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Successive adoptions: the origins of the Neolithic in the Low Countries

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WALKING AMONG ANCIENT TREES

Studies in honour of Ryszard Grygiel and Peter Bogucki
on the 45th anniversary of their
research collaboration

Edited by
Michał Grygiel & Peter Obst



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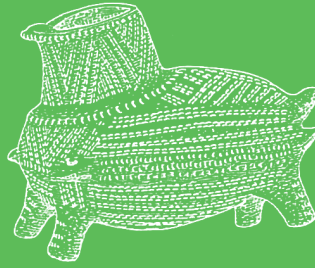
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SUCCESSIVE ADOPTIONS. THE ORIGINS OF THE NEOLITHIC IN THE LOW COUNTRIES

Our view on Neolithization in the Low Countries is dominated by the rich evidence from the intracoastal wetlands where the Rhine and Meuse flow into the North Sea. But this raises two questions. First, how representative these data are in wider respect. Second, how the knowledge was transmitted through the wide coversand landscape, that separates these wetlands from the Neolithic source area in the loess zone, 150 km to the south. Two recent and one earlier field project allow us a first view on the process in this zone and a new time schedule for the 5th millennium cal BC.

Our view on the transition to a Neolithic way of life in the Low Countries is based on data from the – now drained and cultivated – Dutch wetlands with their excellent preservation of organic remains. This however raises some questions, since these wetlands are only one part of a wider area, comprising extensive sandy landscapes.

The former natural conditions in the now drained wetlands were in general suited for the keeping of livestock and especially not for crop farming. This may have resulted in specific adaptations that are not necessarily representative in a wider context.

The region is separated from the early LBK farmers in the loess zone by a c. 150 km wide landscape of coversands, with hardly any subsistence data (Fig. 1). There is no other evidence than surface flint scatters and some occasional pottery sherds, that only give very restricted information in this respect (L.W.S.W. Amkreutz 2013; G.L. Dusseldorp and L.W.S.W. Amkreutz 2015). We assume that the changes observed in the wetlands in fact



■ Fig. 1. The Low Countries and surroundings with its major landscape zones and the sites mentioned in this paper. Drawing: Archol, Leiden
Br – Brandwijk, D – Doel, Ho – Hoge Vaart, Hz – Hazendonk, M – Melsele, Sw – Swifterbant, Wo – Wommersom

were rooted there. How was knowledge transmitted through this zone?

Up till recently there was no way to tackle this problem, but there are now three sites that profited in varying degrees from waterlogged conditions and as such allow us a first direct view on the process in this zone. One is situated in the north, at the southern edge of the wetlands, reflecting upland contacts, the others – recently excavated – are situated respectively at the upland bank of the Scheldt river in the west and on the valley floor of the Meuse, close to the upland, in the east. I have anchored this paper in these three sites, concentrating on five relevant aspects: the continuity from the Mesolithic, the adoption of pottery, of cereals and livestock, and of local cultivation.

The sites are wide apart in different corners of the relevant area, and they are very different as well in preservation, in lay-out and research design. We are however dependent on what nature has preserved for us and it seems still worth to look for aspects that the sites may have in common and illustrate the first stages in the transition from hunting and gathering to farming.

1. The wetland margin: Hardinxveld

Research¹

Both Hardinxveld sites are situated close together at the southern edge of the (now drained) marshes of the intracoastal plain, less than 10 km from the former upland margin. They were discovered in 1996 during a hand coring prospection of the trajectory of a new rail and named Polderweg and De Bruin. Both were situated at the deeply covered tops of Late Glacial river dunes, and occupied from c. 5500 cal. BC onward. Polderweg was used up to c. 4900 cal. BC, De Bruin until c. 4200 cal. BC.² In both cases they became submerged as result of the rise in water level, and were covered by Holocene deposits.

At each dune a representative section was investigated in 1997–98, both measuring about 500 m² and reaching to a depth of 9 m below the present surface or 10 m below present sea level. This

¹ The excavation reports were published in two volumes in 2001, by contract in Dutch and so internationally not very accessible. This was compensated to some extent by a concise overview (L.P. Louwe Kooijmans 2001a; 2001b; 2003).

² The original date of c. 4500 cal. BC has to be revised on the basis of a new ¹⁴C date (C. Çakırlar et al. 2020).

was accomplished by means of a steel sheet piling of the trench walls, the injection of an impermeable layer below its basis and a heavy pumping system (Fig. 2).

The main value of the sites is the excellent preservation of all organic material categories, embedded in the stratigraphy of colluvial and Holocene deposits at the dune's slopes. This stratigraphy is the basis of a robust chronological framework, dated by ¹⁴C dates of uncharred botanical macroremains, to avoid a possible reservoir or old wood effect. These dates were supplemented by some charcoal samples for the early stage, and charred crusts on pottery for the later phases. The Mesolithic character of the early stage is confirmed by the presence of various types of microliths. The typology of some import pottery gives an archaeological time control for the later stages.

The pottery in the later phases testify of the farmer's contacts with the earliest full-fledged farmers in the loess zone farther to the south from 5000 cal. BC onward.

Site function

It is a major question whether the location was a regular home base used throughout the years, or merely a temporary 'extraction camp' for fishing and hunting. There are good arguments for the base camp option and a long term use. Some large but shallow pits were dug, some interpreted as fire places, others as the sunken floors of huts, as known from Denmark. The numerous and wide range of antler and bone implements and waste products testify to their local production, use, repair and discard, most in line with a base camp. Human remains, found mixed between the general refuse comprise bones of children and some women. And there are some formal burials, one of these a female at the age of c. 50 years. All not to be expected in a special activity site.

Archaeozoology demonstrates a wide range of activities with varied hunting, fowling and fishing, representing a true Broad Spectrum Economy in line with the supposed general site function. Within this spectrum some special wetland activities stand out: the extensive pike fishing and trapping of beaver and otter.

There are good arguments to consider the winter as the main season of presence. 80% of the red deer antlers found were thrown, collected in the period February–March. The same period is the spawning season of pikes, when they are a relatively easy catch. Migratory water birds, such as swans, goosander and red-throated diver, which nowadays are wintering in our wetlands, were

shot in numbers. In contrast there are no young mammals and only few specific summer indicators, indicating more incidental use of the sites in the other season.

The conclusion that both sites were winter base camps for full households, at any rate in the Late Mesolithic, leaves us with the question where the occupants would have had their summer dwelling places. A first option are the northern margins of the sand, c. 20 km to the south of the Hardinxveld site in these times. From such locations the sandy upland may have been exploited in the summer and the Meuse river fished for migrating salmon. An important implication is that one and the same people were active in and took profit from both the coversand and wetland landscapes and that material found at the wet sites also to some extent may reflect life on the sand.

