jungsteinSITE Journal of Neolithic Archaeology

19 December 2018
doi 10.12766/jna.2018S.7

Heiloo-Craenenbroeck. A Late Neolithic/ Early Bronze Age settlement on the western coast of the Netherlands

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Article history:
Received 15 December 2017
Reviewed 18 May 2018
Published 19 December 2018

Keywords: Heiloo-Craenenbroeck; province of Noord-Holland; the Netherlands; Late Neolithic; Early Bronze Age; house-plan; ard-marks

Cite as: *Jan de Koning, Erik Drenth: Heiloo-Craenenbroeck. A Late Neolithic/ Early Bronze Age settlement on the western coast of the Netherlands JNA 20, 2018S, 123–142 [doi 10.12766/jna.2018S.7]*

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Acknowledgements
The authors are very grateful to Dr P. C. Vos for providing the palaeogeographical map of the Heiloo district around 2000 BC. Thanks are also due to Mr N. Tuinman and Mr K. Zwaan for their help with Fig. 4 and Fig. 12 respectively.

Abstract

This paper discusses a site in the western coastal district of the Dutch province of Noord-Holland. There, one or two house-plans that were partially two- and partially three-aisled as well as ard-marks were discovered at the transition between a dune and a dune valley which was formed behind a coastal barrier. Stratigraphic evidence indicates that the habitation preceded the agricultural activities. All together, this human presence dates somewhere between c. 2000–1850 BC, the final stage of the Bell Beaker Culture and the onset of the Barbed Wire Beaker Culture in the Netherlands.

Introduction

House-plans dating to the final stage of the Neolithic and the onset of the Bronze Age are still a rare phenomenon in the Netherlands, as shown by a recent overview (Drenth et al. 2014). The discovery of a settlement with one or two dwelling structures at Heiloo-Craenenbroeck (typonym: Kennemerstraatweg 225–229) in the province of Noord-Holland in November 2013 was therefore a welcome surprise (Fig. 1). The site was excavated by *Hollandia archeologen,* an archaeological company housed in Zaandijk.

Although the excavation results have been published by the first author in a site report and the annual archaeological chronicle of the province (De Koning 2014; 2016), it is worthwhile discussing the site here once more. This discussion offers not only the possibility of re-assessing some of the previously postulated ideas, but also the opportunity to bring forward new issues and to present this settlement to an international audience.

Excavation method

The excavation started with three small trenches. In these trenches, an arable layer with ard-marks, some flint artefacts, and settlement features such as postholes, was uncovered. This arable layer was covered by stratified layers of peat, up to 0.8 m thick. This sequence motivated the investigation of a larger area resulting in the excavation of one or two complete house-plans and their surroundings, below the arable layer (Fig. 2). Some larger vertical cross-sections were documented, as they provide the major stratigraphic information. In three stages, a total surface of well over 800 m^2 was uncovered. A distinct cluster of postholes and other settlement features came to light in a large square measuring 25 x 25 m (Figs. 3 and 4).

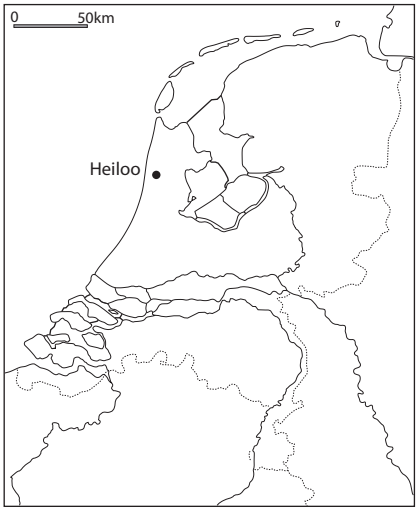


Fig. 1. Location of Heiloo within the Netherlands.

Fig. 2. An unexpected glimpse of a hidden cultural landscape with ard-marks and some postholes covered by peat.

Fig. 3. Extension of the excavation exposing most of the postholes concentrated in a rectangular zone. The features are marked by yellow pins. Photograph facing west.

To do justice to the archaeological and geological stratigraphy, the area in question was excavated in four levels. The first two were dug mechanically by a hydraulic excavator until the top of a peat layer, between 0.4 – 0.6 m below NAP (Dutch Ordnance Datum). The third plane, around 1 m below NAP on average, coincided with the transition from this peat layer to a sandy stratum in which the ard-marks and settlement features came to light. For this final plane a hydraulic

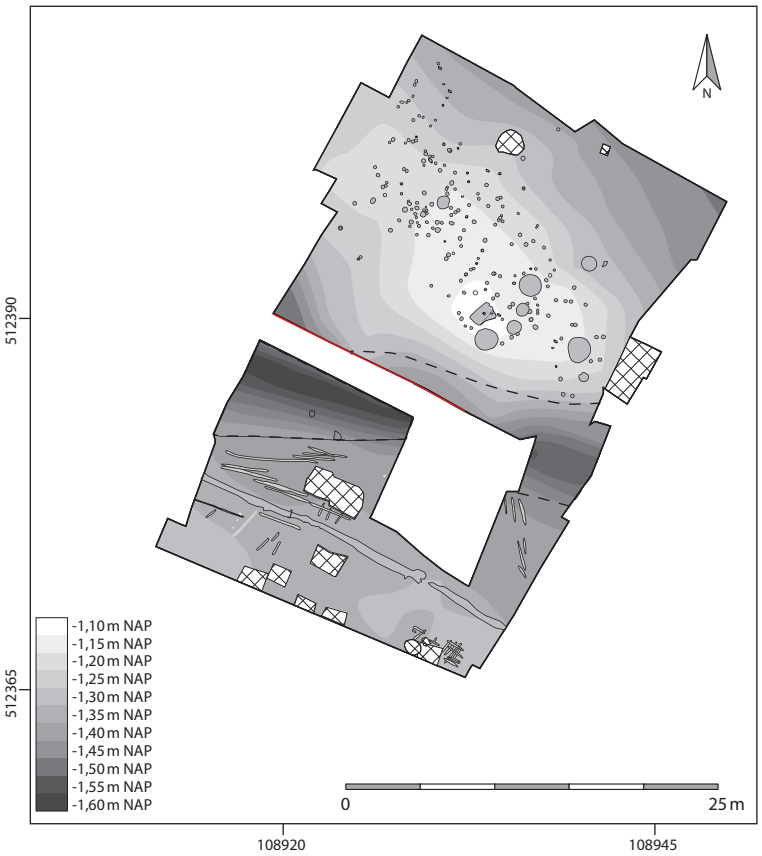


Fig. 4. The features discovered at Heiloo-Craenenbroeck projected on a reconstructed topographic map of the landscape before it was covered by peat. The dotted line symbolizes the boundary of the ard-mark distribution, the cross-hatching disturbances. NAP = Dutch Ordnance Level. Map made by N.Tuinman (*Hollandia archeologen*).

excavator was used at first, followed by shovelling by hand. Eventually this fourth excavation level was just underneath the 0.1 – 0.2 m thick arable layer. During the manual shovelling, a carefully executed procedure in which the subsoil was 'peeled off', most of the artefacts were found. Their limited distribution was interpreted as an indication of one or more dwelling structures. Subsequently, these buildings were uncovered in the same location. Apart from being a useful method of find retrieval and having predictive power, the removal of the arable layer by hand revealed the relief of the prehistoric landscape before it was covered by peat. A dome-shaped sandy elevation was thus exposed. As shown by Fig. 4, the settlement features were confined to a small ridge standing only a few decimetres above the surrounding area. Alongside this ridge was a low-lying (residual?) gully or depression that was partially filled with clay.

After this stage, the rest of the surrounding area was largely excavated, mainly stretching south from the afore-mentioned ridge and gully or depression. Except for ard-marks and a small ditch running parallel to the ridge no further features were discovered.

Eight vertical sections were recorded (Fig. 5). Eleven samples were taken for AMS ^{14}C-dating, OSL dating and palynological analysis. The artefacts and ecofacts that were encountered during the field work (see below, 'Chronology and cultural affiliation') were all recovered by hand, as time and financial limits precluded the possibility of sieving as a method of find retrieval. Most finds could be ascribed to layers or features such as postholes. The three-dimensional location of every find was measured digitally.

Fig. 5. Locations of the vertical sections (red lines) and samples taken for pollen analysis and/or radiocarbon dating (AMS). Numbers refer to Fig. 15 radiocarbon dates and Fig.17 pollen diagram.

Features and structures

Ard-marks

The first features to be briefly discussed are ard-marks (Figs. 6–8). It appears that ard-marks covered the entire horizontal expanse of excavation besides an east-west oriented zone in the centre (Fig. 4). This zone was likely a residual gully. Whether it was a natural border at the time of the arable farming or a post-depositional disturbance cutting previous arable fields is difficult to determine. However, because the ard marks appear to run partially parallel to the residual gully, the former is assumed. From stratigraphic observations it can be inferred that the ard-marks postdate the traces of settlement (see below, 'Chronology and cultural affiliation'). This sequence makes sense from an agricultural perspective.

