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Towards a reconstruction of the techno-economic variability of the Ahrensburgian in Schleswig-Holstein

Ludovic MEVEL, Mara-Julia WEBER and Inger Marie BERG-HANSEN

Abstract: Northernmost Germany represents one of the regions in North-West Europe where a succession of Late Palaeolithic traditions makes it possible to describe the techno-economic changes which led from the Late Upper Palaeolithic to the beginning of the Mesolithic. The aim of this paper will be to propose a model of the techno-economic evolution of the Ahrensburgian that culminated in exceptional lithic productions at the Pleistocene-Holocene transition, and to put it into perspective by discussing the changes which occurred throughout this tradition on the basis of several Ahrensburgian settlements. These conclusions will be drawn from evidence obtained on lithic industries from different sites in Schleswig-Holstein. In the absence of direct dating, the lithic industries from Teltwisch 2 and Teltwisch-Mitte in the Ahrensburg tunnel valley were regarded as sufficiently characteristic to attribute these sites to two different phases of the Ahrensburgian: the recent phase with Long Blades and Zonhoven points (Eggstedt-Stellmoor-Gruppe) in the case of Teltwisch 2 and an older phase lacking these elements in the case of Teltwisch-Mitte. Based on refitting and a detailed techno-economic analysis of these inventories, their similarities and differences will be presented in a more reliable way and a hypothesis for the Ahrensburgian trajectory will be proposed. This hypothesis will be checked by a comparison with other Ahrensburgian lithic industries: a partially refitted surface collection from Klein Nordende that comprises characteristic elements of the most recent phase of the Ahrensburgian and the assemblage from Alt Duvenstedt LA 121 + 123 representing one of the oldest Ahrensburgian sites known thus far. The latter site is not only radiocarbon-dated but also well-documented in a palaeoethnographic way, and its exhaustively refitted lithic industry offers the rare possibility to describe and analyse entire chaînes opératoires.

Keywords: Northern Germany, Lithic technology, Lateglacial societies, Ahrensburgian, Alt Duvenstedt, Teltwisch-Mitte, Teltwisch 2.

Résumé : Le nord de l'Allemagne constitue un secteur géographique particulièrement intéressant dès lors que l'on s'intéresse aux sociétés du Tardiglaciaire. En effet, c'est l'une des rares régions où il est possible de suivre l'évolution des sociétés depuis le Hambourgien (GS-2-a/GI-1e) jusqu'à l'avènement des sociétés mésolithiques au début de l'Holocène. À la différence d'autres secteurs géographiques de la plaine nord-européenne, il n'y a pas de hiatus manifeste dans l'occupation de ce territoire et l'on peut, grâce à quelques sites majeurs (Teltwisch, Alt Duvenstedt, Stellmoor, Duvensee), documenter finement l'évolution des comportements de ces groupes humains. Cette contribution propose d'interroger la variabilité des comportements techniques des groupes ahrensbourgiens qui ont peuplé ce secteur géographique entre la fin de l'Allerød (GI-1c/GI-1a) et la fin du Dryas récent (GS-1). Les recherches menées depuis une dizaine d'années par l'une de nous (MJW) ont permis de redéfinir les comportements des groupes humains du Hambourgien. Aussi, nous disposons de connaissances renouvelées sur les premières populations qui ont occupé ce territoire, à la suite du retrait glaciaire. Nos problématiques visent à développer deux axes. Le premier veut caractériser, sur le temps long (14000-10000 BP), l'évolution des comportements de ces sociétés au sein d'un territoire où la disponibilité en ressources animales fluctue finalement assez peu par rapport à des secteurs plus méridionaux. Le second vise à déterminer à l'intérieur de chaque tradition technique (Federmesser-Gruppen et Ahrensbourgien) le degré de variabilité technique et d'en comprendre la signification. C'est sur cette problématique que nous avons focalisé nos premiers travaux. En plus d'une révision du cadre chronologique de l'Ahrensbourgien, nous proposons la révision de quatre ensembles archéologiques de cette tradition (Alt Duvenstedt LA 121 + 123, Teltwisch 2, Teltwisch-Mitte, Klein Nordende LA 46). S'ils présentent des contextes taphonomiques contrastés, chacun de ces gisements permettent de documenter des aspects essentiels des comportements techniques de ces groupes humains et de leur variabilité. L'assemblage de Teltwisch-Mitte présente des chaînes opératoires clairement plus expéditives, en nette rupture avec ce que nous percevons actuellement des industries plus anciennes (Federmesser-Gruppen et Ahrensbourgien « ancien »). Aussi, ces observations nous amènent à nous interroger sur sa position chronologique et en particulier à nous demander s'il ne représente pas finalement un jalon

récent, voire final de l'Ahrensbουργien dans la région. Cet assemblage présente d'ailleurs des affinités technologiques évidentes avec les comportements mis en évidence à partir des séries du début du Mésolithique (Duvensee : Holst, 2014). En l'état, la différence majeure avec ce que nous connaissons des premières industries du Mésolithique se situe au niveau des armatures qui restent typiques de l'Ahrensbουργien. La présence d'une série à « grandes lames » (Klein Nordende) associée à des armatures clairement ahrensbουργiennes pose aussi la question de sa place dans cette chronologie. Ces premiers résultats nous encouragent à poursuivre nos investigations autour de ces gisements, en raffinant nos analyses, en particulier autour du site d'Alt Duvenstedt où une véritable analyse paléolithique est possible.

Mots-clés : Allemagne du nord, Technologie lithique, Sociétés du Tardiglaciaire, Ahrensbουργien, Alt Duvenstedt, Teltwisch-Mitte, Teltwisch 2.

INTRODUCTION

Research context

Northern Germany represents one of the rare regions in North-West Europe where human occupation is attested for all phases of the Lateglacial, albeit not continuously. Thus, this region is well suited for studying the evolution of the last Palaeolithic traditions. This is all the more the case, since the Lateglacial represents a time of quickly changing climatic conditions and successions of different vegetation types as well as combinations of faunal species in North-West Europe (e.g. Usinger, 1998; Litt et al., 2001; Mortensen et al., 2011 and 2015; Rasmussen, 2014; Bridault, 1997). The contrast seems to be particularly developed between the mid-Lateglacial light forest phase with elk and giant deer, the so-called Allerød (e.g. De Klerk, 2002; Riede et al., 2010; Mortensen et al., 2014), and the following stadial tundra of the Younger Dryas, which witnessed the return of reindeer herds (e.g. Benecke, 2004; Usinger, 2004; Theuerkauf and Joosten, 2012). Changes of comparable magnitude but opposite direction occurred a millennium later, when the climate turned to post-glacial conditions in the lifetime of one generation and triggered the development of dense forests. The Allerød and the Younger Dryas are roughly correlated with the *Federmesser-Gruppen* (FMG, Schwabedissen, 1954) and the Ahrensbουργien (Taute, 1968) respectively. Therefore, it is a matter of discussion if the differences in the material culture between these two entities are due to contrasting climatic and environmental conditions or if they are the consequence of cultural changes or a combination of both.

We try to contribute to answering this overall question by collecting and comparing the evidence provided by lithic industries. In the end, it will be possible to describe how the lithic technical system evolved in our research region from the beginning of the Allerød to the early Preboreal, when the Ahrensbουργien was succeeded by the early Mesolithic.

The focus of this paper and, thus far, of our investigations lies on the Ahrensbουργien, which is mostly known on the North European Plain and on the northern fringe of the upland zone (Taute, 1968; Baales, 1996; Fischer, 1996; Terberger, 2006). More

precisely, this paper combines results of two projects investigating prehistoric trajectories, those obtained by Inger Marie Berg-Hansen (IMBH) during her doctoral research on the first human colonisation of the Scandinavian peninsula (Berg-Hansen, 2017) and those Ludovic Mevel (LM) and Mara-Julia Weber (MJW) collected during their research generally addressing the evolution from the Magdalenian to the Mesolithic in North-West Europe. In order to describe the evolution of the Ahrensbουργien, we have chosen to analyse techno-economic and typological aspects of four assemblages belonging to the Ahrensbουργien in Schleswig-Holstein: Teltwisch-Mitte, Teltwisch 2 (both Kreis Stormarn), Alt Duvenstedt LA 121 + 123 (Kreis Rendsburg-Eckernförde), and Klein Nordende LA 46 (Kreis Pinneberg; fig. 1).

This first overview will mostly be qualitative, considering the mass of available information, and will allow us to identify the discontinuities and continuities within this tradition and to discuss anew their chronological position. We will thus mainly focus on the intentions of the productions and their place within the *chaînes opératoires*.

At present, techno-economic information on the lithic industries of the Ahrensbουργien in northern Germany is not numerous (Hartz, 1987 and 2012; Richter, 1992; Clausen and Schaaf, 2015; Berg-Hansen, 2017, 2018 and 2019). In particular, the characterisation of simplified technical choices in the FMG opposed to sophisticated productions in the Ahrensbουργien seems to be rather a myth than a scientifically proven fact. The technological approach (Tixier et al., 1980; Pelegrin, 1995) is particularly pertinent to discuss the raised questions and to address the behavioural changes that affected the Lateglacial and Early Holocene societies. This question is still ongoing and we are still working on the FMG material. At this stage, the rare published data on lithic technological aspects of this tradition in northern Germany (Bokelmann, 1978; Bokelmann et al., 1983; Clausen and Hartz, 1988; Lempcke, 1996 and 2000; Lübke and Richter, 2000; Gerken, 2001; Kotthaus, 2013) does not necessarily go in the direction of an important simplification from the last Hamburgian industries (Madsen, 1992; Hartz, 1987 and 2012; Petersen and Johansen, 1996; Clausen, 1998; Johansen, 2000; Johansen and Stapert, 2004; Weber, 2012) to the FMG.

Source criticism

Even if we base our study on well- or even exceptionally well-preserved sites, where at least the documentation of the lithic industries is rich enough to reach a high level of comprehension of the technical and economic spheres related to these activities, most of the available documentation remains problematic. This is why we deliberately chose to exclude Stellmoor (Kreis Stormarn; Rust, 1943) and Eggstedt (Kreis Dithmarschen; Taute, 1968, p. 68-71) from our study. The lithic assemblages from both sites seemed to be too fragmented and problematic from a taphonomic point of view to contribute to reaching the goals of this presentation.

Hence, the Ahrensburg tunnel valley is represented here by the Teltwisch site, excavated between 1967 and 1971 by Gernot Tromnau (Tromnau, 1975). It yielded about ten Hamburgian, FMG and Ahrensburgian units (fig. 2). Although the selected assemblages from this site are not completely free of taphonomic problems and potentially represent palimpsests, they present the advantage that their archaeological coherence can be tested and, in particular, they provide the opportunity to make comparisons at different levels.

From the micro-region at Klein Nordende, around the so-called Liether Moor, we include the assemblage from Klein Nordende LA 46, collected by Ewald Both from 1982 to 2004, in our study (Clausen, 2014). On the opposite end of the range of archaeological contexts, the Alt Duvenstedt units were exceptionally well preserved and excavated according to modern standards, including three-dimensional recording (Clausen, 1996 and 2004; Kaiser and Clausen, 2005; Clausen and Schaaf, 2015). Protected by coversands from the Younger Dryas, several occupations from the FMG, the Brommean and the Ahrensburgian have been uncovered there in the 1980s and 1990s preceding sand quarrying.

Chosen assemblages and samples

The chosen assemblages partly contain many artefacts, so it was necessary to sample some of them for our study. The view we obtained is of course partial but we are able to illustrate it by refits and representative quantitative data (table 1). This is the case for Teltwisch-Mitte, which is considered by its excavator as an older Ahrensburgian unit due to the absence of



Fig. 1 – Map of the studied sites in Schleswig-Holstein. Basic map: Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf.

Fig. 1 – Carte de localisation des gisements étudiés au Schleswig-Holstein. Fond de carte : Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf.