Distant external contacts are documented by the sources of the stone material used. These are all found to the south and the east, in a wide range as far as the loess belt and the mountainous landscape beyond. The most probable sources for the smaller stones and flint pebbles are the Limburg Meuse gravels, for which Mesolithic exploitation was attested at Well-Aijen, a distance of at least 100 km east (see below). The origin of the larger

and angular stones, including a large flint precore, and some rare pieces of pyrite are the solid rocks of the Ardennes and the bordering Cretaceous chalk at c. 150 km to the south. Some characteristic quartzite flakes and blades derive from the well-known outcrop near Wommersom, 40 km east of Brussels. This all demonstrates the wide range of action of the hunters. It may explain how they became acquainted with the Bandkeramik farmers, shortly after these had settled in the loess zone c. 5300 cal. BC, as documented at the site by two characteristic Bandkeramik arrowheads in the early phase. In spite of the distance in between they soon adopted all kind of novelties offered in the course of the subsequent centuries.

Native and imported pottery

The first production and use of pottery at the site is well-dated to c. 5000 cal. BC at Polderweg phase 2, and found in larger quantities at De Bruin within a wider time range, 5100–4200 cal. BC. This is a plain ware, coil-built and with a diverse temper of plants, grog and/or stone grit. It has simple closed, ovoid profiles or slightly flaring necks, round or pointed bases, with some occasional rows



■ Fig. 2. Hardinxveld-Polderweg, excavation trench. Photo: Archol, Leiden

of imprints at the rim. It can safely be conceived as the initial stage of the native Swifterbant tradition (J.P. de Roever 2004; Raemaekers 2008).

The pottery style originally raised a discussion about its inspiration, but its early start now leaves the late Bandkeramik or the synchronous La Hoguette/Limburg wares factually as the only option. The lack of similarities can be explained as originating from local practice, based on other technologies such as the coiling technique of basketry (J.P. de Roever 2004, 163), an idea later adopted by Ph. Crombé et al. (2008) and myself. When we conceive Neolithization as the transition to farming, then this adoption of pottery and the new way of food preparation is a prelude to this process, but in a formal sense it is merely the transition to a ceramic Mesolithic.

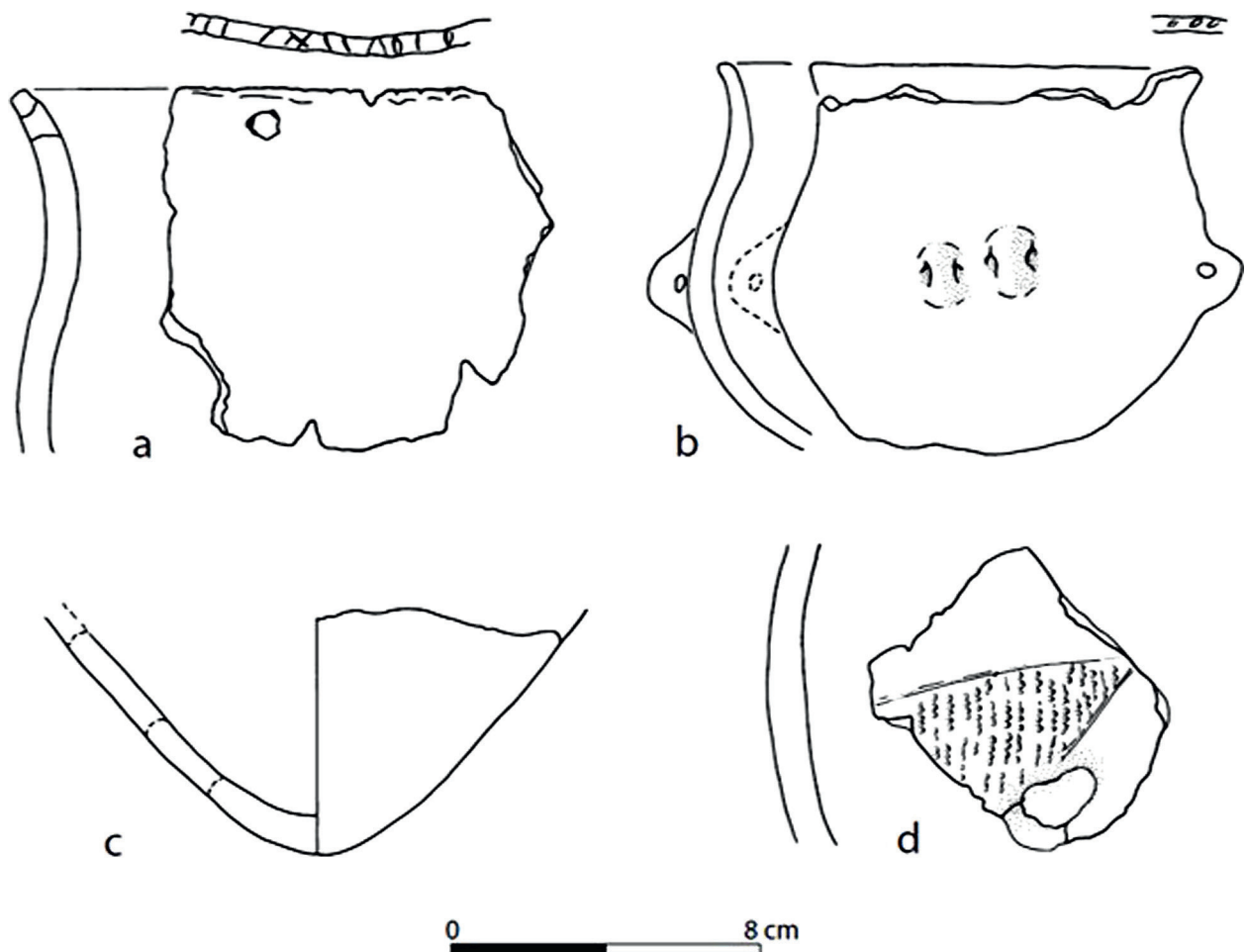
A second 'ware' demonstrates the continued southern contacts. It has all characteristics of the Belgian Groupe de Blicquy, dated 4950–4700 cal. BC, such as the peculiar temper of crushed and burnt bone and a fine decoration of bands,

filled with impressions of a 3- or 4-toothed spatula (Fig. 3c). The sherds may have been the remains of one or a few large vessels imported most likely from the Hesbaye to the west of Liège. Another 'exotic' vessel is a small bowl with four sets of double perforated lugs at its belly. It has good counterparts in the Knickwandbecher of the synchronous Großgartach culture (GGK) of the German Rhineland (Fig. 3d).³

Agriculture?

At Hardinxveld thousands of animal bones could be identified to species and show us the hunting of a wide range of mammals from the Late Mesolithic onward: red deer, wild boar, beaver and otter to name the most important. In addition domestic animals were attested in the final

³ Pointed out to me by Dr. Jens Lüning, Köln.