Fig. 6. Ard-marks on top of the settlement.

Fig. 7. Ard-marks underneath the peat layers as seen in the vertical section.

Fig. 8. Typical vertical section with ard-marks showing their characteristic shape in cross section when superimposed by peat. In front, the horizontal plane with the ard-marks.

House-plan(s) and other settlement features

As will be discussed in the next section, the stratigraphy indicates that the settlement features predate the arable layer. The posthole distribution is such that the first author (De Koning 2014; 2016) has suggested two house-plans; these are depicted in Figures 9 and 10. The first is reconstructed as a NW-SE oriented subrectangle with a

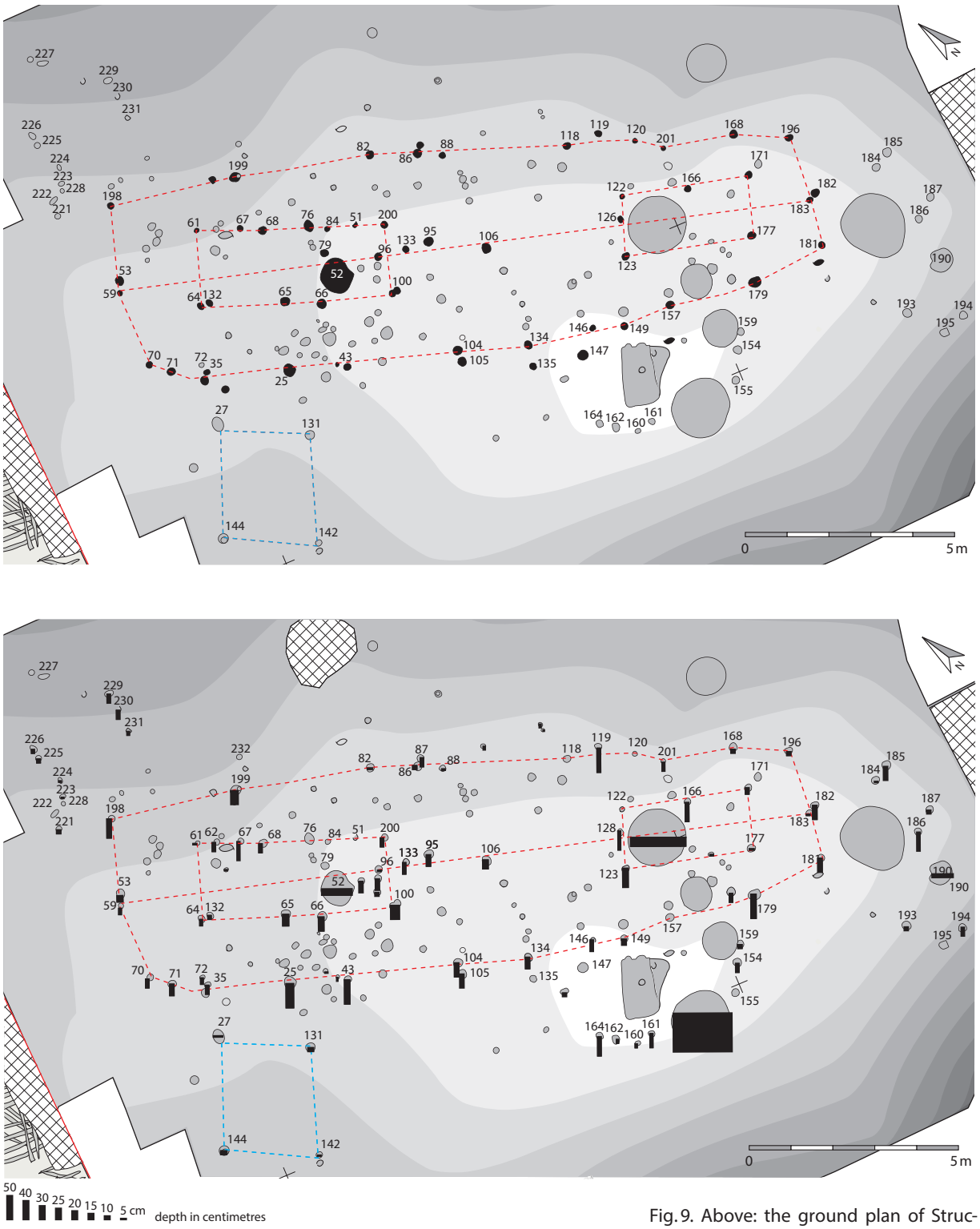
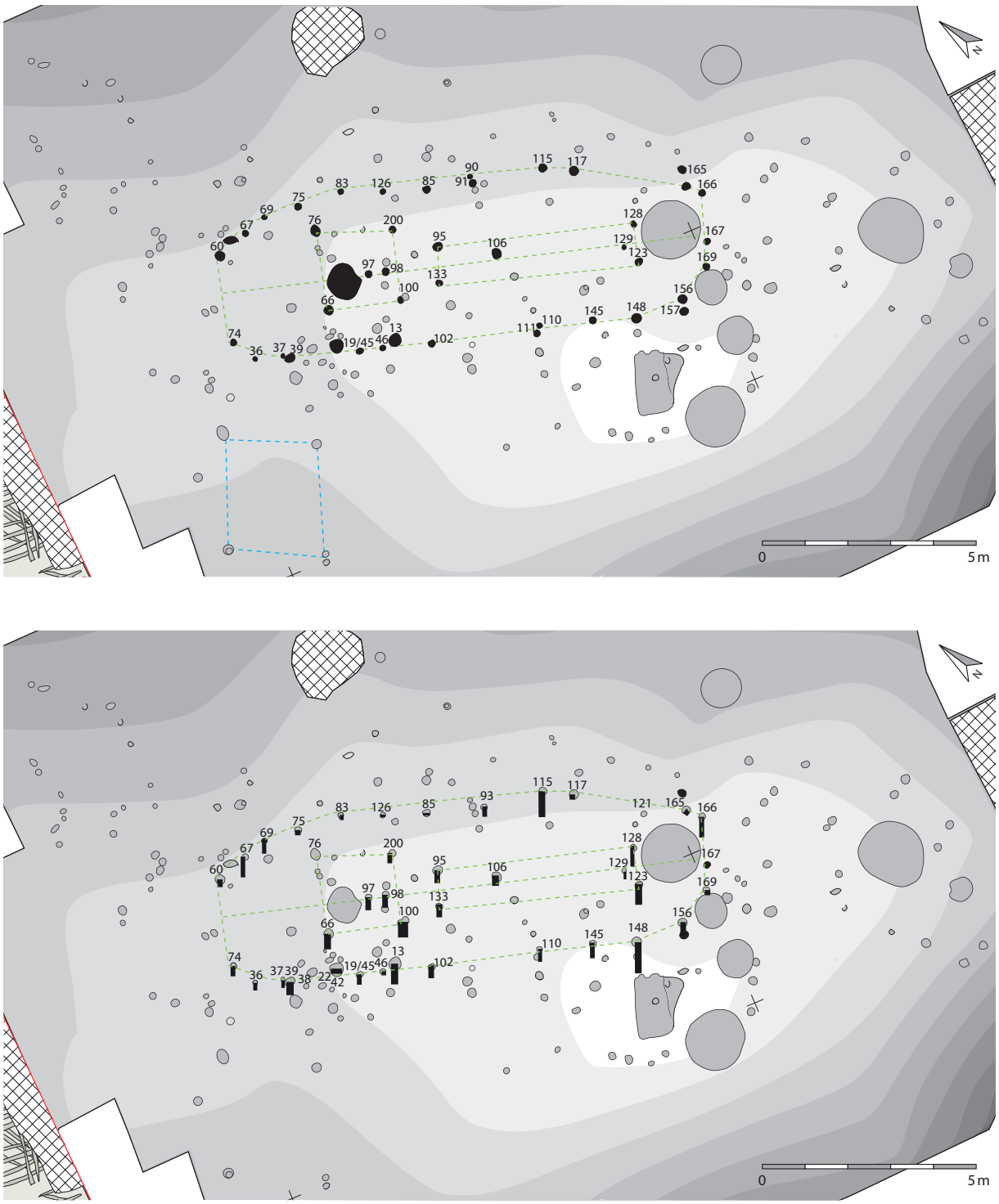


Fig. 9. Above: the ground plan of Structure 1, indicated by the red dotted line, as reconstructed by De Koning (2016). Below: the (remaining) depth of the features attributed to the structure under consideration.

length of 16.6 m and a width of 2.6–4.9 m. Its partially two-aisled and partially three-aisled lay-out is noteworthy. The walls have been reconstructed as slightly curved and the posts were rather irregularly interspaced. A hearth (Feature 52) has been interpreted as a fireplace inside the building. According to the reconstruction, the hearth was situated in the northern half of the house more or less on its longitudinal axis. The postholes outlining this configuration vary in depth from 0.1 m up to and including 0.4 m. Originally these features much have been c. 0.2–0.3 m deeper. In other words, the height of the base of the peat suggests that the former surface was some decimetres



higher. It should be noted that the elevated ridge where the house(s) once stood may have been flattened out somewhat due to prehistoric, post-settlement activities.