Assemblage	Total of lithic artefacts (n)	Sample for quantitative analysis
Teltwisch 2	C. 5,000	55 modified pieces, 213 blades, 11 preparation prod., 10 modification prod., 58 cores (total)
Klein Nordende LA 46	213	-
Teltwisch-Mitte	7,966	313 modified pieces (total), 143 blades and 16 cores from 1 concentration
Alt Duvenstedt LA 121+123	1,837 (incl. 1,196 \leq 1 cm ²) + 338	LA 121: 1,532
Alt Duvenstedt LA 120	5,502 (incl. 4,069 \leq 1 cm ²)	-
Teltwisch 5	717	-

Table 1 – Detailed information on the studied corpus of each site.

Tabl. 1 – Détail des corpus étudiés pour chaque site.



Fig. 2 – A, localization of the Teltwisch sites in the Ahrensburg tunnel valley; **B**, localization of the different excavation areas and detailed view of the studied corpus from Teltwisch-Mitte (Map: Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, excavation plan: Tromnau, 1975, fig. 23).

Fig. 2 – A, localisation des gisements de Teltwisch dans la vallée d'Ahrensbourg; **B**, localisation des différents secteurs fouillés et détail du corpus étudié pour Teltwisch-Mitte (Carte : Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, plan de fouilles : Tromnau 1975, fig. 23).

Long Blades and Zonhoven points (for a discussion of the chronological significance of these artefact types, cf. below), its younger neighbouring unit Teltwisch 2, which contains both of these lithic artefact types, and the thus far oldest Ahrensburgian site in the lowlands according to radiocarbon dating and stratigraphy as well as the lithic artefact composition, lacking Long Blades and Zonhoven points, which is Alt Duvenstedt LA 121 + 123. Thanks to the exceptional quality of preservation, Alt Duvenstedt LA 121 + 123 moreover present the very rare opportunity to apply the palaeoethnological approach. Despite the fact that it represents a surface collection,

Klein Nordende LA 46 is included here because it has been partially refitted and, thus, illustrates the methods of blade production in the presumably latest phase of the Ahrensburgian presenting Long Blades and Zonhoven points or other microliths (Clausen, 2014).

As it had not been analysed since its initial publication (Tromnau, 1975, p. 49-55), the assemblage from Teltwisch-Mitte received most of the attention in LM's and MJW's project. This unit consists of three lithic concentrations, one of which, comprising 15 m², was chosen for a more detailed analysis, in particular attribute analysis of almost all complete blades (n = 143) and all cores (n = 16), whereas the modified pieces

from the whole unit – except for partially retouched artefacts – ($n = 313$) have been analysed in this individual way. Moreover, the refit complexes obtained in this study ($n = 14$) have been described and analysed from a technological point of view.

The second unit from Teltwisch included here, Teltwisch 2 (Tromnau, 1975, p. 61-65), has equally been the object of attribute analysis: IMBH's database comprises 348 artefacts, including 87 complete blades and 126 blade fragments, 11 preparation products, 10 modification waste products and 55 modified pieces, while the 58 cores were analysed as part of both her thesis and LM's and MJW's subsequent project. The latter also carried out refitting on this material.

The lithic artefacts of Alt Duvenstedt LA 121 and its refit complexes in the state of 2013 have been studied entirely and in detail by IMBH as part of her doctoral research (Berg-Hansen, 2017, 2018 and 2019), which included the attribute analysis of 1,532 artefacts. In 2016, LM and MJW carried out a preliminary qualitative study on the refit complexes, which had been completed in the meantime by artefacts from the same unit but also the neighbouring one LA 123 (cf. Clausen and Schaaf, 2015). They did the same with the surface collection from Klein Nordende LA 46 and its refit complexes.

The Ahrensburgian: what evolutionary model?

Before entering really into the subject, it seemed to be important to us to place the studied assemblages into their chronological and cultural context, on a scale which exceeds northern Germany. In our opinion, it is crucial to take a critical view on our perception of the Ahrensburgian and its evolution.

First of all, it should be noted that the dated and well-preserved assemblages, which make it possible to define a model of this evolution are rare. Among the sites included in this study, only Alt Duvenstedt LA 121 + 123 has been directly radiocarbon dated (table 2) to the transition from the Allerød to the Younger Dryas, which corresponds to the stratigraphical position of this unit (Kaiser and Clausen, 2005). Reindeer remains excavated in the vicinity of a Hamburgian and Ahrensburgian surface site and associated with uncharacteristic lithic material at Nahe LA 11 (Kreis Segeberg) yielded radiocarbon ages falling into two groups, an older one contemporaneous with the early Younger Dryas and a younger one corresponding to the late Younger Dryas (table 2; Weber et al., 2011; Wild, 2017). The latter chronological position is equally indicated for the Ahrensburgian site in Schleswig-Holstein which has been most often the object of radiocarbon dating, that is Stellmoor (table 2; Rubin and Suess, 1956; Barendsen et al., 1957; Fischer and Tauber, 1986; Hedges et al., 1993; Benecke and Heinrich, 2003; Weber et al., 2011; Drucker et al., 2016). The observation of four different Ahrensburgian find horizons during the excavation

(Schütrumpf, 1943, p. 10, fig. 3) seems to be compatible with the few hundred years the calibrated radiocarbon dates span (table 2). This time span even comprises the initial part of the Preboreal, which is not surprising in the light of the Long Blade component present at this site and dated to the Younger Dryas-Preboreal transition at sites belonging to two traditions, the Long Blade Assemblages (Barton, 1998) in England and the Belloisian (Fagnart, 1997) in northern France. (Fagnart, 1997; Conneller, 2007; Lewis and Rackham, 2011; Bemilli et al., 2014). Most recently, a comparable dating was obtained for a site with Long Blade component in the Lower Rhine region (Heinen, 2017). On the contrary, the radiocarbon result for the Long Blade site Melbeck-Friedhof (Landkreis Lüneburg) in Lower Saxony differs from the other sites of this tradition since it falls to the mid-Younger Dryas (table 2; Richter, 1992).

Some of the Ahrensburgian sites in the Dutch lowlands have equally yielded radiocarbon dates of the late Allerød or early Younger Dryas but as they were obtained on charcoal in sandy environment and, sometimes, in connection with an Usselo palaeosol, their anthropogenic origin or connection to the Ahrensburgian is debatable (Lanting and van der Plicht, 1996; Vermeersch, 2011, table 2). This is different for Remouchamps (province de Liège) in the Ardennes where animal bones have been dated to the early Younger Dryas in one case and the mid-Younger Dryas in three others (table 2; Gob, 1990; Hedges et al., 1993; Vermeersch, 2011, table 2). Radiocarbon dating of the Kartstein site (near Mechernich, Kreis Euskirchen) in the adjacent Eifel Mountains showed a later occupation, at the end of the Younger Dryas (table 2; Baales, 1996 and 2004; Bronk Ramsey et al., 2002). However, it has to be noted that only two of the nine samples were obtained on single bones (table 2: OxA-9031, OxA-9032) – the latter potentially representing a natural element – whereas the others were bulk bone samples. A few years ago, the third substantial Ahrensburgian site in the mid-range mountains, Hohler Stein at Kallenhardt (Kreis Soest; Baales, 1996), was also radiocarbon dated to the late Younger Dryas by two samples obtained on single bones (table 2; Baales, 2013a). A comparison of the dated sites in the lowlands and the upland zone does not allow us to suggest the anteriority of the Ahrensburgian in either of these geographic units (for a differing view, cf. Vermeersch, 2011, p. 273).

In addition to Ahrensburgian sites, single organic artefacts or organic artefacts associated with unspecific lithic artefacts found in the distribution area of the Ahrensburgian have yielded radiocarbon dates corresponding to the time period covered by this tradition. However, they do not contribute to a better understanding of the internal chronology of the Ahrensburgian. In eastern Germany, a fish hook and a decorated elk antler tool from a Late Palaeolithic horizon at Wustermark 22 (Landkreis Havelland) were dated to the mid-to late Younger Dryas and the final Younger Dryas to the Preboreal respectively (table 2; Gramsch and

Site	Sample	Lab code	Age in ¹⁴ C-BP	±	Calibration (cal BP; 95% confidence interval)	References
Alt Duvenstedt LA 121	charcoal	AAR-2245	10,810	80	12,920 -12,640	Kaiser and Clausen, 2005
	charcoal	AAR-2245-2	10,770	60	12,790 -12,670	Kaiser and Clausen, 2005
Alt Duvenstedt LA 123	charcoal	AAR-2246	11,060	110	13,170 -12,730	Kaiser and Clausen, 2005
Nahe LA 11	bone (<i>Rangifer tarandus</i>)	KIA-23369	10,610	80	12,800 -12,400	Weber et al., 2011; Wild, 2017
	antler & bone (<i>Rangifer tarandus</i>)	KIA-23372	10,544	49	12,760 -12,360	Weber et al., 2011; Wild, 2017
	antler or bone (<i>Rangifer tarandus</i>)	KIA-23370	10,172	45	12,080 -11,640	Weber et al., 2011; Wild, 2017
	antler or bone (<i>Rangifer tarandus</i>)	KIA-23371	10,142	49	12,080 -11,520	Weber et al., 2011; Wild, 2017
Stellmoor (Ahrensburg LA 78)	antler (<i>Rangifer tarandus</i>)	Y-159.2	10,320	250	12,910 -11,190	Barendsen et al., 1957
	bulk bone	KN-2222	10,160	90	12,190 -11,390	Weber et al., 2011
	bone with incisions (<i>Equus</i> sp.)	KIA-48960	10,150	40	12,050 -11,610	Drucker et al., 2016
	bone (<i>Rangifer tarandus</i>)	K-4326	10,140	105	12,220 -11,260	Fischer and Tauber, 1986
	antler (<i>Rangifer tarandus</i>)	K-4327	10,130	105	12,210 -11,250	Fischer and Tauber, 1986
	antler (<i>Rangifer tarandus</i>)	K-4262	10,110	105	12,180 -11,220	Fischer and Tauber, 1986
	bone (<i>Rangifer tarandus</i>)	K-4578	10,100	100	12,140 -11,220	Fischer and Tauber, 1986
	bulk bone and antler (<i>Cervidae</i>)	KN-2221	10,080	80	12,070 -11,230	Weber et al., 2011
	bone (<i>Bison bonasus</i>)	KIA-3331	10,070	50	11,910 -11,310	Benecke and Heinrich, 2003
	bone (<i>Rangifer tarandus</i>)	K-4325	10,010	100	11,950 -11,150	Fischer and Tauber, 1986
	antler (<i>Rangifer tarandus</i>)	K-4581	9,990	105	11,930 -11,130	Fischer and Tauber, 1986
	antler (<i>Rangifer tarandus</i>)	K-4579	9,980	105	11,920 -11,120	Fischer and Tauber, 1986
	antler	K-4323	9,930	100	11,790 -11,110	Fischer and Tauber, 1986
	antler (<i>Rangifer tarandus</i>)	K-4324	9,900	105	11,760 -11,080	Fischer and Tauber, 1986
	antler (<i>Rangifer tarandus</i>)	K-4580	9,810	100	11,520 -10,960	Fischer and Tauber, 1986
	bone (<i>Vulpes vulpes</i>)	OxA-2875	9,680	90	11,330 -10,690	Hedges et al., 1993
Melbeck-Friedhof, trench 3/3A, lower layer	charcoal	Hv-17306	10,515	95	12,820 -12,060	Richter, 1992
Remouchamps	bone (<i>Rangifer tarandus</i>)	OxA-4191	10,800	110	12,970 -12,610	Hedges et al., 1993
	bone (<i>Rangifer tarandus</i>)	Lv-535	10,380	170	12,830 -11,590	Gob, 1990
	bone (<i>Tetrao uragallus</i>)	OxA-4190	10,330	110	12,710 -11,710	Hedges et al., 1993
	bone (<i>Rangifer tarandus</i>)	OxA-3634	10,320	80	12,610 -11,810	Hedges et al., 1993
Kartstein	bone (size of <i>Rangifer tarandus</i>)	OxA-9031	10,220	75	12,230 -11,630	Bronk Ramsey et al., 2002
	bone (<i>Lagopus</i> sp.)	KN-4023	10,090	100	12,130 -11,210	Baales, 1996
	bone (size of <i>Rangifer tarandus</i>)	KN-4254A	10,030	60	11,840 -11,240	Baales, 2004
	bone (size of <i>Rangifer tarandus</i>)	KN-4252	10,000	50	11,740 -11,220	Baales, 2004
	bone (<i>Lagopus lagopus</i>)	OxA-9032	9,995	65	11,790 -11,190	Bronk Ramsey et al., 2002
	bone (size of <i>Rangifer tarandus</i>)	KN-4254B	9,900	45	11,460 -11,180	Baales, 2004
	bone (size of <i>Rangifer tarandus</i>)	KN-4254C	9,685	50	11,310 -10,750	Baales, 2004
	bone (size of <i>Rangifer tarandus</i>)	KN-4072	9,550	90	11,240 -10,560	Baales, 1996
	bone (size of <i>Rangifer tarandus</i>)	KN-4073	9,530	90	11,220 -10,540	Baales, 1996
Hohler Stein near Kallenhardt	bone (<i>Rangifer tarandus</i>)	MAMS-11805	10,198	39	12,100 -11,700	Baales, 2013
	bone (<i>Rangifer tarandus</i>)	MAMS-11804	10,174	46	12,080 -11,640	Baales, 2013
Wustermark 22	fishing hook, bone	Ua-24701	10,370	75	12,660 -11,940	Gramsch and Beran, 2010
	antler tool (<i>Alces alces</i>)	Ua-20962	10,005	70	11,830 -11,190	Gramsch and Beran, 2010
Bützsee-Altfrisesack	biserially barbed point, potentially antler	OxA-8742	10,480	75	12,750 -12,070	Cziesla and Pettitt, 2003
	barbed point of Duvensee type	OxA-8743	10,185	65	12,140 -11,580	Cziesla and Pettitt, 2003
	biserially barbed point	OxA-8841	10,020	60	11,830 -11,230	Cziesla and Pettitt, 2003
Klappholz	antler axe of Lyngby type	AAR-2785	11,560	110	13,670 -13,230	Clausen, 2004
Mikkelsmosse	antler axe of Lyngby type	OxA-2791	10,980	110	13,130 -12,690	Hedges et al., 1995
Odense Kanal	antler axe of Lyngby type	AAR-9298	10,815	65	12,890 -12,650	Fischer et al., 2013
Arreskov	antler axe of Lyngby type	OxA-3173	10,600	100	12,840 -12,240	Fischer, 1996
Earls Barton	antler axe of Lyngby type	OxA-803	10,320	150	12,780 -11,500	Clausen, 2004
Bara Lilla Mosse	antler axe of Lyngby type	OxA-2793	9,090	90	10,500 -10,060	Hedges et al., 1995

