

Archaeology across the Pleistocene-Holocene boundary in western Germany: Human responses to rapid environmental change

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*Submitted for: «Préhistoire de l'Europe du Nord-Ouest: mobilité, climats et entités culturelles»
Conference Proceedings of the XXVIIIe congrès préhistorique de France Amiens, 30th Mai – 4th June 2016. Ses-
sion 3 (2nd – 3rd June 2016), «L'Europe du Nord-Ouest autour de 10 000 BP (9 600 cal BC): quels changements?»,
Workshop organised by Jean-Pierre Fagnart, Boris Valentin, Mara-Julia Weber and Ludovic Mevel for the U.I.S.P.P.
Commission "The Final Palaeolithic of Northern Eurasia".*

Summary

In recent years, new insights into the Mesolithic in Westphalia have been gained. The Early Mesolithic human remains of the Blätterhöhle in Hagen should especially be mentioned as they even attracted international attention. Additionally, a first stratigraphic sequence containing hearth remains and lithic assemblages of the Early to Late Mesolithic age has been excavated there. Further new sites and radiometric investigations on single finds suggest varying influences from northern and southern as well as western regions on the Westphalian Mesolithic. Several sites, which are assigned to the broad blade complexes or the long blade industries / the Belloisien due to the distinct blade technology and simple microlithic projectile points, represent the initial stage of the Westphalian Mesolithic.

Résumé

De nouvelles découvertes en contexte Mésolithique ont été réalisées en Westphalie au cours des dernières années. Il faut mentionner en particulier les restes humains du Mésolithique ancien de la grotte de Blätterhöhle à Hagen qui ont suscité un intérêt international. En outre, et pour la première fois, une séquence stratigraphique comportant des vestiges de foyers et des séries lithiques couvrant l'ensemble du Mésolithique ancien, moyen et final a été mise en évidence dans ce même site. D'autres nouveaux sites, ainsi que des analyses radiométriques menées sur des découvertes isolées semblent indiquer que le Mésolithique de la Westphalie a été tour à tour influencé par celui des régions septentrionales et méridionales ainsi que celui des zones occidentales. Plusieurs sites, attribués aux Long Blade Assemblages, ou Belloisien, en raison de leur évidente technologie laminaire et de la présence d'armatures microlithiques simples, représentent la première phase du Mésolithique de Westphalie.

Zusammenfassung

In den letzten Jahren konnten vermehrt neue Erkenntnisse zum auslaufenden Spätpaläolithikum und Mesolithikum in Nordrhein-Westfalen gewonnen werden. Hierbei erregten vor allem die Ergebnisse der Blätterhöhle in Hagen, nicht zuletzt aufgrund ihrer frühmesolithischen Menschenreste, besondere Aufmerksamkeit. Hier konnte darüber hinaus erstmals in Westfalen an einem Ort eine Abfolge früh- bis spätmesolithischer Funde und auch Befunde freigelegt werden. Die jüngsten Grabungsergebnisse deuten ein zurückreichen der Stratigraphie bis in das Spätpleistozän hinein an.

Darüber hinaus sind weitere Fundplätze bzw. Einzel-funde neu entdeckt und/oder auch datiert worden, so daß u.a. die wechselnden Einflüsse aus nördlichen und eher südlichen sowie westlichen Richtungen auf die mesolithische Entwicklung in Westfalen verdeutlicht wird. An den Beginn der Entwicklung gehören dabei einige Fundinventare, die aufgrund ihrer großen Klingen und einfachen Mikrolithen den nordwesteuropäischen Broad Blade-Komplexen oder den Lpng Blade-Industrien bzw. dem Belloisien an die Seite zu stellen sind.

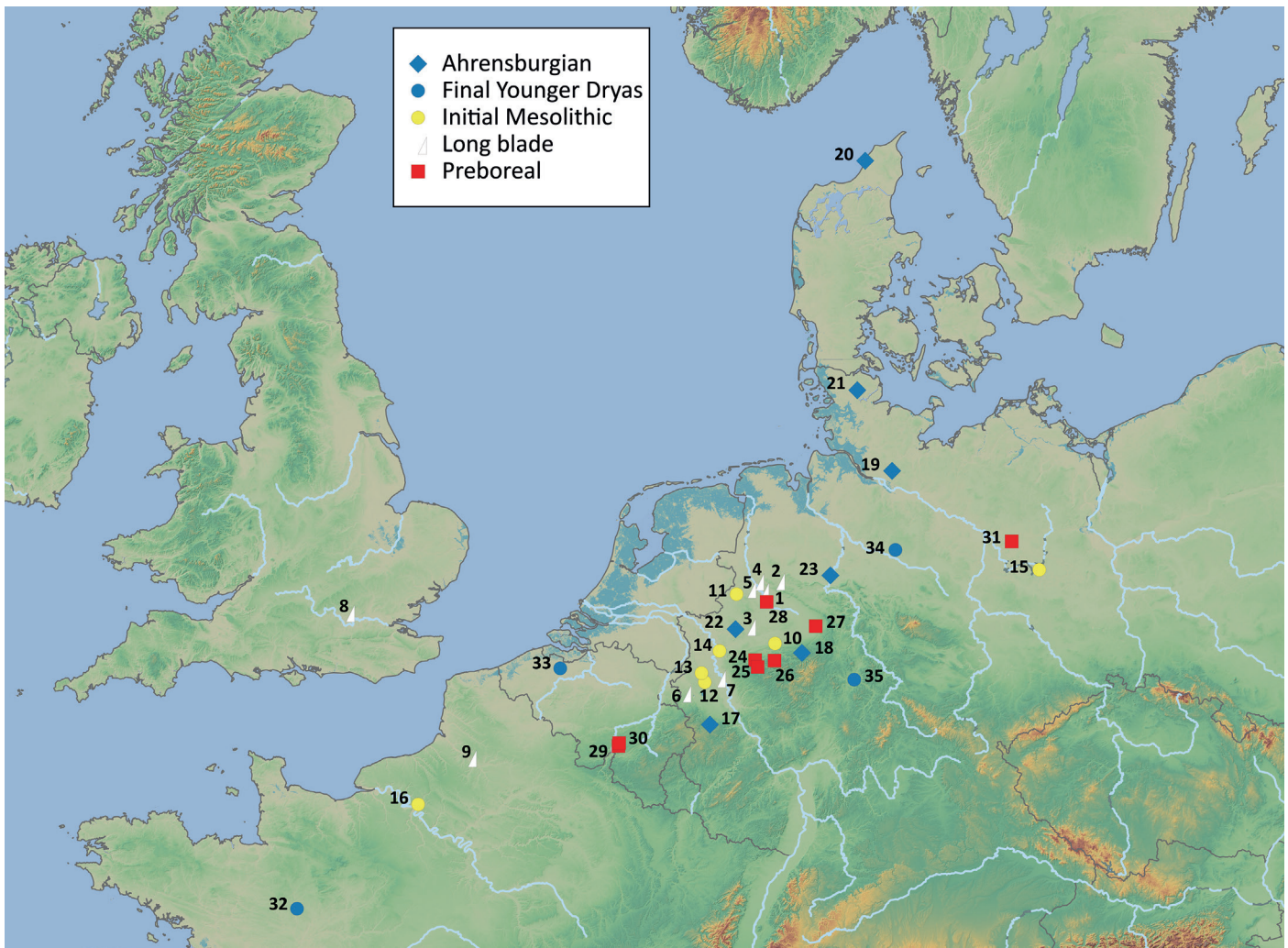


Figure 1: Rhineland and Westphalia consist of different landscapes: its northern regions are part of the North European Lowland, while the southern regions consist of upland landscapes. Sites mentioned in the text: 1 Saerbeck-Sinningen; 2 Westerkappeln-Brennesch; 3 Lüdinghausen-Emkum II; 4 Rheine-Altenrheine; 5 Wettringen (a bruised blade); 6 Übach-Palenberg; 7 Dormagen-Nievenheim; 8 Three Ways Wharf; 9 Belloy-sur-Somme; 10 Werl-Büderich; 11 Heek-Nienborg; 12 Bedburg-Königshoven; 13 Mönchengladbach-Geneicken; 14 Duisburg-Kaiserberg; 15 Potsdam-Schlaatz; 16 Alizay; 17 Kartstein; 18 Hohler Stein; 19 Stellmoor; 20 Nørre Lyngby; 21 Klappholz LA 63; 22 Marl-Sickingmühle; 23 Minden; 24 Hagen “Rieger Busch”; 25 Hagen-Holthausen “Blätterhöhle”; 26 Balver Höhle; 27 Paderborn-Sande; 28 Greven-Bockholt; 29 Grotte Margaux; 30 Abri des Autours; 31 Friesack 4 / 27; 32 La Fosse; 33 Evergem-Nest; 34 Höfer; 35 Rhünda (graphic: B. Gehlen, N. Schneid, K. Vogl, M. Zickel).

