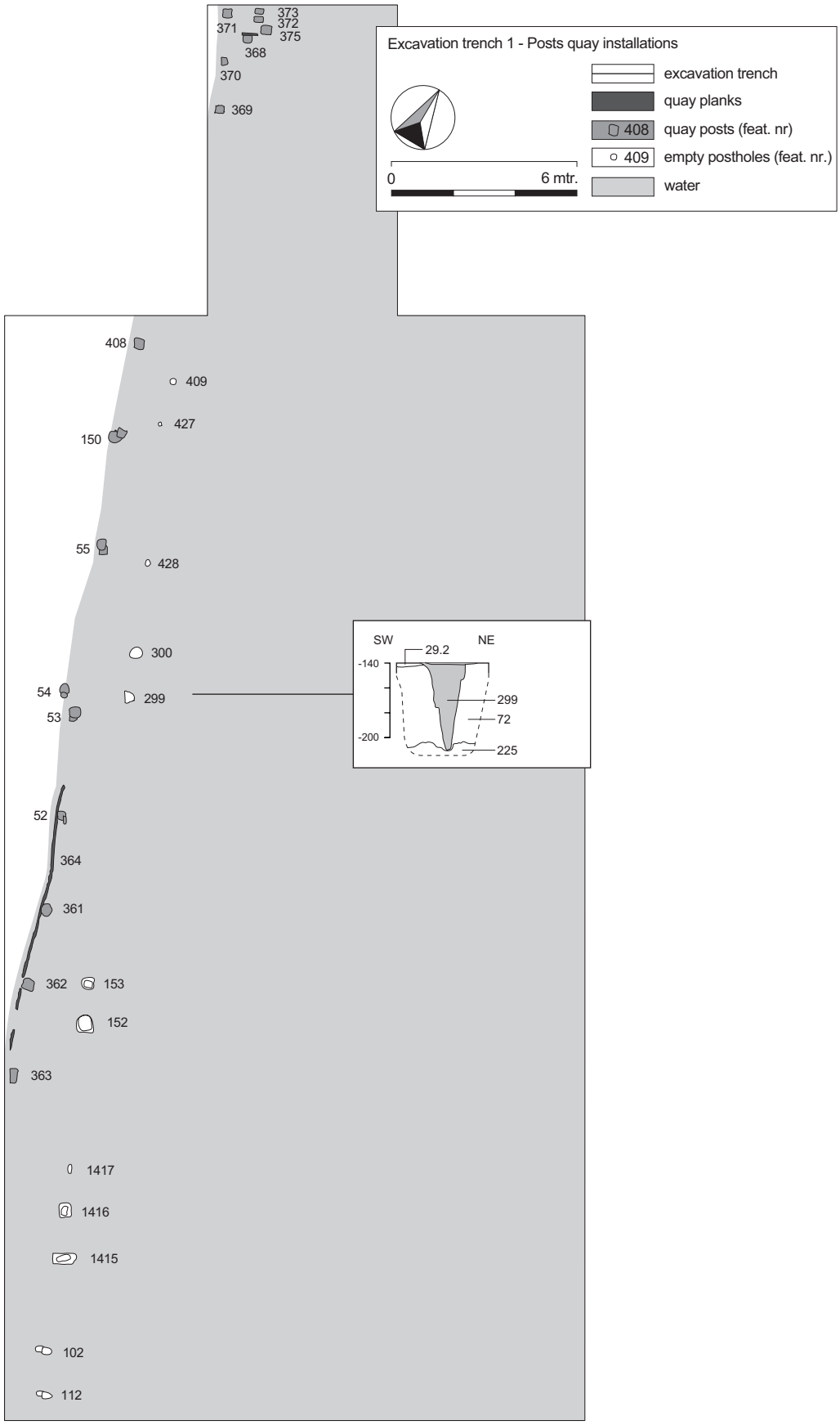

Fig. 10 Row of posts (left) and pulled out posts (right) in northern part of harbour basin. – (Drawing J. Kaarsemaker).