Table 2 – Published radiocarbon dates for the Ahrensburgian sites in Schleswig-Holstein and selected sites in other regions. Calibration by CalPal 2016.2 version (Weninger et al., 2007) using the calibration curve CalPal2007_HULU (Weninger and Jöris, 2008).

Tabl. 2 – Dates radiocarbones publiées des sites ahrensbourgiens au Schleswig-Holstein et de sites choisis dans d'autres régions. Calibration par CalPal 2016.2 version (Weninger et al., 2007) utilisant la courbe de calibration CalPal2007_HULU (Weninger et Jöris, 2008).

Beran, 2010). Three barbed points from Bützsee-Altfrisesack (Landkreis Ostprignitz-Ruppin) seem to represent three different events in the early to mid- as well as the late Younger Dryas and the final Younger Dryas to the Preboreal (table 2; Cziesla and Pettitt, 2003). Another category of directly dated antler artefacts are the so-called Lyngby antler axes. Since they were only found in association with an artefact assemblage at Stellmoor (Rust, 1943) in the lowlands and at Hohler Stein on the northern fringe of the mid-range mountain zone (Baales, 2013b), they were traditionally interpreted as an artefact type of the Ahrensburgian. However, radiocarbon dating of several single finds from Denmark, Sweden and Schleswig-Holstein

indicates that they already occur in the late Allerød and, hence, potentially in the FGM or the Brommean (table 2; Clausen, 2004; Fischer et al., 2013).

What are the artefacts used to chronologically seriate the assemblages (cf. Taute, 1968)?

As stated above, sites belonging to the Long Blade Assemblages and the Belloisian are dated to the transition from the Younger Dryas to the Preboreal. Their characteristics are Long Blades originating from phases of core configuration, regular and straight

blades presumably representing the desired products, bruised elements and projectile implements with concave oblique truncations (cf. Valentin, 2008). Most of these elements also occur in the Ahrensburgian but have been attributed typologically to a slightly earlier phase of this tradition.

In his seminal study of the Tanged Point Groups, Wolfgang Taute (1968) used the presence or absence of certain projectile implement types, of certain common tool types but also of certain technological “markers” such as “Long Blades” to subdivide the Ahrensburgian. One of the most easily recognizable groups, which is moreover of interest here, is the so-called *Eggstedt-Stellmoor-Gruppe* characterized by *Groß-* (blades which are 120-150 mm long and 25-50 mm wide) and *Riesenklingen* (blades which are > 150 mm long and ≥ 25 mm wide or > 120 mm long and > 50 mm wide), Zonhoven points with basal retouch, in particular concave basal retouch, and > 20% of blade end scrapers. Assemblages containing triangles instead of Zonhoven points with basal retouch (*Didderse-Lavesum-Gruppe*) would represent younger groups according to Taute, as triangles are characteristic of the early Mesolithic (Taute, 1968, p. 235-237). Moreover, he attributed them to the late Younger Dryas and initial Preboreal, as is nowadays done as well with the *Eggstedt-Stellmoor-Gruppe*. By other colleagues, these industries considered as final for the Ahrensburgian are called Epi-Ahrensburgian (cf. Fagnart, 2009; Crombé et al., 2013). When G. Tromnau excavated Teltwisch-Mitte, he suggested that this assemblage would probably be older than those of the *Eggstedt-Stellmoor-Gruppe* because it lacked Long Blades and Zonhoven points and showed a scarcity of common tool types associated to the presence of rough burins (Tromnau, 1975, p. 55, 80-82). In the light of the chronological position of Alt Duvenstedt LA 121 + 123, which equally comprises none of these elements, Tromnau’s suggestion appears to be probable.

Interestingly, an opposite view on the chronological significance of Zonhoven points exists for the Ahrensburgian in the BeNeLux area. Vermeersch (2011, p. 273) considers differences between sites in the respective numbers of Ahrensburgian tanged points and Zonhoven points as a reflection of the site function or personal preferences of the hunters. Nevertheless, he contradicts the view of Deeben et al. (2000) that tanged points get less numerous during the existence of the Ahrensburgian while Zonhoven points get more numerous by stating that, among the dated sites, the early ones are characterized by a predominance of Zonhoven points. According to his interpretation, tanged points would be the result of a northern influence in a later stage of the Ahrensburgian.

These subdivisions, which are mostly based on specific markers, raise a number of questions exceeding the scope of this paper, such as: Is it possible to distinguish microliths of the Ahrensburgian and those of the earliest Mesolithic, in particular in surface collections? Do assemblages with Long Blades and

microliths always represent a late phase of the Ahrensburgian and how can the radiocarbon dating of Melbeck-Friedhof be integrated into this model? Is the presence or absence of certain types sufficient to define chronological groups within the Ahrensburgian? Could an inventory without Ahrensburgian tanged points as typological characteristic be considered Ahrensburgian (cf. Veil, 1987)?

In conclusion, we suggest, firstly, that finer analyses of the blank production for projectile implements and their transformation should be carried out and, secondly, that more comprehensive technological data of blank production should be integrated in studies on the evolution of the Ahrensburgian or other Palaeolithic entities.

OBSERVATIONS ON AHRENSBURGIAN ASSEMBLAGES

Here, we will focus now on northernmost Germany and a few sites which contain diachronic occupation events: Teltwisch, Alt Duvenstedt, Klein Nordende. The presence of both FMG and Ahrensburgian units at these sites is relevant for our study but we will concentrate on the Ahrensburgian ones in this paper. In order to contribute to the general discussion, we decided to orientate our study towards certain aspects which technology permits to document based on new refits we carried out on the assemblages from Teltwisch-Mitte and Teltwisch 2 and on the already existing refits of Alt Duvenstedt LA 121 + 123.

Those aspects are, first and foremost, the intentions of the lithic productions and the blank production methods. They include a discussion of the term “preferential blade” and an examination of the characteristics guiding the selection of blades for projectile implements and common tools, such as size, regularity and straightness. We also investigated the place that the production of the blanks for projectile implements on the one hand and that of the blanks for common tools on the other hand occupy within the *chaînes opératoires*. Of secondary importance here, the choice of raw material also appeared to be a pertinent criterion of analysis and discussion.

In order to contribute to the reconstruction of the evolution of the Ahrensburgian, we will treat these aspects in a diachronic perspective, starting with the presumably youngest inventories and moving towards the oldest one. For the former, which are characterised, among others, by the presence of Long Blades, the intentions of lithic production seem to be better palpable and can be analysed with the knowledge of the intentions in the contemporaneous Long Blade Assemblages and the Belloisian in mind. Apart from the impressive aspect of the production of Long Blades in the assemblages considered the most recent ones of the Ahrensburgian, what are the intentions of production that the assemblages allow us to document?

Teltwisch 2: What intentions of blank production?

The sample of blades from Teltwisch 2 analysed by IMBH (Berg-Hansen, 2017, 2018 and 2019) shows that there is a metric continuity, which rather indicates that no specific metric type of blank has been sought for. Nevertheless, the fact that different types of modified pieces have different blanks seems to reflect the existence of different intentions in blade production. The Long Blades and massive blade-like flakes from the first steps of the *chaîne opératoire*, the famous pieces that led to the attribution of Teltwisch 2 to the later Ahrensburgian, show edge damage in some cases and could therefore have been used in an unmodified

state (fig. 3, no. 1). However, this does not necessarily indicate that they have been part of a systematic production of such blades, in particular as they serve configuration purposes on different surfaces (*e.g.* platforms and flaking faces). Due to the absence of extensive refit complexes, it is not possible to determine what the intentions underlying this production are and if Long Blades are systematically part of the objectives of the knappers. The stage of exhaustion of many cores does not allow either to affirm this. Two thirds of the cores have been abandoned at the stage of production of short (c. 50 to 70 mm long) blades or bladelets (width < 10 mm), so the initial state of these volumes is difficult or even impossible to evaluate (fig. 3, nos 2 and 3).



Fig. 3 – Teltwisch 2. 1, bruised blade; 2-3, blade cores (Pictures: Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, CAD: L. Mevel).

Fig. 3 – Teltwisch 2. 1, lame mâchurée; 2-3, nucléus à lames (Photos : Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, DAO : L. Mevel).

