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Jean-Pierre Fagnart, Ludovic Mevel, Valentin Boris, Mara-Julia Weber

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Préhistoire de l'Europe du Nord-Ouest
Mobilités, climats et identités culturelles



XXVIII^e Congrès préhistorique de France
Amiens

30 mai - 4 juin 2016

sous la direction de
Cyril MONTOYA, Jean-Pierre FAGNART et Jean-Luc LOCHT

**Volume 2 : Paléolithique supérieur ancien,
Paléolithique final – Mésolithique**

Publié avec le concours du ministère de la Culture, de l'Inrap,
de la communauté d'agglomération d'Amiens Métropole
et des conseils départementaux de la Somme et de l'Oise

SOCIÉTÉ PRÉHISTORIQUE FRANÇAISE
PARIS - 2019

XXVIII^e CONGRÈS PRÉHISTORIQUE DE FRANCE

AMIENS

30 MAI - 4 JUIN 2016

***PRÉHISTOIRE DE L'EUROPE
DU NORD-OUEST :***

*MOBILITÉS, CLIMATS
ET IDENTITÉS CULTURELLES*

VOLUME 2

Paléolithique supérieur ancien,
Paléolithique final – Mésolithique

Publié par la Société préhistorique française
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de la communauté d'agglomération d'Amiens Métropole
et des conseils départementaux de la Somme et de l'Oise

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XXVIII^e Congrès préhistorique de France

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SESSION 3

L'Europe du Nord-Ouest autour de 10 000 BP (11 600 cal. BP) : quels changements ?

JEAN-PIERRE FAGNART, LUDOVIC MEVEL,
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Introduction

au XXVIII^e congrès préhistorique de France

(Amiens, 30 mai-4 juin 2016)

Cyril MONTOYA, Jean-Pierre FAGNART et Jean-Luc LOCHT

Après les congrès d'Avignon (2004) et de Bordeaux-Les Eyzies (2010) tous deux situés en France méridionale, un retour vers la France septentrionale s'imposait pour le XXVIII^e congrès préhistorique de France. La vallée de la Somme, considérée comme le berceau de la naissance de la Préhistoire depuis les recherches de Boucher de Perthes dans la région d'Abbeville et le choix de la ville d'Amiens pour accueillir les congressistes apparaissent légitimes à différents titres. En plus de son rôle historique dans l'histoire de la Préhistoire, la vallée de la Somme et ses célèbres gisements se situe toujours au cœur des problématiques de recherches pour le Paléolithique et plus particulièrement pour la connaissance des premiers peuplements humains en Europe du Nord-Ouest.

La dimension historique de la vallée de la Somme après les travaux de Victor Commont, Henri Breuil, François Bordes et Franck Bourdier relayée par le dynamisme actuel des recherches menées depuis le début des années 1980 ouvrait d'excellentes perspectives pour une rencontre internationale dans le cadre des congrès de la Société préhistorique française sur une terre privilégiée pour l'étude de la Préhistoire.

La thématique retenue pour le congrès *Préhistoire de l'Europe du Nord-Ouest* s'imposait également à l'esprit en raison de la position géographique de la région dans l'espace européen. Il s'agit d'un titre fédérateur, transversal et diachronique aux différentes périodes, depuis la Préhistoire la plus ancienne jusqu'à l'âge du Bronze. Le sous-titre *Mobilité, climats et identités culturelles* précise la problématique de la rencontre concernant les notions de déplacement et de territoire, l'influence du climat et de l'environnement qui est une donnée particulièrement importante pour le Paléolithique, mais également pour les périodes récentes de la Préhistoire. La région loessique du Nord de la France appartient à la zone périglaciaire, c'est-à-dire en marge des grands glaciers du Quaternaire dont l'extension a eu un impact considérable sur les groupes de chasseurs-cueilleurs du Paléolithique. Enfin la question des entités culturelles est un thème récurrent de la recherche préhistorique et permet d'aborder la pertinence des attributions, des dénominations et des découpages culturels utilisés à ce jour.

Durant la semaine du congrès (30 mai au 4 juin 2016), les communications se sont déroulées dans la salle Robida de la Direction des affaires culturelles de Picardie (sessions 1 à 3 : Paléolithique et Mésolithique de

l'Europe du Nord-Ouest) et dans la salle de conférences de l'Espace Dewailly situé dans l'hyper-centre de la ville d'Amiens (ouverture du congrès, session historiographique, sessions 4 et 5 : Néolithique et âge du Bronze de l'Europe du Nord-Ouest). Suite à l'ouverture officielle du congrès et de la session inaugurale consacrée à l'historiographie de la vallée de la Somme (coordination Noël Coye et A. Hurel), cinq sessions thématiques à caractère chronologique bien tranché ont été présentées. La session 1 – L'Europe du Nord-Ouest au Pléistocène moyen récent – organisée par J.-L. Locht, D. Hérisson et D. Cliquet a porté plus particulièrement sur les aspects de la transition entre le Paléolithique ancien et le Paléolithique moyen durant les stades isotopiques 10 à 6 (c'est-à-dire de 374 000 à 130 000 ans). La session 2 – Palethnologie du Paléolithique supérieur ancien : où en sommes-nous ? – organisée par C. Montoya, C. Paris et P. Bodu a privilégié une approche croisée des données archéologiques afin de reconstituer le comportement des populations du début du Paléolithique supérieur selon la démarche palethnologique amplement développée par l'équipe d'A. Leroi-Gourhan pour les gisements magdaléniens du Bassin parisien. La session 3 – L'Europe du Nord-Ouest autour 11 600 cal. BP – Quels changements ? – organisée par J.-P. Fagnart, L. Mevel, B. Valentin et M.-J. Weber en collaboration avec la commission de l'UISPP «Le Paléolithique final de l'Eurasie du Nord» s'est attachée aux modalités de la transition entre la fin du Paléolithique et le tout début du Mésolithique. La session 4 – L'exploitation du milieu au Néolithique dans le quart nord-ouest de l'Europe : contraintes environnementales, identités techniques et choix culturels – a été dédoublée en deux sous-sessions portant sur l'exploitation des ressources minérales au Néolithique (organisation : F. Bostyn et F. Giligny) et sur l'exploitation des ressources végétales et animales (organisation : C. Hamon et A. Salavert). La session 5 – La fin du Néolithique et la genèse du Bronze ancien dans l'Europe du Nord-Ouest – organisée par N. Buchez, O. Lemerrier, I. Praud et M. Talon s'est orientée sur la période de transition entre le Néolithique final et le début de l'âge du Bronze.

Les séances de communications ont momentanément été interrompues en milieu de semaine par deux excursions qui ont permis aux congressistes de visiter quelques gisements ou sites emblématiques de la vallée de la Somme. L'excursion du jeudi 2 juin 2018, consacrée à la Préhistoire et au Quaternaire de la vallée de la Somme, a permis la visite des gisements de Cagny-la-Garenne et d'Amiens-Renancourt dans la région d'Amiens et de la carrière Carpentier et du gisement de Caours, dans la région d'Abbeville. Nous tenons à remercier la Direction régionale des Affaires culturelles des Hauts-de-France et notamment l'Unité départementale d'architecture et du patrimoine de la Somme (UDAP) en la personne d'A. Paoletti d'avoir permis l'accès aux gisements classés au titre des Monuments Historiques. Nos remerciements s'adressent également à É. Goval, ingénieure d'études à la DRAC des Hauts-de-France pour la coordination et la réalisation du livret-guide qui a accompagné cette première excursion. La seconde excursion, le mercredi 1^{er} juin, a permis à nos collègues néolithiciens et protohistoriens de découvrir le parc archéologique de Samara – situé à une quinzaine de kilomètres à l'ouest d'Amiens sur le territoire de la commune de La Chaussée-Tirancourt – avec ses reconstitutions grandeur nature d'habitats et ses ateliers expérimentaux où ils ont été accueillis par L. Moignet directeur du parc (aujourd'hui EPCC Somme Patrimoine).

Le congrès préhistorique d'Amiens a accueilli environ 250 chercheurs préhistoriens ou protohistoriens originaires de 16 pays différents. Environ un tiers des participants sont d'origine étrangère, ce qui souligne la dimension véritablement internationale de la rencontre.

La publication des actes du congrès intervient trois ans après la tenue de la manifestation. C'est bien évidemment un peu long, mais c'est souvent le temps nécessaire pour ce type de rencontre internationale qui rassemble

de nombreux chercheurs et comporte plusieurs sessions de travail. Il s'agit également du temps indispensable pour réunir l'ensemble des contributions (73 pour le CPF d'Amiens), d'effectuer le travail éditorial et parallèlement de recueillir les soutiens financiers qui impliquent le passage en commissions de l'ensemble des manuscrits qui doivent être évalués par des rapporteurs.

* * *

Il nous reste le plaisir de remercier toutes celles et tous ceux qui ont contribué au bon déroulement et à la réussite du Congrès d'Amiens.

Le Ministère de la Culture, la Direction régionale des Affaires culturelles des Hauts-de-France, le Service régional de l'archéologie des Hauts-de-France en la personne de J.-L. Collart, conservateur régional de l'Archéologie, qui a soutenu constamment notre action et nous a accompagnés tout au long de la mise en place du congrès. Nous avons pu bénéficier pour les séances de communications de la salle de conférences de la Direction des Affaires culturelles (salle Robida) pour les sessions 1 à 3 traitant du Paléolithique et du Mésolithique. L'ensemble des congressistes ont été accueillis dans le cadre prestigieux et rénové de la chapelle des Visitandines par C. Douale, directeur du Pôle patrimoines et architecture du site d'Amiens lors d'un cocktail de bienvenue.

La communauté d'agglomération d'Amiens-métropole et plus particulièrement le Service d'archéologie dirigé par J. Millereux-Le Bechennec a apporté un soutien logistique particulièrement efficace à l'organisation du congrès d'Amiens par la mise à disposition d'une salle de conférences dans l'Espace Dewailly et en participant de manière très active à l'accueil des congressistes des sessions 4 et 5. N. Devèze, vice-présidente d'Amiens-Métropole en charge de la Culture a accueilli l'ensemble des congressistes lors d'un cocktail d'accueil dans le cloître Dewailly lors de la deuxième journée du congrès.

Nos chaleureux remerciements s'adressent à D. Garcia, président de l'Institut national de recherches archéologiques préventives (INRAP) qui a soutenu cette manifestation internationale et a facilité d'un point de vue administratif la participation de très nombreux chercheurs de l'Établissement public en accordant des journées d'études (journées PAS) pour les archéologues impliqués.

Nos remerciements s'adressent également à L. Somon, président du Conseil départemental de la Somme et à É. Courtial, président du Conseil départemental de l'Oise pour leur soutien financier et pour l'ensemble de la documentation remise dans les valisettes du congrès qui a permis à certains collègues de découvrir les richesses touristiques de la région picarde.

Enfin un grand merci à l'ensemble des membres du comité d'organisation et du comité scientifique – dont la liste est présentée en début d'ouvrage – qui nous ont accompagnés tout au long de la mise en place de la manifestation et à celles et ceux qui ont spontanément accepté des présidences de séances. Nos plus chaleureux remerciements s'adressent également aux différents responsables des sessions du congrès d'Amiens qui se sont totalement investis dans l'organisation interne propre à chaque thématique traitée. Après la tenue du congrès, ils ont assuré une première centralisation des manuscrits et contribué à la relecture, la mise en forme et l'homogénéisation des contributions (N. Coye et A. Hurel pour la session historiographie ; J.-L. Lochet, D. Hérisson et D. Cliquet pour la session 1 ; P. Bodu, C. Paris et C. Montoya pour la session 2 ; J.-P. Fagnart, L. Mével, B. Valentin et M.J. Weber pour la session 3 ; F. Bostyn, F. Giligny,

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Session 3

L'Europe du Nord-Ouest autour de 10 000 BP (11 600 cal. BP) : quels changements ?

sous la direction de

JEAN-PIERRE FAGNART, LUDOVIC MEVEL,
BORIS VALENTIN et MARA-JULIA WEBER

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L'Europe du Nord-Ouest autour de 10 000 BP (11 600 cal. BP) : Quels changements ?

Jean-Pierre FAGNART, Ludovic MEVEL, Boris VALENTIN et Mara-Julia WEBER

La session 3 du XXVIII^e congrès préhistorique de France a été organisée en étroite relation avec la commission de l'UISPP – "Le Paléolithique final de l'Eurasie du Nord" – dont nous tenons à remercier très chaleureusement la présidente, B. Valentin Eriksen, pour cette fructueuse collaboration qui a permis de faciliter les contacts entre les chercheurs de l'Europe occidentale et ceux travaillant dans le domaine de l'Europe septentrionale et centrale. La session 3 a également bénéficié du soutien du projet collectif de recherche sur le «Paléolithique final et le Mésolithique dans le Bassin parisien et ses marges. Habitats, sociétés et environnements» financé par la DRAC Centre-Val de Loire et coordonné par B. Valentin, S. Griselin et L. Mevel qui a permis d'accueillir, dans les meilleures conditions, l'ensemble des orateurs à Amiens.

10 000 BP (11 600 cal. BP), c'est bien évidemment le basculement entre le Dryas récent et le Préboréal, le passage entre le Pléistocène et l'Holocène et, d'un point de vue culturel, c'est plus ou moins la charnière entre le Paléolithique final et le tout début du Mésolithique. La transformation des systèmes techniques, économiques, symboliques et par là-même socio-culturels peut présenter, en effet, un certain décalage chronologique selon les régions géographiques étudiées. L'objectif de cette session était justement d'interroger les différents espaces géographiques de l'Europe du Nord-Ouest et de discuter des différentes formes de la transition à travers des synthèses régionales ou thématiques.

La question du passage entre le Paléolithique final et le Mésolithique sur fond de bouleversements climatiques et environnementaux de grande ampleur a déjà été traitée à de nombreuses reprises, depuis une quarantaine d'années lors de différentes rencontres nationales ou internationales : Nice (1976), Bordeaux (1977), Liège (1985), Oxford (1989), Lublin (1993), Berlin (1995), Amiens (1994), Grenoble (1995),

Nemours (1997), Stockholm (1999), Greifswald (2002), Poznań (2003), Lisbonne (2006), Copenhague (2009), Amersfoort (2012), Schleswig (2013), Les Eyzies-de-Tayac (2010 et 2015), Bordeaux (2013) et Kiel (2015). Le dynamisme des recherches sur cette période reflète l'enrichissement permanent des données au cours des dernières décennies. Dans la session 3 du XXVIII^e congrès préhistorique de France qui s'est tenue à Amiens le 3 juin 2016, nous avons choisi de concentrer notre attention sur l'Europe du Nord plutôt occidentale avec quelques incursions vers l'Europe centrale.

Face aux changements climatiques, hydrologiques et sédimentaires – souvent rapides et brutaux – notre ambition était de détailler région par région la reconstitution des associations végétales et animales et de tenter d'en évaluer l'impact sur les sociétés de chasseurs-cueilleurs de la chronozone du Dryas récent à celle du Préboréal. Notre objectif était d'établir un état de nos connaissances le plus actualisé sur les changements intervenus autour du seuil chronologique de 11 600 cal. BP.

La session 3 du Congrès d'Amiens fut également l'occasion de s'interroger sur la pertinence des découpages culturels proposés pour la jonction entre la fin des temps glaciaires et le début de l'interglaciaire holocène (Laborien, Ahrensbourgien, Swidérien, Épi-Laborien, Épi-Ahrensbourgien). La généralisation des approches technologiques tout en précisant beaucoup les connaissances sur la culture matérielle permet dans bien des cas d'éclairer le contexte économique et parfois social.

Il faut toutefois rappeler que la période située autour de 11 600 cal. BP n'est pas facile à appréhender. Le passage entre le Pléistocène et l'Holocène avec ses profonds changements climatiques et environnementaux n'est pas toujours favorable à la sédimentation et à la préservation des gisements à haute résolution stratigraphique. Les problèmes de "palimpsestes" sont

fréquents dans certaines régions et le bilan sédimentaire peut être réduit, en particulier pour les gisements situés en position de versant. L'important plateau des datations radiocarbone vers 11 600 cal. BP constitue également un obstacle à une compréhension fine des phénomènes de cette période cruciale.

En dépit de toutes ces difficultés, il a cependant été possible d'esquisser une réflexion collective sur les phénomènes de filiation ou de rupture selon les régions concernées entre les sociétés de chasseurs-cueilleurs de l'ultime fin du Paléolithique et celles du tout début du Mésolithique. Les réponses apportées en fonction des domaines géographiques distincts ont portées sur la France (B. Valentin et M. Biard; J.-P. Fagnart et P. Coudret; M. Langlais, N. Naudinot *et al.*; T. Ducrocq; C. Guéret et J. Jacquier), la Grande-Bretagne (N. Barton et A. Roberts; C. Conneller *et al.*), la Belgique et les Pays-Bas (P. Combé et M. Niekus), l'Allemagne du Nord (L. Mevel, M.-J. Weber et I.-M. Berg-Hansen; D. Groß, C. Pasda et B. Gehlen; M. Wild et S. Pfeifer), l'Allemagne de l'Ouest (M. Street *et al.*) et la Pologne (K. Pyzewicz *et al.*).

À l'issue de cet avant-propos, nous avons une pensée pour notre collègue J. Deeben qui nous a quittés en 2015 à l'âge de 60 ans. Jos devait participer à la session 3 du XXVIII^e congrès préhistorique de

France pour une communication sur les Pays-Bas et la Belgique en collaboration avec P. Crombé et M. Niekus. Chacun appréciait la qualité et la rigueur de son travail, sa grande gentillesse et son humanisme. Les circonstances tragiques n'ont pas permis qu'il soit parmi nous, à Amiens, en ce mois de juin 2016. ■

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“Belloisian” know-how: clarification on the aims and methods of flint knapping around 11,600 cal. BP in the Paris Basin

Miguel BIARD et Boris VALENTIN

Abstract: Over the last thirty years, a number of sites have been discovered in the Paris Basin that can be roughly estimated at around 11,600 cal BP and the transition between the younger Dryas and the Preboreal. The industries found at these sites are so distinctive that they are often the only criteria used for approximate dating when other archaeological remains are absent. And yet they still lack a satisfactory name. “Long Blade Industries” like their English counterparts, “Belloisian”, “Epi-Ahrensburgian” or “Laborian-Ahrensburgian”: hesitation has arisen not only due to the heterogeneous nature of certain sets of projectile implements but also the somewhat specialized function of some of the sites, suggesting that it involved a specific facies and not the full expression of a cultural tradition. Given this indecision and the advantage of a more generic term encompassing distant but more or less similar technical productions (see the Laborian of South West France, the northern Ahrensburgian or even the Swiderian), new morphometric terms have been proposed such as “Regular Blade and Bladelet Industries” or “Flat Blade and Bladelet Techno-complex.” This new hesitation regarding the knapping objectives that should be emphasized have the merit – as well as promoting the idea of a generic name that goes beyond the Paris Basin and southern England – of recentering the debate on knapping objectives. It is precisely on this theme, in particular regarding blade production, that we have focused in this article by establishing an overview of the observations made at Acquigny, Alizay, Calleville (Eure), and Donnemarie-Dontilly (Seine-et-Marne). At all these sites, we can observe the production by soft stone percussion of blades that appear to have been “favoured” from both an economic and a technical point of view. They are at once long, regular and flat with tapered ends. It has been observed that great care was required to ensure all these qualities, from the selection of the blocks to the highly meticulous preparation of the impact zones for each blade, and their flattening during the knapping process. Interestingly, despite all these rather constraining choices and the need for several quality knapping tools, there was not necessarily a very high degree of systematic advanced planning. Often the meticulous care observed for the favoured blades was found alongside products of far inferior quality, reflecting great versatility. To gain a better understanding of the significance of this dual trend, further palaeoethnographical studies are needed at the best-preserved sites.

Keywords: Lithic technology, Final Palaeolithic, North-West Europe, Terminology.

Résumé : Durant ces trente dernières années, on a découvert dans le Bassin parisien de nombreux gisements que l'on peut dater grosso modo vers 11600 cal BP autour du basculement entre Dryas récent et Préboréal. Ils livrent des industries si facilement reconnaissables qu'elles constituent bien souvent le seul critère de datation approximative quand d'autres vestiges sont absents. Pour autant, on peine à leur trouver un nom satisfaisant. « Long Blade Industries » comme leurs homologues anglais, « Belloisien », « Epi-Ahrensbourgien » ou « Laborien-Ahrensbourgien » : les hésitations proviennent non seulement du caractère mixte de certaines panoplies d'armatures mais aussi de la fonction quelquefois assez spécialisée des gisements, laissant penser alors que l'on est en présence d'un faciès spécifique et non de la pleine expression d'une tradition culturelle. Vu cette indécision et aussi l'intérêt d'une désignation plus générique englobant des manifestations techniques éloignées mais plus ou moins analogues (cf. Laborien du Sud-Ouest de la France, Ahrensbourgien septentrional voire Swidérien), on a proposé de nouvelles désignations morphométriques comme « Regular Blades and Bladelets Industries » ou bien « Flat Blades and Bladelets Techno-complex ». Ces nouvelles hésitations sur les intentions du débitage à mettre éventuellement en exergue ont le mérite – en plus de promouvoir l'idée d'une appellation générique débordant le Bassin parisien et le sud de l'Angleterre – de recentrer le débat sur les objectifs de la taille. C'est précisément sur ce thème, et en particulier sur la production des lames, que nous mettons ici l'accent en synthétisant les observations sur Acquigny, Alizay et Calleville (Eure) ainsi que sur Donnemarie-Dontilly (Seine-et-Marne). Sur tous ces gisements, on observe la production au percuteur de pierre tendre de lames que nous avons considérées comme « favorites » d'un double point de vue économique et technique. Elles sont à la fois longues, régulières et plates tandis que leurs extrémités sont effilées. On détaille ici

le soin qu'il a fallu pour leur conférer toutes ces qualités, depuis la sélection des volumes jusqu'à la gestion de leur aplatissement pendant le débitage, en passant par la préparation très méticuleuse des zones d'impact pour chaque lame. Curieusement, tous ces choix assez contraignants, auxquels s'ajoute l'acquisition nécessaire de plusieurs bons outils de taille, ne s'accompagnent pas pour autant d'un très haut degré de prévision systématique. Beaucoup de méticulosité coexiste donc avec de la souplesse, y compris dans la qualité des produits utilisés en plus des lames favorites. Pour saisir la signification de cette double tendance, il est maintenant nécessaire de développer les études paléolithiques sur les sites les mieux conservés.

Mots-clés : Technologie lithique, Paléolithique final, Europe du Nord-Ouest, Terminologie.

Thirty years ago, Nick Barton (1986) characterized the distinctive nature of the lithic industries of around 11,600 cal BP in southern England. Their counterparts in the Paris Basin, which we will discuss in this article, are equally distinctive from a technical point of view and were produced in a unique economic context given the apparently relatively specialized function of most of the short-term occupations where these productions were found: knapping workshops, temporary bivouacs, and butchery sites. Furthermore, these three functions were probably found alongside each other, although we do not yet know to what respective degree (Valentin, 2008, p. 207-209, 2009). In this article, we have chosen to focus on the technical characteristics of these industries, leaving aside the economic characteristics for the moment, as they are still difficult to clearly establish given the scarcity of sites with preserved fauna.

THE CHOICE OF TERM

Nick Barton was also one of the first archaeologists to characterize these industries from a morphometric point of view by terming them “Long Blade Assemblages” (Barton, 1986, 1989 and 1998) in line with John Wymer (1976). This remains the most widely used term in Britain today, and more broadly, in northwestern Europe, even though it only refers to a one dimensional characteristic (“long”), which is somewhat vague and, moreover, relative. Then, in parallel, references were made in northern France to “bruised blade industries” (e.g. Fagnart, 1988 and 1997; Bodu and Valentin, 1993), which were rapidly considered even more imprecise, as the bruised elements – robust knapping waste with edge damage due to use – were only present in certain sectors of a few sites and in varying quantities. For example, among three sectors explored over a 12 to 40 m² area in Acquigny (Eure), only two of these sectors yielded two to four bruised elements each (Biard, 2010), while at Donnemarie-Dontilly (Seine-et-Marne), the four main sectors – with a surface area of 90 to 170 m² – contained between 25 and 37 pieces of this type (Bodu and Valentin, *op. cit.*). Referring to such inconsistent – and occasional – tools thus became problematic, and terms with cultural connotations subsequently became more common: initially “Belloisian” (e.g. Valentin, 1995; Fagnart, 1997; Bodu, 2000), acknowledging that the term also had an economic significance due to the relatively specialized nature of

the sites. As a result, the term refers more to a facies of activity than a cultural tradition in its own right; it is practical – it is a “convenient abbreviation” as André Leroi-Gourhan (1973, p. 324) may have said – and we have used it for this same reason in our title here. But it remains unsatisfactory because it refers both to particular technical characteristics and specific economic ones, which were probably only occasional in the annual cycle of activity, these characteristics still being poorly known.

In a praiseworthy effort at clarification, Jean-Pierre Fagnart (2009) recently adopted the term “Epi-Ahrensburgian” due to the indisputable typological and technological similarities. But do we have sufficient knowledge of the degree of technological relationship between our industries and those of the Ahrensburgian? And where does this leave Alizay in the Eure (Biard *dir.*, 2016) which includes Epilaborian projectile implements (*sensu* Langlais et al., 2014)? Moreover, how can we term an assemblage of heterogeneous projectile implements that are both Laborian and Ahrensburgian, such as that at Calleville in the Eure (Biard and Hinguant, 2011): should we then use the term “Laborian-Ahrensburgian?” And should we not then also add a reference to the Swiderian to characterize this vast network of similarities, which, moreover, not only involves projectile implements but also debitage methods? For behind this search for a unifying term there is also a desire to account for the possible circulation of ideas, potentially over a very large geographical scale. Identifying the technical choices that circulated is one of the challenges involved in research into this period however, and it requires a far more precise definition of the degree of technical affinity in terms of knapping methods, as well as the similarities between the projectile implements.

There have been several recent attempts, of varying success, at establishing a generic term to qualify technical affinity returning to the terminological principle adopted by Nick Barton, while seeking to clarify the description. With this in mind, we considered “Regular Blade and Bladelet Industries” (Valentin, 2008, p. 204), but this presented the same drawbacks as “Long Blade Industries”: “regular” being no more precise, and taken alone, clearly limiting. Nonetheless, it immediately says something about the care invested in these productions given that they were made with soft hammerstones and that it was difficult to obtain blades that were at once long and regular with this

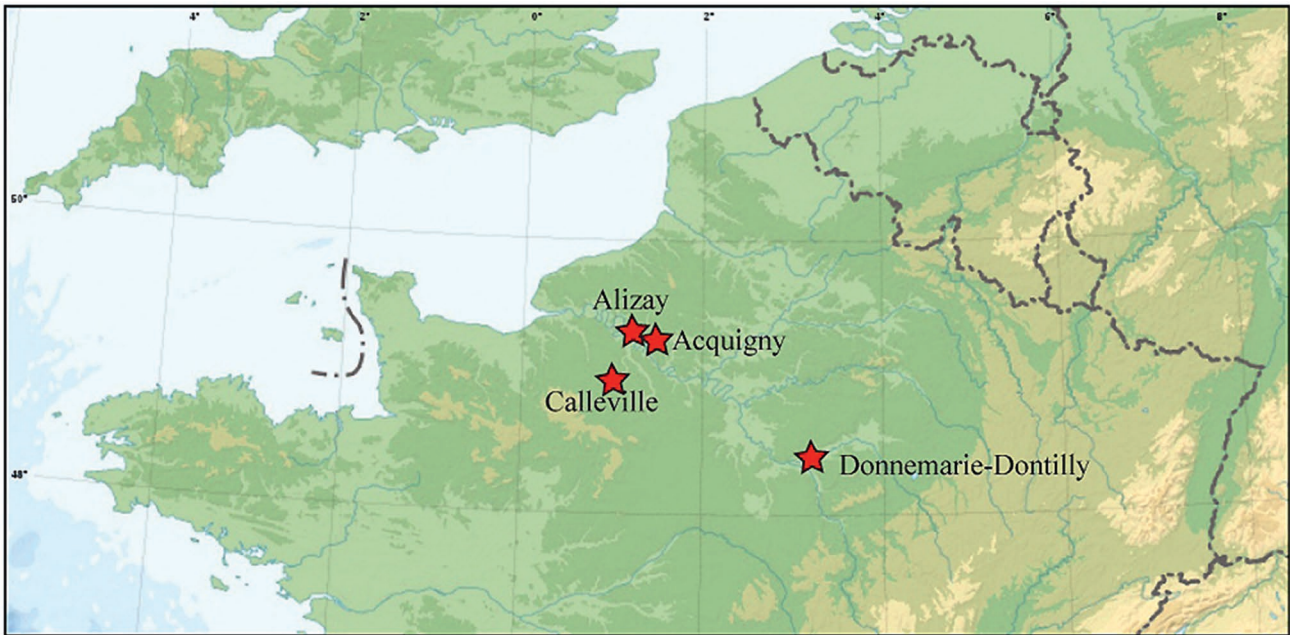


Fig. 1 – Belloisian sites mentioned in this article (CAD M. Biard).
 Fig. 1 – Sites belloisiens mentionnés dans cet article (CAO M. Biard).

kind of hammer. “Straight Blade and Bladelet Industries” was then considered (Naudinot, 2010 and 2013), but it also proved unsatisfactory: the straightness of the profile of the products is undeniable and is related to the use of soft hammerstones, but even if it did involve a real preference and not a mere consequence, it does not allow us to make a distinction in any way with the late Azilian industries, which were also produced using soft hammerstones. Finally, more recently, Nicolas Naudinot and Jérémie Jacquier (2014) proposed “Flat Blade and Bladelet Industries”, which was doubtlessly very pertinent, but nonetheless limiting. Ideally, and we will come back to this point again, a term is required that takes into account a combination of characteristics, but at the risk and the clear disincentive of rendering the generic term somewhat heavy: the blades that were sought were at once long, regular, and flat. Be this as it may, these new questions regarding the knapping objective(s) that the term should focus on, if we are looking for a term that is not excessively heavy, have the merit of refocusing the debate on the knapping objectives.

While awaiting the terminological choice that will have to be made one day and that will probably justify the work of a small group of specialists, we will try to make progress on the matter of knapping objectives, focusing in particular on blade production, which is the most difficult and therefore the most culturally distinctive. For this, we will provide an overview mainly of our observations at Acquigny, Alizay, Calleville, and Donnemarie-Dontilly (fig. 1), sites that were relatively recently excavated and that are generally well conserved. At these sites, refits and spatial analyses have allowed for the relatively precise distinction between knapping waste and productions

of economic value, while shedding light on the intentions underlying the process.

CLARIFICATIONS ON THE MAIN OBJECTIVE OF BLADE PRODUCTION

At all these sites, we have noted at times “a preference for fine blades” (Valentin, 2008, p. 173), a rather vague assessment, but one that is probably relatively close to that held by the flint knappers and users themselves (fig. 2). This estimation of value can be made on the basis of another notion that is far more precise from the technical point of view we have ventured to adopt – that of “primary intention” blades (Biard and Hinguant, 2011, p. 73). This is an evaluation that we have further refined in order to arrive at the not only technical but also economic notion of the “favoured blade” (Biard, 2010, p. 59; Biard dir., 2016, p. 47), a notion that should be distinguished from that of the “preferential blade” – we shall return to this important nuance later on. These favoured blades are relatively long (4 to 17 cm, with many examples ranging from 12 and 15 cm), regular in shape, and flat (in other words both broad and proportionally thin) (fig. 3). At all the sites, the majority of them have been knapped on site and abandoned there, while others have been knapped locally and then taken elsewhere, given the gaps in the refits, and still others have been brought to the sites after being knapped at a different location. With both exported and imported blades – each time in small quantities, it must be pointed out, another aspect that we shall return to later on – we can indeed consider from this dual point of view that these transported blades were favoured blades. Many others may

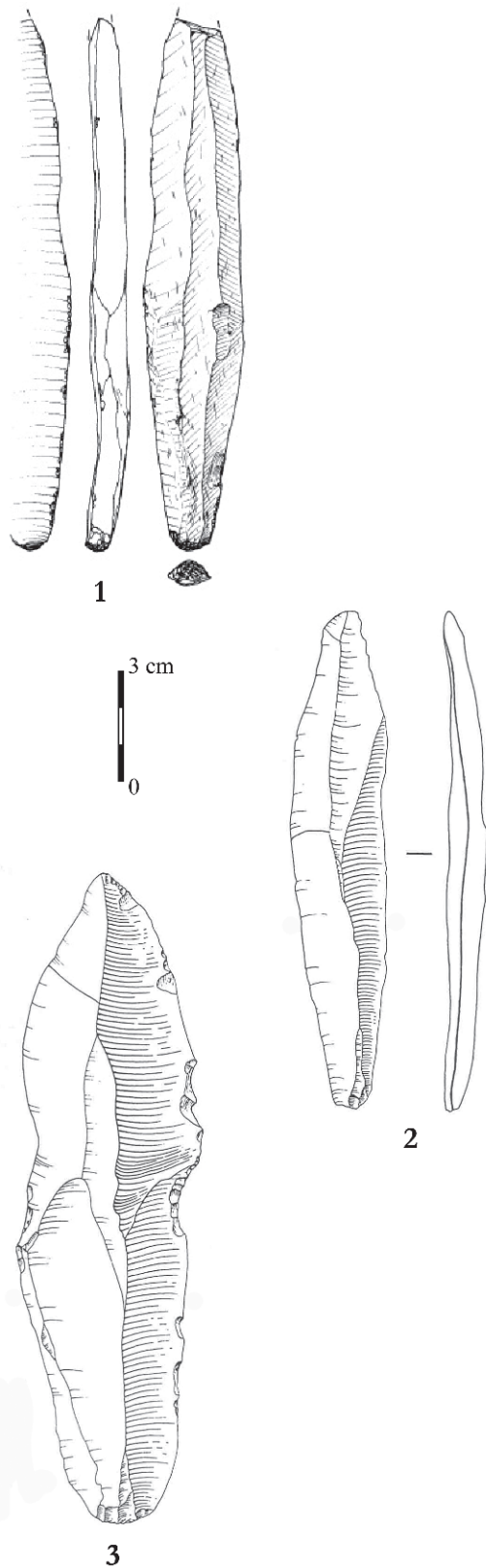


Fig. 2 – Favoured blades. 1: Calleville (drawing Ph. Forré); 2 and 3: Donnemarie-Dontilly (drawings D. Molez).
Fig. 2 – Lames favorites. 1 : Calleville (dessin Ph. Forré) ; 2 et 3 : Donnemarie-Dontilly (dessins D. Molez).

have been too, as the use-wear analysis carried out by Jérémie Jacquier (2015, p. 60-66) at Calleville indicates that the majority of the finest blades produced on site were used, in addition to those that were imported, for the principal activity of the site: vigorous primary butchery. In light of this observation, we can well understand the interest, both in terms of the grip on the blade and the carving process, of long blades with large, sharp and regular cutting edges⁽¹⁾, the sharpness being ensured by the flatness that makes them so distinctive in comparison with other Palaeolithic blade productions.

CLARIFICATIONS ON THE PREVAILING BLADE REDUCTION METHOD

Let us now establish, for the sites in our corpus, how this flattening, regularity, and length were obtained all at once. For this, we must consider the particular technical care surrounding the production of blades combining all these qualities, this rigour supporting the idea that these were favoured blades, not only from an economic point of view but also from a technical point of view.

Care in the selection and reduction of the cores

To begin with, care is observed in the rigorous selection of certain blocks of local flint, although this rigour was not systematic – a point that we shall return to. This conscientious choice always involved large blocks measuring about 20 cm in their longest dimension (fig. 4 no. 1), sometimes with very regular natural convexities.

Some blocks have also been observed exceeding 30 cm (fig. 4, no. 2). This exceptional size implies a lengthy shaping process by means of 2 or 3 crests followed by massive blades, which completed the general configuration by creating long ridges on the flaking face. The use of such large blocks has been observed at all the sites in our corpus, but is nonetheless rare: at locus 4 at Donnemarie, the best studied area of the site, they account for 2 cases out of the 13 blocks used for blades, while at Calleville, there is a single block of this kind out of 50 refits. They are, so to speak, real exploits, and one may wonder whether, given the rather disproportionate nature of the cores in question, there was not significant training behind these productions, which reflect true prowess.

On these exceptional blocks, and on many other less spectacular cores which were nearer to 20 cm in their longest dimension, meticulous care can be observed in other aspects of the process relating to the management of the cores and their convexities. Thus a very regular longitudinal convexity (*carène*) of the flaking face was often obtained in comparison with the industries of the late Azilian, but one that is not very pronounced in comparison with late Magdalenian blade production. This is also the case for the

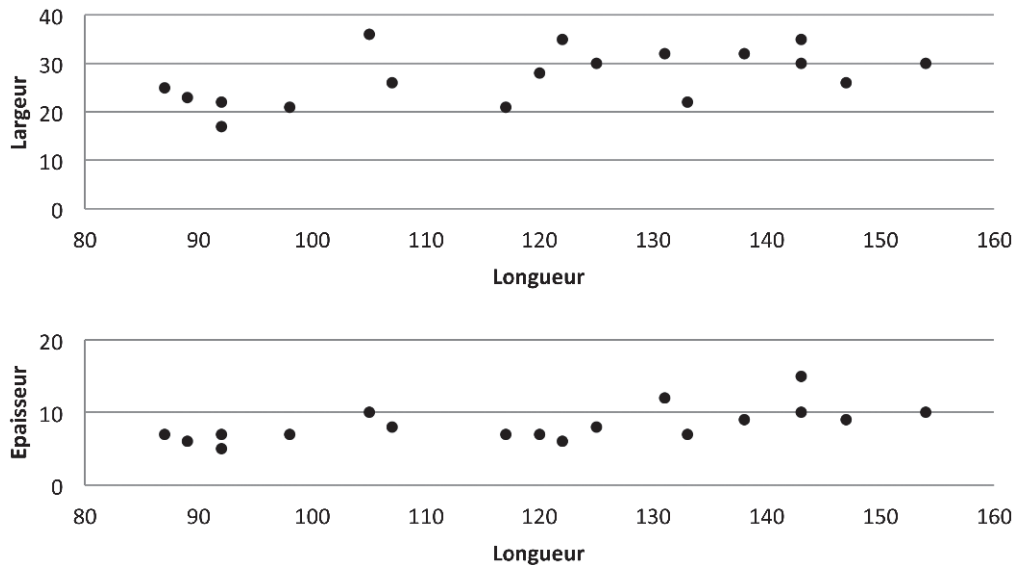


Fig. 3 – Dimensions of the blades used for butchery at Calleville (document J. Jacquier).
 Fig. 3 – Dimensions des lames utilisées pour de la découpe bouchère à Calleville (document J. Jacquier).

transverse convexities (*cintré*) (Valentin, 1995, p. 617 and 648).

The systematic use of two striking platforms is another well-recognized general aspect of the process used for these industries and corresponds to a clear technical need in terms of the length and quality sought for blades extracted with soft stone percussion. The frequent alternation between these platforms – which was much more rapid than during the late Azilian – proceeded from the same necessity. This can be seen in the frequently pervasive negatives on the blades, which are consequently more numerous than in the late Azilian, and far more abundant, of course, than in the late Magdalenian (table 1). These frequent changes in striking platform explain the very low rate of hinging fracture despite the use of soft hammerstones to detach the long blades. Moreover, not only is hinging fracture rare, but the favoured blades also generally have evenly tapering ends, a very practical quality for cutting, the use-wear analysis at Calleville having demonstrated that this activity mainly involved the distal third of the blades in question (Jacquier, 2015, p. 62). This tapering is therefore a quality worthy of note in addition to the general flatness, length, and regularity already mentioned.

In terms of flattening, we must also emphasize another general aspect of the blade reduction process. A detailed study that we recently carried out at Donne-marie-Dontilly (Valentin et al., 2014) demonstrates a

bold choice, also observed at other sites but in proportions that have not yet been quantified. At Donne-marie, after the reduction process was initiated, logically on the narrowest section, on over a third of the cores there was a dissymmetrical progression in the reduction process that was often of a half-rotating extent – in short a clear tendency to exploit the widest and least convex surfaces in order to obtain flat blades (fig. 5). This was a bold choice as the knapping products then had a tendency to sprawl: as the ridges diverged, the knappers in a sense forced destiny and they did this quite regularly. It is worth noting that this risky choice was sometimes adopted, and controlled as much as possible, as far as the production of bladelets, as many cores ended up very flat at this stage and almost at the limits of knapping possibilities (fig. 6).

This emphasis on the flatness of the blades and the tapering of their extremities, in addition to the attention paid to ensuring their length and regularity, also required particular care before each of them was detached. Furthermore, it is this degree of preparation that demonstrates that they were favoured in comparison with more irregularly prepared blades.

Care in preparing the detachment of each blade

These favoured blades often demonstrate the particularly meticulous preparation of the proximal part. For example, the preliminary extraction of micro-bladelets can be observed in the knapping direction in order to recentre the ridges that had diverged due to the exploitation of the broad, flat surfaces, in such a way that the proximal portion is sufficiently arched, thus contributing to the general regularity of the longitudinal convexity (fig. 7, nos. 1 to 4). Re-centering

Donnemarie-Dontilly (Seine-et-Marne): Belloisian	40 %
Ambenay (Eure): Late Azilian	28 %
Le Laitier-Pilé (Cher): Late Magdalenian	9 %

Table 1 – Proportion of regular blades with opposed negatives covering over two thirds of the length.

Table 1 – Proportion de lames régulières avec des négatifs opposés envahissant plus des deux tiers de la longueur.

and arching could also be achieved by means of maintenance crests limited to the proximal part, sometimes created uniquely by the transverse abrasion of a ridge (fig. 7, nos. 5 and 6).

Alongside these localized corrections was the even more punctual preparation of the impact zone itself,

often on a relatively inclined striking platform (around 60°). At a minimum, these meticulous adjustments were made by abrasion (fig. 7, nos. 1 to 5), which is indispensable with soft stone percussion, this preparation often being intense in the case concerned and giving rise to a real polishing that it has become

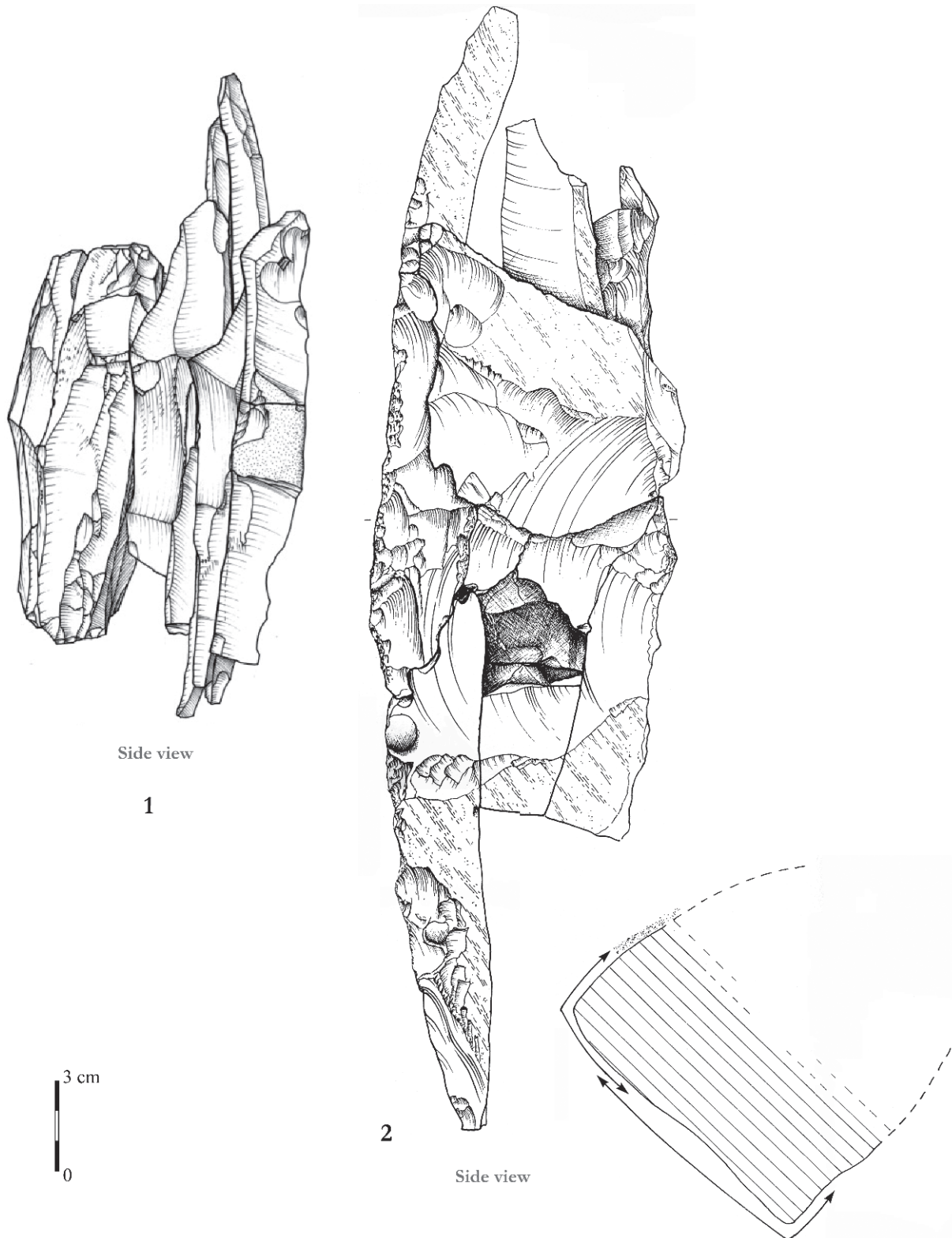


Fig. 4 – Large knapped blocks. 1: Calleville (drawing D. Prost); 2: Donnemarie-Dontilly (drawing D. Molez).
Fig. 4 – Grands blocs débités. 1 : Calleville (dessin D. Prost) ; 2 : Donnemarie-Dontilly (dessin D. Molez).

customary to refer to as “*doucissage*” (*i.e.* smoothing: Pelegrin, 2000). Alongside these gestures, which were intended to remove any fragile micro-asperities, we can sometimes observe the careful adjustment of the thickness and width of the future blade through the convex micro-faceting of the small portion of the

striking platform forming the butt (fig. 7, nos. 2, 3 and 5). Cases have also been noted of the bilateral notching of the edge of the striking platform by abrasion on either side of the main guiding ridge so as to make the part that the hammer must strike protrude. The general inclination of the striking platform and

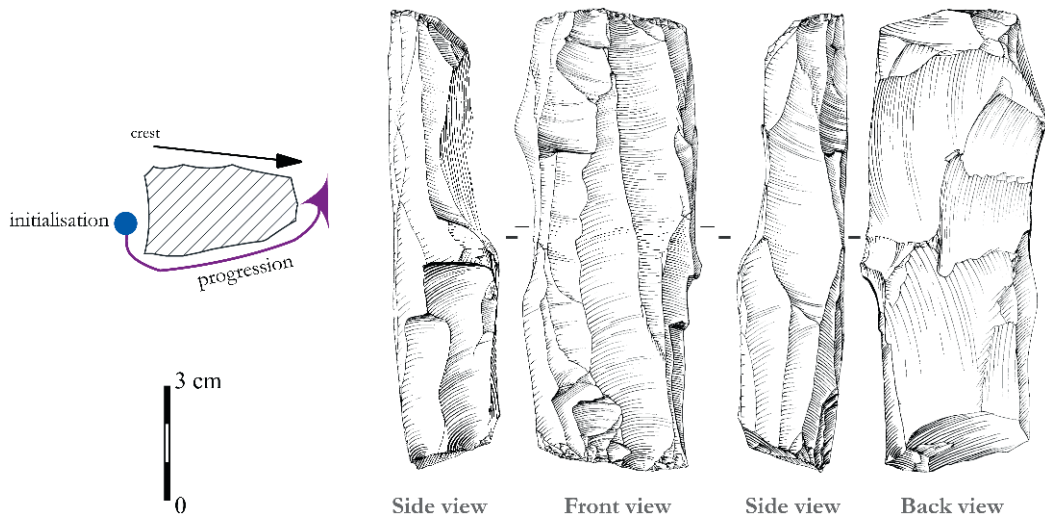


Fig. 5 – Dissymmetrical and half-rotating progression at Donnemarie-Dontilly (drawing M. Ballinger).
 Fig. 5 – Progression dissymétrique et demi-tournante à Donnemarie-Dontilly (dessin M. Ballinger).

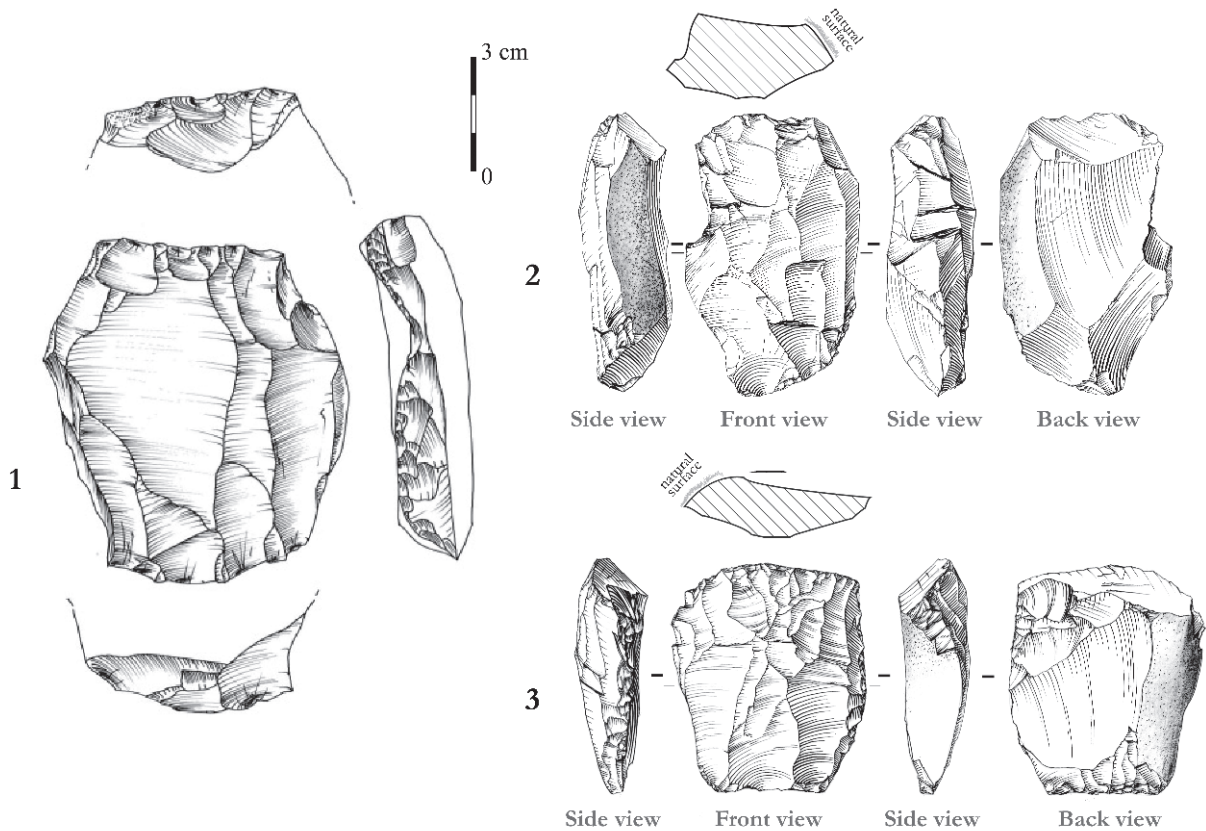


Fig. 6 – Cores very flattened at the time they were abandoned. 1: Alizay (drawing D. Prost); 2 and 3: Donnemarie-Dontilly (drawings M. Ballinger).
 Fig. 6 – Nucléus très aplatis au moment de l’abandon. 1 : Alizay (dessin D. Prost) ; 2 à 3 : Donnemarie-Dontilly (dessins M. Ballinger).

the protrusion of the impact zone often created tearing-out lips on the posterior edge of the butts, a phenomenon that was particularly frequent at sites in Normandy where the knappers used limestone hammers which were particularly soft as a result (Biard and Prost, 2015).

These industries also include some bush-hammered butts, which were detected for the first time in Calleville (Biard and Hinguant, 2011, p. 82), and which, whilst anecdotal, are to our knowledge unique to these industries (fig. 2, no. 1). In our opinion, their appearance is due to a polishing obtained not only by

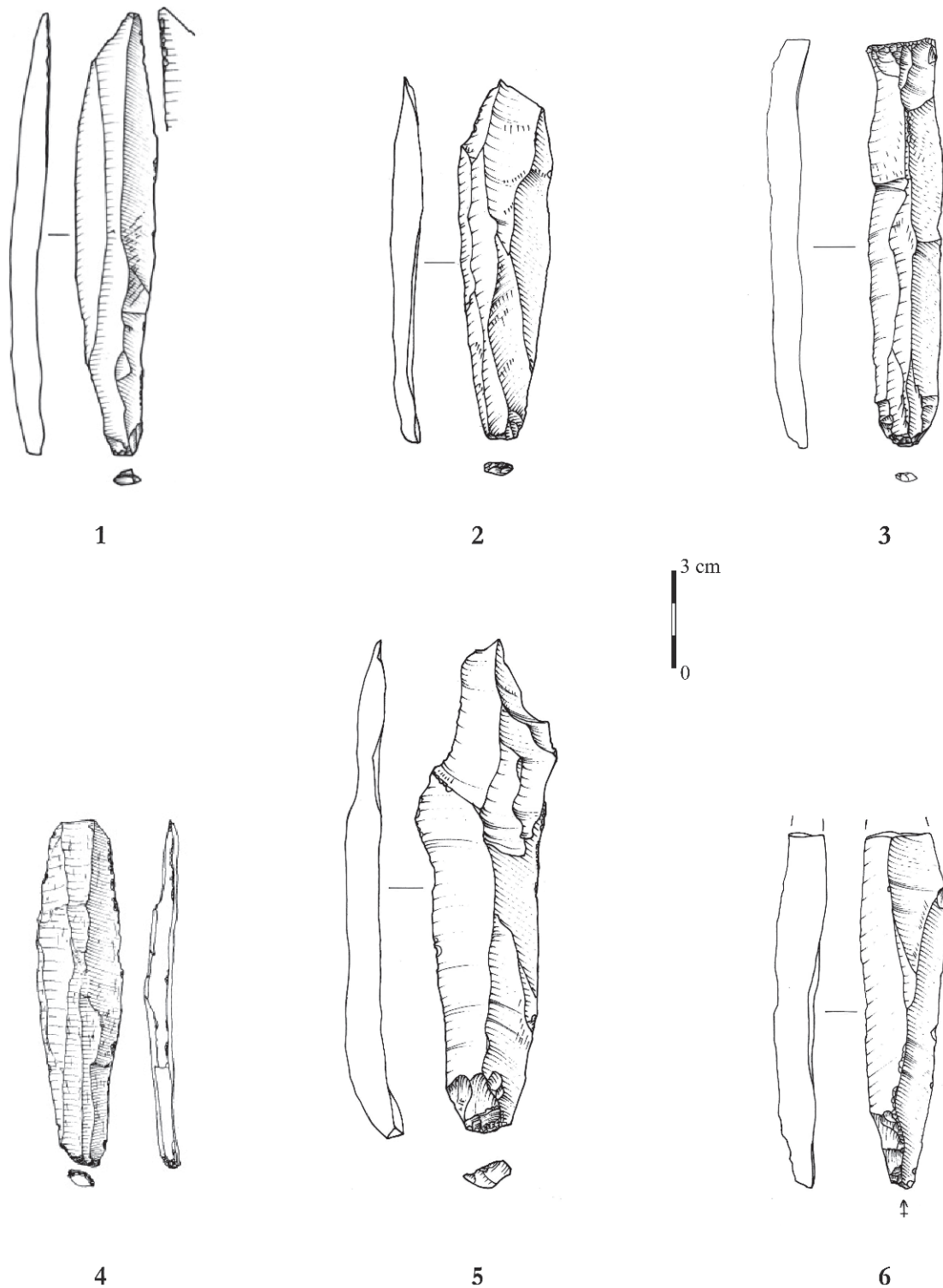


Fig. 7 – Blades and their preparation before detachment. 1: Acquigny (drawing B. Aubry); 2, 3, 5 and 6: Donnemarie-Dontilly (drawings D. Prost); 4: Calleville (drawing Ph. Forré).