many milestones erected in his name, the infrastructure in the north-western part of the empire was a focus of attention under his regime[49]. The regional infrastructure was expanded by the layout of a road with these milestones and one, possibly two, harbour sites. A bronze dedication plate referring to the Germanic fleet found at Naaldwijk could be part of a yet unknown naval base at the south-western end of the road and the Corbulo canal and was possibly dedicated to Antoninus Pius[50]. During the reign of Antoninus Pius the frontier defences were reinforced and the militarization of the nearby coastline was initiated[51]. Dhaeze[52] writes that in particular the *classis Germanica* – and only to a lesser extent the army, the *exercitus Germanicus Inferior* – was involved in the logistic operations and the expansion of the regional infrastructure and coastal defence. The construction of the harbour at Voorburg – with systematic dredging and pile-driven, heavy quay posts from a broad region of provenance – leads one to suspect that the central authority was involved, whereby it seems logical that military troops with naval knowledge and experience – the *classis Germanica* – were employed.
About 50 years after the initial phase, new quay structures were built shortly after 205 AD for which the harbour was completely and efficiently dredged. This renovation could have been initiated as a preparation for the provisioning and backup of Severus' campaigns in northern Britain. More activities had been taking place in the region between the Rhine and Meuse and the coastal area of the Low Countries before Septimius Severus led his troops into battle in Caledonia[53]. A remarkable – probably Severian – inscription (CIL VI, 1643) states that the commander of the *classis Britannica* fleet was also commander of the *classis Germanica, Pannonica* and *Moesica*. Vivian Swan[54] interprets this as the result of an abnormal logistic situation in which troops, equipment and supplies had to be embarked for special campaigns such as those of Septimius Severus in northern Britain. All in all it seems very plausible that the German fleet was actively involved in activities employed in the region and especially around the harbour of Voorburg-Arentsburg. This can be underlined by the distribution of C(lassis) G(ermanica) P(ia) F(idelis) tile stamps in the region, and especially in Voorburg-Arentsburg[55]. These results might shed new light on the long-lasting debate concerning the role of Voorburg-Arentsburg as was started with Holwerda's hypothesis of a naval base in 1923.

Connectivity, discard and depositions

The archaeological data from the site provide interesting insights into the use and function of the Roman harbour of Voorburg-Arentsburg. The find assemblages give information concerning discard, depositions, and provenances of material culture and trade relations.
The vast majority of the retrieved Roman ceramics can be considered as »settlement refuse« discarded in the harbour basin. This pottery is characterized by significantly fragmented and worn sherds, often bearing traces of burning and/or soot[56]. The harbour not only functioned as a dump site, but also played a role in the provisioning of the town itself. A town that according to the integrated coin analysis was interpreted[57] as a judicial administrative central place only where »tax money did indeed come in, but the large-scale circulation of small coins, pre-eminently the lifeblood of a monetarized society, did not altogether get going«.
A second substantial ceramics component which can be distinguished from the »settlement refuse« concerns largely complete pottery that had not been exposed to fire or smouldering fire and whose limited traces of wear are the result of production and transport rather than functional use[58]. This component consists of regional and supraregional commodities, but also of a number of tops and necks of one- and two-handled jugs found with the original stopper still in place. It is assumed that a portion of this component was damaged during transport and dumped here in the harbour during unloading or transhipment, or accidentally fell into the water during transhipment. Other find categories than pottery also provided examples of this »trade component«, but these are not explicitly treated here[59].