■ Fig. 3. Hardinxveld, pottery 5000–4700 cal. BC. a, c) Swifterbant cup, b) Großgartach Knickwandschüssel, d) decorated Blicquy sherds. After: Louwe Kooijmans 2001a; 2001b

phase 3 of De Bruin: cattle, sheep and goat.⁴ They are represented exclusively as postcranial long bones, some worked into implements. As such they should not be seen as illustrative of the local subsistence activities, but to be interpreted as parts of chunks of meat, as raw material or as finished implements from the outside, most likely brought in from the presumed summer sites in the southern upland area. This implies that they inform us about the adoption of domestic animals on the adjacent sands and at the same time confirm that the Hardinxveld inhabitants belonged to that society.

The dating of these animals exclusively in phase 3 implies an introduction sometime after 4700 cal. BC. A recently ¹⁴C dated bone confirms the presence of sheep/goat at c. 4430 cal. BC (C. Çakırlar et al. 2020)⁵. In the same study the domestic status of the relatively few *Sus* bones was disputed. For this reason pig will be left here outside the discussion. The distinction between pig and wild boar is in general rather unreliable, especially in the mixed assemblages of the wetland extend broad spectrum economy. Domestic cattle was originally identified on the basis of their small dimensions in comparison to the wild aurochs bones of nearby Late Mesolithic Polderweg. I see no reason to doubt these identifications.

In the distinct wet conditions at Hardinxveld cereals will not have been grown, but might have been imported. But they were not identified, in spite of a special sampling program. Their absence does however not imply that grain was as yet not introduced and grown at the adjacent upland.

After Hardinxveld, occupation had shifted to similar but higher dune tops some kilometers farther north and farther from the sand upland. At these sites – Brandwijk and Hazendonk – remains of domestic cattle and sheep/goat were found as well, from the earliest layers onward, 4200–3800 cal. BC. Emmer wheat and naked barley were represented by charred grains and threshing remains, but there is no conclusive evidence for local growing of crops in the form of arable weeds in the various pollen diagrams (J.T. Zeiler 1997; W.A. Out 2009; D.C.M. Raemaekers 1999).

Conclusion

The sequence of adoptions at the northern margin of the coversand landscape, is documented at sites in the adjacent wetlands. It started with the

⁴ A few bones registered as (late in) phase 2 are considered either intrusive or field errors (L.P. Louwe Kooijmans 2001b, 223).

⁵ GrA 62951: 5610±40 or 4520–4356 cal BC.

adoption of pottery c. 5000 cal. BC, followed by some form of animal husbandry in the middle of the fifth millennium around 4450 cal. BC. Cereals, are documented not earlier than 4200–3800 cal. BC.

2. The Meuse valley: Well-Aijen

In a wide zone of the coversand upland along the Meuse modest find scatters from Bandkeramik times onward and isolated Neolithic finds of adzes and arrowheads are well-known. They illustrate possible contacts between the farmers on the loess and the hunters on the sand (L.B.M. Verhart 2000, 229; B. Vanmontfort et al. 2010).

A large scale field research at Well-Aijen, half way between Nijmegen and Venlo, in the years 2012–2014 produced interesting new evidence for this phase.⁶ The project was urged by the realization of a high water storage works for the river Meuse and covered a 1.5 km long stretch of the alluvial plain. It resulted in map of a Holocene fluvial micro-landscape with point bar ridges and old stream channels that appeared to have been systematically used from the Early Mesolithic onward throughout Meso- and Neolithic times (Fig. 4). The sites were protected from later disturbance and preserved below younger high water sediments and a subrecent inundation clay cover. The new evidence on Neolithization is however restricted to the relative short period 4700–4300 cal. BC and a bit hidden in the massive report on the evolution of the landscape, but nevertheless of great value to us. The data of these alluvial sites are considered as relevant for the surrounding upland as well, in view of its proximity and the narrow river plain.

Results

The microregion was regularly visited in the Early and Middle Mesolithic for fishing and for the extraction of flint nodules from the active river bed and the older terrace deposits. The stones were collected, tested and partly left at the sites. But these activities were followed by a major hiatus of almost 3 millennia (with only one site documented) at which times this stretch of the alluvial plain for some reason was not of interest.

A sign of contact with the farmers on the loess some 100 km to the south are the isolated find of a LBK arrowhead at the sand bar and ‘a handful’

⁶ A. Müller et al. 2018; J.R. Mooren et al. for a preliminary report.

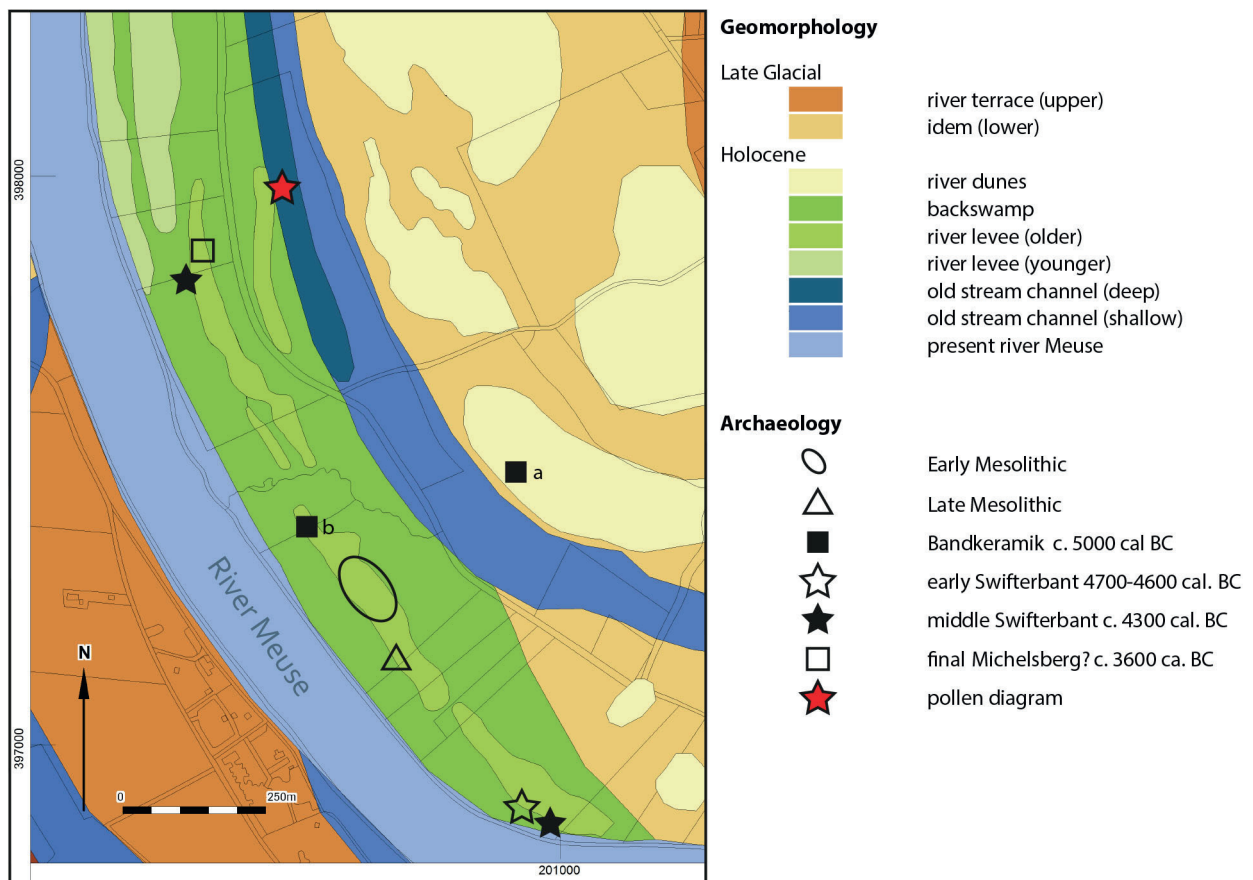
of LBK sherds on the adjacent terrace edge, fitting into the general upland pattern. But any concrete evidence of contact with the farmers is lacking up till 4700 cal. BC when the earliest Neolithic site is documented. It comprises two small stratified assemblages at 'site 35A', separated by c. 15 cm of sterile sand, dated to c. 4700 and c. 4600 cal. BC (Müller et al. 2018, 413, 444). The upper one produced some sherds of a pot with a pointed round base, constructed in coils and with a quartz grit temper. The very modest lower assemblage also shows a coil construction together with a varied temper. Both fit well in the Swifterbant pottery tradition. We may assume, on the basis of the Hardinxveld evidence, that the recovered pottery may not necessarily represent the very start of it, and that also in this region the production of pottery had its origin in contacts with the Bandkeramik farmers, plausible in view of the widespread occurrence of isolated finds, mentioned above.