Fig. 7 – Des lames et leur préparation avant le détachement. 1 : Acquigny (dessin B. Aubry); 2, 3, 5 et 6 : Donnemarie-Dontilly (dessins D. Prost); 4 : Calleville (dessin Ph. Forré).



Fig. 8 – A sandstone hammer among one of the knapping workshops in locus 4 at Donnemarie-Dontilly (photo P. Bodu and B. Valentin).

Fig. 8 – Un percuteur en grès dans un des amas du locus 4 à Donnemarie-Dontilly (photo P. Bodu and B. Valentin).

rubbing but also, in part, by micro-percussion. Jérémie Jacquier (2015, p. 167-171) has suggested that this activity can shed light on the specific function of certain bruised elements with distinctly shouldered edges, which he has been able to prove through use-wear analysis to have been used on hard and angular mineral matter⁽²⁾.

Jérémie Jacquier has also observed that the majority of bruised elements, where there were any, were not shouldered but had rather been used on abrasive materials without any marked angles (Jacquier, *op. cit.*, p. 171). The hypothesis, based on the collective studies in which one of us (B.V.) took part together with Pierre Bodu (Fagnart and Plisson, 1997), is that it involves knapping waste used to prepare and maintain convexities on the soft hammerstones (sandstone or limestone) used for knapping.

Experiments show that for producing favoured blades, which frequently measured 12 to 15 cm in length, the average weight of these hammers would have been around 1.5 kg, as is the case of the sandstone instrument that was found among a knapping workshop from Donnemarie (fig. 8). This is another indication of great skill, as these heavy instruments had to be handled with precision, requiring an obvious dexterity, and were probably relatively difficult to use given their weight (not to mention that of the core which was also held). Let us add that these large blocks of hard limestone or sandstone had to be carefully selected, and that they often had to be prepared and maintained, for example by using knapping waste, which was bruised in the process. This waste completed the diverse toolkit required by the knappers: indispensable abrader(s) and hammers of different weights (small blades and bladelets were also produced and some maintenance operations required particularly light tools).

On the whole, we can see that great skill and care, as well as a range of knapping tools, were required for the production of these favoured blades, leading to diverse complications. This can be seen at various

stages in the *chaîne opératoire*, from the choice of good flint and quality knapping tools to the general configuration and management of the cores, and the preparation of the impact zones.

It is therefore a combination of many different choices and gestures that clearly distinguish the most talented products from the industries of the late Azilian (e.g. Bodu [ed.], 1998; Marchand et al., 2009; Mevel et al., 2014; Naudinot, 2010; Valentin, 2005). Furthermore, this particularly meticulous reduction process often appears to have been very productive, even if it is difficult to determine how many favoured blades were extracted, as the refits are not sufficiently complete⁽³⁾.

OTHER LESS AMBITIOUS PRODUCTIONS

This occasional high productivity was not at all systematic, however – far from it. In locus 4 at Donnemarie-Dontilly, the best-studied area of the site, at least one third of the blocks were in fact relatively unproductive, only yielding one or two fine blades each after somewhat rudimentary shaping (fig. 9, nos. 1 and 2). This is also observed in the refits at Acquigny, which are almost complete.

In fact, in all these industries a great deal of care was invested in the production of certain favoured blades, while great versatility was shown with respect to others. This can be seen, for example, in the choice of raw materials, particularly at Alizay and Calleville, where the best blocks of flint are found alongside the worst ones, which have been damaged by frost or are excessively hard, but which nonetheless represent over half the blocks reported on site.

Another indication of versatility is the evidence at Donnemarie of a few cores that were used to produce short, wide, irregular or thick blades before being abandoned, but that had probably first produced some fine blades (fig. 10, no. 1). These poor quality products are completely at contrast with the favoured blades and yet they seem to have been used: we do not have any use-wear analysis at this time, but the spatial analysis has indicated that some of the products at locus 4 were removed from the knapping workshops and that these simplified productions, which were nonetheless not devoid of skill, were used a short distance away.

Similarly, there are also some facial productions of elongated flakes (fig. 10, no. 2) that are simple in nature, but also not devoid of skill.

All this coexisted alongside the favoured blades, some of which were transported away but many of which were produced for immediate and momentary use, and hence without advanced planning. There is therefore a concomitance between great meticulousness and versatility, between several indications of anticipation of needs and other cases of immediate use. Incidentally, these dual trends are also observed in terms of bladelets production: some very meticulous and productive knapping methods are observed along-

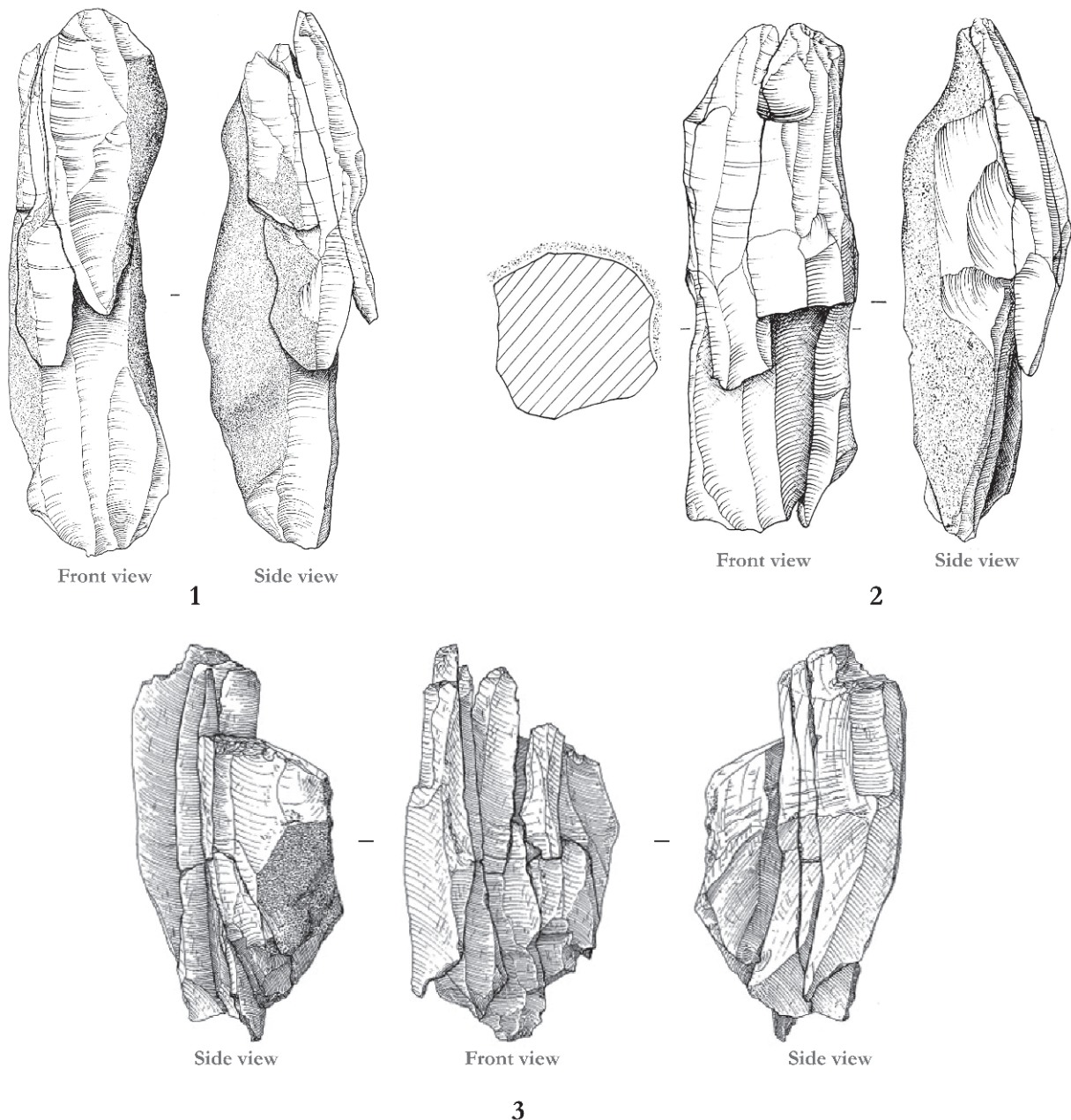


Fig. 9 – Relatively unproductive blade reduction sequences. 1 and 2: Donnemarie-Dontilly (drawings D. Molez); 3: Calleville (drawing Ph. Forré).
Fig. 9 – Des débitages de lames peu productifs. 1 et 2 : Donnemarie-Dontilly (dessins D. Molez); 3 : Calleville (dessin Ph. Forré).

side highly simplified ones made on all sorts of recycled knapping waste.

DISCUSSION

Let us return to the fine blades that are so distinctive of these industries to conclude our provisional overview. It seems to us that many choices revolved around this difficult objective, without a very high level of general predetermination being observed, in other words, without there having been much precise planning regarding the result of the core reduction process in terms of either quality or quantity. In short,

one might think that the knappers often – perhaps even systematically – began their work with the goal in mind of producing fine blades, but that productivity was nonetheless not entirely predictable. As a result, they had to adapt to all the unforeseen factors implied by a method that sometimes approached the technical limits of blade production, in particular in terms of flattening. Adapting to these unforeseen elements was also a matter of economic choice as the search for favoured blades was found alongside the use of other much less regular products.

In summary, we do not find at all the same level of systematic preparation and planning among these industries, as is observed, for example, in many

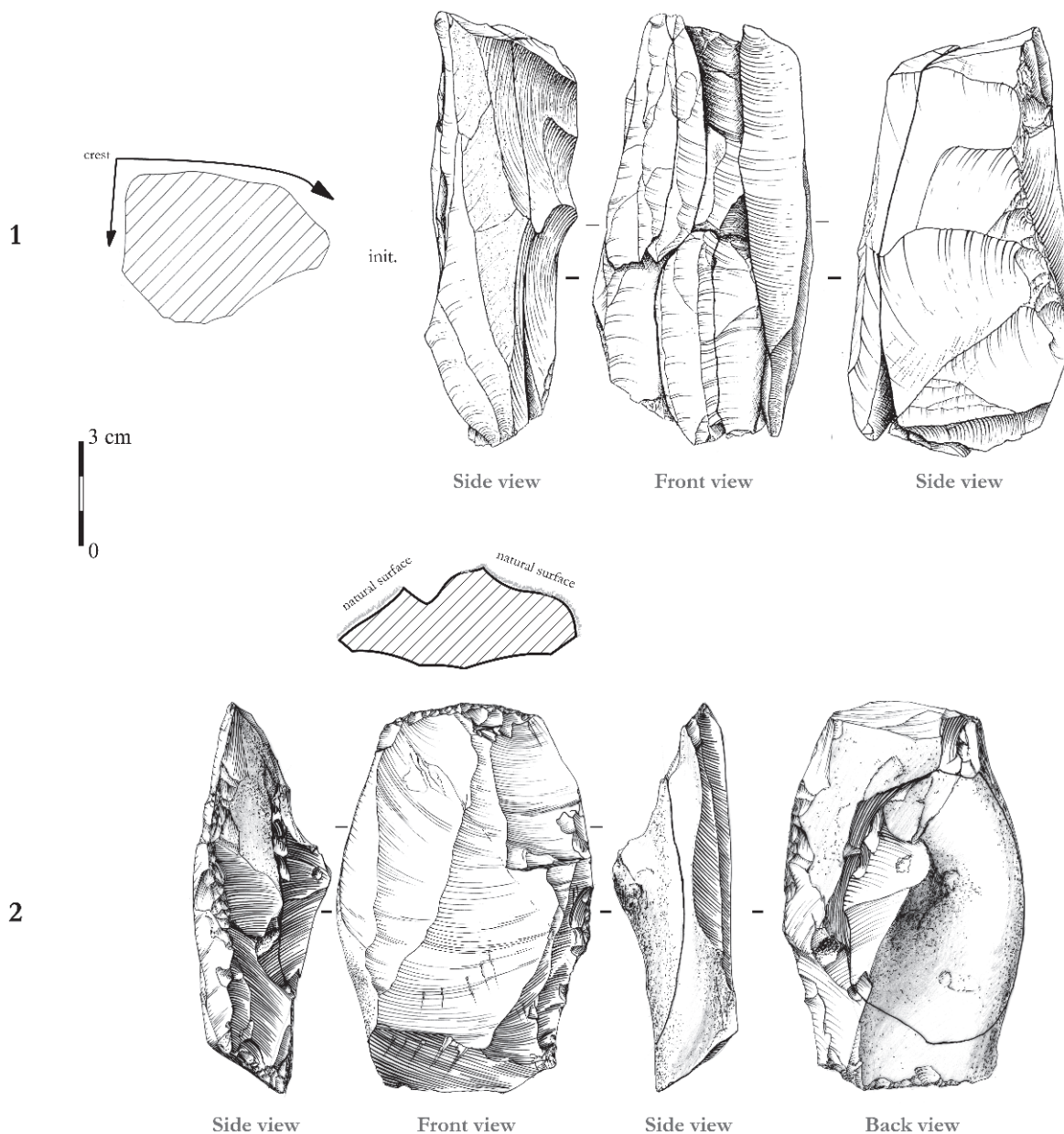


Fig. 10 – Cores with relatively irregular products at Donnemarie-Dontilly (drawings D. Molez and M. Ballinger).
 Fig. 10 – Des débitages de produits peu réguliers à Donnemarie-Dontilly (dessins D. Molez et M. Ballinger).

naviform blade reductions from the Pre-Pottery Neolithic, which were nevertheless structured by rather similar dimensional and qualitative objectives, also achieved by soft stone percussion (e.g. Abbès, 2003; Barzilai, 2010). It would be very useful now to attempt close comparisons between the Belloisian and the Swiderian (e.g. Migal, 2007) for which productions, although yielding shorter blades, may have more similarities with naviform methods. Let us note first of all that the level of predetermination observed in the Belloisian also appears inferior to that which characterizes the late Magdalenian of the Paris Basin – particularly in most levels of Etiolles in Essonne (e.g. Pigeot [dir.], 2004) – the constraints however being somewhat different as the process was performed with

organic percussion. It should nonetheless be noted that at the end of the Palaeolithic, the late Magdalenian remains unrivalled in terms of the rigidity of the standards guiding blade production – a point that needs further consideration in terms of all its economic and even social consequences.

In conclusion, we can see that in the Paris Basin in around 11,600 cal BP a very high level of care was paid to blade production, in significant contrast with that observed in the late Azilian with its rather unambitious blade objectives. Despite the high level of meticulousness that was often seen around 11,600 cal BP however, it was not systematic to the point of reflecting a high degree of planning and preparation on all the knapped blocks. This versatility was

accompanied by a low level of anticipation of future needs, as most of the products remained on site. All this may seem somewhat contradictory, but it is probably an appearance resulting from the incomplete reconstruction of the activities at the sites over this period, and consequently of a still vague understanding of the structure of the economic activities involved. There are a few other apparent paradoxes too, such as the extreme scarcity of projectile implements at sites where butchery took place, such as Donnemarie-Dontilly, and the use of two nearby sources of flint at this same site, with all the stages in the *chaîne opératoire* represented, although it is not located at either of the two deposits but a few hundred metres from each of them. Clearly, there is still much to be learnt about these sites that were occupied around the climatic shift between the Pleistocene and the Holocene. This will require the paleoethnographical study of the best preserved occupations as well as a deeper technological analysis, particularly in the areas we have just outlined. ■

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FOOTNOTES

- (1) It should be noted, incidentally, that the importance of sharp edges in these industries, and consequently of flattening, is emphasized by a minor, but significant, feature observed by Jérémie Jacquier (2015, p. 280-284; Jacquier and Naudinot, 2015) at the contemporaneous domestic site of La Fosse (Mayenne). At this site, where the flint comes from at least 40 km away, the edges of some blades have been carefully sharpened during use by tranchet blows.
- (2) Without rejecting this hypothesis, it should nonetheless be noted that the preliminary tests carried out by one of us (M. B.) indicate that a sandstone "abradant" can be used both for polishing and micro-percussion. In short, there is no need to change tool to achieve this bush-hammered appearance on a few butts. As a result, it may be necessary to look for other (complementary?) hypotheses concerning the function of these shouldered bruised elements. In particular, we may question whether some of them could not have been used for the bilateral notching of the edges of the striking platforms (see above).
- (3) In the absence of an estimation of this productivity for on site productions, we can at least cite the case of a collection of 14 allochthonous blades, mostly favoured blades, extracted from the same block and brought to Calleville (Biard and Hinguant, 2011, p. 95-96). This gives us an idea of the minimum productivity on a volume that can be considered one of the best observed on the site, both in terms of quality and dimensions.

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La transition Dryas récent-Préboréal dans le Nord de la France

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Résumé : Dans le Nord de la France et plus particulièrement dans le bassin de la Somme, les conditions climatiques rigoureuses du Dryas récent se traduisent d'un point de vue morphologique par une réactivation des versants crayeux et une augmentation de l'intensité des crues qui engendrent un colmatage généralisé des fonds de vallées par des limons calcaires. L'occupation humaine relativement bien documentée durant l'oscillation d'Allerød (tradition des groupes à Federmesser ou Azilien) semble avoir fortement décliné lors du Dryas récent. En dépit de 35 années de recherches, de prospections, d'observations et de surveillances archéologiques intensives, aucune trace archéologique n'a été relevée dans les nombreuses séquences du bassin de la Somme. Dans l'état actuel de nos connaissances, le Dryas récent semble constituer un important hiatus dans le peuplement humain. Vers 10000 BP (11 500 cal. BP), à la transition entre le Dryas récent et le Préboréal, une nouvelle phase d'occupation significative de la région se caractérise d'un point de vue technologique par la production de grandes lames, parfois de dimensions exceptionnelles, associée à un débitage lamellaire. Les supports laminaires aisément identifiables d'un site à l'autre se singularisent par leur profil rectiligne, mais également par la largeur et le caractère plat des produits. Les principaux ensembles recueillis présentent une forte unité technique et économique témoignant d'une exigence et d'un haut degré de savoir-faire de la part des tailleurs de silex. Dans le bassin de la Somme, cette ultime tradition technique s'individualise par la présence de nombreux gisements spécialisés dans l'acquisition de la matière première et la production de supports lithiques parfois associés à des aires d'activités dévolues à la boucherie (abattages de chevaux ou d'aurochs). La présence de pointes à troncature oblique rattache ces ensembles aux traditions septentrionales et plus particulièrement à la phase la plus récente du techno-complexe ahrensbourgien (Épi-Ahrensbourgien). Les premiers véritables groupes du Mésolithique à nombreuses armatures microlithiques obtenues par la technique du microburin apparaissent dans la région vers 9800 BP (11 200 cal. BP) de manière concomitante avec le retour des conditions nettement interglaciaires (Holocène).

Mots-clés : Paléolithique final, Nord de la France, Bassin de la Somme, Dryas récent, Préboréal, Belloisien, Épi-Ahrensbourgien.

Abstract: In the north of France and more particularly in the Somme basin, the severe climatic conditions of the Younger Dryas are reflected from a morphological point of view by a reactivation of the chalky slopes and an increase in the intensity of flooding that generated a general filling of valley bottoms by calcareous silts. The relatively well-documented human occupation during the Allerød oscillation (Federmesser group tradition or Azilian) seems to have declined sharply in the Younger Dryas. There is virtually no archaeological evidence in the many sequences of the Somme basin despite 35 years of extensive research, survey, observation and archeological monitoring. According to our current knowledge, the Younger Dryas seems to constitute an important hiatus in human occupation. Around 10,000 BP (11,500 cal. BP) at the transition between the Younger Dryas and the Preboreal a new phase of significant occupation of the region occurred. It is characterized from a technological point of view by the production of large blades, sometimes of exceptional dimensions, and associated with lamellar production. The blade blanks, easily identifiable from one site to another, are distinguished by their straight profile, but also by the width and flatness of the products. The principal assemblages present a strong technological and economic unit testifying to exigent standards and a high degree of know-how on the part of the flintknappers. In the Somme basin, this ultimate technical tradition is typified by the presence of numerous sites specialized in the acquisition of raw materials and the production of lithic blanks sometimes associated with activity areas indicating butchery (of hunted horse or aurochs). The presence of obliquely truncated points links these assemblages to northern traditions and more particularly to the most recent phase of the Ahrensburgian techno-complex (Epi-Ahrensburgian). The first real Mesolithic groups with numerous microlithic implements appear in the region around 9,800 BP (11,200 cal. BP), contemporaneously with the return of clearly interglacial (Holocene) conditions.

Key-words: Final Palaeolithic, Northern France, Somme basin, Younger Dryas, Preboreal, Belloisian, Epi-Ahrensburgian.

INTRODUCTION

Au cours des deux dernières décennies du XX^e siècle, la découverte de nombreux gisements attribuables au Paléolithique final dans le bassin de la Somme a permis d'établir un cadre de référence chronologique et culturel bien détaillé pour les occupations humaines du Tardiglaciaire weichselien (Fagnart, 1993 et 1997; Fagnart et Coudret, 2000a et 2000b). Les études pluridisciplinaires entreprises ont permis également de situer ces occupations dans un contexte paléocologique et environnemental relativement précis et de corréliser les principales phases du peuplement humain avec les variations globales du climat à la fin de la dernière période glaciaire (Antoine, 1997a, b et c; Antoine *et al.*, 2000, 2003, 2011, 2012, 2014). Près de 25 années se sont écoulées depuis les fouilles de Belloy-sur-Somme, gisement éponyme d'une tradition technique originale de l'extrême fin du Paléolithique du bassin de la Somme (« Belloisien »). Si la documentation archéologique de la fin du Tardiglaciaire weichselien ne s'est pas ou peu renouvelée pour les raisons qui seront évoquées ci-dessous, la découverte de nouveaux gisements dans les régions voisines (Normandie, Île-de-France, Ouest de la France), mais également dans les pays limitrophes a permis de poser un nouveau regard sur l'importante documentation recueillie dans le bassin de la Somme et en particulier sur la période comprise entre le Dryas récent et le Préboréal.

L'espace géographique traité dans le cadre de cet article correspond à la région des Hauts-de-France, découpage administratif récent résultant de la fusion des anciennes régions de la Picardie et du Nord/Pas-de-Calais (fig. 1). La région couvre environ

32000 km², mais l'essentiel de l'information archéologique disponible est fourni par le bassin de la Somme qui occupe une position centrale et dont le substratum anté-Quaternaire est constitué par la craie de l'auréole du Crétacé supérieur du nord-ouest du Bassin parisien.

LES PLAINES ALLUVIALES DU BASSIN DE LA SOMME, UN TRÈS RICHE POTENTIEL ARCHÉOLOGIQUE, MAIS PAS TOUJOURS AISÉMENT ACCESSIBLE...

L'exploitation des anciennes nappes alluviales du bassin de la Somme au cours du XIX^e et du XX^e siècle a largement contribué à la reconnaissance et la renommée du Paléolithique ancien et moyen du Nord de la France. Initialement limitée, pour des raisons d'accessibilité, aux anciennes alluvions préservées de manière étagée sur les versants des principales vallées, l'exploitation industrielle des granulats s'est orientée, plus particulièrement depuis les années 1970, vers les milieux humides des plaines alluviales actuelles. L'extraction des graviers de la nappe weichselienne de fond de vallée dans les milieux gorgés d'eau, mais où le rabattement de la nappe phréatique n'est pas autorisé, a été rendue possible grâce à l'utilisation de draglines. L'importance du potentiel archéologique enfoui sous les plaines alluviales déjà présentée par J. Boucher de Perthes (1847-1864) puis surtout par V. Commont (1910, 1912, 1913) lors de l'exploitation des tourbières a été largement confirmée par les extractions récentes de granulats. Dans les années 1980 et 1990, l'exploitation industrielle des graviers situés sous la nappe phréatique actuelle a été l'occasion de

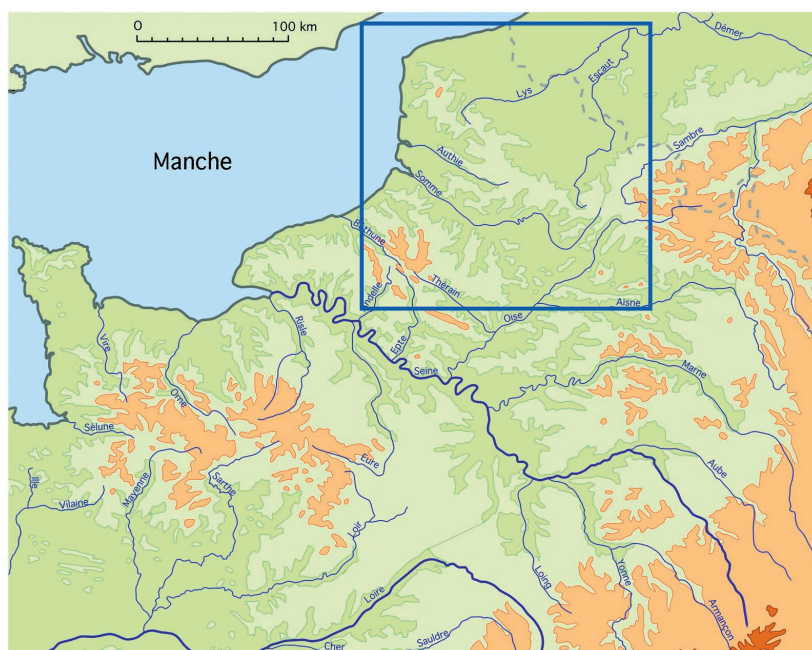


Fig. 1 – Délimitation de l'espace géographique traité dans le cadre de l'article.
Fig. 1 – Geographical area covered in this paper.

la découverte de toute une série d'occupations tardi-glaciaires. La mise au jour de nombreux gisements dans le secteur de Flixecourt et d'Hangest-sur-Somme dans la moyenne vallée de la Somme (Fagnart, 1993), mais également à Conty dans la vallée de la Selle (Antoine *et al.*, 2012), a considérablement enrichi notre documentation et renouvelé notre connaissance du Tardiglaciaire régional et en particulier de la période comprise entre le Dryas récent et le Préboréal.

L'accès aux gisements enfouis sous les plaines alluviales actuelles a été cependant de courte durée, tout au plus une dizaine d'années (1985-1996). L'exploitation industrielle des granulats s'est interrompue de manière abrupte à la fin des années 1990 dans le bassin de la Somme en raison de l'application de nouvelles réglementations liées à la préservation des milieux sensibles des fonds de vallées humides. La découverte de nouveaux gisements s'est donc très fortement réduite depuis une vingtaine d'années. Le potentiel archéologique des plaines alluviales, particulièrement exceptionnel dans le bassin de la Somme, est donc provisoirement en partie hors d'atteinte.

LES DONNÉES MORPHOLOGIQUES ET ENVIRONNEMENTALES DU BASSIN DE LA SOMME

L'évolution du système fluvial du bassin de la Somme depuis 15000 ans est bien connue dans ses grandes lignes dès les premiers travaux de P. Antoine (1990, 1997a, b et c). Depuis une vingtaine d'années, les recherches pluridisciplinaires menées sur les fonds de vallées de la Somme et de ses principaux affluents comme la Selle ont permis de décrire les grandes phases de l'évolution fluviale et de l'environnement durant le Tardiglaciaire et le début de l'Holocène et de corréliser ces modifications avec les variations globales du climat (Antoine *et al.*, 2000, 2003, 2011, 2012, 2014). Entre la fin du Pléni-glaciaire supérieur et le début de l'Holocène, le système fluvial périglaciaire en tresses évolue progressivement vers un système à méandres qui s'est imposé à partir de l'oscillation de Bølling (fig. 2).

D'un point de vue morpho-sédimentaire, le Tardiglaciaire du bassin de la Somme est délimité par deux incisions importantes du système fluvial, la première lors de l'oscillation de Bølling, la seconde au tout début du Préboréal. Les occupations du Paléolithique final (Belloisien ou Épi-Ahrensbourgien) se situent stratigraphiquement un peu avant ou pendant cette dernière incision, mais de toute évidence après la mise en place des importants dépôts calcaires du Dryas récent. Les données environnementales obtenues à partir de la palynologie, la malacologie, l'anthracologie ou l'entomologie (coléoptères) permettent de recueillir des informations précises sur les milieux naturels et les écosystèmes qui se sont succédé depuis le Tardiglaciaire jusqu'au début de l'Holocène (Antoine *et al.*, 2000, 2003, 2011, 2012, 2014).

Après l'oscillation tempérée fraîche de l'Allerød, un fort refroidissement du climat se manifeste lors du

Dryas récent pendant plus d'un millénaire. Les données malacologiques recueillies sur le gisement de Conty dans la vallée de la Selle (Limondin *in* Antoine *et al.*, 2012) montre une bipartition assez nette de cette dernière péjoration climatique du Tardiglaciaire avec une phase initiale froide et humide caractérisée par le développement d'*Oxyloma elegans* suivie d'une phase moins froide, mais plus sèche, individualisée par l'abondance de *Columella columella* et *Trichia hispida*. Parallèlement les données de la palynologie indiquent un net recul du couvert arboréen et une extension des herbacées de milieu steppique (Antoine *et al.*, 2012).

Le début du Préboréal se caractérise par une nouvelle topographie des fonds de vallées corrélable avec la rapide amélioration du climat du début de l'interglaciaire Holocène. On assiste à la mise en place des toutes premières tourbes holocènes datées entre 9900 et 9800 BP (11300 et 11200 cal. BP). Selon les différents bio-indicateurs, un décalage de 2 ou 3 siècles entre l'évolution du système fluvial et les différentes étapes de la recolonisation de la végétation est généralement observé. En ce sens, le paysage du début du Préboréal dans le bassin de la Somme est encore très ouvert, en particulier durant la petite période immédiatement antérieure au bref refroidissement de l'oscillation du Préboréal datée des environs de 9900 BP (vers : 11300 cal. BP).

LE LONG HIATUS DU DRYAS RÉCENT

Alors que l'oscillation d'Allerød est marquée par une occupation humaine relativement importante et continue dans le bassin de la Somme, on assiste à un important hiatus d'occupation pendant près d'un millénaire durant le Dryas récent (fig. 3). Ce hiatus est commun à une partie de l'Europe du Nord-Ouest. En Grande-Bretagne, dans le nord de la Belgique et le nord de la France, l'Ahrensbourgien classique, caractérisé par la présence de pointes pédonculées comme armature de trait, est absent dans l'état actuel de nos connaissances. L'extension occidentale de ce technocomplexe est limitée au sud-est de la Belgique dans le bassin mosan. Des conditions climatiques particulièrement rigoureuses semblent expliquer ce phénomène. La chute drastique des températures (moyennes du mois de janvier égale à -15°, moyennes du mois de juillet autour de 10 ou 11°) et la baisse importante des précipitations (passage de 800 mm à 400 mm/an) témoignent de conditions froides et arides, proches de celles de la fin du Pléni-glaciaire supérieur.

Dans le bassin de la Somme et dans la basse vallée de la Seine, l'érosion des versants crayeux sous régime périglaciaire entraîne le colmatage du fond des vallées par des dépôts calcaires. Cette sédimentation traduit les conditions climatiques particulièrement froides du Dryas récent et l'accentuation des phénomènes de gel-dégel sur les versants dénudés. Ces dépôts calcaires, mis en place par solifluxion, sont remobilisés dans le fond des vallées par une dynamique fluviale

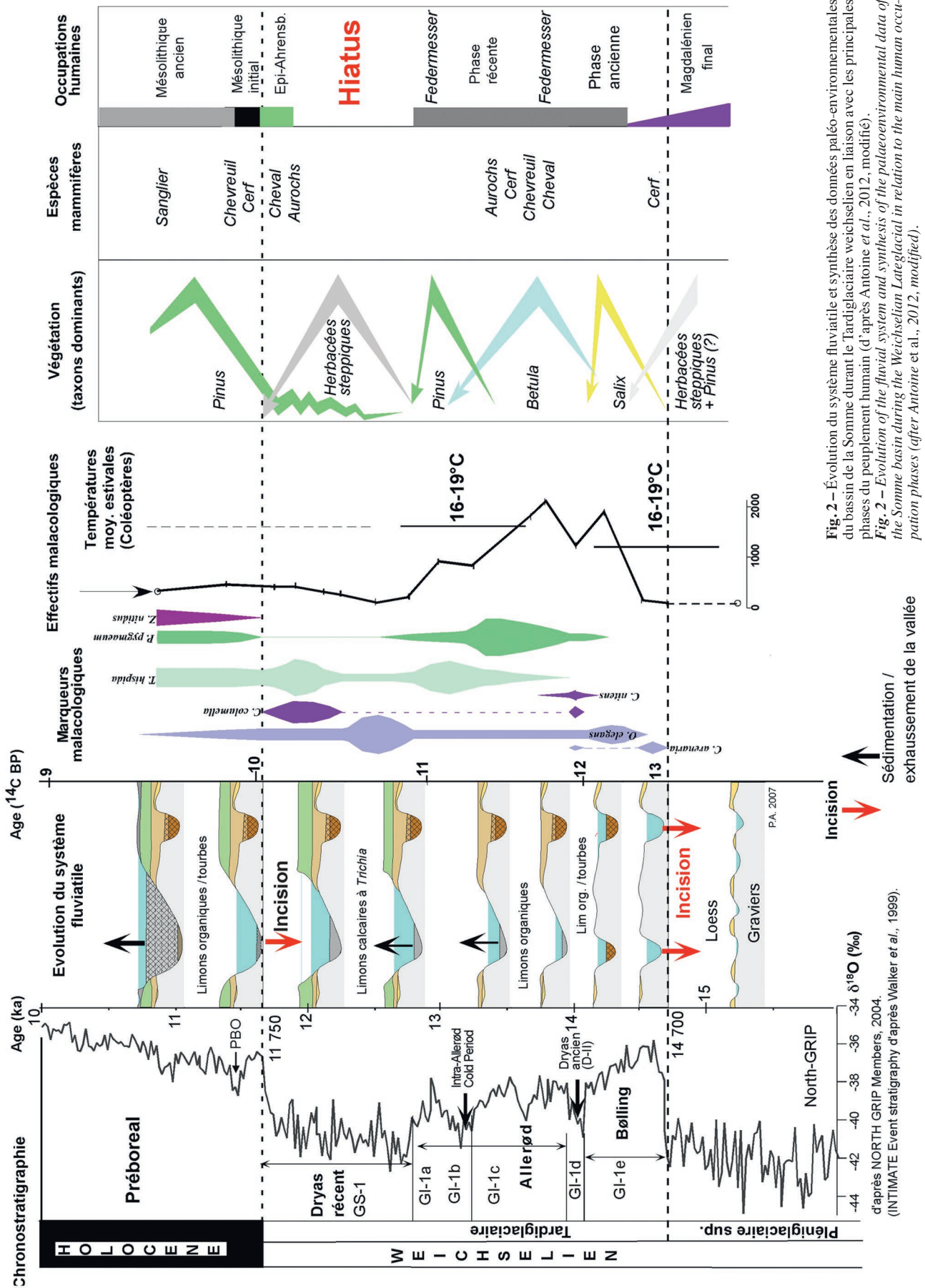


Fig. 2 – Évolution du système fluvial et synthèse des données paléo-environnementales du bassin de la Somme durant le Tardiglaciaire weichselien en liaison avec les principales phases du peuplement humain (d'après Antoine et al., 2012, modifié).
 Fig. 2 – Evolution of the fluvial system and synthesis of the paleoenvironmental data of the Somme basin during the Weichselian Lateglacial in relation to the main human occupation phases (after Antoine et al., 2012, modified).

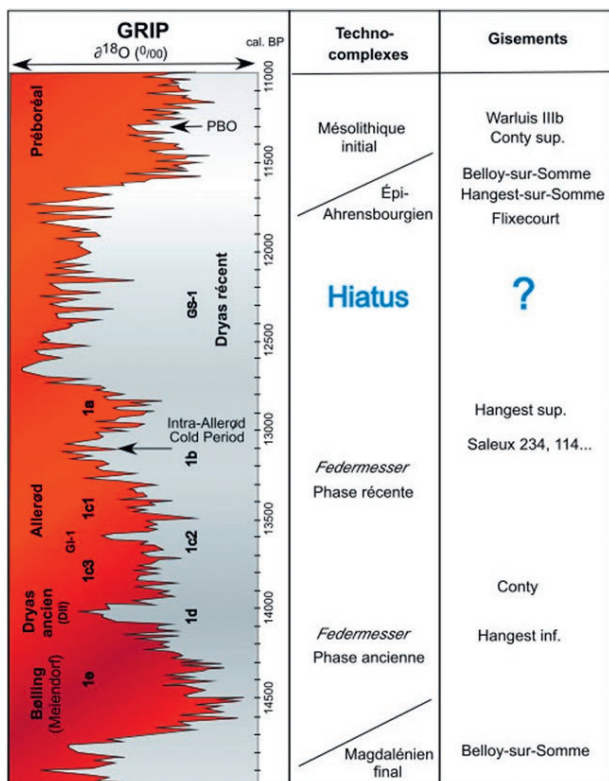


Fig. 3 – Occupations et hiatus archéologiques durant le Tardiglaciaire weichselien dans le bassin de la Somme en parallèle avec la courbe de GRIP (d’après North Greenland Ice Core Project Members, 2004).

Fig. 3 – Human occupations and archaeological gap in the Somme basin during the Weichselian Lateglacial in relation to the GRIP curve (based on North Greenland Ice Core Project Members, 2004).

marquée par une augmentation du rythme et de l’intensité des crues. L’importance de ces dépôts atteint et dépasse souvent un mètre d’épaisseur. Ce phénomène généralisé implique un rehaussement des plaines alluviales et une régularisation progressive qui aboutit à des surfaces quasiment planes. En dépit de 35 années de sondages et d’observations, aucune trace d’occupation humaine n’est perceptible dans ces dépôts pourtant favorables à un bon enregistrement des données archéologiques.

La réoccupation humaine de la région s’effectue à l’extrême fin du Dryas récent ou au tout début du Préboréal, vers 10000 BP (11500 cal. BP), avec la tradition épi-ahrensbourgienne (Ahrensbourgien final). La présence du Renne à Uxbridge en Angleterre (Lewis et Rackham, 2011) et de manière plus anecdotique à Alizay dans la vallée de la Seine (Bémilli *et al.*, 2014) pourrait témoigner de l’extrême fin du Dryas récent. Par contre, l’absence de faune froide dans les gisements de Belloy-sur-Somme et d’Hangest-sur-Somme (gisement II.1) où les spectres fauniques sont dominés par le Cheval et l’Aurochs (Chevallier *et al.*, 2014) pourrait infléchir pour une attribution des occupations archéologiques au tout début du Préboréal. Il faut cependant noter que les datations radiocarbone obtenues pour le Mésolithique initial des bassins de la Somme et de l’Oise sont de plus en plus anciennes et

se situent entre 9800 et 10000 BP, soit entre 11200 et 11500 cal. BP (Ducrocq, 2001, 2009 ; Ducrocq *et al.*, 2008 et ce volume). Le plateau radiocarbone de 10000 BP (11500 cal. BP) dont la durée est estimée à 500 ans ne facilite pas la compréhension fine de l’organisation de la période et nous empêche de ce fait de percevoir les transformations culturelles parfois très rapides et subtiles situées à la charnière entre le Tardiglaciaire et l’Holocène.

LES GISEMENTS EN BORDURE DE LA PLAINE ALLUVIALE : L’EXEMPLE DE BELLOY-SUR-SOMME

Le gisement de Belloy-sur-Somme est situé dans la vallée de la Somme, à une quinzaine de kilomètres au nord-ouest d’Amiens. Localisé dans l’auréole crayeuse du nord du Bassin parisien, il s’inscrit dans une région particulièrement riche en matériaux siliceux du Crétacé supérieur. Découvert à la fin du XIX^e siècle, le gisement de « La Plaisance » à Belloy-sur-Somme est bien connu dans la littérature archéologique par les fouilles que V. Commont entreprit avant la Première Guerre mondiale de 1907 à 1910 (Commont, 1913). Des recherches ont été menées plus récemment sur ce gisement classique du Paléolithique supérieur du bassin de la Somme de 1984 à 1992 (Fagnart, 1993).

Le gisement est établi sur la très basse terrasse de la Somme et domine de quelques mètres la plaine alluviale actuelle qui atteint dans ce secteur une largeur d’un kilomètre (fig. 4, n^o 1). Les vestiges archéologiques sont présents sur une distance de 250 m, parallèle à l’axe de la vallée, et sur une largeur de 20 à 30 m, soit une bande d’une superficie d’un peu moins d’un hectare. Les témoins lithiques sont particulièrement nombreux aux abords d’un petit vallon (« la Vallée à Cailloux ») qui incise le système de la très basse terrasse de la Somme. C’est également dans ce secteur que l’information stratigraphique est la mieux développée. De 1984 à 1992, environ 2000 m² ont été fouillés, dont 1624 m² d’un seul tenant aux abords immédiats de « la Vallée à Cailloux ». Dans ce vaste gisement occupé à plusieurs reprises au cours du Tardiglaciaire et de l’Holocène, les occupations de l’extrême fin du Paléolithique caractérisées par la présence de grandes lames au profil rectiligne se placent au sommet de la couverture limoneuse weichselienne de la très basse terrasse. Elles reposent directement sur un sol humifère légèrement organique (« le sol de Belloy-sur-Somme ») attribué à l’oscillation d’Allerød. Les limons calcaires du Dryas récent, absents sur le glaciaire de la très basse terrasse, se développent uniquement en position topographique plus basse dans la vallée (Fagnart, 1993).

Dans ce gisement localisé en bordure de la plaine alluviale, les décapages sur de grandes surfaces sont possibles car les occupations archéologiques ne sont pas noyées sous la nappe aquifère de fond de vallée (fig. 4, n^{os} 1 et 3). Les informations sur l’organisation spatiale sont directement et aisément accessibles contrairement aux autres gisements du bassin de la



Fig. 4 – Paléolithique final du bassin de la Somme. 1, vue aérienne du gisement de *La Plaisance* à Belloy-sur-Somme localisé en bordure de la plaine alluviale actuelle; 2, vue aérienne du gisement du *Marais* de Flixecourt situé sous la plaine alluviale actuelle. Les talus crayeux («larris») qui bordent la plaine alluviale constituent des gîtes importants pour l'acquisition des matériaux siliceux; 3, Belloy-sur-Somme, occupation épi-ahrensbourgienne : poste de taille (amas T5 de la section 151); 4, Belloy-sur-Somme (Épi-Ahrensbourgien) : remontage lithique du nucléus B145-S16-4487; 5, Belloy-sur-Somme (Épi-Ahrensbourgien) : remontage d'une série laminaire (dessin G. Leroy); 6, Pièce mâchurée du gisement épi-ahrensbourgien de Bettencourt-Saint-Ouen (dessin P. Alix); 7, détails macroscopiques de mâchures (esquillements bifaciaux et écrasements) de Flixecourt et de Belloy-sur-Somme (photos H. Plisson); 8, remontage d'une série laminaire de Belloy-sur-Somme témoignant du débitage alternatif de lames plates au profil rectiligne (dessin G. Leroy); 9, Flixecourt, *Le Marais* (Épi-Ahrensbourgien) : lames issues de la séquence de plein débitage.

Fig. 4 – Final Palaeolithic of the Somme basin. 1, aerial photograph of the *La Plaisance* site at Belloy-sur-Somme showing the location on the border of the present flood plain; 2, aerial photograph of the *Le Marais* site at Flixecourt located under the present flood plain. The cretaceous steep slopes ("larris") along the flood plain form important sources for the acquisition of good flint; 3, Belloy-sur-Somme (Epi-Ahrensbourgian occupation): workshop (concentration T5 in section 151); 4, Belloy-sur-Somme (Epi-Ahrensbourgian): refit group of core B145-S16-4487; 5, Belloy-sur-Somme (Epi-Ahrensbourgian): refit group showing a laminar blade sequence (drawing G. Leroy); 6, bruised blade from the Epi-Ahrensbourgian site of Bettencourt-Saint-Ouen (drawing P. Alix); 7, macroscopic details of invasive scalar retouch and distinct battering-damage (bruising) from the Flixecourt and Belloy-sur-Somme sites (photos H. Plisson); 8, refitted blade sequence from Belloy-sur-Somme showing bidirectional removal of flat and straight blades from regularly changing platforms (drawing G. Leroy); 9, Flixecourt, *Le Marais* (Epi-Ahrensbourgian occupation): blades originating from the main blade reduction sequence.

Somme profondément enfouis sous la plaine alluviale actuelle.

LES GISEMENTS ENFOUIS SOUS LA PLAINE ALLUVIALE ACTUELLE

À la fin des années 1980 et au début des années 1990, un ensemble de gisements profondément enfouis sous la plaine alluviale actuelle a été mis au jour (fig. 4, n° 2). Il s'agit principalement du gisement de Flixecourt révélé lors d'opérations de dragages et de curages de la Somme en 1985 et des gisements d'Hangest-sur-Somme dont la découverte, entre 1989 et 1992, est liée à l'ouverture d'une série de gravières destinées à exploiter les alluvions de la nappe weichselienne de fond de vallée (Fagnart, 1993). L'intérêt de ces gisements réside dans la bonne préservation des témoins lithiques et osseux dans des contextes sédimentaires bien plus développés que ceux étudiés dans les gisements localisés à la base des versants des principales vallées ou en bordure des plaines alluviales actuelles. Les données paléoenvironnementales (pollens, macrorestes végétaux, mollusques, insectes...) sont généralement bien préservées dans ces milieux humides.

Le seul inconvénient repose sur la présence à faible profondeur du niveau piézométrique de la nappe aquifère de fond de vallée qui limite considérablement les investigations archéologiques de terrain et ne permet pas d'effectuer des décapages extensifs comparables à ceux réalisés pour les gisements localisés en bordure des plaines alluviales actuelles. Par ailleurs, la protection des milieux humides et plus particulièrement la réglementation appliquée aux vallées tourbeuses n'autorise pas le rabattement par pompage de la nappe aquifère de fond de vallée dans le bassin de la Somme, ce qui est en revanche pratiqué dans les vallées voisines de l'Aisne et de l'Oise.

Les investigations archéologiques, menées dans des positions morphologiques variées, sont donc parfaitement complémentaires. Les gisements situés en bordure de la plaine alluviale actuelle apportent des informations sur la structuration de l'espace et la répartition spatiale des vestiges ; les gisements enfouis sous la plaine alluviale contribuent davantage à fournir des informations sur le paléoenvironnement et la chronostratigraphie des occupations paléolithiques.

UN APPROVISIONNEMENT EN MATÉRIAUX SILICEUX TRÈS SÉLECTIF

Dans le bassin de la Somme, les industries à grandes lames de la fin du Tardiglaciaire témoignent d'une acquisition très sélective en matériaux siliceux qui contraste avec les modes opératoires utilisés par les groupes de la tradition à *Federmesser* (ou aziliens) durant l'oscillation d'Allerød. Les derniers chasseurs paléolithiques ont privilégié systématiquement l'emploi du silex de la craie du Crétacé supérieur et plus

particulièrement celui du Turonien supérieur ou du Coniacien basal (« zone a » micropaléontologique établie par C. Monciardini à partir des foraminifères ; notice de la carte géologique d'Amiens au 1/50000^e, feuille XXIII-8, édition du BRGM, 1972). Il s'agit d'un silex de qualité, offrant de bonnes aptitudes à la taille, et présentant assez fréquemment un cortex de couleur rosée aisément identifiable. Il se présente sous la forme de gros rognons ou de grandes plaquettes dont les dimensions peuvent atteindre 35 à 45 cm de long. Ce critère dimensionnel semble avoir été particulièrement déterminant pour les Épi-Ahrensbourgiens dont l'objectif laminaire repose sur la production de grandes lames, larges et plates. Par contre, durant l'oscillation d'Allerød, les groupes appartenant à la tradition à *Federmesser* (ou aziliens) ont privilégié une acquisition moins exigeante en utilisant de préférence le silex du Coniacien b et c qui se présente sous la forme de blocs de dimensions beaucoup plus modestes (rognons d'une vingtaine de centimètres pour un poids compris entre un et deux kilogrammes).

Dans la vallée de la Somme, la craie du Coniacien basal constitue la couche la plus ancienne à l'affleurement. Dans le paysage actuel, les gîtes primaires d'acquisition du silex se trouvent à la base des coteaux crayeux qui bordent les vallées et qui peuvent atteindre une cinquantaine de mètres de haut dans le secteur de Flixecourt ou d'Hangest-sur-Somme (fig. 4 n° 2). La partie supérieure de ces versants abrupts, dénommés localement *larris*, est constituée par les étages plus récents du Crétacé supérieur (Coniacien b et c). La plupart des gisements épi-ahrensbourgiens de la fin du Tardiglaciaire ou du début de l'Holocène se situent généralement à proximité immédiate, ou à faible distance, de ces affleurements riches en matériaux siliceux où le choix entre différentes qualités de silex est rendu possible (Coniacien a). *A contrario*, l'absence de gisements dans la haute vallée de la Somme en amont de Corbie s'explique sans doute par la pauvreté en silex des différents étages de la craie.

Le choix d'une matière première très ciblée, offrant des possibilités de performance dans la production laminaire, par les derniers groupes paléolithiques tranche avec l'acquisition moins sélective des groupes à *Federmesser* qui ont occupé l'ensemble du territoire durant l'oscillation d'Allerød, mais également avec celle des premiers Mésolithiques du tout début du Préboréal.

LES CARACTÉRISTIQUES TECHNO-TYPOLOGIQUES DES ASSEMBLAGES

L'identité technique et typologique des assemblages à grandes lames de la fin du Tardiglaciaire est maintenant bien connue (Fagnart, 1997 ; Valentin, 1995, 2008 ; Valentin *et al.*, 2014 ; Valentin et Biard, ce volume ; Bodu, 2000 ; Bodu *et al.*, 1997). L'objectif principal du débitage réside dans la production de grandes lames au profil rectiligne (longueur des produits : 15 à 20 cm, mais pouvant atteindre 25 ou

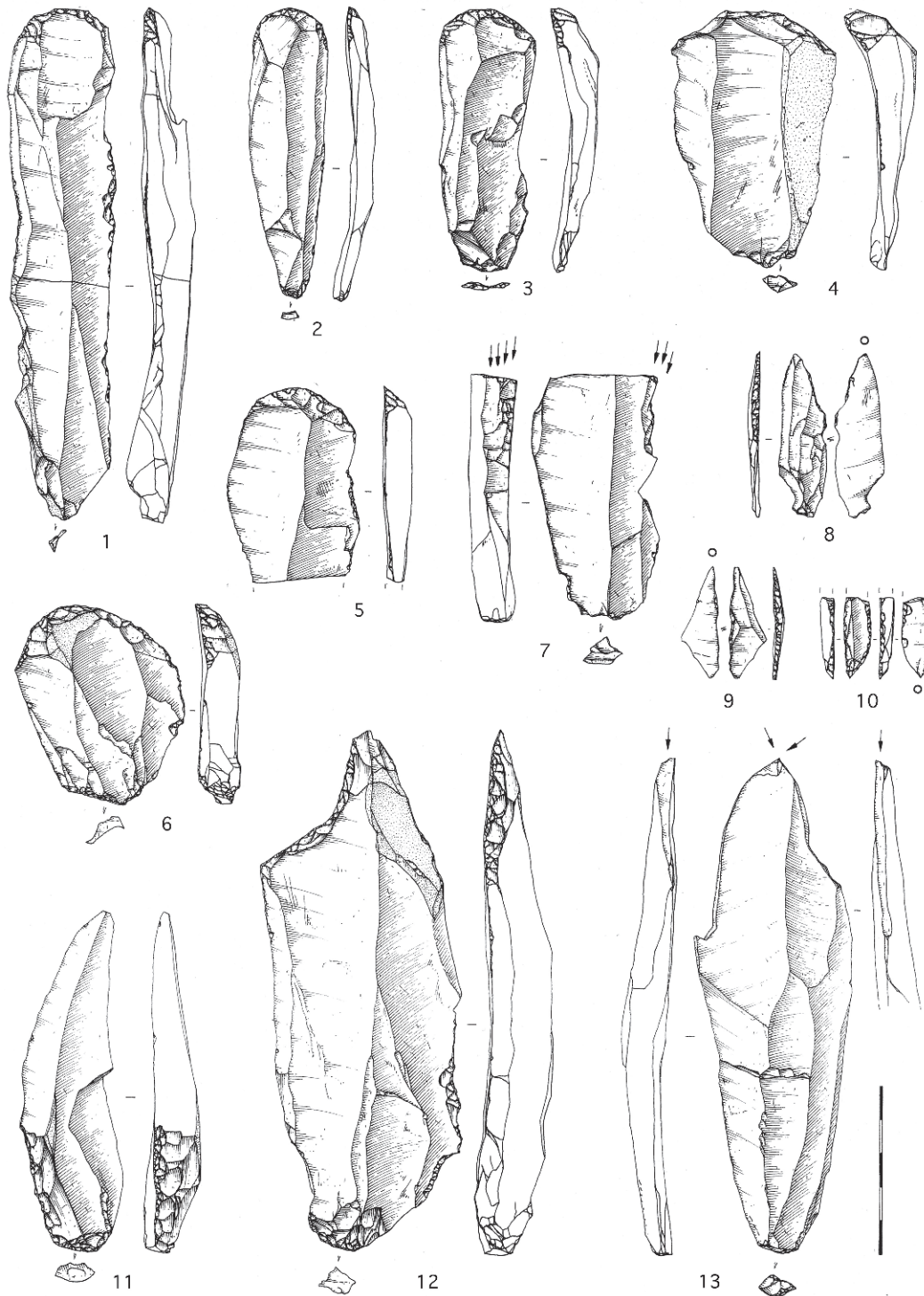


Fig. 5 – Belloy-sur-Somme, *La Plaisance* (Épi-Ahrensbourgien). Industrie lithique : 1-6, grattoirs ; 7, burin d'angle sur cassure ; 8-10, armatures ; 11, couteau à dos retouché partiel ; 12, lame tronquée ; 13, burin dièdre (dessins P. Alix).
Fig. 5 – Belloy-sur-Somme, *La Plaisance* (Epi-Ahrensbourgien). Lithic industry: 1-6, end-scrapers; 7, angle burin; 8-10, microliths; 11, partially retouched backed knife; 12, truncated blade; 13, dihedral burin (drawings P. Alix).