Harbours do not function only in the provisioning of a local settlement; otherwise these waterfront structures would have been called loading platforms. Harbours are pivotal in regional and/or supraregional connectivity. A regional provisioning of the hinterland of the town of Voorburg-Arentsburg would be suspected, but the pottery assemblage from the active harbour phases (160-230 AD) does not correspond to those from local and regional rural settlements. The regional connectivity seems to have a more military character, which can be derived from a number of characteristics. First and most important are the great similarity to the pottery of regional military sites and its marked contrast to the pottery spectra from regional rural settlements[60]. Given the noticeably military character of the pottery and the relative scarcity of *militaria* in Voorburg-Arentsburg, the thesis is postulated that the harbour of Voorburg-Arentsburg played an important role in the trade directed and controlled by the military and/or the German fleet for the provisioning of the newly established military forts and structures in the regional coastal zone.

The North Sea coastal line of the Low Countries, which can be characterized by a continental shelf under tidal influence, produced (produces?) no natural sea harbour. One or more of such harbours for maritime-riverine transhipment would appear necessary in view of this coastal delta where three natural »trans-European« transport arteries come together. What would be the preferable location for such harbours in the Roman period? The Roman river barges, many examples of which have been excavated in the Netherlands, were most probably developed and adapted for the quietly meandering and anastomosing river systems with the unpredictable water levels of the north-western part of the empire[61]. Their very limited depth (up to *c.* 0.4 m) and long, flexible construction made them suitable for such circumstances, but useless on open water with wind or surface waves (like the North Sea and the mouth of the Helinium) where these long flatboats would twist and break[62]. Recent discoveries and analyses of these barges also make clear that they were not only used for one-way downstream transport, but were also employed for possible return upstream transport as well. These widely used river barges would require transhipment harbours located at an inland location. Such locations should also be reachable by coasters, such as the Blackfriars I type of ship. Because of their limited length, robust structure and limited draught (*c.* 1.0 m) such small seaworthy vessels were suitable for coasting and probably also for the southerly North Sea crossing. A larger seaworthy transport ship such as the Guernsey – with a draught of 1.5 m – may have been used for coasting as well as for the crossing.

The harbour of Voorburg-Arentsburg was dredged on at least three occasions, apparently to keep the navigable depth at its usual level or to improve it. After the first dredging the harbour basin was levelled to an average depth of minus 1.90 m ASL. But what about the water level? The relationship between the depth of the harbour basin and the water level determines the navigable depth. The water level of the harbour undoubtedly fluctuated depending on seasonal amplitudes and long-term changes. Unfortunately, the excavation did not reveal any direct evidence on the antique water levels. The stratigraphy from the higher levels of the harbour almost completely disappeared as a result of a later process of intensive biological turbulence, resulting in a more or less homogeneous »dark earth« horizon. The tops of the posts from the youngest quays were observed to minus 0.64 m ASL and the post ghosts of rotted posts to minus 0.42 m ASL, but parts of the oldest quays had subsided and were consequently preserved more completely. As a result of a reconstructive replacement of the quay posts, it appeared that these posts once reached to +0.60 m ASL. These data are very interesting, but do not provide any hard data regarding the antique water level(s). The sections of the excavation trenches show that it silted up in the Roman period after the last dredging of the harbour. At a few spots this process of silting could archaeologically be detected to around the present water level, but this level can also be the result of an event like a spring tide taking place in the post-harbour period[63]. We might expect proper navigable water depths; why else would people in the Roman period invest in the establishment and renovation of such elaborate quay structures and periodic and systematic dredging of

the harbour basin? Only to enable flat-bottomed river barges with a draught of around 0.4 m to moor? One of the main strengths of such boats is that they do not require harbour sites with regulated water depths for berthing. A navigable depth of between 0.5 and 1.5 m – depending on the tide and the water level – is all in all not implausible. The harbour of Roman London – the find-spot of the coaster Blackfriar I – had such a navigable depth as well[64]. Consequently, it may be assumed that similar coasters were able to manoeuvre and berth in the harbour of Voorburg-Arentsburg.