Archaeology across the Pleistocene-Holocene boundary in western Germany

This paper presents a brief summary of the current state of our knowledge of the archaeological record for the transition from the most recent Palaeolithic to the earliest Mesolithic at the western boundary of Germany. This is here broadly defined by the state of Nordrhein-Westfalen (NRW / North Rhine-Westphalia) with some reference to bordering regions.

The Rhineland and Westphalia are historically important for the investigation of some of the earliest humans in Europe, perhaps most famously as the location of the Kleine Feldhofer Grotte in the Neander(h)al valley, destined to provide the type specimen for Neander(t)hal hominins (Schmitz, 2006). Many other limestone caves,

particularly those in the Hönne river valley near Balve in the Westphalian Sauerland upland, became the focus of further pioneering prehistoric investigations by renowned contemporary researchers such as Hermann Schaaffhausen and Rudolf Virchow. A number of syntheses exist for the Pleistocene and earlier Holocene archaeology of the region under study (Westphalia: Günther, 1988; Baales et al., 2015; Rhineland: Bosinski, 2008; Bosinski et al., 1995) and a general overview will not be repeated here. The archaeological events of interest here fall together with the last period of major climatic and ecological change, the Pleistocene – Holocene boundary around 9,650 cal BC. It is not the purpose of this paper to discuss the role played by environmental change in the observed developments in the archaeological record, something

which can only be attempted at a larger geographical scale and by the incorporation of many more archives. Instead, this study will characterize the archaeological / cultural contexts recognized in the region at this time of major environmental and cultural change and concentrate on the few sites with well documented stratigraphic context and / or good radiometric dates which can serve as fixed points of reference (Figure 1). A number of newly discovered archaeological sites and recently obtained radiometric dates make it possible to re-examine this theme at a level of resolution not possible even only a few years ago.

Southernmost tanged-point groups during the Younger Dryas

The Younger Dryas is marked by a pronounced fall in temperature relative to the preceding Allerød interstadial, bringing a return to sub-arctic conditions. Radiocarbon ages from the Northern European Lowland in Germany or the Netherlands and from Remouchamps in the Belgium uplands suggest that archaeological assemblages defined as the Ahrensburgian may have appeared in North-western Europe very soon after this ecological change (Weber et al., 2011).

Tanged points characteristic of this period are known as surface finds from several localities in the region under study (e.g. Bosinski, 2008), however sites with reliable radiometric dating or stratigraphic controls are the exception in western Germany. Two sites recovered *in situ* which exceptionally have organic preservation



Figure 2: Three Ahrensburgian tanged points from the site of Hohlen Stein at Rùthen-Kallenhardt. Photo provided by LWL: Michael Baales and Andreas Müller.

are the Kartstein rock shelter in the northern Eifel uplands (Baales, 1996) and the Hohler Stein cave near Rùthen-Kallenhardt in the Westphalian uplands (Figure 2; Baales, 2013a; Baales et al., 2013a). At both sites it was possible to document in detail the exploitation of hunted reindeer and identify the spring hunting of migrating reindeer herds as an economic strategy of Younger Dryas Ahrensburgian hunters at the margins of the Rhineland and Westphalian uplands.

Lyngby axes made from the beams of reindeer antlers



Figure 3: Three certain "Lyngby axes" are known from Westphalia, all probably dating to the Ahrensburgian (Tanged Point Complex).
- 1 Minden, 2 „Hohler Stein“ at Rùthen-Kallenhardt, 3 Marl-Sickingmùhle. Photo provided by LWL: Stefan Brentfùhrer and Andreas Müller.



Figure 4: The two “Lyngby axes” from Minden (top) and Marl-Sickingmühle (bottom) show similar traces from their manufacture and / or use. Photo provided by LWL: Stefan Brentführer and Andreas Müller.

are a recurring element in northern European Final Palaeolithic contexts such as the northern German sites Stellmoor (Ahrensburgian) and Klappholz LA 63 or the eponymous Danish Nørre Lyngby locality and other sites in southern Scandinavia (e.g. Fischer et al., 2013; Weber et al., 2011). They are usually manufactured on robust male antlers collected after they had been shed following the autumn rut (Baales, 2013b), which is also the case for all three such artefacts known from Westphalia (Figure 3). A specimen found at the spring-occupied Hohler Stein site must have been brought there as a curated object. The two further Westphalian specimens were recovered as single finds without closer context at Marl-Sickingmühle and Minden. Their location near the Lippe and Weser rivers may suggest the existence here of autumn hunting grounds, when reindeer herds migrated from the upland zone to overwinter on the North European Plain. The surface of the Lyngby axe from Hohler Stein is quite weathered but the antlers from Minden and Marl-Sickingmühle still preserve traces of ancient anthropogenic surface modifications ((Figure 4; Baales, 2013b).

Although none of the Lyngby antler axe specimens contained sufficient dateable collagen, it was possible to obtain radiocarbon dates for both the Hohler Stein and the Kartstein sites on other faunal remains (Baales et al., 2013a; Bronk Ramsey et al., 2002; Weber et al., 2011). Many of the Kartstein dates must be rejected for reasons of poor context (e.g. no evidence for human association, sometimes bulked samples...) or methodology

(inadequate pretreatment / low precision of conventional results...). The three dates remaining for the two Ahrensburgian contexts all fall towards the end of the Younger Dryas stadial (Table 1).

It has been suggested that during the final phase of the Ahrensburgian, while the overall technology of lithic assemblages remained unchanged, the lithic armature component was characterized by a reduction in size of the typical tanged points and the appearance / increase in numbers of simple microlithic (“Zonhoven”) points created by oblique retouch. Although it is difficult to define an exact chronology for this development it probably dates to the end of the Younger Dryas stadial. Ultimately, the total disappearance of tanged points and their replacement by simple oblique points at the onset of the Holocene has led to nomenclatural proposals such as “tanged point groups without tanged points” (Veil, 1987), a phenomenon discussed below.

“Long Blade industries” at the Pleistocene – Holocene boundary

The boundary between the Pleistocene and the Holocene is marked in north-western Europe by the appearance of lithic assemblages characterized by the presence of long and regular rectilinear blades, serially produced from exhaustively worked broad and partially bipolar cores, which are usually associated with various simple microlithic and / or basally retouched points of “Zonhoven-type”. These “Long Blade industries” are particularly well known from