The most interesting feature, however, is a natural depression more than 1 km farther north with a rich collection of pottery, dated some centuries later by multiple ¹⁴C dates, to around 4300 cal. BC, and classified as Middle Swifterbant (Fig. 5; Müller

et al. 2018, 437–448). It is coil built with oblique joints, dominantly tempered with plant remains, often combined with quartz and/or sand. Bases are round, as far as these can be observed, and most rims are flaring with sharp incisions (*Randkerbung*) or occasional fingertip impressions. Most remarkable are an occasional row of *Doppelstiche* as wall decoration and perforated lugs with a row of transverse impressions (Fig. 5), reflecting easterly contacts with the Late Rössen neighbours in the Rhineland. But its technology and the absence of the traditional rich Rössen decoration motifs exclude the option of direct imports.

The raw material for flint artefacts was chiefly collected locally from the Meuse bed or from terrace deposits nearby, like before in the Mesolithic. The flint artefacts are rather undiagnostic and not fundamentally different from the preceding Mesolithic, which supports the in essence native origin of the ceramics and its inhabitants. Rullen flint, from a source 100 km to the south and characteristic for the Rössen-sites in the wider region, is moreover absent, as are traces of their characteristic trapezoid houses.

The use of cereals at both sites is well-attested for this stage. In two samples from the depression,



■ Fig. 4. Geomorphology of a segment of the Meuse valley between the villages of Aijen and Well, with Mesolithic and Neolithic sites, Limburg (NL), After: Mooren et al. 2015

so dating to c. 4300 cal. BC, grains and threshing remains of emmer wheat (*Triticum dicoccum*) were identified, pointing at least to the threshing of ears at the site. A single grain of emmer wheat at site 35A has an even earlier date, around 4450 cal. BC.

Of special value in this respect is a pollen diagram of the nearby channel fill showing the presence of *Cerealia* type pollen at a level correlated by interpolation of direct ¹⁴C dates with this stage. The pollen goes together with an increase of microscopic charcoal and pollen of anthropogenic indicators, like *Plantago lanceolata*, *Artemisia* and *Rumex acetosella*. It is interpreted as the reflection of the local small scale growth of cereals in new clearings on the wooded levees (Fig. 6; J.A.A. Bos 2018).

In contrast to the botany, information on husbandry is completely lacking due to the non-calcareous sediments in which no bone was preserved, other than small calcinated and unidentifiable fragments.

The occupation of this stretch of the alluvial landscape was interrupted for some 6 centuries and resumed with a small site no. 30, consisting of a small fragmentary house plan, close to the pottery-depression discussed above. It is ¹⁴C-dated to c. 3600 cal. BC, only associated with some mined flint artefacts, but not with any diagnostic pottery or botanical material and as such not very informative for us. As such we lack in fact evidence for continued occupation during the Michelsberg culture in

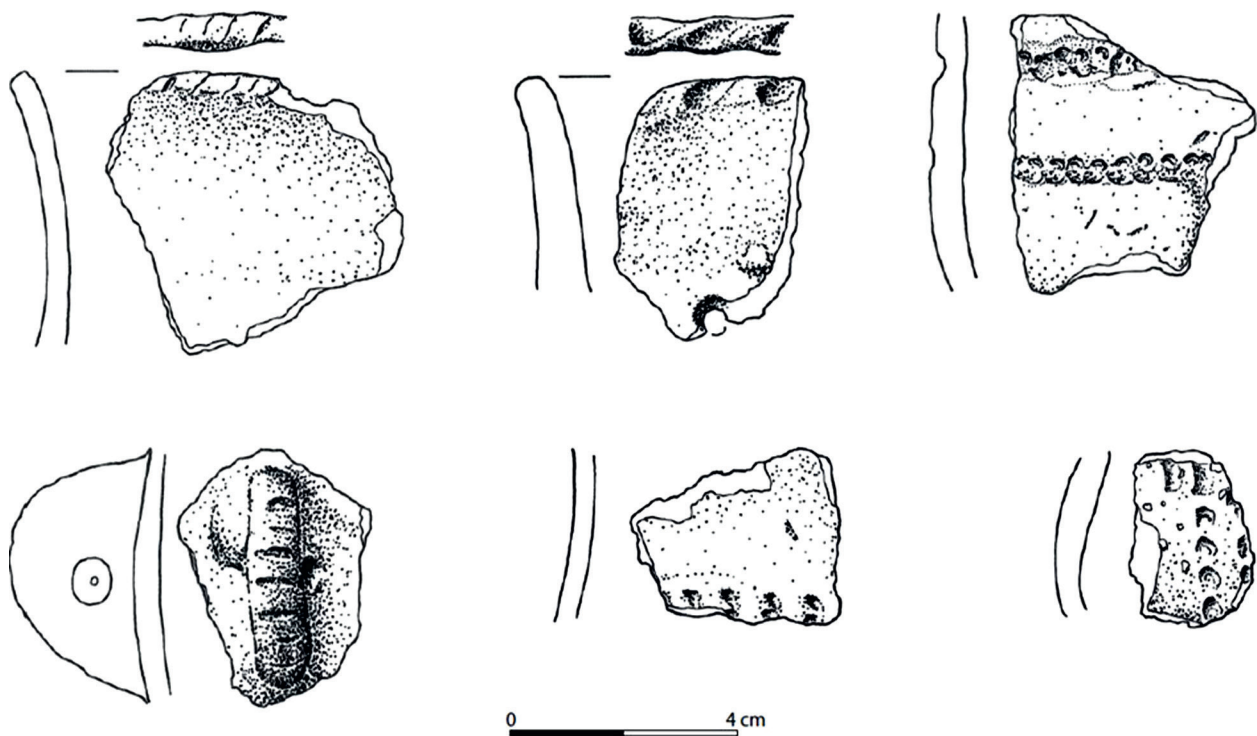
this specific microregion. Sites on the upland along the Meuse (Verhart 2000) show a distinct culture break towards the new Michelsberg tool kit and pottery style. The reason why people did not settle in the alluvial plain may have been their transition to a fully agrarian way of life, but factual evidence on subsistence is lacking.