The hypothesized second dwelling structure lies entirely inside the just described reconstruction. Accordingly, it is smaller, measuring c. 11.5 x 3.75 m. Its orientation, however, is more or less the same. The general lay-out, including the rectangular inner constructions, is also very similar. The postholes attributed to these inner constructions are deeper than the ones constituting the walls, suggesting that the weight of the roof was mainly resting on the interior building framework.

A reassessment of the posthole distribution raises the question if these configurations might not represent one instead of two buildings

Fig. 10. Above: the ground plan of Structure 2, indicated by the green dotted line, as reconstructed by De Koning (2016). Below: the (remaining) depth of the features attributed to the structure under consideration.

with 'Structure 2' being part of the interior of 'Structure 1'. This interpretation emerges because there are absolutely no intersections of the features attributed to the two configurations. If the postholes represent a single structure, its walls must be reconstructed differently (Fig. 11). Instead of a line of single posts, there was a row of paired ones. Although the spacing between these pairs is fairly wide, a similar spacing was uncovered in a dwelling structure of the Late Neolithic Single Grave Culture (c. 2800–2400 BC) that was part of a posthole swarm excavated at Opmeer-Mienakker, province of Noord-Holland, Netherlands (Nobles 2016, 144 and Fig. 4.9). However, it must also be recognized that this posthole swarm could be reconstructed differently. Therefore, this comparative case cannot be used to make a decisive argument in the case of Heiloo-Craenenbroeck. Consequently, it cannot be decided whether one or two houses one stood at this location.

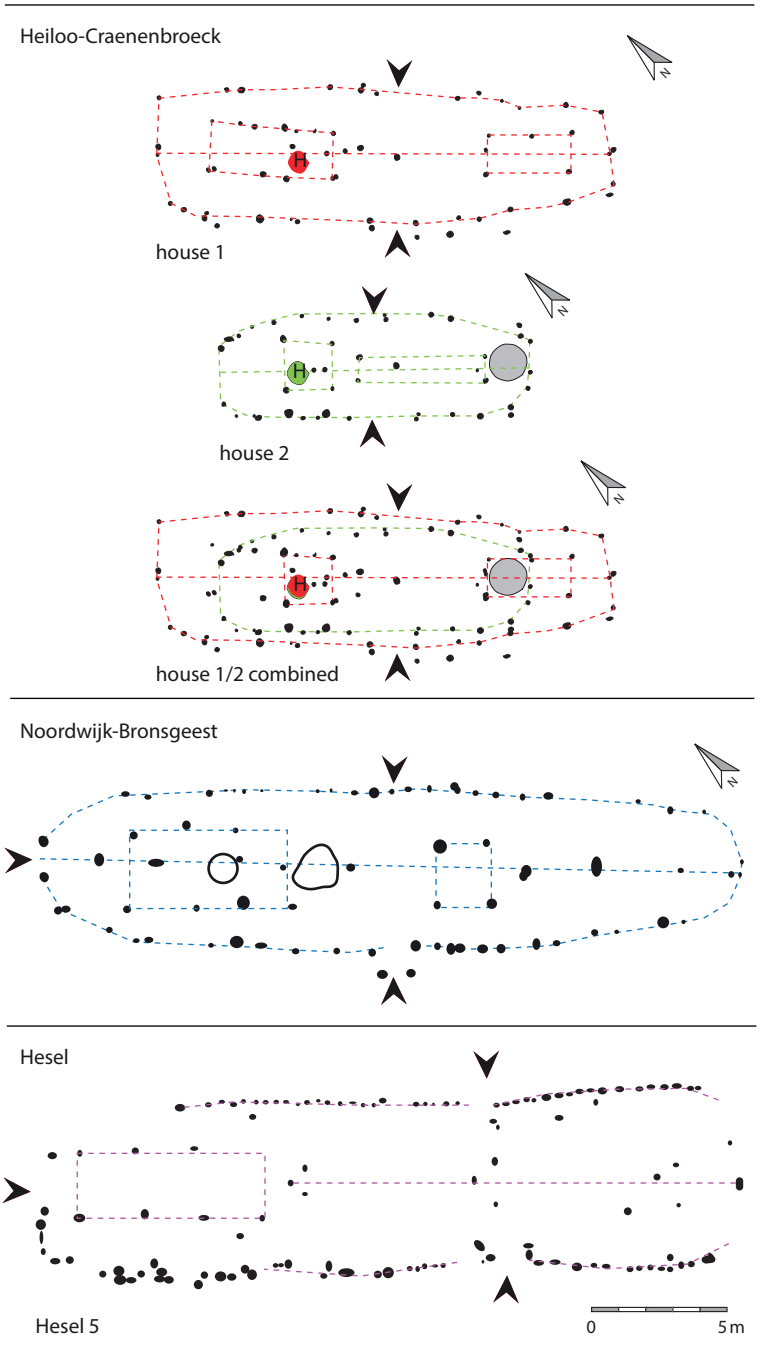


Fig. 11. The hypothesized House-plans 1 and 2 from Heiloo-Craenenbroeck and a combination of both. For comparison, structures from Noordwijk-Bronsgeest (Van der Velde 2008) and Hesel (house-plan 5; Waterbolk 2009). Possible entrances are marked with an arrow. H stand for hearth. The scale bar refers to all house-plans.

As far as the other postholes are concerned, only one structure may be derived from them with a reasonable degree of certainty; a 'four-poster', presumably the remains of a granary (Figs. 9 and 10).

Eight pits, including the already mentioned hearth inside 'Structure 1,' were uncovered; all were circular in plan view with one rectangular exception. Apart from the hearth, these pits are thought to have been dug for the collection of groundwater. Their shallowness indicates that this freshwater source must have been located close to, that is around 0.15–0.4 m below, the former surface. There is a good chance that at least some of those waterholes, if not all, were dug after habitation of the site had ceased. Two of these features were lying inside, or in one case even intersecting, the house-plan(s) (Figs. 9 and 10), which is difficult to reconcile with the idea of simultaneity. What is more, the ^{14}C date recovered from a six-year-old branch from an ash tree from the largest pit (Feature 153) indicates that this feature may have been constructed around the same time as the oldest peat layer (see the section about chronology and cultural affiliation). This pit may thus postdate the dwelling. Given the arable phase between the occupation of the settlement and the peat growth, these pits should however not be interpreted as evidence that rising water caused the abandonment of the settlement.

Neither are there indications that the settlement was given up because the dwelling structure(s) burned down (see in this connection Rasmussen 2007). There is also no evidence that the abandonment of the settlement was accompanied by the dismantling of the wooden constructions.

Finds

The total number of finds is extremely small. The inorganic component is confined to three tiny crumbs of pottery (too small to attribute to a specific period, let alone an archaeological culture), eleven flint artefacts (two flakes, a blade, a flake core(?), a block, three scrapers, a roughout of a scraper(?), a retouched core and a splintered piece), a quartzite core and a piece (block) of granite (Fig. 12; Drenth in De Koning 2016). About a dozen animal bones represent two or three species: cattle, sheep and/or goat. Although Heiloo-Craenenbroeck was a small-scale excavation, the distribution of finds was distinct (Fig. 13). The arte- and ecofacts are mainly confined to the small settlement area on the elevated ridge. It is unlikely that the retrieval method alone accounts for the scarcity of material remains because a considerable portion of the excavation consisted, as mentioned before, of the painstaking shovelling by hand necessary to expose ard-marks. If originally present in substantial numbers, this way of working would certainly have brought far more objects to light that those that were recovered.

The dearth of material culture may attest to a systemic and rigorous cleaning of the site by its Late Neolithic/Early Bronze Age inhabitants. Where this refuse was subsequently dumped remains to be seen. The possibility also remains that the paucity of pottery can be accounted for by the re-use of the settlement as farmland. In that case, the ploughing of the field would have contributed to the almost complete destruction of sherds. The few miniscule pottery fragments and flint artefacts that survived did so because they ended up at the bottom of postholes (Fig. 14).