Although no more or less complete remains of ships or river barges were excavated in the harbour, several ship-related artefacts like fragments of oars, a pulley, a frame knee[65], three boat hooks, an iron ship fitting[66] and a possible part of a bilge pump[67] were, however, retrieved. As is the case with Velsen I (see above), this harbour bedding also revealed several lead strips with nail holes which relate to seafaring ships. These were applied on the hull of seafaring ships, but no such evidence was found on any of the river barges. The lead strips from Mediterranean harbours such as Myos Hormos and Caesarea Maritima not only correspond to those from Voorburg-Arentsburg in thickness, but also in the size of the holes and the impressions of the nail heads[68].

There is sufficient archaeological evidence for an active exchange of goods between the northern continental provinces like Germania inferior and Gallia Belgica and the overseas Britannia[69]. Judging by finds from the basins of the Rhine, Moselle and Meuse, this connectivity probably took place via one or more transhipment harbour(s) in the lower German coastal delta. The harbour of St Magnus House in London revealed the same kind of imported ceramics as was excavated in the harbour of Voorburg-Arentsburg. From the provenance of this pottery it may be inferred that substantial amounts of commodities reached Voorburg and London via transport over the Rhine and/or the Meuse rivers. Given its location between the Rhine and Meuse, Voorburg may have played a part in this trade. Remarkable similarities have been observed between the harbours of London and Voorburg-Arentsburg, not only regarding the provenance but also the specific deposition patterns of the pottery[70]. A link with Britain is further supported by the presence of specific kinds of Romano-British wares and brooches in the harbour fillings[71]. A Romano-British trumpet-head *fibula* and a Romano-British knee *fibula* (**fig. 11**), which are rare on the continent, were discovered with a complete and, moreover, closed pin. These brooches do not appear to have been specimens that were broken and discarded, nor had they sprung open and got lost. These brooches did not end up as part of the »trade component« or »settlement refuse« in the harbour channel, but are most probably part of an intentional deposition. Ritual and everyday matters were closely interwoven in the Roman period; whereby specific objects could be discarded as part of various socio-ritual role patterns, but could also, or likewise, be used as offerings. Certain rituals such as offerings and intentional depositions appear to be repetitive and formalized, because they took place according to certain rules. These characteristics may be important criteria for archaeologists in order to recognize special depositions. Water – in various forms and contexts – plays an important role in this and is often chosen as a location. Because of observed formalizations and repetitions of location and interpretation, depositions from wells are regularly used as examples of symbolic acts. The same applies to various forms of open water in or near, for instance, a settlement. In view of a number of remarkable finds, the Voorburg harbour channel appears to have functioned also as a special deposition site. It is not the intention to present a complete study of these special depositions from the Voorburg harbour in this paper. The brooches are just one example. The completeness, the fine state of preservation pointing to their excellent condition at the time of deposition, and the closing of the pins of some brooches may be indicative of such practices. It is, however, remarkable that the brooches denoting ethnicity, such as those with a British connection, are among these complete and excellently preserved brooches. The reason for their deposition here is not clear. Perhaps they were small personal offerings made on embarking or disembarking. A second example of such a special offering in the Voorburg harbour is a complete black

Fig. 11 Two complete Romano-British brooches with closed pin from the harbour basin: **a** Romano-British knee *fibula*. – **b** Romano-British trumpet head *fibula*. – (Photo Restaura). – Scale 2:1.

slip-glazed Niederbieber 33 beaker from Trier. The beaker had a small crack in the rim which had occurred during production (**fig. 12**). It is interesting mainly for its remarkable contents, consisting of 26 complete hazelnuts, one grain of six-row hulled barley, one grain of bread wheat, one grain of spelt wheat, one grain of undefined wheat, one grape seed, henbane, wild catnip and a seed of flax or linseed. These are mainly cultivated plants, and the hallucinogenic henbane was not part of the so-called environmental background as no other macrobotanical or palynological evidence of black henbane was retrieved from the harbour. The custom linked with this deposition is not clear, and no parallels for it are known to the author. Perhaps it was a medicine, a fertility offering for a good harvest or an offering for a safe voyage home by/for traders in food crops. This publication will hopefully lead to new analogies or interesting suggestions. These two examples are only shown here to illustrate that harbours do not only give insight into socio-economical functions and relations, but can also shed light on other aspects of life of the communities that lived and worked here in Roman days.