30 cm ; fig. 4, n° 9), mais également la production de petites lames et de lamelles à partir de petits volumes. Les processus mis en œuvre témoignent d'un haut savoir-faire technique avec une mise en forme élaborée des volumes à traiter et une exploitation menée à partir de deux plans de frappe ouverts dès le début de la

séquence de débitage (fig. 4 n°s 4 et 5). Les deux plans sont utilisés généralement selon un rythme alternatif afin de produire des supports rectilignes et d'éviter les accidents de taille sur des surfaces peu carénées (fig. 4, n° 8). Les bords des plans de frappe sont préparés avec soin par abrasion, piquetage ou doucissage. Initialisée

à partir de la face la plus étroite du bloc, la progression débitage est souvent dissymétrique et semi-tournante. Elle évolue souvent sur la face la plus large du bloc afin d'obtenir des produits larges et plats avec toutefois une certaine performance dans la recherche de la longueur (fig. 4, n° 9). Les exploitations symétriques sont cependant bien représentées en particulier à Belloy-sur-Somme (Valentin *et al.*, 2014). Les produits de la séquence initiale du débitage ne présentent pas une grande régularité, mais le plein débitage est nettement plus normalisé. Dans les gisements du bassin de la Somme, les petits volumes destinés à la production de petites lames et de lamelles sont traités selon le même mode de gestion que les grands volumes. La technique de percussion employée est caractéristique de la pierre tendre selon un geste tangentiel et un point d'impact situé en bordure du plan de frappe (Pelegrin, 2000 ; Valentin, 2000 ; Valentin *et al.*, 2014).

À Belloy-sur-Somme, comme dans la plupart des sites de production lithique, les supports transformés en outils sont très peu nombreux (Fagnart, 1997, 2009). Il s'agit de quelques burins dièdres ou sur troncature, de grattoirs sur longs supports laminaires ou de grattoirs sur lame raccourcie ou sur éclat (fig. 5). Les armatures sont particulièrement rares, mais il s'agit uniquement de pointes à troncature oblique qui soulignent des affinités septentrionales avec la phase la plus récente du technocomplexe ahrensbourgien.

LES ESPÈCES CHASSÉES

Les témoins osseux associés aux occupations de la fin Dryas récent ou du début du Préboréal ne sont pas nombreux dans le bassin de la Somme. Seuls les gisements de Belloy-sur-Somme et d'Hangest-sur-Somme II.1 ont livré des ensembles suffisamment significatifs (Fagnart, 1997 ; Chevallier *et al.*, 2014). Le Cheval et l'Aurochs dominant de manière souvent exclusive les spectres fauniques et les taxons froids, comme le Renne, sont absents. Cette association de grands herbivores semble par ailleurs traduire des conditions paléoécologiques et environnementales plus compatibles avec le début du Préboréal qu'avec la fin du Dryas récent.

Dans le secteur 113-117 du gisement de Belloy-sur-Somme, au moins cinq chevaux ont été abattus ; il s'agit de 2 sub-adultes et 3 adultes dont l'un de plus de 10 ans (Chevallier *et al.*, 2014). Ce petit secteur, très spécifique, d'environ 150 m², est isolé et se situe à une centaine de mètres de la zone la plus riche du site où paradoxalement les témoins osseux sont très rares, voire absents (secteur du vallon). Il est important de dissocier ces deux secteurs qui correspondent à des occupations éloignées dans l'espace et sans doute dans le temps. Différentes fonctions ont pu être établies pour le gisement particulièrement étendu de Belloy-sur-Somme selon les secteurs considérés. Dans l'état actuel de nos connaissances, il n'est malheureusement pas possible de préciser si ces fonctions distinctes (production de supports lithiques d'une part, et

acquisition et traitement de chevaux, d'autre part) correspondent à une même occupation motivée par plusieurs objectifs ou s'ils relèvent de séjours différents et d'activités distinctes. Aucun lien de stricte contemporanéité ne relie pour l'instant ces secteurs de fouilles éloignés les uns des autres. De même, dans le secteur du vallon où les activités sont orientées de manière quasi exclusive vers la production de supports lithiques, l'abondance des témoins lithiques suggère également que l'espace investi pourrait avoir été occupé à différentes reprises. En ce sens, le matériel recueilli pourrait représenter le bilan de plusieurs passages de tailleurs de silex espacés dans le temps.

LA FONCTION DES SITES ET LA QUESTION DES EMPORTS DE LAMES

La présence de sites spécialisés dans la production de supports lithiques apparaît liée aux régions où la matière première est particulièrement abondante et de bonne qualité, c'est-à-dire dans le nord de l'auréole crétacée du Bassin parisien (Picardie, Normandie), dans le bassin de Londres (Kennet Valley), ou encore dans les régions situées au contact avec les formations tertiaires (Donnemarie-Dontilly). Cette particularité ne se retrouve pas pour l'instant dans l'ouest de la France (Naudinot, 2010, 2013), ni en Belgique et aux Pays-Bas à l'est du domaine d'étude (Vermeersch, 2008 et 2011 ; Crombé *et al.*, 2014). Une des raisons de la segmentation de la chaîne opératoire de fabrication lithique réside peut-être dans le problème de transport de gros blocs qu'il est préférable de débiter sur place ou à proximité immédiate des gîtes d'acquisition du silex.

Durant l'oscillation d'Allerød, où la segmentation de la chaîne opératoire n'est pas attestée dans le bassin de la Somme, les tailleurs de silex de la tradition des groupes à *Federmesser* ont ciblé leur choix sur le silex des formations du Coniacien b et c. Il s'agit généralement de blocs peu volumineux d'une vingtaine de centimètres et pesant moins de deux kilogrammes. À la charnière du Dryas récent et du Préboréal, les Épi-Ahrensbourgiens ont en revanche systématiquement porté leur choix sur le silex des formations basales du Coniacien ou du Turonien supérieur dont la dimension des blocs est beaucoup plus importante (fig. 4, n° 4). Avec des rognons mesurant 35 à 45 cm et un poids atteignant les 4 ou 5 kg, la contrainte liée au transport et à l'acheminement apparaît particulièrement prégnante et les blocs sont généralement débités sur les lieux d'acquisition.

Les supports laminaires sélectionnés sont ensuite transportés pour un usage différé vers les sites d'habitat, mais aussi très vraisemblablement sur les lieux d'abattage de gros gibier ou encore pour compléter un équipement technique en couteaux de boucherie en vue d'un nouvel épisode de chasse (Bodu *et al.*, 2012). À ce jour, les sites résidentiels ne sont pas connus dans le bassin de la Somme. Ils sont par contre bien identifiés dans les régions voisines comme à Calleville en

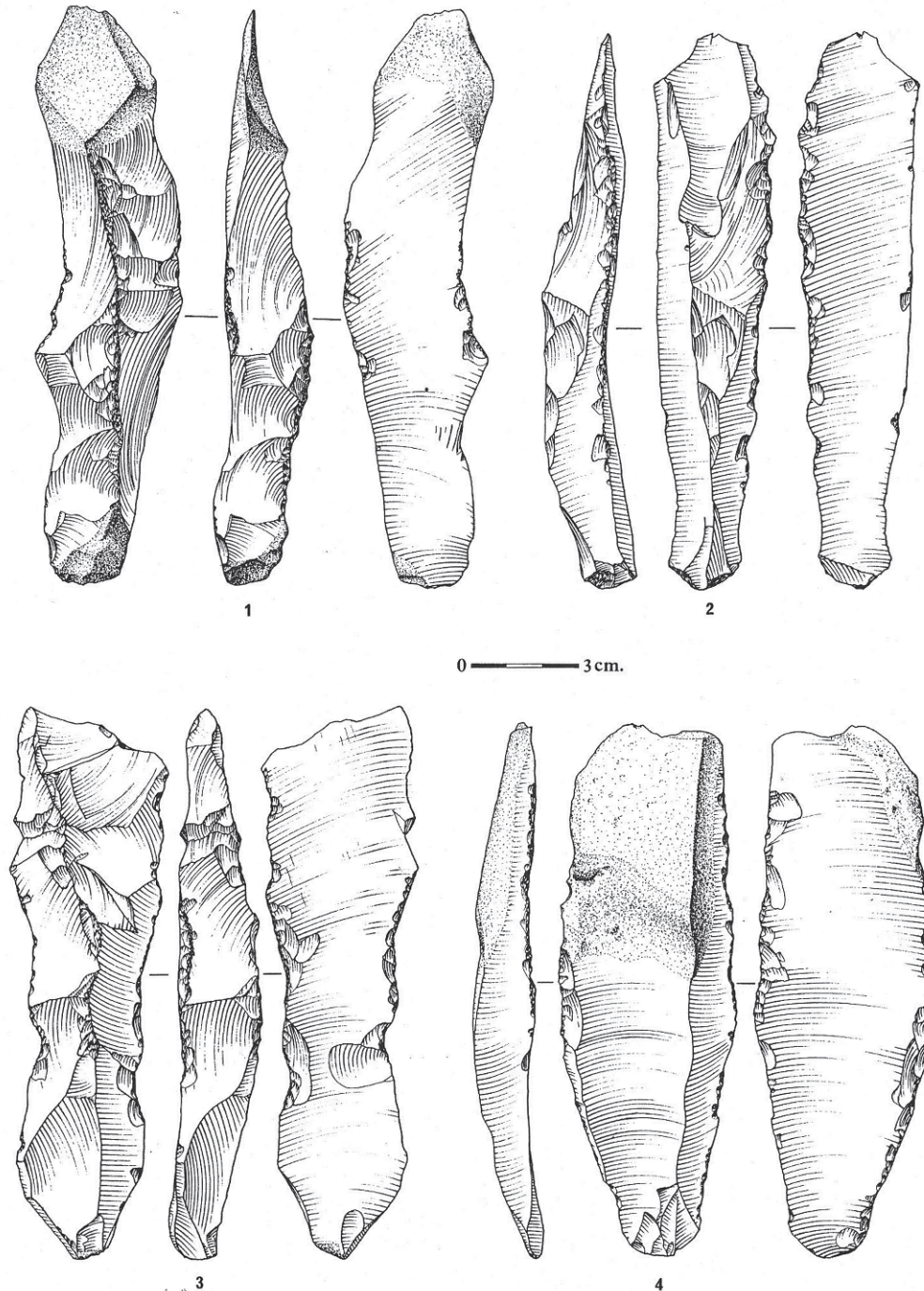


Fig. 6 – Flixecourt, *Le Marais* (Épi-Ahrensbourgien). 1 à 4 : lames mâchurées (dessins S. Lancelot).
Fig. 6 – Flixecourt, *Le Marais* (Epi-Ahrensbourgian). 1-4, bruised blades (drawings S. Lancelot).

Normandie (Biard et Hinguant, 2011 et 2013), à Uxbridge (Lewis et Rackham, 2011) ou à Launde (Cooper, 2006) en Grande-Bretagne ou encore à Gramsbergen aux Pays-Bas (Stapert, 2000; Johansen et Stapert, 2000). Les gisements découverts à ce jour dans la vallée de la Somme ne représentent donc qu'un segment de la chaîne économique. L'absence de sites résidentiels est sans doute provisoire et ne constitue qu'un état actuel de la recherche. Les sites à vocation

résidentielle existent très vraisemblablement et sont sans doute enfouis sous la plaine alluviale actuelle. L'interruption de l'exploitation des gravières situées en fond de vallée pour des raisons liées à la protection de l'environnement nous prive de l'accès à l'important potentiel archéologique enfoui dans ces zones humides sensibles. La découverte de nouveaux gisements susceptibles de documenter l'ensemble de la chaîne économique reste actuellement très problématique.

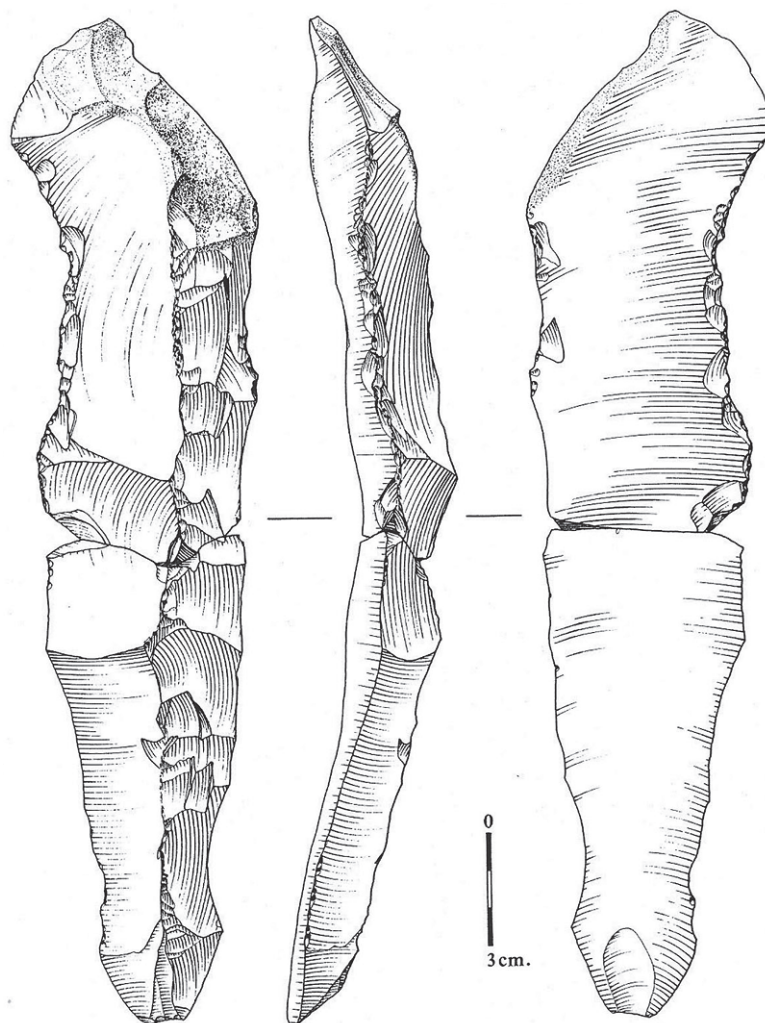


Fig. 7 – Hangest-sur-Somme, gisement II.2 (Épi-Ahrensbourgien). Grande lame à crête mâchurée (dessin S. Lancelot).

Fig. 7 – Hangest-sur-Somme, site II.2 (Epi-Ahrensbourgian). Long and large bruised crested blade (drawing S. Lancelot).

LES ÉLÉMENTS MÂCHURÉS : DES INDICATEURS AVANT TOUT TECHNIQUES

Les lames et éclats mâchurés constituent une grande composante des industries à grandes lames de la fin du Tardiglaciaire du bassin de la Somme. Ce sont des outils *a posteriori* dans la mesure où ils ne résultent pas d'un façonnage intentionnel, mais sont le produit d'une utilisation souvent opportuniste de supports bruts. Il s'agit très généralement de produits de seconde intention, issus de la séquence initiale du débitage (lames à crête, lames épaisses et peu régulières ou produits d'entretien de la surface laminaire). Les mâchures affectent généralement un ou deux bords le plus souvent en secteur mésial (85 % des cas). Elles se présentent sous la forme d'écrasements ou d'esquillements scalariformes avec fissurations du silex plus ou moins intenses (fig. 4, n° 7 et fig. 6 et 7). Les

études tracéologiques de H. Plisson et plus récemment de J. Jacquier témoignent souvent d'un contact violent avec une matière dure minérale, parfois abrasive (Fagnart et Plisson, 1997; Jacquier, 2014 et 2015). À Belloy-sur-Somme, mais également dans de nombreux gisements, l'association spatiale de ces objets à des postes de taille indique de manière évidente une action étroitement liée aux activités de débitage (fig. 8). À l'hypothèse initiale de la réfection des percuteurs en grès, il faut surtout ajouter l'abrasion ou le piquetage des plans de frappe, des corniches et très certainement des crêtes des nucléus en cours d'exploitation. Ces différents procédés techniques permettent aux tailleurs de nettoyer les aspérités et d'adoucir les angulations afin de se protéger les mains et d'établir un certain confort lors de la manipulation de volumes lourds et de grandes dimensions.

D'autres fonctions concernant l'utilisation des pièces mâchurées ont été proposées en particulier par N. Barton (1986a et b) en référence à l'étude du

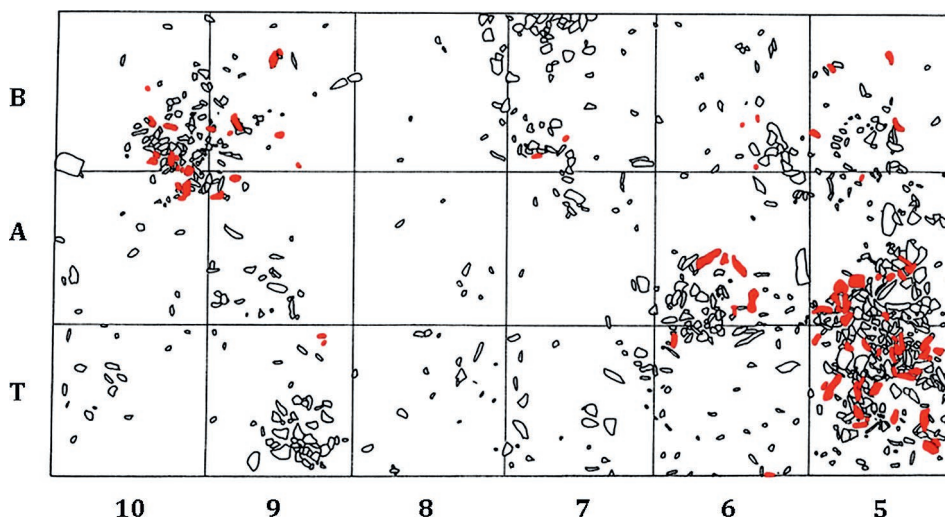


Fig. 8 – Belloy-sur-Somme, *La Plaisance* (occupation épi-ahrensburgienne). Plan partiel de répartition des vestiges illustrant la liaison étroite entre les pièces mâchurées et les postes de taille à la limite entre les sections 145 et 151. En blanc : produits de débitage et nucléus ; en rouge : éléments mâchurés.

Fig. 8 – Belloy-sur-Somme, *La Plaisance* (Epi-Ahrensburgian occupation). Distribution of the lithic industry showing the close relationship between bruised blades and workshops in sections 145 and 151. In white: debitage and cores; in red: bruised artefacts.

matériel du gisement de Stellmoor en Allemagne du Nord (Rust, 1943 et 1958). Il s'agit d'un contact avec un matériau assez tendre comme l'os ou le bois de cervidé. Cette activité a été confirmée récemment par les analyses tracéologiques réalisées sur le gisement de Calleville en Normandie (Jacquier, 2014; Biard et Hinguant dir., 2011 et 2013). L'utilisation des pièces mâchurées relève donc d'une explication plurielle et d'une certaine diversité de fonctionnement qui peut varier d'un site à l'autre. À Belloy-sur-Somme, dans le secteur du vallon où la fonction du site est nettement orientée vers les activités de taille, le travail de la pierre apparaît particulièrement exclusif dans l'utilisation des pièces mâchurées.

Les éléments mâchurés sont connus dans différentes traditions culturelles depuis l'Aurignacien jusqu'à la fin du Tardiglaciaire weichselien. Ces outils *a posteriori* sont cependant souvent associés au débitage de grandes lames à la pierre tendre et à la gestion de blocs de dimensions importantes. Leur présence ubiquiste dans un certain nombre de cultures du Paléolithique supérieur et du Paléolithique final témoigne de leur caractère davantage technique que culturel.

LA QUESTION DE L'ATTRIBUTION CULTURELLE DES ASSEMBLAGES

Comme pour les ensembles du sud-est de la Grande Bretagne (Barton, 1986a, 1989, 1991 et 1998; Barton et Dumont, 2000), les caractéristiques techniques et typologiques des industries à grandes lames de la fin du Tardiglaciaire ou du début de l'Holocène du Nord de la France présentent de fortes affinités avec la phase évoluée ou tardive de l'Ahrensbourgien, c'est-à-dire les assemblages attribués à l'Épi-Ahrensbourgien (Taute, 1968; Stapert, 2000; Johansen et Stapert,

2000; Terberger, 2006). C'est en effet avec les ensembles caractérisés par la présence de nombreuses pointes à troncature oblique, mais où les pointes pédonculées sont absentes ou rares, que les rapprochements sont les plus significatifs. Ces systèmes techniques situés à la charnière entre le Dryas récent et le Préboréal s'individualisent souvent par la présence de grandes lames et l'abondance de pointes à troncature oblique obtenues toutefois sans la technique du microburin. Certains assemblages comme Eersel-Panberg (Deeben *et al.*, 2000) présentent les modalités du débitage alternatif bien connu dans les gisements du Nord de la France et du Bassin parisien. La présence de nombreuses pointes à troncature oblique concave dans le gisement de Calleville en Normandie (Biard et Hinguant dir., 2011; Biard et Hinguant, 2013) témoigne de fortes analogies techno-typologiques et stylistiques avec les gisements britanniques comme Uxbridge (Lewis et Rackham, 2011) ou Launde (Cooper, 2006) en particulier dans la fabrication des armatures.

L'Ahrensbourgien classique à pointes pédonculées est daté de la chronozone du Dryas récent dans l'ouest de la grande plaine européenne et dans la zone des plateaux qui la limite au sud (Taute, 1968; Baales, 1996). Dans l'état actuel de nos connaissances, l'extension la plus occidentale de l'Ahrensbourgien dans sa phase classique se situe en Belgique dans le bassin mosan avec en particulier la grotte de Remouchamps (Dewez, 1974 et 1987). Durant le Dryas récent, le Nord de la France et les régions voisines connaissent un long hiatus d'un peu plus d'un millénaire. La réoccupation de cet espace géographique à l'extrême fin du Dryas récent ou au tout début du Préboréal est liée à une extension du territoire de l'Ahrensbourgien dans sa phase la plus récente vers l'ouest (Grande-Bretagne) et le sud-ouest (Nord de la

France, Bassin parisien). La datation précise de cette extension reste délicate en raison du plateau radiocarbone situé autour de 10000 BP (11 500 cal. BP). D'une durée d'environ 500 ans, ce plateau nous prive d'une compréhension fine de cette période cruciale où l'on assiste au basculement brutal des conditions climatiques froides de la fin du Tardiglaciaire vers celles nettement plus tempérées du début de l'Holocène. Dans certains gisements, la présence du Renne inciterait à placer les occupations à grandes lames à la fin du Dryas récent. Par ailleurs, les datations de plus en plus anciennes obtenues pour le Mésolithique initial, entre 9800 et 10000 BP (entre 11 200 et 11 500 cal. BP), pourraient corroborer cette attribution (Ducrocq, 2001 et 2009, Ducrocq *et al.*, 2008 ; Ducrocq, ce volume). Il n'est cependant pas exclu que l'Épi-Ahrensbourgien se place chronologiquement au tout début du Préboréal, lors la phase d'amélioration climatique qui précède immédiatement la petite oscillation froide du début du Préboréal (PBO) datée des environs de 9900 BP (11 300 cal. BP). Le problème actuel réside dans le fait que les datations obtenues par la méthode du radiocarbone ne sont malheureusement pas étayées et recoupées par d'autres variables établies à partir des données bio-climatiques. Le croisement entre les données radiocarbone et l'évolution du milieu naturel reste encore à préciser pour cette période.

Le terme *Belloisien* appliqué aux industries à grandes lames de la France septentrionale a d'abord été utilisé d'un point de vue strictement culturel en tant que vocabulaire d'attente (Fagnart, 1993, 1997 et 2009). Le terme a été étendu par la suite pour souligner et mettre en exergue certains aspects techniques, mais surtout économiques des assemblages (Valentin 1995, 2008, 2009 ; Valentin *et al.*, 2014). Le terme *Belloisien* est désormais largement utilisé dans la littérature archéologique, mais sous des acceptions parfois bien différentes. Les dénominations de plus vastes entités regroupées sous le vocable de « Regular Blades and Bladelets Industries » (Valentin, 2008 et 2009) ou plus récemment de « Flat Blades and Bladelets Technocomplexe » (Naudinot, 2010 ; Naudinot et Jacquier, 2014 ; Jacquier et Naudinot, 2015 ; Naudinot *et al.*, 2017) sont plus globalisantes et privilégient les objectifs de taille et la production de supports. Elles présentent l'avantage de regrouper au sein d'un même technocomplexe des cultures différentes comme l'Épi-Laborien et l'Épi-Ahrensbourgien qui partagent effectivement des caractères techniques et économiques communs. Cependant, le terme *Belloisien*, pourrait continuer à désigner – de manière restrictive – les différentes expressions culturelles liées à l'extension tardive de l'Ahrensbourgien dans les régions de la France septentrionale situées au nord de la vallée de la Loire.

CONCLUSIONS

Après une occupation humaine relativement importante durant l'oscillation d'Allerød par les groupes de chasseurs de la tradition *Federmesser* (ou Azilien), le

Nord de la France semble connaître une période de hiatus dans le peuplement de plus de 1000 ans durant le Dryas récent. Ce déclin brutal de l'occupation humaine que l'on retrouve sur une partie de l'Europe du Nord-Ouest semble lié à la mise en place de nouvelles conditions écologiques et environnementales lors de la dernière péjoration climatique du Tardiglaciaire weichselien.

Vers 10000 BP (11 500 cal. BP) à la charnière entre le Dryas récent et le Préboréal, la région est de nouveau occupée de manière significative par des groupes humains qui se caractérisent par la production de grandes lames plates, au profil bien rectiligne, associées à un débitage lamellaire. La forte unité technologique et économique qui se dégage de ces ensembles témoigne d'un haut degré de savoir-faire des tailleurs de silex. Dans le bassin de la Somme, cette ultime tradition technique du Paléolithique se singularise par la présence de nombreux gisements spécialisés dans l'acquisition de la matière première et la production de supports lithiques. Ces aires dévolues à la taille du silex sont parfois associées à des zones d'activités liées au travail de boucherie (abattage et découpe primaire de chevaux ou d'aurochs). À ce jour, aucun site à vocation domestique témoignant d'une occupation prolongée n'a été découvert dans la région étudiée. Les sites résidentiels, connus dans les régions et pays voisins, restent encore à découvrir. La présence quasi-exclusive de pointes à troncature oblique dans le corpus des armatures rattache ces ensembles aux traditions techniques septentrionales et plus particulièrement à la phase la plus récente du technocomplexe ahrensbourgien.

Les occupations archéologiques du Nord de la France s'inscrivent dans la phase tardive de l'extension vers l'ouest et le sud-ouest de la tradition ahrensbourgienne à l'extrême fin du Dryas récent ou au tout début du Préboréal. Ce phénomène d'extension s'effectue très vraisemblablement dans un intervalle de temps très court. Alors que le centre du Bassin parisien se situe au carrefour de diverses influences entre le monde septentrional (Épi-Ahrensbourgien) et méridional/atlantique (Épi-Laborien), le bassin de la Somme et le Nord de la France se situent résolument dans la sphère d'influence du monde septentrional à l'image de ce que sera le Mésolithique ancien régional.

Le terme *Belloisien*, utilisé depuis un peu plus d'une vingtaine d'années dans la littérature archéologique, parfois sous des acceptions différentes, pourrait cependant continuer à désigner, d'un point de vue culturel, les différentes composantes de l'extension géographique tardive de la tradition ahrensbourgienne (Épi-Ahrensbourgien ou Ahrensbourgien final) dans les régions septentrionales de France situées au nord de la vallée de la Loire.

La transition vers le Mésolithique régional, aux environs de 9800 BP (11 200 cal. BP), est longtemps apparue comme une rupture technologique et socio-économique assez brutale entre les productions laminaires très exigeantes du Paléolithique final et les débitages plus simplifiés de grandes lames du début

du Mésolithique, ou le débitage à vocation plus exclusivement lamellaire de certains gisements. D'un point de vue fonctionnel, cette rupture était également bien perceptible dans l'importance accordée par les Mésolithiques au travail des végétaux qui n'apparaît que de manière très sporadique durant le Paléolithique final (Guéret, 2013 ; Jacquier, 2015). La découverte des gisements de Warluis, dans l'Oise et du niveau supérieur de Conty, dans la Somme, a cependant révélé la présence d'armatures mésolithiques obtenues par la technique du microburin clairement associées à des débitages aux conceptions volumétriques témoignant d'une exigence qui rappellent les toutes dernières

industries du Paléolithique final. Ces ensembles du Mésolithique initial évoquent la présence de faciès transitionnels que les recherches futures permettront de mieux caractériser (Ducrocq *et al.*, 2008 ; Ducrocq, ce volume ; Coudret et Fagnart, 2012).

La spécialisation des sites représente un trait économique fort des sociétés de l'extrême fin du Paléolithique du bassin de la Somme. En opposition avec le modèle de mobilité résidentielle propre aux groupes de chasseurs de l'oscillation d'Allerød, le système économique qui caractérise la transition entre le Dryas récent et le Préboréal apparaît de plus en plus clairement de nature logistique. ■

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Mésolithique initial et Mésolithique ancien en France septentrionale à Warluis (Oise)

Thierry DUCROCQ

Résumé : L'étude des sites mésolithiques inscrits dans les plaines alluviales tourbeuses du bassin de la Somme a permis de préciser sensiblement la chronologie du début du Mésolithique avec de nombreuses données sur des assemblages microlithiques à segments et pointes à base retouchée (Beuronien à segments) calées à la fin du Préboréal et au début du Boréal. Cependant, les informations sur la plus grande partie du Préboréal sont restées plus lacunaires en raison de la profondeur d'enfouissement des niveaux très nettement sous le niveau de la nappe aquifère. Quelques observations ont tout de même abouti à la découverte d'industries à pointes à base non retouchée parfois associées à des outils massifs sur blocs en forme de hache ou d'herminette. Le gisement de Warluis (Oise) dans la vallée du Thérain fait exception avec des niveaux archéologiques bien conservés et accessibles. Il met aussi en évidence de sensibles différences techno-typologiques au sein du Mésolithique ancien qui seraient dues à des positions chronologiques légèrement distinctes. Ces industries lithiques produisent des lame(lle)s relativement régulières extraites par percussion directe à la pierre. Elles sont clairement plus anciennes que le Beuronien à segments qui est aussi présent à Warluis. Le Mésolithique avec des armatures microlithiques, des microburins et une production de petites lames (lamelles) apparaît entre environ 11 800 et 11 200 cal. BP sur le site de Warluis IIIb. La production lamellaire est particulièrement soignée et la question d'une chaîne opératoire laminaire distincte reste ouverte. Le spectre microlithique est dominé par des petites pointes à base non retouchée, mais il compte aussi des triangles et des pointes à base retouchée particulières. Cette industrie lithique aurait autrefois été attribuée à l'Épiahrensbourgien au sens d'A. Gob (1988). Ce Mésolithique initial est la manifestation locale d'un processus qui touche toute l'Europe occidentale. Un autre secteur de Warluis (Warluis V) livre un ensemble un peu plus récent daté aux environs de 11 000 cal. BP. Une seule chaîne opératoire laminaire est décelée. Elle conduit à une variété de dimensions par simple réduction laminaire. Les armatures sont uniquement des pointes à troncature oblique obtenues par le procédé du microburin. De nombreux grattoirs et burins sont réalisés sur des supports variés. Des outils massifs de type herminette sont attestés. Cette industrie est très similaire à plusieurs industries lithiques du Mésolithique nordique qui sont parfois qualifiées de Maglemosien ancien. Ces subdivisions évoquent également celles faites en Grande-Bretagne avec le groupe de Star Carr (Warluis IIIb), le groupe de Deepcar (Warluis V) et le groupe de Horsham (Beuronien) (Reynier, 2005).

Mots-clés : Mésolithique initial, Mésolithique ancien, Préboréal, Chronologie, Maglemosien, Beuronien, Nord de la France, Plaine alluviale, Archéologie préventive.

Abstract: The study of the Mesolithic sites from the peat alluvial plains of the Somme basin made it possible to specify the chronology of the early Mesolithic period with numerous data on microlithic assemblages with crescents and points with retouched base (Beuronian with crescents) dated to the end of the Preboreal and the early Boreal.

However, information on the longest part of the Preboreal has remained scarce because the Mesolithic levels are deeply buried beneath the water table. Some observations have nonetheless led to the discovery of industries characterized by points with unretouched base, sometimes associated with massive ax-shaped or adze-shaped tools. The site of Warluis (Oise – France), in the Thérain valley, is an exception with well-preserved and accessible archaeological levels. It also reveals significant techno-typological differences within the ancient Mesolithic that would be due to slightly different chronological positions. These lithic artefacts include relatively regular blade(lets) extracted by direct percussion with a soft stone. They are clearly older than the Beuronian with crescents, which is also present at Warluis. The Mesolithic with microliths, microburins and a production of small blades (bladelets) appears between circa 11 800 and 11 200 cal. BP on the site of Warluis IIIb. The production of bladelets is particularly elaborated. It is possible that the production of blades results from another "chaîne opératoire". The microlithic spectrum is dominated by small points with unretouched base, but it also has triangles and points with retouched base. This lithic assemblage would have been previously assigned to

the Epiahrensburgian in the sense of A. Gob (1988). This initial Mesolithic is the local manifestation of a process that affects all of Western Europe. Another area of Warluis (Warluis V) delivers a slightly newer set dated at about 11 000 cal. BP. Only one "chaîne opératoire" was detected. Blades and bladelets were produced successively during the core reduction. The microliths are only points with unretouched base. The oblique truncation is obtained by the microburin fracturing process. Many end scrapers and burins are made on various lithic blanks such as flakes and blades. Big tools such as adzes are also present. This lithic assemblage is close to a series of several sites of the Nordic Mesolithic which are sometimes described as Early Maglemosian. These subdivisions also evoke those made in Great Britain with Star Carr-type Assemblages (Warluis IIIb), Deepcar-type Assemblages (Warluis V) and Horsham's Group (Reynier, 2005).

Keywords: Initial Mesolithic, Early Meso lithic, Preboreal, Chronology, Maglemosian, Beuronian, Northern France, Alluvial plain, Rescue archaeology.

INTRODUCTION

Le passage du Paléolithique au Mésolithique dans le Nord de la France et les régions voisines est généralement interprété comme une évolution sur place de l'Ahrensbourgien, surtout marquée par le remplacement des pointes pédonculées et des pointes de Zonhoven par des assemblages microlithiques dominés par des pointes à base non retouchée obtenues par le procédé du microburin (Rozoy, 1978 ; Gob, 1988 ; Vermeersch, 2008). La pointe de Zonhoven est une pointe à tronçature plus ou moins oblique sur lame ou lamelle obtenue sans la méthode de fracturation du microburin. La production de grandes lames est aussi abandonnée au profit de plus petits produits laminaires (lamelles) supports d'éléments microlithiques de projectile. Cependant, aucun site ahrensbourgien n'a été clairement identifié dans le nord de la France. La fin du Paléolithique y est représentée par des industries à grandes lames et éléments mâchurés datés de la fin du Dryas récent ou du début du Préboréal et parfois qualifiés d'Épiahrensburgien (Fagnart, 1997 et 2009) dans un sens plus restreint que celui de A. Gob (1988). En raison de possibles mélanges de vestiges et aussi d'un nombre limité d'objets, la typologie des éléments de projectile est difficile à préciser, mais il semble acquis (Fagnart, 2009) qu'elle comprenne des pointes à tronçature oblique mais pas de microburin.

Dans toutes ces régions, la date d'apparition des toutes premières industries lithiques mésolithiques est imprécise. En Belgique et dans le sud des Pays-Bas, il existerait, pour le moment, un hiatus chronologique entre la fin du Paléolithique et le début du Mésolithique faute de site daté du Mésolithique initial (Crombé *et al.*, 2014). En Île-de-France, ce hiatus existe aussi, mais il est moins grand car le gisement du secteur IV des Closeaux (Lang et Sicard, 2008) y est bien daté du milieu du Préboréal. Les microlithes comptent essentiellement des pointes à tronçature oblique et des microburins. Des sortes de haches ou herminettes taillées sur bloc y sont bien attestées.

Le présent travail essaye de documenter les premières industries mésolithiques du Nord de la France en examinant rapidement les quelques données disponibles sur le bassin de la Somme puis en s'intéressant plus particulièrement au gisement de Warluis

dans l'Oise (Ducrocq *et al.*, 2008). Ce dernier compte plusieurs concentrations datées du Préboréal. Certaines montrent la précocité du Mésolithique avec des microlithes, des microburins et une production de petites lames qui apparaît entre, environ, 11 800 et 11 200 cal. BP. Il met aussi en évidence de sensibles différences techno-typologiques au sein du Mésolithique ancien qui seraient dues à des positions chronologiques légèrement distinctes. L'approche est ici restreinte à des considérations techno-typologiques sur les sites de Warluis IIIb et Warluis V.

LES DONNÉES DISPONIBLES SUR LE MÉSOLITHIQUE DU PRÉBORÉAL EN FRANCE SEPTENTRIONALE (HAUTS-DE-FRANCE) AVANT LA FOUILLE DE WARLUIS

Bien que le nord de la France ait une importance historique pour la reconnaissance de la période mésolithique avec les gisements éponymes du Tardenois (fig. 1 ; Rozoy, 1994), les connaissances sur son insertion chronologique et son évolution interne sont restées longtemps restreintes en raison de fouilles limitées au substrat sableux impropre à la conservation de séquence stratigraphique et de matière organique. Avec le recul, on peut actuellement interpréter la plupart des séries lithiques issues de ces sites comme des mélanges d'industries imputables à de multiples fréquentations diachroniques.

À la fin des années quatre-vingt, les recherches se sont orientées vers les plaines alluviales tourbeuses pour obtenir de meilleures conditions de conservation. Les opérations se sont d'abord focalisées sur des gisements très denses comme Thennes « Le Grand Marais I » qui se sont avérés être des points particulièrement attractifs pendant tout le Mésolithique. Il en a résulté de nouveau des séries lithiques mélangées. Cependant, des états physiques correspondant à des caractéristiques technotypologiques distinctes ont permis de scinder ces ensembles en un certain nombre de lots apparemment cohérents. Ainsi une industrie lithique très patinée du site de Thennes a été clairement individualisée et attribuée au Mésolithique ancien local (Ducrocq, 1989). Le spectre microlithique largement dominé par des pointes à tronçature oblique

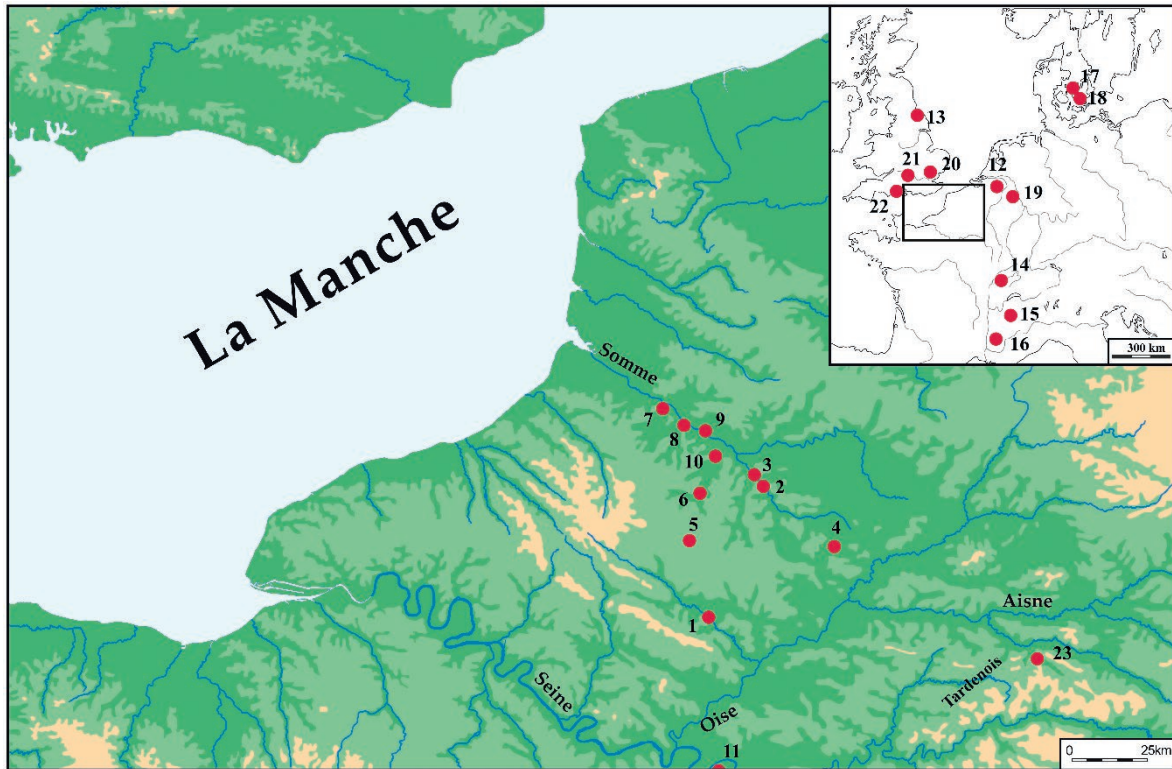


Fig. 1 – Localisation des gisements cités dans le texte. Warluis (1), Thennes (2), Hailles (3), Boulogne-la-Grasse (4), Lihus (5), Conty (6), Hangest-sur-Somme (7), Crouy-Saint-Pierre (8), Belloy-sur-Somme (9), Amiens-Renancourt (10), Rueil-Malmaison (11), Geldrop (12), Star Carr (13), Choisey (14), La Fru (15), Le Sansonnet (16), Vig (17), Barmose I (18), Bedburg-Königshoven (19), Broxbourne (20), Thatcham (21), Hengistbury-Head (22) et Rosnay (23); (T. Ducrocq, Inrap).

Fig. 1 – Location of the sites mentioned in the text. Warluis (1), Thennes (2), Hailles (3), Boulogne-la-Grasse (4), Lihus (5), Conty (6), Hangest-sur-Somme (7), Crouy-Saint-Pierre (8), Belloy-sur-Somme (9), Amiens-Renancourt (10), Rueil-Malmaison (11), Geldrop (12), Star Carr (13), Choisey (14), La Fru (15), Le Sansonnet (16), Vig (17), Barmose I (18), Bedburg-Königshoven (19), Broxbourne (20), Thatcham (21), Hengistbury-Head (22) and Rosnay (23) (T. Ducrocq, Inrap).

associées à des points à base retouchée atypiques et de rares géométriques (fig. 2) s'accordait bien alors à la perception des premières industries mésolithique décrites comme dérivant de l'Ahrensbourgien (Rozoy, 1978) avec comme caractéristique principale l'abondance des points à base non retouchée (Gob, 1988). Ce critère de la large domination des points à base non retouchée a permis de proposer un âge équivalent à trois autres séries : Boulogne-la-Grasse, Lihus I et Hailles (Ducrocq, 2001). Elles comptent parfois de nombreux segments mais toujours beaucoup de pointes à troncature oblique obtenues par le procédé du microburin.

Avec la surveillance de travaux dans le fond de la moyenne vallée de la Somme, entre Amiens et Abbeville, des corpus lithiques et fauniques ont été recueillis ainsi que des données paléoenvironnementales. Les vestiges sont inclus dans des limons organiques scellés par des tourbes franches. Le laps de temps entre l'abandon des objets et son recouvrement par les tourbes est variable suivant la paléotopographie et la vitesse du colmatage. Ce fait peut encore conduire dans certain cas à des palimpsestes qu'il faut décrypter. On peut inversement collecter des ensembles nettement plus homogènes quand les vestiges ont été scellés

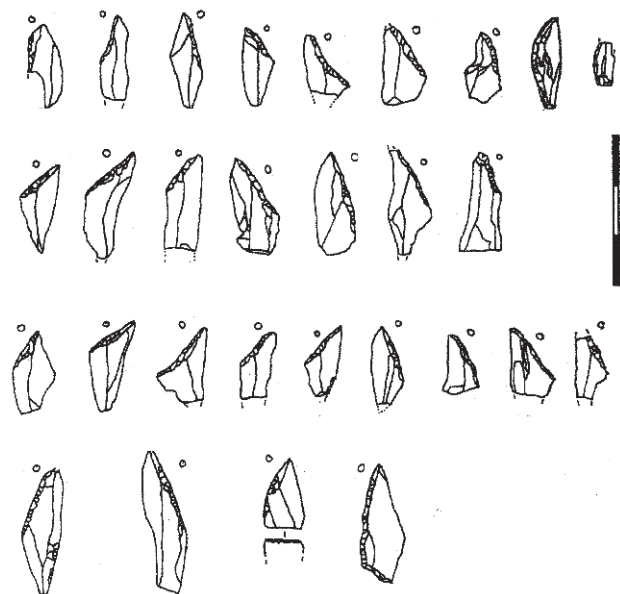


Fig. 2 – Armatures de la série très patinée de Thennes « Le Grand Marais I » (T. Ducrocq, Inrap).

Fig. 2 – Microliths of the very patinated assemblage of Thennes « Le Grand Marais I » (T. Ducrocq, Inrap).

rapidement. Diverses analyses palynologiques des formations organiques ont révélé des enregistrements discontinus dans cette plaine alluviale, mais certains ont permis de reconstituer l'environnement végétal du début de l'Holocène (Munaut et Defgnée, 1997) en identifiant les palynozones 5 et 6 de Van Zeist et Van Der Spoel-Walvius (1980) grossièrement corrélables avec la chronozone du Préboréal. Une première phase est largement dominée par le bouleau puis le pin avant l'essor du noisetier dans un milieu qui se ferme progressivement. La malacofaune enregistre le réchauffement climatique holocène qui entraîne le développement du couvert forestier avec l'apparition des thermophiles aux environs de 11 500 cal. BP (Limondin-Lozouet, 1997).

Les recherches dans cette portion de vallée ont surtout permis d'identifier les assemblages à segments et pointes à base retouchée qui datent de la fin du Préboréal et du début du Boréal entre 10 500 et 9 500 cal. BP (site de Hangest II N; Ducrocq, 2001) et du début de la palynozone 7 (début Boréal) à Crouy-Saint-Pierre (Ducrocq, 2001). Depuis, ces ensembles parfois qualifiés de Beuronien à segments ont été reconnus sur de nombreux gisements régionaux bien datés (Ducrocq, 2013). Par ailleurs, la moyenne vallée de la Somme a aussi fourni des informations déterminantes sur le Paléolithique terminal à longues lames et éléments mâchurés qui est calé à la fin du Dryas récent ou au tout début de l'Holocène, autour de 10 800 cal. BP notamment à Belloy-sur-Somme et Hangest-sur-Somme (Fagnart, 1997, 2009). Les indices d'occupations intercalées chronologiquement entre ces deux ensembles espacés d'environ 1 000 ans (de 11 500 à 10 500 cal. BP) sont restés ténus sauf à Hangest-sur-Somme où deux concentrations de vestiges (Hangest « Etang » et Hangest « Gravière II3 »; Ducrocq, 2001) ont livré quelques microlithes uniquement représentés par des pointes à troncature oblique effilées obtenues par le procédé du microburin (fig. 3). Ces ensembles lithiques comptent aussi des outils massifs sur bloc assimilables à des sortes d'herminettes (fig. 3). Malheureusement, ces séries ont été recueillies dans des mottes de sédiments extraites lors de travaux de terrassement. En effet, l'enfouissement des niveaux nettement sous le sommet de la nappe phréatique n'a pas permis d'observations précises.

Plusieurs diagnostics menés dans la vallée de la Selle, l'un des principaux affluents de la Somme, ont abouti à la collecte de quelques artefacts lithiques à la base de la séquence holocène vers 11 400 cal. BP non calibré. Ainsi, quelques pièces datées sur Amiens-Renancourt (Ducrocq, 2001) révèlent un débitage lamellaire pratiqué à partir d'un type de silex absent des séries du Paléolithique terminal régional.

Un autre type d'information provient du niveau supérieur de la gravière du marais de Conty qui correspond à quelques pièces lithiques dispersées et deux amas de débitage positionnés au sommet des limons gris blanchâtre du Dryas récent juste sous des dépôts d'époque romaine (Antoine *et al.*, 2012). Un débitage lamellaire et deux microburins permettent une attribution au Mésolithique. La probable coexistence de deux

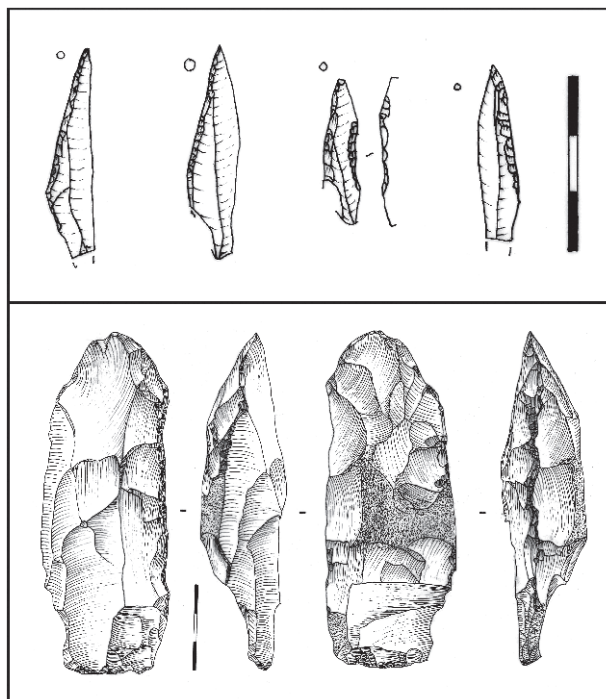


Fig. 3 – Armatures et «herminette» de Hangest «Gravière II3» (T. Ducrocq, Inrap).

Fig. 3 – Microliths and adze of Hangest «Gravière II3» (T. Ducrocq, Inrap).

chaînes opératoires, l'une laminaire proche des méthodes observées dans les industries à pièces mâchurées, l'autre lamellaire avec un débitage soigné à partir de nucléus à table plate et crête postéro-latérale, orientent vers une phase initiale du Mésolithique (Coudret et Fagnart, 2012).

DONNÉES GÉNÉRALES SUR LE DÉBUT DE L'Holocène À WARLUIS

Le gisement de Warluis correspond à une carrière de graviers d'une quarantaine hectares inscrite dans la plaine alluviale tourbeuse du Thérain qui est un affluent de l'Oise (fig. 1). Une succession de fouilles préventives y a été menée entre 2000 et 2006 (Ducrocq *et al.*, 2008). Les grandes lignes stratigraphiques sont caractéristiques des vallées tourbeuses avec des industries lithiques incluses dans des limons intercalés entre la nappe de graviers et les tourbes de colmatage (Coutard *et al.*, 2010).

L'intérêt de ce secteur est d'abord la minceur des sédiments récents et des tourbes. L'âge de ces dernières est également un atout avec des tourbes préboréales développées dans des chenaux puis une extension des tourbes boréales sur une large surface qualifiée de zone basse. Cette dynamique sédimentaire a permis la conservation de plusieurs concentrations de vestiges du Préboréal dans des limons organiques recouverts par les tourbes. La partie inférieure de ces limons

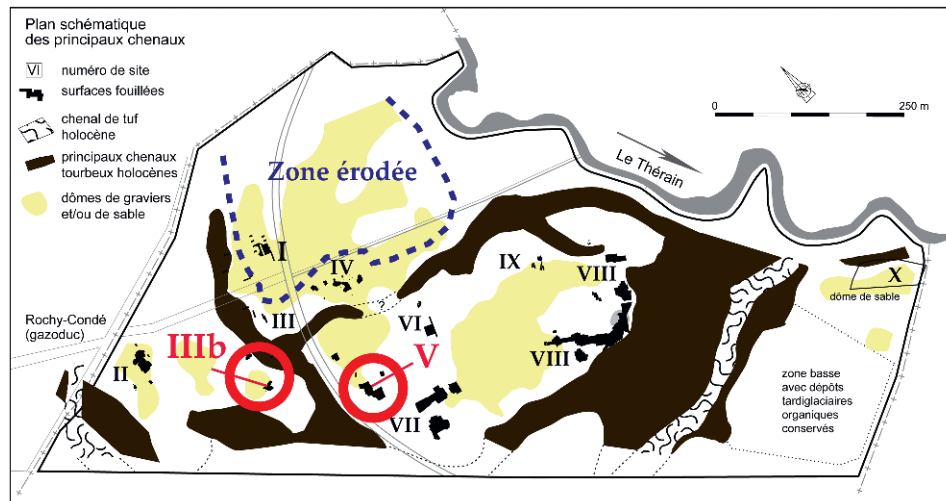


Fig. 4 – Localisation de Warluis IIIb et Warluis V (S. Coutard et T. Ducrocq, Inrap).
 Fig. 4 – Location of Warluis IIIb and Warluis V (S. Coutard and T. Ducrocq, Inrap).

contient des silex taillés attribuables au Paléolithique à *Federmesser* (Azilien) qui sont aisément différenciables des vestiges mésolithiques par leur forte patine. Ensuite le colmatage tourbeux se poursuit sur des surfaces légèrement plus hautes qui livrent essentiellement du Beuronien à segments. Enfin, l'érosion des secteurs un peu plus élevés explique l'absence des industries lithiques à feuilles de gui et du Mésolithique à trapèzes.

Les analyses palynologiques de C. Leroyer (Coutard *et al.*, 2010) sur le colmatage tourbeux d'un chenal révèle une partie inférieure largement dominée par le pin qui est attribuable au Préboréal. Elle est subdivisée en deux avec d'abord un cortège pin-bouleau qui laisse ensuite la place à l'association pin-noisetier. La raréfaction progressive des herbacées héliophiles témoigne de la densification du boisement.

Les analyses malacologiques de N. Limondin (Coutard *et al.*, 2010) sur les limons de la zone basse, notamment ceux du site IIIb, révèlent une succession Allerød/début Holocène avec un hiatus du Dryas récent. L'évolution des cortèges malacologiques témoigne aussi d'une densification du couvert végétal. La succession de deux espèces du genre *Discus* (*D. ruderatus* et *D. rotundatus*) confirme l'âge préboréal puis début boréal des limons holocènes.

L'analyse micromorphologique de ces limons témoigne d'une genèse par apport fluvial mais aussi d'une forte bioturbation (Coutard *et al.*, 2010). Des périodes de crue ont été suivies de la stabilisation d'un sol particulièrement attractif par sa proximité avec des paléochenaux.

L'ensemble des datations absolues réalisées sur de la faune, des charbons ou des noisettes issus des niveaux préhistoriques de la zone basse s'étale entre 12000 et 9400 cal. BP (Coutard *et al.*, 2010). Pour l'instant, ce sont essentiellement les sites IIIb et V (fig. 4) qui permettent de mieux appréhender la liaison entre ces datations absolues et les vestiges.

