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The start of pottery production by hunter-gatherers in the Low Countries (Swifterbant Culture, 5th millennium BC)
A critical assessment of the available radiocarbon dates

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1. Introduction

In the course of the 5th millennium cal BC, hunter-gatherers in The Netherlands and northern Belgium gradually adopted Neolithic practices, through contact with early farming communities from the southern lœss regions. It seems to have started with the production of pottery (in Late Mesolithic context), followed by animal husbandry and plant cultivation. Research into the neolithisation process in the Low Countries is largely focused on these hunter-gatherers in transition, known as the Swifterbant (SW) Culture. The exact timing for the introduction of animal husbandry and plant cultivation is the subject of ongoing research and debate (*e.g.*, Çakırlar *et al*., 2020; Crombé *et al*., 2020, in press; Raemaekers *et al*., 2021). Contrary, the starting date for pottery production by local hunter-gatherers is never really questioned. It has been set around 5000 cal BC, based on the finds at two river dune sites in the Rhine/Meuse river delta (Louwe Kooijmans, 2001a, 2001b), and has not been challenged since. Up to now, four sites in The Netherlands yielded SW Culture pottery dating to the period between ca. 5000-4600 cal BC (see Raemaekers, 2011). However, this chronology is not unambiguous.

The starting date for pottery production by local hunter-gatherers is an important issue in the neolithisation debate and is therefore worth discussing. It provides insight into when the social relations with early farming populations intensified to a point where complex technologies such as pottery production could be transferred, and which farming populations could have been involved in this process. Moreover, the starting date for pottery production is also considered the starting point for the SW Culture. This paper critically reviews the available radiocarbon (^{14}C) dates for the earliest SW Culture sites with pottery in the Netherlands.

2. Swifterbant Culture sites and general chronology

The SW Culture occupations are situated in wetland environments in the sandy areas between the Scheldt river in northern Belgium and the Elbe river in north-western Germany (Fig. 1). So far, five sites in the lower Scheldt valley represent the most southern and western distribution. These include occupations on top of Pleistocene coversand ridges in the river floodplain (Doel *Deurganckdok* sites *B*, *J* and *M*) and on levees along the Scheldt palaeochannel (Bazel *Sluis*; Melsele *Hof ten Damme*) (Crombé *et al*., 2015; Meylemans *et al*., 2016; Teetaert, 2020). The most eastern distribution is represented by the site of Hüde I at lake Dümmer in Lower Saxony (Kampffmeyer, 1991; Raemaekers, 1999). Most SW Culture sites are however situated on river dunes, levees and coversand ridges in the wetland areas of The Netherlands. Today, well over 20 sites are known here, including multiple sites near the eponymous Swifterbant in Flevoland (*e.g.*, Raemaekers & De Roever, 2010; Devriendt, 2013). These sites largely cluster in two areas: the Rhine/Meuse river delta and the IJssel/Vecht/Eem river area (Fig. 1). Many of the wetland sites

became covered by Holocene clay and peat, which led to a generally good preservation of organic materials. From the dryer, upland Pleistocene sand areas, only stray finds are known, while substantial occupation remains are lacking. This could be partly due to the poor preservation conditions in these areas (Raemaekers, 1999).

Recent chronologies distinguish between an early (5000/4900-4600/4400 cal BC), a middle (4600/4400-3900/3800 cal BC) and a late or "Pre-Drouwen" phase (until ca. 3400 cal BC) for the SW Culture (Raemaekers, 1999; ten Anscher, 2012). The boundaries between these phases are largely based on differences in the pottery shapes, decoration and temper materials observed between sites (Raemaekers, 1999; Raemaekers & De Roever, 2010). The early phase is only represented at four sites. First, the river dune occupations at Hardinxveld-Giessendam *Polderweg* (ca. 5000-4500 cal BC) and *De Bruin* (ca. 5100-4450 cal BC)[1], situated in the Rhine/Meuse river delta (Louwe Kooijmans, 2001a, 2001b). Second, the occupations at Almere *Hoge Vaart - A27*, situated on a coversand ridge near a precursor of the Eem river (ca. 4900-4400 cal BC) (Haanen & Hogestijn, 2001; Hogestijn & Peeters, 2001; Peeters, 2010). Finally, there is the Bronneger vessel (ca. 4850-4550 cal BC), a dredged find from the Buinen-Schoonoord canal in the province of Drenthe (Kroezenga *et al.*, 1991; Hedges *et al.*, 1992; Lanting & van der Plicht, 1999/2000; Raemaekers, 2011).