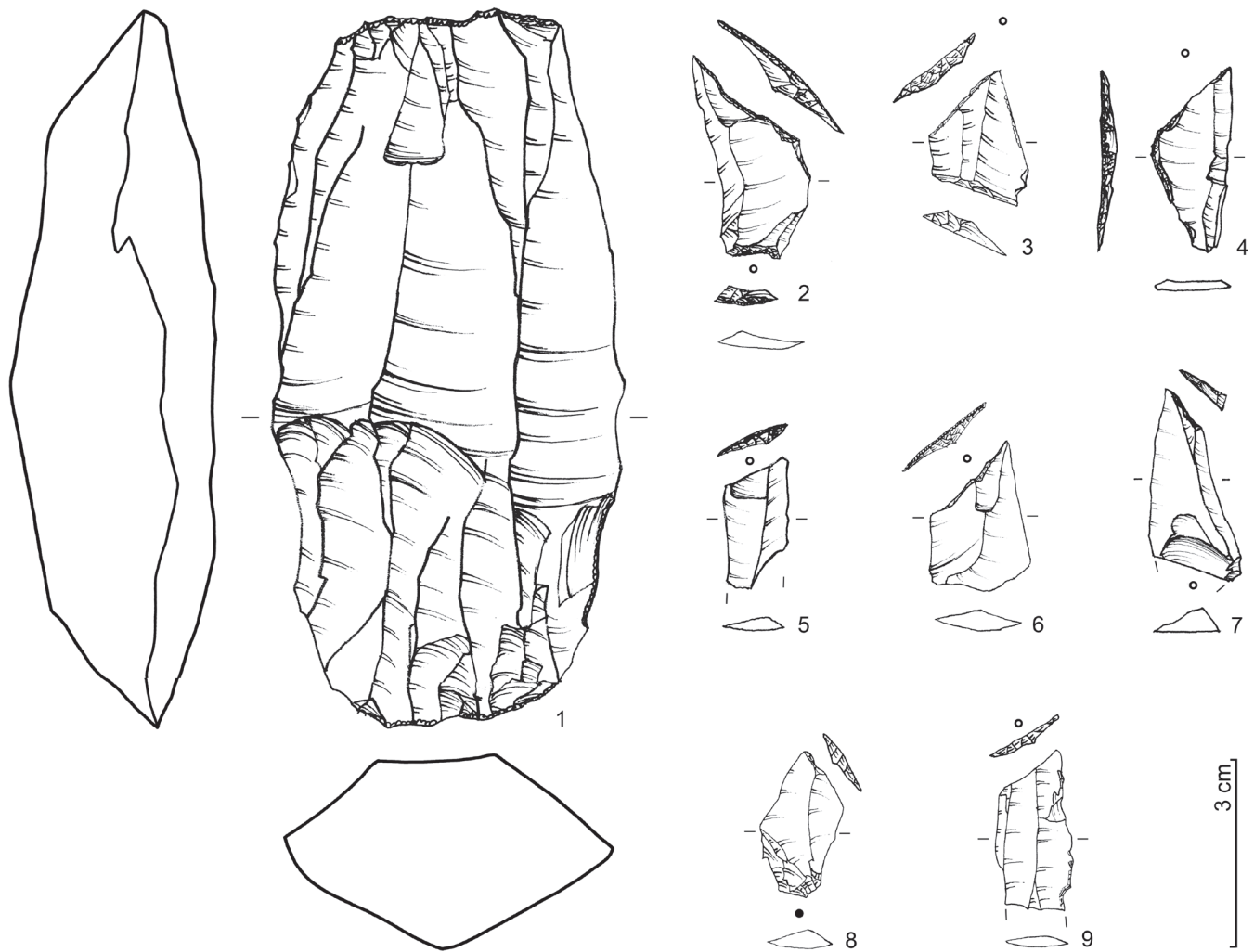


Figure 5: Westerkappeln-Brennesch, “Long Blade” assemblage. – 1 large blade core; 2–9 several simple microliths; all made of Baltic flint. Drawings by K. Koana and M. Kloss / LWL.

southern England (Barton, 1998; Lewis and Rackham, 2011) and northern France (here also referred to as the “*Belloisien*”: Fagnart, 1991; Valentin, 2008), but are also found in contexts much further to the North (Sørensen and Sternke, 2004). At a number of “Long Blade” sites the edges of some of the heavier laminar elements show very distinctive patterns of invasive flake negatives. They are referred to as “bruised blades” or “*lames mâchurées*” and were probably used for some sort of chopping or battering activity.

Western German sites assigned to the “Long Blade industries” include Saerbeck-Sinningen (Stapel, 2006, 2013a and 2016), Westerkappeln-Brennesch (Figure 5; Stapel, 2010 and 2013b), Lüdinghausen-Emkum II and Rheine-Altenrheine (Stapel, 2013b), and Wettringen (which produced a bruised blade; Figure 6; Baales et al., 2015; Stapel, 2016), all in Westphalia, and the Rhineland sites Übach-Palenberg (Jöris and Thissen, 1997) and Dormagen-Nievenheim (this paper).

Comparable very large blades (“*Riesenklingen*”), sometimes in the form of bruised blades with battered edges,

also occur together with tanged points in some Ahrensburgian contexts (Taute, 1968) in which case they are assigned to the later Younger Dryas stadial. The absence of tanged points in “Long Blade” assemblages thus probably reflects an even younger chronological position, exactly at the transition from the Pleistocene to the Holocene, when they probably represent only a short-lived phenomenon¹.

At most western German “Long Blade” sites no organic

¹ The presence of a tanged point at the Avington VI “Long Blade” site (Barton and Froom, 1986) in southern England, far outside the northern European distribution of Ahrensburgian tanged points is enigmatic (another Avington VI backed armature resembles a *pointe des Blanchères* typical of the French Épi-Laborien). Far to the North, rare finds of tanged points and lithic assemblages from Scottish final Pleistocene or initial Holocene sites (Ballin and Saville, 2003; Mithen et al., 2015) have also been discussed in the context of a geographical extension of the Ahrensburgian. It is beyond the scope of this paper to discuss this material, which should probably be seen within the broader context of the early Holocene expansion of human groups (e.g. Fosna [Komsa] / Hensbacka) along newly deglaciated north European coastlines (Ballin, 2016; Bang-Andersen, 2003; Fuglestad, 2007; Wygal and Heidenreich, 2014).

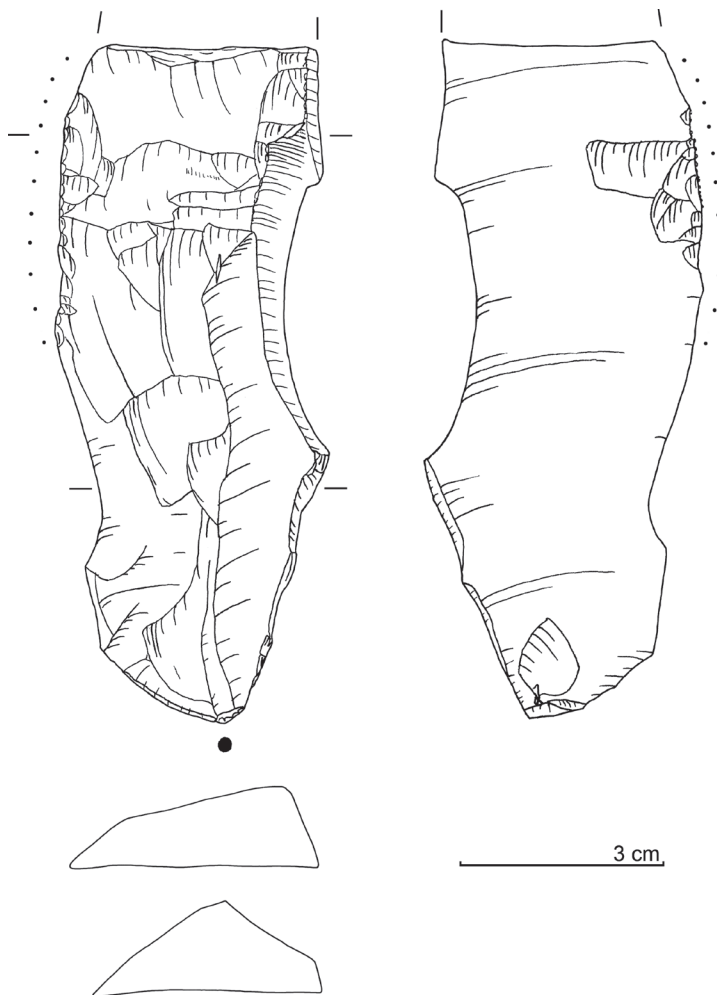


Figure 6: Wettringen, “Long Blade” assemblage. – lame mâchurée, Baltic flint. Drawings by M. Kloss and B. Stapel / LWL. From: M. Baales et al. 2015.

matter has been preserved which might be radiometrically dated so that the estimation of the chronological position of these industries is largely based on techno-typological arguments. The suggested dating of the assemblage is supported at Übach-Palenberg by strong stratigraphic arguments (Jöris and Thissen, 1997) since the “Long Blade” assemblage here lay at the base of a sequence of cover sands within which the numerous Mesolithic assemblages are always stratified at much higher levels.

The recent discovery of a new “Long Blade” site in the Rhineland has provided the first evidence for the radiometric age of this phenomenon. Archaeological investigations in 2016 near Dormagen-Nievenheim, some 10 km south of Düsseldorf, uncovered late Palaeolithic settlement structures located close to a channel of the late Pleistocene Rhine braided river system. The Palaeolithic finds were embedded in and covered by deposits of high flood loam which are OSL dated to about 11.5 ± 0.9 ky BP. An area of 366 m² was investigated, uncovering two artefact concentrations some 10 meters apart, which together produced 2,355 lithic artefacts. Both areas contained burned artefacts and bone fragments suggestive of hearths and yielded the same range of tool types (Figure 7): Zonhoven points with and without basal retouch,

backed bladelets, scrapers, burins and large numbers of blades with use wear. Most of the 138 retouched tools, particularly scrapers and burins, are made on larger blades of good quality. The largest blade, although incomplete, measures 17 cm in length.

The composition of the raw material is remarkable. Moraine-transported (Baltic) Cretaceous flint is the absolutely dominant material (76 %) among which is a specific type (1.4 %) identified as red Heligoland flint.