Conclusion

Mesolithic hunter-gatherers started the local production of pottery not later than c. 4700 cal. BC, after incidental previous contacts with the Bandkeramik immigrants. A few centuries later they adopted pottery decoration and acquired cereals from the Rössen societies in the Rhineland and developed small scale local cultivation c. 4300 cal. BC. The trajectory to animal husbandry remains unknown.

3. The Scheldt valley: Bazel-sluice

In the last decades a number of Meso- and Early Neolithic sites have been uncovered along the alluvial plain of the lower course of the river Scheldt: a series at Doel and a site at Melsele (Ph. Crombé et al. 2008). They show us Swifterbant related



■ Fig. 5. Well-Aijen, site 35. Swifterbant sherds with Rössen derived lug and decoration, 4300 cal. BC. After: Müller et al. 2018

pottery and a flint industry with indigenous (Mesolithic) roots, but evidence on subsistence is quasi absent. It is an interesting western counterpart to the Meuse valley, with an essentially different cultural hinterland in Hainaut and Northern France. As such an independent view on its Neolithization, as presented recently by the site of Bazel-sluice, was more than welcome (E. Meylemans et al. 2016 for the full report; E. Meylemans et al. 2018; Ph. Crombé et al. 2015).

Conditions

The site lies some 5 km south of Antwerp on the left side of the fluvial plain of the Lower Scheldt. It was discovered during the construction of a sluice and partially excavated in two trenches at both sides of the sluice, together measuring 800 m². It is situated at the Late Glacial margin of the alluvial plain and appeared to have been occupied from the Late Mesolithic up till the Middle Neolithic. The lack of true stratigraphy as the basis for site chronology was compensated for to some extent by a large

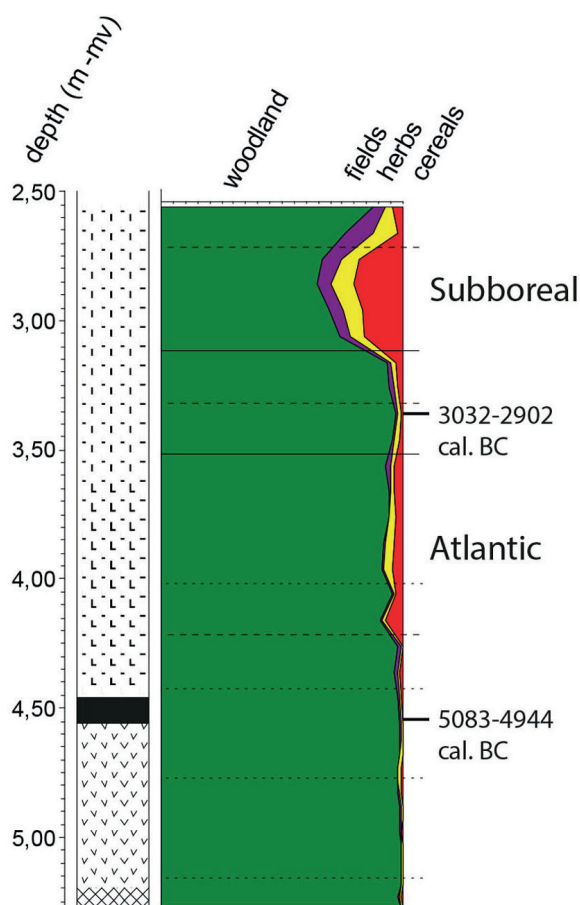
number of radiocarbon dates on individual finds. These range from 5200 to 3500 cal. BC, with only two outliers: hazelnut shells at c. 7000 cal. BC, corresponding to earlier Middle Mesolithic activities, such as documented by some microliths, characteristic for this phase.

The archaeological material of this long term occupation was all confined to a single c. 50 cm thick zone in the top of the sand, protected from later disturbances and contamination by a cover of peat and clay deposits. The finds in this layer comprised pottery, flint and other stones, calcinated and unburnt bone, and charred macroremains, especially cereals. Material from all phases was, however, mixed up and very fragmented as result of heavy trampling during the continued occupation. Only the lowest zone of the culture layer in the deeper trench 2, where it merges into contemporaneous peat, had escaped the fragmentation to some extent and profited from the wet conditions. So the larger, identifiable bones and pottery sherds were confined to this lower zone, considered to be a refuse dump, while seeds were sampled in trench 1, representing the margin of the settlement area.

Material

Three categories of dated material from the culture layer each give us separate and independent information on the Neolithization process: pottery on the cultural context, animal bones on domestication and charred cereals on familiarity with crops (Fig. 7).