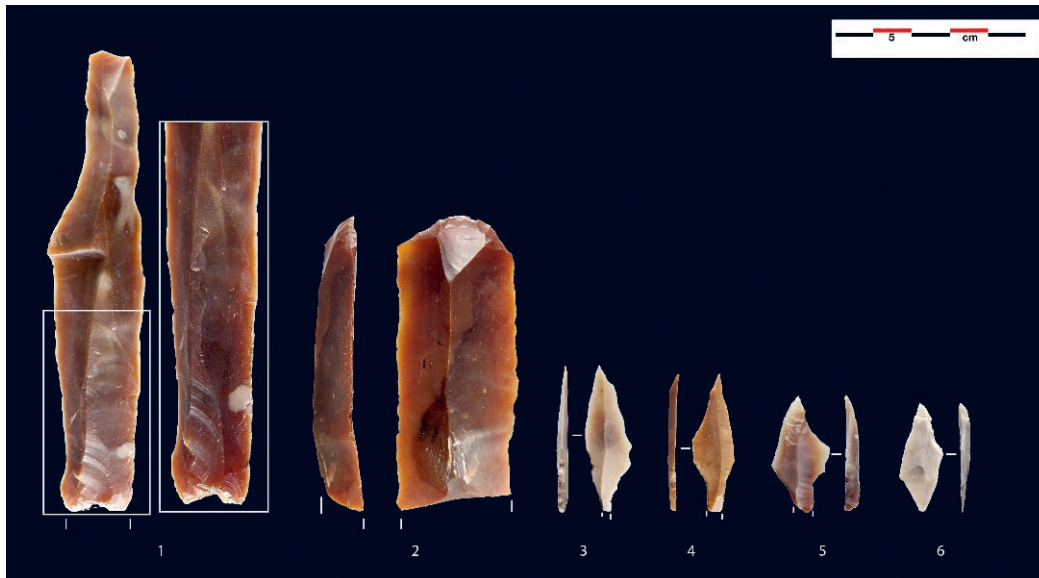


Fig. 4 – Teltwisch 2. 1, unretouched blade with potential use-wear traces; 2, end scraper; 3-5, Ahrensburgian points; 6, Zonhoven point (Pictures: Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, CAD: L. Mevel).

Fig. 4 – Teltwisch 2. 1, lame potentiellement utilisée brute; 2, grattoir sur lame régulière; 3-5, pointes ahrensbourgiennes; 6, pointe de Zonhoven (Photos : Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, DAO : L. Mevel).

It is equally difficult to distinguish between edge damage due to taphonomy, storage conditions and actual prehistoric use without an exhaustive use-wear analysis. However, we can note that many regular and long blades (> 100 mm) with straight longitudinal profile, which constitute a second category of blades present in the assemblage, could possibly represent one of the important intentions of the knappers (cf. “lames favorites”, Biard and Hinguant, 2014, p. 611; Biard and Valentin, this volume; fig. 4, no. 1). Use-wear analysis on blades of this type from the Belloisian site Le Buhot at Calleville (département Eure) has shown that they had been produced explicitly for butchering activities since all but one active zones observed on them resulted from this type of activity (Jacquier, 2014a, p. 229). In the absence of faunal material preserved in the dry mineral sediments of the Ahrensburg tunnel valley, we cannot evaluate yet if a similar use of the most regular blades at Teltwisch 2 is plausible. Once again, this shows that micro-wear analysis is necessary here.

In contrast to most Belloisian sites, Teltwisch 2 comprises a considerable number of modified artefacts, which should make it easier to determine the intentions of blank production than in the French tradition (fig. 4, nos. 2 to 6). However, this task is not straightforward either because blades of variable morphology and regularity, originating both from preparation or rejuvenation and pure blade production phases of core reduction, served as blanks for one and the same common tool type, for instance in the case of scrapers or burins. Moreover, blade-like flakes and flakes from preparation or rejuvenation were equally chosen to be transformed into the same common tool types.

The only intention of blank production which can be directly observed is that of obtaining short blades and bladelets – considered here together as a third category of blades – for the transformation into projectile implements. Not only the blanks of the implements indicate this intention but also the cores, two thirds of which show a predominance of this intention at the end of their exploitation. Thus, short blades and bladelets seem to represent an important goal of production in this assemblage, and the place of this production in the *chaîne opératoire* is recognizable without problems. The fact that small, c. 40 to 60 mm long volumes, represented by 9 cores on frost shatter or intentional flakes, seem to have been reserved for the production of short blades and bladelets equally expresses the intention of obtaining these products and shows that they were also produced in an independent *chaîne opératoire*.

Teltwisch 2: Methods and techniques of blank production

In general, the methods and techniques used for the production of blanks, in this case blades and bladelets, correspond to those described for the Ahrensburgian (Hartz, 2012). The chosen volumes are predominantly nodules, next to natural or intentional flakes, and consist for two thirds of the cores of good quality Senonian flint. Core decortication and preparation by large flakes is common. The configuration of the volumes by crests is indicated by crests or transversal flake negatives on 16 of the 58 cores and rather rarely by crests visible on the dorsal faces of the blanks. The flaking face is mostly installed in one of the narrow

sides of the core, and 76 of the 98 platforms are created by the removal of at least one flake.

The cores predominantly possess two opposite platforms ($n = 43$) and in 22% of the cases one single platform. One core has multiple platforms and another one was abandoned in a pre-form state. According to the few refit complexes and the biggest cores, both platforms are installed from the beginning of the exploitation. They remain in use until the end of the core exploitation and particularly on the cores which yielded short products of blade and bladelet width. Among the cores with two opposite platforms, a strictly or predominantly unidirectional orientation of the blank negatives is only visible in five cases. These observations all indicate a bidirectional core reduction as the norm at Teltwisch 2 but further investigations are necessary to describe the rhythm of the platform alternation. Bidirectional reduction usually creates flat flaking surfaces and, hence, blades with a straight longitudinal profile, which seems to represent one of the characteristics sought for at least on the most regular and flat blades (cf. above, intentions).

The flaking face is half-rotating, *i.e.* covers circa half of the core perimeter (cf. Valentin et al., 2014), on the majority of cores, staying rather narrow throughout the reduction process. This corresponds to the observation of a predominantly one-sided exploitation in this inventory, *i.e.* with the flaking face staying on one side of the core (cf. Berg-Hansen, 2019). The flaking face covers three quarters of the core perimeter on eleven of them and represents an almost completely rotating flaking face on two cores. Determining the symmetric or dissymmetric character of the flaking face progression is difficult on most of the cores and in the absence of refits but it can be said that clearly dissymmetric progressions seem to be rare. Most of the cores are abandoned in a reduced state, the biggest dimension amounting to 51-108 mm.

With regard to the knapping technique, a soft hammer stone was used in a tangential way (cf. Pelegrin, 2000) for the production of blades and bladelets. This concurs with the intention of producing regular and rather flat blades, the predominance of small butts (Berg-Hansen, 2019, fig. 4) and the majority of platform angles on the cores being inferior or equal to 70° ($n = 55$). However, 28 platforms have angles of 80° or more, and the sample of butts analysed by IMBH ($n = 135$) comprises 40% of 80° angles followed by 37% of 90° angles.

Finally, one technical aspect of the modification phase worth mentioning is the use of the micro-burin technique for the production of Ahrensburgian tanged points. The Teltwisch 2 assemblage comprises two simple micro-burins.

Klein Nordende LA 46: What intentions of blank production?

The surface collection treated in this study consists of 232 flint artefacts (a smaller amount of artefacts is published by Clausen [2014]). The fact that it

comprises a core axe next to Late Palaeolithic artefacts and different types of patina indicates that the assemblage is certainly not homogeneous. The presence of axes at a site with Long Blades is known from Nørregård VI (Region Syddanmark) where six core axes and their preforms or fragments and twelve flake axes including preforms and fragments were found (Sørensen and Sternke, 2004, table 1). As this site was excavated and axe production flakes were discovered as well, the association of the axes with the rest of the material is plausible, which is different for Klein Nordende LA 46 where, moreover, the core axe shows a diverging patina from that of the Long Blades. Thus, we have chosen to include in this study only the artefacts which show the same patina as the Long Blades. This leads to the problem that the two projectile implements cannot be included. One of them represents a typical Ahrensburgian tanged point (fig. 5, no. 1) with a slight apical fracture and a bending fracture with hinge-terminating *languette* at the tang. The second implement is backed and broken at the base. Small retouch negatives adjacent to the fracture on the otherwise unretouched edge could indicate a broken-off tang. Among the 172 artefacts bearing a white-grey patina, 148 blades of different sizes and regularities, 1 retouched blade, 1 burin, 1 scraper-like tool and 3 cores occur. The Long Blades, most of which could be refitted, seem to have had a configuring function as in the Belloisian so that the same question as for Teltwisch 2 applies: do they really represent an intention of the blade production (fig. 5, no. 2)? The second category of intentional products discussed for Teltwisch 2, long, regular blades with a straight longitudinal profile, is only represented by one specimen (fig. 5, no. 3). A group of five shorter but still regular blades may form a third category of intentional products, potentially destined at the transformation into tools. Finally, traces of an intentional production of short blades and bladelets only appear in the form of a few products, which could also be by-products of blade production, and two cores (fig. 5, no. 4).

Klein Nordende LA 46: Methods and techniques of blank production

Preparation flakes and the sequences of Long Blades indicate both preparation and configuration of the Senonian flint volumes, which for some of them must have had initial dimensions of up to 20 cm. Crests are almost completely absent but one always has to bear in mind that this assemblage is most mixed and incomplete.

The blade core with a completely rotating flaking face is reminiscent of one of the two cores from Teltwisch 2 exploited in the same way and shows a few negatives oriented opposite to the negatives of the products struck from the visible platform. A second platform for correction of the flaking face or the obtention of products must have existed at an earlier stage of reduction. One of the bladelet cores still possesses



Fig. 5 – Klein Nordende LA 46. **1**, Ahrensburgian point; **2**, refitting of two Long Blades; **3**, blade from main blank production sequence?; **4**, blade core (Pictures: Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, CAD: L. Mevel).

Fig. 5 – Klein Nordende LA 46. **1**, pointe Ahrensbourgienne ; **2**, remontage de deux longues lames ; **3**, lame de plein débitage ? ; **4**, nucléus à lames (Photos : Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, DAO : L. Mevel).

two opposite platforms and a second flaking face installed in its back. This core presents a broad flaking face whereas the second bladelet core has two independent and narrow flaking faces.

Percussion with a soft hammer stone varies between the different types of products. While the Long Blades rather show thick butts struck at a certain distance from the platform edge, the long, regular blades with a straight longitudinal profile and the smaller regular blades have small to linear butts attesting a tangential application of the hammer stone.

Teltwisch Mitte: an early Ahrensburgian settlement?

The lack of Long Blades and Zonhoven points led G. Tromnau to consider the inventory from Teltwisch-Mitte as the result of an older Ahrensburgian settlement at Teltwisch than that yielding Teltwisch 2 (Tromnau, 1975, p. 68-71). Since the stratigraphic position of both assemblages in relation to a Lateglacial soil, probably of Usselo type, is comparable and since ^{14}C dating is impossible at both locales due to the absence of organic



Fig. 6 – Teltwisch-Mitte. 1-4, end scrapers; 5-6, burins; 7-12, Ahrensburgian points; 13-14, micro-burins (Pictures: Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, CAD: L. Mevel).

Fig. 6 – Teltwisch-Mitte. 1-4, grattoirs; 5-6, burins; 7-12, pointes ahrensbourgiennes; 13-14, micro-burins (Photos : Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, DAO : L. Mevel).



Fig. 7 – Teltwisch-Mitte. Regular unretouched blades with edge damage (Pictures: Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, CAD: L. Mevel).

Fig. 7 – Teltwisch-Mitte. Lames régulières avec bords endommagés (Photos : Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, DAO : L. Mevel).

material and the non-recording of charcoal pieces, there is no external way of establishing a relative or absolute chronology of both assemblages.

Thus, it appeared necessary to us to carry out a technical diagnosis of Teltwisch-Mitte in order to identify similarities and differences with Teltwisch 2, and, more generally, with the other studied assemblages. Excavated on a surface of 105 m², this concentration has delivered 7,966 stone artefacts, including 424 modified artefacts according to the accounts published by Tromnau (1975; cf. fig. 2). Given the significant size of the collection, we conducted a sampling to document the outlined aspects. The modified artefact assemblage is mainly composed of scrapers (n = 238; fig. 6, nos. 1 to 4), burins (n = 43; fig. 6, nos. 5 and 6) and Ahrensburgian points (n = 23; fig. 6, nos. 7 to 12), the production of which is indicated by rarer microburins (n = 2; fig. 6, nos. 13 and 14). The modified artefacts allowed us to determine that two main categories of blades were produced and selected in Teltwisch-Mitte. This is a first distinctive element compared with Teltwisch 2 where we saw that three different categories of blades – including the Long Blades as non-necessarily intentional blades – were produced and used. At both sites, one potential additional category is represented by long, regular blades with a straight longitudinal profile. In general, the modified blades at Teltwisch-Mitte are more massive for the common tools and lighter for the lithic projectile implements. If most of the blanks selected to make the Ahrensburgian tanged points are regular narrow and thin blades, this is not the case of the blanks selected to make the common tools, which are not only broader and thicker but also less regular. Indeed, many are made on flakes or what we would classify as maintenance blades. Thus, the question of the intentions of the blade production is clearly raised here.