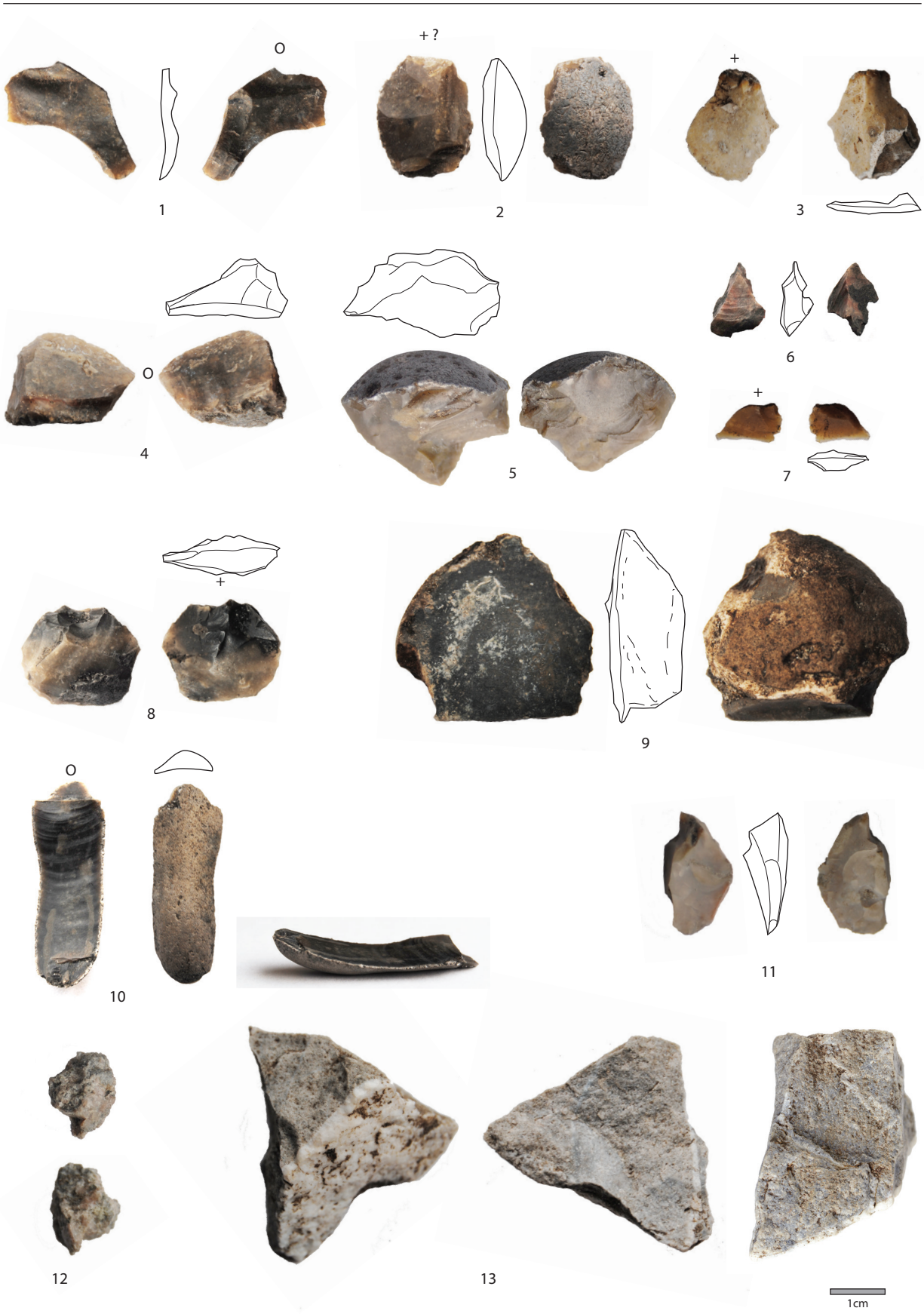


Fig. 12. Overview of the lithic finds (nos. 1–11 of flint and nos. 12–13 of non-flint stone). 1 and 7: flakes; 10: a blade; 2: a splintered piece; 3, 4 and 8: scrapers; 9: a roughout of a scraper? (on a frost-split piece of flint); 5: a retouched core; 11: a (fragmented) flake core(?); 6: a block; 12: a piece (block) of granite; 13: a quartzitic core (initial debitage); + = position of the bulb of percussion, the bulb still present; O = position of the bulb of percussion, the bulb no longer present.

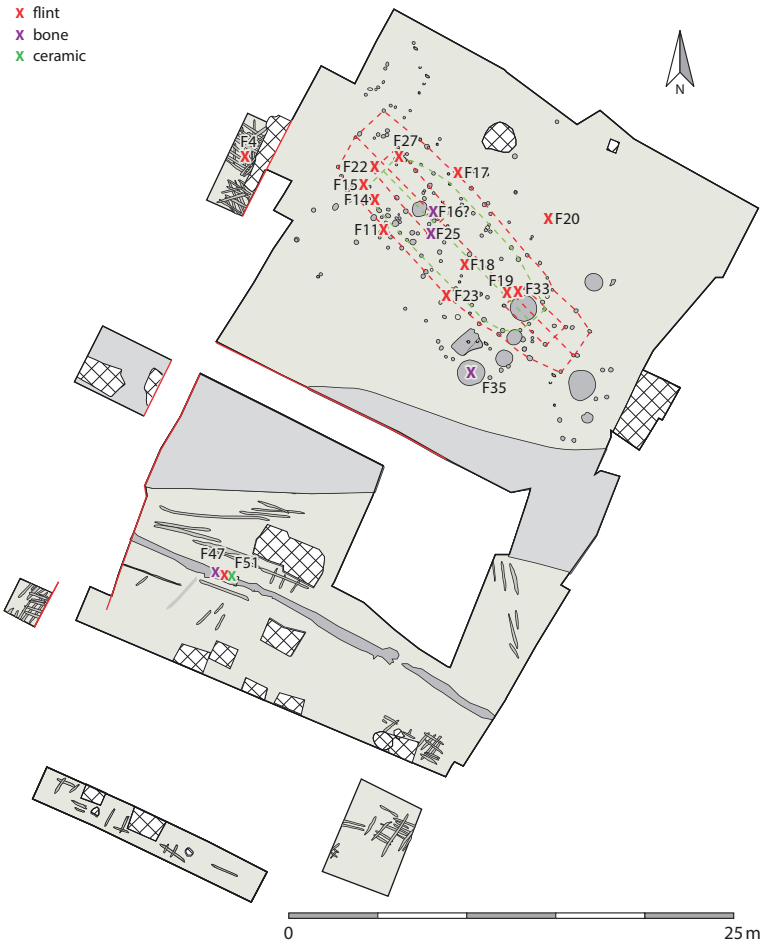


Fig. 13. The horizontal distribution of flint (including non-flint stone), bone, and pottery.

Fig. 14. A flint artefact (splintered piece) from a posthole (Feature 18).

Chronology and cultural affiliation

The lack of typologically datable finds meant that the chronological unravelling of the site completely depended upon radiocarbon dates and stratigraphic observations. The stratified peat layers, which reached a thickness of up to 80 cm and covered the settlement features and the arable land with its ard-marks, were undeniably the youngest stratigraphic units.

It was almost impossible to determine the exact stratigraphic relation between the ard-marks and the postholes. However, some

postholes and a feature that is interpreted as a hearth had a very dark fill rich in humus and charcoal. As noted by one of the excavators, Mr K. Salomons, some ard-marks had 'taken' some of this dark fill. Consequently, there is strong evidence that the ard-marks must postdate the postholes and the hearth.

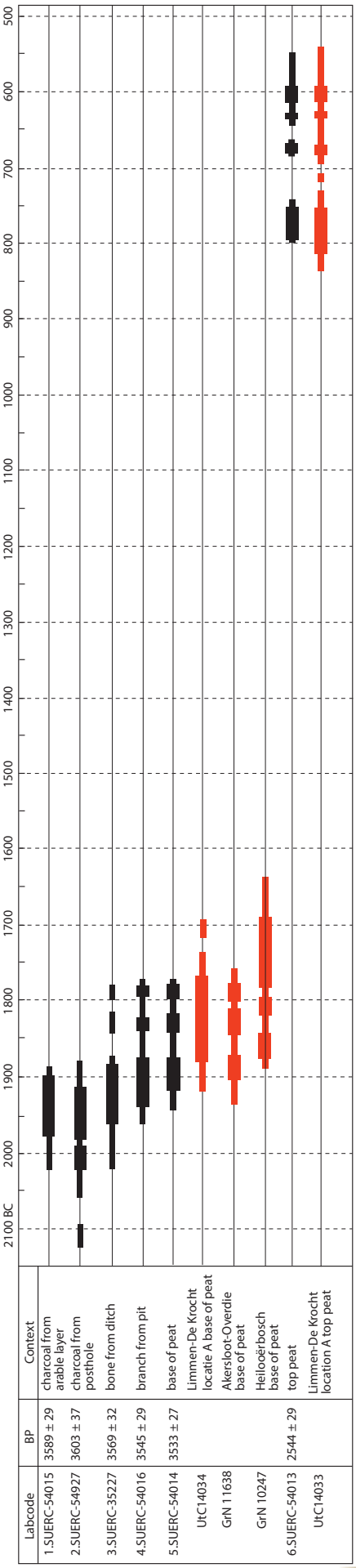
^{14}C samples were taken strategically throughout the excavation; due to the lack of other datable material, in most cases charcoal was collected. Two charcoal samples interpreted as the remains from (scattered) hearths, and thus as habitation traces, were dated. One of them comes from the arable layer covering the house-plans, the other from a posthole (Figs. 5 and 15: no. 1). Additional ^{14}C dates were obtained from a piece of cattle bone stemming from the (residual) gully and from a branch of ash wood found in a water-hole (Feature 153). Lastly, the base of the peat overlying the archaeological features and layers was ^{14}C-dated. Fig. 18 presents the results and the 2-σ calibrations. The first three ^{14}C dates in this figure refer to the human presence at the site. They hint at an occupation somewhere during the 20th century BC. The base of the peat appears to be only slightly younger. The ^{14}C date for this layer probably shows that stagnation of groundwater already started around 1850 BC. Contrary to expectation, since the waterhole with the ^{14}C dated ash wood branch was supposed to be one of the habitation traces, the final radiocarbon date lies practically within the same time span as the formation of the peat.