LE MÉSOLITHIQUE INITIAL SUR WARLUIS IIIb

Généralités sur le gisement IIIb

La fouille manuelle s'est étendue sur une surface de 80 m² (fig. 5) qui n'a pas permis de fouiller la totalité de la concentration de vestiges lithiques et osseux. Cependant, des marges stériles sont atteintes sur la majeure partie des pourtours de la fouille. La faune est dominée par le cerf, le chevreuil puis l'aurochs (Ducrocq *et al.*, 2008). Les vestiges lithiques présentent une certaine dispersion verticale dans un limon recouvert par des tourbes. Les petits restes osseux ont également une forte dispersion verticale mais les plus gros ossements affectés d'action anthropique apparaissent bien en place dans la partie inférieure du limon. D'autres, beaucoup moins nombreux, sont également bien à plat juste sous la tourbe.

Une zone plus restreinte et moins dense a été fouillée à une trentaine de mètres. Il s'agit du gisement IIIa.

Insertion chronologique du gisement IIIb

Depuis une note préliminaire (Ducrocq *et al.*, 2008), plusieurs datations ont confirmé l'âge de la série (fig. 6). Elles sont d'ailleurs confortées par quelques résultats sur le gisement IIIa.

Les ossements bien à plat au sommet des limons ou à la base des tourbes sont grossièrement datés entre 9900 et 9400 cal. BP. Liés en grande partie à un apport naturel, ces os ne sont pas associés à des vestiges lithiques sauf à quelques éléments épars comme une pointe à base retouchée bien différente du reste du corpus (fig. 10, n° 32). La faune bien en place

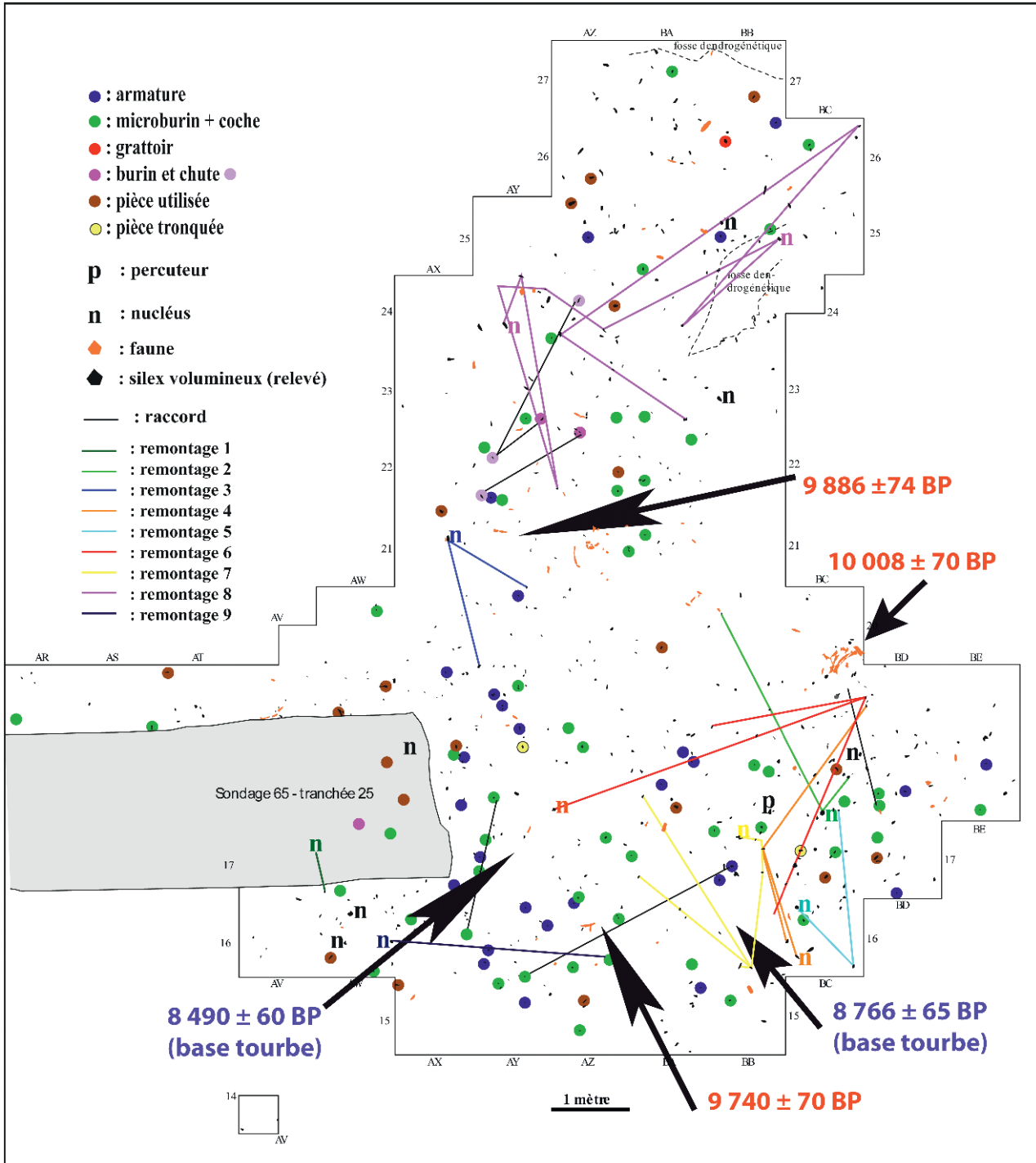


Fig. 5 – Plan de Warluis IIIb où sont figurées de nombreuses informations comme l'emplacement des ossements datés (T. Ducrocq, Inrap).
Fig. 5 – Map of Warluis IIIb showing a lot of information such as the location of the dated bones (T. Ducrocq, Inrap).

dans la partie inférieure du limon livre des dates comprises entre 10000 BP et 9700 BP non calibré, soit à peu près entre 11800 et 11200 cal. BP. Des petits ossements plus dispersés dans le limon offrent un résultat comparable sur le site IIIa. Les petits vestiges lithiques suivent la même dispersion avec des gros éléments vers la partie inférieure. Ils sont donc associés à cette faune qui est bien datée. Le gisement IIIb est calé dans la première moitié du Préboréal, mais les

résultats sont encore trop étalés pour envisager une position au tout début de l'Holocène. L'élimination de la date la plus ancienne (l'aurochs; fig. 6) orienterait plutôt vers une insertion dans la petite oscillation froide du Préboréal (PBO; Bjork *et al.*, 1997) ou plutôt à la fin de cette dernière (Coutard *et al.*, 2010). Cette position chronologique correspond au tout début du développement des espèces de mollusques thermophiles dans le bassin de la Somme (voir ci-dessus).

L'industrie lithique sur le gisement IIIb

La série lithique, forte de plus de mille objets, compte beaucoup d'éléments de débitage, des pièces brutes avec des traces d'utilisation visibles à l'œil nu (21), quelques outils du fonds commun (6) et des microlithes (33 armatures et 57 microburins).

Les produits laminaire et lamellaires ont un profil rectiligne, des corniches abrasées et plusieurs stigmates compatibles avec un débitage à la pierre tendre (Pelegrin, 2000). Plusieurs lames portent des stigmates d'utilisation sur leurs tranchants. Trois de ces supports relativement robustes sont modifiés en burin (fig. 7). Deux sont étroitement associés à la faune datée (n^{os} 1 et 2).

Aucun nucléus susceptible d'avoir produit ces lames n'est présent dans le corpus, sauf si un processus

de réduction laminaire a transformé un nucléus à lames en nucléus à lamelles. 17 nucléus se répartissent en 2 nucléus informes peu débités, 5 nucléus à lamelles unipolaires et 10 nucléus à lamelles bipolaires. Le débitage de certains nucléus est particulièrement bien soigné. Par exemple, un nucléus sur éclat (fig. 8) a fait l'objet d'une mise en forme très élaborée avec la mise en place d'un plan de frappe dans la portion distale de l'éclat. Le bord de l'éclat est devenu la nervure guide d'un débitage lamellaire unipolaire. Le soin apporté à la mise en forme est surtout évident avec la réalisation d'une crête dorsale par l'enlèvement de nombreux petits éclats. Cette crête a permis d'entretenir le plan de frappe au cours du débitage. Cette préparation méticuleuse contraste avec l'accident d'outrepassage qui a très vite provoqué l'arrêt de l'extraction laminaire. Si l'exploitation d'un éclat en nucléus est très fréquente pendant le Mésolithique, la

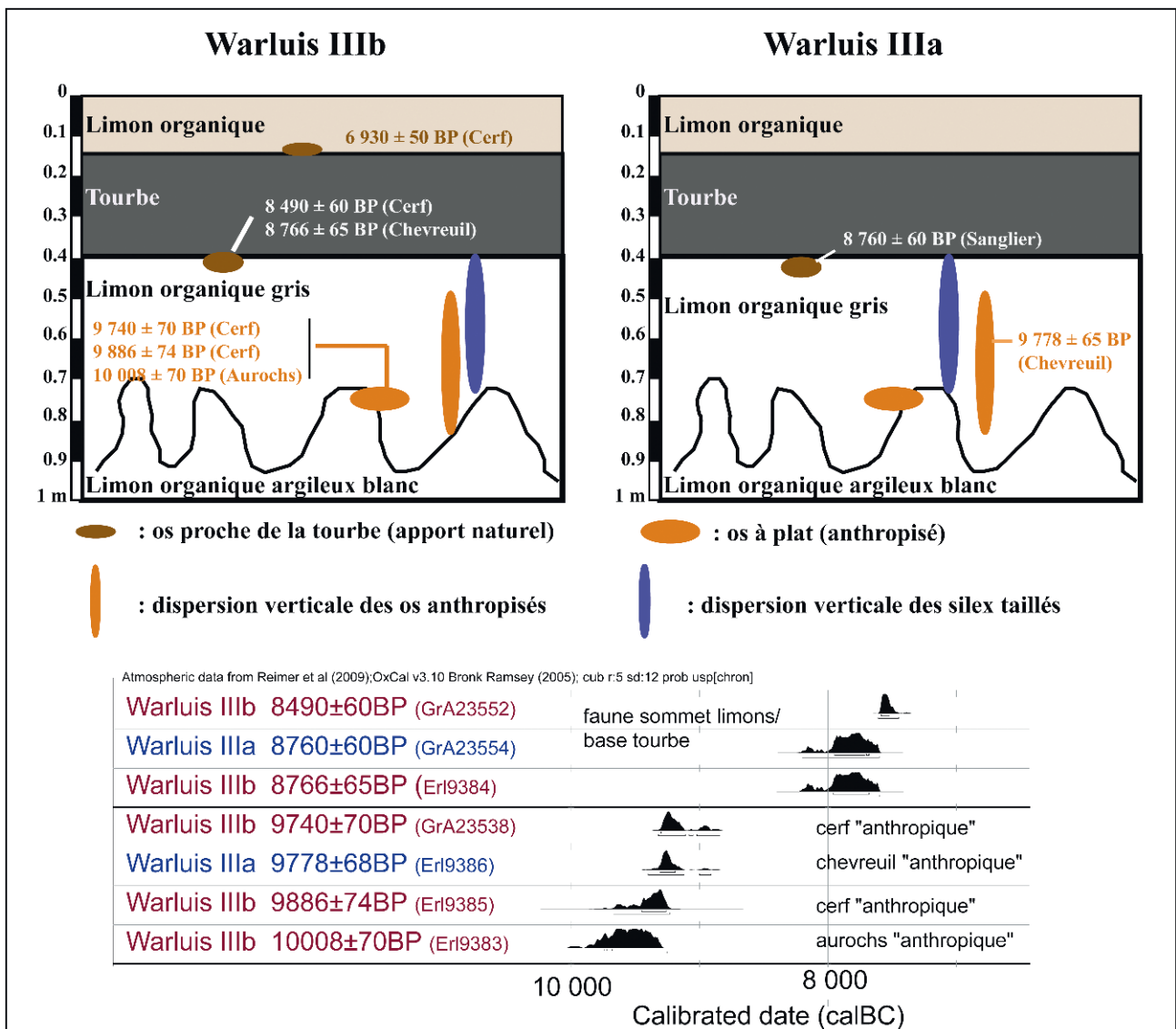


Fig. 6 – Profils stratigraphiques schématiques comportant la position des vestiges et des différents ossements datés sur le site IIIb et le secteur proche IIIa (T. Ducrocq, Inrap).
 Fig. 6 – Schematic stratigraphic profiles containing the position of the remains and various dated bones on the IIIb site and the nearby IIIa area (T. Ducrocq, Inrap).

préparation est généralement très simplifiée à l'image de l'ensemble du débitage, notamment dans les industries « beuroniennes » du nord de la France (Ketterer, 1997; Souffi, 2008).

Un autre nucléus illustre très bien le débitage pratiqué sur Warluis IIIb (fig. 9). Ce nucléus à lamelles à deux plans de frappe opposés, abrasés, apparemment exploités successivement, révèle un soin apporté à

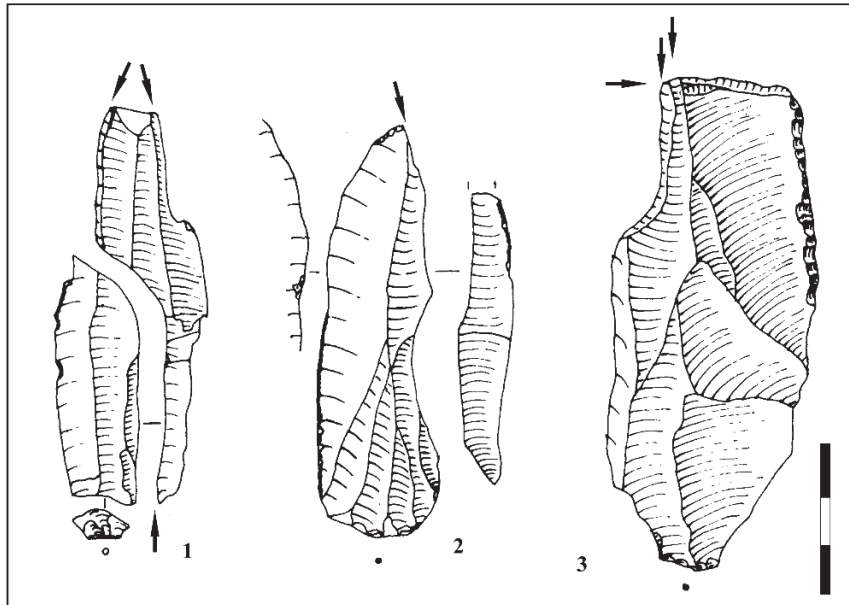


Fig. 7 – Les trois burins sur lame de Warluis IIIb (T. Ducrocq, Inrap).
Fig. 7 – The three burins on blade of Warluis IIIb (T. Ducrocq, Inrap).

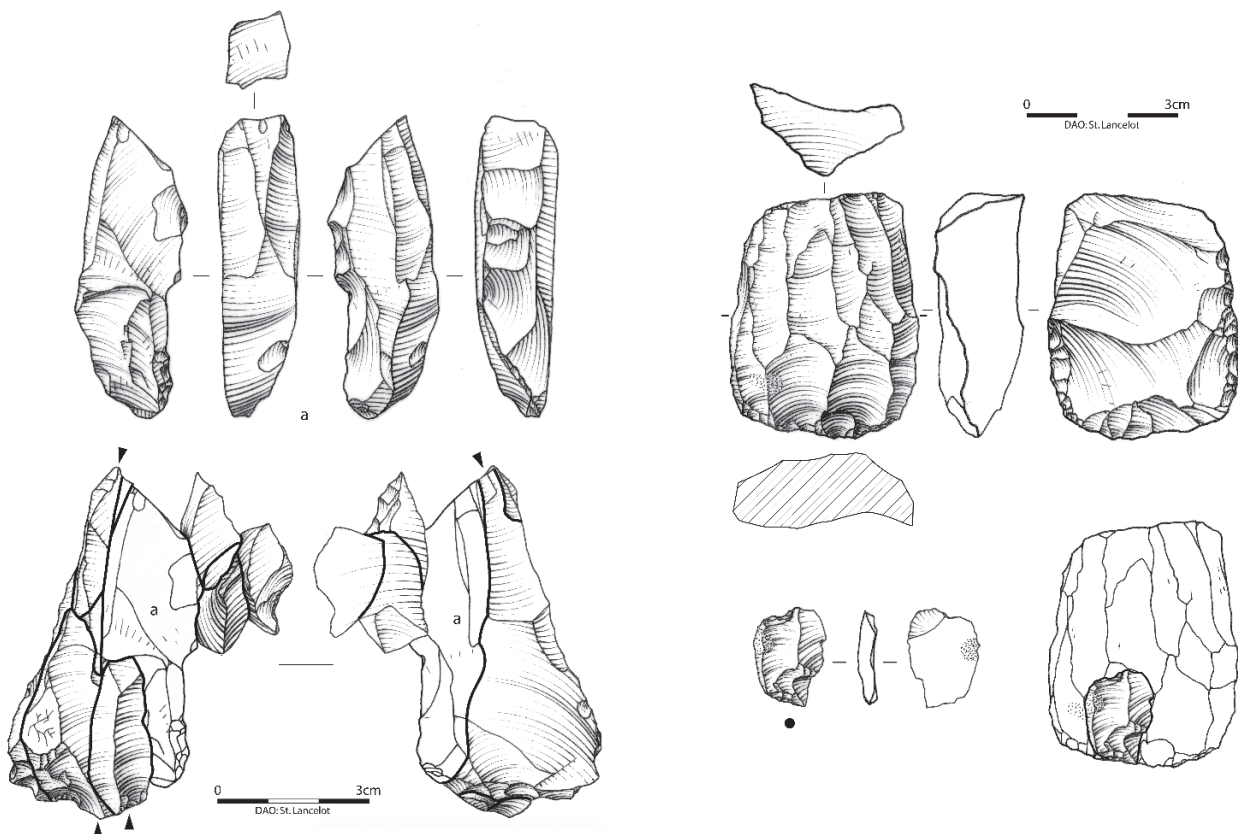


Fig. 8 – Warluis IIIb : nucléus sur éclat (en haut) avec des pièces raccordées (en bas) (dessins : S. Lancelot, Inrap).
Fig. 8 – Warluis IIIb: core on flake (top) with refitted pieces (bottom). (drawings: S. Lancelot, Inrap).

Fig. 9 – Nucléus avec un microburin raccordé; Warluis IIIb (S. Lancelot, Inrap).
Fig. 9 – Core with a refitted microburin; Warluis IIIb (S. Lancelot, Inrap).

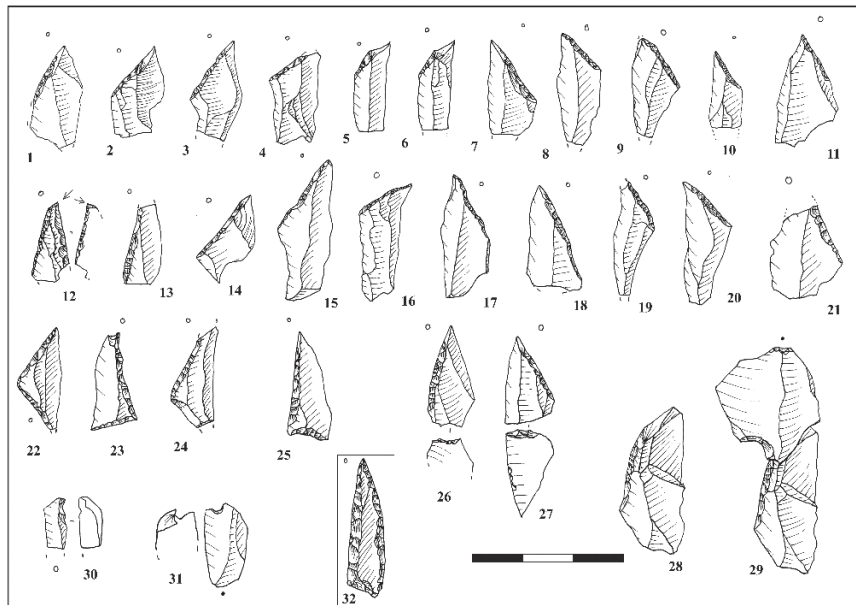


Fig. 10 – Warluis IIIb : Pointes à base non retouchée (1 à 21), triangles (22 à 24), pointes à base retouchée (25 à 27 et 32), piquant trièdre (28) et son raccord avec un microburin (29) et microburins (30 et 31); (T. Ducrocq, Inrap).

Fig. 10 – Warluis IIIb: Points with unretouched base (1 to 21), triangles (22 to 24), points with retouched base (25 to 27 and 32), “piquant trièdre” (28) with a refitted microburin (29) and microburins (30 and 31) (T. Ducrocq, Inrap).

l’entretien du débitage avec des petits enlèvements qui affectent un plan de frappe et dessinent deux crêtes postéro-latérales. Ces caractéristiques alliées à la forme large et relativement plate de la table laminaire évoquent les nucléus du Mésolithique initial de Conty (Coudret et Fagnart, 2012). Elles permettent aussi un rapprochement avec certains nucléus du Paléolithique terminal de l’ouest de la France (Naudinot, 2013) et du Bassin parisien (Valentin *et al.*, 2014) ainsi qu’avec des nucléus de l’Ahrensbourgien de type Geldrop de Belgique et du sud des Pays-Bas (Vermeersch, 2008). Cependant, la quasi absence de remontage sur ce bloc ne permet pas de reconstituer le déroulement du débitage et d’affirmer qu’il suit les modalités décrites pour le Paléolithique terminal. Ces dernières sont caractérisées par une extraction laminaire ou lamellaire qui s’étend rapidement à la face la plus large du bloc. Cette rareté des remontages, y compris sur les autres nucléus, ne permet pas non plus d’affirmer qu’il y ait une chaîne opératoire lamellaire distincte d’une chaîne opératoire laminaire.

Le seul raccord réalisé avec ce nucléus est un microburin (fig. 9). Il conforte la relation entre ce type de débitage et les microlithes. Rappelons que le procédé du microburin est absent de l’Ahrensbourgien et de l’Épiahrensbourgien au sens de J.-P. Fagnart (1997 et 2009). L’utilisation de ce type de fracturation est attestée par de nombreuses pièces mais aussi par des traces de piquant trièdre perceptibles sur les pointes des microlithes (fig. 10). La majeure partie des armatures est composée de 21 pointes à base non retouchée à troncature plus ou moins oblique. Ces petits objets relativement trapus ont toujours leur

extrémité pointue et retouchée orientée vers la partie proximale de la lamelle. La latéralisation est indifférente. Le raccord d’un piquant trièdre et de son microburin (fig. 10, n^{os} 28 et 29) révèle des supports parfois assez larges. Trois triangles, bien associés au reste de la série, ont des dimensions similaires aux pointes à base non retouchée (fig. 10, n^{os} 22 à 24). Les quatre pointes à base retouchée comportent une pièce retrouvée juste sous la tourbe qui doit correspondre à une fréquentation discrète du Beuronien (fig. 10, n^o 32). Les trois autres ont aussi des dimensions comparables aux pointes à base retouchée. Elles comptent une pièce à base à retouche directe (fig. 10, n^o 25) et deux objets avec un simple aménagement de la base (fig. 10, n^{os} 26 et 27).

Quelques comparaisons

Au niveau régional, l’industrie lithique de Warluis IIIb s’apparente par la forme de ses nucléus à crêtes postéro-latérales, par la coexistence de lames et de lamelles et par ses microburins au Mésolithique initial de Conty. Son corpus microlithique la rapproche aussi étroitement de la série très patinée de Thennes I. Elle se différencie de l’Épiahrensbourgien au sens de J.-P. Fagnart (2009) et de l’Ahrensbourgien de type Geldrop par la taille des microlithes, la présence de quelques géométriques, de pointes à base retouchée et surtout par l’utilisation quasi-systématique du procédé du microburin. Les datations absolues sont très proches et suggèrent une position chronologique de Warluis IIIb juste après ce Paléolithique terminal. D’ailleurs, cette

industrie lithique de Warluis IIIb pourrait être qualifiée d'Épiahrensbourgeois au sens de A. Gob (1988). En effet, la filiation avec l'Ahrensbourgeois tardif occidental semble acquise avec l'utilisation des pointes à tronçatures. L'appartenance au Mésolithique est révélée par une microlithisation plus affirmée allant de pair avec le procédé du microburin.

Cette microlithisation et l'utilisation du microburin est à peu près synchronique en Europe occidentale avec, pour poursuivre dans les affinités septentrionales, une certaine proximité typologique avec les assemblages regroupés sous le terme de Groupe de Star Carr qui représente le plus ancien Mésolithique de Grande Bretagne (Jacobi, 1978; Reynier, 2005; Conneller *et al.*, 2016). Ces ensembles livrent des microburins, beaucoup de pointes à base non retouchée et aussi des triangles similaires à ceux de Warluis IIIb.

Dans l'est de la France, à Choisey (niveau C2), une industrie lithique avec des lames et des lamelles, de nombreux microburins, et des armatures dominées par les pointes à base non retouchée, puis les triangles et quelques pointes à base aménagée par des retouches directes est datée de 9805 ± 65 BP non calibré soit environ 11 300 à 11 200 cal. BP (Séara, 2014). La datation et le mobilier lithique sont absolument similaires à ceux de Warluis IIIb. L'auteur (Séara, 2014) insiste sur les rapports avec l'Épiahrensbourgeois mais reconnaît des caractères beuronien avec la présence de triangles isocèles et de pointe à base retouchée.

Un peu plus au sud, dans les Alpes, ce caractère Beuronien est encore plus net avec l'assemblage microlithique du niveau 4a de La Fru qui est composé de triangles et de pointes à base retouchée et qui est daté de 9840 ± 90 BP non calibré soit environ 11 300 à 11 200 cal. BP (Mével *et al.*, 2014). En-dessous, un niveau « mixte » pose des problèmes d'interprétation.

Plus au sud encore, dans la sphère sauveterrienne, le site du Sansonnet révèle un Sauveterrien à microburins qui est daté du tout début de l'Holocène à 9995 ± 95 BP non calibré soit environ 11 800 à 11 400 cal. BP (Guilbert, 2003). Il montre l'apparition et la généralisation précoce de ce type de fragmentation.

Ce bref survol d'exemples contemporains montre que l'industrie lithique de Warluis IIIb s'intègre bien au Mésolithique initial d'Europe occidentale qui apparaît très tôt au cours du Préboréal. De fortes affinités sont perceptibles avec les séries du nord-est de la France comme avec certains gisements de Grande-Bretagne.

LE MÉSOLITHIQUE ANCIEN «MAGLEMOSIEN» DE WARLUIS V

Généralités sur le gisement V

Warluis V correspond à deux concentrations de vestiges lithiques et osseux (fig. 11). L'une d'elles est organisée autour d'une grande fosse qui pourrait être une structure d'habitat. Des raccords entre les deux zones et un mobilier identique en tous points plaident pour un ensemble homogène et une contemporanéité entre les deux zones.

L'insertion chronologique de Warluis V

Les datations absolues (fig. 12) réalisées sur un os de cerf et de sanglier se placent autour de 9 300 BP non calibré, mais des doutes sur la conservation des ossements nous ont incité à multiplier les datations. Le reste de l'os de sanglier préalablement daté a été confié à D. Drucker qui a bien voulu extraire du collagène qui a ensuite été daté de 9 500 BP non calibré (fig. 12). Enfin, la datation de deux charbons (pin et bouleau) a permis de conforter cette dernière datation avec des résultats de 9 520 et 9 570 BP non calibré. La courbe de calibration de ces trois dernières dates dessine deux possibilités autour de 11 000 cal. BP.

L'industrie lithique de Warluis V se place bien après celle de Warluis IIIb. Les imprécisions dans les datations suggèrent une distance chronologique variant entre quelques siècles et un demi millénaire (fig. 6 et 12).

L'industrie lithique sur le gisement V

L'industrie lithique est très abondante et toutes les étapes du débitage semblent avoir été réalisées sur place à partir d'une matière première très abondante. Les principaux traits de l'industrie encore en cours d'étude ont été présentés précédemment (Ducrocq *et al.*, 2008). Il s'agit d'un débitage soigné apparenté au style de Coigny (Rozoy, 1969). L'extraction laminolaire est pratiquée par percussion directe à la pierre tendre. Les changements d'orientation du sens du débitage sont extrêmement rares comme le sont les crêtes postéro-latérales limitées à 3 unités pour 101 nucléus. Il n'y a quasiment pas de nucléus qui aient la même forme que ceux de Warluis IIIb (fig. 9). La principale chaîne opératoire est orientée vers la production de lamelles supports d'armature.

L'outillage du fonds commun (fig. 13) est largement dominé par les grattoirs et les burins (Ducrocq *et al.*, 2008). Les supports des grattoirs sont surtout des éclats qui proviennent des différentes phases de la chaîne opératoire. Les burins sont plus souvent façonnés à partir de produits laminaires épais. Quelques raccords orientent vers un prélèvement des premiers enlèvements laminaires avant la poursuite du débitage vers des produits plus petits, transformés en microlithes. Les armatures comptent 110 pointes à tronçatures (fig. 14) pour un segment et une pointe à base retouchée, tous deux atypiques. Le procédé du microburin est systématiquement employé pour dessiner une tronçature très oblique orientée vers la partie proximale de la lamelle. La latéralisation est variable. Ces pièces se distinguent de celles de Warluis IIIb par une pointe plus acérée et des dimensions nettement plus importantes.

Enfin, deux blocs façonnés sont assimilables à des sortes d'herminettes (fig. 15). La présence de « coup de tranchet » à leur extrémité oriente plutôt leur interprétation en tant qu'outil massif plutôt qu'en préforme de nucléus.



Fig. 11 – Plan de Warlus V (T. Ducrocq, Inrap).
 Fig. 11 – Map of Warlus V (T. Ducrocq, Inrap).

Quelques comparaisons

Les différences avec Warlus IIIb sont la position chronologique et les aspects technologiques. Les pointes à troncature oblique obtenue par le procédé du microburin sont communes aux deux ensembles mais les armatures sont beaucoup plus trapues sur Warlus IIIb. C'est quasiment la seule forme microlithique présente sur Warlus V alors que les triangles et les pointes à base retouchée sont relativement abondantes sur Warlus IIIb. Enfin, les outils massifs comme les haches ou les herminettes sont, pour l'instant, absents du Mésolithique initial.

Les comparaisons régionales permettent de rapprocher de Warlus V plusieurs sites de Hangest-sur-Somme avec des pointes à base non retouchée et des outils massifs sur bloc (fig. 3).

En Île-de-France, l'assemblage de silex taillés de Rueil-Malmaison Closeaux IV (Lang et Sicard, 2008) montre des affinités étroites avec Warlus V sur les plans technologique, stylistique et typologique.

Par ailleurs, l'industrie lithique de Warlus V est parfois qualifiée de Maglemosien ancien (Ducrocq, 2014) en raison de fortes similitudes typologiques avec le Mésolithique ancien du Danemark (Brinch Petersen,

2009) par la quasi exclusivité des pointes à bases non retouchée parmi les microlithes et/ou par la présence de hache. On peut ainsi citer les armatures associées à l'aurochs de Vig qui est contemporain de Warlus V (Brinch Petersen, 2009) où le site à pointes à troncature de Barmose I (Reynier, 2005).

Des rapprochements sont aussi envisageables en Allemagne avec, par exemple, le site de Bedburg-Königshoven (Street, 1997).

Les affinités typologiques et technologiques sont encore plus évidentes avec certains gisements du groupe de Deepcar défini en Grande Bretagne (Jacobi, 1978; Reynier, 2005) comme, par exemple, les sites de Thatcham III (série patinée), Broxbourne 102 (Warren *et al.*, 1934) ou Hengistbury Head Powell Mesolithic site (Barton, 1992).

Toutes ces industries proches de Warlus V peuvent être qualifiées de Maglemosien ancien ou d'Épiahrensbourgien au sens de A. Gob.

La filiation avec le Mésolithique initial du type de Warlus IIIb est probable. Cependant, le mobilier de Warlus IIIb se rapproche des industries lithiques du nord-ouest de l'Europe mais aussi de vestiges issus de la sphère beuronienne au sud-est. Le Mésolithique de Warlus V et les gisements proches du Bassin parisien

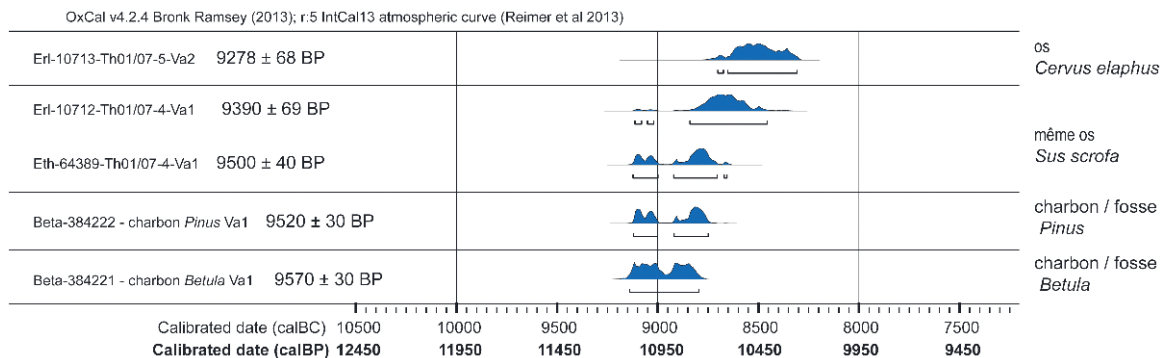


Fig. 12 – Datations de Warluis V (Erl-10711 ; 7 936 ± 63 BP n'est pas figuré en raison d'un C/N de 3,19 qui indique un collagène détérioré) (S. Coutard, Inrap).

Fig. 12 – Dating results of Warluis V (Erl-10711 ; 7 936 ± 63 BP is not represented because of a C/N of 3.19 which indicates deteriorated collagen (S. Coutard, Inrap).

(Hangest-sur-Somme ou Rueil-Malmaison) sont, quant à eux, uniquement comparables à des sites du monde septentrional.

QUELQUES DONNÉES SUR LE MÉSOLITHIQUE ANCIEN DU TYPE BEURONIEN À SEGMENTS

Warluis livre aussi de précieux documents sur la fin du Préboréal ou le tout début du Boréal (Ducrocq *et al.*, 2014) qui viennent enrichir les données déjà abondantes sur le bassin hydrographique de la Somme et plus largement sur le Bassin-Parisien (Ducrocq, 2013).

Il s'agit d'assemblages microlithiques radicalement différents composés essentiellement de segments et de pointes à base retouchée typiques. Les pointes à base non retouchée y sont rares et ce sont souvent des pièces inachevées ou des versions simplifiées des deux autres types microlithiques. Le débitage est aussi apparenté au style de Coincy. La mise en forme est simplifiée avec d'abord la mise en place d'un plan de frappe. Ensuite, des enlèvements allongés le long d'une convexité naturelle permettent d'initier le débitage. Les changements de sens de débitage sont fréquemment employés pour contourner quelques accidents de taille. Les irrégularités des produits sont gommées lors du façonnage des armatures par le procédé du microburin ou par d'importantes retouches. Les éclats issus des gros volumes de matière première sont très souvent exploités comme nucléus. Par ailleurs, les haches et herminettes semblent absentes de ces industries lithiques.

De nombreuses datations placent beaucoup de ces gisements dans le plateau de 8 800/8 700 BP non calibré mais un certain nombre indiquent aussi parfois un âge plus ancien vers 9 100 BP non calibré (Ducrocq, 2013). D'ailleurs, si on retient les données de Rosnay dans la Marne (Souffit *et al.*, 2015), certaines datations seraient proches de 9 300 BP non calibré, soit vers 10 500 cal. BP, La distance chronologique avec les

assemblages du type de Warluis V serait de l'ordre de quelques siècles à un demi millénaire.

Ces industries lithiques s'intègrent à un vaste technocomplexe défini par l'utilisation massive des pointes à base retouchée. On peut éventuellement le qualifier de Beuronien au sens large (Ducrocq, 2013). Cet ensemble montre des variations typologiques suivant les régions où la chronologie fine. Il couvre toute la moitié septentrionale de la France et il est présent en Grande-Bretagne avec le groupe de Horsham (Reynier, 2005) comme il est attesté dans la Benelux, dans une grande moitié ouest de l'Allemagne ainsi qu'en Europe centrale. Il est surtout intéressant de noter son absence du Danemark et dans le nord-est de l'Allemagne. Les affinités géographiques sont donc sensiblement différentes de celles des industries lithiques du type de Warluis V.

CONCLUSION

Le gisement de Warluis a permis d'identifier trois industries lithiques différentes qui se succèdent au cours de la chronozone du Préboréal.

La distinction concerne les spectres microlithiques avec d'abord des pointes à base non retouchée associées à des éléments beuronoides, puis uniquement des pointes à base non retouchée et enfin des segments et des pointes à base retouchée du Beuronien. Les aspects technologiques montrent aussi des variations avec un débitage de moins en moins soigné.

Les comparaisons extrarégionales montrent aussi de sensibles différences. Toutefois, on observe pendant tout le Préboréal d'étroites affinités avec la Grande-Bretagne qui est encore accessible à pied sec. La séquence de la Belgique et du sud des Pays-Bas est aussi très proche, mais, curieusement, la fin de l'Ahrensbourgien y est très bien représentée mais il n'y a pas d'équivalent, à ma connaissance, aux industries du type de Warluis IIIb ou de Warluis V. Le Mésoolithique du Danemark et du nord-est de l'Allemagne semble proche jusqu'au développement du

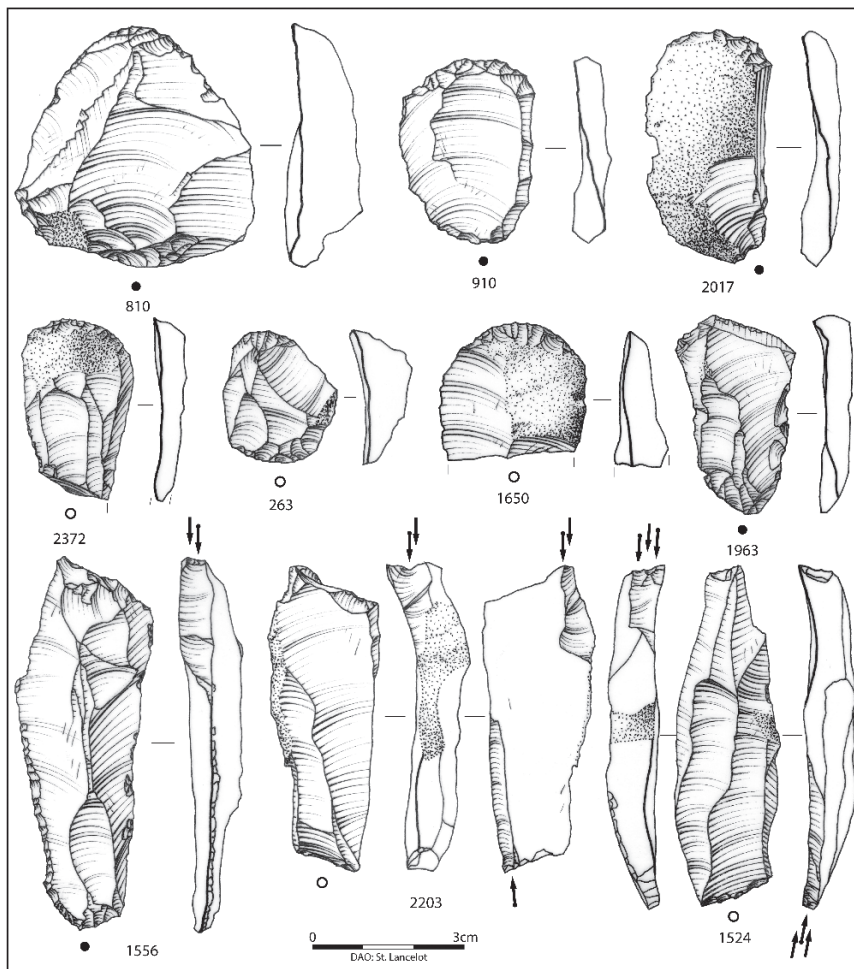


Fig. 13 – Grattoirs et burins de Warluis V (S. Lancelot, Inrap).
Fig. 13 – Endscrapers and burins of Warluis V (S. Lancelot, Inrap).

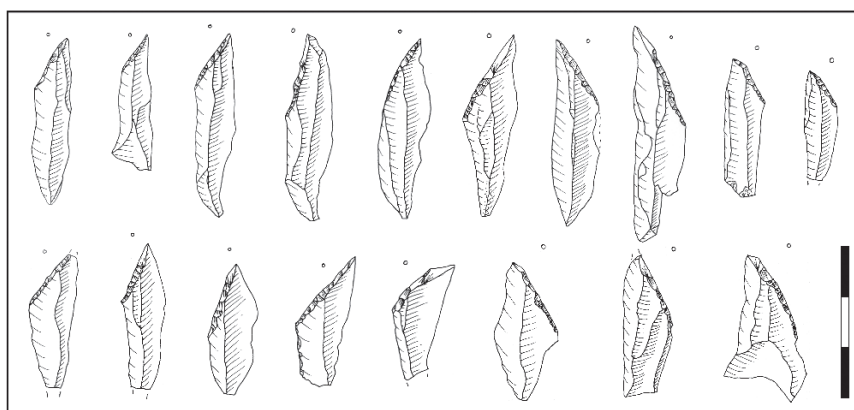


Fig. 14 – Armatures de Warluis V (T. Ducrocq, Inrap).
Fig. 14 – Microliths of Warluis V (T. Ducrocq, Inrap).

Beuronien dans le nord de la France, inexistant là-bas. La terminologie est aussi délicate. On pourrait suivre A. Gob en qualifiant d'Épiahrensbourgien les industries de Warluis IIIb et de Warluis V.

Pour ma part, je pense que le terme de Mésolithique initial du nord de la France est suffisamment

précis pour désigner les industries du type de Warluis IIIb. Elles ont de fortes affinités techno-typologique avec les premières séries connues en Europe occidentale, mais montrent aussi des spécificités régionales. Pour les ensembles du type de Warluis V, j'utilise parfois le terme fort discutable de

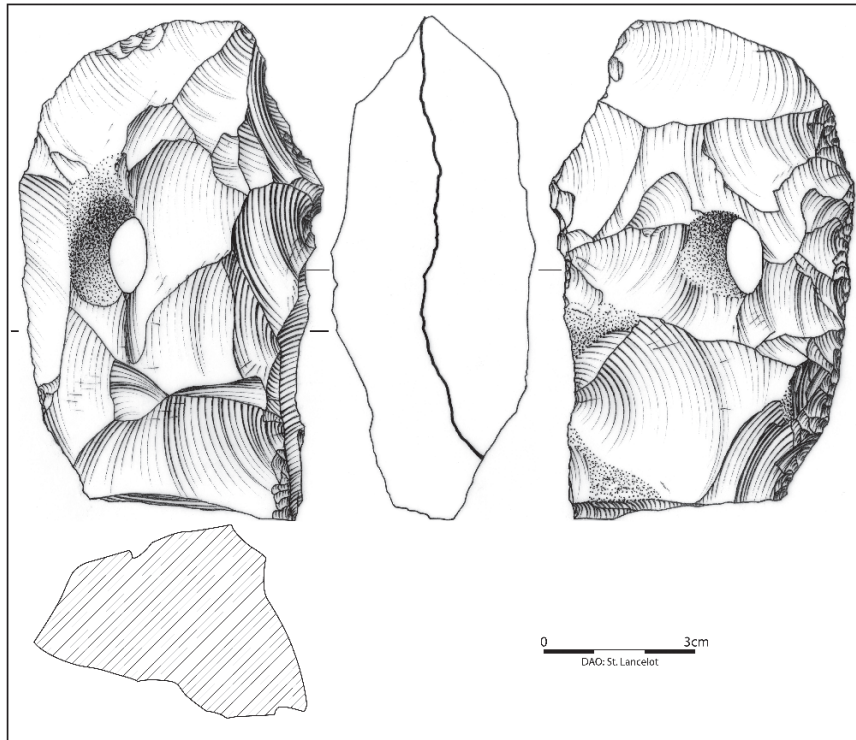


Fig. 15 – « Herminette » de Warluis V (S. Lancelot, Inrap).
Fig. 15 – « Adze » of Warluis V (S. Lancelot, Inrap).

Maglemosien ancien pour souligner les rapprochements évidents avec les gisements septentrionaux. Il est surtout question de trouver une appellation différente de Mésolithique initial ou Mésolithique ancien pour éviter les confusions.

Le gisement de Warluis permet de poser des bases chronologiques fiables pour le premier millénaire du Mésolithique. Ce n'est qu'un préalable indispensable à toute étude plus précise sur les sociétés humaines du nord du Bassin parisien. ■

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D'un Massif à l'autre : synthèse sur le Laborien entre France méridionale et atlantique

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Résumé : Du Massif armoricain aux portes de l'Italie, en passant par l'Aquitaine, les Pyrénées et l'Auvergne, une vaste étendue géographique aux environnements contrastés est jalonnée par de nombreux gisements livrant les témoignages matériels des chasseurs-collecteurs de la transition Pléistocène – Holocène. La réévaluation collective de séries fondatrices du Laborien mais également des travaux de terrain aboutissent à proposer un nouveau panorama des traditions culturelles autour de 12000 cal. BP dans cet espace. Le XXVIII^e Congrès préhistorique de France d'Amiens est l'occasion de faire le point et de confronter les données obtenues pour cette période dans une vaste région, longtemps mise de côté, et qui s'avère finalement essentielle pour les préoccupations scientifiques portant sur le Dryas récent et les premiers temps du Préboréal. Si, parmi les témoignages de ces groupes, les productions lithiques demeurent au premier plan, d'autres registres seront également mobilisés (art mobilier, industrie osseuse, gibier...). Il s'agira de relater les comportements techniques, économiques ou symboliques afin de s'interroger sur les identités des groupes humains ayant occupé ces espaces durant cette période. De nouvelles données provenant de sites de plein air permettent d'expliquer certaines variations d'ordre socio-économique, tandis que la réévaluation d'occupations en cavités offre l'opportunité d'enquêter sur la dilatation chronologique du Laborien et de ses contemporains ou héritiers. Dans une actualité qui fait la part belle aux migrations humaines et à l'intérêt parfois mal compris de la mixité culturelle, nous tâcherons de souligner une dialectique entre des valeurs fédératrices permettant une forme d'intégration culturelle globale et des variations régionales pour lesquelles la question de leur signification chronologique ou d'identité territoriale se pose. La présentation dans le temps et l'espace de ces données nouvelles ou actualisées sera ainsi l'occasion d'éclairer des problématiques de diffusion d'innovations et de « melting pot » culturel en réinterrogeant notamment les différences terminologiques héritées des recherches régionales. L'agencement des productions lithiques à vocation domestique ou de l'armement, s'avère alors un levier efficace pour tenter de reconstruire à une plus grande échelle l'évolution des dernières sociétés humaines pléistocènes et la dilution de leurs traditions dans le Mésolithique européen.

Mots clés : Europe occidentale, Tardiglaciaire, Laborien, Technologie lithique, Industrie osseuse, Art mobilier.

Abstract: The vast expanse spanning from the Armorican Massif to Italy, passing by southwestern France, the Pyrenees and the Massif Central, is characterized by contrasting landscapes containing numerous sites from the Pleistocene-Holocene transition. During this period, the European archaeological record can be divided into two broad entities – the Epigravettian in the northern Mediterranean Basin and industries characterized by the return of a well-developed blade technology in northwestern Europe. This large Western European techno-complex comprises several cultural traditions defined essentially by various types of projectile points. One of these cultures, the Laborian, occupies an area at the crossing of northern traditions (Ahrensburgian) and the Epigravettian techno-complex. Here we investigate a large region extending from the Armorican Massif to southern France. Situated between the Azilian and Mesolithic, the Laborian (12,500-11,000 cal. BP) is, paradoxically, poorly defined in southwestern France where it was initially defined. In fact, more data is available for this culture in the surrounding regions of northern (Valentin, 2008; Fagnart, 2009) and western France (Naudinot, 2010, 2013). The reevaluation of key Laborian lithic assemblages (La Borie del Rey, Le Camp d'Auvours) as well as the discovery of major new sites (La Fosse, Peyrazet, Vaise) today paint a new picture of the various cultural traditions occupying this large area around 10,000 BP (i.e. 12,000 cal. BP). The XXVIII^e Congrès préhistorique de France presents an ideal opportunity to update the data discussed during the last CPF in Bordeaux-Les Eyzies-de-Tayac (2010) and an SPF workshop in Bordeaux two years later. Neglected for some time, this large region has recently become the focus of an important research dynamic and now plays a critical role in our understanding of the Younger Dryas (GS-1) – Preboreal transition in Western Europe. Lithic hunting weaponry essentially based around point forms, much like during the Azilian, allow two chronological phases

of the Laborian to be identified: an older phase with straight backed points with truncated bases (Maurie points) and bitruncated backed blades (rectangles) and a recent phase with pointed backed bladelets (Blanchères points) and bitruncated trapezoids. In addition to adding chronological structure to Laborian industries, these lithic projectiles also allow interactions between the various contemporaneous European traditions during this period to be explored. The production of large, standardized, straight blades with flat cross-sections during the Laborian reveals clear similarities with concepts defined in northern regions (e.g. functional facies of the Belloisian) even if blade lengths rarely reach the standards known on these sites. While lithic assemblages provide the majority of information concerning this period, other forms of evidence are also instructive. The exploitation of large game typical of open temperate landscapes, the maintenance of bone barbed points or artistic conventions (engraved pebbles) along with several symbolic innovations, such as the development of a unique zoomorphic art, are among important elements that shed light on these societies. The goal of our approach is to mobilize these various technological, economic and symbolic aspects to investigate the identity of human groups occupying western France during this transitional period. New data from open-air sites (Port-de-Penne, La Fosse) also highlights socio-economic diversity, while the study of cave sites helps to further refine the chronology of the Laborian. The spatiotemporal distribution of this new and revised data permits diffusion processes and the idea of a cultural “melting pot” in particular by readdressing underlying differences between local traditions defined from regional research perspectives. Finally, the technological study of domestic stone tools and hunting weaponry is an effective means for reconstructing larger scale evolution processes influencing these last Pleistocene societies and the persistence of their traditions into the European Mesolithic.

Keywords: Western Europe, Lateglacial, Laborian, Lithic technology, Osseous industry, Portable art.

INTRODUCTION

Durant la charnière climatique Pléistocène-Holocène, l'Europe est traversée par plusieurs courants culturels parmi lesquels le Laborien occupe un espace à l'interface des traditions septentrionales (Épi/Ahrensbourgien) et méditerranéennes (Épigra-vettien italique et provençal, Épipaléolithique ibérique). Nous nous attacherons ici à naviguer entre le Massif armoricain et la France méridionale. Succédant à l'Azilien et précédant le Mésolithique, le Laborien (ca. 12,5-10,8 ky cal. BP) demeurerait paradoxalement mal connu dans le sud-ouest de la France (région éponyme) au regard des travaux menés dans le Nord (e.g. Fagnart, 1993, 2009; Valentin, 1995; 2008, 2009; Bodu, 2000) ou l'Ouest (Naudinot, 2010) de la France notamment. Il y a quelques années, une première réévaluation a été proposée pour le Laborien du sud-ouest français (Langlais *et al.*, 2014a). Le travail collectif mené ensuite sur le gisement éponyme de La Borie del Rey (Blanquefort-sur-Briolance, Lot-et-Garonne) a permis, dans la lignée des travaux de L. Coulonges et J.-M. Le Tensorer, de proposer une subdivision du Laborien en deux phases, ancienne (intégrant ProtoLaborien et Laborien) et récente (*i.e.* Épilaborien). Durant la table-ronde de Bordeaux réunissant des spécialistes de la moitié sud de la France et du nord de l'Italie, les regards se sont surtout focalisés sur les industries lithiques et la faune (Langlais *et al.* dir., 2014). Plusieurs projets⁽¹⁾ ont ainsi permis de revisiter des collections anciennes et récentes (Fat Cheung *et al.*, 2014; Langlais *et al.*, 2014b). Des synthèses permettent également de mieux apprécier la variabilité des comportements techniques durant cette période tant dans le Massif armoricain (Naudinot, 2013; Jacquier, 2015) que dans les Pyrénées (Fat Cheung, 2015). Depuis 2016, le PCR «*Le Laborien en Aquitaine*» a pour objectif de faire le

point sur les différents registres de la culture matérielle durant cette période et de réfléchir à son phasage chronologique (Langlais coord, 2016a). La synthèse que nous proposons ici est donc le fruit de ces dernières années de réflexions, réévaluations et analyses collectives autour du/des Laborien(s) dans les moitiés sud et atlantique de la France.

CORPUS

La révision de stratigraphies tardiglaciaires du sud-ouest de la France a permis de souligner – à la suite des travaux de G. Célérier au Pont d'Ambon – la présence d'assemblages laboriens en sommet de séquences «*magdaléno-aziliennes*» dans des sites fouillés anciennement et souvent un peu trop tôt. La distribution stratigraphique de certains marqueurs (essentiellement des armatures lithiques) du Magdalénien supérieur (e.g. pointes à cran, pointes de Lauge-rie-Basse ou de Teyjat), aziliens (e.g. bipointes à dos et monopointes épaisses à base modifiée) et laboriens (e.g. pointes de Malaurie, rectangles, pointes des Blanchères, bitruncatures trapézoïdales) permet en particulier d'apprécier différents niveaux de confiance de ces archéoséquences. Assez cohérent pour le Pont d'Ambon (Bourdeilles, Dordogne; Célérier, 1998), les stratigraphies de Rochereil (Grand-Brassac, Dordogne; Jude, 1960), du Morin (Pessac-sur-Dordogne, Gironde; Bordes *et al.*, 1979), de Gare de Couze (Lalinde, Dordogne; Fitte et Sonnevill-Bordes, 1962) ou du Roc d'Abeilles (Calviac, Dordogne; Champagne et Espitalié, 1970) sont plus complexes. Ce travail aboutit à remettre en question le modèle culturel accrétif proposé par F. Bordes et D. de Sonnevill-Bordes à la fin des années 1970 (Langlais *et al.*, 2014a; Fat Cheung *et al.*, 2014; Mallye *et al.*, 2018). Ce modèle d'un Magdalénien final progressivement enrichi par des éléments aziliens – bâti sur des séquences

mélangées – a finalement perturbé la reconnaissance du Laborien dans cette région. D'autres séries, comme Auberoche (Le Change, Dordogne ; Daniel, 1969) ou Gouerris (Lespugue, Haute-Garonne ; Saint-Périer, 1927), quelque peu tombées dans l'oubli, ont été revues et désormais attribuées au Laborien (Fat Cheung, 2015 ; Langlais coord., 2016a). La réévaluation de la série éponyme de la Borie del Rey (Blanquefort-sur-Briolance, Lot-et-Garonne, fouilles Coulonges) a permis de préciser l'évolution chronologique du Laborien (voir *infra*) à partir notamment des morphotypes d'armatures lithiques (Langlais *et al.*, 2014b). Parmi les autres gisements stratifiés en cours de révision, le site du Cuze de Sainte-Anastasia (Cantal, collection Pierron-Derville et fouilles Delpuech) apporte également de nouvelles données sur l'évolution du Laborien (Delpuech *et al.*, 1983 ; Langlais *et al.*, 2018).