The distance between the Rhineland site and Heligoland is almost exactly 350 km and Nievenheim appears to be the most southern evidence for Heligoland flint in Europe known to date. Alongside the northern raw material, Cretaceous flint of western origin (~ 21 %) was used, among which are material derived from Meuse river gravels and of Rijckholt type transported over distances of 40 – 80 km. A few artefacts are made of distinctive Lousberg Flint obtained from an outcrop which today lies at the centre of the city of Aachen some 80 km to the Southwest. The characteristic combination of Zonhoven points with very long rectilinear blades would on its own, identify Nievenheim as a “Long Blade” industry from the extreme end of the late Palaeolithic. Moreover, the techno-typological attribution of the site is supported by an AMS date for charcoal from the site (KIA51665: $10,136 \pm 73$ BP / ~ 9.8

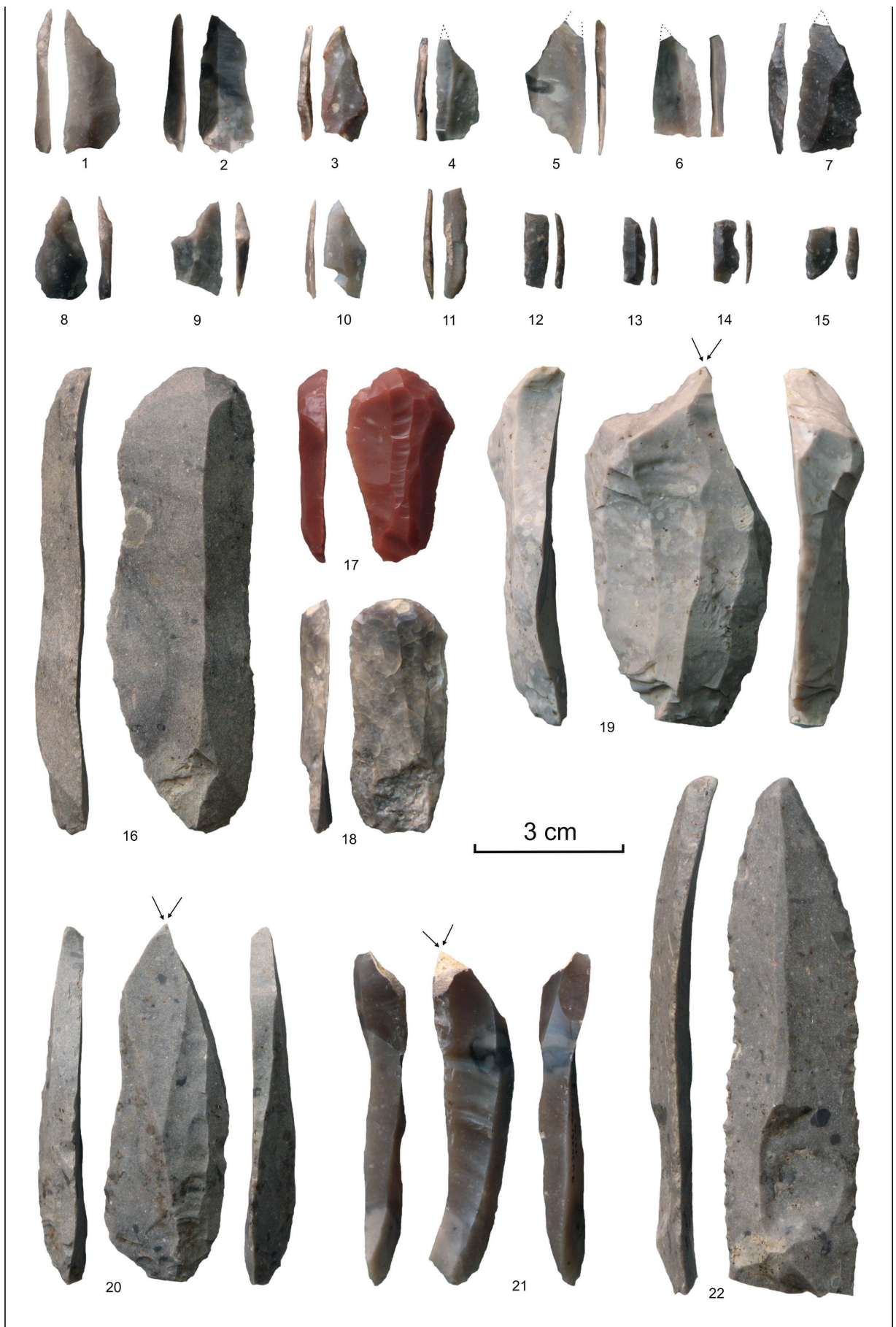


Figure 7: Dormagen-Nievenheim. “Long Blade” artefacts including a specimen manufactured of characteristic red Heligoland flint. Photographed by Martin Heinen.

Table 1: Radiocarbon dates for the archaeology of the Pleistocene-Holocene interface (terminal Palaeolithic - early Mesolithic) in western Germany. Only dates considered to be reliable (on grounds of context, methodology, precision) are included in this overview.

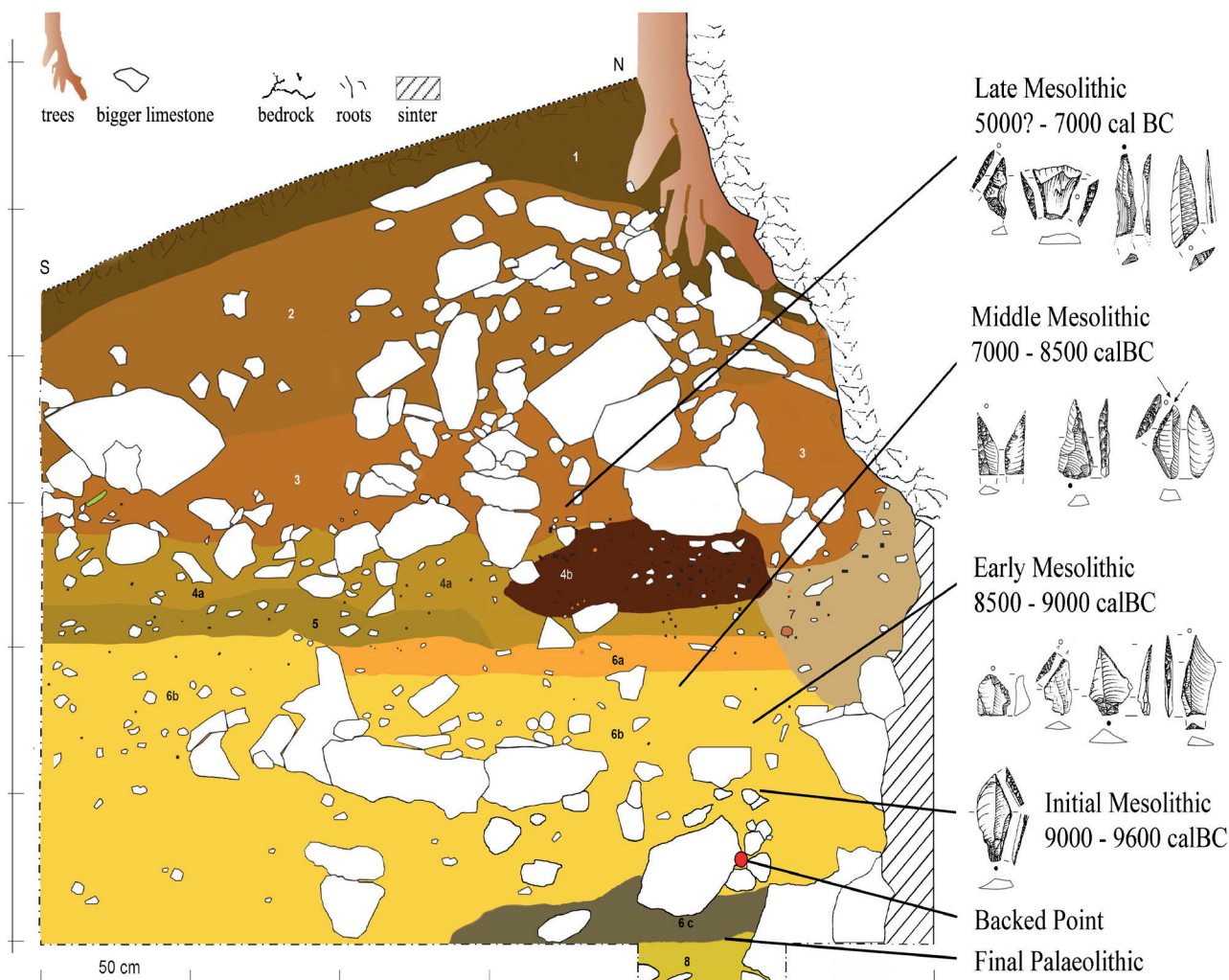


Figure 8: Idealized stratigraphy of the Blätterhöhle cave platform “Vorplatz“. Drawing by W. Heuschen, S. Grunwald, B. Gehlen, J. Orschiedt.

ky calBC) which falls just at the transition from Younger Dryas to Preboreal (Table 1), exactly the same period as the sites of Three Ways Wharf in England (Barton, 1998; Lewis and Rackham, 2011) and Belloy-sur-Somme in France (Fagnart, 1991).

Mesolithic horizons at the Blätterhöhle, a small cave at Hagen in the northern Sauerland region, have been under investigation for several years (see below). Excavations have on a number of occasions provided hints for an older, late glacial occupation of the rock shelter platform in front of the cave (Figure 8). Birch wood charcoal (*Betula*) from a disturbed area (possibly due to animal burrowing) was radiocarbon dated (COL 1448:10,981 ± 40 BP) to ~ 10,949 ± 96 cal BC (Table 1). Moreover, a combination burin-scraper recovered from a different disturbance is a tool form typical for a pre-Mesolithic context

and was seen as perhaps indicative of deeper Upper or Final Palaeolithic layers.