In conclusion, the ^{14}C results indicate that the Heiloo-Craenenbroeck site dates somewhere between c. 2000–1850 BC. After having been a place for dwelling, this location was used as an arable field. These activities were likely related to the final stage of the Late Neolithic Bell Beaker Culture and perhaps also to the onset of the Earl Bronze Age Barbed Wire Culture, which are datable in the Netherlands to c. 2400–1900 BC and c. 1900–1575 BC respectively (see in this connection Lanting/Van der Plicht 2000, 2002).

Landscape

The landscape setting (Fig. 16)

The Heiloo-Craenenbroeck site is located in the coastal area of the western Netherlands, close to the North Sea in a district that was mainly dominated by the Oer-IJ and the adjacent estuary during the Neolithic and Bronze Age. The Oer-IJ, a northern branch of the Rhine, was one of the few interruptions in the western coastline in prehistory. It was essentially a series of coastal barriers and adjacent dunes. Fresh water from the river Rhine flowed through the Oer-IJ toward the North Sea during low tide, while seawater did the opposite during high tide, creating an estuary. The landscape was thus multifaceted, consisting of an estuary with streams connecting settlement areas situated on the higher dunes. During the Late Neolithic, the Dutch coast was still expanding towards the west. Heiloo-Craenenbroeck is located on the eastern part of the second coastal barrier and dune area, a part of the landscape which developed around 4500 years ago. An older dune and coastal barrier closing off a huge peat area to the east were already in existence at this time. Part of a third coastal barrier had also formed by c. 2000 BC as part of the northern ridge of



Labcode	BP	Context
1.SUERC-54015	3589 ± 29	charcoal from arable layer
2.SUERC-54927	3603 ± 37	charcoal from posthole
3.SUERC-35227	3569 ± 32	bone from ditch
4.SUERC-54016	3545 ± 29	branch from pit
5.SUERC-54014	3533 ± 27	base of peat
UtC14034		Limmen-De Krocht locatie A base of peat
GrN 11638		Akersloot-Overdie base of peat
GrN 10247		Heilooërbosch base of peat
6.SUERC-54013	2544 ± 29	top peat
UtC14033		Limmen-De Krocht location A top peat

Fig. 15. Radiocarbon dates from Heiloo Craenenbroeck) and other relevant sites. The samples were calibrated with OxCal 4.2.

the Oer-IJ river; when Heiloo-Craenenbroeck was occupied it would have been slowly expanding towards the west in the direction of the present coastline (Fig. 16A). The site of Heiloo-Craenenbroeck was located in the middle of a valley – here dubbed 'Craenenbroeck Valley' – which was sandwiched between an old coastline to the east (the oldest coastal barrier from Uitgeest to Akersloot and St Pancras) and the 'new' coastline (Limmen-Heiloo-Alkmaar) to the west. This sandy valley provided agricultural and settlement opportunities and was part of the Oer-IJ estuary. The settlers of the Heiloo-Craenenbroeck site are regarded as pioneers or first settlers of this valley since, so far, no older settlements or farmland have been discovered in this particular area. At the time, i.e. at the ultimate end of the Late Neolithic and the very beginning of the Early Bronze Age, the natural drainage system was still working. Water from the Craenenbroeck Valley could run freely southwards to the Oer-IJ, keeping the settlement and arable fields dry. This same water movement, however, gradually created the coastal barrier that eventually closed off the valley, causing serious drainage problems and resulting in the formation of peat (Fig. 16B). ^{14}C-dating indicates that this process started significantly earlier at the Heiloo-Craenenbroeck site than at several locations in its surroundings such as Heiloöerbos, Akersloot-Overdie and Limmen-De Krocht (see Fig. 14 for locations). Between 800–600 BC, peat growth came to an end due to erosion of the ridge that had been preventing water movement out of the valley (Fig. 16C). When the drainage of the valley resumed, it caused the oxidation of the peat, the desiccation of the dune tops, and consequently aeolian erosion which led to the spread of sand over the valley (Fig. 16D).

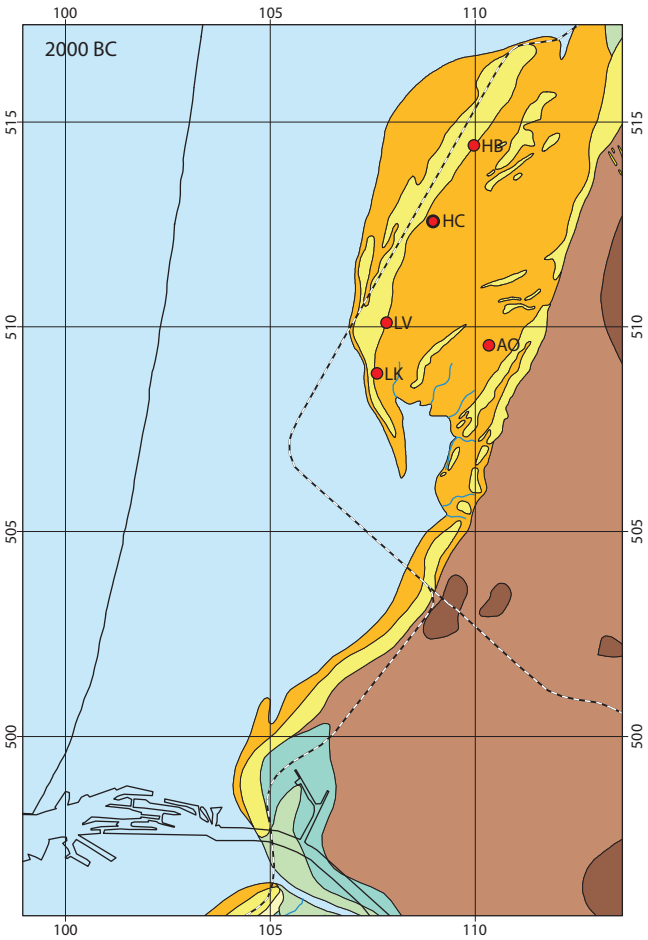
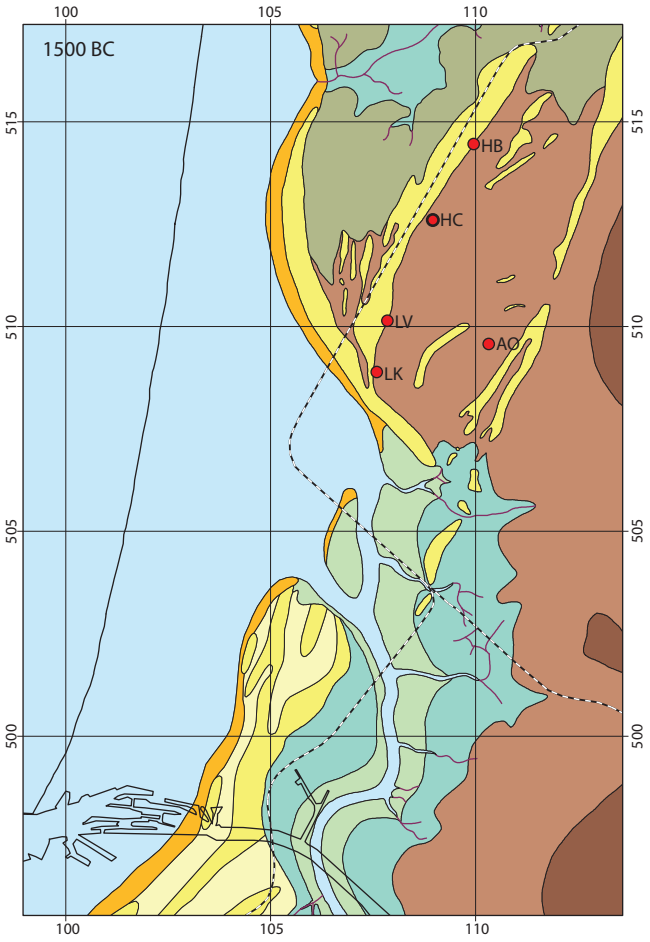


Fig. 16A. Palaeogeographical reconstructions of the Oer-IJ area. Legend: blue = North Sea, tidal channels, lagoons; orange = beaches and wash overs; light green = mud and sand flats; light blue-green = salt marsh plains; bluegreen = salt marsh ridges and levees; light yellow = lower dune areas; yellow = higher dune areas; other greens = former tidal landscape. HC = Heiloo- Craenenbroeck; HB = Heiloo-Heilooërbos; LV = Limmen-Visweg; AO = Akersloot-Overdie; LK = Limmen-De Krocht. After Vos 2015, 113–114, except the 2000 BC map which was made especially for the Heiloo-Craenenbroeck site by Vos (Deltares).