For the period between ca. 4600-3800 cal BC (middle phase), there is a significant increase in known SW Culture sites. These now occur in all three major distribution areas: the Scheldt river valley (*e.g.* Doel)[2], the Rhine/Meuse river delta (*e.g.*, Brandwijk; Hazendonk; Medel), and the IJssel/Vecht/Eem river area (*e.g.*, several sites near Swifterbant). These three main clusters of sites have been interpreted as regional (pottery) groups within the SW Culture (Raemaekers, 1999, 2003/2004; Raemaekers & De Roever, 2010). Only in the area north of the Rhine, a late phase until ca. 3400 cal BC is observed (Raemaekers, 2003/2004; ten Anscher, 2012, 2015).

3. The early phase of the Swifterbant Culture versus ^{14}C dates

Following, we present the available ^{14}C dates for the early phase of the SW Culture. For each of the four sites involved, the dated materials are listed (Tab. 1) and the reliability of the ^{14}C dates is evaluated.

3.1. Hardinxveld-Giessendam Polderweg

Hardinxveld-Giessendam *Polderweg* is a river dune site with a series of dated find layers on its slopes. These layers could largely be related to two main occupation phases: phase 1 (ca. 5500-5300 cal BC) and phase 2 (ca. 5000-4500 cal BC) (Louwe Kooijmans & Mol, 2001). The small number of pottery remains (86 sherds) from this site seem to be restricted to phase 2 (Raemaekers, 2001a: 107). The chronology of phase 2 is based on five AMS ^{14}C determinations of different types of organic remains from the lithological units related to this occupation phase. One of these dates, performed on a sample of alder (*Alnus*) fruit cones[3], cannot be related with certainty to phase 1 or phase 2 and is

1. These sites have a longer occupation history, but only the occupation phases with SW Culture pottery are mentioned here (based on Raemaekers, 2011).

2. The SW Culture occupations at the levee sites of Bazel *Sluis* and Melsele *Hof ten Damme* are difficult to date, because of the palimpsest situation at these sites. The remains of several occupations, dating from the Early Mesolithic to the Middle Neolithic, became mixed.

3. GrA-9802: 6050 ± 50 BP; ca. 5205-4797 cal BC (2σ) (Louwe Kooijmans & Mol, 2001: tab. 3.2).

Fig. 1 – Location of Swifterbant Culture sites mentioned in the text. The site locations for the early phase are indicated in red.

therefore left out of the discussion. The other dates include one date of (unidentified?) organic macro-remains, two dates of pottery food crusts and one date of a human skull (Tab. 1). In addition to these AMS ^{14}C determinations, there is one tree-ring date from an oak sample (4972 ± 6 BC) that can be related to phase 2, although its association with the human occupations is uncertain (Louwe Kooijmans & Mol, 2001: 67). Based on the available dates, the excavators suggest a starting date for occupation phase 2 around 5000 cal BC. This is, consequently, also the earliest possible date for the SW Culture pottery from this phase.

In our view, this should be reconsidered. The food crust dates and the human skull date more or less cluster between ca. 5200-5000/4950 cal BC (2σ). However, the reliability of these dates is uncertain. Louwe Kooijmans & Mol (2001: 70) already indicated that a

reservoir effect of several centuries due to the consumption of fish is plausible for the human skull date. This was later confirmed by stable isotope analysis (Smits & van der Plicht, 2009); all human bones from *Polderweg* yielded elevated $\delta^{15}N$ values (>13), which points to the importance of aquatic resources in the diet. *Polderweg* yielded an estimated total of two million fish remains. Over 57000 of these have been studied (Beerenhout, 2001a). Almost all identified remains are of freshwater fish, especially species of the carp family (*Cyprinidae*) and pike. Of the analysed fish remains from occupation phase 2 (n = 252), 76 % was calcined and 8 % was heavily burnt, which points to consumption. This raises questions about the reliability of the pottery food crust dates. If fish was processed in these vessels, the dates will be too old. A possible reservoir effect on the food crust dates from *Polderweg* was already pointed out by several authors (e.g., Lanting & van der Plicht, 1999/2000: 54; Raemaekers, 2003/2004, 2011). The stable isotope ratios do not provide sufficient information on the possible presence of freshwater components in this food residue, as only the $\delta^{13}C$ values were measured (Tab. 1), not the $\delta^{15}N$ values (*cf.* Craig *et al.*, 2007). However, recent analysis of absorbed lipids in the pottery from