The 2016 excavation of a small area of deposits from the very end of the Pleistocene or the Pleistocene-Holocene boundary produced an exceptionally slender partially retouched backed point, distinct from Mesolithic types (Heuschen et al., 2017; Orschiedt et al., 2017). It possibly corresponds to similar elongate elements from contemporary French (Épi-Laborien) or Belgian assemblages with further distinct backed elements variously described as Blanchères- or Auvours-type points (Devriendt et al., 2010; Naudinot, 2008; Naudinot, 2013, Fig. 1; 2; Naudinot and Jacquier, 2009).

Towards the end of the 2016 excavation and some 20 cm below the level of the backed point an area was uncovered which might represent a zone of activities linked to a

hearth. No charcoal was recovered but the observed grey colouration of the sediment is typical for these features at the site. The area produced flattish cobbles bearing traces of abrasion and polish and, rarely, zones with picking marks. These were associated with numerous small flakes and chips of flint, a longer blade, a short blade scraper and an artefact which might be classed typologically as a fine double borer. The morphology of the retouched tools is not at all Mesolithic and, together with the stratigraphic position, suggests the presence of a late Palaeolithic level somewhat older than that of the backed point. The horizon is apparently undisturbed and further investigations of this area are awaited impatiently.

The Initial Mesolithic of the Early Preboreal

A number of further lithic assemblages from western Germany and adjacent regions of continental North-western Europe are characterized by oblique retouched microlithic points and by quite large blades which are however smaller and less standardized than those of the “Long Blade” tradition. These assemblages present clear differences to unambiguous Mesolithic assemblages characterized by regular narrow lamellar debitage (bladelets) and geometric microliths. Although they often lack precise stratigraphic or radiometric contextual controls they can probably be attributed to the initial Holocene.

Sites such as Duisburg-Kaiserberg in the Rhineland (Tromnau, 1982) or Gramsbergen and Swalmen in the northern Netherlands (Johansen and Stapert, 2000; Stapert, 1979) were suggested to derive from or represent the final expression of a Final Palaeolithic tradition of blade production. Even though tanged points are absent this was specifically equated with the Ahrensburgian of the Younger Dryas stadial as reflected by terminology such as “*Epi-Ahrensburgien*” (Gob, 1991). Although the equivalent German term “*Stielspitzengruppen ohne Stielspitzen*” / “tanged point groups without tanged points” (Veil, 1987) was applied to an assemblage from Höfer near Celle in Lower Saxony, this was interpreted here as reflecting functional variability within the Tanged Point complex and not a chronologically younger derivation. Looking beyond present day continental Europe to the British Isles, similar assemblages with microliths in association with a significant component of larger blades (“Broad Blade” tradition) have here long been accepted as a manifestation of the Early Mesolithic (Jacobi, 1978) and this interpretation will be adopted here for the following earliest (Initial) Mesolithic sites and inventories.

Bedburg-Königshoven

One of the very few early Mesolithic sites of this type in

western Germany to be found in stratigraphic context is the Rhineland locality Bedburg-Königshoven (Street, 1991, 1993 and 1998). Excavation of the surviving part of a waterside encampment produced a small lithic assemblage and well preserved remains of hunted large and medium-size mammals discarded as butchered waste into the off-bank area adjacent to the site. The hunted species - aurochs (*Bos primigenius*), red and roe deer (*Cervus elaphus* / *Capreolus capreolus*), wild pig (*Sus scrofa*) and horse (*Equus* sp.) - indicate temperate conditions, with woodland but also open spaces.

Among the recovered faunal remains were two bone tools and two “frontlets” of red deer antler which show affinities with other northern European early Mesolithic sites (summary in Street and Wild, 2015), while the hunting of aurochs as the principal game species finds parallels at early Holocene localities such as Potsdam-Schlaatz in Brandenburg (Benecke et al., 2002) or Alizay in northern France (Bémilli et al., 2014).

Stratigraphic, palynological and radiometric evidence shows that the organic gyttja containing the Bedburg archaeological assemblage formed in sub-aquatic conditions during the middle Preboreal (Street, 1991) and it was assumed until recently that the age of the deposit was the exact equivalent of that of the contained bones. Attempts to radiocarbon date the faunal assemblage directly using conventional bulk samples had delivered anomalous results, probably due to unrecognized contaminants, and were rejected. However, a recent project by two of the authors (BG, MS) has dated several aurochs individuals directly using AMS and rigorous pre-treatment protocols.

The new results show conclusively that the occupation of the Bedburg site was earlier than was thought and dates to the initial Preboreal at the very beginning of the Holocene warming event (**Table 1**). The formation of gyttja took place subsequently during the Middle Preboreal as this sediment was precipitated onto the discarded butchery waste lying on the bed of the meander during the process of silting up and subsequent overgrowth.

The very early Holocene context of the site can now be defined more clearly and the interpretation of the technology and typology of the lithic artefact assemblage (relatively large blades and a non-geometric microlithic spectrum) as characteristic for the “Broad Blade” tradition can now be explained by the Initial Mesolithic status of the Bedburg site at the very beginning of the Holocene.

Heek-Nienborg

At the site of Heek-Nienborg in the western Münster region of Westphalia, a total of 361 lithics were recovered

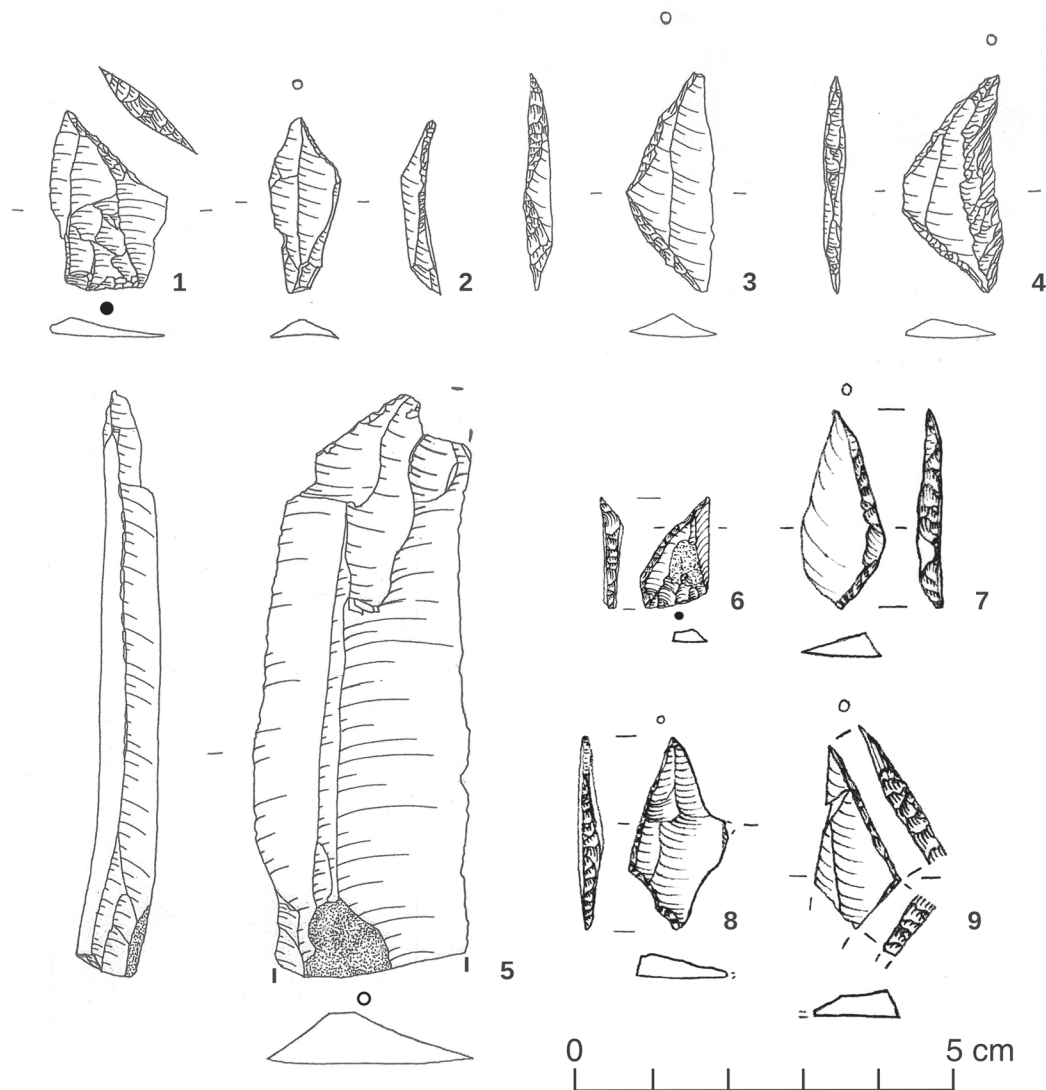


Figure 9: “Broad Blade” Lithic artefacts from Heek-Nienborg (1-5) and Werl-Büderich (6-9): 1 Zonhoven point; 2 Concave truncated point; 3 Scalene triangular point; 4 Elongated trapeze; 5 One of the broad blades; 6 Zonhoven point with a unilateral edge retouch; 7 Rhombic slightly bend point; 8 Slightly notched point; 9 Fragment of a triangular point (Drawings: LWL-Archäologie für Westfalen/J. Piesniewski; University of Cologne/B. Gehlen; Graphic: A. Zander and K. Vogl).