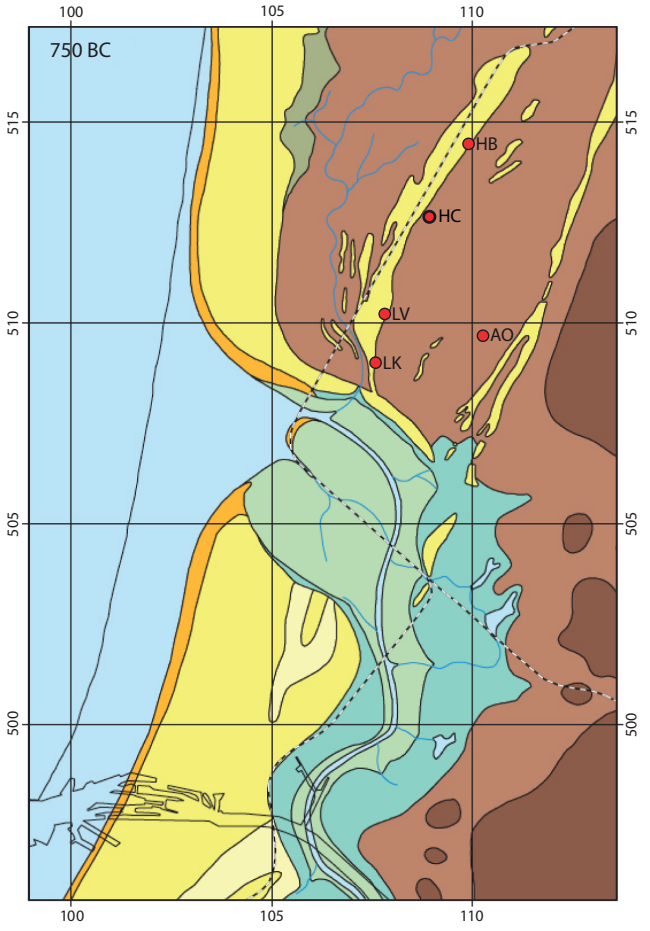


Fig. 16B+C. Palaeogeographical reconstructions of the Oer-IJ area. Legend: blue = North Sea, tidal channels, lagoons; orange = beaches and wash overs; light green = mud and sand flats; light blue-green = salt marsh plains; bluegreen = salt marsh ridges and levees; light yellow = lower dune areas; yellow = higher dune areas; other greens = former tidal landscape. HC = Heiloo- Craenenbroeck; HB = Heiloo-Heilooërbos; LV = Limmen-Visweg; AO = Akersloot-Overdie; LK = Limmen-De Krocht. After Vos 2015, 113–114).

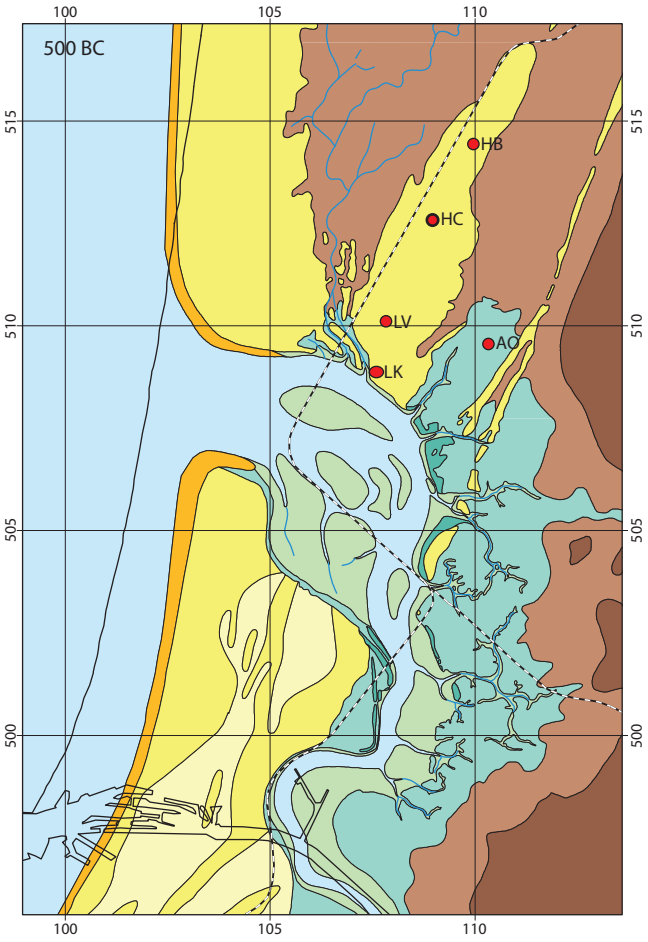


Fig. 16D. Palaeogeographical reconstructions of the Oer-IJ area. Legend: blue = North Sea, tidal channels, lagoons; orange = beaches and wash overs; light green = mud and sand flats; light bluegreen = salt marsh plains; bluegreen = salt marsh ridges and levees; light yellow = lower dune areas; yellow = higher dune areas; other greens = former tidal landscape. HC = Heiloo- Craenenbroeck; HB = Heiloo-Heilooërbos; LV = Limmen-Visweg; AO = Akersloot-Overdie; LK = Limmen-De Krocht. After Vos 2015, 113–114).

Pollen analysis (after Bunnik 2016)

Five samples were taken for palynological examination. Two of these samples are not included in the pollen diagram (Fig. 17) due to poor pollen preservation. These samples, 2 and 5, stem from the arable layer and the bottom of a water pit. The pollen that was, however, recognized in these samples during a pollen scan was tabulated (Table 1). Both samples contain anthropogenic indicators: charcoal and spores of fungi which grow on manure (Sordariaceae). The presence of the latter points to cattle on the site .

Sample 1 was taken from an ard mark (Fig. 5: M10). Among the tree pollen, that of pine (*Pinus* sp.) dominates, while the percentage of pollen from the deciduous trees alder (*Alnus* sp.), birch (*Betula* sp.), hazel (*Corylus avellana*) and linden (*Tilia* sp.) is low. The same is true for pollen of the Ericaceae family. Herbaceous pollen grains are relatively well represented with dandelions (Liguliflorae) and grasses (Poaceae) as the main constituents. The presence of purging flax (*Linum catharicum*), a species whose habitat is sandy marshes or wet dune valleys adjacent to the dune foot, is noteworthy. Cerealia pollen was also found in low numbers. With regards to spore bearing plants, a very high percentage of fern (*Dryopteris* sp.) spores were observed. *Ophioglossum vulgatum* (adder's tongue), wall fern (*Polypodium* sp.) and royal fern (*Osmunda regalis*) are represented at low frequencies. The high percentage of sphagnum (peat-moss) spores is remarkable. Among the pollen of plants from a swampy, waterlogged habitat, that of sedges (*Carex* sp.) abounds. Brackish and salt water environments are modestly represented by pollen of the goosefoot family (Chenopodiaceae), sea plantain (*Plantago maritima*) and some dinoflaggelates.

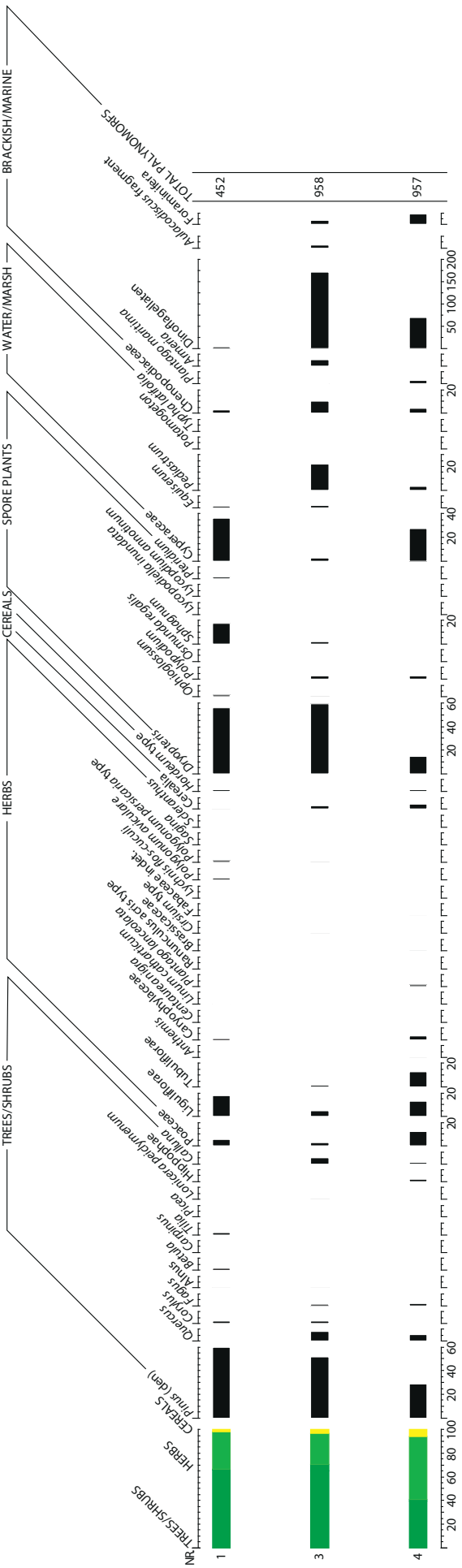


Fig. 17. Pollen diagram drawn from three well-preserved samples (nos. 1, 3 and 4). For the sample locations see Fig. 8. After Bunnik in De Koning 2016.