Site	*Lab code*	*Sample*	*^{14}C age BP*	*cal BC (2σ)*	*$\delta^{13}C$ (‰)*
Polderweg	GrA-9800	Macro-remains	5780 ± 50	4766 - 4499	
Phase 2	GrA-11829	Food crusts	6130 ± 50	5216 - 4941	-29.3
	GrA-11841	Food crusts	6140 ± 50	5217 - 4948	-28.1
	GrA-11830	Human skull	6170 ± 60	5297 - 4981	-24.3
De Bruin	GrA-10950	Macro-remains	5430 ± 60	4438 - 4056	
Phase 3	GrA-13320	Food crusts	5730 ± 50	4694 - 4461	-29.3
	GrA-13317	Food crusts	5880 ± 50	4896 - 4610	-27.7
	GrA-13272	Macro-remains	5900 ± 50	4932 - 4621	
De Bruin	GrA-14864	Macro-remains	5685 ± 50	4685 - 4374	
Phase 2	GrA-13278	Macro-remains	5730 ± 50	4694 - 4461	
	GrA-15034	Macro-remains	6010 ± 55	5051 - 4749	
	GrA-13296	Macro-remains	6050 ± 50	5202 - 4799	
	GrA-13315	Food crusts	6070 ± 50	5207 - 4839	-28.2
	GrA-13313	Food crusts	6090 ± 50	5208 - 4851	-27.4
	GrA-13318	Food crusts	6100 ± 50	5210 - 4856	-27.1
	GrA-14865	Macro-remains	6120 ± 50	5216 - 4912	
	GrA-12304	Macro-remains	6170 ± 50	5291 - 4991	
Hoge Vaart	UtC-5719	Food crusts	5396 ± 43	4343 - 4068	-27.6
Phase 3	UtC-12478	Charcoal	5667 ± 42	4610 - 4366	
	UtC-12456	Charcoal	5690 ± 50	4682 - 4371	
	UtC-12482	Charcoal	5707 ± 46	4683 - 4449	
	UtC-4620	Charcoal	5709 ± 47	4686 - 4457	
	UtC-4621	Charcoal	5710 ± 50	4689 - 4454	
	UtC-5711	Wooden pole	5714 ± 49	4688 - 4457	
	UtC-5712	Wooden pole	5729 ± 46	4690 - 4464	
	UtC-12471	Charcoal	5735 ± 43	4699 - 4458	
	UtC-4619	Charcoal	5739 ± 44	4706 - 4487	
	UtC-5710	Wooden pole	5742 ± 47	4709 - 4486	
	UtC-12473	Charcoal	5745 ± 40	4704 - 4494	
	UtC-12464	Charcoal	5753 ± 45	4714 - 4465	
	UtC-12465	Charcoal	5753 ± 45	4714 - 4465	