– The intentions of the blade production

First, we can note that half of the unretouched blades recorded show damage on their edges (60 out of 144; fig. 7). As for Teltwisch 2, without use-wear analysis we cannot exclude a post-depositional cause, but if they are connected to an anthropogenic activity, it could change our perception of the intention of the blade production, especially regarding the regularity of some of these blades – sometimes more regular than the blades selected to be retouched (fig. 6, nos. 3 and 4 for example). On this point, the two settlements of Teltwisch are very close, and edge damage on regular blades is also observable in the Ahrensburgian settlements of Alt Duvenstedt. Indeed, the low regularity and the diversity of the blades selected in Teltwisch-Mitte clearly raise the question if a core reduction phase restricted to the production of intentional products is present in this assemblage. In a FMG context, this diversity would simply be attributed to the lower standards of production. Here, the blades used to make the common tools present attributes of maintenance blades (fig. 6, nos. 3 and 4). In consequence, the selection of

the common tool blanks was done on a wide range of products beyond the strict framework of regular blades, which are usually interpreted to be of first intention in Upper Palaeolithic traditions. However, this situation is similar with that at Teltwisch 2. The projectile implements at Teltwisch-Mitte are exclusively represented by Ahrensburgian tanged points. The size categories are quite diverse, since the width varies between 10 and 16 mm and the thickness between 2 and 5 mm.

– Methods and techniques of blank production

The following data are mainly based on 15 refitted sequences involving between 3 and 5 products and cores each. Technical and morphometric data were also recorded on the complete blades coming from the studied concentration of Teltwisch-Mitte. On the site scale, interestingly, the amount of blades is more or less the same between Teltwisch-Mitte and Teltwisch 2, whereas the Teltwisch 2 collection contains 3,000 artefacts less than Teltwisch-Mitte. In addition, there are three times less cores in the Teltwisch-Mitte assemblage (table 1). These quantitative data probably reflect economic reasons, for example connected to the productivity of the exploited blocks.

The few refittings we made, and more generally the data collected on Teltwisch-Mitte, allowed us to argue in this way but these statements are preliminary and based – as we previously mentioned – on a reduced part of the corpus. Therefore, these data need to be confirmed by an analysis of the blades and cores of the two other concentrations at the site. The blades produced are mainly between 80 and 40 mm in length (fig. 8). According to the refittings and the analysed remains, we can argue that the longest and the shortest blades were produced on the same cores. The raw materials used are very diverse and often of quite low quality. However, an autonomous production of shorter blades is also documented, at least on edges or ventral faces of flakes used as cores (fig. 9). We never identified a complex initialization phase before the blade production on the refitted sequences. The knappers mainly used short

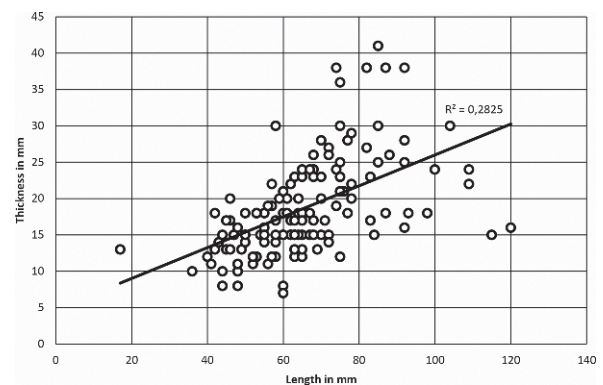


Fig. 8 – Teltwisch-Mitte. Length/thickness ratio of the corpus of studied blades (459 retouched and unretouched blanks).

Fig. 8 – Teltwisch-Mitte. Rapport longueur/épaisseur du corpus de lames étudiées (459 supports bruts et retouchés).

blocks, large natural flakes and large flakes. The initialization of the blank production was mainly done by the extraction of cortical flakes and blades on one core face in the future longitudinal axis of the flaking face.

The production of blades is exclusively unipolar. The striking platform and the angles measured on the blade butts show that the knappers favoured angles between 80 and 90°. The butts are systematically abraded but this action is clearly less intense compared to the Teltwisch 2 blade assemblage. They are thin and linear or punctiform and mainly thinner than 2 mm.

Obviously, we can find some similarities between the Ahrensburgian assemblages from Teltwisch:

- the blades selected for the common tools vary in size and regularity;
- the blades used to make the Ahrensburgian points are regular;
- they both contain regular blades potentially used as unretouched tools and possibly representing the products at which the knappers aimed most.

On the other hand, we must underline the important differences, in particular in the *chaîne opératoire* details. In addition to the absence of Long Blades, we have to underline the simplicity of the production patterns at Teltwisch-Mitte. It is probably linked with the lower productivity of the exploited volumes and the use of low quality raw materials.

We also observed differences in the use of the soft hammer stone. Moreover, a comparison of the quantitative data for Teltwisch 2 (Berg-Hansen, 2017 and 2019) and Teltwisch-Mitte point in the direction of a more standardized *chaîne opératoire* and a higher productivity at the former site. Regarding the details of the *chaîne opératoire*, we are aware that extensive refitting should be necessary to strengthen the argument concerning the economic behaviour. At this stage, we can discuss a possible relationship of this assemblage with the FMG phase or with the early Mesolithic, in particular because of the simplified process of blank production (cf. conclusion). Before considering any hypothesis about the chronological affiliation of the Teltwisch-Mitte lithic assemblage, it seems most important to compare Teltwisch-Mitte with the secured and well-dated site of the early Ahrensburgian without Zonhoven points, Alt Duvenstedt LA121+123. We will see if we can find any affiliations between these two settlements.

Alt Duvenstedt LA121 + 123: an early Ahrensburgian settlement in Schleswig-Holstein

Alt Duvenstedt LA 121 + 123, excavated in 1992 and 1994 as well as 2001, are two small adjacent concentrations with relatively few artefacts spread



Fig. 9 – Teltwisch-Mitte. Blade cores (Pictures: Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, CAD: L. Mevel).

Fig. 9 – Teltwisch-Mitte. Nucléus à lames (Photos : Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, DAO : L. Mevel).



Fig. 10 – Alt Duvenstedt LA 121 + 123. **A**, refitting showing several unretouched blades with damaged edges; **B**, projectile implements and retouched tools; **C**, diversity of the blanks used for the manufacturing of the Ahrensburgian points (Drawing: Clausen, 1995, fig. 10, pictures and CAD: L. Mevel).

Fig. 10 – Alt Duvenstedt LA 121 + 123. **A**, remontage d'une série de lames brutes dont certaines présentent des esquillements marqués sur leurs tranchants; **B**, armatures et outils; **C**, diversité des supports laminaires utilisés pour la confection des pointes ahrensburgiennes (Dessin : Clausen, 1995, fig. 10, photos et DAO : L. Mevel).

around two fireplaces (Clausen, 1996; Clausen and Schaaf, 2015). No artefacts from organic materials were found, and the fireplaces were identified by the concentration of fire cracked flint and charcoal. The two units are directly connected by several refittings, in particular by a blade production which began in LA 121 and was finished in LA 123 (Clausen and Schaaf, 2015). The site is typologically related to the Ahrensburgian by the presence of Ahrensburgian points. The lithic assemblage comprises cores and core fragments, core preparation waste, blades, flakes and fragments, as well as modified artefacts. We cannot go into details on this well-preserved settlement here and we will focus on the technological features in order to compare them with the other Ahrensburgian assemblages previously studied.

We examined nine different refitting sequences performed by I. Clausen, B. Schaaf and IMBH representing 65.5% and 82% of the artefacts > 1 cm² at

LA 121 and LA 123 respectively (Clausen and Schaaf, 2015). The retouched artefacts are rare (n = 21; Clausen, 1996, p. 105; Clausen and Schaaf, 2015, p. 16), while only a low quantity of blanks was carried away from the concentrations. Additionally, three terminal stages of core exploitation took place elsewhere. The small number of retouched artefacts and the low quantity of exported blanks raises the question of the production intentions. Indeed, the transformation of several blades into Ahrensburgian points or common tools does not justify the intensity of the blade production – dozens of blades – which took place at the site(s). However, studies show similar situations where a large number of unretouched tools are left at the sites (*e.g.* Fiedorczuk, 1995; Berg-Hansen, 2017), and use-wear analyses have documented extensive exploitation of blades and flakes without secondary preparation (Guéret, 2013; Guéret et al., 2014; Jacquier, 2014b; Naudinot and Jacquier,

2014; Taipale et al., 2014; Knutsson et al., 2015). If an initial assessment by a micro-wear specialist resulted in the impossibility of analysing this corpus due to wind-blown surfaces, a more recent assessment by C. Guéret during a working session in 2015 contradicted this view. Indeed, several blades show slightly

damaged edges and are perfectly suitable for micro-wear analysis (fig. 10A). Thus, to refine our understanding of the production intentions, a functional analysis is a priority.

Moreover, except for the Ahrensburgian point blanks – which were produced in different sequences



Fig. 11 – Alt Duvenstedt LA 121 + 123. Examples of two exhaustive refittings of blade production. **1**, the first blade of the reduction sequence yielding intentional products has been transformed into an Ahrensburgian point; **2**, only one of the last blades produced was transformed into an end scraper (in red on the picture; Pictures and CAD: L. Mevel).

Fig. 11 – Alt Duvenstedt LA 121 + 123. Deux remontages exhaustifs de la production de lames réalisées sur place. **1**, la première lame de la première séquence de plein débitage a été transformée en pointe ahrensbourgeoise; **2**, seule l'une des dernières lames débitées a été transformée en grattoir (en rouge sur la photo; Photos et DAO : L. Mevel).

of the *chaîne opératoire* – the other blanks transformed into common tools are clearly not the most regular blades of the collection (fig. 10B). Furthermore, several retouched tools are made from preparation flakes. In addition, the manufacturing waste of the Ahrensburgian points also confirms that the selection of blanks involved a large category of blades (fig. 10C). Thus, since no pursuit of specific size or regularity categories of blades for common tools and projectile implements can be observed, we suggest that instead the intention of obtaining sharp edges, present on flat blades with a straight longitudinal profile, strongly conditioned the production in these two units. The range of blades produced is quite diverse as it includes light blades of 50 to 60 mm length and other, much more massive ones, measuring up to 120 mm in length. The exploited volumes are either large flakes, exploited on their edges in order to benefit from the natural lateral convexity of the volume, or large blocks, which were also exploited on one of their broader faces.

All the sequences produced in both units were performed on high quality raw materials collected 2 km from the site. Each step of the *chaîne opératoire* was carefully conducted:

- configuration of the volume by one or several crests;
- maintenance of the striking platform generally comprised between 70 and 80°;
- use of a second striking platform for the initialization phase or the maintenance of the longitudinal convexity.

To illustrate these points, we will discuss in detail two refitted sequences.

The first volume has been totally exploited on the site (fig. 11, no. 1). It is a large flake exploited on its longest edge. The striking platform, with a relatively steep platform angle, was initialized by the extraction of a large and thick flake. A long and large longitudinal flake initialized the flaking face. The longitudinal convexities were immediately corrected by small flakes coming from the second striking platform. The knapper rectified the lateral convexity by the extraction of thick flakes on the sides of the volume. The first phase consisted of the production of small blades of 6 cm length. These blades are clearly linked to the preparation of the volume. The first phase of the blade production yielded straight and narrow blades of 8 cm length. The second blade of this sequence was transformed into an Ahrensburgian point and the next blades were larger and also regular. On these blades we can clearly distinguish edge damage in the form of scars potentially resulting from use. Finally, 24 blades were produced of which only one was transformed into a point and another one shows fine retouch which may be either intentional or use retouch.