A series of 23 radiocarbon dates on cereals show that cultivated grain was brought to the site from 4700 cal. BC onward up till 3500 cal. BC, so possibly already in Blicquy times (E. Meylemans et al. 2018). Bread wheat (*Triticum aestivum*) was attested throughout the occupation, emmer wheat (*Triticum dicocum*) only twice. This dominance of *aestivum* points indeed to a post-Bandkeramik origin. The frequency distribution of the dates show three distinct chronological clusters while the large number of cereals indicate a regular supply, possibly by means of exchange with farmers in the south.⁷ Local cultivation could not be attested in the pollen diagrams of peat deposits close to the site. Fields at some distance may, however, not been reflected and as such cannot be excluded



■ Fig. 6. Well-Aijen, summary pollen diagram. After: Bos 2018

⁷ It is not easy to assess the importance of cereals at Bazel compared to sites with only a few samples and without such an extensive documentation. At Bazel 104 bulk samples of 50x50x5 cm each were sieved over a 2x2 mm mesh (E. Meylemans et al. 2018, 4), producing 23 cereal grains from a volume of 1.3 m³. For the total of the culture layer in trench 1 (20x20x0.5 m = 200 m³) this implies 4600 grains, deposited in c. 1000 years or less than 5 grains a year.

for the later phases. The absence of chaff in the macroremains may be the result of the recovery by means of wet sieving.

The 27 dated animal bones show a rather different pattern. They cluster in two phases, 5000–4500 and 4200–3800 cal. BC, separated by three centuries without any dates. Game animals – red deer, aurochs and wild boar – are all dated to the first phase, except for one red deer. Undisputed identifications of domestic animals in contrast are restricted to the second cluster: two sheep are dated as early as 4200–4050 cal. BC, cattle (2×) and pigs (3×) to 3950–3800 cal. BC.

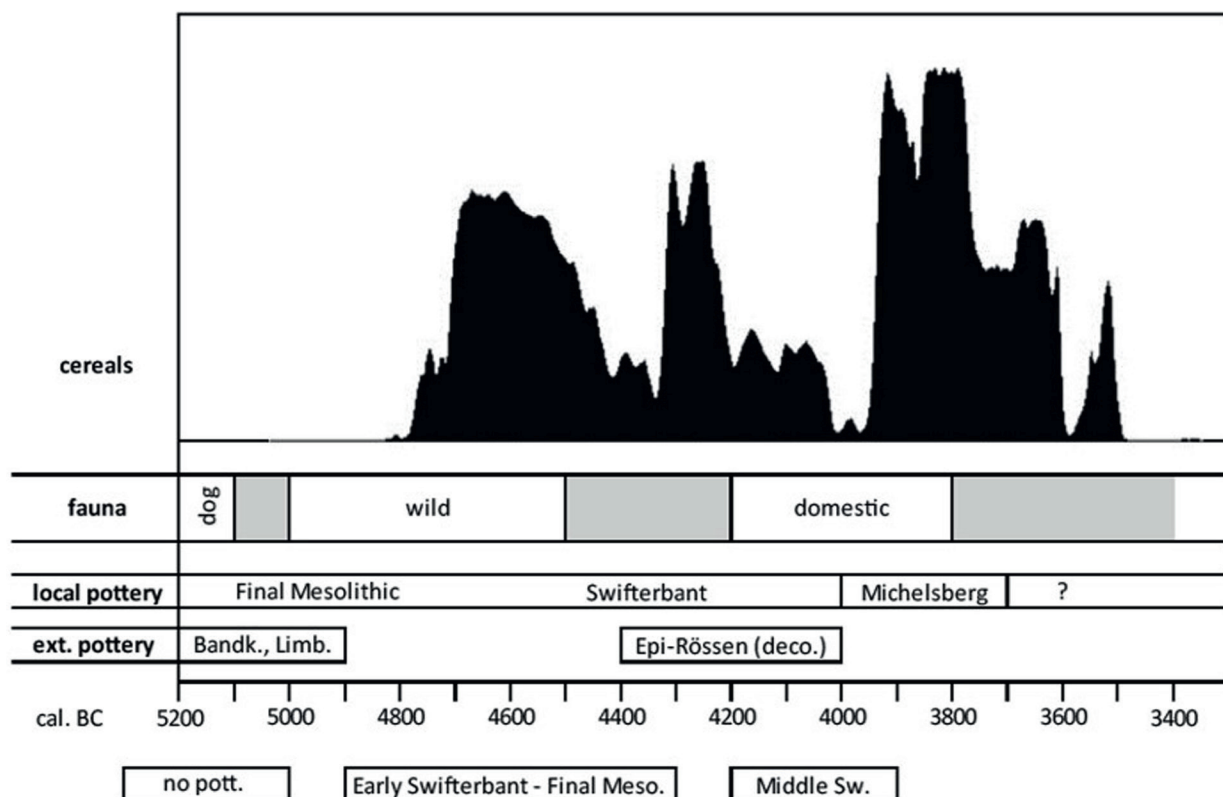
The recovered pottery has no associated ¹⁴C dates and can only be dated by means of the technology and the typology of its decoration, but its fragmentary state hardly allows any assessment of the pot shapes (Fig. 8).

A small, oldest group (3,5%) consists of a few sherds of Limburg pottery, characterized by crushed bone temper and simple line motifs on some sherds, plus a few unmistakable late Bandkeramik sherds. This 'exotic' pottery may have been acquired as pots during expeditions of the inhabitants for flint or stone – just as suggested for the Blicquy ware at Hardinxveld – or alternatively left

by visitors from the south. These sherds predate all agrarian indicators.

The majority of the pottery (64%) has a less remarkable temper of organic (plant) material, mixed with 'grog' (crushed pottery) and/or some quartz grit. Some of the rims have impressions or incisions (*Randkerbung*). Together with other Flemish complexes it is conceived as an indigenous ware, a Flanders Swifterbant-group, most likely inspired by the southern Neolithic of the Hesbaye and Hainaut, c. 75 km in both directions. Such links are confirmed by distant flint sources in the same areas used during the time of occupation. This undecorated pottery probably represents the start of a local, indigenous pottery production. The time range for this start, can be delimited to c. 4500 cal. BC on the basis of the dates for nearby Doel sector B (Ph. Crombé et al. 2008, 473).

A minor part (6%) of this pottery group shows rather casual impressions that seem to have been derived from the so-called final Epi-Rössen ceramics, as represented at some sites in the south of Belgium (Hainaut). This gives the subgroup a date in the end of the 5th millennium. Very characteristic for this phase are some sherds with *Lochbuckel* (or: *boutons repoussés*) with a non-local micaceous



■ Fig. 7. Bazel, scheme with ¹⁴C dated cereals and animal bones; pottery dated in reference to external dates. Cereal graph after Meylemans et al. 2018; drawing: Archol, Leiden

paste, that will be fragments of true imports. But in the absence of other more specific motifs this subgroup as a whole may best be explained as a local, indigenous product, as suggested by E. Meylemans et al. (2018).

A third group (27%) is tempered with crushed flint or quartz, and fully undecorated. As such it matches Michelsberg pottery and can be dated at the other end of the occupation range (4200–3500 cal. BC).