Site	Lab code	Sample	^{14}C age BP	cal BC (2σ)	$\delta^{13}C$ (‰)
Hoge Vaart	UtC-12463	Charcoal	5758 ± 41	4711 - 4501	
Phase 3	UtC-12466	Charcoal	5766 ± 45	4719 - 4497	
	UtC-12474	Charcoal	5778 ± 43	4724 - 4502	
	UtC-5715	Food crusts	5778 ± 43	4724 - 4519	-26.8
	UtC-12470	Charcoal	5780 ± 45	4770 - 4500	
	UtC-12454	Charcoal	5785 ± 46	4778 - 4502	
	UtC-12462	Charcoal	5786 ± 43	4776 - 4505	
	UtC-12461	Charcoal	5790 ± 48	4783 - 4504	
	UtC-12475	Charcoal	5791 ± 40	4777 - 4538	
	UtC-12458	Charcoal	5803 ± 46	4785 - 4542	
	UtC-4624	Charcoal	5807 ± 43	4777 - 4547	
	UtC-4625	Charcoal	5808 ± 45	4778 - 4547	
	UtC-4615	Charcoal	5810 ± 50	4785 - 4544	
	UtC-12472	Charcoal	5811 ± 38	4782 - 4548	
	UtC-4622	Charcoal	5820 ± 50	4791 - 4546	
	UtC-12477	Charcoal	5823 ± 48	4791 - 4548	
	UtC-12479	Charcoal	5824 ± 43	4789 - 4551	
	UtC-12452	Charcoal	5826 ± 48	4792 - 4549	
	UtC-12460	Charcoal	5828 ± 47	4792 - 4550	
	UtC-12455	Charcoal	5828 ± 48	4793 - 4549	
	UtC-4618	Charcoal	5831 ± 47	4793 - 4554	
	UtC-12468	Charcoal	5836 ± 47	4796 - 4550	
	UtC-12469	Charcoal	5841 ± 43	4827 - 4552	
	UtC-4617	Charcoal	5851 ± 45	4832 - 4589	
	UtC-12453	Charcoal	5853 ± 48	4838 - 4555	
	UtC-4616	Charcoal	5870 ± 50	4881 - 4596	
	UtC-12467	Charcoal	5874 ± 44	4845 - 4611	
	UtC-4630	Food crusts	5882 ± 45	4882 - 4616	-27.5
	UtC-12457	Charcoal	5890 ± 60	4935 - 4605	
	UtC-4631	Food crusts	5894 ± 47	4901 - 4616	-27.4
	UtC-12459	Charcoal	5899 ± 47	4904 - 4618	
	UtC-4627	Food crusts	5900 ± 50	4932 - 4621	-26.3
	UtC-12476	Charcoal	5904 ± 44	4904 - 4681	
	UtC-4629	Food crusts	5920 ± 60	4963 - 4619	-26.9
	UtC-12481	Charcoal	5921 ± 42	4932 - 4706	
	UtC-4628	Food crusts	5930 ± 46	4933 - 4713	-27.8
	UtC-5718	Food crusts	5947 ± 45	4941 - 4721	-26.7
	UtC-5717	Food crusts	5953 ± 47	4947 - 4720	-26.9
	UtC-5716	Food crusts	5956 ± 46	4949 - 4721	-28.5
	UtC-4626	Charcoal	5976 ± 48	4988 - 4730	
Bronneger	OxA-2909	Antler	5720 ± 90	4770 - 4363	
	OxA-2908	Food crusts	5890 ± 90	4990 - 4543	n.a.
	OxA-2910	Antler	5970 ± 90	5205 - 4614	

Tab. 1 – Available ^{14}C determinations for the early phase of the Swifterbant Culture in the Netherlands (Hedges *et al.*, 1992; Louwe Kooijmans & Mol, 2001; Mol & Louwe Kooijmans, 2001; Peeters *et al.*, 2001; Peeters, 2007). This table is a reproduction from Raemaekers (2011: tab. 1), with the addition of one ^{14}C determination of organic macro-remains from Hardinxveld-Giessendam *Polderweg* (Louwe Kooijmans & Mol, 2001), nine ^{14}C determinations of pottery food crusts and 31 ^{14}C determinations of charcoal from Almere *Hoge Vaart A27* (Peeters *et al.*, 2001; Peeters 2007). ^{14}C calibrations are performed using OxCal v.4.3 (Bronk Ramsey, 2009) and the IntCal13 calibration curve date (Reimer *et al.*, 2013).

Polderweg revealed aquatic biomarkers, which clearly indicate that freshwater fish was processed in these vessels (Demirci *et al*., 2021). Based on this information, it is likely that both the food crust dates and the human skull date are several centuries too old, due to a freshwater reservoir effect[4]. Their actual age is probably more in line with that of the dated organic macro-remains from occupation phase 2: ca. 4800/4750-4500 cal BC (2σ) (Tab. 1: GrA-9800). Even if these macro-remains cannot be associated with certainty to the human activities, they provide a time frame for the sediment deposits in which the pottery was found. The tree-ring date of ca. 5000 cal BC is more or less in line with the food crust and human skull dates. If we assume a reservoir effect for the latter, the death of this tree is probably not contemporaneous with the human occupation with pottery. Rather, the tree-ring date provides *a terminus ante quem* for occupation phase 1.