The second example corresponds to an ovoid flint block (fig. 11, no. 2). Only one striking platform was installed and offered an angle close to 70°. The cortex was partially removed and one irregular crest was installed. Two flakes, localized on the core flank,

allowed to shape the future flaking surface. The blade production was half-rotating and symmetric. Only one blade was transformed into an end scraper. Several shorter blades show scars on their edges representing potential use-wear. The end of the exploitation was realized outside the excavated area, since the core is missing.

The two chosen examples show differences in the production sequences, the intentions of the blade production and the rhythm of the process. In one case, the absence of the last stage of blank production does not allow us to discuss the last intention. On the other refitted complex and all complete ones from the site, interestingly, there is no sequence devoted solely to the production of the Ahrensburgian point blanks.

To conclude, we can underline the important difference between this assemblage and the one from Teltwisch-Mitte, which presumably also represents an older phase of the Ahrensburgian. In our opinion, the important difference between them is not only due to the different amount of information available through refittings. The care taken at all the stages of the *chaîne opératoire* in AD LA 121 + 123 contrasts with the low quality raw material, the low degree of core preparation, the open platform angles and the non-intensive abrasion at Teltwisch-Mitte.

CONCLUSION

This first comparative analysis constitutes a preliminary assessment which must be improved by further research and a multi-proxi approach (fauna, bone industry...). For now, we have to underline the high diversity of the techno-economic behaviour between the different Ahrensburgian assemblages we evaluated, but there are also some common points.

In fact, the main shared characteristics of all the studied assemblages are:

- the presence of a common type of lithic implement (Ahrensburgian point), mainly made on regular small blades;
- a common behaviour regarding the selection of a high diversity of blades to make the different common tools, which raises the question if the regularity of the blades is a good criterion to identify the real objectives of the production;
- a potential importance of unretouched blades used as tools without modification in all collections.

But the differences are important in particular in the production patterns:

- size and quality of the raw material selected;
- in the use of the soft hammer stone – which has to be better understood;
- in the degree of standardization of the blade production *chaîne opératoire* and in the intentions (on the site scale as well: cf. Alt Duvenstedt LA 121 + 123);
- in the productivity of the exploited volumes.

Obviously, the question of chronology arises considering these differences. Unfortunately, we lack elements to answer it but our analysis documents several changes before the emergence of the Mesolithic. The differences between Teltwisch-Mitte, which is supposed to be an early Ahrensburgian site, and the well-preserved and directly dated site of Alt Duvenstedt LA 121 + 123 are important. In the light of the evidence from the definitely early Ahrensburgian at the latter site, it is difficult to consider Teltwisch-Mitte as an early Ahrensburgian site. We lack stratigraphic or radiometric data to support the diagnosis. Nevertheless, we can observe that the techno-economical behaviour is perhaps closest to the early Mesolithic (Duvensee 8/9; Bokelmann et al., 1981; Bokelmann, 1991; Holst, 2014) – and why not to an initial Mesolithic phase as it is now well documented in Northern and eastern France (Ducrocq, this volume; Séara, 2014)? The observations on Teltwisch-Mitte should also be considered in the context of the results obtained by a recent comparison between Ahrensburgian and Early Mesolithic sites (Berg-Hansen, 2017 and 2018). At this point a comparative

typo-technological analysis of the Ahrensburgian points and the microliths from different sites within a larger area should provide some new elements. The technological process to obtain the blanks of these points should also be described in more detail to understand their place in the *chaîne opératoire*. More generally, we have to increase our understanding on the site scale by the multiplication of refittings, use-wear and spatial analyses.

From a more diachronic perspective, it will also be necessary to have an overview of the technological behaviour in the FMG. Indeed, while in several geographical areas the Allerød technical traditions are distinguished by an important simplification of technical behaviour (cf. Fagnart, 1997; Valentin, 2008; Mevel and Bodu, 2018), it is necessary to check whether this is also the case in northern Germany. The rare published data (Clausen and Hartz, 1988; Clausen, 1999 and 2004; Veil et al., 2012) suggest that the evolutionary dynamics of the Lateglacial societies may be more contrasted than we might think. On this point, only a thorough work on the available collections will allow us to demonstrate it. ■

REFERENCES

- BAALES M. (1996) – *Umwelt und Jagdökonomie der Ahrensburger Rentierjäger im Mittelgebirge*, Mainz, Römisch-Germanisches Zentralmuseum (Monographien des Römisch-Germanischen Zentralmuseums, 38), 364 p.
- BAALES M. (2004) – Final Palaeolithic archaeology of the northern Rhineland and the Belgian Ardenne: state of research, in Le Secrétariat du Congrès (ed.), *Sessions générales et posters, Section 6 : Le Paléolithique supérieur, proceedings of the 14th UISPP congress (Liège, 2001)*, Oxford, Archaeopress (BAR International Series, 1240), p. 63-71.
- BAALES M. (2013a) – Die letzten Rentierjäger im westfälischen Bergland, in M. Baales, H.-O. Pollmann and B. Stapel (eds.), *Westfalen in der Alt- und Mittelsteinzeit*, Darmstadt, Philipp von Zabern, p. 152-155.
- BAALES M. (2013b) – Spätpaläolithische Lyngby-Beile in Westfalen, in M. Baales, H.-O. Pollmann and B. Stapel (eds.), *Westfalen in der Alt- und Mittelsteinzeit*, Darmstadt, Philipp von Zabern, p. 156-157.
- BARENSEN G.W., DEEVEY E.S., GRALENSKI L.J. (1957) – Yale natural radiocarbon measurements III, *Science*, 126, p. 908-919.
- BEMILLI C., BIARD M., CHAUSSE C., DONNART, K. (2014) – Une partie de chasse à l'Aurochs il y a 10 000 ans. Le Locus 28704 d'Alizay (Eure, France), in S. Costamagno (dir.), *Histoire de l'alimentation humaine : entre choix et contraintes*, Paris, Édition électronique du CTHS (Actes des congrès des sociétés historiques et scientifiques), p. 170-187.
- BENECKE N. (2004) – Faunal succession in the lowlands of northern Central Europe at the Pleistocene – Holocene transition, in T. Terberger and B.V. Eriksen (eds.), *Hunters in a Changing World. Environment and Archaeology of the Pleistocene – Holocene Transition (ca. 11000-9000 B.C.) in Northern Central Europe, proceedings of the Workshop of the UISPP – Commission XXXII (Greifswald, 2002)*, Rahden/Westfalen, Verlag Marie Leidorf (Internationale Archäologie, 5), p. 43-51.
- BENECKE N., HEINRICH D. (2003) – Neue Daten zur Entwicklung der Huftierfauna im Tieflandgebiet zwischen Elbe und Oder im Spätglazial und Altholozän, *Archeozoologia*, 21, p. 19-36.
- BERG-HANSEN I.M. (2017) – *Den sosiale teknologien – teknologi og tradisjon i Nord-Europa ved slutten av istida, 10 900-8500 f.Kr.*, doctoral thesis, Universitetet i Oslo.
- BERG-HANSEN I.M. (2018) – Continuity and change in Late- and Post-Glacial social networks – knowledge transmission and blade production methods in Ahrensburg and Early Mesolithic Northwestern Europe, in K. Knutsson, H. Knutsson, J. Apel and H. Glørstad (eds.), *Technology of early settlement in Northern Europe – Transmission of knowledge and culture*, Sheffield, Equinox Publishing (The early settlement of Northern Europe, 2), p. 63-98.
- BERG-HANSEN I.M. (2019) – Alt Duvenstedt LA 121 revisited – Blade technology in Ahrensburgian culture, in B.V. Eriksen, E. Rensink and S. Harris (eds.), *Proceedings of the Amersfoort, Schleswig and Burgos meetings of the UISPP commission for “The Final Palaeolithic of Northern Eurasia”*, Kiel, Verlag Ludwig (Schriften des Museums für Archäologie Schloss Gottorf, Ergänzungsreihe, 13), p. 169-192.
- BIARD M., HINGUANT S. (2014) – Des grandes lames aux microlithes : unité technologique d'un assemblage lithique du Paléolithique supérieur final à Calleville (Eure), in J. Jaubert, N. Fourment and P. Depaepe (eds.), *Transitions, ruptures et continuité en préhistoire, Volume 2 : Paléolithique et Mésolithique, Actes du XXVII^e Congrès préhistorique de France (Bordeaux-Les Eyzies, 2010)*, Paris, Société préhistorique française, p. 605-621.
- BOKELMANN K. (1978) – Ein Federmesserfundplatz bei Schalkholz, Kreis Dithmarschen, *Offa*, 35, p. 36-54.
- BOKELMANN K. (1991) – Duvensee, Wohnplatz 9. Ein präborealzeitlicher Lagerplatz in Schleswig-Holstein, *Offa*, 48, p. 75-114.
- BOKELMANN K., AVERDIECK F.-R., Willkomm H. (1981) – Duvensee, Wohnplatz 8. Neue Aspekte zur Sammelwirtschaft im frühen Mesolithikum, *Offa*, 38, p. 21-40.
- BOKELMANN K., HEINRICH D., MENKE B. (1983) – Fundplätze des Spätglazials am Hainholz-Esinger Moor, Kreis Pinneberg, *Offa*, 40, p. 199-239.
- BRIDAULT A. (1997) – Chasseurs, ressources animales et milieux dans le nord de la France de la fin du Paléolithique à la fin du Mésolithique :