Tab. 1. Results from two samples (nos. 2 and 5) with poor pollen preservation showing anthropogenic indicators like charcoal and spores which grow on manure. For the sample locations see Fig. 5.

	sample 2	sample 5
Pinus sp. (Pine)	20	50
Liguliflorae (dandelions)	15	435
Aulacodiscus (a marine diatom species)	–	9
Dryopteris sp. (Fern Plant)	25	25
Ophioglossum vulgatum (adder's tongue)	2	5
Polypodium sp. (Wall Fern)	–	2
Fungi	++++	++++
charcoal	–	+++

The composition of the total pollen assemblage in Sample 1 suggests that the landscape was relatively open with dunes mainly overgrown by grasses and members of the Liguliflorae subfamily, species that prefer grassy dunes as a habitat. The few trees in the area were either pines (palynologically overrepresented) or deciduous. The *Ophioglossum vulgatum* (adder's tongue) is indicative of wet dune valleys. There is furthermore clear evidence of cereal cultivation, especially wheat/oat and barley. These species have a low pollen dispersal and are thus underrepresented in the pollen diagram. The absence of both elm (*Ulmus* sp.) and beech sp. (*Fagus* sp.) pollen can to a certain extent also be taken as an indicator of Neolithic or Bronze Age agriculture. The large amount of pollen from sedges, in the present context probably the brackish water tolerant *Scirpus maritimus* (sea club-rush) and *Scirpus lacustris* subsp. *tabernaemontana* (grey club-rush), hints at shallow dune pools where the species under consideration would have stood close together. Wall fern and heather point to relatively dry, leached sandy soils, whereas decalcified wet spots must have housed Royal Fern and *Sphagnum*.

Sample 3 stems from a clayey deposit in the (residual) gully or depression S210 which was found more or less in the centre of the excavation area and which may have been contemporary with the occupation (Fig. 5: M28). The tree pollen mainly belonged to pine, though the pollen of deciduous species like alder, beech, buckthorn (Hippophae rhamnoides) and oak are present in low percentages. Herbaceous pollen has a modest share, with grasses and dandelions as the most frequent representatives. Cerealia are again clearly present. Like in Sample 1, spores mainly stem from ferns with royal fern, wall fern and stiff club moss (*Lycopodium annotinum*) spores identifiable to a species level. As far as the marsh and water vegetation is concerned, the high percentage of *Pediastrum*, a genus of fresh water algae, and the low percentages of sedge pollen are striking. A brackish and marine environment are reconstructable in the pollen spectrum by the presence of the goosefoot family, sea lavender (*Limonium* sp.)/ sea pink (*Armeria maritima*), numerous marine dinoflagellates, the marine diatom species *Aulacodiscus argus*, and foraminifera.

The pollen assemblage from Sample 3 suggests an arboreal landscape with patches of dune grassland, arable fields, and dune heath. The abundance of Chenopodiaceae pollen and the presence of salt water tolerant species like sea lavender/sea pink and sea plantain provide strong evidence for at least partial saltmarsh vegetation cover. Lastly, buckthorn indicates the existence of calcareous dunes and coastal barriers. Whether the pollen spectrum fully reflects the local vegetation is, however, questionable. There is a good chance that

the various marine elements were deposited by seawater. As mentioned earlier, Heiloo-Craenenbroeck adjoined an area under the influence of the tides. The presence of the marine vegetation, therefore, suggests that the depression or (residual) gully from which Sample 3 came was likely either connected to a tidal gully or was relict of a tidal gully itself.

The bottom of the peat layer which covered the clayey deposit S210 was also sampled (Sample 4). In comparison with herbaceous pollen, tree pollen plays a quantitatively minor role within this sample. Like in the case of the Samples 1 and 3, pine is dominant while beech, buckthorn, hazel, and oak are present in low proportions. In addition, there are a few pollen grains of hornbeam (*Carpinus betulus*) and Norway spruce (*Picea abies*). A small percentage of the pollen stems from heather (*Calluna vulgaris*).

The herbaceous pollen is characterised by high rates of Asteraceae (Liguiflorae and Tubuliflorae), and grasses. The remainder includes members of the carnation family (Caryophyllaceae), chamomile-like plants, crucifers (Cruciferae), legumes (Papilionaceae), knawel (*Scleranthus* sp.), and plantain (*Plantago lanceolata*). Pollen from cereals (wheat/oat and barley) has also come to light. Spore bearing plants are few and include bracken (*Pteridium aquilinum*), wood fern (*Dryopteris* sp.), marsh club moss (*Lycopodiella inundata*), adder's tongue *(Ophioglossum vulgatum*), peat moss (*Sphagnum* sp.) and wall fern (*Polypodium* sp.).

Sample 4 (Fig. 5: M28) contains the remains of several representatives of marsh and water vegetation: equisetum (*Equisetum* sp.), naiad (*Potamogeton* sp.), *Pediastrum* sp., and sedges. From the indicators of a brackish-saline environment, Chenopodiaceae, dinoflagellates, foraminifera (salt), and sea plantain (brackish), have a substantial presence.

The palynological data from Sample 4 indicates an open landscape with dunes covered by grass and buckthorn in addition to dune pools and arable fields. These data further suggest that the coastal vegetation was made up of saltwater marsh species. There are high percentages of Tubuliflorae pollen, mainly of the *Aster tripolium* type, which may derive from the salt water tolerant sea aster (*Aster tripolium*) or royal herb (*Eupatorium cannabinum*). Although their concurrence cannot be completely ruled out, the lithological context, sedge peat, suggests the latter species. Royal herb is a brackish water tolerant plant occurring *en masse* at the edges of wet dune valleys.

Hornbeam and Norway spruce pollen have to be considered as contamination or as pollen originating from the hinterland (long distance transport). The presence of the former suggests an Iron Age date for its context, which is stratigraphically impossible (see above, chronology and cultural affiliation)). Like in Sample 3, intrusion and deposition by incoming sea water is therefore plausible, a stance which is corroborated by the numerous marine elements in Sample 4. The tree pollen in question may originate from the Rhine hinterland where hornbeam was already expanding in the earliest Bronze Age.

The overall picture of the surroundings of the Late Neolithic/Early Bronze Age site of Heiloo-Craenenbroeck that emerges from the palynological research is that of a rich biotic mosaic. The landscape at the time of occupation can be described as relatively open, despite the presence of a mixed forest, and was characterised by dune and salt marsh vegetation. It is easy to imagine that in such an environment the flanks of lower dunes were used as arable fields. The cereal pollen in Samples 3 and 4 may be taken as proxies for local cultivation. The absence of beech (*Fagus* sp.) and elm (*Ulmus* sp.) in the former sample can also regarded as a signal of agriculture. The numerous spores of fungi (Sordariacaea) in Samples 2 and 5 furthermore

hint at the presence of manure and thus the presence of cattle . In this case, the valley adjacent to the settlement might have served as pasture. The many spores of *Dryopteris* sp. observed in the samples are also interesting. Though perhaps overrepresented, they suggest the collection of ferns to be used to create a dry floor in the buildings. The ferns were probably gathered from the peat district behind the coastal barriers, since the species belonging to the *Dryopteris* type are halophobes.