Conclusion

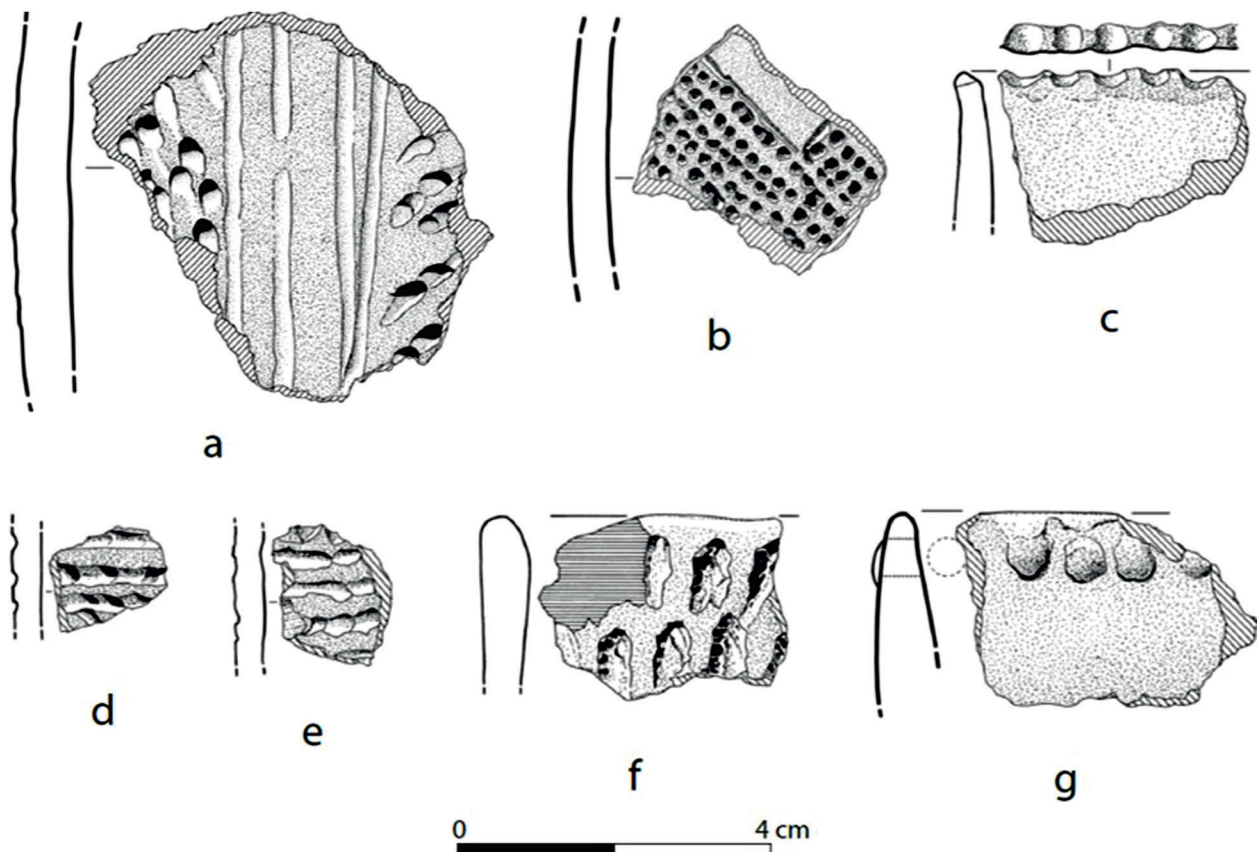
It seems that the location was used by several groups in successive stages of the Neolithization process, separated by relatively short hiatuses.

The sequence starts in the Late Mesolithic, represented by the ¹⁴C dated dog bone and part of the recovered flint. Southern contacts of these hunters are reflected in the presence of Bandkeramik and Limburg pottery. This may have been an inspiration for the local production of pottery in a native 'Swifterbant' style. Continued and intensive southern contacts are shown by

a fluctuating import of cereals from 4700 cal. BC onward.

The first cereal cluster can be correlated with an early stage of the Swifterbant occupation, the second with the southern Epi-Rössen contacts. Farm animals were introduced in two shifts after 4200 cal. BC: sheep first and slightly later pigs and cattle, rather late as compared to the introduction at Hardinxveld. It meant the end of the Swifterbant pottery style and way of life. The moment of first adoption of domestic animals is however obscured by the low number bones and the absence of dates previous to 4200 cal BC and among the earlier dates of game.

The distinct third peak in the cereal ¹⁴C curve corresponds to the second cluster of the fauna dates, with exclusive farm animals and to the Michelsberg pottery tradition (B. Vanmontfort 2004). At other locations in the region crop cultivation is reflected in the pollen record for the same period, from c. 4000 cal. BC onward (E. Meylemans et al. 2018, 2). So this stage meant a rigorous culture change. We assume that the shift to a fully agrarian way of life took place in this stage and relate the cereals to the new subsistence practices, rather than to continued import.



■ Fig. 8. Bazel, pottery sherds 5200–4200 cal BC. a) Limburg ware, b) Bandkeramik, c) Randkerbung, d–f) Swifterbant sherds with Epi-Rössen derived impressions, g) Lochbuckel. After: Meylemans et al. 2016