which bear similarities to the assemblage from Bedburg-Königshoven. However, no organic artefacts were preserved making it difficult to confirm this possible Initial Mesolithic date of the assemblage. Among the finds were 12 microliths, including a triangular point and an elongated trapeze, which suggested a possible Early Mesolithic occupation. The assemblage further contains several well-made large blades of up to 76 mm length, which although initially regarded as quite unusual in the Mesolithic context have led to the subsequent identification of the inventory as a “Broad Blade” assemblage (Figure 9). Over 70% of the artefacts from Heek are made of Baltic flint, which was available locally from the terminal moraine of the Saale/Drenthe glaciation. However, an analysis of the raw material showed that 87 artefacts were made of Western European flint. An investigation of the cortex indicates that the flint is derived from south-

ern Limburg in the Netherlands. This primary source is located over 100 km to the southwest of Heek-Nienborg, showing a possible cultural connection to this western region. Based on the small size of the assemblage the site of Heek-Nienborg was probably occupied for a short period of time only (Zander, 2016a, 2016b and 2016c).

Mönchengladbach-Geneicken

In 2013 and 2014 extensive excavations at the Rhineland site of Mönchengladbach-Geneicken uncovered Final Palaeolithic and early Mesolithic finds and features in several locations over a total area of 2,723 m² (Figure 10). Of outstanding importance are more than 150 bones of an aurochs found at the bottom of a palaeo-channel of the River Niers which silted up during the Preboreal (Area 169). The bones were distributed over a surface of approximately 25 m² and represent almost 80% of the

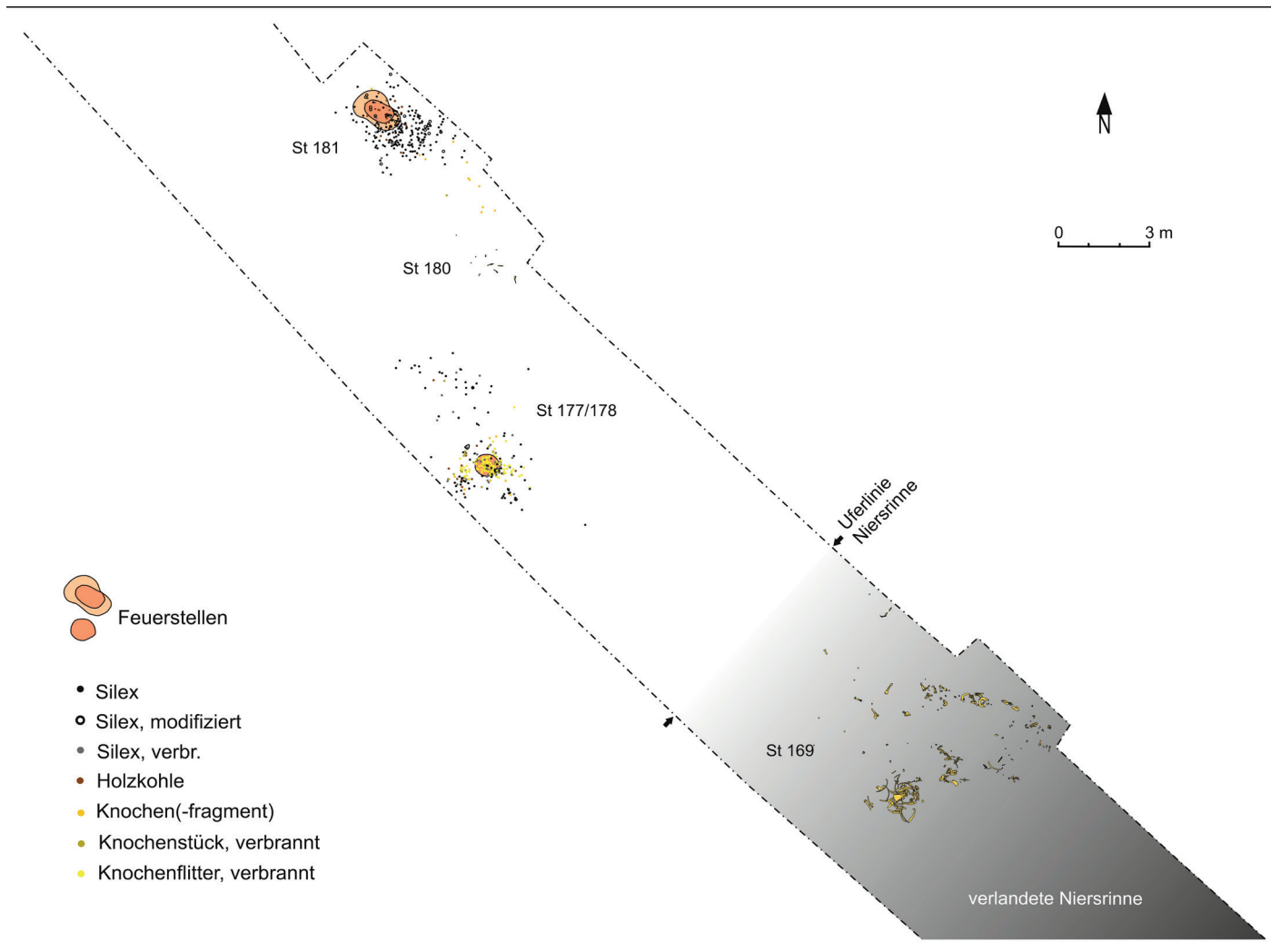


Figure 10: Plan of the early Holocene Mesolithic site Mönchengladbach-Geneicken. Drawing by Martin Heinen.

entire skeleton. Two microliths found among the remains show that the animal was killed by Mesolithic hunters. Radiocarbon dates show that the Geneicken aurochs was hunted towards the middle of the 10th millennium BC (Table 1).

To judge by the almost complete representation of the skeletal material, the aurochs must have been killed near to the place of discovery. After butchery the waste and unwanted remains of the animal were discarded into the shallow water-filled channel. Several smashed long bones show that the marrow was first extracted from them. The discovery at Mönchengladbach-Geneicken represents the most complete archaeological skeleton of an aurochs in Germany and the association of the hunted animal and arrow armatures remains unique for the country, although close parallels are known (Aaris-Sørensen and Brinch Petersen, 1986; Hartz and Winge, 1906; Noe-Nygaard, 1973).

It is unclear whether the hunting event represented by the aurochs skeleton is related to one or both of two broadly contemporary concentrations of Mesolithic finds excavat-

ed some 10 m (Area 177/178) and 20 m (Area 181) away from the channel. Each of the areas contained a hearth, numerous flint artefacts and a few bones. The assemblage from Area 181 contains basally retouched triangular points and their presence here might demonstrate the replacement of initial Mesolithic assemblages (possibly without geometric microlithic elements) by others with such geometric forms, which might be ultimately of southern origin.

Werl-Büderich

In 2011, an open-air site with preserved, unburned animal remains was discovered by chance on intensively ploughed farmland near Werl-Büderich in the southern part of the Westphalian Embayment. This locality in the fertile loess region known as the Soester Börde turned out to be one of the earliest Mesolithic sites identified on the North European Plain.

This oldest radiometrically dated Westphalian Mesolithic assemblage was excavated the same year during an archaeological project ahead of road construction work

(Baales and Heinen, 2012; Heinen, 2013; Heinen and Baales, 2013, p. 182-185). Even though the partly destroyed site is located on constantly ploughed farmland, the Early Mesolithic open-air locality was preserved within a small depression some 70 cm beneath the surface. The fact that in addition to lithic artefacts animal bones and teeth and a fragment of red deer antler have been preserved in calcareous, silty sediments is of special interest. This was the first discovery of unburned animal remains certainly attributed to an Early Mesolithic at an open-air site in Westphalia. Most of the remains are identified as red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*), with a few fragments of wild boar (*Sus scrofa*) and red fox (*Vulpes vulpes*), all which would be expected representatives of an Early Holocene fauna. Due to the generally bad preservation of bone surfaces, no cut marks are recognizable. However, the fragmentary skeletal remains in some cases show oblique breakage patterns generally accepted as a typical feature of green bone fracture, possibly due to intentional human smashing to gain bone marrow.