Parallèlement à la réévaluation de collections anciennes, de nouveaux sites stratifiés ont été mis au jour et fouillés dans le cadre d'opérations programmées comme la grotte-abri de Peyrazet qui livre une séquence du Magdalénien supérieur au Laborien récent (Langlais *et al.*, 2015). Quelques gisements en plein air – fouillés en archéologie programmée ou préventive – apportent des précisions quant à l'organisation spatiale d'occupations structurées autour de foyers et interrogent sur la fonction des sites et les stratégies de mobilité des groupes du Laborien. C'est le cas notamment des sites de la Fosse (Villiers-Charlemagne, Mayenne ; Naudinot et Jacquier, 2014), Port-de-Penne (Penne d'Agenais, Lot-et-Garonne ; Langlais *et al.*, 2014b), Manirac (Lectoure, Gers ; Beyneix *et al.*, 2001 ; Fat Cheung, 2015), Champ Chalatras (Les Martres d'Artière, Puy-de-Dôme ; Pasty *et al.*, 2002) ou Vaise (Lyon, Rhône ; Jallet, Bouvier dir., 2012 ; Treffort dir., 2017).

LES POINTES LITHIQUES : UN PROXY GÉOCHRONOLOGIQUE

Durant la phase ancienne du Laborien, le morphotype dominant est une pointe à dos rectiligne et base tronquée, la pointe dite de Malaurie, parfois associée à des bitroncatures à dos (*i.e.* rectangles) qui pourraient correspondre pour partie au recyclage de pointes fracturées (Langlais *et al.*, 2014b ; fig. 1). Rappelons qu'aucune latéralisation préférentielle des dos et troncatures n'est démontrée sur ces objets (*ibid.* voir fig. 23) et que l'on peut noter une variabilité dimensionnelle des supports et du soin de la retouche selon les gisements considérés. Si l'on observe la répartition géographique des sites ayant livré des pointes de Malaurie attribuables au Laborien (fig. 2), on remarque une forte concentration de gisements dans le Bassin aquitain et quelques jalons, pour le moment, vers le Nord (Fagnart, 1988 ; Valentin, 1995, Bodu, 2000 ; Naudinot, 2010 ; Biard et Hinguant dir., 2011) et l'Est (Monin, 2000 ; Fornage-Bontemps, 2013).

Durant le Laborien récent, on assiste à une recombinaison du contenu lithique des carquois avec le déve-

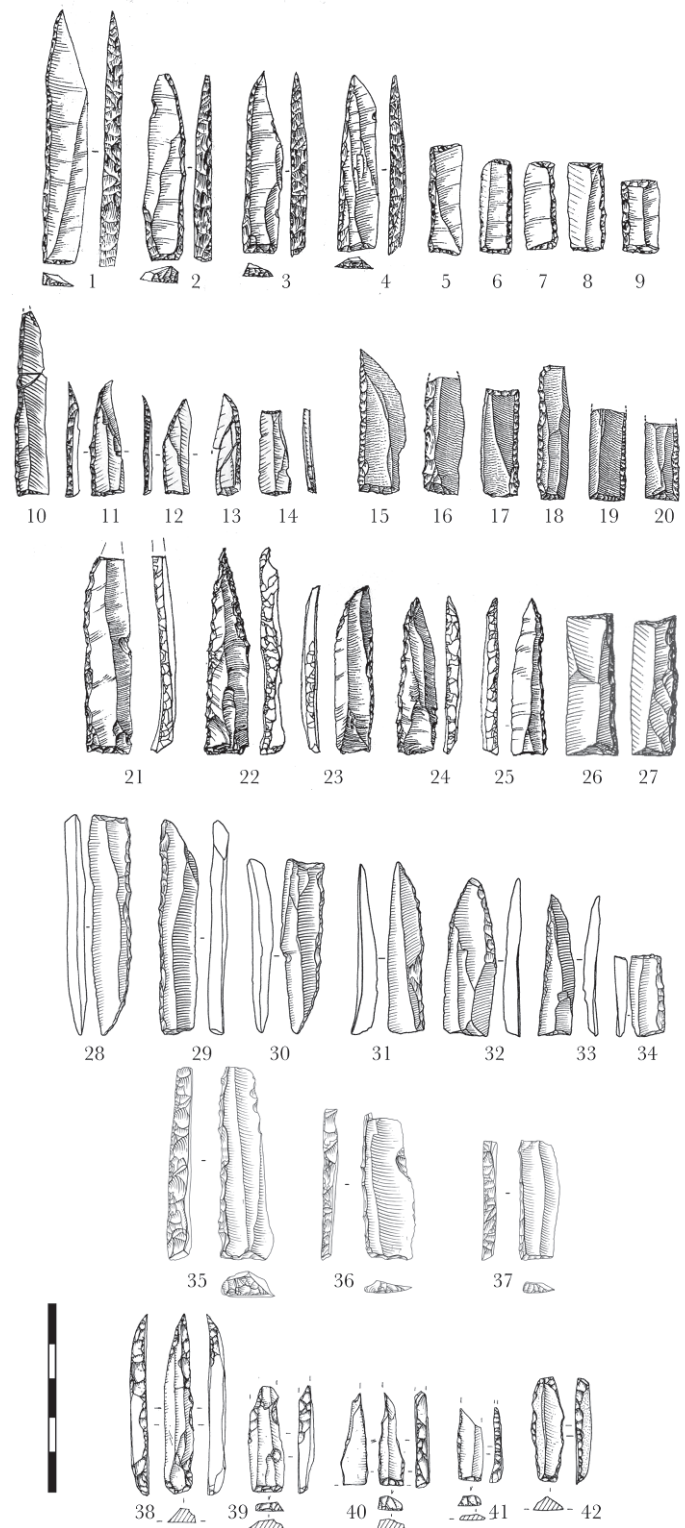


Fig. 1 – Exemples de pointes de Malaurie et bitroncatures à dos du Laborien ancien. 1-9 : La Borie del Rey, d'après Le Tensorer, 1981 ; 10-14 : Port-de-Penne, d'après Detrain dir., 1996 ; 15-20 : Roc d'Abeilles, d'après Champagne et Espitalié, 1970 ; 21-27 : Pont d'Ambon c.2, d'après Célérier, 1993 ; 28-34 : Le Morin, dessins S. Pasty ; 35-37 : Rochereil, dessins C. Fat Cheung ; 38-42 : Vaise, dessins P. Alix d'après Pasty in Jallet, Bouvier dir., 2012.

Fig. 1 – Examples of Malaurie points and backed bitruncation of Early Laborian. 1-9 : La Borie del Rey, after Le Tensorer, 1981 ; 10-14 : Port-de-Penne, after Detrain dir., 1996 ; 15-20 : Roc d'Abeilles, after Champagne and Espitalié, 1970 ; 21-27 : Pont d'Ambon c.2, after Célérier, 1993 ; 28-34 : Le Morin, drawings S. Pasty ; 35-37 : Rochereil, drawings C. Fat Cheung ; 38-42 : Vaise, drawings P. Alix after Pasty in Jallet, Bouvier dir., 2012.

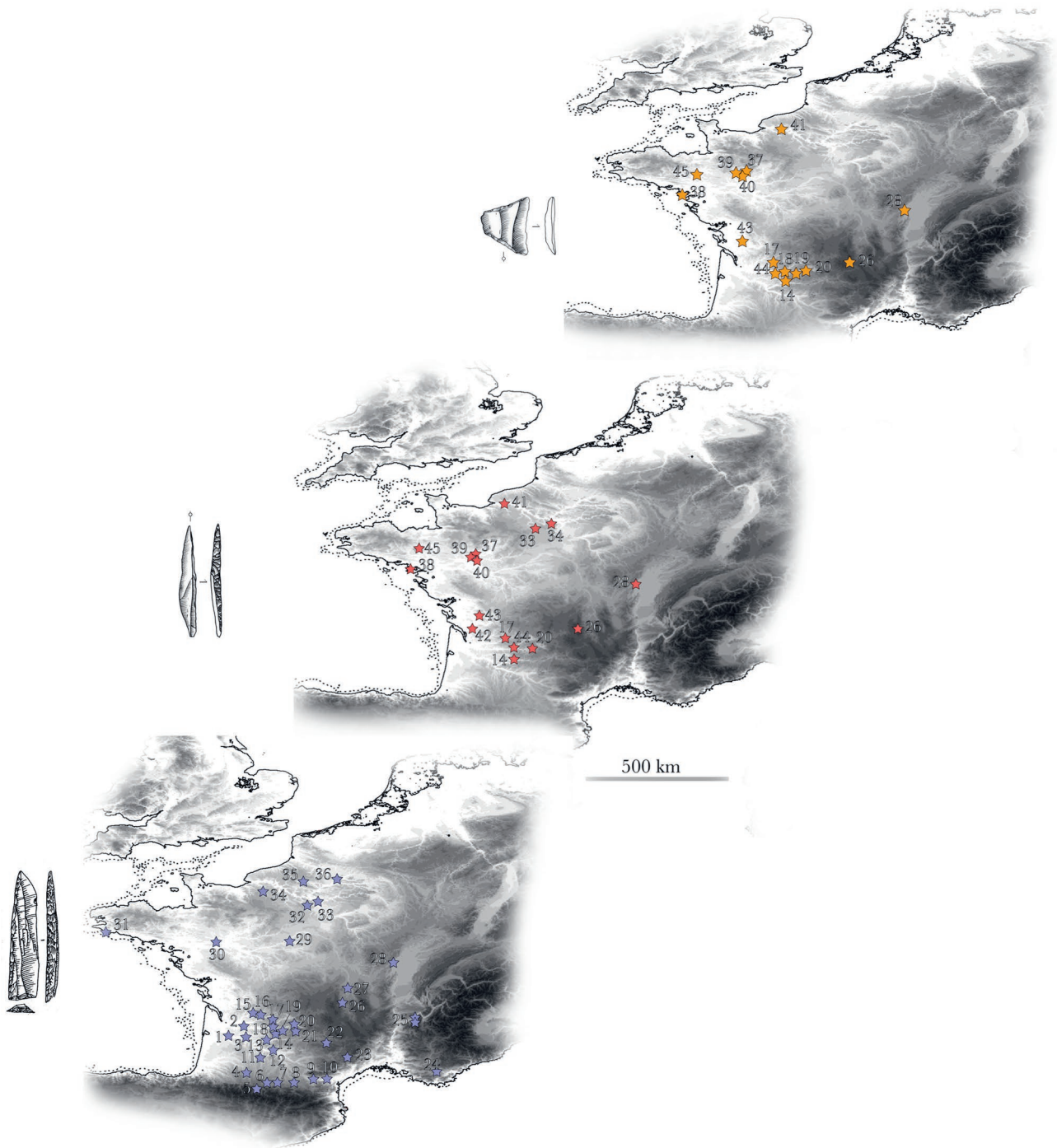
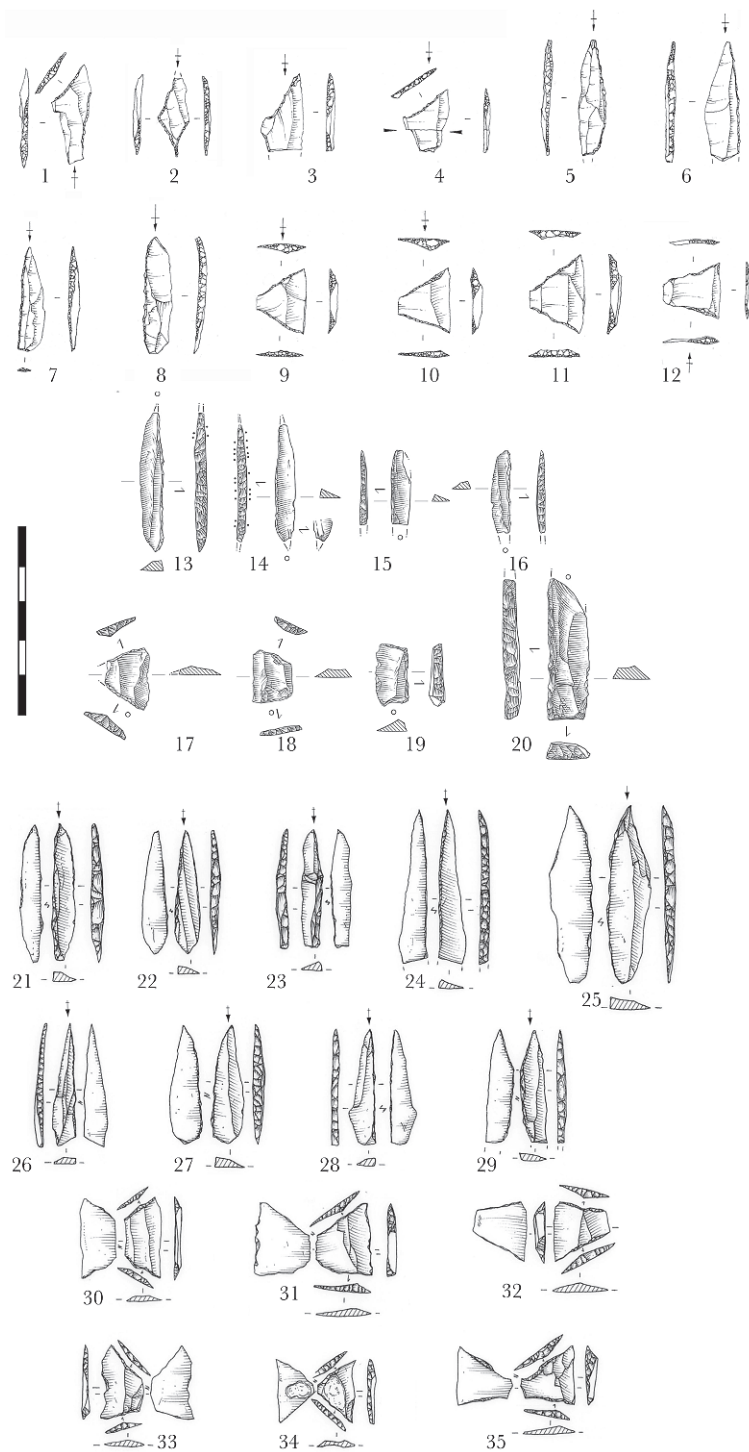


Fig. 2 – Répartition des principales armatures lithiques du Laborien (violet : pointes de Malaurie; rouge : pointes de Blanchères; orange : bitruncatures trapézi-formes); DAO ML.

Fig.2 – Location of main lithic weaponry from the Laborien (purple: Malaurie points; red: Blanchères points; Orange: Trapeziform bitruncations); CAD ML.

lancement de deux nouveaux morphotypes : les pointes des Blanchères et les bitruncatures trapézi-formes (Naudinot, 2013; Langlais *et al.*, 2015; fig. 3). Rappelons que les apex des pointes des Blanchères sont préférentiellement latéralisés en partie proximale (Valentin, 1995; Naudinot, 2010; Langlais *et al.*, 2014b voir fig. 23) tandis que les dos sont dextres ou senestres à la Borie del Rey (Langlais *et al.*, *op. cit.*)

et plus fréquemment positionnés à gauche dans le Grand Ouest (Naudinot, *op. cit.*). Des pointes à troncature oblique et concave, proches de celles mises au jour sur le site du Buhot à Calleville en Normandie (Biard et Hinguant dir., 2011), sont également présentes à la Fosse et aux Prises (Naudinot, 2010, 2013). Sur le site de la Fosse, à côté du couple dominant pointes des Blanchères – bitruncatures



n°	site	n°	site
1	Preignac	24	Baume Goulon
2	Le Morin	25	Colomb
3	Le Roc	25	La Passagère
4	Gouerris	26	Cuze de Neussargues
5	Troubat	27	Champ Chalatras
6	La Tourasse	28	Vaise
7	Buholoup	29	Muides/Loire
8	Mas d'Azil	30	Guichamerie
9	Gazel	31	Plobannalec
10	L'Abeurador	32	Blanchères
11	Manirac	33	Closeau
12	Guitard	34	Calleville
13	Port-de-Penne	35	La Muette
14	Borie del Rey	36	Ercheu
15	Rochereil	37	La Fosse
16	Pont d'Ambon	38	Vigie Romaine
17	Auberoche	39	Auvours
18	Moulin du Roc	40	Rochefort
19	Roc d'Abeilles	41	Alizay
20	Peyrazet	42	La Pouyade
21	Malaurie	43	Les Prises
22	Roquemissou	44	Gare de Couze
23	Usclades	45	La Cadiais

Fig. 3 – Exemples d'armatures du Laborien récent. 1, 3-4 : pointes à troncature oblique ; 2 : pointe à pédoncule ; 5-8, 13-16, 21-29 : pointes des Blanchères ; 9-12, 17-18, 30-35 : bitroncatures trapézoïdiformes ; 19 : bitroncature à dos ; 20 : pointe de Malaurie ; 1-12 : La Fosse, dessins F. Blanchet d'après Naudinot, 2013 ; 13-20 : Peyrazet, dessins S. Ducasse d'après Langlais *et al.*, 2015 ; 21-35 : Vaise, dessins P. Alix d'après Pasty in Treffort *dir.*, 2017.

Fig. 3 – Examples of lithic weaponry from the recent Laborian. 1, 3-4: oblique truncated points; 2: tanged points; 5-8, 13-16, 21-29: Blanchères points; 9-12, 17-18, 30-35: trapeziform bitruncations; 19: backed bitruncations; 20: Malaurie point; 1-12: La Fosse, drawings F. Blanchet after Naudinot, 2013; 13-20: Peyrazet, drawings S. Ducasse after Langlais *et al.*, 2015; 21-35: Vaise, drawings P. Alix after Pasty in Treffort *dir.*, 2017.

Tabl. 1 – Sites mentionnés sur la figure 3.
Table 1 – List of sites depicted in figure 3.

trapézoïdales, on peut rappeler la présence de quelques pièces pédonculées et à troncature oblique qui soulignent également des liens culturels avec l'Épiahrensbourgien (Naudinot, 2010, 2013; Naudinot et Jacquier, 2014). Ainsi, parallèlement à une diffusion – certes discrète – de morphotypes septentrionaux vers l'Ouest, on peut remarquer la présence des idées du Laborien récent dans le Nord-Ouest de la France tant pour les pointes des Blanchères que pour les bitroncatures trapézoïdales (fig. 2). Pour ces dernières, l'extension vers l'Est, grâce à la découverte du site de Vaise (Pasty *in* Jallet, Bouvier dir., 2012; Pasty *in* Treffort dir., 2017), offre un nouveau jalon avec les voisins épigravettiens possédant ces mêmes bitroncatures trapézoïdales dans des contextes précoces du Dryas récent (Peresani *et al.*, 2000; Dalmeri *et al.*, 2004; Ferrari et Peresani, 2003).

Dans le site éponyme comme dans plusieurs gisements stratifiés ou en plein air, rappelons également la présence de quelques bitroncatures à dos et pointes de Malaurie en contexte de Laborien récent associées donc au couple dominant Blanchères-Bitroncatures trapézoïdales (Naudinot, 2010; Langlais *et al.*, 2014b). On peut également noter l'association de pointes à troncature oblique concave et pointes de Malaurie au Buhot-Locus 2 (Biard et Hinguant dir., 2011). La question de la perdurance des pointes de Malaurie au cours du Laborien récent demeure toutefois sujette à discussion notamment au regard du contexte taphonomique des enregistrements (*ibid.*).

Les dates ^{14}C AMS permettent de circonscrire le Laborien *sensu lato* entre 12,5 et 10,8 ka cal. BP (Langlais *et al.*, 2014a et b, 2015). Les deux phases reconnues du Laborien – ancien et récent – ne sont pas bien distinguées du point de vue des dates ^{14}C (Langlais *et al.*, 2014b). Néanmoins, à partir de quelques données disponibles, nous proposons l'hypothèse d'un Laborien ancien correspondant *grosso modo* à la seconde moitié du Dryas récent et un Laborien récent pour la première moitié du Préboréal. Malgré le plateau ^{14}C , cette transition culturelle semble centrée non pas sur le début de l'Holocène à 11,7 ky cal. BP mais plutôt autour de « l'évènement 11.4 » reconnu dans les archives glaciaires (Rasmussen *et al.*, 2014). Toutefois, de nouvelles datations permettront de préciser cette corrélation et des travaux sur des enregistrements continentaux sont nécessaires pour la contextualisation régionale de cet événement climatique.

LE LABORIEN : UN COMPLEXE À LAMELLES DE SECTION PLATE ET DE PROFIL RECTILIGNE

En l'état des recherches et des analyses sur le matériel, il est difficile – pour ne pas dire impossible – de distinguer la production laminaire du Laborien ancien ou récent. Pour le Laborien ancien, les séries de La Borie del Rey (c.7 et c.5), Rochereil (II sup.), Port-de-Penne (niveaux 1 et 2 notamment), Le Pont d'Ambon (c.2), Champ-Chaltras et Vaise (Pasty *in*

Jallet, Bouvier dir., 2012; Langlais *et al.*, 2014b, Pasty *et al.*, 2002) montrent une recherche de lames régulières et larges, de section plate et de profil rectiligne (fig. 4). Ces supports particuliers sont obtenus à partir de l'exploitation à la pierre de la face large d'un volume. Ce même objectif avait été reconnu plus tôt et décrit pour le Laborien récent à La Fosse ou au Camp d'Auvours (Naudinot, 2010, 2013) puis à Peyrazet (Langlais *et al.*, 2015) et à Vaise (Pasty *in* Treffort dir., 2017). Dans ses grandes lignes, le schéma laminaire présenté ci-dessous et défini d'abord pour des industries dites « post-aziliennes » correspond bel et bien au schéma laborien *sensu lato*. Il rappelle fortement – bien que plus modeste en dimension – ce qui a été récemment proposé pour le Belloisien (Valentin *et al.*, 2014).

Quand il s'agit d'un bloc ou d'un rognon, la mise en forme bifaciale depuis les faces étroites (dièdres) permet de « façonner » des convexités transversales régulières. C'est à partir d'un de ces dièdres antéro-latéraux que s'opère l'initialisation. Le débitage envahit ensuite progressivement la face large à partir de deux plans de frappe. Régulièrement, afin de maintenir des conditions de convexités minimales, un retour vers un des dièdres antéro-latéraux est effectué avant de revenir vers la face large (fig. 5). Le dos, rarement exploité, témoigne généralement de négatifs transversaux qui sont les vestiges de la mise en forme transversale initiale (fig. 6; fig. 7, n° 2) et de réaménagements par néocrêtes antéro-latérales. Toutefois, on peut noter quelques cas de débitages « enveloppants », qui résultent d'une succession de séquences agglomérées (fig. 7, n° 1) et non pas d'un véritable débitage « tournant ». Sur éclat, le débitage, après avoir débuté par un enlèvement antéro-latéral plus ou moins préparé, investit la face inférieure naturellement convexe (fig. 7, n° 3). La plupart des nucléus et des lames témoignent de l'emploi de deux plans de frappe alternant plus rapidement dans les premières séquences laminaires qu'une fois le volume réduit en petites lames et lamelles. L'emploi d'un percuteur à la pierre est systématique et s'accompagne d'une abrasion plus ou moins soignée des bords de plans de frappe.

La réduction des volumes selon un schéma linéaire permet d'intégrer des supports laminaires (outils) et des petites lames (pièces tronquées et pointes de Malaurie/bitroncatures). Les séries du Laborien récent indiquent en revanche un net développement de la composante lamellaire, soit en continuité du débitage laminaire réduit, soit de manière autonome à partir de petits volumes exploités selon un schéma identique ou bien encore selon des débitages moins productifs de type sur tranche d'éclat (Naudinot, 2013; Langlais *et al.*, 2014b; fig. 6, fig. 7).

Lames, petites lames et lamelles du Laborien sont normalisées et présentent un *design* identique structuré autour d'un profil rectiligne et d'une section plate. Les terminaisons peuvent être plus ou moins effilées (*sic.*). En outre, les supports laminaires désirés au Laborien peuvent être rapprochés des lames dites « favorites » par M. Biard à partir de séries normandes attribuées

au Belloisien (Valentin, 2008 ; Biard et Hinguant dir., 2011). L'outillage dominant est composé typologiquement de pièces tronquées, grattoirs, burins et plus rarement de pièces aux tranchants mâchurés (fig. 8). Ces dernières ne sont pas sans rappeler les exemplaires de La Fosse ou du Camp d'Auvours (Naudinot, 2010, 2013), de séries septentrionales belloisiennes (e.g. Fagnart, 1993 ; Bodu et Valentin, 1992) ou encore « long blades » de Grande-Bretagne (e.g. Barton et Dumont, 2000). Au-delà de la question utilitaire de ces pièces mâchurées (e.g. Fagnart et Plisson, 1997 ; Jacquier, 2015), les études fonctionnelles menées récemment sur des assemblages laboriens ont bien montré la corrélation technofonctionnelle entre les caractères plats et rectilignes des supports laminaires et leur utilisation notamment en couteau (pour la boucherie ou le végétal ; Jacquier, 2014, 2015 ; Jacquier et Naudinot, 2015 ; Jacquier *in* Langlais *et al.*, 2015).

Du point de vue technoéconomique, cette recherche de supports normalisés et spécifiques requiert des silex de bonne qualité clastique. Ainsi, au cours du Laborien ancien et récent, on assiste à un renouvellement des réseaux d'approvisionnement de matière première comparativement à l'Azilien récent moins exigeant en terme technoéconomique (Naudinot, 2010, 2012 ; Fat Cheung *et al.*, 2014 ; Fat Cheung, 2015). C'est ainsi que dans des régions présentant de faibles disponibilités lithologiques (Massif armoricain, Massif central, Pyrénées notamment), les importations de volumes transportés sur de grandes distances (> 200 km, fig. 5, n° 2) ne sont pas rares. Plus généralement on peut noter un transport de lames en silex provenant fréquemment de plusieurs centaines de kilomètres (Pasty *et al.*, 2002 ; Naudinot, 2012 ; Naudinot et Jacquier, 2013, 2014 ; Langlais *et al.*, 2014b, 2015 ; Jacquier, 2015).

LES AUTRES REGISTRES

Au-delà des comportements technoéconomiques originaux exprimés sur les industries lithiques, le sud-ouest français livre d'autres informations sur les comportements économiques et symboliques des chasseurs-collecteurs du Laborien.

Ces groupes ont exploité différents gibiers. Ils ont particulièrement affectionné des grands Bovidés et Ongulés de milieux ouverts (aurochs et cheval notamment), comme par exemple à Champ-Chaltras (Griggo *in* Pasty *et al.*, 2002) et Port-de-Penne (Ferrié *in* Langlais *et al.*, 2014b) ou du cerf à Peyrazet (Costamagno *in* Langlais *et al.*, 2015) et au Pont d'Ambon (Ferrié *in* Fat Cheung *et al.*, 2014). La mésofaune est également mise à contribution comme par exemple le castor à La Borie del Rey (Mallye *in* Langlais *et al.*, 2014b) et au Pont d'Ambon (Ferrié *in* Fat Cheung *et al.*, 2014) ou la marmotte dans les Alpes à La Passagère et Colomb (Monin *et al.*, 2010). Rappelons enfin que la présence du chien est avérée au Laborien (Célérier et Delpéch, 1978 ; Célérier *et al.*, 1999 ; Chaix, 2000 ; Boudadi-Maligne *et al.*, 2018).

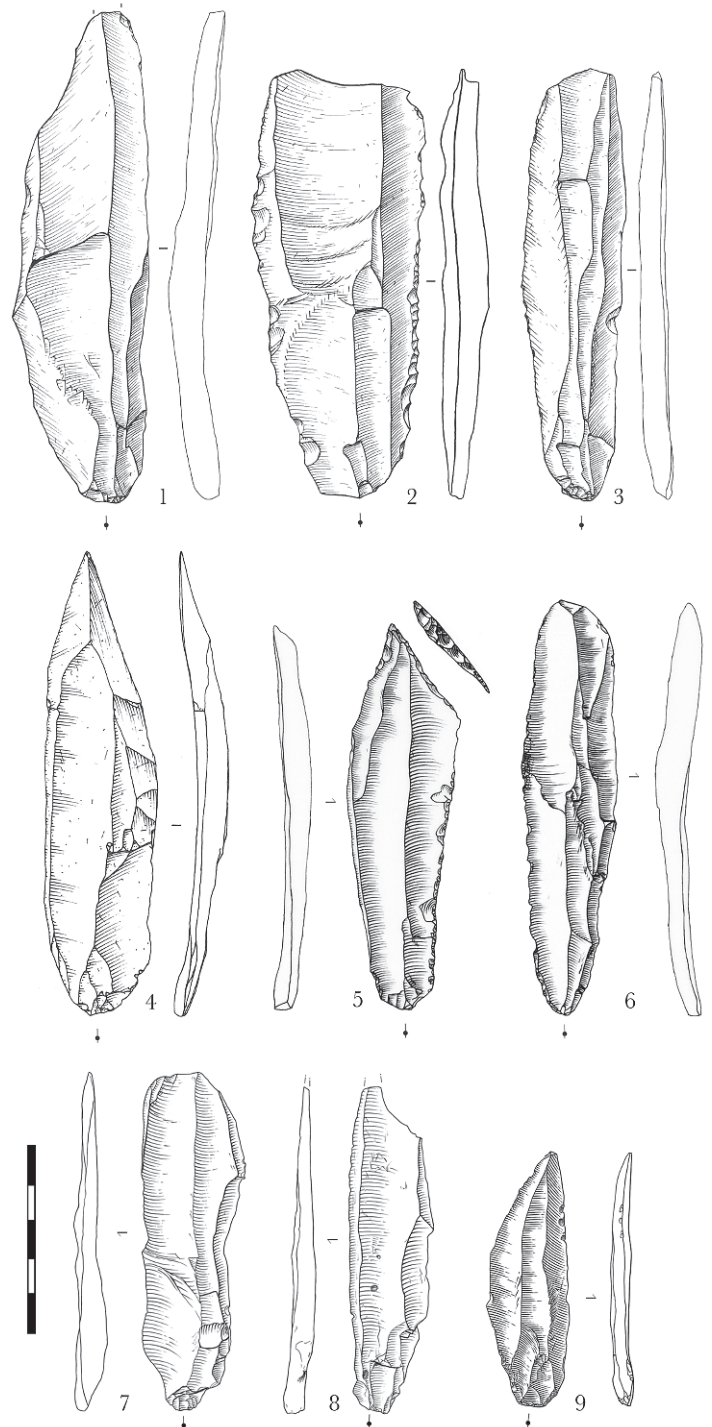


Fig. 4 – Exemples de lames de plein débitage du Laborien. 1-3 : Rocheireil, dessins G. Devilder ; 4 : Champ Chaltras, dessin P. Alix d'après Pasty *et al.*, 2002 ; 5-6 : La Borie del Rey, dessins C. Fat Cheung d'après Langlais *et al.*, 2014b ; 7-8 : Port-de-Penne, dessins C. Fat Cheung ; 9 : Peyrazet, dessins S. Ducasse d'après Langlais *et al.*, 2015.

Fig. 4 – Examples of « plein débitage » Laborian blades. 1-3: Rocheireil, drawings G. Devilder ; 4: Champ Chaltras, drawings P. Alix after Pasty *et al.*, 2002 ; 5-6: La Borie del Rey, drawings C. Fat Cheung after Langlais *et al.*, 2014b ; 7-8: Port-de-Penne, drawings C. Fat Cheung ; 9: Peyrazet, drawings S. Ducasse after Langlais *et al.*, 2015.

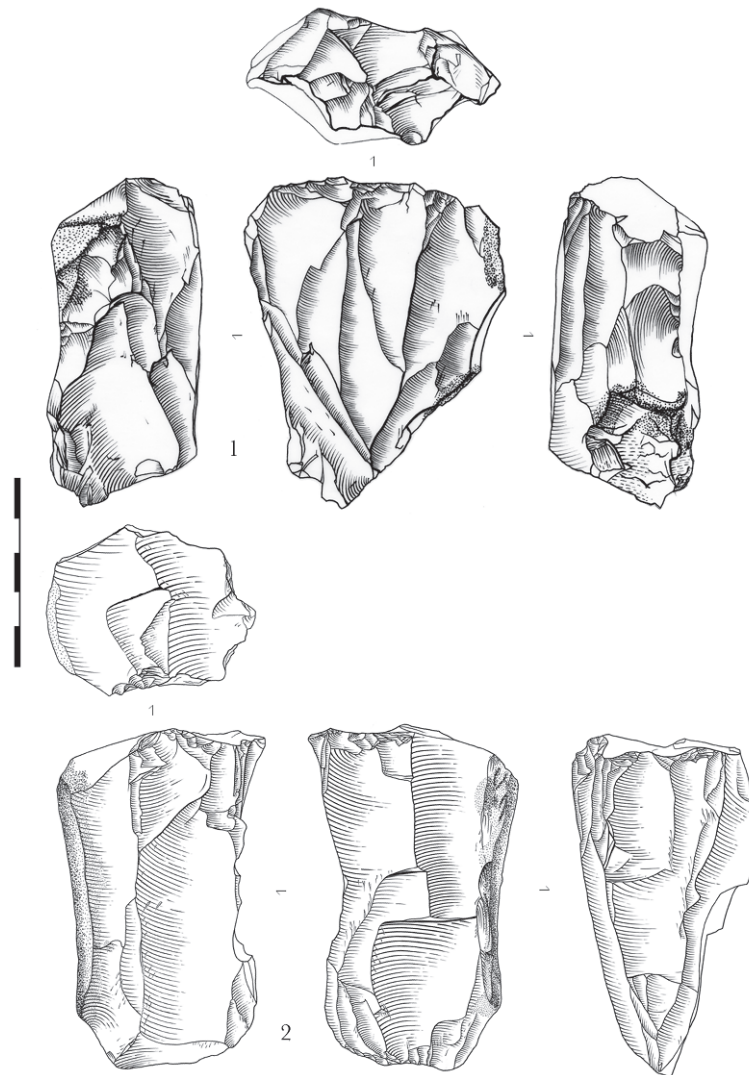


Fig. 5 – Exemples de nucléus à lames du Laborien (face large avec entretien antéro-latéral ; 1 : La Borie del Rey ; 2 : Port-de-Penne (dessins C. Fat Cheung).
Fig. 5 – Examples of Laborian blade cores (large face with antero-lateral maintenance ; 1 : La Borie del Rey ; 2 : Port-de-Penne (drawings C. Fat Cheung).

Pour l'industrie osseuse, peu de séries ont, pour l'instant, fait l'objet d'une étude approfondie : La Borie del Rey, Le Pont d'Ambon, Gouerris, Peyrazet et Port-de-Penne (Chauvière, Marquebielle *in* Langlais *et al.*, 2014b ; Pétillon *in* Langlais *et al.*, 2015 ; Marquebielle *in* Langlais coord, 2016a). Malgré les biais dus soit à la pauvreté des séries, soit à la taphonomie des sites, un premier bilan peut être présenté. On ne distingue pas pour le moment d'évolution des équipements entre Laborien ancien et récent. Le travail de l'os est fréquemment mené selon un schéma de transformation par fracturation, notamment de diaphyses. Les fragments obtenus sont façonnés par raclage, principalement en poinçons et lissoirs et ce façonnage est le plus souvent limité à la mise en forme de la partie active. Notons des indices de sciage transversal et de rainurage longitudinal dans certaines séries, qui pourraient indiquer l'application de méthodes de débitage plus complexes. En parallèle

d'une production globalement caractérisée par la simplicité des outils produits, les seuls objets décorés sont en os. Pour le bois de cervidé, on peut remarquer au Pont d'Ambon la présence d'un déchet d'extraction d'une large baguette en face postérieure d'un bois de cerf, au moyen d'un procédé de double rainurage parallèle (Marquebielle, 2018). Le principal type d'objet réalisé dans ce matériau est la pointe barbelée, documentée en particulier à Gouerris et Pont d'Ambon mais également, vraisemblablement, au Mas d'Azil (*ibid.*) ainsi qu'au Morin (pièce datée directement à 10365 ± 45 BP, Barshay-Szmidt *et al.*, 2016). Les éléments manquent néanmoins encore pour associer formellement extraction de baguettes et pointes barbelées au sein d'un même schéma de transformation. Quelques exemples de production d'objets sur supports en volume, type tronçons, sont également à signaler.

Concernant les comportements dits symboliques, l'attribution au Laborien de la sépulture de l'enfant de

La Madeleine s'appuie sur la date ^{14}C directe obtenue (10190 ± 100 BP) et la position du corps en *decubitus* dorsal dans une fosse remplie d'ocre – qui rappelle d'ailleurs des comportements mis en œuvre dans l'Épi-gravettien italien (Gambier *et al.*, 2000). La parure laborienne est essentiellement composée de coquillages et notamment de turitelles et dentales comme cela a été vu à La Borie del Rey, Port-de-Penne ou Peyrazet (Chauvière, Rigaud *in* Langlais *et al.*, 2014b; Rigaud *in* Langlais *et al.*, 2015). Quant à l'art mobilier, certaines séries livrent des galets présentant des gravures géométriques rappelant fermement les traditions ancestrales de l'Azilien récent : Champ Chalatras (Pasty *et al.*, 2002); le Roc en Gironde (Lenoir, 1996); Vaise (Pasty *in* Treffort *dir.*, 2017) et peut-être La Guichauderie (Naudinot, 2010) ou Roquemissou (Bobœuf, 2003). Parallèlement, quelques gisements

possèdent des fragments d'os longs finement gravés de représentations zoomorphes (aurochs ou cheval) schématiques munis de remplissages en croisillons localisés. Ces objets sont documentés dans des contextes du Laborien ancien sur le site éponyme ($N = 1$; Coulonges, 1963), au Morin ($N = 3$; Guy, 1993) et au Pont d'Ambon ($N = 23$ auxquels s'ajoute une représentation sur galet, Paillet et Man Estier, 2014).

CONCLUSIONS

Au terme de ce panorama entre France atlantique et méridionale, l'image du Laborien se précise. La proposition d'un phasage en deux temps – ancien et récent – permet au regard du contenu lithique des

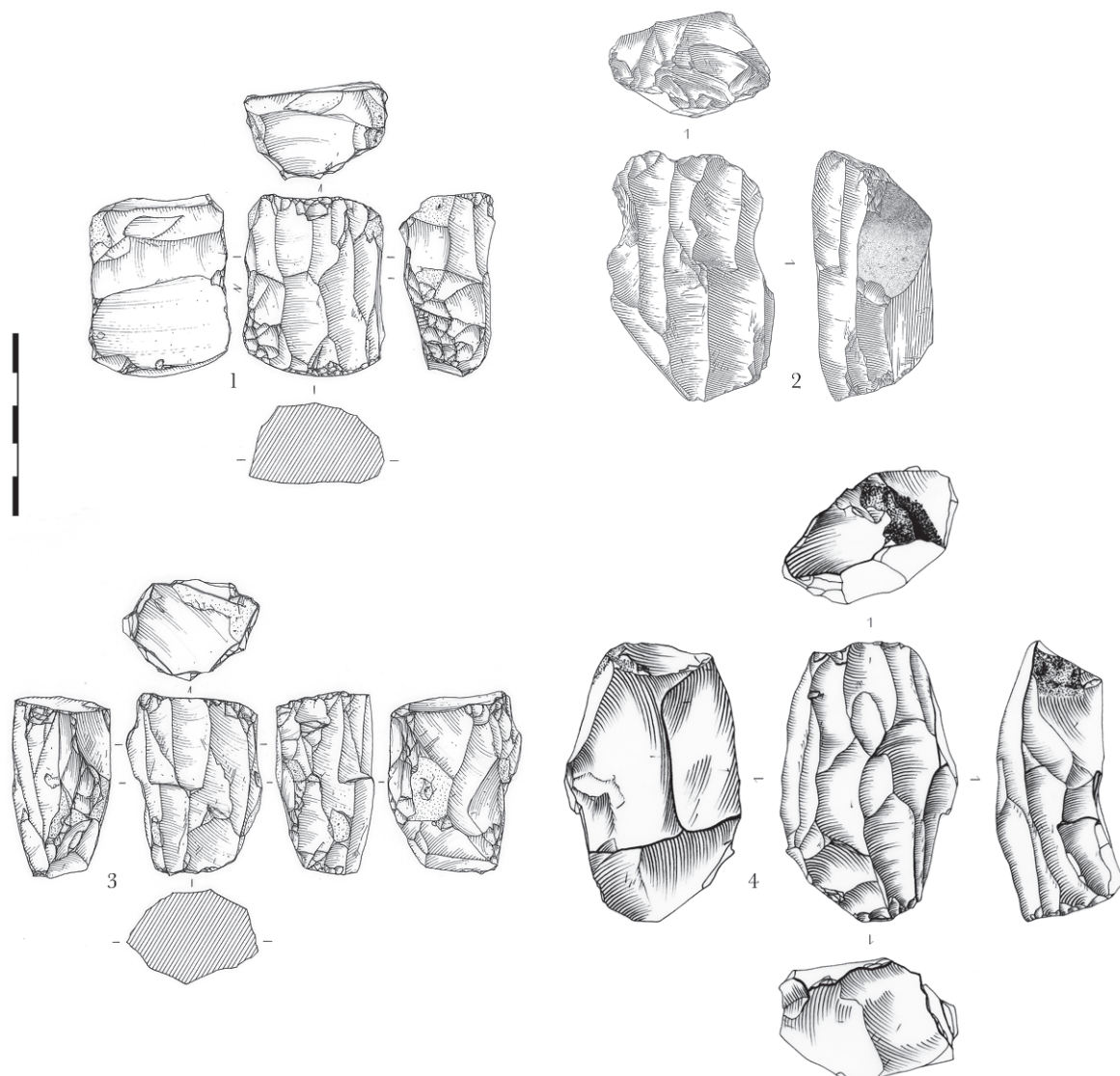


Fig. 6 – Exemples de nucléus lamino-lamellaires du Laborien (face large avec négatifs dorsaux de mise en forme bifaciale; 1-3 : Vaise, dessins P. Alix d'après Pasty *in* Treffort *dir.*, 2017; 2 : Peyrazet, dessins S. Ducasse d'après Langlais *et al.*, 2015; 4 : La Borie del Rey, dessins C. Fat Cheung d'après Langlais *et al.*, 2014b).
Fig. 6 – Examples of Laborian blade/bladelet cores (large face with bifacial preparation; 1-3 : Vaise, drawings P. Alix after Pasty *in* Treffort *dir.*, 2017; 2 : Peyrazet, drawings S. Ducasse after Langlais *et al.*, 2015; 4 : La Borie del Rey, drawings C. Fat Cheung after Langlais *et al.*, 2014b).

carquois d'élargir l'aire de diffusion de cet ensemble vers des contrées septentrionales dites belloisiennes à l'interface avec les territoires épi-ahrensbourgiens notamment. La mise au jour de nouveaux sites, comme Vaise à Lyon, ouvre également de nouvelles

perspectives sur les interactions entre les groupes laboriens et épigravettiens. On voit ainsi se dessiner un véritable « melting pot » culturel en Europe occidentale avec comme vecteurs principaux les armatures de chasse et un concept de production laminaire original.



Fig. 7 – Exemples de nucléus lamino-lamellaires du Pont d'Ambon c.2. 1 : « enveloppant », 2 : plat sur face large, cliché Ph. Jugie MNP; 3 : face large sur éclat; DAO ML.
Fig. 7 – Examples of Laborian blade/bladelet cores from Pont d'Ambon c.2. 1: « enveloppant », 2: flat on large face, photo Ph. Jugie MNP; 3: large face on flake; CAD ML.

À ce sujet, les nombreux travaux menés sur les industries à *lames plates et rectilignes (sic.)* nous permettent de souligner à nouveau les liens culturels évidents entre les technologies laboriennes et belloisiennes (si tant est que cette dernière appellation ait une valeur culturelle ou plus strictement économique, voir notamment Valentin, 2008 ; Fagnart, 2009 ; Naudinot, 2013).

C'est ainsi que l'existence de sites de production laboriens dans le sud-ouest français, présagés pour le moment sous la forme de sondages (Brizambourg, Charentes, Naudinot inédit) ou d'opérations préventives (Saint-Laurent-sur-Manoire, Dordogne, Detrain *in* Poissonnier dir., 2011), méritera prochainement toute notre attention.

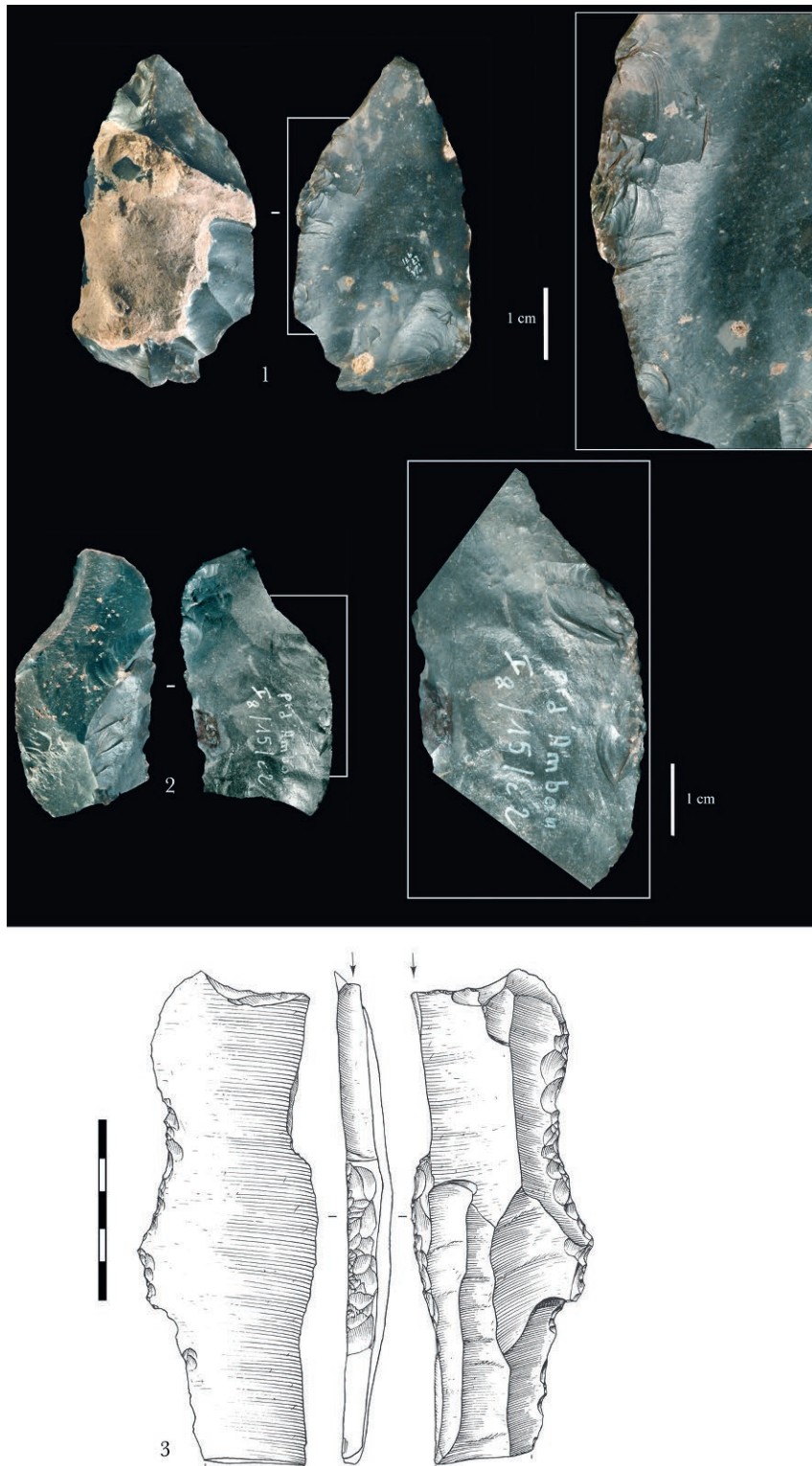


Fig. 8 – Exemples de pièces à bords « mâchurés » du Pont d'Ambon c.2 (cliché Ph. Jugie, MNP).
Fig. 8 – Examples of «bruised» pieces from Pont d'Ambon level 2 (photo Ph. Jugie, MNP).

Les armatures de chasse, pointes perforantes et tranchantes qu'arborent les chasseurs laboriens témoignent donc d'interactions avec les groupes de l'Épi-ahrensbourgien (pointes à pédoncule ou à troncature oblique) mais également avec l'Épigravettien (bitroncatures trapézoïdiformes). Le développement des productions lamellaires au Laborien récent répond à la confection des pointes des Blanchères. Ces groupes n'abandonnent pas pour autant la production de petites lames qui étaient privilégiées au Laborien ancien pour les pointes de Malaurie et désormais aux pointes à troncature oblique et bitroncatures trapézoïdiformes. L'équipement osseux du Laborien, certes encore mal connu, présente tout de même des éléments structurants qu'il faut désormais rechercher plus assidûment comme par exemple les pointes barbelées (voir *supra* avec le Pont d'Ambon ou surtout Gouerris), dont il s'agit maintenant de comprendre les possibles liens de filiation avec les productions aziliennes. La variabilité morphologique de ces pointes pose également question. Même conséquence avec la présence de galets aux gravures géométriques dans quelques sites anciens tandis que d'autres s'autonomisent régionalement – en l'état des découvertes – avec un art zoomorphe original sur os. Se dessine alors l'image de groupes du

Laborien, certes structurés autour de concepts techniques et symboliques fédérateurs, mais arborant un armement lithique empreint de multiculturalisme européen. ■

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NOTE

(1) Il s'agit en particulier du projet « Laborien entre Lot et Garonne » (2012; Langlais, coord; financement CG 47 et DRAC Midi-Pyrénées), du projet MAGDATIS « Des chasseurs-cueilleurs face aux changements environnementaux : le Magdalénien de la façade atlantique au Tardiglaciaire (18-14 kyr cal. BP) » (2011-2014; J.-M. Pétilion et V. Laroulandie coord.; financement ANR), du projet « Peuplements et cultures à la fin du Tardiglaciaire dans le nord du Périgord, entre Dronne et Tardoire » (2012-2016; P. Paillet coord.; financement DRAC Aquitaine).

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La transition Pléistocène-Holocène dans le Nord-Ouest de l'Europe vue par le prisme de la tracéologie lithique : essai de synthèse

Colas GUÉRET et Jérémie JACQUIER

Résumé : *Initialement, en Europe du Nord, les recherches concernant l'extrême fin du Paléolithique et le début du Mésolithique se sont avant tout intéressées aux changements perçus dans l'armement de chasse, puis dans les objectifs et les modalités des productions lithiques. Toutes ont insisté sur l'ampleur des contrastes entre ces deux périodes. L'adaptation des stratégies de chasse et des régimes de mobilité aux changements environnementaux profonds qui marquent le basculement holocène a souvent été invoquée pour expliquer les mutations typo-technologiques observées. En revanche, les industries lithiques n'ont été qu'exceptionnellement approchées à travers l'analyse fonctionnelle, et l'évolution de l'outillage commun est donc restée une question de second plan. L'objectif de cet article est donc de pallier cette lacune en présentant les résultats des études techno-fonctionnelles menées sur les industries lithiques du Paléolithique final et du premier Mésolithique réalisées dans le cadre de deux thèses de doctorat soutenues il y a quelques années. En considérant de très larges échantillons de pièces brutes et retouchées et en nous intéressant aux choix des supports employés, aux finalités de la retouche ou encore aux modalités d'emploi/réemploi des outillages, notre démarche nous permet de comparer les manières de concevoir l'équipement domestique à la charnière Pléistocène-Holocène en Europe de l'Ouest. Par là même, ces analyses nous permettent d'inférer indirectement sur les autres sous-systèmes techniques (peausserie, travail des matières dures animales, végétales, etc.) et de mettre ainsi en lumière des inflexions notables des systèmes économiques, notamment en ce qui concerne le travail du végétal. Même si ces deux techno-complexes apparaissent liés par quelques traits de continuité, ces analyses témoignent surtout d'une rupture profonde des pratiques entre Paléolithique final et Mésolithique.*

Mots-clés : *Paléolithique final, Premier Mésolithique, Tracéologie lithique, Économies, Travail de la peau, Travail des matières végétales.*

Abstract: *Initially, in Northern Europe, research about the Final Palaeolithic-Early Mesolithic transition has mainly focused on the changes observed in the hunting weaponry, then on those in the blade production. All have emphasised the major typological and technological shift, often explained by the adaptation of hunting strategies and mobility patterns to environmental changes. In comparison, the evolution of the common tools remains a secondary question in the current debates. The purpose of this paper is to present new technological and use-wear investigations, conducted on both Final Palaeolithic and Early Mesolithic lithic toolkits of Western Europe. The results allow us to compare the different ways of conceiving tools, as much as regarding the blank selection, the retouch process or the recycling process. Most importantly, the analysis of use-wear traces gives food for thought about the economy of human groups at the Pleistocene-Holocene transition and the changes that have occurred in the exploitation of animal and plant resources. Even though it is possible to distinguish a slight continuity in the toolkits, the differences are far more numerous.*

At the end of the Lateglacial, the lithic technological system is oriented toward the production of regular blades and bladelets with quantitative and qualitative variations depending on the functional and socio-economic status of the sites. In the Long Blade assemblages of Northern France, the very demanding production of blades seems to be closely related to the butchering of large mammals such as horses or aurochs. Outside of these blade production workshops and butchering areas, large blades are conceived as multifunctional and curated tools. Small blades are widely used in all the ranges of activity but in a more expedient way. The bladelets are essentially produced to be transformed into projectile points. In general terms, regular blades are conceived as unmodified knives and the retouched tools (hide scrapers, burins for bone and antler processing) involve secondary products or recycled regular blades already used as unmodified knives.

In the Mesolithic, the way of conceiving lithic tools also marks a deep change with the preceding period even if the unmodified blanks remain the overwhelming part of the equipment. Demanding blade production is abandoned in favour of bladelets which are used for projectile point manufacture as well as domestic activities.

In parallel, flakes are much more used than during the final Lateglacial and even become an independent objective of the lithic production in some Mesolithic contexts. The simplification of the lithic production also goes with a more expedient way to use the tools.

As in the previous Upper Palaeolithic phases, the Final Lateglacial economy appears to be clearly tied up to the transformation of animal resources. Nevertheless, the scarcity of bone and antler processing observed through functional analysis marks a contrast with the Magdalenian situation. This assessment is consistent with the direct data coming from bone industry analysis, which shows a quantitative and typological collapse at the end of the Magdalenian period. In this way, the role of the final Lateglacial lithic industry seems to be narrowed down to hunting and the processing of soft animal tissues.