- problématique et état de la recherche, in J.-P. Fagnart and A. Thévenin (dir.), *Le Tardiglaciaire en Europe du Nord-Ouest, Actes du 119^e Congrès national des sociétés historiques et scientifiques, Amiens (octobre 1994)*, Paris, CTHS, p. 165-176.
- BRONK RAMSEY C., HIGHAM T.F.G., OWEN D.C., PIKE A.W.G., HEDGES R.E.M. (2002) – Radiocarbon dates from the Oxford AMS system: archaeometry datelist 31, *Archaeometry*, 44, suppl. 1.
- CLAUSEN I. (1995) – Alt Duvenstedt, Kreis Rendsburg-Eckernförde, LA 121. Ein Ahrensburger Kulturvorkommen in allerödzeitlichem Boden, *Archäologische Nachrichten aus Schleswig-Holstein*, 6, p. 103-126.
- CLAUSEN I. (1996) – Alt Duvenstedt LA 121, Schleswig-Holstein. Occurrence of the Ahrensburgian culture in soils of the Allerød interstadial. Preliminary Report, in L. Larsson (ed.), *The Earliest Settlement of Scandinavia and Its Relationship with Neighbouring Areas, proceedings of the Symposium Ystad (Ystad, 1994)*, Stockholm, Almqvist and Wiksell International (Acta Archaeologica Lundensia, IN 8, 24), p. 99-110.
- CLAUSEN I. (1998) – Neue Untersuchungen an späteiszeitlichen Fundplätzen der Hamburger Kultur bei Ahrenshöft, Kr. Nordfriesland. Ein Vorbericht, *Archäologische Nachrichten aus Schleswig-Holstein*, 8, p. 8-49.
- CLAUSEN I. (1999) – Alt Duvenstedt, Kr. Rendsburg-Eckernförde: Jungpaläolithische Stationen LA 120A und LA 121, *Offa*, 53, 1996, p. 372-373.
- CLAUSEN I. (2004) – The reindeer antler axe of the Allerød period from Klappholz LA 63, Kreis Schleswig-Flensburg/Germany. Is it a relic of the Federmesser, Bromme or Ahrensburgian culture, in T. Terberger and B.V. Eriksen (eds.), *Hunters in a Changing World. Environment and Archaeology of the Pleistocene – Holocene Transition (ca. 11000-9000 B.C.) in Northern Central Europe, Proceedings of the Workshop of the UISPP – Commission XXXII (Greifswald, 2002)*, Rahden/Westfalen, Verlag Marie Leidorf (Internationale Archäologie, 5), p. 141-164.
- CLAUSEN I. (2014) – Roter Helgoländer Flint in einer Station der Ahrensburger Kultur bei Klein Nordende, Kr. Pinneberg (Schleswig-Holstein), in Niedersächsisches Institut für historische Küstenforschung (ed.), *Flint from Heligoland – the exploitation of a unique source of raw-material on the North Sea coast, Proceedings of the Marshland Council Colloquium (Wilhelmshaven, 2012)*, Rahden/Westfalen, Verlag Marie Leidorf (Siedlungs- und Küstenforschung im südlichen Nordseegebiet, 37), p. 103-112.
- CLAUSEN I., HARTZ S. (1988) – Fundplätze des Spätglazials am Sorgetal bei Alt Duvenstedt, Kreis Rendsburg-Eckernförde, *Offa*, 45, p. 17-41.
- CLAUSEN I., SCHAFF B. (2015) – Zwanzig Jahre nach der Ausgrabung: Zusammengeführte Steinartefakte erzählen erstaunliche Geschichte(n)... Aktuelle Forschungsergebnisse zu den spätaltsteinzeitlichen Stationen der "Ahrensburger Kultur" von Alt Duvenstedt, Kreis Rendsburg-Eckernförde (LA 121 und LA 123), *Archäologische Nachrichten aus Schleswig-Holstein*, 21, p. 9-17.
- CONNELLER C. (2007) – Inhabiting new landscapes: settlement and mobility in Britain after the last glacial maximum, *Oxford Journal of Archaeology*, 26, 3, p. 215-237.
- CROMBÉ P., DEEBEN J., VAN STRYDONCK M. (2013) – Hunting in a changing environment : the transition from the Younger Dryas to the (Pre)boreal in Belgium and the southern Netherlands, in J. Jaubert, N. Fourment and P. Depaepe (dir.), *Transitions, ruptures et continuité en Préhistoire, Actes du 27^e Congrès préhistorique de France, Bordeaux – Les Eyzies, 31 mai-5 juin 2010*, Paris, Société préhistorique française, p. 583-604.
- CZIESLA E., PETTIT P.B. (2003) – AMS-¹⁴C-Datierungen von spätaltsteinzeitlichen und mesolithischen Funden aus dem Bützsee (Brandenburg), *Archäologisches Korrespondenzblatt*, 33, p. 21-38.
- DEEBEN J., DIJKSTRA P., VAN GISBERGEN p. (2000) – Some new ¹⁴C dates from sites of the Ahrensburg culture in the Southern Netherlands, *Notae Praehistoricae*, 20, p. 95-109.
- DE KLERK P. (2002) – Changing vegetation patterns in the Enderling Bruch area (Vorpommern, NE Germany) during the Weichselian lateglacial and early Holocene, *Review of Palaeobotany and Palynology*, 119, p. 275-309.
- DRUCKER D.G., ROSENDAHL W., VAN NEER W., WEBER M.-J., GÖRNER I., BOCHERENS H. (2016) – Environment and Subsistence in north-western Europe during the Younger Dryas: An isotopic Study of the Human of Rhünda (Germany), *Journal of Archaeological Science: Reports*, 6, p. 690-699.
- FAGNART J.-P. (1997) – *La fin des temps glaciaires dans le nord de la France. Approches archéologique et environnementale des occupations humaines du Tardiglaciaire*, Paris, Société préhistorique française (Mémoire, 24), 269 p.
- FAGNART J.-P. (2009) – Les industries à grandes lames et éléments mûchés du paléolithique final du Nord de la France : une spécialisation fonctionnelle des sites épiahrensbourgiens, in P. Crombé, M. Van Strydonck, J. Sergeant, M. Boudin and M. Bats (eds.), *Chronology and Evolution within the Mesolithic of North-West Europe, Proceedings of an International Meeting (Brussels 2007)*, Cambridge, Cambridge Scholars Publishing, p. 39-56.
- FIEDORCZUK J. (1995) – Production, selection and "export" of blanks in the Final Palaeolithic Masovian complex. A case study of the blade workshops from Rydno IV/57 in Southern Poland, *Archaeologia Polona*, 33, p. 59-69.
- FISCHER A. (1996) – At the border of human Habitat. The late Palaeolithic and early Mesolithic in Scandinavia, in L. Larsson (ed.), *The Earliest Settlement of Scandinavia and Its Relationship with Neighbouring Areas, proceedings of the Symposium Ystad (Ystad, 1994)*, Stockholm, Almqvist and Wiksell International (Acta Archaeologica Lundensia, IN 8, 24), p. 157-176.
- FISCHER A., TAUBER H. (1986) – New C-14 datings of the late Palaeolithic cultures from northwestern Europe, *Journal of Danish Archaeology*, 5, p. 7-13.
- FISCHER A., CLEMMENSEN R., DONAHUE R., HEINEMEIER J., LYKKE-ANDERSEN H., LYSDAHL P., MORTENSEN M.F., OLSEN J., PETERSEN P.V. (2013) – Late Palaeolithic Nørre Lyngby – a northern Outpost close to the West coast of Europe, *Quartär*, 60, p. 137-162.
- GERKEN K. (2001) – *Studien zur jung- und spätaltsteinzeitlichen sowie mesolithischen Besiedlung im Gebiet zwischen Wümme und Oste, Oldenburg*, Isensee-Verlag (Archäologische Berichte des Landkreises Rotenburg (Wümme), 9, 360 p.
- GOB A. (1990) – *Chronologie du Mésolithique en Europe. Atlas des dates ¹⁴C*, Liège, Centre Informatique de Philosophie et Lettres (Travaux publiés par le Centre Informatique de Philosophie et Lettres. Série histoire de l'art et archéologie, 1).
- GRAMSCH B., BERAN J. (2010) – Spätaltsteinzeitliche Funde von Wustermark, Fundplatz 22, Lkr. Havelland, *Veröffentlichungen zur brandenburgischen Landesarchäologie*, 41/42, 2007/2008, p. 95-142.
- GUÉRET C. (2013) – Character and variability of Early Mesolithic toolkits in Belgium and Northern France. The contribution of a functional approach, in B. Valentin, B. Souffri, T. Ducrocq, J.-P. Fagnart, F. Séara and C. Verjux (eds.), *Mesolithic Palethnography. Research on open-air sites between Loire and Neckar, Proceedings of the international round-table meeting, Paris, November 26-27, 2010*, Paris, Société préhistorique française (Séance, 2-2), p. 147-167.
- GUÉRET C., GASSIN B., JACQUIER J., MARCHAND G. (2014) – Traces of plant working in the Mesolithic shell midden of Beg-an-Dorchenn (Plomeur, France), *Mesolithic Miscellany*, 22, 3, p. 3-15.
- HARTZ S. (1987) – Neue spätaltsteinzeitliche Fundplätze bei Ahrenshöft, Kreis Nordfriesland, *Offa*, 44, p. 5-52.
- HARTZ S. (2012) – Grundformerzeugung im Nordischen Endpaläolithikum, in H. Floss (ed.), *Steinartefakte vom Altpaläolithikum bis in die Neuzeit*, Tübingen, Kerns Verlag Tübingen (Tübingen Publications in Prehistory), p. 389-398.
- HEDGES R.E.M., HOUSLEY R.A., BRONK RAMSEY C., VAN KLINKEN G.J. (1993) – Radiocarbon dates from the Oxford AMS system: archaeometry datelist 16, *Archaeometry*, 35, 1, p. 147-167.