None of the bones from Werl-Büderich could be dated because of the lack of collagen, however a charcoal fragment (identified by Ursula Tegtmeier from Cologne University as a deciduous tree) was radiocarbon dated (MAMS 15941) to $9,923 \pm 33$ BP (Table 1). The charcoal was recovered from a probable hearth in the western part of the excavation and is therefore assumed to derive from the Mesolithic settlement activities. With a calibrated age of 9.3 ky cal BC Werl-Büderich is one of the oldest dated Mesolithic assemblages in Germany, or indeed in the whole of the north-west European Lowlands.

Mesolithic finds were encountered over a preserved area of some 30 m² which can be subdivided into two activity zones. While most faunal remains and lithic artefacts were located over an area of some 15 m² in the eastern part of the site, all of the microliths and microburins were found in the western part of the site together with a distinct concentration of small burned animal remains suggesting the former presence of a hearth.

The presence of both microliths and microburins (none of which could be refitted) suggests that arrows were repaired with armatures produced at this part of the site. Whilst no obvious concentration of burnt finds and therefore no evidence of a hearth were found in the eastern part of the excavation, further fireplaces might have existed in the surrounding area. Presumably, the eastern zone is just part of the dump area of a much larger settlement which has unfortunately not been preserved due to erosion and the former excavation of a small channel adjacent to the site.

188 lithic artefacts (83%) are made of easily accessible "Baltic" moraine flint transported to the region by the Drenthe glaciation. This material can be collected easily in the Soester Börde, however, since larger flint nodules usually show numerous frost cracks and therefore tend to shatter irregularly when knapped, mainly small, compact nodules were selected for lithic production. Several of these manuports and small exhausted cores have been found at the site. As the size of the usable raw material limited the size of the flint artefacts, all blanks like flakes, blades and bladelets are rather small.

Apart from a single flake made of a fine-grained quartzite the remaining lithic assemblage (16.5%) is made of siliceous slate (black lydite), a raw material which can be found in primary outcrops in the adjacent northern Westphalian uplands, the Sauerland (some 20 km away) or as pebbles within river gravels (e.g. the Ruhr, which is 6 km away). This pattern demonstrates the migration of the Büderich hunter-gatherer group from the southern uplands into the Soester Börde area. The biggest artefact – a broad flake 8 cm in length – is of lydite and has a heavily battered edge that may have resulted from working organic material.

The five microliths identified at Werl-Büderich (Figure 9) are made of Baltic flint and comprise two simple microliths – a Zonhoven point with unilateral edge retouch and a lanceolate form – and three irregular scalene triangles (Zander, 2016b).

The Werl-Büderich assemblage shows a degree of similarity to one from the well-known site of Friesack 27a in Brandenburg in the northern German Lowlands, where Bernhard Gramsch excavated a stratified sequence of Preboreal age with five Early Mesolithic assemblages found in superposition (Groß, 2017). The spectrum of microliths from layer 8 (defined by Daniel Groß as Schichtkomplex 1) is characterized by predominantly simple (non-geometric) forms accompanied by a single isosceles triangle (Groß, 2017, Tab. 6; Taf. 17, 1-11) and therefore bears a resemblance to the small microlithic assemblage from Werl-Büderich. However, the inventory from Friesack 27a seems to be slightly younger than Werl-Büderich, as it is dated to around 9.05 ky cal BC at the beginning of the middle Preboreal. The assemblages from layers 7 to 4 are dated only slightly younger (Groß, 2017, p. 19). They contain a variety of isosceles and scalene triangles, together with elongate trapezes and micro-points both with and without dorsal basal retouch (Groß, 2017, Tab. 6; Taf. 17, 12-32). These microlithic inventories with non-geometric and geometric microliths are very similar to those from the lower Preboreal levels of the Friesack 4 stratigraphy located only a few hundred meters further



Figure 11: Distinctive Early Mesolithic elk antler mattock-head from Paderborn-Sande. Such implements are typical of the northern European early Mesolithic (Maglemosian sites, Star Carr) dated to ca 9.0 ky cal BC. Photo by S. Brentführer and A. Müller/LWL and LWL Bielefeld. From: M. Baales et al. 2015.

south (Gramsch, 2002; Groß et al. 2017, this volume, Fig. 12; 14). The finds from the Friesack sites demonstrate rapid changes in microlith morphology within only a few generations between approximately 9.1 and 8.9 ky calBC.

Early to Late Preboreal artefacts and sites

Mesolithic bone and antler artefacts from the Westphalian Embayment

Similarities to (or perhaps influences from?) the North European Lowlands can be recognized in the Early Mesolithic Westphalian Embayment on the basis of analyses of organic single finds. Some decades ago, a mattock-head of elk (*Alces alces*) antler (Figure 11) was found in a sandpit near Paderborn-Sande in eastern Westphalia. Such implements are characteristic of the northern European early Mesolithic (Preboreal to Early Boreal) Maglemosian (Pratsch, 2006, p. 53). The specimen from Paderborn-Sande has an elongated, carefully shaped working edge and the perforation, which is located diagonally to the longer axis of the antler, penetrates the proximal part of the palmate area at an oblique angle. The implement is AMS-dated (MAMS 14119: 9,591 ± 30 BP) to the second half of the Preboreal, around 9 ky cal BC (Stapel et al.,

2013). This object in particular strongly suggests that the Early Mesolithic of the Westphalian Embayment formed part of a region subject to Nordic influences.

Sub-aquatic sand dredging at locations within the Westphalian Embayment has resulted in occasional discoveries of slender bone points, so called Duvensee points. They are of types common for the Maglemosian, but may also have been in use during the late glacial (Cziesla and Pettitt, 2003). Only one attempt to directly date the Westphalian specimens was successful, however a basal fragment found during sand dredging at Greven-Bockholt was dated to 8.7 cal BC (MAMS 18465: 9,402 ± 32 BP) and therefore to the late Preboreal-early Boreal transition (Stapel and Schlösser, 2014). This fragment is similar to those from the Early Mesolithic of Friesack (Gramsch, 2011, 23 & Fig. 9, 28).

Hagen “Rieger Busch”

Although broad micro-points with dorsal-ventral basal retouch already appear in south-western Germany in Beuronien A contexts dating to the middle Preboreal (e.g. layer 13 at the Jägerhaus Höhle: Gehlen, 2009, p. 373; cf. Heinen, 2005, p. 154 ff.), no such microliths have yet

been identified from contemporary contexts in Westphalia and further north. The tradition of dorsal-ventral basal retouch on micro-points first began to expand northward only during the Boreal, however without gaining in importance comparable to that in southern and western Germany (cf. Gehlen, 2009; Koch et al., 2016), and in fact never reached eastern and northern Germany (cf Cziesla, 2016).

Bearing this in mind, it is interesting to note that broad micro-points with dorsal-ventral basal retouch are represented in the Early Mesolithic lithic assemblage from Hagen "Rieger Busch". Located at the northern edge of the Sauerland, the site was excavated in the 1980s by amateurs and produced a small lithic assemblage together with some charcoal. One of us (NS) has recently analyzed the lithic inventory in the course of a thesis at the University of Cologne (Schneid, 2013 and 2016), while some of the charcoal determined as willow by Ulrike Tegmeier (who excluded a number of intrusive recent fragments) was dated by the Mannheim laboratory (MAMS 14123: $9,333 \pm 36$ BP). The calibrated age of around 8.6 ky cal BC provides a Late Preboreal context for the lithic assemblage (Stapel et al., 2013).

The presence of the above mentioned basal-retouched micro-points alongside triangular microliths shows that some influence from regions to the Western and South extended at least as far as the southern part of the Westphalian Embayment. Since the Hagen "Rieger Busch" microlithic assemblage also includes four slender lanceolate points of a type present at Friesack during the Late Preboreal (Gehlen, 2009, p. 367) it appears that quite different regional influences are represented during this period, at least in southern Westphalia (Schneid, 2016).