3.2. Hardinxveld-Giessendam De Bruin

The river dune site of *De Bruin* is located only 1 km away from *Polderweg*. The environmental setting and stratigraphy are quite similar to *Polderweg*, but *De Bruin* has a different occupation history, in three phases: phase 1 (ca. 5500-5100 cal BC), phase 2 (ca. 5100-4800 cal BC) and phase 3 (ca. 4700-4450 cal BC). The boundaries between these occupation phases are represented by sediment layers with few archaeological finds (Louwe Kooijmans, 2001c; Mol & Louwe Kooijmans, 2001). The 4270 potsherds are restricted to occupation phases 2 and 3 (Raemaekers, 2001b: 121). Most of this is SW Culture pottery, but phase 2 also yielded 49 sherds of Blicquy/Villeneuve-Saint-Germain (BVSG) Culture pottery. The chronology of phase 2 is based on six ^{14}C dates of (unidentified?) organic macro-remains and another three ^{14}C dates of pottery food crusts, whereas the chronology of phase 3 is based on two ^{14}C dates of (unidentified?) organic macro-remains and two ^{14}C dates of pottery food crusts (Tab. 1). The excavators set an artificial boundary between occupation phases 1 and 2 (at 5100 BC), based on the youngest samples for phase 1 and the oldest samples for phase 2, which clearly came from subsequent sediment layers (Mol & Louwe Kooijmans 2001: 69). This means that the oldest pottery from *De Bruin* could theoretically date back to 5100 cal BC.

In our view, this chronology should be treated with caution. For phase 2, two macro-remains date between ca. 5200-5000/4900 cal BC (2σ), followed by three food crust dates between ca. 5200-4850 cal BC (2σ), a third date on macro-remains between ca. 5200-4800 cal BC (2σ) and another date on macro-remains between ca. 5050-4750 cal BC (2σ). These seven samples represent the oldest date cluster for phase 2, largely situated between 5200/5000 and 4800 cal BC. Two other samples of macro-remains yielded younger dates, between ca. 4700-4450/4400 cal BC (2σ). For phase 3, one of the macro-remains and one food crust sample date between ca. 4900-4600 cal BC (2σ), followed by a second food crust date between ca. 4700-4450 cal BC (2σ) and a second sample of macro-remains dating between ca. 4450-4000 cal BC (2σ).

The reliability of the food crust dates is uncertain at least. A possible reservoir effect on these dates has already been suggested by several authors (*e.g.*, Lanting & van der Plicht, 1999/2000; Raemaekers, 2003/2004, 2011). The stable isotope ratios cannot be used as an indication for freshwater components in the food residue, as the δ^{15}N values were not measured. However, the excavations at *De Bruin* yielded an estimated 0.6 million fish remains, ca. 15000 of which were analysed in detail, including around 7000 remains from phase 2 and 4000 from phase 3 (Beerenhout, 2001b). As for *Polderweg*, freshwater

4. The freshwater reservoir effect on food crust dates (n = 24) from the Doel sites in the Scheldt valley is variable, but can reach up to ca. 400 years cal BC (Boudin *et al*., 2009, 2010; Teetaert, 2020; Teetaert *et al*., 2020).