The Heiloo-Craenenbroeck house-plan(s) in a wider perspective

The Heiloo-Craenenbroeck house-plan(s) appears/appear to be somewhat unusual, especially when compared with other more or less contemporary European examples such as those shown by Arnoldussen and Theunissen (Fig. 18). Nonetheless, good counterparts can be found in the coastal area of the western Netherlands. These structures,discovered at Molenaarsgraaf (Louwe Kooijmans 1974, Chapter 4, and reinterpreted by Arnoldussen/Theunissen 2014, 123 and Fig. 6) and Noordwijk-Bronsgeest (Van der Velde 2008), can also be divided into a two-and three-aisled section and display curved walls presumably of wattle (Fig. 11). Similar house-plans have also been discovered elsewhere in continental Europe, as illustrated by the settlement of Hesel in northwestern Germany. This is the type site of house-plans of type Hesel B, according to Waterbolk (2009, 43 and Fig. 18), who dates such structures to the Early or Middle Bronze Age. The partially two-aisled and partially three-aisled lay-out is characteristic of house-plans of this type. It might be, like Van der Velde (2008, 171) also supposes for the Noordwijk-Bronsgeest house-plan, that the Hesel B type is the precursor for the well-known three-aisled house-plans of the Middle Bronze Age. In other words, over time in northwestern Europe there may have a gradual transition from

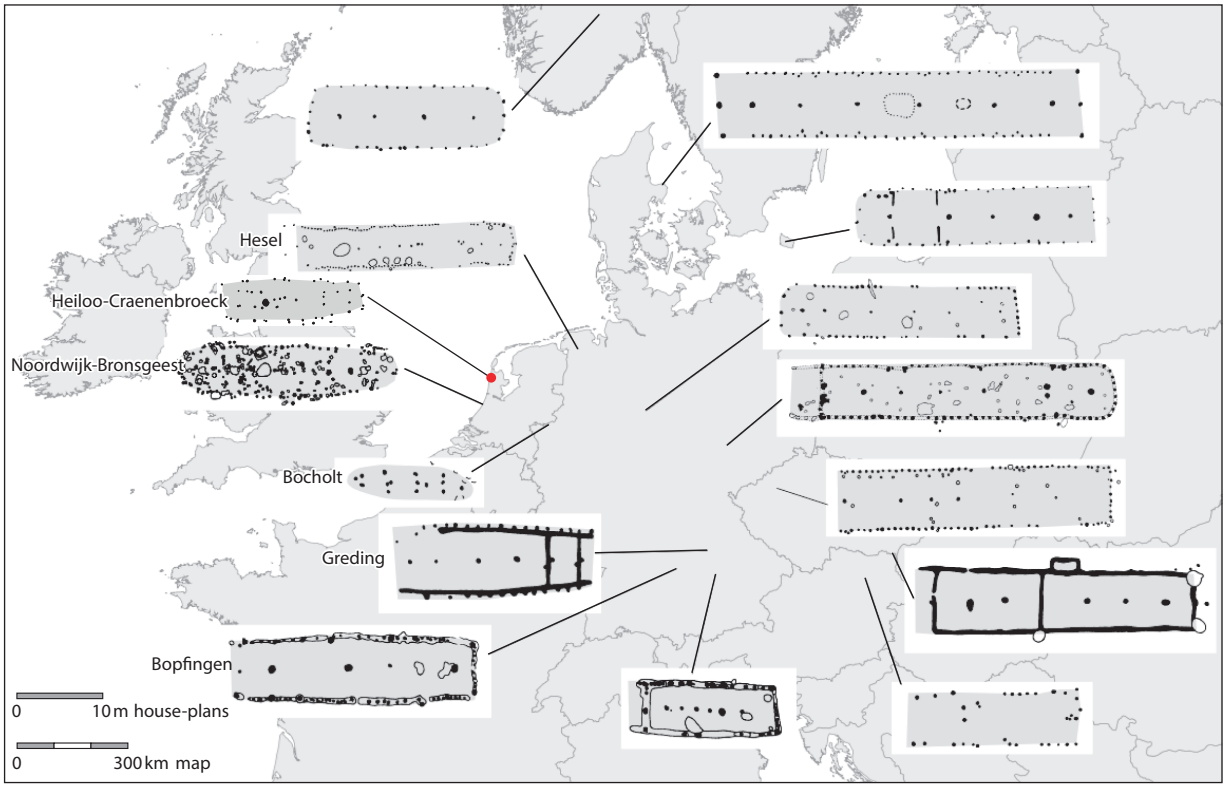


Fig. 18. Examples of house-plans from the Late Neolithic and Early Bronze Age in northwestern continental Europe. After Arnoldussen 2008, 170- Fig. 5.3. and Arnoldussen & Theunissen 2014, Fig. 7. Added are Heiloo-Craenenbroeck and some sites that are mentioned in the present text.

two- to three-aisled houses. The question then arises whether this transition was related to cattle-stalling, since it is usually supposed that the latter (three-aisled) buildings housed both men and cattle (e.g. Waterbolk 2009, 42).

Final remarks

For decades the (possible) Late Neolithic/Early Bronze Age finds in the surroundings of Heiloo-Craenenbroeck were confined to a stone battle-axe from Uitgeest-Achterloet and a fragment of a similar item from Limmen-Zuideinderweg (Fig. 19: UA and LZ respectively). The former artefact was found in 1926, the latter some 30 years later. Later, a granite saddle quern was found near the Limmen-Zuideinderweg stone battle-axe (Fig. 19: L2). In 2004 a Late Neolithic site with ard-marks was discovered at Akersloot-Klein Dorregeest on the oldest coastal barrier (Fig. 19: AK). Several fragments of bell beakers and some lithic artefacts, including a flint arrowhead, were uncovered there (Müller et al. 2008). In the centre of the Craenenbroeck valley at Limmen-Hooghuizen (Fig. 19: LH) ard-marks were also exposed and a flint artefact was found (Dijkstra 2012). Further away from Craenenbroeck there are contemporary sites to the north (St. Pancras-De Domeinen, Fig. 19 PD; Verduin 2012) and south (Velsen-Hofgeest, -Noordzeekanaal and -Waterland, Fig. 19 VH, VNZ, VW; Kleijne 2015). Although most of these archaeological remains are hard to precisely date, even their approximate ages indicate that most of the area was already under cultivation by some 4000 years ago.

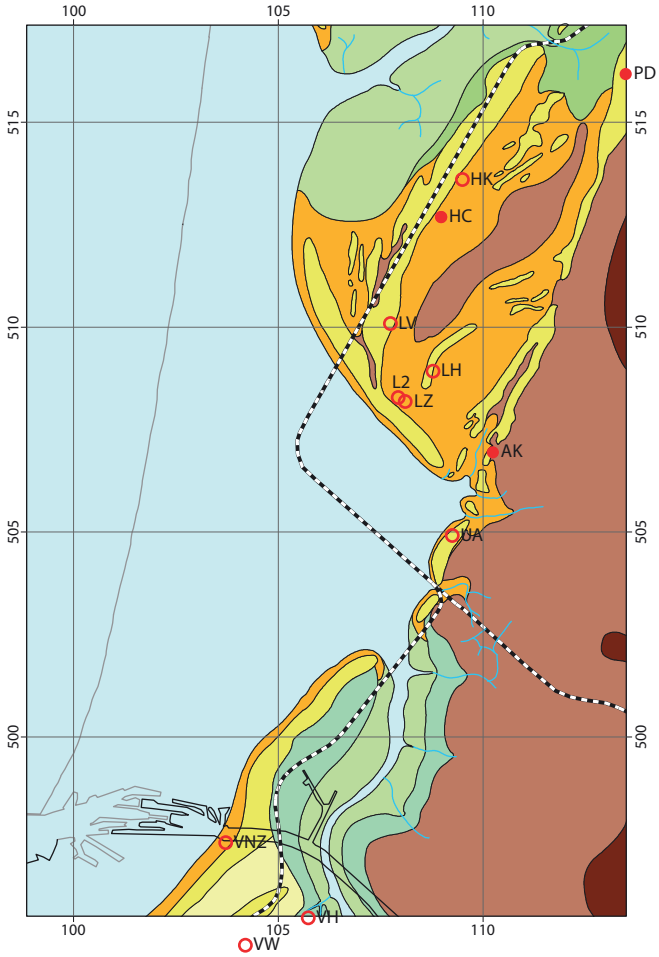


Fig. 19. Distribution of the (possible) Late Neolithic and Early Bronze Age finds and features within the Oer-IJ area. Map by P.C. Vos (Deltares). Dots are sites with settlement features and/or finds. Open dots: ard-marks or stray finds. Findspots: Akersloot- Klein Dorregeest (AK), Heiloo-Craenenbroeck (HC), HK (Heiloo-Kennemerstraatweg 43–45), Limmen-Zuideinderweg (LZ: stone battle-axe), Limmen 2 (L2: stone quern), Limmen-Hooghuizen (LH), Limmen-Visweg (LV). Sint Pancras-Domeijnen (PD), Uitgeest- Achterloet (UA: stone battle-axe), Velsen-Hofgeest (VH), Velsen-Noordzeekanaal (VNZ), Velsen-Waterland (VW).

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Imprint

ISSN 2197-649X

Layout draft: Holger Dieterich, Ines Reese
Technical edition: Agnes Heitmann
Language revision: Sarah Martini

Published by the Institute of Prehistoric and Protohistoric Archaeology,
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