The Blätterhöhle – a unique Mesolithic stratigraphy in Westphalia

Although the presence of hundreds of open-air sites demonstrate that the whole of the Central European uplands were used intensively during the Mesolithic, only few excavations of material in stratified context have been conducted in this region using modern techniques. Excavations conducted by Klaus Grote during the 1980s (Grote, 1994) at rock shelters in the Göttinger Forest (Lower Saxony) adjacent to the northern edge of the upland area, and excavations initiated by Jirí A. Svoboda (Svoboda et al., 2007 and 2013) in the sandstone region of northern Bohemia are two exceptions which provide deeper insights into Mesolithic life and chronology. This renders the Westphalian cave site Blätterhöhle, located in the town of Hagen close to the northern border with the Sauerland, of special interest for the question of Early to

Late Mesolithic settlement in the northern Central European upland zone. The discovery here in 2004 of Mesolithic human remains within the narrow cave fissure first drew attention to the site and in subsequent years these finds were supplemented by further human remains and the excavation of several hearths and lithic finds in stratigraphic superposition in front of the small cave entrance. The area in front of the Blätterhöhle was identified as a former rock shelter and has now been excavated methodically since 2006, proving to be of exceptional importance for the Early to Late Mesolithic chronology of Westphalia (Orschiedt et al., 2010, 2012, 2013, 2015 and 2017; Heuschen et al., 2016 and 2017).

Upon discovery, the cave entrance initially appeared only as a small hole, however recent excavations revealed that the opening was originally much larger and had only subsequently been buried by a 1.5 m thick debris layer collapsed from the rock shelter roof.

Sediments containing Mesolithic finds identified and excavated below this debris so far cover a sequence including the second half of the Preboreal, early, middle and late Boreal, and probably the early Atlantic (Table 1). High concentrations of charcoal are due to the existence of former hearths located at different parts of the site, which are radiocarbon dated exclusively to the Middle Mesolithic. Several lithic artefacts and faunal remains were uncovered around the hearths. Microlithic spectra here correspond to the chronological periods suggested by the radiocarbon dates, extending from the Early to Middle Mesolithic, and thus represent the first stratified sequence of Mesolithic artefacts to be identified at a single Westphalian site (Figure 8).

Simple oblique and irregular microliths of triangular shape similar to elements in the Werl-Büderich assemblage are assigned, together with a large semi-lunate, to the Preboreal. Nevertheless, the majority of finds are dated to the late Boreal Middle Mesolithic, showing this to be main phase of occupation at the site, as was already indicated by most dates for the hearths. The microlithic spectrum of this phase consists of simple end-retouched points, scalene triangles, broad base-retouched micro-points and tiny backed bladelets.

Two fragments of bifacially retouched microliths are some of only a very few such specimens found in Westphalia or indeed east of the Rhine, since these forms are present in the region west of the Rhine and the Moselle. They are typical for the Rhine-Meuse-Schelde Culture (RMS) and the Blätterhöhle specimens thus demonstrate an association with or influence from this western group extending into the Westphalian Middle Mesolithic (Baales et al., 2013b, p. 217-218). Possibly the west-east orientation of



Figure 12: Proposed chronology for the archaeology of the Pleistocene-Holocene interface (terminal Palaeolithic - early Mesolithic) in western Germany based on the few radiocarbon dated sites and occurrence of distinct “Long Blade”, “Broad Blade” and younger microlithic inventories (graphics B. Gehlen).

the major rivers Lippe and Ruhr facilitated an eastward expansion of the distinctive RMS tradition during the Late Boreal to Early Atlantic.

A few Late Mesolithic artefacts found in stratigraphic position above the later Middle Mesolithic find horizon have up to now not been associated with any features identified as hearths.

Human remains from the Blätterhöhle

Human remains found since 2004 in the small and narrow interior of the Blätterhöhle cave can be assigned to both the Late Neolithic and the Early Mesolithic (Orschiedt et al., 2010, 2012, 2013, 2014, 2015, 2017 and in press). According to micromorphological analyses, the lower layer of the Blätterhöhle was partly disturbed by rodent activity and contained the remains of a minimum of five Mesolithic individuals, including two children. All radiocarbon dates on six of the human bones cluster between 8.5 ky and 8.8 ky calBC (see Table 1) and can therefore be attributed to the Preboreal (Bollongino et al., 2013; Orschiedt et al., 2010 and 2012).

An additional small human cranial fragment with an age of $9,210 \pm 29$ cal BC (KIA 45012: $9,700 \pm 30$ BP;) is the earliest Mesolithic human find at the site and probably one of the oldest postglacial human remains in Central Europe (Orschiedt et al., 2010 and 2012). In stratigraphic association but at a slightly higher level than the human remains were found three boar skulls without canines and mandibles. Direct dating suggests they are a few hundred years younger but they are in a similar spatial context as the humans. Although affected by bioturbation

the Preboreal human remains and the boar skulls might together represent a ritual deposition. The placing of Early Mesolithic human remains inside caves is a phenomenon well documented at contemporary sites in Belgium and the southern British Isles and might reveal a special treatment of the dead during the Preboreal, at least for western Europe. The closest parallels for the particular situation at the Blätterhöhle is provided by Preboreal human remains from Grotte Margaux and Abri des Autours in southern Belgium (Cauwe et al., 1998; Polet and Cauwe, 2002; Orschiedt, 2016; Orschiedt et al., in press).

A Mesolithic human from the Balver Höhle

A second Westphalian site with evidence for the probably intentional disposal of Early Mesolithic human remains inside caves is the Balver Höhle, a large and important cave in the Sauerland region (Baales, 2013c). A fragment of a robust skull cap found long ago in this well known but now almost completely emptied out cave was directly dated to $9,160 \pm 50$ BP (GrA-19538). The calibrated age of $8,385 \pm 67$ cal BC (Table 1) means that this Early Mesolithic individual, probably a man, died during the early Boreal. Possibly by the early Holocene the originally large (and today once again emptied) vault of the cave had become infilled to such a degree that only a small space was left, suitable for a similar ritual of disposal of the dead as at the far smaller Blätterhöhle cave.

A human skull recovered without archaeological context at Rhünda in the neighbouring state of Hesse yielded a radiocarbon date within the Younger Dryas stadial (Rosendahl, 2002). However, since the specimen pro-

duced a stable isotope signature, indicating a significant freshwater component in the diet (Drucker et al., 2016), a reservoir effect cannot be ruled out and this human might in fact also derive from an early Holocene context.

Conclusions

To conclude, the results presented here in synthesis suggest that the Pleistocene-Holocene transition in the western regions of Germany represents a period of extremely rapid technological and typological change characterized by a mosaic of successive or parallel developments reflecting influences from quite different regions (Figure 12).

During the final Younger Dryas and early Preboreal the archaeological record of the hunter-gatherer communities of the north-west European Lowlands can be seen to reflect a survival or continuation of settlement within the Final Palaeolithic (Ahrensburgian) tradition. Certain aspects of their lithic and organic techno-typological equipment are subject to modification and evolution or are lost or discarded, probably within the context of an adaptation of subsistence practises and social systems to radically changing ecological conditions.

The few lithic artefacts of the “Long Blade” tradition to have been found in the northern part of the Westphalian Embayment and Lower Rhineland are believed to fit in with this scenario. So far there is a lack of finds dating to this defining period from both the Westphalian and the Eifel uplands to the south, perhaps suggesting the pre-existence of other traditions in this region during the Younger Dryas.

Sites from the region dated to the very beginning of the Preboreal appear to fall into a tradition recognized across much of early Holocene northern and north-western Europe, the “Broad Blade” Mesolithic. The subsistence economy of these Initial Mesolithic assemblages is clearly attuned to the temperate, broadly woodland fauna now present across western Europe although elements of their lithic technology and typology may be directly derived from the earlier “Long Blade” industries. It is unclear what role, if any, the northward movement of people (or transmission of their ideas / adaptations) may have played in the first appearance of a “Mesolithic” way of life in the region.

An ecological gradient may have continued to play a role, leading to a broader-based hunting economy (perhaps aurochs dominated: e.g. Bémilli et al., 2014; Benecke et al., 2002; Street, 1991 and 1999) at the edge of the upland zone and contemporaneous specialisation on elk at more northern lowland sites such as the oldest phase at Lundby in Denmark (Møller-Hansen, 2003; Møller-Han-

sen et al., 2004; Leduc, 2014), where a more diverse fauna is first demonstrated after the passage of a few hundred years (Jessen et al., 2015).

In western Germany it is only somewhat later in the Preboreal (after the Preboreal Oscillation?) that there appear to have followed further, innovative developments in the lithic assemblages, which can now be defined as fully Mesolithic and are characterized by an expanded spectrum of geometric and non-geometric, often highly standardized microlithic forms. Until the arrival of the Neolithic the different and changing spectra of these microlithic assemblages define the Mesolithic chronologically and geographically across much of Europe.

In summary, both the Final Palaeolithic and the initial Mesolithic of the western German regions under study reflect shifting influences from several neighbouring regions. Investigations in progress, such as the excavation of the cave platform at the Blätterhöhle, may provide more details of how Final Palaeolithic humans survived the Pleistocene-Holocene transition, resulting in the widely shared but variable adaptation we know as the Mesolithic.

Acknowledgements

We would like to thank Bernhard Stapel for providing the assemblage from Heek-Nienborg for Annabell Zander's Masters Dissertation.

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