In contrast, the Mesolithic seems to be associated with a progressive decline of the animal sphere and the rise of an intense exploitation of plants and wood enabled by the climatic warming of the Holocene. Butchering tools become much more discreet as are the use-wear traces observed on them. Skin processing remains well represented but the diversity of use-wear on the scraping tools decreases and hide cutting tools become almost absent suggesting a deep change in the way of making leather goods.

These results must be seen as the first step of a more ambitious collective project: now, the investigations have to be focused on well-dated assemblages on a European scale to gain a better understanding of the rhythm of these changes and their historical mechanisms.

Keywords: Final Palaeolithic, Early Mesolithic, Use-wear analysis, Economy, Hide-working, Working of vegetal material.

INTRODUCTION

Contrairement au Paléolithique, la période mésolithique a longtemps été sujette à débat quant à sa place dans l'Histoire des sociétés humaines en Europe. À partir du moment où l'hypothèse d'un hiatus entre Paléolithique et Néolithique a été invalidée, les débats se sont orientés sur le statut de cette phase, tantôt considérée comme un pré-Néolithique ou un Épipaléolithique, voire comme un moment de transition aux contours souvent mal définis (Guillomet-Malmassari, 2014). Le militantisme de certains chercheurs a permis progressivement d'installer le Mésolithique comme un moment à part au cours duquel se sont développées des traditions culturelles originales qui se distinguent de celles qui les ont précédées et succédées. Cette reconnaissance finalement assez tardive explique en grande partie les lacunes scientifiques rencontrées lorsqu'il s'est agi de réfléchir à la charnière Pléistocène-Holocène et aux transformations socio-économiques qui ont accompagné le réchauffement climatique.

Le rôle de J.-G. Rozoy (1978) dans l'émergence de cette problématique de la transition est central en France, dans le sens où il est le premier à avoir dépassé le simple constat d'un changement des productions lithiques au Mésolithique en le reliant au développement de nouveaux modes de vie conditionnés par les bouleversements environnementaux (Guillomet-Malmassari, 2014). Comme souvent, ce sont les armatures de chasse en pierre qui ont été les supports de ces réflexions, notamment dans le rapport de causalité effectué par J.-G. Rozoy entre le développement de la forêt, la généralisation de l'arc et la microlithisation lithique. Depuis, l'analyse des industries a profité des apports de l'approche technologique, ce qui a permis d'insister encore sur les différences majeures entre les productions laminaires parfois très

exigeantes du Paléolithique final (Fagnart, 1997; Valentin, 2008; Naudinot, 2013) et celles beaucoup plus lamellaires et souples du premier Mésolithique (Marchand, 1999, 2014; Souffi, 2004; Séara, 2014a). Ce renouvellement méthodologique et conceptuel est venu appuyer les considérations typologiques précédemment développées, mais a finalement apporté peu d'éléments nouveaux sur la question spécifique de la transition Pléistocène-Holocène sinon pour insister sur le caractère apparemment abrupt des transformations technologiques. Si l'on sait désormais que l'arc était utilisé au moins dès le Paléolithique final (Plisson, 2005), le postulat énoncé par Rozoy reste pourtant toujours d'actualité dans la communauté préhistorienne et occupe une place toujours centrale dans les scénarios proposés pour expliquer l'émergence du Mésolithique dans nos régions.

Au sein de ces débats, l'outillage, contrairement aux armatures de projectiles, est intervenu en marge car il fournissait peu de données typologiques pour comparer les deux périodes. Pendant longtemps, les gisements du Paléolithique final livraient en effet très peu de pièces retouchées, en particulier les sites belloisiens du Bassin parisien (Valentin, 2008), au même titre que ceux du premier Mésolithique, souvent assez pauvres en outils typologiques un tant soit peu normés (Guéret, 2013). Dans les dernières années, deux thèses indépendantes ont toutefois été l'occasion d'aborder les productions lithiques de la toute fin du Paléolithique (Jacquier, 2015) et du premier Mésolithique (Guéret, 2013) sous un angle techno-fonctionnel encore inédit dans le Nord de la France. Grâce à la lecture des traces d'utilisation, nous avons été en mesure de mieux caractériser l'outillage de chacune de ces deux phases, tout en abordant l'économie des groupes humains d'un point de vue systémique grâce à l'identification des activités réalisées à l'aide des tranchants lithiques. Les résultats obtenus, confrontés pour la première fois, permettent d'apporter de



Fig. 1 – Localisation des sites étudiés.
 Fig. 1 – Location of the studied sites.

nouveaux éléments qui viennent enrichir les scénarios concernant la fin des traditions paléolithiques et l'émergence de celles du Mésolithique.

CORPUS ET STRATÉGIE D'ÉTUDE

Des occupations de référence du Nord-Ouest de la France et de Belgique

Nos recherches ont été principalement centrées sur deux secteurs géographiques distincts : l'Ouest de la France pour le Paléolithique final ; le Bassin parisien et la Flandre belge pour le premier Mésolithique (fig. 1). Les données comparées pour les deux périodes ne sont donc pas issues des mêmes régions. Mais par bien des aspects, ces deux zones connaissent la même ambiance chrono-culturelle tant pour la fin du Pléistocène que pour le début de l'Holocène.

En ce qui concerne la toute fin du Paléolithique, les analyses se sont concentrées en priorité sur les deux gisements de plein air de référence pour l'Ouest de la France qui présentaient le plus de potentiel fonctionnel :

- Le site de La Fosse (Villiers-Charlemagne, Mayenne), fouillé récemment par N. Naudinot et un des auteurs de cet article, a été exploré sur près de 100 m² et a livré plusieurs dizaines de milliers de restes lithiques parmi lesquels de nombreux outils et

armatures de projectiles (Naudinot et Jacquier, 2014). Cette richesse et la forte homogénéité du corpus sont de toute évidence liées à un ou plusieurs séjours de longue durée qui s'illustrent également par des structures d'habitats circulaires.

- Ce profil contraste avec celui du site du Buhot (Calleville, Orne), fouillé par M. Biard et S. Hinguant (2011). Ce gisement, composé de deux concentrations lithiques moins denses et moins structurées, a notamment été le lieu d'une production de grandes lames évoquant les ateliers belloisiens, ce qui permettait d'aborder la vocation de ces débitages emblématiques de la toute fin du Paléolithique du Nord de la France.

- À ces deux corpus septentrionaux s'est enfin ajouté celui de l'occupation laborienne de la grotte-abri de Peyrazet (Creysse, Dordogne), fouillée dans les dernières années par M. Langlais et V. Laroulandie et datée du tout début du Préboréal (Langlais *et al.*, 2015).

Le premier Mésolithique a été abordé par l'intermédiaire de cinq corpus issus de quatre sites, sélectionnés parmi un ensemble de gisements de plus en plus étoffé pour le Bassin parisien et la Belgique grâce à l'archéologie préventive. Le choix s'est orienté en priorité vers des ensembles bien fouillés, datés et homogènes du point de vue chrono-culturel :

- Trois d'entre eux sont issus des fouilles menées par P. Crombé et son équipe sur les gisements de Verrebroek «Dok» et Doel «Deurganckdok» (Flandre orientale). Ces opérations ont permis d'explorer

plusieurs milliers de mètres carré d'occupations datées de la charnière des IX^e/VIII^e millénaires avant notre ère, installées sur des dunes et se manifestant sous la forme de dizaines de concentrations lithiques bien délimitées (Crombé, 1998, 2005). Outre nos analyses sur les locus C2 de Doel et C57/C58 et C17 de Verrebroek, il faut signaler que ces deux sites ont fait l'objet d'analyses tracéologiques précédemment menées par V. Beugnier sur d'autres locus (Crombé et Beugnier, 2013).

– L'occupation de Rosnay (Marne), fouillée en 2010 par B. Souffi, est également située en contexte sableux et se manifeste sous la forme d'un petit locus isolé, exploré en quasi-totalité sur une surface de 20 m² (Souffi *et al.*, 2015). Deux datations cohérentes et convergentes réalisées sur os brûlé et noisette ont permis d'attribuer ce site à la fin du IX^e millénaire avant notre ère.

– Noyen-sur-Seine (Seine-et-Marne), en comparaison avec les autres occupations, présente la particularité d'être un gisement en milieu humide où les restes organiques ont été préservés au fond de mares tourbeuses. Pirogues, vanneries, restes fauniques et humains parfaitement conservés font de ce site, fouillé par C. et D. Mordant, une référence unique pour le Bassin parisien (Mordant et Mordant, 1989; Mordant *et al.*, 2013). L'analyse fonctionnelle s'est concentrée sur le corpus lithique de la fin du premier Mésolithique daté du tout début du VII^e millénaire.

Un souci d'exhaustivité dans l'échantillonnage tracéologique

L'approche des corpus paléolithiques et mésolithiques a été faite indépendamment, mais selon des protocoles identiques construits à partir d'échanges scientifiques constants, ce qui permet une comparaison des résultats pertinente.

Du point de vue méthodologique, l'analyse des collections s'est à chaque fois basée sur les stratégies et les grilles de lecture mises en place dans les travaux de S. Semenov (1964) et L. Keeley (1980) et désormais partagées par la quasi-totalité des tracéologues européens. Les stigmates d'utilisation ont été observés à l'échelle macroscopique grâce à une loupe binoculaire (grossissements inférieurs à $\times 100$) et à plus fort grossissement grâce à un microscope métallographique ($\times 50$ - $\times 500$). Ces traces ont ensuite été comparées à des collections expérimentales afin de déduire les gestes pratiqués et les matières travaillées par les tranchants archéologiques.

La particularité de notre démarche se manifeste dans le souci d'exhaustivité affiché au moment de l'échantillonnage : si les pièces retouchées typologiques ont été concernées, nous avons aussi intégré au corpus étudié un nombre important de supports bruts afin d'estimer la part de cette composante dans l'outillage des deux périodes.

Concernant le Mésolithique, le choix de départ d'aborder de petits corpus a permis de mener une analyse complète à l'échelle macroscopique et micro-

scopique de l'ensemble des supports utilisables (hors esquilles donc) pour chaque collection, indépendamment de la présence de retouches volontaires. Seul le locus C17 de Verrebroek «Dok» a fait l'objet d'une sélection en raison du fort taux de pièces lithiques fragmentées par le feu qui biaisait de toute manière la valeur de l'échantillon de départ. Dans ce cas spécifique, l'approche fonctionnelle a concerné la totalité des outils retouchés et des supports bruts marqués à l'œil nu par des stigmates potentiellement liés à l'utilisation. Les occupations du Paléolithique final étant beaucoup plus riches en matériel, il a fallu adapter cette sélection en fonction des sites. Ainsi, seul le corpus de Peyrazet a fait l'objet d'une approche exhaustive, à l'exception de quelques pièces non disponibles au moment de l'étude. Pour le Buhot, ont d'abord été concernés l'ensemble des supports retouchés, toutes les pièces brutes ébréchées isolées lors de l'étude technologique ainsi que dix-huit ensembles lithiques remontés. Une analyse de la totalité du matériel (hors esquilles) issue de deux bandes traversant le site (40 m²) a aussi été menée. À la Fosse également, le matériel brut et retouché de deux secteurs correspondant à 22 m² a été analysé exhaustivement, auquel il faut ajouter des outils retouchés et quelques grandes lames issus d'autres zones du site.

Au total, le corpus étudié, tant pour le Paléolithique final que pour le premier Mésolithique, s'élève à plus de 7 500 objets parmi lesquels près de 7 000 supports bruts. Ce large échantillon permet, pour la première fois, de mener en Europe du Nord-Ouest une discussion sur les évolutions de l'outillage et de son statut techno-économique à la charnière Pléistocène-Holocène.

RÉSULTATS

Au total, tous sites confondus, les analyses ont permis l'identification de 747 outils utilisés, soit 1 177 zones utilisées (tabl. 1). Ces résultats nous autorisent à dégager des tendances en matière de finalités des productions lithiques, d'économie des débitages, de gestion des outillages et plus généralement sur les économies préhistoriques en inférant indirectement sur les autres sous-systèmes techniques (peausserie, industries osseuses, etc.).

Finalités et économie des débitages, gestion des outillages et rôle de la retouche

– *Un emploi massif des supports bruts : une constante entre Paléolithique final et Mésolithique*

L'un des grands apports de ces travaux est d'avoir pu mettre en évidence l'importance des supports bruts au sein de l'équipement. Ce constat est valable aussi bien pour le Paléolithique final que pour le premier Mésolithique. Selon les sites, les zones utilisées (ZU) repérées sur l'outillage brut constituent entre 60 %

	Paléolithique				Mésolithique			
	La Fosse	Le Buhot	Peyrazet	Total	Flandres	Rosnay	Noyen	Total
Travail des matières végétales (plantes et bois)	3	2	5	10	55	15	90	160
longitudinal			3 (2)		1		16	
transversal	3 (2)	2	2		53 (1)	15	73 (2)	
indéterminé					1		1	
Travail de la peau	224	23	26	273	44	69	43	156
raclage	86	20	14		41 (1)	53 (7)	37 (3)	
découpe	135 (3)	3 (1)	7		3	8	6	
autre et indéterminé	3		5			8 (2)		
Travail des matières dures animales	14	7	2	23	9		12	21
raclage	14	7 (1)	1		9		9 (2)	
rainurage			1		0 (5)		1 (1)	
sciage							2	
Travail des matières tendres animales	106	44	10	160	11	33	15	59
boucherie	45 (31)	44 (15)	10 (2)		10 (2)	20 (1)	15 (3)	
découpe matière tendre animale indéterminée	61 (9)				1 (3)	13 (1)		
Travail des matières minérales	46	36	3	85	10	4	30	44
percussion (type briquet)					6?		23 (1)	
percussion (type lame machuré)	20	29						
rainurage/sciage	6 (1)	2						
travail de l'ocre					3		5	
raclage	19	5	3					
Autre	1				1 (1)	4 (2)	2	
Indéterminé	79	31	15	125	20	13	28	61
raclage	45	3			11	6 (2)	21 (1)	
rainurage					1			
découpe	21	2			2	1(1)	2	
percussion/fendage	4	24	6 (2)			1	5 (1)	
indéterminé	9	2	9		6	5	0 (2)	
Total	472	143	61	676	149	134	218	501

Tabl. 1 – Résultats de l'analyse tracéologique en nombre de zones utilisées. Les chiffres entre parenthèses s'ajoutent aux décomptes et correspondent aux zones utilisées douteuses.

Table 1 – Number of use zones identified for each corpus. The numbers in brackets can be added to the total but correspond to uncertain use zones.

(Flandre) et 88 % (Noyen-sur-Seine) des ZU identifiées sur l'ensemble de l'outillage (fig. 2). Cette réalité est encore plus éclatante si l'on compare la nature des zones actives et ce pour trois raisons principales : (1) les supports bruts sont fréquemment utilisés en plusieurs endroits, (2) les outils retouchés ont fréquemment été utilisés bruts avant leur transformation par retouche, et (3) bon nombre d'outils, à peine modifiés (troncatures notamment), ont été employés par leurs bords bruts. Ainsi, dans ces deux technocomplexes, les qualités intrinsèques des supports débités suffisent le plus souvent à satisfaire les besoins des utilisateurs. Leur capacité de coupe explique sans doute leur polyvalence ainsi que leur succès. Nous verrons que l'aménagement des supports intervient pour des besoins spécifiques.

– *Le choix des supports : un changement de paradigme*

Au-delà de cette constante et corrélativement aux transformations intervenues dans les modalités et objectifs de production, la nature des produits employés se voit profondément changée. Sur les sites du Paléolithique final, une dichotomie très nette existe entre l'usage qui est fait des lames, réservées à la

sphère domestique et des lamelles strictement dédiées à la fabrication des armatures de projectiles. Les seules exceptions à cette règle concernent les rares pointes de type Malaurie et les bitroncatures trapézoïdales (probables armatures tranchantes, étude en cours) réalisées aux dépens de lames étroites. Les premières sont emblématiques de la phase ancienne du Laborien (seconde moitié du Dryas récent), mais semblent perdurer dans les assemblages à micropointes de type Blanchères de la phase récente (ancrage Préboréal) du Laborien (cf. Langlais *et al.*, 2014 et 2015); c'est le cas sur les trois sites étudiés (Biard et Hinguant, 2011; Naudinot, 2013; Langlais *et al.*, 2014). Les secondes apparaissent dans la phase récente du Laborien (Langlais *et al.*, 2014 et 2015) et sont également connues en domaine épigravettien (par exemple, Duches *et al.*, 2014).

Ainsi, les lamelles ne sont presque jamais utilisées à l'état brut et ne sont, sauf cas exceptionnels, les supports d'aucun outil typologique. Les lames quant à elles semblent avant tout débitées pour servir de couteaux, sous forme brute ou à peine modifiée (dos, troncature).

D'après les résultats obtenus au Buhot, le soin remarquable porté aux productions laminaires de grandes dimensions dans la Somme et le Bassin parisien a été motivé par des exigences particulières en

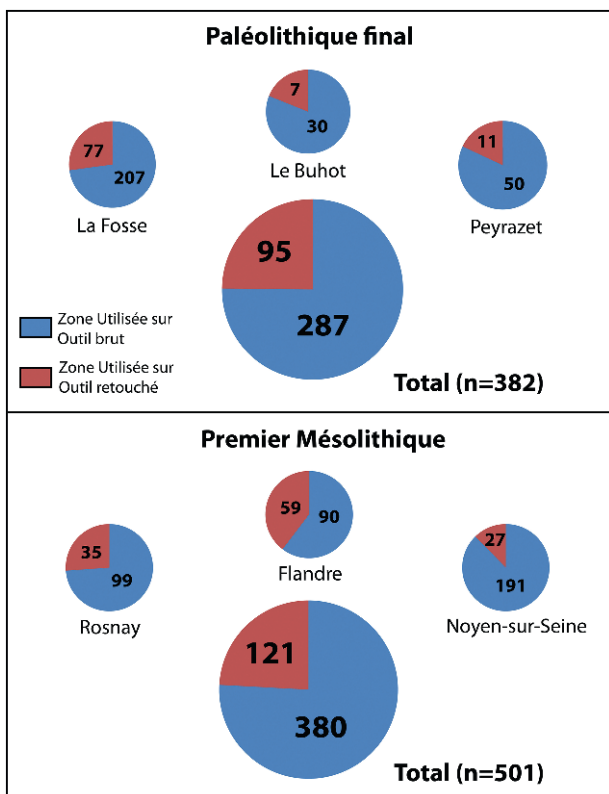


Fig. 2 – Proportions de zones utilisées sur des outils retouchés (rouge) et bruts (bleu) pour le Paléolithique final (en haut) et le premier Mésolithique (en bas). Pour le Paléolithique final, les données prises en compte concernent la totalité du matériel de Peyrazet et celui issu des secteurs de La Fosse et du Buhot étudiés exhaustivement.

Fig. 2 – Proportion of use zones on retouched tools (red) and unretouched tools (blue) for the Final Palaeolithic (top) and the Early Mesolithic (bottom). For the Final Palaeolithic, data concerns the lithic material from Peyrazet and the sectors of La Fosse and Le Buhot which have been studied exhaustively.

matière d'outillage de boucherie (fig. 3). Ces résultats concordent avec les quelques observations faites par H. Plisson sur des grandes lames de plein débitage de Flixecourt (Fagnart, 1997; Fagnart et Plisson, 1997). En dehors de ces sites très particuliers (pour un bilan sur le faciès Belloisien, cf. Valentin, 2008), les débitages sont moins ambitieux et deux ensembles laminaires se distinguent alors par leur gabarit, leur rôle et leur gestion. Les lames les plus larges (25-30 mm) et régulières constituent des couteaux avant tout employés à la découpe de tissus carnés et cutanés. Étant systématiquement ou presque recyclés, on ne retrouve que rarement ces supports entiers. Le plus souvent, ils sont abandonnés sous forme de grattoir, de burins ou de chutes. En fait, après une première vie fonctionnelle, ils rejoignent les produits « déclassés » (lames irrégulières ou épaisses, éclats laminaires, éclats, lames à crête) pour servir de supports à l'outillage retouché. Les lames étroites quant à elles sont les produits les plus polyvalents, mais sont nettement moins fréquemment intégrées dans les cycles d'utilisation-réutilisation-recyclage. Les éclats, régulièrement supports des grattoirs, ne sont que peu utilisés à l'état brut.

L'avènement du Mésolithique correspond à des changements significatifs dans les objectifs de débitage qui se traduisent également dans les types de supports utilisés. La disparition des débitages laminaires exigeants au profit de productions lamellaires très majoritaires s'accompagne ainsi d'une utilisation massive des lamelles, tout autant pour la fabrication des microlithes que pour les activités domestiques (fig. 4). Ce phénomène apparaît très marqué en Flandre et à Rosnay où les lamelles constituent respectivement 71 % et 69 % des supports bruts marqués par des traces d'utilisation. En parallèle, les éclats sont plus régulièrement mis à profit pour l'outillage brut et retouché (grattoirs, denticulés) qu'à la fin du Paléolithique. Ces produits peuvent, dans certains cas, être issus de débitages lamellaires, mais dans d'autres, ils semblent constituer l'objectif premier de productions assez simples réalisées à la pierre dure. Cette pratique a pu être observée à Noyen-sur-Seine (Mordant *et al.*, 2013) qui se caractérise d'ailleurs par la prédominance des éclats (74 %) sur les lamelles au sein de l'outillage brut. La simplification des chaînes opératoires lithiques et la relative souplesse constatée dans la sélection des supports utilisés sont également à relier à des cycles d'utilisation plus courts au sein desquels le recyclage n'intervient que ponctuellement : en effet, la plupart des outils sont abandonnés après une utilisation spécifique sur un type de matériau et le plus souvent par un ou deux bords actifs seulement. Ces résultats rejoignent totalement les observations faites par plusieurs chercheurs dans des contextes français et belges contemporains (Philibert, 2002; Khedhaier, 2003; Crombé et Beugnier, 2013) et marquent une différence notable avec le Paléolithique final.

– Des outils typologiques peu parlants sur la nature du changement

Nous avons vu que malgré les changements profonds qui affectent la forme, les dimensions et la régularité des supports débités entre le Paléolithique final et le Mésolithique, les supports bruts et leurs tranchants aigus restent la base de l'équipement domestique. Ainsi, la simplification des débitages au début du Mésolithique ne témoigne pas d'une conception nouvelle de l'outil où le rôle de la retouche (calibration des supports, adaptation des zones actives aux besoins fonctionnels) serait profondément changé.

Pour la plus grande part, l'équipement retouché évolue essentiellement sur des petits aspects typologiques marginaux. Les grattoirs dominent généralement les ensembles typologiques et restent sans surprise des outils de peausserie (fig. 5 et 6). Même la cinématique précise de ces outils est constante puisqu'ils sont essentiellement employés selon un angle rasant entre la face inférieure et la peau. Ajoutons que dans chacun des technocomplexes, des variations inter-sites très fortes peuvent être observées dans les dimensions et morphologies de ces outils, l'intensité des traces et des affûtages, les caractéristiques optiques des usures ou les modalités d'emmanchement

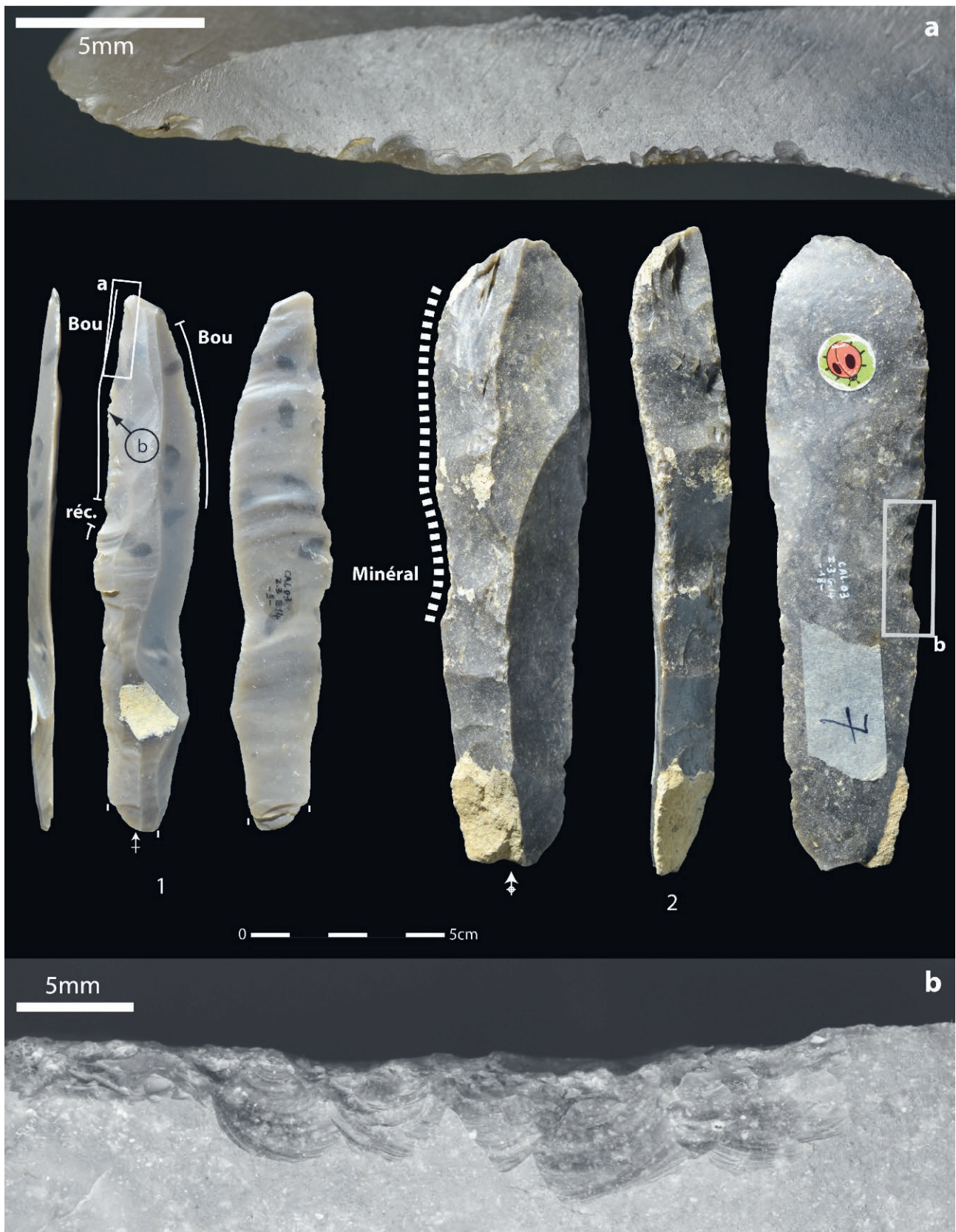


Fig. 3 – L'utilisation de grandes lames pour la boucherie (lame favorite, à gauche) et pour le travail des matières minérales (lame massive, à droite), observée au Buhot, est une particularité du Paléolithique final d'Europe du Nord-Ouest.
Fig. 3 – Long butchery knives corresponding to «lames favorites» (on the left) and massive bruised blades (on the right) used on mineral material are a specificity of the Final Palaeolithic in northwestern Europe. Examples from Le Buhot.

supposées. Cette complexité qui tient sans doute à la fois du statut des sites au sein des systèmes économiques préhistoriques et du caractère hautement identitaire du travail de la peau dans les sociétés traditionnelles (voir notamment Weedman Arthur, 2008 ; Badenhorst, 2009) ne simplifie pas la reconnaissance d'inflexions sur le temps long.

Les burins quant à eux se raréfient au Mésolithique. La fonction de ces outils n'a encore fait l'objet que de peu d'attention de la part des tracéologues. L'analyse de quelques exemplaires par l'un d'entre nous n'a livré que peu de traces d'usage, si bien que leur fonction reste délicate à appréhender. Ces premiers résultats pourraient cependant indiquer une continuité technique avec le Paléolithique final dans la mesure où les seules usures qui ont mené à une détermination

précise se rapportent au travail de matières dures animales (Guéret, 2013).

Le premier Mésolithique voit tout de même se développer une gamme d'outils originale : les denticulés. Ces éclats, généralement épais et aménagés à la pierre dure par une succession d'enlèvements grossiers déterminant des coches et des dents, sont présents parfois en nombre dans les séries comme à Noyen-sur-Seine, mais sont par contre absents des gisements plus anciens de Flandre et de Rosnay. Leur fonction pourrait être en rapport avec le traitement des carcasses animales, mais les indices tracéologiques qu'ils livrent pour l'instant restent trop ténus pour que cette interprétation puisse être considérée comme définitive.

En termes d'innovation, le Nord de la France voit également l'émergence, dès le début du Mésolithique,

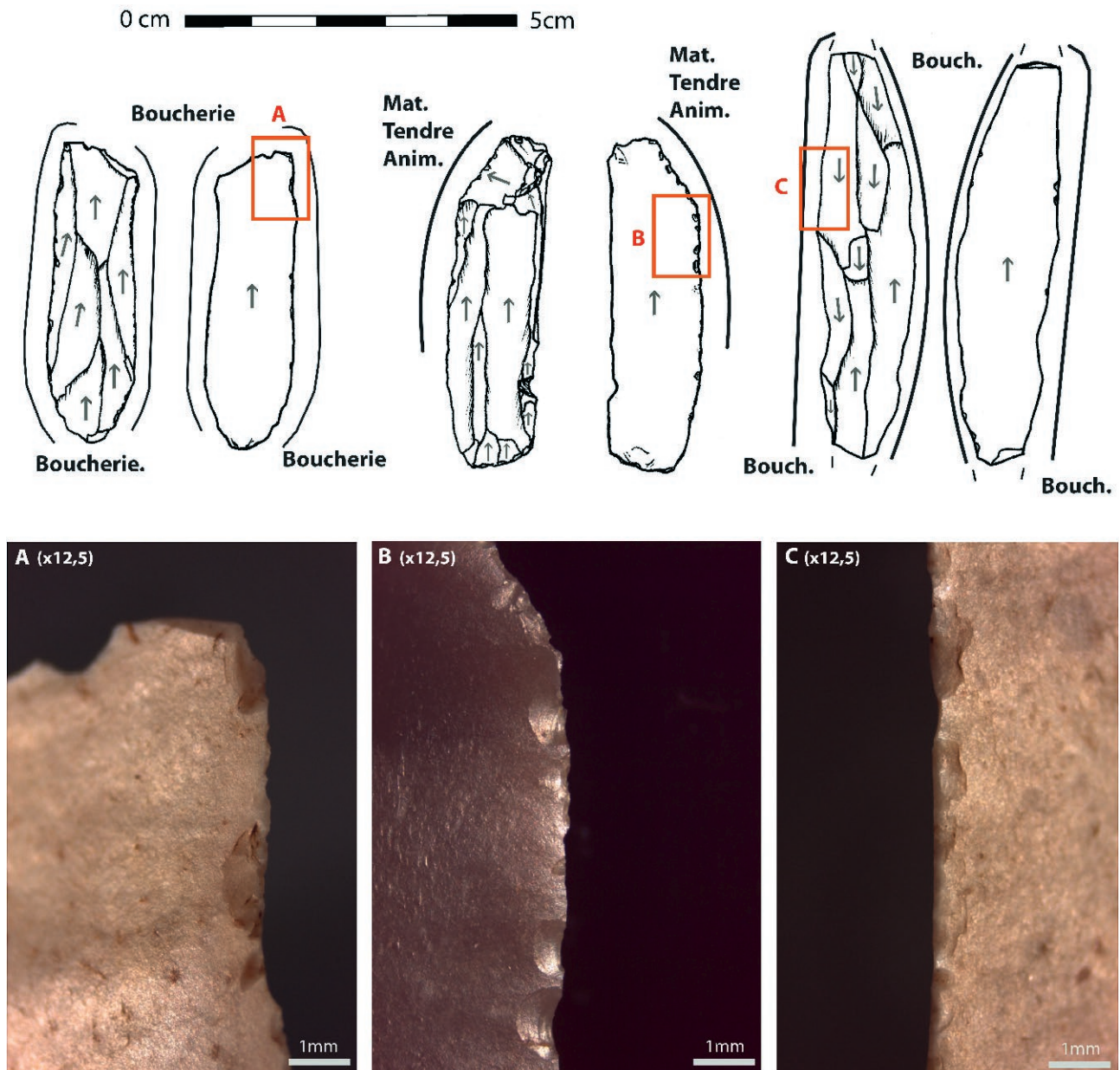


Fig. 4 – À Rosnay, la boucherie a été réalisée par les Mésolithiques grâce à des supports lamellaires très peu utilisés par leurs prédécesseurs.
 Fig. 4 – At Rosnay, the Mesolithic hunters used bladelets for butchery. This type of blank was rarely used as a tool by their predecessors.

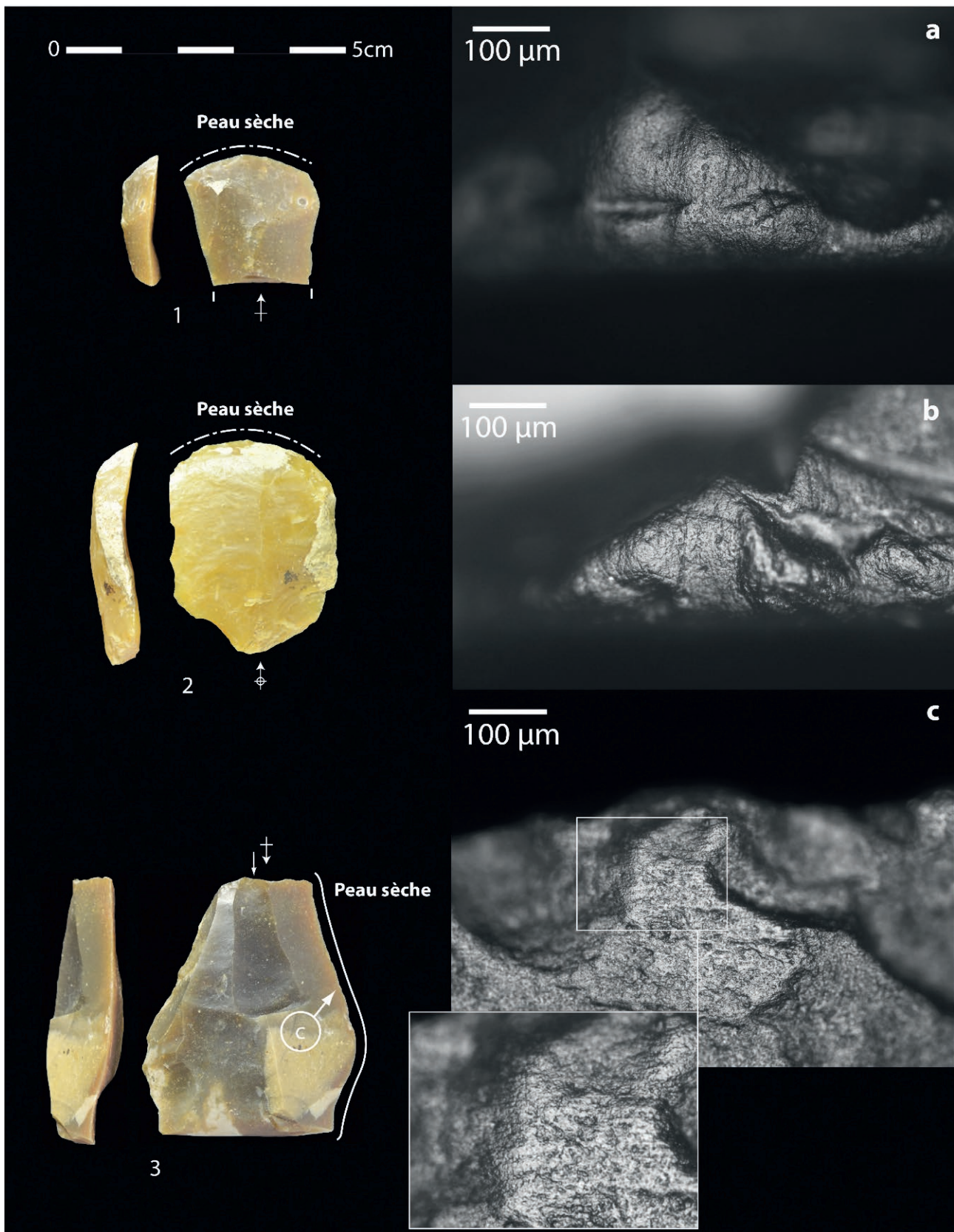


Fig. 5 – Travail de la peau à la Fosse (Paléolithique final). Grattoirs (1, 2) et support laminaire (3) utilisés respectivement en raclage et en découpe sur de la peau sèche.

Fig. 5 – Hide-working at La Fosse (Final Palaeolithic). Scrapers (1, 2) and elongated flake (3) respectively used to scrape and cut dry hide.

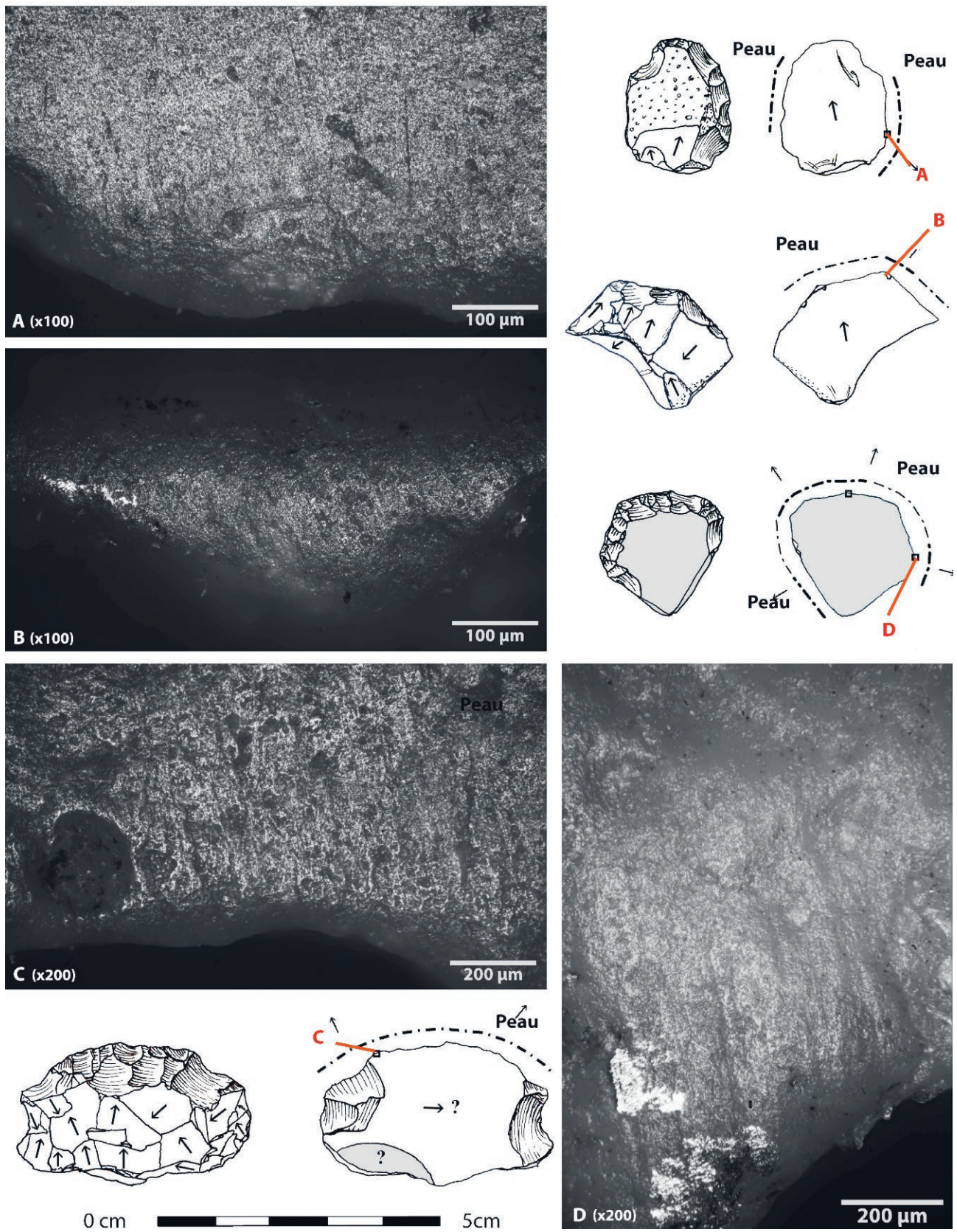


Fig. 6 – Petits grattoirs mésolithiques de Verrebroek C58 utilisés pour racler des peaux sèches ou en cours de séchage et recouvertes d'abrasif.
Fig. 6 – Small scrapers from Verrebroek C58 (Early Mesolithic) used to scrape dry hides or hides in the process of drying with an abrasive additive.

d'un macro-outillage taillé en grès et en silex (Griselin, 2015). Parmi celui-ci ont notamment été reconnus des outils hachettiformes répartis dans toute l'Europe du Nord-Ouest et dont le Bassin parisien constitue la zone d'extension la plus méridionale. Par analogie avec les outils néolithiques, ces pièces hachettiformes ont souvent été associées au travail du bois (Valdeyron, 2011). Cette hypothèse ne peut actuellement être confirmée car aucune pièce de ce type n'a été découverte au sein des gisements étudiés ici. Mais cette question apparaît pour autant assez cruciale et méritera d'être abordée dans les prochaines années. En effet, cette nouvelle gamme d'outils pourrait participer à l'émergence d'un système techno-économique original au début de l'Holocène dont l'ampleur est perceptible grâce aux approches fonctionnelles que nous avons menées.

Économie et systèmes techniques paléolithiques et mésolithiques : les apports de la tracéologie

Au-delà d'une meilleure définition de l'outillage et plus généralement des productions lithiques du Paléolithique final et du premier Mésolithique, nos recherches avaient comme objectif de mieux documenter les systèmes techno-économiques de ces périodes grâce aux informations fournies par les traces d'utilisation.

– Le Paléolithique final : un système centré autour de l'exploitation des produits carnés et cutanés

Comme pour l'ensemble du Paléolithique supérieur, le système technique des populations de la transition Pléistocène-Holocène semble centré autour de l'exploitation des ressources animales. Ce constat repose avant tout la rareté du végétal au sein des spectres fonctionnels. Parmi les trois sites étudiés, seuls 5 outils sur les 398 identifiés (soit 10 ZU) ont livré des usures attribuables de manière catégorique à ce registre d'activité. Il s'agit toutefois d'un décompte *a minima* dans la mesure où un lot de 19 outils (soit 32 ZU) présentant des usures atypiques (essentiellement identifiées à la Fosse) pourrait également y être rattaché (Jacquier, 2015).

Les spectres fonctionnels du Paléolithique final sont donc dominés par la découpe des tissus carnés (160 ZU) et cutanés (145 ZU) ainsi que par le travail de la peau par raclage (120 ZU). Le travail des matières dures animales est en revanche assez mal documenté dans les trois corpus analysés (23 ZU). Ce résultat concorde avec l'appauvrissement considérable de l'industrie osseuse observé dès le début de l'Azilien. Cet appauvrissement s'exprime tant quantitativement qu'à travers l'effondrement de la diversité typologique (voir notamment Christensen et Chollet, 2005; Street *et al.*, 2006; Pétilion, 2016). Ce constat semble également concordant avec la redéfinition de l'équipement domestique lithique à la suite du Magdalénien. En effet, ce

sont les outils d'extrémité de type bec et perçoirs, c'est à dire avant tout des outils relatifs au travail de matières dures animales, qui font les frais de cette redéfinition de l'équipement domestique.

Nous ne pouvons brosser le portrait des activités réalisées à travers l'industrie lithique à l'extrême fin du Paléolithique sans dire deux mots du travail du minéral qui, sur les sites à grandes lames du Nord de la France et du Bassin parisien, est souvent le registre fonctionnel le plus facilement perceptible. Nous faisons allusion ici aux pièces mâchurées (supports massifs aux bords intensément endommagés, fig. 3) que nos études (notamment au Buhot; Jacquier, 2014a, 2014b et 2015) et celles menées précédemment sur les sites de Flixecourt, Hangest-sur-Somme, Belloy-sur-Somme (Fagnart et Plisson, 1997) ou encore Donnemarie-Donville (Bodu et Valentin 1993; Jacquier, 2012) mettent avant tout en relation avec les activités de débitage (aménagement/entretien des percuteurs de pierre tendre et éventuellement préparation au détachement des supports par piquetage). L'extension de cette pratique pourrait aller bien au-delà de la moitié Nord de la France puisque les pièces mâchurées sont présentes en nombre au Sud de l'Angleterre ou encore au Nord de l'Allemagne. Dans ces contextes, leur rôle reste toutefois à préciser et l'hypothèse d'un emploi au tronçonnage des bois de cervidés a plusieurs fois été avancée (notamment Barton, 1986). Cet emploi de sous-produits du débitage dans le cadre de la taille du silex semble en tout cas être un phénomène plutôt septentrional dans la mesure où il n'est pas attesté pour l'instant au sud de la Loire. Il s'exprime surtout dans des contextes au moins partiels d'atelier et accompagne donc des exigences toutes particulières en matière de longueur et de régularité de la production laminaire.

Mettons un instant de côté cette pratique essentiellement limitée à certains statuts fonctionnels du Nord de l'Europe et qui met en jeu des sous-produits du débitage, pour prendre un peu de recul. Finalement, si l'on admet le déclin apparent de l'industrie osseuse entre le Magdalénien supérieur et l'Azilien et la faible implication de l'industrie de pierre taillée dans le travail des matières végétales, un constat important semble se dégager pour la toute fin du Paléolithique récent : celui d'un resserrement du rôle de l'industrie lithique autour de l'acquisition du gibier et de la transformation des ressources carnées et cutanées.

– Le Mésolithique : l'irruption du végétal

Les ressources animales continuent évidemment à occuper une place de choix dans les systèmes techniques des chasseurs-cueilleurs mésolithiques. Cette période est toutefois marquée par un changement de paradigme révélé par les traces d'utilisations. Parmi les transformations intervenues entre Tardiglaciaire et Postglaciaire, l'explosion du travail des matières végétales au Mésolithique est le fait le plus marquant et le mieux établi. Tous les sites étudiés ont en effet livré des pièces utilisées sur ce type de matériaux. À Doel et Noyen-sur-Seine, il s'agit même de la première

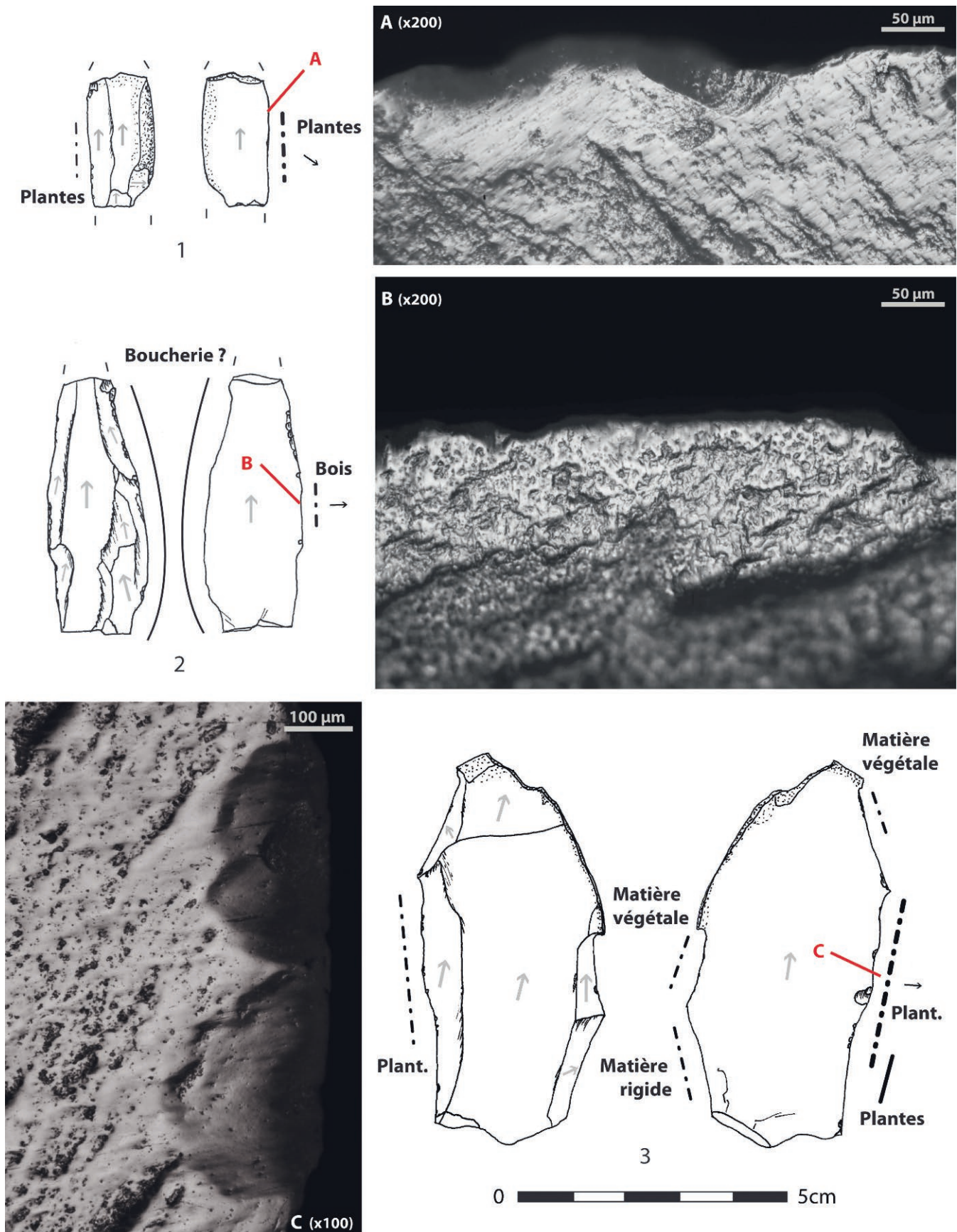


Fig. 7 – Trois exemples illustrant le travail des matières végétales au premier Mésolithique. 1 : lamelle de Verrebroek C17 utilisée sur des plantes selon un geste transversal oblique. 2 : lamelle de Noyen-sur-Seine utilisée pour racler du bois tendre. 3 : éclat de Noyen-sur-Seine intensément utilisé pour racler des plantes.

Fig. 7 – Three examples of vegetal material working in the Early Mesolithic. 1: bladelet from Verrebroek C17 used on plant material with an oblique scraping motion. 2: bladelet from Noyen-sur-Seine used on soft wood with a scraping motion. 3: flake from Noyen-sur-Seine intensively used to scrape plant material.

activité reconnue. Parmi les 160 ZU attribuées à ce domaine (sur un total de 501 ZU), les actions longitudinales (17 ZU) apparaissent très minoritaires et la longueur limitée des zones actives permet d'exclure la récolte de végétaux à vocation alimentaire. L'abondance des gestes transversaux (141 ZU) sur du bois et surtout sur des plantes (fig. 7) correspondrait plutôt à des activités artisanales comme la sparterie ou la vannerie (tabl. 1).

Cette orientation techno-économique vers les matières végétales, inédite par son ampleur, s'accompagne d'un désinvestissement relatif constaté dans l'acquisition et la transformation des matières animales. Celui-ci se traduit d'abord par la disparition des couteaux de boucherie spécialisés tels qu'on en connaissait dans le Paléolithique final : les grandes lames régulières sont ainsi remplacées par un outillage lamellaire plus léger et utilisé moins intensément, ce qui se traduit par une certaine difficulté à reconnaître ce type d'utilisation (seulement 59 ZU sur 501 ZU). Ce constat est évidemment à relier avec la relative simplification des chaînes opératoires lithiques et la plus grande souplesse constatée dans le choix des supports d'outils que nous avons présenté auparavant. Par ailleurs, si le travail de la peau reste une activité toujours bien présente au Mésolithique, elle s'exprime toutefois selon des modalités bien différentes. Ainsi, les traces liées à la découpe deviennent très ponctuelles (17 ZU), tandis que celles provoquées par le raclage, très majoritaires avec 131 ZU, présentent une variabilité moins importante qu'au Paléolithique final (fig. 6). Cette tendance semble révélatrice de chaînes opératoires moins variées et probablement moins poussées.

Le début de l'Holocène apparaît donc comme un moment particulier. Cette période voit en effet les groupes humains adopter un système économique où les matières végétales prennent une place inédite, à la faveur du réchauffement climatique et au détriment des chaînes opératoires lithiques et animales qui occupaient auparavant un rôle central. Ce basculement systémique va bien au-delà de la simple adaptation des pratiques de chasse et de la mobilité au nouvel environnement forestier, souvent présenté comme le paramètre primordial pour expliquer la fin des traditions paléolithiques et l'émergence du Mésolithique (Rozoy, 1978). Il s'agit d'un phénomène profond et durable dont l'ampleur et les modalités devront évidemment être précisées. Pour cela, les approches fonctionnelles apparaissent comme un moyen efficace qui fournit d'ores et déjà une base solide à enrichir par l'analyse de nouvelles collections.

DISCUSSION

Si la comparaison des données issues de nos recherches respectives a permis de souligner les différences systémiques majeures constatées entre le Paléolithique final et le Mésolithique, il reste encore beaucoup à faire pour comprendre la rapidité de ces changements et leur rythme.

Jusqu'à présent, nos recherches ont soit concerné des gisements paléolithiques au cadre chronologique incertain, soit des occupations du premier Mésolithique trop tardives pour aborder précisément la transition entre les deux phases. Ces limites sont à l'image de celles du corpus archéologique à notre disposition dans le Nord de la France (Valentin, 2008). En effet, les occupations du Paléolithique final y sont encore mal datées et souvent pauvres en outils évidents, à l'image des sites belloisiens, tandis que les témoignages mésolithiques du tout début du Préboréal restent peu nombreux. Certains gisements fouillés récemment tiennent toutefois une place centrale dans ces débats et leur analyse permettrait à n'en pas douter d'avancer sur la question de la transition Paléolithique-Mésolithique. On pense par exemple à Alizay en Normandie pour le Paléolithique final (Bémilli *et al.*, 2014) ou aux occupations anciennes de Warluis dans l'Oise (Ducrocq *et al.*, 2008) et des Closeaux en Île-de-France (Lang et Sicard, 2008) pour le Mésolithique.

Au cours de la présentation des résultats, nous avons insisté sur les différences manifestes entre les traditions culturelles de la fin du Pléistocène et du début de l'Holocène, en particulier du point de vue techno-économique. Mais ces contrastes ne sont pas obligatoirement le résultat d'une rupture nette : au contraire, quelques éléments plaident pour un phénomène plus graduel, se traduisant potentiellement par une certaine continuité entre Paléolithique final et Mésolithique initial. Ainsi, plusieurs débitages lamino-lamellaires livrés par les occupations les plus anciennes de Warluis IIIb (Ducrocq *et al.*, 2008) évoquent indubitablement les standards technologiques bien documentés des phases post-aziliennes (Naudinot, 2013). Au sein de l'outillage également, certaines tendances pourraient indiquer la perdurance de traditions paléolithiques au début du Mésolithique. Ainsi, les burins et les grattoirs, notamment sur supports allongés, sont parfois retrouvés en grand nombre dans les corpus du IX^e millénaire (fig. 8), alors qu'ils apparaissent beaucoup plus rares dans ceux datés du VIII^e millénaire (Ducrocq *et al.*, 2008 ; Lang *et al.*, 2008 ; Séara, 2014b ; Pasty *et al.*, 2015).