Hopefully, this paper and especially the archaeological research into Voorburg-Arentsburg's Roman harbour not only show that the geographical position and the logistic potential of the coastal delta in the Low Countries was already recognized and exploited in the Roman period, but also make clear that the Holocene waterscapes of the Low Countries are intriguing archaeological field laboratories. I believe the discoveries of such laboratories, of which the Roman harbour town of Voorburg-Arentsburg is merely one example, should be viewed as a clarion call on the one hand for more integrated archaeological research in the region, and on the other hand for the proper protection and appreciation of our Holocene waterscapes, which are subjected to an increasing and serious decline.

Fig. 12 Niederbieber 33 beaker with part of contents from the harbour basin. – (Photo A. Dekker).

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Notes

1) de Kort/Raczynski-Henk 2014.
2) Graafstal 2002. – van der Kamp 2009, 117-127.
3) Morel 1988. – Bosman 1997. – Driessen/van Driel in prep.
4) de Weerd 1988, 284-308. – Morel 2007, 53-67. – Bockius 2007, 94ff.
5) de Ridder 1999. – van Londen 2006.
6) See for instance the certain and presumed Roman military and urban settlements in our river areas in **fig. 1**.
7) Jones 2009, 48. – Rogers 2013, 143ff. and literature references in these.
8) McGrail 1997, 49-63.
9) Rogers 2013, 144.
10) Horden/Purcell 2000, 123.
11) Morris 2010, 1.
12) Rogers 2013, 144f.
13) Westerdahl 2006; 2011.
14) Salemink 2010 (Fragments of more than life-size bronze (emperor) statues were found in Naaldwijk, Voorburg-Arentsburg, Leiden-Roomburg, Arnhem-Meinerswijk and Nijmegen, and foundations or fragments of large statue pedestals from Valkenburg, Utrecht and Nijmegen. For the locations of these places see **fig. 1**). – Driessen 2014, 207.
15) Driessen 2007, 21f.
16) See e.g. Driessen 2007, 22.
17) Polak 2014.
18) Polak 2014, 76-85.
19) Polak 2014, 93f.

20) Morel 1988. – Bosman 1997. – Driessen/van Driel in prep.

21) Fitzgerald 1995, 182-195.

22) Meffert 1989, 24-29. – Fitzgerald 1995, 67-69. 184-195.

23) Driessen 2007, 93-99.

24) Driessen 2007, 99-108. 128-138.

25) Tacitus *Historiae* IV, 35. – van Rossum 1992.

26) Driessen 2007, 234 f.; 2009, 1253 ff. – See also Vitruvius X, 2, 11 f. for such rollers.

27) Driessen 2007, 67 f.

28) de Bruin et al. 2012.

29) de Bruin 2012, 150. – de Bruin et al. 2012, 138 f.

30) de Bruin et al. 2012, 139 f.

31) Buijtendorp 2010.

32) Holwerda 1923.

33) Bogaers 1972, 303.

34) Waasdorp 2003, 21. 39.

35) Kooistra 2014a, 45.

36) Kooistra 2014a, 46.

37) Kooistra 2014b, 27-30.

38) van Kerckhove 2014, 469.

39) Dressel 43 / Crétoise 4.

40) van den Berg 2012, 218 ff.

41) Driessen 2014, tab. 6.2. – Domínguez-Delmas et al. 2014.

42) Domínguez-Delmas et al. 2014.

43) Kooistra et al. 2013.