- HEDGES R.E.M., HOUSLEY R.A., BRONK RAMSEY C., VAN KLINKEN G.J. (1995) – Radiocarbon dates from the Oxford AMS system: archaeometry datelist 20, *Archaeometry*, 37, 2, p. 417-430.
- HEINEN M. (2017) – Dormagen-Nievenheim – ein Lagerplatz späteiszeitlicher Jäger am Rhein, *Archäologie im Rheinland*, 2016, p. 74-77.
- HOLST D. (2014) – *Subsistenz und Landschaftsnutzung im Frühmesolithikum: Nussröstplätze am Duvensee*, Mainz, Verlag des Römisch-Germanischen Zentralmuseums (Monographien des RGZM, 120), 282 p.
- JACQUIER J. (2014a) – Analyse fonctionnelle des outillages lithiques et interprétations socio-économique du statut des sites tardiglaciaires du Buhot à Calleville (Eure) et de la Fosse à Villiers-Charlemagne (Mayenne), in M. Langlais, N. Naudinot and M. Peresani (dir.), *Les groupes culturels de la transition Pléistocène-Holocène entre Atlantique et Adriatique, Actes de la séance de la Société préhistorique française de Bordeaux (24-25 mai 2012)*, Paris, Société préhistorique française (Séances de la Société préhistorique française, 3), p. 221-246.
- JACQUIER J. (2014b) – A specialized occupation despite appearances : Function of the Buhot late glacial site (Calleville, North-Western France), in J. Marreiros, N. Bicho and J.F. Gibaja (eds.), *International Conference on Use-Wear Analysis, Use-Wear 2012, Cambridge*, Cambridge Scholars Publishing, p. 2-12.
- JOHANSEN L. (2000) – The Late Palaeolithic in Denmark, in B. Valentin, P. Bodu and M. Christensen (eds.), *L'Europe centrale et septentrionale au Tardiglaciaire. Confrontation des modèles régionaux de peuplement, Actes de la table ronde internationale (Nemours, 1997)*, Nemours, APRAIF (Mémoires du Musée de Préhistoire d'Ile-de-France, 7), p. 197-215.
- JOHANSEN L., STAPERT D. (2004) – *Oldeholtwolde. A Hamburgian family encampment around a hearth*, Lisse, A.A. Balkema Publishers, 229 p.
- KAISER K., CLAUSEN I. (2005) – Palaeopedology and stratigraphy of the late Palaeolithic Alt Duvenstedt site, Schleswig-Holstein (North-west Germany), *Archäologisches Korrespondenzblatt*, 35, p. 447-466.
- KNUTSSON H., KNUTSSON K., TAIPALE N., TALLAVAARA M., DARMARK K. (2015) – How shattered flakes were used: Micro-wear analysis of quartz flake fragments, *Journal of Archaeological Science: Reports*, 2, p. 517-531.
- KOTTHAUS J.K. (2013) – *The late glacial Federmesser site of Borneck-Ost, Germany: a technological reanalysis of the lithic assemblage using a chaîne opératoire approach*, master thesis, Universitetet i Oslo, 104 p.
- LANTING J.N., VAN DER PLICHT J. (1996) – De ¹⁴C-chronologie van de Nederlandse Pre-en Protohistorie. I: Laat-Paleolithicum, *Palaeohistoria*, 37/ 38, p. 71-125.
- LEMPCKE K.-H. (1996) – Agethorst LA 9, Kreis Steinburg. Ein Federmesser-Fundplatz des Spätglazials, *Offa*, 53, p. 7-25.
- LEMPCKE K.-H. (2000) – Ein mehrperiodischer steinzeitlicher Siedlungsplatz in Drage, Kreis Steinburg, *Archäologische Nachrichten aus Schleswig-Holstein*, 11, p. 7-23.
- LEWIS J.S.C., RACKHAM J. (2011) – *Three Ways Wharf, Uxbridge: a late Glacial and early Holocene Hunter-gatherer Site in the Colne Valley*, London, Museum of London Archaeology (MOLA Monograph Series, 51), 226 p.
- LITT T., BRAUER A., GOSLAR T., MERKT J., BAŁAGA K., MÜLLER H., RALSKA-JASIEWICZOWA M., STEBICH M. and NEGENDANK J.F.W. (2001) – Correlation and synchronisation of Lateglacial continental sequences in northern central Europe based on annually laminated lacustrine sediments, *Quaternary Science Reviews*, 20, p. 1233-1249.
- LÜBKE H., RICHTER P. (2000) – Die spätpaläolithischen und neolithischen Steinartefakte einer trichterbecherzeitlichen Siedlung bei Pennigbüttel, Ldkr. Osterholz, *Nachrichten aus Niedersachsens Urgeschichte*, 69, p. 3-37.
- MADSEN B. (1992) – Hamburgkulturens flintteknologi i Jels, in J. Holm and F. Rieck (eds.), *Itidsjægere ved Jelsøerne. Hamburgkulturen i Danmark*, Haderslev, Haderslev Museum (Skrifter fra Museumsrådet for Sønderjyllands Amt, 5), p. 58–130.
- MEVEL L., BODU P. (2018) – Le Closeau revisité. Actualités et perspectives autour des occupations de l'Azilien récent du Closeau (Rueil-Malmaison, Hauts-de-Seine, France), in A. Averbough, P. Bonnet-Jacquement and J.-J. Cleyet-Merle (dir.), *L'Aquitaine à la fin des temps glaciaires – Aquitaine at the end of the Ice Age. Les sociétés de la transition du Paléolithique final au début du Mésolithique dans l'espace nord aquitain, Actes de la table ronde organisée en hommage à Guy Célérier (Les Eyzies-de-Tayac, 2015)*, Paléo, numéro spécial, p. 203-214.
- MORTENSEN M.F., BIRKS H.H., CHRISTENSEN C., HOLM J., NOE-NYGAARD N., ODGAARD B.V., OLSEN J., LUND RASMUSSEN K. (2011) – Late-glacial vegetation development in Denmark – new evidence based on macrofossils and pollen from Slotseng, a small-scale site in southern Jutland, *Quaternary Science Reviews*, 30, 19-20, p. 2534-2550.
- MORTENSEN M.F., HENRIKSEN P.S., BENNIKE O. (2014) – Living on the good soil: relationships between soils, vegetation and human settlement during the late Allerød period in Denmark, *Vegetation History and Archaeobotany*, 23, 3, p. 195-205.
- MORTENSEN M.F., HENRIKSEN P.S., CHRISTENSEN C., VANG PETERSEN P., OLSEN J. (2015) – Vegetation development in south-east Denmark during the Weichselian Late Glacial: palaeoenvironmental studies close to the Palaeolithic site of Hasselø, *Journal of Danish Archaeology*, 3, p. 33-51.
- NAUDINOT N., JACQUIER J. (2014) – Socio-economic organization of Final Paleolithic societies: New perspectives from an aggregation site in Western France, *Journal of Anthropological Archaeology*, 35, p. 177-189.
- PELEGRIN J. (1995) – *Technologie lithique : Le Châtelperronien de Roc-de-Combe (Lot) et de La Côte (Dordogne)*, Paris, éditions du CNRS (Cahiers du Quaternaire, 20), 297 p.
- PELEGRIN J. (2000) – Les techniques de débitage laminaire au Tardiglaciaire : critères de diagnose et quelques réflexions, in B. Valentin, P. Bodu and M. Christensen (eds.), *L'Europe centrale et septentrionale au Tardiglaciaire. Confrontation des modèles régionaux de peuplement, Actes de la table ronde internationale (Nemours, 1997)*, Nemours, APRAIF (Mémoires du Musée de Préhistoire d'Ile-de-France, 7), p. 73-86.
- PETERSEN P.V., JOHANSEN L. (1996) – Tracking Late Glacial reindeer hunters in eastern Denmark, in L. Larsson (ed.), *The Earliest Settlement of Scandinavia and Its Relationship with Neighbouring Areas, proceedings of the Symposium Ystad (Ystad, 1994)*, Stockholm, Almqvist and Wiksell International (Acta Archaeologica Lundensia, IN 8, 24), p. 75–88.
- RASMUSSEN S.O., BIGLER M., BLOCKLEY S.P., BLUNIER T., BUCHARDT S.L., CLAUSEN H.B., CVIJANOVIC I., DAHL-JENSEN D., JOHNSEN S.J., FISCHER H., GKINIS V., GUILLEVIC M., HOEK W.Z., LOWE, J.J., PEDRO J.B., POPPT., SEIERS-TAD I.K., STEFFENSEN J.P., SVENSON A.M., VALLELONGA P., VINTHER B.M., WALKER M.J.C., WHEATLEY J.J., WINS-TRUP M. (2014) – A stratigraphic framework for abrupt climatic changes during the Last Glacial period based on three synchronized Greenland ice-core records: refining and extending the INTIMATE event stratigraphy, *Quaternary Science Reviews*, 106, p. 14-28.
- RICHTER P. (1992) – Ein spätglazialer Fundplatz auf dem Friedhof in Melbeck, Ldkr. Lüneburg, *Nachrichten aus Niedersachsens Urgeschichte*, 61, p. 3-32.
- RIEDE F., GRIMM S.B., WEBER M.-J., FAHLKE J.M. (2010) – Neue Daten für alte Grabungen: Ein Beitrag zur spätglazialen Archäologie und Faunengeschichte Norddeutschlands, *Archäologisches Korrespondenzblatt*, 40, 3, p. 297-316.
- RUBIN M., SUESS H.E. (1956) – U. S. Geological Survey Radiocarbon Dates III, *Science*, 123, p. 442-448.
- RUST A. (1943) – *Die alt- und mittelsteinzeitlichen Funde von Stellmoor*, Neumünster, Karl Wachholtz, 240 p.
- SCHÜTRUMPF R. (1943) – Die pollenanalytische Untersuchung der Rentierjägerfundstätte Stellmoor in Holstein, in A. Rust, *Die alt- und*

- mittelsteinzeitlichen Funde von Stellmoor*, Neumünster, Karl Wachholtz, p. 6-45.
- SCHWABEDISSEN H. (1954) – *Die Federmesser-Gruppen des nordwesteuropäischen Flachlandes, Zur Ausbreitung des Spät-Magdalénien*, Neumünster, Karl Wachholtz (Vor- und frühgeschichtliche Untersuchungen aus dem Schleswig-Holsteinischen Landesmuseum für Vor- und Frühgeschichte in Schleswig und dem Institut für Ur- und Frühgeschichte der Universität Kiel, 9), 106 p.
- SEARA F. (2014) – Considérations sur le processus de mésolithisation dans l'Est de la France : les apports du site de Choisey dans le Jura, in J. Jaubert, N. Fourment and P. Depaepe (dir.), *Transitions, ruptures et continuité en préhistoire, Volume 2 : Paléolithique et Mésolithique, Actes du XXVII^e Congrès préhistorique de France (Bordeaux-Les Eyzies, 2010)*, Paris, Société préhistorique française, p. 547-565.
- SØRENSEN M., STERNKE F. (2004) – Nørregård VI – Late glacial Hunters in Transition, in T. Terberger and B.V. Eriksen (eds.), *Hunters in a changing World. Environment and Archaeology of the Pleistocene-Holocene Transition (ca. 11000-9000 B.C.) in Northern Central Europe, Proceedings of the Workshop of the UISPP – Commission XXXII (Greifswald, 2002)*, Rahden/Westfalen, Marie Leidorf (Internationale Archäologie, 5), p. 85-111.
- TAIPALE N., KNUTSSON K., KNUTSSON H. (2014) – Unmodified quartz flake fragments as cognitive tool categories: Testing the wear preservation, previous low magnification use-wear results and criteria for tool blank selection in two late mesolithic quartz assemblages from Finland, in J. Marreiros, N. Bicho and J.F. Gibaja (eds.), *International Conference on Use-Wear Analysis, Use-Wear 2012*, Cambridge, Cambridge Scholars Publishing, p. 352-361.
- TAUTE W. (1968) – *Die Stielspitzen-Gruppen im nördlichen Mitteleuropa. Ein Beitrag zur Kenntnis der späten Altsteinzeit*, Köln, Böhlau (Fundamenta Monographien zur Urgeschichte Series A, 5), 326 p.
- TERBERGER T. (2006) – From the first humans to the Mesolithic hunters in the northern German lowlands – Current results and Trends, in K.M. Hansen and K.B. Pedersen (eds.), *Across the Western Baltic, proceedings of the conference The Prehistory and Early Medieval Period in the Western Baltic (Vordingborg, 2003)*, Vordingborg, Sydsjællands Museum (Sydsjællands Museums Publikationer, 1), p. 23-56.
- THEUERKAUF M., JOOSTEN H. (2012) – Younger Dryas cold stage vegetation patterns of central Europe – climate, soil and relief controls, *Boreas*, 41, 3, p. 391-407.
- TIXIER J., INIZAN M.-L., ROCHE H. (1980) – *Préhistoire de la pierre taillée 1 : terminologie et technologie*, Nanterre, Cercle de Recherches et d'Études Préhistoriques, 120 p.
- TROMNAU G. (1975) – *Neue Ausgrabungen im Ahrensburger Tunnel. Ein Beitrag zur Erforschung des Jungpaläolithikums im nordwesteuropäischen Flachland*, Neumünster, Karl Wachholtz (Offa-Bücher, 33), 153 p.
- USINGER H. (1998) – Pollenanalytische Datierung spätpaläolithischer Fundschichten bei Ahrenshöft, Kr. Nordfriesland, *Archäologische Nachrichten aus Schleswig-Holstein*, 8, p. 50-73.
- USINGER H. (2004) – Vegetation and climate of the lowlands of northern Central Europe and adjacent areas around the Younger Dryas-Preboreal transition – with special emphasis on the Preboreal oscillation, in T. Terberger and B.V. Eriksen (eds.), *Hunters in a changing World. Environment and Archaeology of the Pleistocene-Holocene Transition (ca. 11000-9000 B.C.) in Northern Central Europe, Proceedings of the Workshop of the UISPP – Commission XXXII (Greifswald, 2002)*, Rahden/Westfalen, Marie Leidorf (Internationale Archäologie, 5), p. 1-26.
- VALENTIN B. (2008) – *Jalons pour une Paléohistoire des derniers chasseurs (XIV^e-VI^e millénaire avant J.-C.)*, Paris, Publications de la Sorbonne (Cahiers archéologiques de Paris 1, 1), 325 p.
- VEIL ST. (1987) – Ein Fundplatz der Stielspitzen-Gruppen ohne Stielspitzen bei Höfer, Ldkr. Celle. Ein Beispiel funktionaler Variabilität paläolithischer Steinartefaktinventare, *Archäologisches Korrespondenzblatt*, 17, p. 311-322.
- VEIL ST., BREEST K., GROOTES P., NADEAU M.-J. (2012) – A 14000-year-old amber elk and the origins of northern European art, *Antiquity*, 86, 333, p. 660-673.
- VERMEERSCH P.M. (2011) – The human occupation of the Benelux during the Younger Dryas, *Quaternary International*, 242, p. 267-276.
- WEBER M.-J. (2012) – *From technology to tradition – Re-evaluating the Hamburgian-Magdalenian relationship*, Neumünster, Karl Wachholtz (Untersuchungen und Materialien zur Steinzeit in Schleswig-Holstein und im Ostseeraum, 5), 252 p.
- WEBER M.-J., GRIMM S. B., BAALES M. (2011) – Between warm and cold: Impact of the Younger Dryas on human Behavior in Central Europe, *Quaternary International*, 242, p. 277-301.
- WENINGER B., JÖRIS O., DANZEGLOCKE U. (2007) – CalPal-2007. Cologne radiocarbon calibration & palaeoclimate research package, version 2016.2. <http://www.calpal.de>, accessed 2018-11-16.
- WENINGER B., JÖRIS O. (2008) – A ¹⁴C age calibration curve for the last 60 ka: the Greenland-Hulu U/Th timescale and its impact on understanding the Middle to Upper Paleolithic transition in Western Eurasia, *Journal of Human Evolution*, 55, p. 772-781.
- WILD M. (2017) – 18 km nordwärts – Archäozoologische und technologische Analyse eines Inventars der Ahrensburger Kultur von Nahe LA11 am Itzstedter See (Kr. Segeberg/D), *Archäologisches Korrespondenzblatt*, 47, 4, p. 461-480.

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