On mesure donc bien tout l'intérêt qu'il y aurait à documenter ces collections sous l'angle fonctionnel pour aborder la question des ruptures économiques détaillées précédemment. Sur le travail de la peau par exemple, l'apparente simplification des chaînes opératoires (*cf.* chute de la découpe de peau et faible diversité des traces de raclage) s'observe-t-elle dès les premières phases du Mésolithique ? À cet égard, un test tracéologique mené sur quelques grattoirs des Closeaux IV (Guéret, 2013) utilisés sur des peaux fournit déjà quelques pistes de travail qui méritent d'être prolongées : l'attention portée à l'aménagement de certains fronts et la présence d'émoisés brillants très particuliers évoque en effet beaucoup plus les manières de faire de la fin du Paléolithique que du VIII^e millénaire.

De la même manière, par le rôle systémique que ce domaine est susceptible d'occuper dans le processus de Mésolithisation, la question de l'artisanat

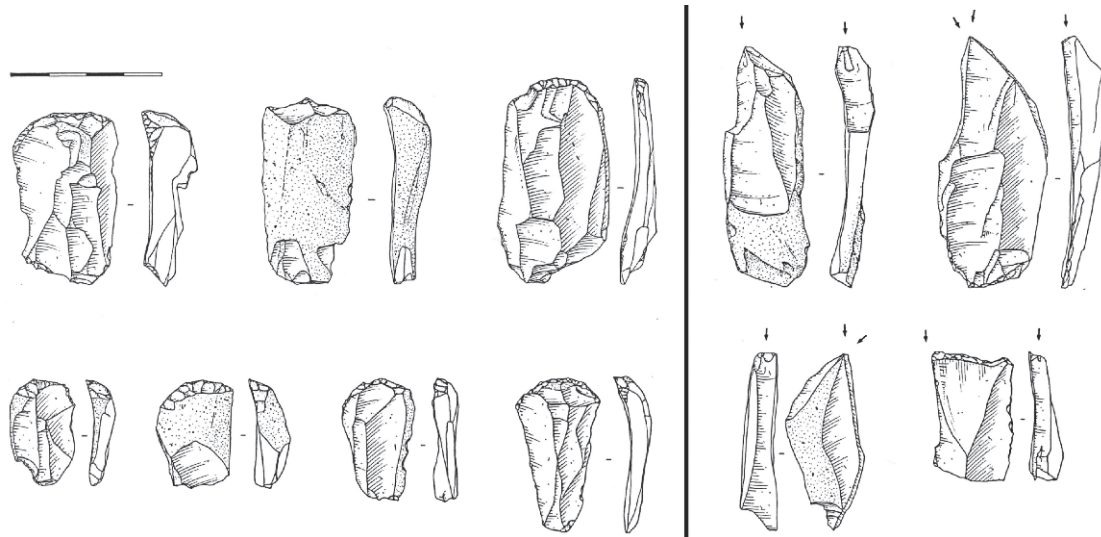


Fig. 8 – Les nombreux grattoirs (à gauche) et burins (à droite) des Closeaux (Mésolithique ancien), parfois réalisés sur supports allongés, évoquent certains exemples plus anciens du Paléolithique final (modifié, d'après Lang et Sicard, 2008).

Fig. 8 – The numerous scrapers (left) and burins (right) from Les Closeaux (Early Mesolithic), sometimes produced on elongated blanks, share common attributes with the ones from the Final Palaeolithic (modified from Lang and Sicard, 2008).

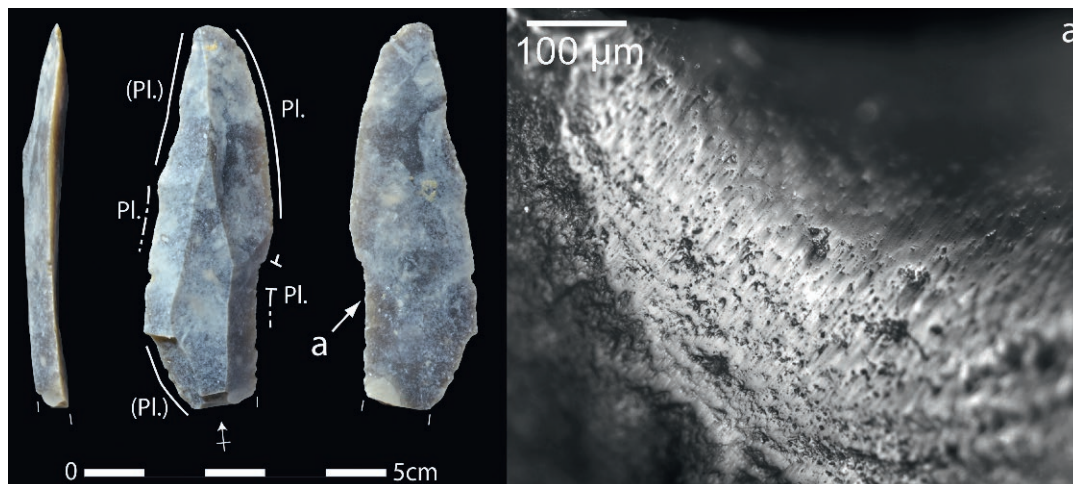


Fig. 9 – Un des rares exemples de travail des plantes reconnu pour le Paléolithique final. Les traces relevées sur cette petite lame de Peyrazet apparaissent identiques aux nombreux cas décrits dans le premier Mésolithique d'Europe du Nord-Ouest (à comparer avec la fig. 5-1).

Fig. 9 – One of the few tools used on plant material for the Final Palaeolithic. Use-wear traces observed on this small blade from Peyrazet are similar to the numerous examples described for the Early Mesolithic of northwestern Europe (to be compared with fig. 5-1).

des plantes et du bois constitue un angle d'attaque crucial pour aborder le rythme et les modalités de la transition entre Paléolithique et Mésolithique. À l'heure actuelle, il est toutefois difficile de savoir si l'apparente explosion du travail des matières végétales est intervenue brutalement dès le début de l'Holocène ou s'il s'agit d'un phénomène graduel et étalé dans le temps. Ce qui semble certain par contre, c'est que cet artisanat n'est pas une invention mésolithique à proprement parler. Ce constat peut tout d'abord être déduit de l'analyse des objets en bois du début du Mésolithique : les aménagements de sols en planches à Star Carr (Conneller *et al.*, 2012) ou encore les flèches, filets et cordes et panier en écorce de Friesack (Gramsch, 1993) démontrent en effet une

maturité technique très certainement plus ancienne et qui doit être recherchée dans le Paléolithique. Du point de vue tracéologique, quelques indices vont également dans ce sens. Ainsi, si les traces d'utilisation liées au travail des plantes sont peu fréquentes au Paléolithique final, les quelques exemples de la Fosse et de Peyrazet (fig. 9) apparaissent en tout point identiques à ceux que l'on retrouve en plus grand nombre sur les sites mésolithiques de Rosnay et de Flandre. D'orientation oblique par rapport au tranchant, souvent envahissants en face inférieure, assez plats et striés, ces poliss constituent une signature fonctionnelle très spécifique et donc très diagnostique. H. Juel Jensen est la première à avoir reconnu ce type de traces en contexte mésolithique en dénommant les

pièces qui les portent «*curved knives*» en raison de la délinéation concave des tranchants utilisés (Juel Jensen, 1994). Ils ont depuis été reconnus uniquement au sein de corpus mésolithiques (Beugnier, 2007 ; Guéret, 2013) et à présent à la toute fin du Paléolithique. Si nous ne sommes pas encore en mesure de restituer précisément la chaîne opératoire dans laquelle ces outils s'insèrent, l'origine paléolithique de ce fait technique apparaît par contre relativement solide. Le début du Mésolithique ne correspondrait alors pas obligatoirement à une période d'invention, mais plutôt à un moment d'intensification dans l'exploitation des ressources végétales rendue possible par une abondance nouvelle de ces matériaux à la faveur du réchauffement climatique holocène. Cette hypothèse, encore fragile en raison des lacunes de notre corpus, mériterait désormais d'être étayée par des investigations ciblées bénéficiant d'un recul chronologique plus significatif concernant le Mésolithique et en intégrant plus largement l'ensemble du Tardiglaciaire.

CONCLUSION

Cette comparaison techno-fonctionnelle entre la fin du Paléolithique et le premier Mésolithique doit être vue comme une première étape destinée à poser les bases d'une recherche plus ambitieuse. En effet, à l'heure actuelle, les données disponibles et leur résolution chronologique ne permettent pas d'aborder avec finesse un phénomène de toute évidence complexe. Dans cette perspective, l'intérêt de la tracéologie lithique est de venir enrichir l'analyse des productions de pierre tant en ouvrant la discussion sur des pans des économies souvent marginalisés dans le discours archéologique, surtout dans les contextes d'Europe de

l'Ouest où la conservation des matières organiques est souvent très mauvaise. En documentant tout autant le travail des matières animales que végétales et leurs interactions avec les ressources lithiques, nos analyses permettent de développer une approche systémique qui ne considère pas uniquement le passage Paléolithique-Mésolithique comme la conséquence mécanique du réchauffement climatique ou d'une invention technique. Ce que l'on perçoit, c'est au contraire un changement plus profond des économies à l'aube de l'Holocène : les mutations techniques et culturelles s'articulent pour aboutir progressivement à un nouveau système qui entérine définitivement la rupture avec les traditions paléolithiques.

C'est cette piste de travail que nous souhaiterions approfondir pendant les prochaines années par l'analyse de nouvelles collections afin de confirmer ce premier aperçu. Pour cela, il sera nécessaire de combler les vides chronologiques déjà discutés, tout en élargissant notre point de vue à l'ensemble du Tardiglaciaire afin de mieux saisir la profondeur temporelle des changements constatés. De même, on ne pourra se contenter d'aborder ces problématiques à l'échelle uniquement régionale : la Mésolithisation est un phénomène largement continental qui s'est épanoui dans des environnements très différents à partir de substrats paléolithiques contrastés. En partant de ce constat, il y a fort à parier qu'au-delà d'une trajectoire commune à toute l'Europe, les modalités du changement ont dû prendre des formes variées qu'il conviendra d'aborder d'une manière dynamique. Jusqu'à ce jour, l'approche techno-fonctionnelle des industries lithiques a été peu mobilisée dans cette optique. Les résultats présentés dans cet article montrent qu'elle aurait pourtant tout son rôle à jouer pour aborder une étape majeure dans l'Histoire des sociétés humaines en Europe. ■

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The transition from the Younger Dryas to the Pre-Boreal in southern Britain: some new perspectives on the spatial patterning and chronology of long blade sites

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Abstract: *In this paper we review evidence for long blade technology in southern Britain. In particular we consider the distinctive patterns of distribution of these sites, which are often preferentially located in the floodplains of river valleys and near good flint sources. As these lithic assemblages typically contain relatively few tools it has been hypothesised that they represent only a partial picture of human uses of the Late Glacial landscape. Amongst the present suggestions are that such localities were principally workshop sites where blades were manufactured for later use, and/or that they served a special function related to horse and reindeer butchery. To test these ideas further we re-examine the question of variability in long blade assemblages and how this might be reflected in their topographic positioning. We consider such questions as: Were the floodplain sites as technologically and typologically homogeneous as has often been assumed? And, as has been suggested recently, were there any differences in the composition of assemblages in more elevated terrace locations?*

Keywords: *Long blade technology, Southern Britain, Late Glacial, Younger Dryas/Pre-Boreal, Chronology, Spatial patterning.*

Résumé : *Situées dans les plaines alluviales des principales vallées – généralement à proximité de gîtes de matière première de bonne qualité – les occupations archéologiques des sites attribuables à la « Long blade technology » du sud de la Grande-Bretagne font l'objet d'une révision critique en tenant compte des modalités d'implantation des gisements. La rareté des supports transformés en outils – observée dans les différents sites – témoigne d'activités ponctuelles ou spécialisées qui ne livrent qu'une image très partielle de l'occupation du territoire par les groupes de chasseurs-cueilleurs de la fin du Tardiglaciaire. La présence d'ateliers de production de grands supports laminaires pour un usage différé ou de lieux d'activités de boucherie liés à la découpe de chevaux ou de rennes est habituellement avancée. Afin de tester cette hypothèse, les assemblages à grandes lames du Paléolithique final sont réexaminés en fonction de leur identité typologique et technologique et de leur position topographique respective. Les occupations situées en contexte de plaine alluviale sont-elles toujours aussi homogènes qu'il est admis à ce jour? Les occupations situées dans des positions topographiques plus élevées – sur les versants des vallées – présentent-elles des différences notables dans la composition technotypologique de leurs assemblages?*

Mots-clés : *Long blade technology, Sud de la Grande-Bretagne, Tardiglaciaire, Dryas récent/Préboréal, Chronologie, Modalités d'occupation.*

INTRODUCTION

Recent papers have suggested that from the second half of the Lateglacial Interstadial there was a marked change in lithic technologies across NW Europe

(Naudinot and Jacquier, 2014; Crombé *et al.*, 2014; Crombé and Robinson, 2017). The transition from the earlier Federmesser technology is marked by the appearance of standardised and relatively straight blades and bladelets detached from elaborately prepared cores and by the inclusion of microlithic

armatures (Crombé and Robinson, 2017). Such technologies flourished during the Younger Dryas (from around 11,800 yrs BP) and can be recognised from a wide arc of locations across the North European Plain and extending into the southern half of France. According to Naudinot and Jacquier (2014) there are enough taxonomic similarities in these regionally dispersed lithic technologies to group them under a single “Flat Blades and Bladelets Technocomplex” (FBBT). Within this broad grouping they include the Ahrensburgian/Epi-Ahrensburgian which is found from the Northern European Plain into southern England and across northern France, the Swiderian that exists across western Poland and into the southern Ukraine, and the Laborian/Epi-Laborian complex, which is known from the southern half of France from the Paris Basin to the Pyrenees. Also assigned to this technocomplex are examples of long blade or “bruised blade” (Belloisian) assemblages in southern England and northern France which can be compared to the late Ahrensburgian in northern Germany, especially to Taute’s (1968) “Stellmoor-Eggstedt” group (see Barton and Roberts, 2004).

In the light of the newly proposed taxonomic framework we take this opportunity to review some of the latest research on the chronological development of the long blade technology in southern Britain paying attention to the timing of its first appearance in the Younger Dryas and its latest occurrences at the beginning of the Holocene. We also consider whether such assemblages have been correctly interpreted in the past. Were they only associated with very special locations such as riparian settings and in proximity to good raw material sources? Does this imply that other landscape locations were avoided or is this simply an artefact of inadequate fieldwork? Is it time to question the homogeneity of long blade assemblages, have we ignored for too long variation amongst individual assemblages? These are some of the questions that will be addressed in the present paper.

CHARACTERISING LONG BLADE ASSEMBLAGES

Long blade assemblages are defined as being typified by large, well-made blades detached from opposed platform cores. The blades are often straight in profile and they range in length from > 120 mm to bladelets smaller than 50 mm. Some of the longer and thicker blades exhibit heavy damage on one or both lateral edges and are known as “bruised blades” or *lames mâchurées*. The assemblages usually only contain small quantities of formal retouched tools which can include a restricted variety of types from end-scrapers to burins and microlithic retouched forms. The tool debitage may include microburins.

The term “long blade” was first introduced by John Wymer in 1976 to describe the flint assemblage he excavated at the Devil’s Wood Pit, Sproughton in Suffolk (Wymer with Rose, 1976). This is the type-site for British long blade assemblages and since then the

term has been widely used to characterise lithic artefacts from other locations in southern Britain with similar technological features and often including heavily bruised blades (Barton, 1986 and 1989). Clear parallels for the British sites can be found in northern France especially in the Somme Valley (Fagnart, 1984). Victor Commont had originally described these lithic assemblages and was the first to draw attention to large blades and *pièces mâchurées* (1907 and 1908). It is interesting to note that he had been in correspondence with the British antiquarian archaeologist, R.H. Chandler, who had made finds of large blades from a “working floor” in the Cray valley, near North Cray in Kent. In his published report (1915), Chandler noted the following:

“M. Commont has kindly examined these implements, and he is good enough to write to me from Amiens : This industry... corresponds exactly with a stock of tools I have found in the Somme Valley, in brick-earth at several localities, and also in making excavations in different beds – at Saint-Acheul, Montières, Renancourt-lès-Amiens, and especially at Belloy-sur-Somme type-beds.” (Chandler, 1915)

Another distinctive feature that has habitually been noted concerns the geographic distribution of long blade sites. They are often preferentially located in floodplain riparian situations and frequently near primary sources of chalk flint. As these lithic assemblages typically contain relatively few tools it has been suggested that they were principally workshop sites where blades were manufactured and exported for later use (Fagnart and Plisson, 1997; Fagnart, 2009). Alternatively, in addition to raw material acquisition they may also have been conveniently situated close to animal kill sites. The idea that they were occupied only briefly is implied by the almost total absence of hearths and rarity of burnt artefacts (Barton, 1986). Some of these claims however will be re-examined below.

In 1986 it was possible to document over 160 potential findspots of long blades in southern Britain (Barton, 1986), including 28 examples associated with long bruised blades (Barton, 1986 and 1989). Since then other work has identified c. 60 findspots in Norfolk (Robins and Wymer, 2006), while around 29 are recorded in a recent study covering the region of East Anglia (Billington, 2016). There is inevitably some overlap between the sites on the new lists and those highlighted in Barton, but the overall number of findspots has continued to rise and a high proportion of new long blade material has been recovered as a result of commercial development schemes. It should also be acknowledged that not all individual finds of long blades can be assumed to derive from one technocomplex. It is known for example that large blades and even bruised examples can occur in a variety of temporal contexts including Mesolithic and Neolithic examples (Barton, 1986; Conneller and Ellis, 2007; Billington, 2016) and it is often hard to assign single artefacts to a particular technocomplex. Another problem arises from the very restricted range of retouched tools known from such

Site	Lab No.	Sample	Date BP	Cal BP (2 sigma) OxCal 4.3	Cal BC (2 sigma) OxCal 4.3
Devil's Wood Pit, Sproughton	HAR-259	Willow twigs*	9,888 ± 120	11,930-10,883	9,981-8,934
Kingsmead Quarry, Horton	SUERC-57714	Horse tooth	9,920 ± 39	11,598-11,231	9,649-9,282
Kingsmead Quarry, Horton	SUERC-62321	Aurochs bone*	9,946 ± 53	11,614-11,238	9,665-9,289
Three Ways Wharf Scatter A	OxA-1902	Horse tooth	10,010 ± 120	11,985-11,226	10,036-9,277
Three Ways Wharf Scatter A	OxA-18702**	Horse tooth	10,060 ± 45	11,815-11,340	9,866-9,391
Three Ways Wharf Scatter A	OxA-1788	Horse tooth	10,270 ± 100	12,515-11,619	10,566-9,670
Seamer Site L	OxA-19511	Horse bone	10,025 ± 45	11,751-11,319	9,802-9,370

*found in palaeochannel near long blades ** redating of OxA-1902

Table 1 – AMS dates of fauna and flora associated with long blades.

Tabl. 1 – Datations AMS de vestiges animaux et végétaux associés aux occupations attribuées à la Long blade technology.

assemblages which makes it difficult to distinguish typologically single finds from those in other Later Upper Palaeolithic and Mesolithic technologies. This is especially true for microlithic tools. Nevertheless, in cases where larger collections exist from excavated contexts it is possible to undertake techno-typological studies which allow greater confidence in classifying these collections as long blade. This is the case for published assemblages from Avington VI, Berkshire (Froom, 2005), Gatehampton Farm, Oxon (Barton, 1995), Three Ways Wharf, Uxbridge, Middlesex (Lewis with Rackham, 2011), Lullingstone, Kent (Anderson-Whymark and Pope, 2016), Herne Bay, Underdown Road, Kent (Gardiner *et al.*, 2015), Church Lammas, Surrey (Jones, 2013), Launde, Leicestershire (Cooper, 2006), and various examples from East Anglia including Carrow Road Norwich, Norfolk (Adams, 2009), and Hinxton Hall, Cambridgeshire (Haskins and Clarke, 2015; Gregory and Donnelly, 2015). Most of the above consist of flint scatters with no associated fauna. The exceptions are Three Ways Wharf and a new site at Kingsmead Quarry, Horton, Berkshire (Barclay *et al.*, 2017). Generally speaking, the excavated sites show minimal signs of post-depositional disturbance and this has been confirmed in cases where refitting studies have been undertaken, for example at Avington VI, Gatehampton Farm, Three Ways Wharf, Lullingstone and Carrow Road.

The site at Kingsmead Quarry site, Horton is of special interest and deserves a brief description here because it is a rare example of a site with associated faunal remains and will be referred to again. Kingsmead Quarry is situated on the wide floodplain of the River Colne, 1 km south-east of Horton in the Royal Borough of Windsor and Maidenhead, Berkshire. It lies on a slightly raised gravel bar between palaeochannels of the Colne. The site consists of an extensive scatter of flint and bone situated in coarse silts and very fine sands that cover an estimated area of 150 m². Excavations of small test pits revealed flint blades in mint fresh condition and some bone that can be identified as horse (*Equus*, sp.). The freshness of the flint and presence of microdebitage leaves little doubt that the assemblage is in near primary context, probably only affected by gentle overbank flooding

processes and some later vertical displacement of finds. The quality of the surface of the bone is however rather variable but it does include some fragments with percussion marks suggesting marrow breakage (Simon Parfitt, pers. comm.). Unusually for a long blade assemblage there are quantities of burnt bone and calcined flint. So far the flint assemblage has only been cursorily examined, it includes very few bruised blades and there is at least one microlithic tool (but no microburins). One of the horse bones has been radiocarbon dated as has an aurochs bone found in an adjacent palaeochannel (see below).

CHRONOLOGY OF LONG BLADE ASSEMBLAGES

The dating of the long blade technology is believed to cover a time-span from near the end of the Younger Dryas to early within the initial Holocene, a period of perhaps no more than a few thousand years (Barton, 1991). This is based on admittedly very few directly associated radiocarbon dates and there are problems in this period with radiocarbon plateaux but, even so, as yet there appear to be no unambiguous examples of long blade sites that definitely fall outside this proposed time range (Table 1). One of the youngest long blade sites so far securely documented is that of Sproughton. The assemblage is known to have come from stratigraphically below a Holocene soil and within low energy sands and gravels. The only relevant date is on a bulked sample of willow twigs (*Salix*) from high energy channel deposits beneath the horizon with long blades and, if correct, provides a terminus post quem of 9,888 ± 120 BP for the industry (Wymer with Rose, 1976). More securely dated is Three Ways Wharf, Uxbridge in Middlesex (Lewis, 1991), where scatters of long blades were associated with fragmentary remains of horse and reindeer. Two horse teeth from Scatter A provided AMS dates of 10,270 ± 100 BP (OxA-1788) and 10,010 ± 120 BP (OxA-1902) respectively. They came from fine-grained argillaceous sediments with long blades most likely laid down by gentle overbank flooding conditions of the River Colne (Lewis with Rackham, 2011). At Kingsmead Quarry, further down the Colne Valley,

remains of horse were found in association with the lithic assemblage. There is a single AMS date on a horse tooth of $9,920 \pm 39$ BP (SUERC-57714). This is consistent with another date of $9,946 \pm 53$ BP (SUERC-62321) on a partial aurochs skeleton from adjacent channel deposits. Outside southern England but of interest is a site in the Vale of Pickering, Yorkshire (Seamer site L) where long blades were found in amongst a scatter of horse bones and yielded an age of $10,025 \pm 45$ BP (OxA-19511) (Conneller, 2007). None of these ages appear to overlap with those of Early Mesolithic sites recently reviewed by Conneller and Higham (2015). According to this study the Early Mesolithic probably dates from the period associated with the reappearance of birch/pine woodland in the Vale of Pickering from around 9,200 cal. BC, with nearly identical dating for southern England.

Apart from AMS radiocarbon dates there are also OSL (Optically Stimulated Luminescence) ages of varying reliability on sediments from Avington VI (Barton *et al.*, 1998), Hinxton Hall (Antony Haskins pers comm.) and Carrow Road (Adams, 2009; Billington 2016). At Carrow Road a single OSL date of $11,160 \pm 740$ ka BP (x-1700) was obtained on sediments underlying cluster 2 that provides an age range which falls in the later part of the Younger Dryas or the early Holocene. However, OSL dates for cluster 1 at Carrow Road (X-1697 – $9,530 \pm 770$ ka BP) and for Avington VI (1523b – $10,250 \pm 250$ ka BP) appear to be too young being in the region of 10,300 calendar years BP and therefore well into the early Holocene.

One word of caution should be added on the chronology of long blade assemblages. It concerns the growing evidence that humans were present in southern Britain throughout the Late Glacial and at least sporadically during parts of the Younger Dryas. Evidence for this includes a reindeer Lyngby Axe from Earl's Barton (Table 2; OxA-803 – $10,320 \pm 150$ BP) and a biserial barbed point of reindeer antler from Victoria Cave in Yorkshire that has two ultra-filtrated AMS dates of $10,810 \pm 100$ BP and $10,930 \pm 45$ BP that may just fall within the YD. Also potentially relevant is one of two barbed osseous points from Sproughton which has recently been re-dated and has an ultrafiltrated AMS age of $10,960 \pm 50$ BP that places it near the beginning of the YD (Jacobi *et al.*, 2009). At the other end of the scale is the decorated horse mandible from Kendrick's Cave in North Wales originally with an age of $10,000 \pm 200$ BP (Gillespie *et al.*, 1985) which is currently being re-dated using the ultrafiltration method and may turn out to be older (Rhiannon Stevens, pers. comm.). Although none of these finds can be directly associated with lithic assemblages it raises the possibility that earlier (YD) examples of FBBT or long blade technologies may eventually come to light in southern Britain. The recent discovery of the site at Ruien in Belgium (Crombé *et al.*, 2014), which dates to the very end of the Allerød or early Younger Dryas, makes this seem entirely plausible.

VARIATION IN LONG BLADE ASSEMBLAGES

It has long been noted that variability exists among the southern British long blade assemblages (Barton, 1986 and 1989). What is far less clear, however, is whether this is primarily due to chronological, functional, stylistic or other factors. In previous studies, it was proposed that typological and technological indicators could be employed informally as chronological markers. For instance it was observed that blades from the early Pre-Boreal site of Sproughton in some ways shared “Mesolithic-like” features in that there were parallels in the *chaîne opératoire* with the reduction of cores involving the removal of core tablets and a prevalence of blades with plain platforms and with heavy abrasion, whilst microliths in the same assemblage included only simple oblique forms. At the other extreme were sites like Avington VI, where the platform angle of blade cores was mostly controlled by faceting and this resulted in a high proportion of long blades with faceted platforms. In addition to oblique points at Avington VI, the retouched tools included small Ahrensburgian tanged points and elongate narrow backed points (cf. Les Blanchères points) (Barton and Froom, 1986). Such tools could be seen as characteristic of Younger Dryas European assemblages (Crombé and Robinson, 2017), so it was reasonable to assume that British sites with these tools were probably of a similar age. A further typo-chronological marker was observed at Launde and Three Ways Wharf where oblique microliths have a distinctly concave retouch (Cooper, 2006; Lewis with Rackham, 2011). This is a feature shared, for example, with Zonhoven points in the late and epi-Ahrensburgian assemblages of Belgium and the Netherlands (Gob, 1991) that are also presumed to be of YD age.

In addition to the chronological studies, another area for research concerns the possible links between assemblage variability and the spatial distribution of sites. This could provide important clues about differences in landscape use and site function. As has previously been remarked, one of the most striking features of the spatial distribution of long blade sites is in their proximity to high quality raw material sources (Barton, 1989; Billington, 2016). Many of them are situated within a few hundred metres of primary chalk flint *e.g.* Sproughton, Avington VI, Gatehampton Farm, Swaffham Prior, Carrow Road, Lullingstone etc., or otherwise close to secondary gravel sources of flint cobbles *e.g.* Kingsmead Quarry, Three Ways Wharf, Hinxton Hall. The spatial pattern of long blade sites thus closely follows the known distribution of Upper Cretaceous Chalk deposits in southern Britain and river valleys that have cut down through this geology (Barton, 1989). This juxtaposition of long blade sites and flint-yielding geological deposits is hardly surprising given the requirement of raw material for producing long blades. However, in an earlier publication (Barton, 1986) it was suggested that a secondary factor determining the

Site	Lab No.	Sample	Date BP	Cal BP (2 sigma) OxCal 4.3	Cal BC (2 sigma) OxCal 4.3
Earl's Barton	OxA-803	Reindeer antler axe	10,320 ± 150	12,620-11,412	10,671-9,463
Sproughton	OxA-15219	Antler uniserial barbed point	10,960 ± 50	13,119-12,644	11,024-10,768
Sproughton	OxA-14943	Bone uniserial barbed point	11,485 ± 60	13,456-13,201	11,507-11,252
Victoria Cave	OxA-2607	Antler biserial barbed point	10,810 ± 100	12,945-12,560	10,996-10,611
Victoria Cave	OxA-14888	Antler biserial barbed point	10,930 ± 45	12,910-12,704	10,961-10,755

Table 2 – AMS dates of isolated bone and antler artefacts not associated with a lithic technology.
Tabl. 2 – Datations AMS d'outils en os et en bois de cervidé non associés à une industrie lithique.

distribution of sites was their low-lying topographic position in relation to river networks. It was claimed that the majority of mapped long blade sites in southern Britain occurred “in low-lying positions, particularly floodplain situations, at altitudes seldom more than 61 m OD” (Barton, 1986, p. 205). This was partly seen as responding to the need for raw material acquisition but also noting the fact that such locations would have provided strategic points for ambush-hunting migrating herds of horse and reindeer and were also the preferred habitats of solitary aquatic feeders such as elk (*Alces alces*) (Barton, 1986, p. 208).

Some of these ideas have subsequently been refined and developed by other authors who have also pointed out that not all long blade sites are restricted to floodplain situations. One interesting observation put forward by Gardiner *et al.* (2015) suggests that the site at Underdown Lane (Herne Bay) occupied a prominent position on a low plateau overlooking the Thames valley. While not particularly high-lying or far from the river, its altitude would have been further accentuated if factors such as the contemporary low sea level in the Late Glacial were considered. According to these authors the site may deliberately have exploited an ecotonal location, within reach of the rich resources of the river valley but also with access to the higher plateau above. They also theorised that Underdown Lane may have occupied a transitional vegetational zone where the denser woodland cover of the plateau became much lighter affording possibilities for browsing herbivores as well as allowing greater visibility for hunter-gatherers (Gardiner *et al.*, 2015, p. 20). A second idea put forward by Naudinot and Jacquier (2014) explores the possibility of functional differences in the FBBT technologies, with sites subdivided into several categories: 1) small sites oriented specifically around the production and export of long blades, 2) small sites with evidence for various (unspecified) activities and 3) large sites with evidence for diversified activities (2014, fig. 8). They consider that the British long blade sites fall mainly into two of the categories with typical examples of 1) being Avington VI, Gatehampton Farm and Three Ways Wharf, and of 2) being principally that of Launde.

To test these ideas a little further we selected a sample of long blade assemblages mainly reported in Barton (1986) but including newer discoveries such as Underdown Lane, Herne, mentioned above. The

Floodplain locations	Excavated assemblage	Metres above river (local datum)
Avington VI	✓	
Church Lammas	✓	
Gatehampton Farm	✓	
Hinxton Hall	✓	
Kingsmead Quarry, Horton	✓	
King's Site, Mildenhall	✓	
Lullingstone Country Park	✓	
North Cray	No	
Riverdale, Canterbury	No	
Springhead	✓	
Sproughton	✓	
Swaffham Prior	No	
Three Ways Wharf	✓	
Titchwell	No	
Wawcott XII	✓	
Wrabness	No	
Non-floodplain locations		
Herne Bay, Underdown Road	✓	15
Ivry Street, Ipswich	No	32
Launde	✓	66

Table 3 – Topographic position of long blade sites in relation to rivers.
Tabl. 3 – Localisation topographique des sites de la Long blade technology en relation avec le système fluvial.

aim was to examine the relationship, if any, between landscape topography and the techno-typological components of the long blade assemblages. The sites listed in Table 3 are mainly located in floodplains. For the purposes of completeness these include the more recently excavated sites of Hinxton Hall and Kingsmead Quarry Horton though neither were included in the overall analysis as they have not yet been studied in detail. Only three sites were identified as coming from non-floodplain locations. The list is by no means exhaustive and we would anticipate that as other sites and assemblages are recorded they can be added to these data. In terms of the techno-typological features (fig. 1), we classified assemblages according to various criteria including the presence/absence of technological features, typological attributes and the category of “burnt” was added to highlight the presence of fire altered artefacts and probable hearth activity. Under technological types we identified the methods of core reduction and the use of preparation techniques such as faceting (if it was > 20%). Other signs of

SiteName	BLADE PRODUCTION				BLADELET PRODUCTION		OTHER KNAPPING						
	Cresting	Core tablets	Platform abrasion	Blades with faceted butts > 20%	Bladelet Cores	Bladelets	Cortical flakes	Tested nodules / pre-cores	Hammerstones	End-scrapers	Burins	Awls / piercers	Backed bladelets
Avington VI													
Church Lammas, scatter 1													
Gatehampton Farm													
King Site													
Lullingstone													
North Cray (Vansittart)													
Riverdale, Canterbury													
Springhead "Lower Floor"													
Sproughton													
Swaffam Prior													
Three Ways Wharf - A													
Three Ways Wharf - C e													
Titchwell													
Wawcott XII													
Wrabness													
Herne Bay													
Ivry Street, Ipswich													
Launde													

Fig. 1 (on left and on right) – Schematic chart indicating presence/absence of certain technological and typological attributes of Long Blade assemblages. The main categories describe blade and bladelet production, retouched and utilised pieces (including *pièces machûrées*), microliths and burnt artefacts. **Fig. 1** (à gauche et à droite) – Tableau synthétique de présence/absence des caractéristiques technologiques et typologiques des assemblages à « longues lames ». Les principales catégories définies font référence à la production laminaire ou lamellaire des assemblages, la proportion relative des supports modifiés ou utilisés (incluant les éléments mâchurés), les armatures et les éléments lithiques chauffés.

flint-knapping were signalled according to the presence of cortical artefacts, hammerstones and tested nodules or core preforms. The retouched tools and utilised pieces generally only contribute a minor fraction of these assemblages but were recorded for comparative purposes and included the sub-category of “bruised blades”. A separate category was used for the microliths to compare the different sub-types of these tools and if the microburin technique was employed.

ANALYSED RESULTS

The schematic chart shown in figure 1 is based on the presence or absence of specific components of the assemblages and allows for relatively easy comparison between sites in the floodplain with the three examples in higher-lying topographic positions. According to the criteria analysed it would appear superficially that the similarities outweigh any small differences and that no major distinction exists between the sites in the two topographical settings. However, at an individual level, it is noticeable that Ivry Street deviates slightly from the norm. This high-lying site represents a small scatter of lithics that includes long blade debitage and a few bruised blades but no retouched tools or major signs of other activity (Reid Moir, 1914). Unfortunately, the finds from this

site were recorded many years ago but if accepted at face value this collection may represent the remains of a workshop where blades were exported for use elsewhere. Ivry Street certainly contrasts with the two other higher locations at Herne Bay and Launde. The latter is striking in that it is one of the few sites with an absence of bruised blades. The occurrence of microburins and a richer than usual retouched tool and microlith inventory is also significant. This has been remarked upon by Naudinot and Jacquier (2014) who recognise Launde not as a workshop site but as an unusual example of a small FBBT site with evidence for a low diversity of activities. The presence of burning amongst the artefacts also implies that it was not a short-lived knapping station. The assemblage at Herne Bay is a little harder to categorise. It resembles some of the sites from lower lying locations with the presence of a few tools (several burins, an end-scraper and an obliquely truncated microlith) and bruised blades. The blade debitage includes a fairly high percentage of faceted butts and there are burnt artefacts present (Gardiner *et al.*, 2015).

When data are presented in the same way for the floodplain sites, there again seems to be overall consistency in the techno-typological features of the assemblages but with some notable internal variation. There are only two assemblages that closely resemble Ivry

RETOUCHED AND UTILISED							MICROLITHS							BURNT	
Truncated blades	Rubbed end / edges	Denticulated / notched	Other Retouch	Burin spalls / Retouch flakes	Other edge damage / utilised	Pièce mâchurée	Bi-truncated (inc.Zonhoven)	Broad oblique truncation	Rhombic or trapeziform	Straight backed (inc Blanchères)	Backed with basal retouch	Equilateral triangle	Tanged point	Microburins	Burnt

Street. They are the floodplain sites of North Cray and Riverdale both in Kent. While the exact conditions of artefact recovery at these locations is unclear there is enough documentation about Riverdale in letters in the British Museum (where the Riverdale collection is housed) to suggest that the long blade finds were found tightly packed together in a relatively undisturbed condition. This is confirmed by the fact that many of them can be refitted (Barton, 1986). The presence of a large abandoned blade core (250 mm long) indicates that this was probably a workshop site. No formal tools are present in the assemblage, none of the finds are burnt and R.G. Grace who reported the discoveries specifically noted that there was no sign of a hearth.

Most other floodplain sites display evidence of blade and bladelet production combined with the presence of a variety of retouched tools and microliths. Only Launde (a non-floodplain locality) seems to share the diversity of microlithic tool forms found in the richest floodplain sites and it has already been mentioned that there are striking similarities in the microliths from Launde and Three Ways Wharf. Both sites also show evidence of the use of the microburin technique and it is interesting that microburins have been recovered at six of the 15 floodplain sites. Here it should be noted that only three of the remaining nine floodplain sites without microburins were subject of excavation so it is possible such items were overlooked in these cases.

One feature previously highlighted has been the scarcity of evidence for hearth activity at long blade sites. Amongst other things this was used to conclude

that occupation was mainly of an ephemeral nature and fitted the idea of the sites being workshops or short-term butchery locations (Barton, 1989). However, such an interpretation may now require revision in the light of observation that thermal alteration is more common than originally envisaged with burnt artefacts recovered in six of the 15 floodplain assemblages and one of the higher-level sites (fig. 1). In most of these cases it is possible to rule out post-depositional factors to explain their presence and indeed it has been argued by several authors that there is a likelihood of hearths at some sites (Launde, Cooper, 2006; Three Ways Wharf, Lewis with Rackham, 2011; Herne Bay, Anderson-Wymark and Pope, 2016).

CONCLUSIONS

In this paper we have considered the latest evidence for the dating of long blade sites in southern Britain and have concluded that although the chronology extends into the earliest postglacial that it is unlikely there is significant overlap with the traditionally defined Mesolithic. We therefore can find no reason to challenge the original proposition that long blade sites belong to a technocomplex with closest affinities to “bruised blade” assemblages in northern France (Fagnart, 1993 and 1997; Fagnart and Coudret, 2000) and the Ahrensburgian groups with *riesenklingen* (giant blades) in northern Germany (Taute, 1968).

Notwithstanding these observations, it is clear that there is significant variability amongst the documented long blade assemblages in southern Britain. This

ranges from a low presence of bladelets and an absence of bruised blades at some sites to a wide divergence in the types of retouched tools, microliths and microburin technique at others. It was suggested that differences in topographic site location (whether floodplain riparian or higher level non-riparian) might be functionally related and therefore account for differences in the composition of these assemblages. Our examination of the evidence does not support this hypothesis. Although there are clearly taphonomic factors that need to be taken into consideration, particularly in collections that were not excavated or where sieving did not take place, we could find little evidence for a simple division between assemblages in floodplain and more elevated positions. The most commonly encountered sites are those in floodplain, riparian locations (19 of 22) and it was noted that these varied from examples of workshops (Riverdale, North Cray) to locations where other categories of activity took place. Such examples could also be found amongst the admittedly small sample of higher level localities described. Today, not all of the long blade

sites – either floodplain or in elevated positions – would be classed as very short-term encampments. The inferred presence of hearths from thermally altered artefacts (e.g. at Launde, Church Lammas, King's Site, Lullingstone, Sproughton, Swaffham Prior, Three Ways Wharf-Scatter C) would suggest that some of these locations were occupied for several days or even longer.

Finally, even though the long blade sites have been found in a variety of topographic settings we would not be surprised if other contemporary sites (with bigger microlithic tool inventories and possibly even without long blades) were to be discovered especially in non-riparian settings and perhaps well above the floodplain. ■

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The Pleistocene/Holocene transition in the Vale of Pickering: Settlement and mobility in Northern England

Chantal CONNELLER, Paul PETTITT and Simon CHENERY

Abstract: *This contribution reports on Long Blade material in the Vale of Pickering, North Yorkshire. In addition to describing the techno-typological attributes of this material, refitting is used to understand the use of space at the site of Seamer C. We also report on a raw material sourcing programme which identifies long-distance transport of flint to the Vale of Pickering. Evidence from sourcing and refitting is used to throw light on Long Blade mobility and settlement in northern England and beyond.*

Key words: *Long Blade, Vale of Pickering, Refits, Flint sourcing.*

Résumé : *Cet article présente les gisements à Long Blades de la vallée de Pickering, North Yorkshire. En complément des principales caractéristiques typo-technologiques des industries lithiques, l'étude des remontages permet d'étudier la structuration de l'espace du gisement de Seamer C. L'étude de la provenance de la matière première met en évidence l'emploi de silex allochtone dans la vallée de Pickering. Ces recherches apportent de nouveaux éclairages sur la mobilité et le type d'implantation au nord de l'Angleterre et dans les régions avoisinantes pour les gisements à grandes lames du Paléolithique final.*

Mots-clés : *Long Blades, Vallée de Pickering, Remontages, Provenance du silex.*

INTRODUCTION

In recent years a number of finds have extended the distribution of Long Blade sites in Britain from a classic southeastern bias northwards. Evidence for a wider distribution in the midlands and north of England has become evident, particularly through work at Launde, Leicestershire (Cooper, 2006), the banks of the river Bain near Horncastle, Lincolnshire (Hogue, 2016) and in the Vale of Pickering, North Yorkshire (Conneller, 2007), with new reports of Ahrensburgian material on Islay, Western Scotland (Mithen et al., 2015). This contribution focuses on the Long Blade material from the Vale of Pickering, North Yorkshire, recovered among a cluster of sites belonging to the late Pleistocene and early Holocene around the Palaeolake Flixton. This contribution outlines the typological and technological character of these northern Long Blade assemblages, and draws on refitting to discuss intra-site spatial organisation. Results of a new raw material sourcing programme and

refitting studies are reported here for the first time, and permit some broader observations on patterns of mobility at the edge of the Long Blade world.

THE CONTEXT AND THE SITES

The Vale of Pickering is a shallow glacial valley, near to the coastal town of Scarborough (fig. 1). The chalk escarpment of the Yorkshire Wolds forms the southern boundary of the Vale, while the North York Moors rise to its north. Following the melting of Late-glacial ice, a lake formed in the uneven glacial topography of the valley, which subsequently formed a focus for periodic human activity from the Allerød (*Federmessergruppen*) onwards. This lake, known as Lake Flixton, is today infilled with peat, resulting in good states of organic preservation along areas of the ancient lake edge. The original discovery of early prehistoric remains in the Vale can be credited to John Moore, a local amateur archaeologist, who located a number of sites through fieldwalking and through the

examination of the sections of the numerous ditches that drain the area of the former lake. Moore is perhaps best known for his discovery of the early Mesolithic site of Star Carr, but of greater relevance here was his

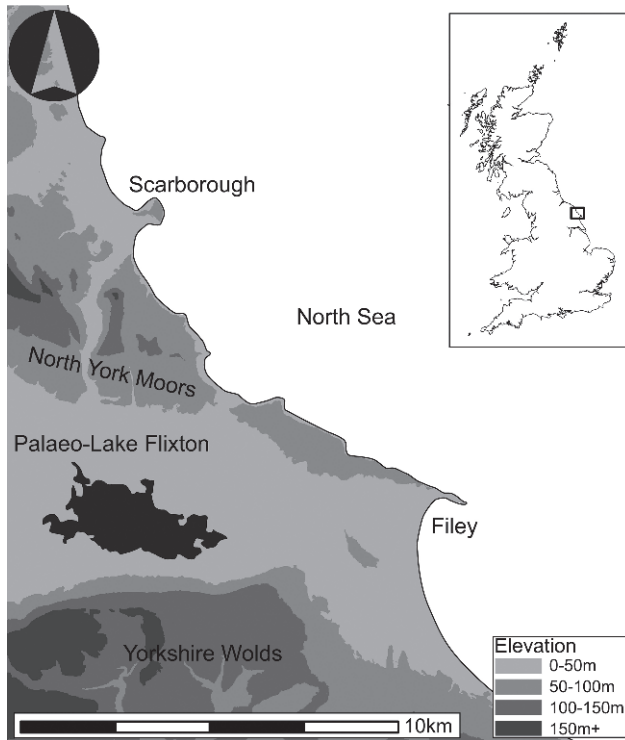


Fig. 1 – Location of palaeolake Flixton (image: Barry Taylor).
Fig.1 – Localisation du paléolac de Flixton (DAO : Barry Taylor).

excavation of the site of Flixton 2 (Moore, 1954), which takes the form of a scatter of horse remains associated with a small shouldered point.

Clark's subsequent excavations at Star Carr established the importance of the Vale of Pickering for early prehistoric research, and thus when the Seamer area, less than 1.5 km from Star Carr was earmarked for landfill in the 1970s, a programme of archaeological survey and excavation was carried out in advance of this work. These excavations, undertaken by Tim Schadla-Hall, located further sites around the edges of the lake (fig. 2). Much of this work involved testpitting, but two large areas of open excavation (spanning several hundred square metres) were undertaken at Seamer (sites C and K), and at two smaller areas uncovered at Seamer D and L. Preliminary work on the lithic assemblages by Andrew David identified Seamer L as of Long Blade attribution, while further technological and refitting study by one of the authors (CC) in the 1990s as part of doctoral research identified additional Long Blade evidence at Seamer C (Conneller, 2000). Following the Seamer excavations, Schadla-Hall, supported by the Vale of Pickering Research Trust, continued fieldwork around Lake Flixton until 2006, focusing on coring aimed at the reconstruction of the topography of the palaeo-lake Flixton basin, in addition to small-scale testpitting. This strategy located sites mainly of the Mesolithic period, although butchered horse remains which appear synonymous with Long Blade activity around Lake Flixton, were also recovered, thus extending our understanding of the distribution of Long Blade activity. Renewed excavations at Star Carr between 2004

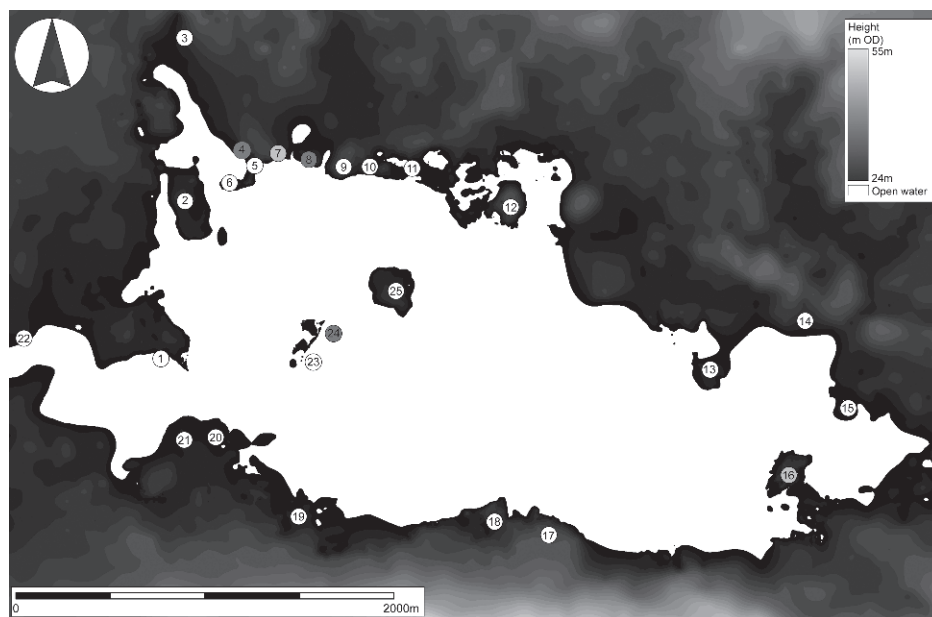


Fig. 2 – Long Blade and early Mesolithic sites in the Vale of Pickering. Long Blade occupation sites are highlighted in dark grey, humanly modified horse remains in light grey. 4: Seamer L; 8: Seamer C; 24: Flixton 2; 7: Seamer test pits; 16: Barry's Island (image: Barry Taylor).
Fig. 2 – Gisements du Paléolithique final à « longues lames » et du Mésolithique ancien de la vallée de Pickering. Les sites à « longues lames » correspondent aux pastilles de couleur gris foncé et les ossements de chevaux avec des traces anthropiques aux pastilles gris clair. 4 : Seamer L; 8 : Seamer C; 24 : Flixton 2; 7 : Seamer test pits; 16 : Barry's Island (DAO : Barry Taylor).

and 2015 (Conneller et al., 2013 and 2016; Milner et al., 2018) have refined in particular our understanding of the chronology of the earliest Mesolithic of the Vale in relation to the Long Blade activity. Finally, new excavations at John Moore's site of Flixton 2 were undertaken between 2013 and 2015 by Milner and Taylor (*in prep.*), and have thrown new light on the nature of the horse butchery site.

As a result of this long history of fieldwork, Long Blade evidence around lake Flixton currently consists of one large – possibly repeatedly occupied – site at Seamer C; a smaller knapping scatter at Seamer L; a horse kill/butchery site at Flixton 2; and isolated evidence for humanly-modified horse bones at a number of locations around the lake. Of these, Seamer C has undergone the fullest study, and will thus be used here as an exemplar for the techno-typological characteristics of Long Blade sites in the Vale of Pickering we present here. It is also from Seamer C that we have selected lithics for Laser Ablation-Inductively Coupled Plasma-Mass Spectrometric (LA-ICP-MS) trace elemental analysis, discussed towards the end.

LITHIC TECHNOLOGY

Long Blade technology in the Vale of Pickering bears many similarities to that of Southern English sites (Barton, 1989 and 1998). Large blocks of high quality material was preferentially used at Seamer C, with imported nodules up to 200 mm in length. Tabular and semi-tabular flint was used preferentially, with blade reduction exploiting the full length of the nodule. A soft stone hammer was used for knapping. Cresting was used to initiate blade production, with the angles of tabular pieces used to initiate the crest, before longitudinal blade removal occurred. Cores could be recreted to maintain and prolong blade production. Some cores have cortical backs, others are crossed by transverse removals from bilateral cresting.

Faceting was employed, although not exclusively. Some refit sequences have a high level of faceted and dihedral butts; on others the platforms are plain. Extensive and neat abrasion is a feature of the latter sequences, more so than amongst the Mesolithic assemblages of the area. Platform/core face angles are rather lower than Mesolithic examples, which tend to be nearer 90°. Refitting indicates that we are dealing with a true opposed platform technology, with one or two removals from one platform before the core was rotated and a similar number of removals occurred from the opposed platform. This resulted in blades that are generally flat in profile. Blades are also longer than their Mesolithic counterparts, though smaller on average than those of Long Blade assemblages in southern England, where much larger raw material packages were readily available. Fourteen blades from Lake Flixton are > 80 mm in length and four are > 100 mm. Many of the larger blades are broken, however, and conjoins of snapped blades indicate lengths of up to 140 mm were achieved.

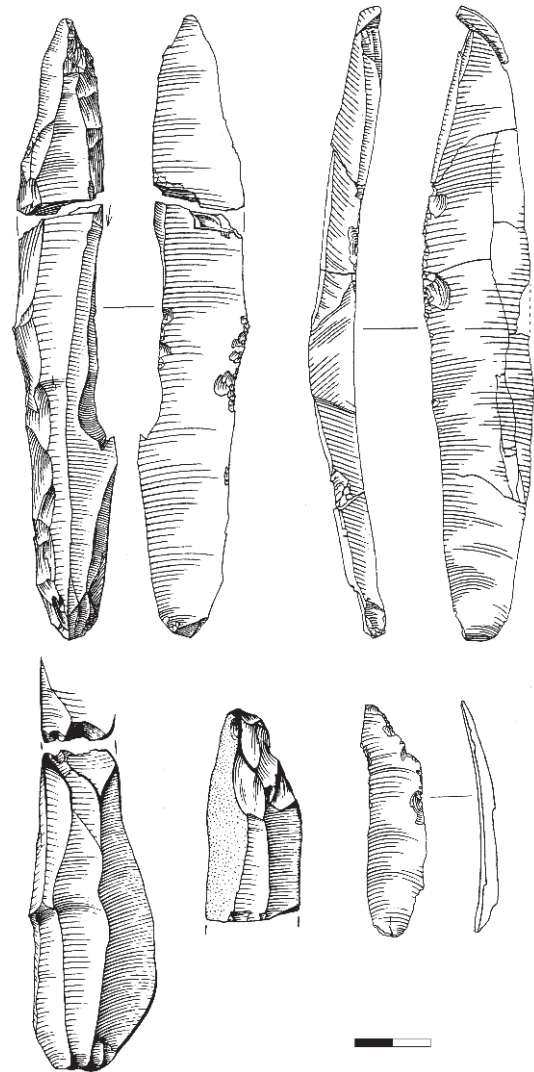


Fig. 3 – Bruised elements and rubbed-end pieces from Seamer C (image: Hazel Martingell).

Fig. 3 – *Éléments mâchurés et pièces abrasées en partie distale provenant de Seamer C (dessins : Hazel Martingell).*

Bruising is less common than on many southern Long Blade sites; it is absent, for example, at Seamer L, but it is present on six pieces at Seamer C (fig. 3), most notably on a crested piece, where one of the bruising spalls has been refitted (fig. 4). As in Southern England, crested pieces or similarly thick blades were the most common supports for bruising.