fish dominates the assemblage, with mainly *Cyprinidae* and pike. Part of the fish remains are charred or calcined, and could thus represent consumption waste. Fish consumption was also demonstrated by the stable isotope analysis of 5 human bones (Smits & van der Plicht, 2009). Moreover, recent analysis of the absorbed lipids in pottery from *De Bruin* revealed aquatic biomarkers, which clearly indicate the processing of freshwater fish in at least some of the vessels (Demirci *et al.*, 2021). Therefore, it is likely that most if not all food crust dates from *De Bruin* are several centuries too old, due to a freshwater reservoir effect. Given the unreliable nature of these dates, it is better to focus on the dates of organic macro-remains, as these provide a time frame for both occupation phases with pottery, albeit in an indirect way. For phase 2, the oldest macro-remains date between ca. 5200/5000-4800/4750 cal BC (2σ), which is in line with the food crust dates, whereas the youngest macro-remains date between ca. 4700-4450/4400 cal BC (2σ). If we assume a reservoir effect on the food crust dates, it is likely that the actual age of the pottery is closer to that of the youngest cluster of macro-remains. After all, there are no clear indications that pottery already appeared from the very beginning of occupation phase 2. This seems to be corroborated by the stratigraphical evidence. The vast majority of pottery comes from layers 30 (ca. 34 %) and 40 (ca. 53 %). Layer 30 represents the upper peat showing evidence of multiple trampling activities, and is attributed to the later stages of phase 2 (Mol & Louwe Kooijmans, 2001). Layer 40 on the other hand consists of colluvial deposits, implying the possible admixture of cultural and macrobotanical remains. Hence, a starting date for the pottery from phase 2 at *De Bruin* around or after 4700 cal BC should be considered. The presence of BVSG pottery among the remains from this phase does not contradict this. It could either pre-date the SW Culture pottery at this site, or be contemporaneous with it, as the chronology for the BVSG Culture spans the period between ca. 5000/4950-4700/4650 cal BC (Dubouloz, 2003; Denis, 2017; Praud *et al.*, 2018). Of course, it would also imply that occupation phase 3 at *De Bruin* started later than ca. 4700 cal BC. This seems to be supported by two recent dates on sheep/goat bones from phase 2 [ca. 4520-4356 cal BC (2σ)][5] and phase 3 [ca. 4335-4060 cal BC (2σ)][6] (Çakırlar *et al.*, 2020).

3.3. Almere Hoge Vaart – A27

At Almere, the human occupations are situated on a coversand ridge, flanked by a lower lying area intersected by riverine and tidal gullies (Peeters, 2009). The oldest occupations date back to the Middle and Late Mesolithic. The SW Culture pottery (2666 sherds) is however restricted to phase 3 (ca. 4900-4400 cal BC) (Peeters *et al.*, 2001; Peeters, 2010). The chronology for this occupation phase is based on 10 ^{14}C dates of pottery food crusts, 41^{14}C dates of charcoal, retrieved from shallow surface hearths, and three ^{14}C dates of wooden poles preserved inside postholes, which likely relate to dwelling structures (Peeters *et al.*, 2001; Peeters, 2007, 2010) (Tab. 1).

Previous analysis by Crombé *et al.* (2013) has shown that although the 97.5 % probability range is very similar for the charcoal and food crust dates from *Hoge Vaart* (ca. 4950-4600 cal BC and ca. 4900-4500 cal BC, respectively), the floruit for both series do not overlap, indicating that the food crust samples are on average about 100 years older. This might be due to a fish reservoir effect. Sadly, so far, residue analysis has not yet been performed for the pottery from *Hoge Vaart*, and the δ^{15}N values for the dated food crusts have not been measured. Peeters (2010) however states that additional measurements of the stable carbon and nitrogen isotope ratios for food crusts from this site yielded values of -25.1 to -27.5 ‰ δ^{13}C and +2.4 to +15 ‰ δ^{15}N, which could

5. GrA-62951: 5610 ± 40 BP.

6. GrA-64342: 5380 ± 40 BP.

well indicate freshwater components in these residues (*cf.* Craig *et al.*, 2007). The excavations at *Hoge Vaart* yielded over 2600 fish remains, most of which were found on the coversand ridge. Freshwater fish, in particular perch, species of the carp family, and pike, dominate the assemblage (Laarman, 2001). Part of these fish remains are burnt, which points at consumption. It is not clear which part of these fish remains are associated with occupation phase 3. During the excavations, the remains of three wishing weirs and two fish traps were retrieved from a gulley to the east of the sand ridge, but these belong to a younger occupation (ca. 4300-4000 cal BC). (Peeters *et al.*, 2001; Peeters & Hogestijn, 2001). Nonetheless, the location of this site, in vicinity of riverine and tidal gullies, and the presence of (burnt) fish bones on the coversand ridge, make it plausible that fish was consumed and prepared in the pottery from *Hoge Vaart*. The $\delta^{15}N$ values mentioned by Peeters (2010) strengthen this idea, although they do not provide conclusive proof. Further, it cannot be excluded that some of the charcoal samples yielded slightly too old dates as a result of an old wood effect. The analysed charcoal from the surface hearths derives from different wood species, but mainly from oak (van Rijn & Kooistra, 2001). Since oak is a long-lived tree species, ^{14}C dates of oak have a high risk of old wood effect.