44) Domínguez-Delmas et al. 2014.

45) Measures were taken in NAP, which is the Dutch abbreviation for Amsterdam Ordnance Datum.

46) Kooistra 2014b, 28 f.

47) Domínguez-Delmas et al. 2014.

48) Lange 2014, 841 ff.

49) Waasdorp 2003, 23 f.

50) Derks 2008, 156 f.

51) Waasdorp 2003, 55; 2012, 125 ff. – Waasdorp/van Zoolingen 2015, 407 ff.

52) Dhaeze 2011, 164-169.

53) CIL XIII, 8825 and 8828. – Polak/Kloosterman/Niemeijer 2004, 210 ff. – Besuijen 2008, 43. – Dhaeze 2011, 183.

54) Swan 2009, 88.

55) de Bruin 2012, 152.

56) van Kerckhove 2014, 466 f.

57) Kemmers 2014, 608.

58) van Kerckhove 2014, 467-472.

59) See the different chapters in Driessen/Besselsen 2014.

60) van Kerckhove 2014, 469-472. The pottery spectrum shows also great resemblages to that from the castella of the *Obergermanisch-Raetischer Limes*; the *post cocturam* graffiti found on pottery utensils and *amphorae* are predominantly retrieved at military sites; these graffiti on the – secondarily used – *amphorae* are according to van der Werff (1989) part of administrative grain rationing of army units; and the high percentage of jugs and drinking vessels point, in Vivian Swan's view (2004) to »Roman drinking customs« stemming from the army.

61) Morel 2007, 57-67.

62) Moeyes 2007.

63) Unfortunately, this interaction became only clear after the excavation so no samples for micromorphological analyses were taken.

64) Marsden 1994, 90.

65) Lange 2014, 852-857.

66) Hoss 2014, 635 ff.

67) Driessen 2014, 173 f.

68) Stolk 2014, 692.

69) See among others Morris 2010, mainly chapters 4 and 5.

70) van Kerckhove 2014, 467. 471.

71) As are Black Burnished Ware I, painted ware from the Nene Valley, rough-textured pottery with possibly Southern British patterns of decoration and British handmade pottery.

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Summary

The site of Roman Voorburg-Arentsburg – situated along the Corbulo canal between the Rhine and Meuse rivers – was initially interpreted as a fleet station of the *classis Germanica* by Holwerda in 1923. Later on it was reinterpreted as the Roman town Forum Hadriani, which served as the capital for the *civitas* of the Cananefati. The hand of the central Roman authority can be felt all around the coastal delta area of the Low Countries. This varies from infrastructural adjustments, building and keeping up the frontier line with all kind of military installations, to the construction of new planned towns.

The location of the recently discovered harbour of Voorburg-Arentsburg – near the North Sea coast which lacked natural harbours – the retrieved structures, the adaptations of the harbour channel and the nature and provenances of the retrieved materials fuelled the idea that this harbour was not only laid out to supply this central place of the *civitas* Cananefatium. The harbour was pivotal in the provisioning of the military in the coastal zone of the West Netherlands, but was also constructed for supraregional aims.

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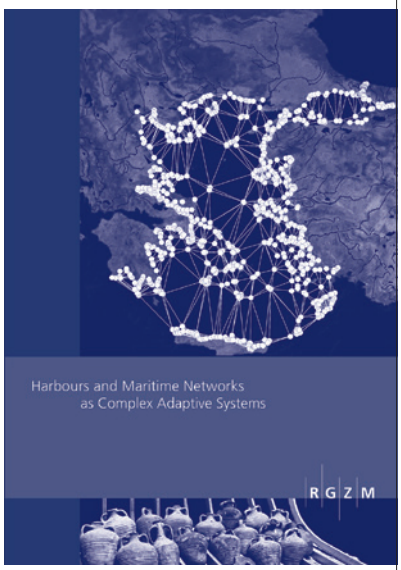

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