4. Synthesis

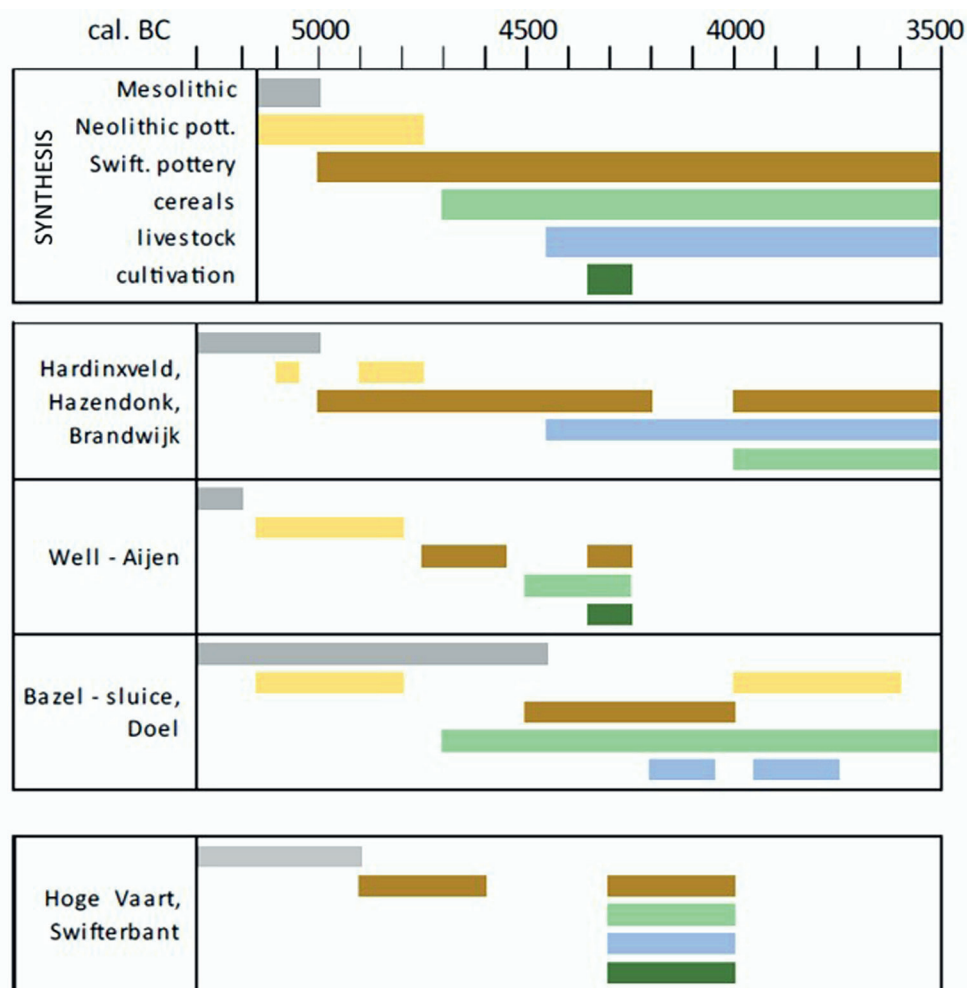
Neolithization started just like elsewhere in Northern Europe with the Bandkeramik colonization of the loess zone. This is not conceived any more as a 'wave of advance' but generally as the outcome of a 'leap frogging' chain colonization, prospected and initiated by pioneer settlers (D.W. Anthony 1997). Mutual contacts will not have been hostile but cooperative, with the exchange of knowledge and material, as predicted in the pioneer colonization model.

The expansion of the Bandkeramik stopped at the loess-sand boundary, with an open frontier, allowing regular connections. Factual contacts of the Mesolithic are documented by flint arrow heads and pottery, both at two of the sites and most distinct at Bazel (Fig. 8), while the indigenous roots of the northern Neolithic are documented by the continuity of occupation at two sites from the Late Mesolithic onward. The later flint industry was rooted in the previous Mesolithic in such a way that both

cannot be separated properly when found apart, and southern connections for flint supply existed already from the beginning.

The Neolithization in this area had the form of several successive adoptions of Neolithic novelties. Four successive stages are distinguished, not as 'substitutions' of traditional customs in a relative short time span according to the model of M. Zvebil (1986), but as additions by means of a series of adoptions by the Mesolithic hunters, over a trajectory of centuries, as illustrated in the time table of Fig. 9, which is just based on the data at present available and possibly may be adjusted on the basis of new evidence.

The first adoption was the production of pottery in a fully native technique and style, with a reliably dated start around 5000 cal. BC in the Hardinxveld stratigraphy. It has a slightly later counterpart in phase 3 of the upland margin site of Hogevaart, some 100 km to the north, dated to 4800–4500 cal. BC (D.C.M. Raemaekers 2008). This pottery is coil-built, with a temper of local readily available



■ Fig. 9. Chronological overview of the first occurrences of Neolithic adoptions at the three discussed sites; with the Swifterbant area as a reference. Drawing: Archol, Leiden

materials. It has characteristic pointed or round bases and generally flaring rims, with rows of impressions as the only detailing. The new 'culture' is in essence just the transformation into a ceramic Mesolithic, comparable in process to the Danish Ertebølle. It was named 'Swifterbant' after the first well-documented complexes, that, however, represent an evolved stage of the tradition. No other innovations are dated to this stage so far. Why pottery? It will be attractive for the hunters as a means for a new way of food preparation, as documented by food crusts, and as storage vessels for perishable materials that had to be protected against moist, insects and rodents.

In this same early stage Bandkeramik adzes found their way north, especially in the eastern part of the area. Some may have been acquired by the Late Mesolithic hunters, but the majority most probably relate to small scale expeditions of the Bandkeramik people into the sand area, as documented by their camp sites in Middle Limburg (L. Verhart 2012; G.L. Dusseldorp and L.W.S.W. Amkreutz 2015).

Continued contacts, with successors of the Bandkeramik (Großgartach and Blicquy) are reflected in the presence of their 'exotic' pottery at Hardinxveld, and later by the application on indigenous pots of decoration derived from Rössen to the east in the Meuse area and late Epi-Rössen to the south along the Scheldt. In this way regional pottery styles were created. Farther to the north – in the Swifterbant region – such contacts were perhaps not to the south, but in a more easterly direction.

In this trajectory the first cereals were adopted by the Swifterbant people, as documented at Bazel, followed by Well-Aijen c. 4450 cal BC. But their (small scale) cultivation is not earlier attested than mid fifth century. Domestic animals start at Hardinxveld about the same time around 4450, possibly even slightly earlier, followed by Bazel 4200 cal. BC, where they may be connected with the successive Michelsberg occupation.⁸

These marked contrasts between the sites might reflect different choices of the societies involved, but may for the greater part be understood by the strong differences in the various site parameters like taphonomy, preservation and research strategy. Why these adoptions? Each of

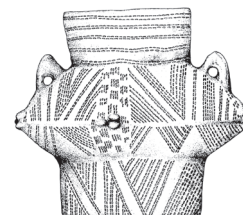
these meant a widening of the traditional Broad Spectrum Economy, desirable as a way of lowering the risks of failures of the natural resources, and a contribution to their well-being, in an evolutionary perspective (G.L. Dusseldorp and L.W.S.W. Amkreutz 2015).

The shift to a fully agrarian society may, however, not have taken place before 4000 cal. BC after the change from the Swifterbant to the Michelsberg occupation at Bazel, where a co-occurrence of cereal grains and a pure domestic faunal spectrum is documented. It reflects the expansion of a fundamentally different society, developed in the loess zone, familiar with collective enterprises like flint mines and massive earth works.

It is in these societies in the southern coversand landscape that the adoptions farther to the north in the wetlands must have been rooted and applied in tandem with a continuity in the exploitation of the typical rich resources like fishing and beaver trapping. Subsistence there was attuned to the specific sedimentary local conditions like tidal levees and coastal barriers, in some areas even up till Beaker times, as frequently described, for instance in my paper now almost thirty years ago for the 'Case Studies' volume initiated by Peter Bogucki (1993) and later (L.P. Louwe Kooijmans 2007; G.L. Dusseldorp and L.W.S.W. Amkreutz 2020).

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⁸ The new earlier radiocarbon data for sheep at Bazel as published by Crombé et al. in "Nature - Scientific Reports" (2020) 10-20083 were not available to me when the manuscript was closed (October 2020).

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