Based on the information mentioned above, we support the conclusion by Crombé *et al.* (2013) that the food crust dates from *Hoge Vaart* might be, on average, 100 or even several hundred years too old, due to a freshwater reservoir effect. This would imply that the SW Culture pottery from this site should not be dated before ca. 4800 cal BC. This assumption might be reinforced by three ^{14}C dates obtained on wooden poles[7] of supposedly contemporaneous dwelling structures, which cluster between ca. 4700-4570 cal BC (2σ) (Crombé *et al.*, 2013).

3.4. Bronneger

The Bronneger vessel was found together with two red deer antlers in dredged sediment from the Buinen-Schoonoord canal in the province of Drenthe (Kroezenga *et al.*, 1991). Possibly, the finds originate from a sandy river deposit of the Voorste Diep stream, the natural predecessor of this canal. All three finds were dated by AMS ^{14}C dating (Hedges *et al.*, 1992) (Tab. 1). One antler dates between ca. 5200-4600 cal BC (2σ), the other antler between ca. 4750-4350 cal BC (2σ), and the food crusts preserved on the vessel yielded an intermediate date between ca. 5000-4450 cal BC (2σ). Despite the variability between these dates, several researchers agree that the vessel and antlers are associated finds, that were likely deposited together (Kroezenga *et al.*, 1991; Hedges *et al.*, 1992; Lanting & van der Plicht, 1999/2000). Based on this premise, Lanting & van der Plicht (1999/2000) ignore the possibility of a reservoir effect on the food crust date, and provide a combined date for the three finds of 5860 ± 52 BP [ca. 4844-4552 cal. BC (2σ)]. However, a reservoir effect for this food crust date is definitely possible[8]. The only way to prove or disprove it is by performing residue analysis. Furthermore, there is no reason to assume that the Bronneger vessel and the red deer antlers represent a single deposition or belong to the exact same period. Since the objects were found in dredged soil, out of context, there are no arguments to support that hypothesis. Hedges *et al.* (1992) even note that more antlers, antler implements and bones were found during the construction of the canal in 1927 to 1930. In our view, the Bronneger vessel should not be taken into account as one of the possibly oldest SW Culture vessels until the possibility of a reservoir effect on the food crust date can be excluded based on residue analysis.

7. It is not clear which wood species were used for the wooden stakes of the dwelling structures.

8. This has already been suggested by ten Anscher (2012: 128, footnote 67).

4. Discussion and conclusions

The available ^{14}C dates for the occupation phases with SW Culture pottery at *Polderweg*, *De Bruin* and *Hoge Vaart*, and the dredged finds from Bronneger, do not allow to strictly date the oldest SW Culture pottery around 5000/4900 cal BC. Such an early date is possible. However, if we exclude the food crust dates with a probable reservoir effect from the list and focus on the dates of organic macro-remains that were found within the same sediment layers as the pottery remains, the dates for these occupations could be reduced to 4800/4750-4500 cal BC (2σ) (*Polderweg*) or 4700-4550/4450 cal BC (2σ) (*De Bruin* and *Hoge Vaart*[9]). This means that, based on the currently known sites, the start of pottery production in the SW Culture could well be situated between 4800 and 4700/4600 cal BC.

This younger date makes sense, if we consider the significant increase in the number of known sites with SW Culture pottery for the period after ca. 4600 cal BC. It reduces the time difference between these sites. After all, the characteristics of the pottery itself do not necessarily support a gap of ca. 400 years between the oldest pottery and that of the middle phase. The distinction between an early and a middle phase was originally based on the increase in the use of plant temper, being marginal in pottery from the early phase and becoming dominant in the middle phase (Raemaekers, 1999). However, the pottery from *De Bruin* showed that plant temper can also be dominant at the early sites. Raemaekers & De Roever (2010) therefore concluded that, for now, the main difference between the pottery of the early and late phases is the increase in the percentage of body decoration (also see Raemaekers 2003/2004: fig. 11, 12). However, body decoration is not entirely absent from the early sites. Some decorated body sherds were found at both *De Bruin*, *Polderweg* and *Hoge Vaart*. The problem is that these sites only yielded small pottery assemblages compared to most sites of the middle phase. This makes it difficult to evaluate the significance of the observed differences in pottery morphology, decoration and temper materials.

A difference of a few hundred years for the start of indigenous pottery production might seem irrelevant, but it has important implications as to which farming populations could have transferred this technological know-how. A starting date for SW Culture pottery production between 4800 and 4700/4600 cal BC certainly excludes the Linearbandkeramik (LBK) Culture populations of north-western Europe as the source of inspiration. It is rather contemporaneous with the BVSG Culture in central Belgium and the Paris Basin (ca. 5000/4950-4700/4650 cal BC) (Dubouloz, 2003; Denis, 2017; Praud *et al.*, 2018), and with the Hinkelstein/Grossgartach/Planig-Friedberg/Rössen Cultures in the Rhineland (ca. 4900/4850-4450 cal BC) (Denaire *et al.,* 2017). Several researchers have already indicated a possible link between the SW Culture and Grossgartach/Rössen Cultures, based on similarities in pottery shapes and decoration (Raemaekers, 1999; Crombé, 2009; ten Anscher, 2012, 2015). Recent analysis of the SW Culture pottery from the Scheldt river valley, on the other hand, shows clear parallels in pottery technology with the BVSG Culture (Teetaert, 2020). The SW Culture pottery from this area was built using the exact same coiling procedures and shaping techniques that were used at the BVSG site of Vaux-et-Borset (Hesbaye region, Belgium) (van Doosselaere *et al.*, 2016). Based on these recent insights, it is hypothesized that the hunter-gatherers in northern Belgium, and perhaps in The Netherlands, adopted the pottery technology from potters of the BVSG Culture (Teetaert, 2020). More research on these possible links with the BVSG and Rhineland Cultures is necessary. In any case, this transfer of knowledge indicates close and long-term interactions between the hunter-gatherer and farming communities. In this context, it is relevant to note that the oldest cereal

9. That is, if we take the ^{14}C dates on wooden poles from Almere *Hoge Vaart* into account.

grains and bones of domestic animals in the Scheldt river valley also date to the period between ca. 4800-4600/4500 cal BC (Meylemans *et al.*, 2018; Crombé *et al.*, 2020). Together, these data point to an increased mobility of people/objects between the læss and coversand regions, and to intensified contacts between hunter-gatherer and farming populations during the second quarter of the 5th millennium cal BC.

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Abstract

In this paper we critically review the earliest dates for pottery production by hunter-gatherers in the Low Countries (Swifterbant Culture). The start of pottery production in the Swifterbant Culture is traditionally set around 5000 cal BC. We argue that his date is largely based on pottery food crust dates, which have a probable reservoir effect due to the processing of freshwater fish in these vessels. If we focus only on the ^{14}C dates of organic macro-remains, found within the same sediment layers as the pottery remains, then it is quite possible that the oldest Swifterbant Culture pottery actually dates between ca. 4800 and 4700/4600 cal BC.

Keywords: Swifterbant Culture, early Swifterbant phase, The Netherlands, pottery, ^{14}C dating.

Samenvatting

In dit artikel worden de vroegste dateringen voor aardwerkproductie bij de Swifterbantcultuur in de Lage Landen op kritische wijze geëvalueerd. De startdatum wordt traditioneel geplaatst rond 5000 cal BC. We stellen dat deze startdatum grotendeels gebaseerd is op dateringen van aangekoekt voedselresidu op aardewerk. Deze dateringen zijn naar alle waarschijnlijkheid te oud, omwille van een reservoir effect dat voortkomt uit de verwerking van zoetwatervis in deze potten. Indien we ons richten op de dateringen van organische macroresten, afkomstig uit dezelfde sedimentlagen als het aardewerk, dan is het oudste Swifterbantaardewerk mogelijk eerder te dateren tussen ca. 4800 en 4700/4600 cal BC.

Trefwoorden: Swifterbantcultuur, vroege Swifterbantfase, Nederland, aardewerk, ^{14}C-datering.

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