SEAMER C

Site C is located on the northern shore of Lake Flixton, on a relatively flat shelf of land formed by a Devensian kame deposit (Lane, 1998). An area of c. 78 × 30 m was excavated between 1977 and 1984. The site yielded a large assemblage of worked flint, a small faunal assemblage of 106 pieces of bone and charcoal. The site consists of three large, dense flint scatters and several smaller scatters, dating variously

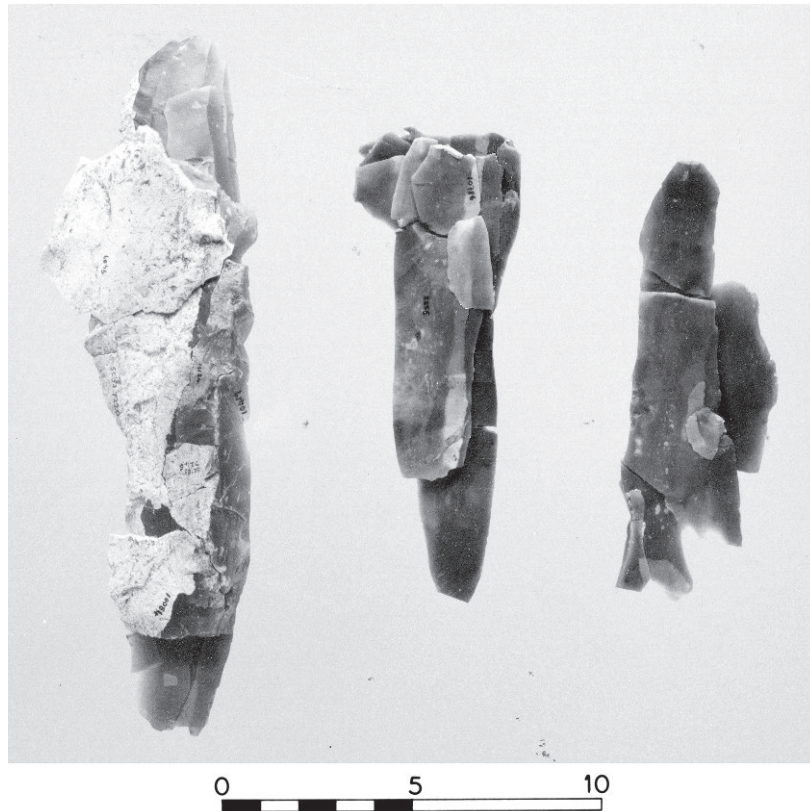


Fig. 4 – Refit groups C1 (left), C5 (centre) and C7 (right). Note the bruising spall refitted to the bruised blade in the sequence on the right (image: Gwil Owen).

Fig. 4 – Remontages C1 (gauche), C5 (centre) et C7 (droite). Voir le raccord d'une esquille de mûchurage sur la lame mûchurée dans la séquence de droite (photo : Gwil Owen).

to the Pleistocene/Holocene transition and to the early Mesolithic (fig. 5). There is no observable stratigraphic separation between the scatters of different date; all derive from an early Holocene buried soil which is sealed by peat. It is not known whether the soil development was contemporary with the Long Blade occupation or whether the Long blade occupation preceded soil development, and was only later buried. The condition of the Long Blade material is fresh and unpatinated, although faunal remains associated with Long Blade lithic material appear less well preserved than those associated with the Mesolithic scatters.

Based on techno-typological analysis and refitting, the Long Blade occupation of Seamer C consists of one large scatter, Scatter C, located in the north-central part of the site, and two smaller scatters B1 and F, the former located to the northwest of scatter C, and the latter around 35 m to the southeast. Refitting of these scatters has been very successful, with sequences up to 51 pieces long conjoined, offering an insight into lithic-related activities at the site. Six long refit sequences have been conjoined at Scatter C, highlighting different areas of activity. At Scatter C, a cluster of burnt flint (fig. 5) represents the location of a hearth, around which much of the knapping activity seems to have taken place. Two distinct knapping areas are visible around the hearth; one to the southwest, the other to the northwest, probably

indicating the presence of two different knappers. The knapper in the southwest was focused on initiating the reduction of two large tabular blocks of high quality clear brown flint, each of which only represents the early stage of reduction (fig. 4). Block C1 (fig. 4, left), a large tabular piece with a chalky cortex was shaped and crested before ten large blades were removed, six from one platform (one of which is now missing), and four from the opposed platform. The core, which would have been narrow but around 200 mm in length, was not recovered. Products from the core were not circulated widely (fig. 6): three were found in the northeastern cluster and one to the southeast of the hearth. A second tabular block, C5 (fig. 4, centre), this one with a thin cortex indicative of a derived context, was also knapped by this individual. This block underwent some preliminary shaping, but was not crested as this was not necessary given that removals were guided by its tabular ridge. Blades and large flakes were removed from along its long axis as well as the short axis that served as its platform. A third edge of the tabular block was probably also reduced (and one resulting blade used as a *lame mûchurée*) although this sequence (refit group C7, fig. 4, right) cannot be refitted to the C5 sequence, and the core itself was not recovered. Products from C5 and C7, as with C1 were not widely circulated (fig. 6). A single blade was found to the east of the hearth. This had



Fig. 5 – Lithic distribution at Seamer C with Long Blade scatters circled (image: Chantal Conneller).
Fig. 5 – Distribution spatiale des éléments lithiques à Seamer C. Les cercles indiquent les concentrations avec des « longues lames » (plan : Chantal Conneller).

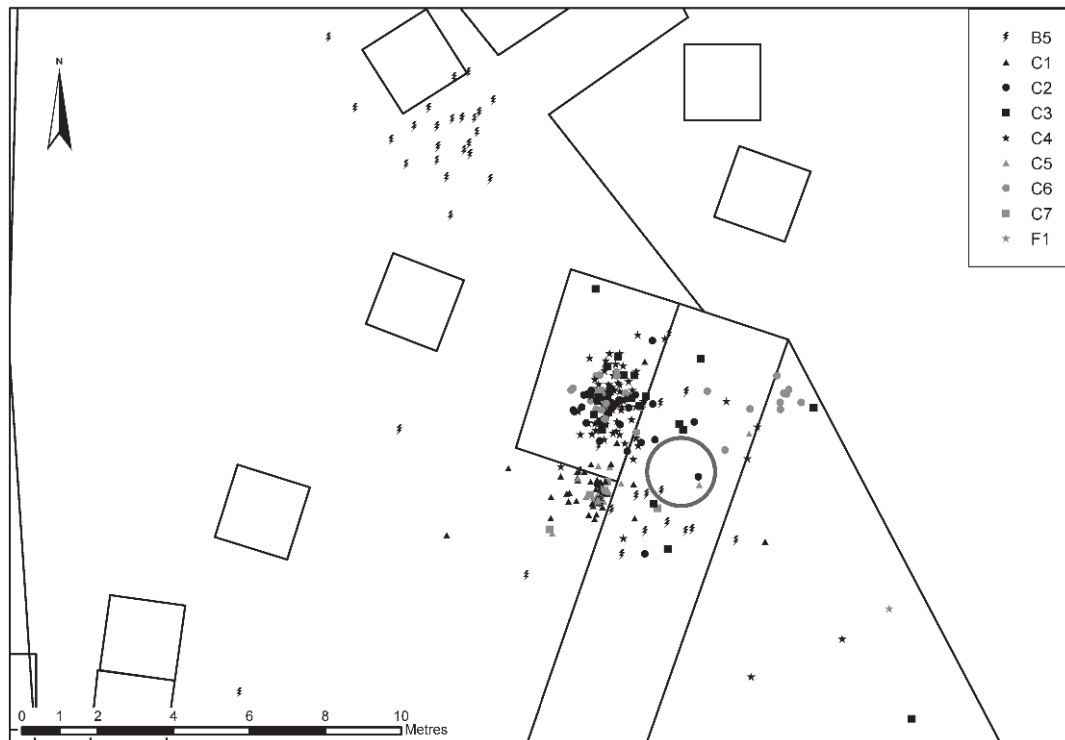


Fig. 6 – Seamer C: refit groups in scatters B and C. The location of the hearth at scatter C is represented by the grey circle (image: Chantal Conneller).
Fig. 6 – Seamer C : remontages des concentrations B et C. L'emplacement du foyer de la concentration C est représenté sous la forme d'un cercle gris (plan : Chantal Conneller).

been snapped and the two pieces found 1.9 m apart. A second bruised piece was also recovered, probably deriving from this sequence, as was a scraper. Three further scrapers and a couple of burins were associated with this area.

In the northeastern knapping area, three raw material units (refit groups C2, C3 and C4, fig. 7) (all brown/speckled grey semi-tabular pieces) were

reduced. In contrast to the unmodified tabular block in the southwest, all three were imported as preformed cores that had been crested elsewhere. All three underwent the remainder of the reduction sequence on site, from cortical blades and flakes, through blade production to the discard of the core. Discarded cores from the three refit sequences range in size from 80 to 100 mm. In contrast with the sequences from the

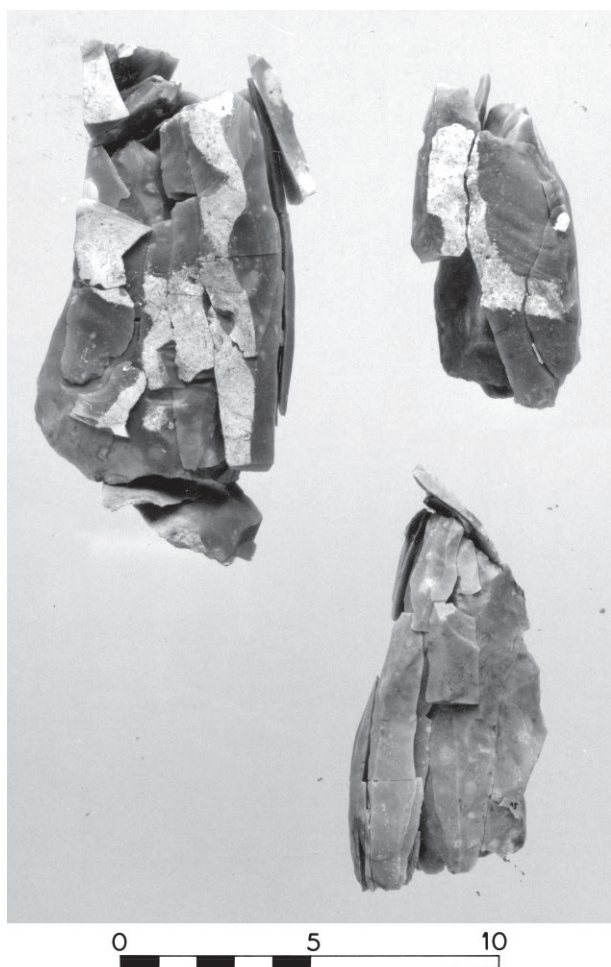


Fig. 7 – Blade core refit groups C2, C3 and C4 (image: Gwil Owen).
 Fig. 7 – Remontages de production laminaire des concentrations C2, C3 et C4 (photo : Gwil Owen).

southwest, faceting was minimally used in this sequence, though platform edges were neatly abraded. Knapping proceeded from two alternate platforms. Associated with this area were four burins, three projectile points and a scraper. Blades from these three refit sequences are more widely dispersed, found to the south, southeast and east of the hearth up to a distance of 20 m away. Also present in this area was a refit sequence based on the preliminary shaping of an opaque grey flint (refit sequence C6). This raw material unit also appear to have been worked to the east of the hearth.

Away from the southwestern and northwestern knapping areas, the hearth served as a focus for tool use. Blades that refit to the sequences recovered from the knapping areas were taken to the north east of the hearth and used. To the south of the hearth, deliberately segmented blades were brought from scatter B, around 10 m to the northeast (fig. 6). Tools (fig. 8) were also used in these areas: burin spalls are particularly common, indicating both the manufacture and resharpening of burins that were presumably made and used in these areas. Scrapers are also common –

mainly to the east of the hearth – while rarer examples of projectile points cluster immediately adjacent to it.

Fauna is associated with this scatter but is relatively sparse, and in the main too poorly preserved to be identifiable to taxon. The only element that can be ascribed to species are teeth, which all belong to horse, the most common faunal association of all northern and southern English Long Blade sites, which at Seamer C was recovered from the southern margins of scatter C. A small cluster of horse remains were also located around 12 m to the south of scatter C and may represent an associated butchery area.

Scatter B1, around 10 m to the west of scatter C, has a clear association with scatter C and is likely to be contemporary. A distinctive nodule of grey flint with a white stripe (refit group B5) was knapped in an area seemingly unassociated with any hearth. Though this nodule was mainly worked at scatter B, the presence of small debitage from this unit in scatter C suggests it was also worked here at some point. Blades from this sequence were deliberately segmented. The presence of positive and negative bulbs of percussion on the break surface indicate fracture through percussion from the dorsal surface; flexion breaks are also present, however these also can be produced by deliberate fragmentation (Bergman et al. 1987). Further support for intentional segmentation comes from the broad distribution of these segmented blades that have much greater refit distances than other knapping sequences (fig. 6). The deliberate segmentation of blades is not a usual feature of British Long Blade sites, although is known from the early *Federmesser* site of Nea Farm in Hampshire (Barton et al., 2009). Products from this sequence are the most widely distributed of any on site and are found up to 25 m to the south, although there is a distinct cluster at scatter C to the south of the hearth. Refitting indicates that not only already segmented pieces were moved from scatter B to scatter C, but also whole blades were brought to scatter C and segmented there.

The final area of Long Blade activity at Seamer C is Scatter F (fig. 5). This takes the form of a more diffuse scatter, based on the reduction of one raw material unit – a fine translucent brown flint – that was probably imported in already partly-reduced form (fig. 9). Here, blades were produced in an area to the west of a probable hearth, and products from this sequence were found distributed across an area of around 8 m around the hearth. Several long blades in a range of different raw material units which were not produced around this hearth were also recovered, indicating that raw material was imported to the site not just in the form of prepared cores but also as a stock of long, elegant blades. Tools are relatively few: two projectiles (a backed bladelet fragment and two refitting fragments of a thicker backed piece), a burin and a scraper. Horse remains, mainly teeth, reflecting poor preservation, were recovered. The potential connection between Scatter F and the other areas of Long Blade activity is unclear. The proximal part of a small obliquely blunted point, found 5 m from the main focus of flintknapping in Scatter F, conjoins to a distal

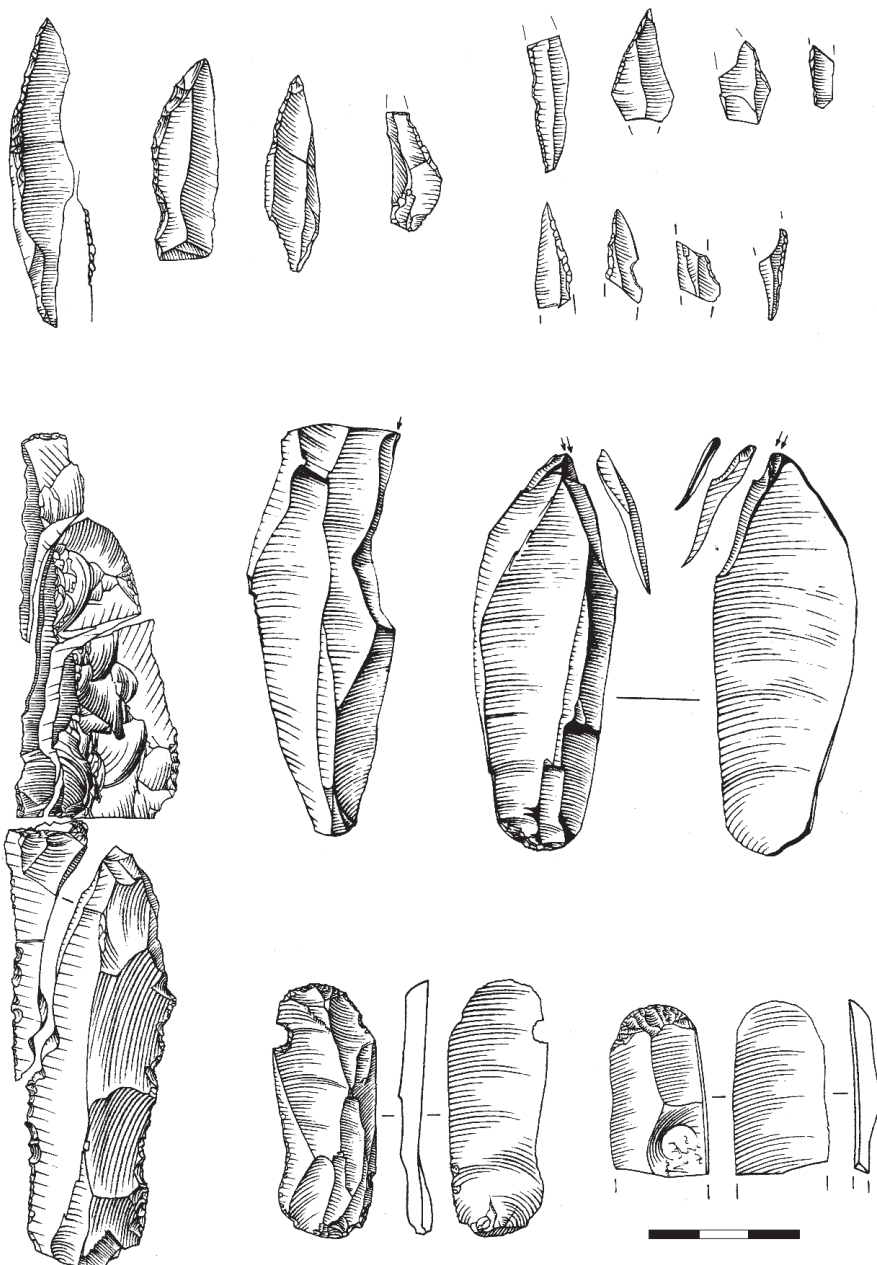


Fig. 8 – Tools from Seamer C (image: Hazel Martingell).
Fig. 8 – Supports transformés en outils de Seamer C (dessins : Hazel Martingell).



Fig. 9 – Partially reduced core from scatter F (image: Gwil Owen).
Fig. 9 – Nucléus partiellement débité provenant de la concentration F (photo : Gwil Owen).

part found in Scatter C. This could indicate a functional relationship between the two scatters, or simply that activity areas have been superimposed during different occupations.

SEAMER L

A second, smaller area of Long Blade activity was uncovered at Seamer L. Site L was first located as part of the Seamer testpitting programme of 1982, and underwent further investigation in 1984 (fig. 2). The site is situated around 350 m west of Seamer C. In contrast to site C, Seamer L is a small scatter of

410 pieces of flint, although its faunal assemblage is relatively large by comparison, comprising 88 elements including two horse mandibles. Seamer L appears to represent two distinct occupations; the first a Long Blade-type industry, the second a larger, Early Mesolithic scatter. There is, however, no stratigraphic separation between the material relating to these two distinct occupations, though they can in practice be separated by condition and raw material use. One of the horse mandibles yielded a radiocarbon measurement of $9,790 \pm 180$ BP (BM-2350), although this was measured using conventional (beta) counting a long time ago and carries the imprecision of the time, and is now considered to be too young, probably as a

result of humic acid contamination. If anything, we should regard it simply as a minimum age.

A large blade core of Wolds flint and probably also a large flake core also of Wolds material belong to this assemblage. The blade core measures 125 mm in length and displays the scars of numerous large blades which were mainly removed from one direction along a single face of the core. No pieces can be refitted to this core, and wear down one side suggests that it may have been subsequently used as a tool. Two long blades, a crested blade and a large flake all appear to have been manufactured from another Wolds flint nodule, though only the two blades refit. All three blades are broken – lacking their proximal portions – although even in their incomplete form they range up to 128 mm in length. No tools are associated with the long blade material here. In contrast to Seamer C this seems to have been a short-lived activity area. Its raw material associations also contrast. It may be a related site where a new stock of blades was produced on local raw material to replenish the stock of imported blades.

FLIXTON SITE 2

Flixton site 2 is located on an island in the middle of Lake Flixton (fig. 2). The site was first excavated by J. Moore in 1949. A layer of peat containing Mesolithic material was underlain by a gravel layer, and beneath this, a layer of peat containing a well-defined spread of cut-marked horse bones (MNI = 3) was excavated. The only artefacts associated with this layer were a small blade and a projectile originally described as a small shouldered point (Clark, 1954, pl. XVI) but which could also be a broken tip of a narrow-backed bladelet, similar in this respect to examples from Seamer C. Moore believed this layer to represent a Late Glacial horse kill site. Four additional 2 × 2 m testpits were excavated at Flixton site 2 in 1986 and a further unit in 1993 by the Vale of Pickering Research Trust, all aimed at locating Moore's original trench and adding to our understanding of the site. Only two animal bones were recovered from these excavations, although one was an almost complete horse mandible, which is likely to be related to Moore's layer of horse bones. Further excavations were conducted at Flixton site 2 between 2011 and 2013 by Milner and Taylor (*in prep.*).

ISOLATED FAUNAL FINDS

Given that horse is not present on Early Mesolithic sites in the Vale of Pickering, and is unlikely to be associated with the Allerød *Federmesser* occupation, humanly modified horse can be taken as a proxy for Long Blade activity in the Vale of Pickering. Humanly modified horse remains were identified by R. Jacobi, as a part of his project on redating horse remains using ultrafiltration and exploring the relationship between the presence of horse and the human

recolonization of Britain (Jacobi and Higham, 2009). He identified modified horse (mainly teeth showing evidence that the jaws from which they derived had been smashed for marrow) from three further areas around the lake: two testpits located between Seamer C and Seamer L and Barry's Island, on the southern lake shore (fig. 2). These remains do not appear to be associated with Long Blade flintwork, however the Seamer finds are from small test pits and it is possible that undiagnostic material may be present amongst Mesolithic flintworking, while the horse jaw from Barry's Island has been redeposited by a stream channel, thus its original associations are uncertain. Isolated and unmodified horse remains have also been recovered from Flixton School and Cayton Carr, respectively on the southern and northern shore of Lake Flixton.

RADIOCARBON CHRONOLOGY

Radiocarbon dating of Long Blade material in England has proved problematic due to low surviving collagen levels in surviving bone and difficulties eliminating humic acid contamination. At Flixton 2, where the greatest number of radiocarbon measurements have been attempted, problems of humic acid contamination have still been common (Marom et al., 2013), which has resulted in a spread of age ranges extending over a millennium. The most consistent set of measurements have been obtained by using the ion-exchange and hydroxyproline protocols (Marom, *ibid.*). These measurements (table 1) suggest horses were butchered on Flixton Island sometime between ~ 11,800 and 11,695 cal. BP (1σ). Contamination has also been a problem at Seamer L; however a recent ultra-filtrated date on horse remains (Jacobi and Higham, 2009) is compatible with those from Flixton site 2. A final date comes from a humanly modified horse jaw from Barry's Island.

RAW MATERIAL SOURCING

In 2010, lithic artefacts from Seamer C were included in the first major attempt to characterise major British sources of flint using LA-ICP-MS trace element analysis. A pilot study of British flint and a selection of Lateglacial flint artefacts (Rockman, 2003) had suggested that successful separation of major regions of flint might be achievable, and the provision of a joint funding initiative of the National Science Foundation (USA) and Arts and Humanities Research Council (UK) aimed at fostering collaboration between American and British researchers provided the opportunity for one of us (PP) to begin in collaboration with Marcy Rockman an ambitious attempt to characterise a material that many have thought too chemically variable to reliably characterize in an archaeologically meaningful manner. Central to the project was the LA-ICP-MS facility at

Site	Laboratory number	Radiocarbon measurement (BP)	$\delta^{13}\text{C}$	Sample ID
Flixton site 2	X-2395-14	10,155 ± 55	-24.60	Bone, <i>Equus ferus</i>
Flixton site 2	OxA-6328	10,150 ± 90	-20.20	Bone, <i>Equus ferus</i>
Flixton site 2	OxA-6319	10,150 ± 80	-20.80	Bone, <i>Equus ferus</i>
Flixton site 2	OxA-6318	10,090 ± 90	-20.80	Bone, <i>Equus ferus</i>
Seamer L	OxA-19511	10,025 ± 45	-20.7	Bone, <i>Equus ferus</i>
Barry's Island	OxA-6330	10,160 ± 90	-19.6	Bone, <i>Equus ferus</i>

Table 1 – Radiocarbon measurements on horse bones from Long Blade sites of Lake Flixton.
Tabl. 1 – Datations radiocarbones sur os de chevaux des gisements à « longues lames » du lac de Flixton.

the British Geological Survey, run by one of us (SC) who produced the analytical work.

As part of this project we have to date analysed a number of lithic artefacts from thirteen lateglacial sites of Creswellian and Long Blade attribution (Pettitt et al., 2012, 2013 and 2015). Our aims have been to reconstruct for the first time a glimpse of lateglacial hunter-gatherer land use in Britain from the perspective of procurement and use of lithic raw material. Four artefacts from Seamer C Long Blade scatters, as well as a single artefact from the *Federmesser* occupation of Seamer K were included in the project, and we report the results of the LA-ICP-MS trace elemental analysis of these below. They provide an as yet unique glimpse of potential raw material movements of the Long Blade assemblages.

Characterisation of British flint source regions

Other than the pilot study by Rockman (2003), no major trace element characterization of surface-accessible or non-mine British flint sources had been attempted before that reported in Pettitt et al. (2012). In this, we characterised with high confidence the major regions of British flint, subsequently using them as a basis for assessing probable regional origins of and movement of flint to archaeological sites. The bedrock source of flint in Britain, northern France and Belgium is the Cretaceous Chalk, which in Britain extends across southern England from limited exposures in Devon in the southwest to the “Downs” of Hampshire, Sussex and Kent in the southeast, and northward from the vicinity of Salisbury Plain in Wessex, through the Cotwolds and eastwards into East Anglia, and north into the “Wolds” of Lincolnshire and southern Yorkshire. Of particular interest is its southward extension under the English Channel to the Paris Basin and eastward extension onto Doggerland and into Belgium. Additional, although limited, chalk deposits of Cretaceous age occur in the Inner Hebrides of Scotland (Hopson, 2005); these contain some

secondary or detrital deposits of flint, but no primary bedrock sources (Wickham-Jones and Collins, 1977; Saville, 2005).

The distribution of English chalk/flint sources is shown (in dark shade) in figure 10. The stratigraphic framework of the Cretaceous Chalk in Britain has recently been revised by the British Geological Survey (Hopson, 2005). Within this framework, the traditional divisions of Lower, Middle, and Upper Chalk are re-portioned into the Grey Chalk and White Chalk Subgroups. As described in Hopson (2005) all flint-bearing formations and members occur in the White Chalk Subgroup (late Cenomanian, Turonian, Coniacian, Santonian, and Campanian in age), which overlies the Grey Chalk (earlier Cenomanian). The division of the Chalk into Provinces is a continuing process, at present including Southern and Northern Provinces (the Thames River southwards and from just south of The Wash northwards respectively), with the additional recognition of a Transitional Province from the Thames northward across much of East Anglia. With respect to flint morphology, boundaries between Provinces are understandably diffuse: flint in the Southern, Transitional, and the South Lincolnshire portions of the Northern Province tends to occur in nodules and is characteristically translucent and dark in colour. By contrast, flint from sources further north in the Northern Province is generally tabular to massive in form and often an opaque medium to light grey in colour. Recent assessment of tectonic movements during the Cretaceous (Mortimore, 2011) reveal that the period was more active than previously thought, with tectonic influences on regional sedimentation, correlation of marker beds across regions, and post-Cretaceous removal of upper layers of Chalk in England – particularly southern England – as compared with contemporaneous deposits on the European mainland. Relationships between variations in Chalk sedimentation at these scales and flint composition does not yet appear to have been addressed.

Accessible exposures of flint sources in Britain include bedrock outcrops and cliffs, glacial till and both consolidated and unconsolidated post-Cretaceous

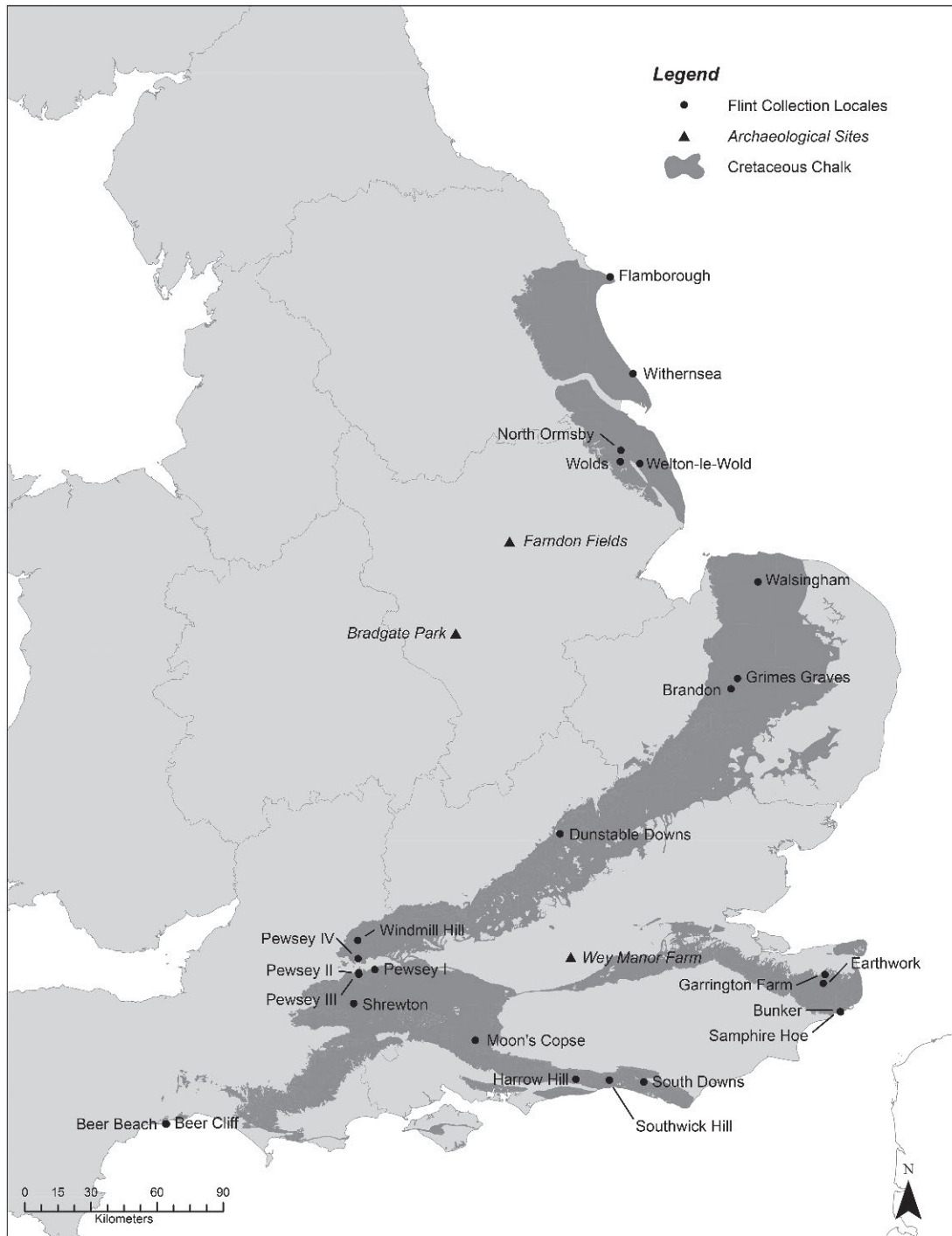


Fig. 10 – Location of British Chalk and sampling locations (image: Marcy Rockman).

Fig. 10 – Localisation des affleurements de craie en Grande-Bretagne et des lieux d'échantillonnage (carte : Marcy Rockman).

detrital deposits of flint cobbles and gravels. Contributions from both now-terrestrial chalk lands and its extensions under the English Channel and North Sea make up the unconsolidated flint deposits along rivers and beaches along both southern and northeastern coasts. Although these deposits are mixed, few major rivers in England drain across more than one Province, removing a potentially confusing factor for source identification. Glacial till is also an important potential

source of flint, particularly in the context of the Vale of Pickering, where flint obtained from the till, or as till-derived beach pebbles was the main source used by Mesolithic groups. The characterization process we employ is directed at the *differentiation of regions* of flint within the Cretaceous Chalk bedrock. Artefacts produced on river cobbles or glacial till would, given this baseline, be associated with their original bedrock region, rather than their point of procurement. Given

the broad regional landscape approach of this analysis, such associations retain utility. The extent to which regional mixing of flints has occurred along river and other detrital contexts is a point for further research, although given the results we report below we can be confident that rivers and other potential sources of mixing were not responsible for the patterns observed at Seamer C.

We characterised the major British flint regions using a series of flint samples taken from 25 flint locales. These comprised 12 that were originally identified and sampled in the pilot study by Rockman (2003), in addition to 13 new locations which were sampled by Paul Pettitt and Marcy Rockman in order to complement or fill-in the extent of locales used in the pilot study and allow, for example, more detailed analysis of compositional patterns in the Salisbury Plain and North Lincolnshire regions identified in the pilot study. The complete corpus of flint source regions characterized in our study is published in Pettitt et al. 2012 (and repeated in Pettitt et al., 2013 and 2015). Both locale distributions were designed to test for variations in surface-accessible flint at regional to Province-level scales. This approach specifically does not attempt point-source artifact attribution such as the early series of flint artifact geochemical studies developed for British Neolithic-era flint mines (Sieveking et al., 1970 and 1972; De Bruin et al., 1972; Craddock et al., 1983; Barber et al., 1999), but instead to identify regional differentiation toward pre-Neolithic colonization and landscape-scale movement (Tolan-Smith, 1998; Golledge, 2003; Rockman and Steele, 2003).

We initially identified viable sampling areas through a combination of geological maps, Ordnance Survey maps, and notations of flint outcrops in regional British Geological Survey geological reports as well as our own observations in the field. While effort was made to identify and sample locales exposed through natural processes, due to limitations of time and particularly restrictions to modern access, some locales are exposed or have enhanced exposure due to human activity, particularly ploughed fields. Once identified, locales were recorded with respect to location (GPS coordinates, elevation, access), outcrop characteristics (type, length, height, area, orientation, aspect, geological strata characteristics, general description, and search strategy used to find outcrop), flint description (primary color(s), mottled or solid, nodule shape, nodule distribution/density [per sample sq. m], maximum visible dimension, flint inclusions/visual quality, cortex description [colour, texture], other notes, no. of samples collected). A photographic archive was created of each locale. Ten separate samples (typically large natural cobbles) were collected from each locale, each typically separated from the others by several metres. From these, samples were prepared in the field by knapping each down to several small flakes using a flint cobble from the same source in order to minimize the potential for cross-source/cross-material contamination; it should be obvious why we avoided using a metal rock hammer. In the

laboratory, LA-ICP-MS analysis was conducted on three distinct areas, in each case with three separate measurements; thus, each sample (flake) was characterized by nine measurements and therefore each source by a total of 90. The host geological stratum was determined following fieldwork using a GIS and 1:50,000 scale geological map system at the British Geological Survey.

LA-ICP-MS methodology

The geological samples and artefacts from Seamer C were analysed at the British Geological Survey using LA-ICP-MS. Our objectives were twofold: first, to characterize (and hopefully distinguish between) each major flint region and establish a high degree of confidence in the results; and secondly to match the selected artefacts to specific regions or portions of regions and by so doing establish a basic picture of flint procurement networks. As noted above, in order to both identify and address analytical effects arising from heterogeneity in the natural flint material, each sample (geological and archaeological) was ablated in nine spots, organized in three spatially distinct sets each of three closely-spaced spots. Each spot was pre-ablated and the material discarded before analysis in order to avoid potential surface contamination. For the archaeological artefacts analyses were preferentially (in most cases) performed on “fresh” (i.e. unpatinated) surfaces, usually accessed at modern breaks. To perform the analysis the samples were placed inside a windowed chamber and the laser (NewWave 266 nm for original geological samples and NewWave 193 nm for current samples) fired at the sample, removing less than a microgram of material. Because of this low sample size although the technique must be regarded as destructive the sampling in almost all cases is invisible to the naked eye. Following this the sample was carried from the chamber to the quadrupole ICP-MS (Agilent 7500) by a stream of helium gas. The ICP-MS was repeatedly fast jumped through the 38 trace elements in which we were interested. The integrated signal was blank subtracted and calibrated to that produced by a standard glass of known concentration (NIST SRM612). Quality control glasses samples (NIST SRM614) were regularly run throughout each day’s analysis (Chenery and Cook, 1993).

Median sample concentrations for each sample were statistically analysed using Minitab and R software with the geological type material being used as a training dataset for canonical discriminant analysis (CDA). The CDA factors produced were applied to the archaeological dataset and assignments being made from observation of sample loading both graphical and tabular. The resulting characterization of locales and artefacts is presented in figure 11, and flint regions (each comprised of one or a cluster of locales) linked to the archaeological artefacts noted in table 2. For these samples CDA1 and CDA2 are the most

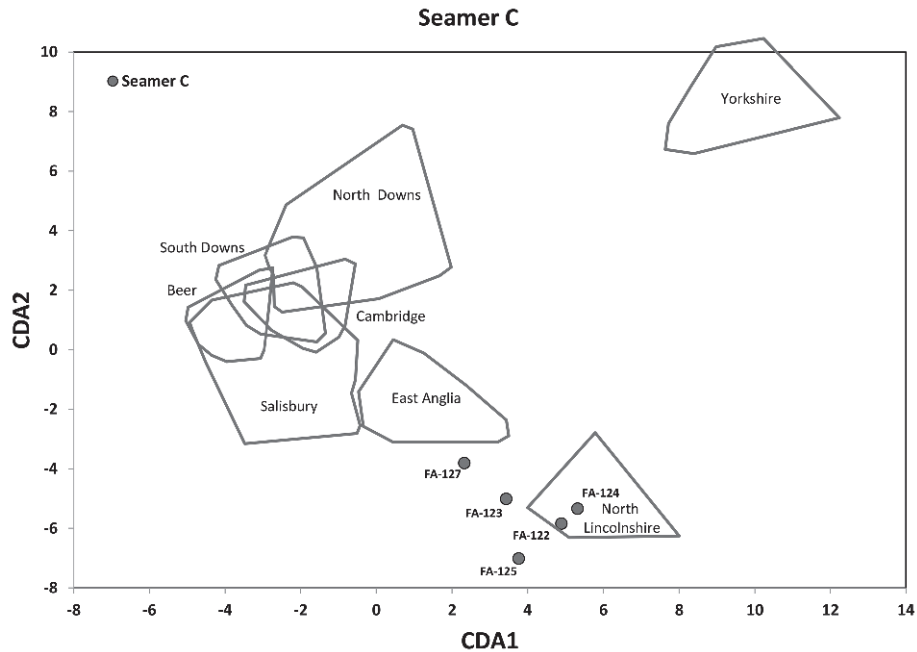


Fig. 11 – Characterisation by canonical discriminant analysis of Long Blade artefacts from Seamer C (F-122-126). Also shows characterisation of *Federmesser* artefact from Seamer K (F-127) (image: Simon Chenery).
Fig. 11 – Caractérisation par analyse canonique discriminante des artefacts des concentrations à « longues lames » de Seamer C (F-122-126). La figure présente également la caractérisation d'un artefact *Federmesser* de Seamer K (F-127) (graphique : Simon Chenery).

Sample	Identification	Most probable source	Less probable source
FA 122 (find no 5719), Seamer C, Long Blade	Burin spall from imported burin	North Lincolnshire Wolds	/
FA 123 (4947), Seamer C, Long Blade	Fragment from refit group C3 (prepared core)	North Lincolnshire Wolds	East Anglia
FA 124 (7450), Seamer C, Long Blade	Fragment from refit group C1 (imported chalky tabular flint)	North Lincolnshire Wolds	/
FA 125 (345), Seamer C, Long Blade	Blade fragment, fine honey-coloured imported blade	North Lincolnshire Wolds	/
FA 127 (22069), Seamer K <i>Federmesser</i> series	Tool in patinated till material	East Anglia	North Lincolnshire Wolds

Table 2 – LA-ICP-MS trace elemental sourcing of lithic artefacts from Seamer C. “FA” stands for Flint Artefact; these are unique numbers within the LA-ICP-MS sourcing project. “Most probable source” indicates the most likely source identification. “Less probable source” indicates an identification which, while this cannot be eliminated, is less likely to be the source than the most probable.

Tabl. 2 – Identification de l'origine des matériaux par LA-ICP-MS d'éléments traces d'artefacts lithiques provenant de Seamer C. « FA » désigne un artefact de silex ; ce sont des numéros uniques dans le projet de LA-ICP-MS sourcing. « Source la plus probable » indique l'identification la plus vraisemblable. Le terme « source moins probable » indique une identification qui, bien qu'elle ne puisse être éliminée, a moins de probabilité d'être la source la plus probable.

appropriate for assigning the data. Sample values for CDA3, the next most significant factor, are consistent with either sources in East Anglia or North Lincolnshire, this factor not being a particularly good discriminator for either of these regional groupings. The reader should be aware that the regional areas defined by the modern geological samples may not encompass the full range of possible CDA values, by virtue of access to sample material being likely

different to that of the original flint artificer. Therefore, that samples falling outside the defined regions is not surprising.

Within the CDA factors, CDA1 accounts for the biggest variation (discrimination) in the dataset, CDA2 for the next largest and so on. In the current dataset, CDA1 variation was dominated by the North Lincolnshire group and to a lesser extent by the East Anglia group. Whereas CDA2 split off the North

Yorkshire group and to a lesser extent the North Downs group. CDA3 was most significant in separating the Beer group from the Salisbury group. Higher CDA factors had a tendency to split off individual samples within regional groups. The variation within the training groups when used for the CDA suggests the regional resolution chosen is the finest scale we can currently work at. To improve this further, i.e. perhaps to distinguish between Norfolk and Suffolk within the broad East Anglian source, would require a larger and possibly more focused training set of samples.

A parsimonious interpretation of the most likely source identifications indicates that the two most important sources for the four Long Blade artefacts analysed were the North Lincolnshire Wolds (at least 60 km to the south), with a less probable identification for one artefact (FA123) of East Anglia (at least 150 km to the south/south east, in a direct line across part of Doggerland). Though only a single artefact from Seamer K has been examined, it seems that *Federmesser* groups used, at least on occasions, a different source from Long Blade groups, clustering with East Anglian flint sources. Visually this piece appears very similar to the glacial till flint used by Mesolithic groups. Further work to characterise this source and offshore deposits would be useful in order to understand whether these and the East Anglian chalk flint can be distinguished.

Thus, parsimoniously, the lithic material used during the Long Blade occupation derived from a source 60 km to the south, suggestive of a north-south axis of movement, possibly facilitated by travel along a major English river such as the Trent, as has been suggested for the Creswellian (Pettitt et al., 2012). It is interesting that North Lincolnshire or East Anglia has also been identified as the possible source of one artefact from the Long Blade site of Church Lammas (Surrey) in a procurement network that was overwhelmingly local (Pettitt et al., 2013). Given the relative imprecision of the available radiocarbon chronology, the environmental context of Long Blade occupation is unclear. However, the presence of horse can be taken to suggest an open landscape, and hence relatively long-distance mobility – at least seasonally – may not be surprising.

DISCUSSION

As noted above, a degree of imprecision characterises the raw material sourcing evidence, as definition of regional groups is based on the geographical distribution of analysed samples, in addition to the fact that there will inevitably be some trace elemental overlap between adjacent sources. One area we are currently blind on is the elemental characterisation of flints sourced on Doggerland, i.e. which are now offshore. It remains a possibility that what we parsimoniously identify as North Lincolnshire (or East Anglian) flint was actually sourced on Doggerland. Our interpretation is, however, at least parsimonious, and certainly

indicates that the Long Blade groups moving back into northern England after the coldest part of the Younger Dryas prioritised the use of raw material that was not only large in form and high in quality, but whatever the specific case, obtained this material from sources that were much more distant than those of the subsequent Mesolithic occupation of the Vale. The current sourcing work suggests that people were moving to the Vale of Pickering from the south, from Lincolnshire, possibly along the river systems. The fact they appear to be carrying so much material with them may suggest two things: first, the possible use of boats to transport materials, and secondly, that they were not confident of securing similar large, high quality material at their destination and thus “geared up” in preparation for moving on into unfamiliar territory.

The Vale of Pickering sites represent the most northwesterly occupation at this time, at least until the small assemblage from Islay can be confirmed as of Lateglacial age through full techno-typological study and/or radiocarbon dating. We therefore think it likely that the Seamer Long Blade material represents a pioneer occupation, undertaken by groups moving from a core area of more familiar territory (cf. Housley et al., 1997), and it may be that these people were unfamiliar with the location and nature of lithic sources so far north of their core area (Conneller, 2007).

Long Blade/Belloisian sites are frequently located close to high quality raw material sources (Fagnart, 1997). The presence of Long Blade sites in the Midlands and Northern England, where large packages of high quality raw material are uncommon, would thus create problems for Long Blade groups that was solved in different ways in different regions. At Seamer C high quality raw material was transported from flint-rich areas in the form of partly-worked nodules or preformed cores and large blades; only one nodule or possibly two nodules of local wolds flint were procured and underwent preliminary testing and preparation. It is likely that the latter formed the more mobile and flexible aspect of the technology, and were perhaps carried as personal equipment; material imported as blades appears to have been preferentially transformed into tools – particularly burins and rubbed-end pieces – either on site, or possibly as need arose during activities in the wider landscape. However local sources were also employed at Seamer L, where local Yorkshire Wolds chalk flint was used. Though Wolds flint is available in large packages it is of relatively poor quality, and it is likely greater selectivity was needed in locating appropriate material than in southern England. Local glacial till material was also employed at Launde, Leicestershire (Cooper, 2006); though this can be found as large nodules these are rare and greater search time would have been needed. The assemblage at Launde was patinated which may disguise the presence of some exotic material amongst an assemblage of predominantly local flint.

There are indications that more exotic material was imported on to other Long Blade sites, both as

prepared cores and blades/tools, though in lower quantities than the Vale of Pickering: A blade and microlith made from East Anglian/Lincolnshire flint were found at Church Lammas, Surrey, on the Colne floodplain; while in the Kennet Valley Froom (2005) reports differential cortex in the Avington VI assemblage, suggesting some material comes from a more distant chalk source, and notes the presence of distinctive dark flint cores at Wawcott XII. It is also likely that distant material may be disguised in assemblages that are frequently patinated.

Material is also missing from sites that are predominantly focused on core preparation and blade production, such as Riverdale, Kent, where the core belonging to a refitting sequence of giant blades is missing (pers. obs.). Fagnart (1997, p. 211) also notes blades frequently missing from refit sequence on Belloisian sites in the Somme Valley. This system of provisioning supported what appears to have been a very mobile lifestyle, relating perhaps to the seasonal movement of horse, the main prey of these groups. The longer-term changes in the distribution of animal populations may also have been a factor in the context of the dynamic climatic and environmental changes of the Pleistocene/Holocene transition.

The Vale of Pickering sites also offer new insights on the nature of Long Blade settlement. The classic Belloisian sites of northern France are focused on the exploitation of good quality raw material. On these sites burnt flint (indicating the presence of hearths) and formal tools are relatively rare, while blades appear to have been manufactured for use elsewhere, leading to suggestions these may represent workshop components of a single settlement system (Fagnart, 1997). Potential residential sites with a varied set of formal tools are less well-known but represented by recent finds such as Calleville in Normandy (Biard and Hinguant, 2011). A similar pattern appears to have pertained in Britain, with the classic Long Blade sites often focused on procurement and core reduction, with burnt flint and formal tools rare (Barton, 1989 and 1998). In Britain too, more recent work has revealed sites with reasonable quantities of formal tools and evidence for hearths. Amongst these sites we can include Adventurers Farm/Whiteway Drove, Cambridgeshire (Billington, 2017), Launde, Leicestershire (Cooper, 2006) and Three Ways Wharf, Middlesex (Lewis, 2011), as well as Seamer C. It is interesting to note that at none of the sites where reasonable quantities of formal tools have been recovered is the procurement of high quality raw material and the production of prepared cores and large blades for export a major focus of activities. At Adventurer's Farm/Whiteway Drove (Cambridgeshire) the early stages of reduction are absent (Billington, 2017), suggesting imported material; at Three Ways Wharf (Middlesex) local gravels were used (Lewis, 2011), as they were at Church Lammas (Surrey), where material was also imported (Jones et al., 2013).

Valentin (2008) has suggested that Belloisian assemblages display a limited range of functions, leading to a highly differentiated series of sites within

a particular area, a theory that the evidence cited above suggests also holds true of the British evidence. This can be seen more clearly through the study of material from the edges of Lake Flixton, a relatively small geographical area where a high level of differentiation can be witnessed between sites. Seamer C might be characterised as a place where more "domestic" activities occurred. Seamer L is more similar to the classic workshop sites where large, local chalk flint nodules were prepared and cores and large blades exported. Flixton site 2 is entirely focused on the hunting and butchery of horses, associated lithic material being almost completely absent. The isolated finds of humanly modified horse remains around Lake Flixton may represent similar sites to Flixton site 2, given that no associated lithic material has been noted. These findings indicate that even on the margins of Long Blade occupation a highly diversified, logistical use of space pertained.

Our current spread of radiocarbon dates does not clarify with any confidence the broader issue of whether the Long Blade occupation of the north took place in the late Pleistocene or early Holocene. Recent work (Conneller and Higham, 2015) does however throw more light on the end of the Long Blade occupation of Britain, suggesting this coincided with an early Holocene short-term climatic downturn, possibly the Preboreal oscillation. This suggestion is supported stratigraphically by the Flixton site 2 sequence, where a sand layer post-dating the horse remains is likely to represent an early Holocene climatic event (Jacobi, 2006). Current evidence indicates a chronological gap between the last Long Blade sites and the earliest Mesolithic. This holds true not just in the Vale of Pickering, where the marginal nature of the occupation might be expected to manifest itself in the ebb and flow of population, but also in Southern England where the Thames and its tributaries were a major focus of occupation for Long Blade and Early Mesolithic groups. Currently it appears that the last Long Blade and earliest Mesolithic people occupied very different landscapes, with the horse predominantly exploited by Long Blade groups indicating open landscapes, and the rarer reindeer remains found alongside horse at Scatter A, Three Ways Wharf (Lewis, 2011) and Church Lammas (Jones et al., 2013), suggesting at least some Long Blade sites date to a period when it was still relatively cold. Neither horse nor reindeer are associated with Mesolithic sites in Britain, instead a range of animals whose preferred habitat is woodland were exploited. The occasional presence of elk at both northern Mesolithic sites such as Star Carr (Clark, 1954) and southern sites such as Wawcott XXX, Berkshire (Froom, 2012), indicate these woodlands were relatively open, particularly in the wetland (lake-edge and river floodplain) areas favoured by these groups; this landscape characterisation is supported by environmental work (e.g. Mellars and Dark, 1998, Barnett, 2009) in both regions. In these more wooded landscapes the large scale mobility of Long Blade groups indicated by our sourcing work was less easy, and early Mesolithic people, at least in the context of

the Vale of Pickering, are characterised by use of relatively local materials and a persistent, long-term investment in place (Conneller et al., 2012). ■

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The impact of environmental changes on the human occupation of the Scheldt basin during the Younger Dryas

Philippe CROMBÉ

*In memory of my good friend
and highly-appreciated colleague Jos Deeben (1955-2015)*

Abstract: This paper explores possible explanations for two important patterns within the Younger Dryas occupation of the Scheldt basin in northwestern Belgium: 1° the abrupt decrease in sites at the transition from the Allerød (Federmesser Culture) to the Younger Dryas and the related shift from lake edges to river banks; 2° the contrast in Younger Dryas site density with the adjacent Meuse basin. Starting with a taphonomic analysis, it is concluded that Younger Dryas sites can still be expected sealed underneath aeolian sediments, in particular in and along the Scheldt floodplain and its tributaries. The latter became much more important from the Younger Dryas onwards due to an important lowering of the ground water level, which started at the end of the Allerød. This resulted in a nearly total disappearance of numerous shallow lakes and ponds in the interior of the Lower Scheldt basin, making rivers the only sources of freshwater for both animals and humans. Apparently, the Meuse basin was less confronted with these drastic environmental changes, possibly explaining the longer survival of hunter-gatherers into the Younger Dryas.

Keywords: Allerød, Younger Dryas, Scheldt basin, Meuse basin, Site density, Occupation shift, Environmental changes.

Résumé : Dans cet article nous nous interrogeons sur les causes de deux phénomènes importants relatifs à l'occupation humaine dans le bassin de l'Escaut durant le Dryas récent : 1° une diminution abrupte et significative du nombre de gisements par rapport à l'Allerød qui s'accompagne d'un déplacement depuis la rive des lacs vers les bords de rivières ; 2° une densité d'occupation très différente par rapport au bassin de la Meuse. Une analyse taphonomique indique que l'activité éolienne est probablement responsable de l'enfouissement d'un certain nombre de sites du Dryas récent, en particulier le long de l'Escaut et de ses affluents (par ex. Kale/Durme). Les études paléo-environnementales montrent que le bassin de l'Escaut a connu une baisse importante de la nappe phréatique suite au refroidissement de la fin de l'Allerød (Intra Allerød Cold Period) et du Dryas récent. Ceci a provoqué une disparition totale des milieux marécageux, les rivières devenant les seuls sources d'eaux. Le bassin de la Meuse semble beaucoup moins atteint par ces changements environnementaux, ce qui pourrait expliquer la persistance des chasseurs-cueilleurs durant le Dryas récent.

Mots-clés : Allerød, Dryas récent, Bassin de l'Escaut, Bassin de la Meuse, Densité de sites, Déplacements humains, Changements environnementaux.

INTRODUCTION

Compared to the *Federmesser* techno-complex, there are currently only few sites in the Scheldt basin of western Belgium, which can be attributed to the

Younger Dryas (YD). At present, at least 30 *Federmesser* sites are known, mainly situated in the sandy lowland of the Lower Scheldt basin (fig. 1). The majority cluster along the dry banks of former freshwater lakes and ponds (Crombé et al., 2011; Crombé, in press; Crombé and Robinson, 2017), locally forming

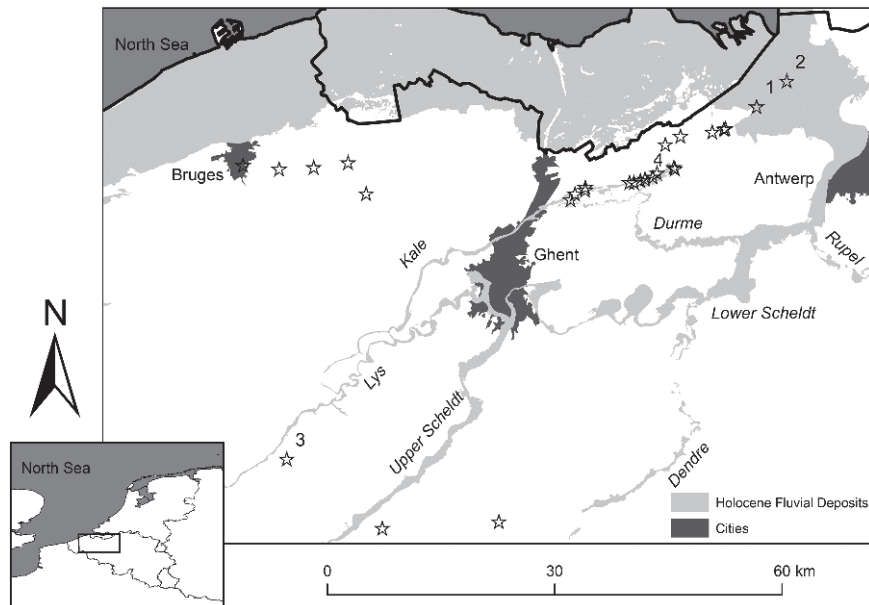


Fig. 1 – Distribution of the *Federmesser* Culture sites in the Scheldt basin.

Fig. 1 – Carte de répartition des gisements attribuables à la tradition à *Federmesser* dans le bassin de l'Escaut.

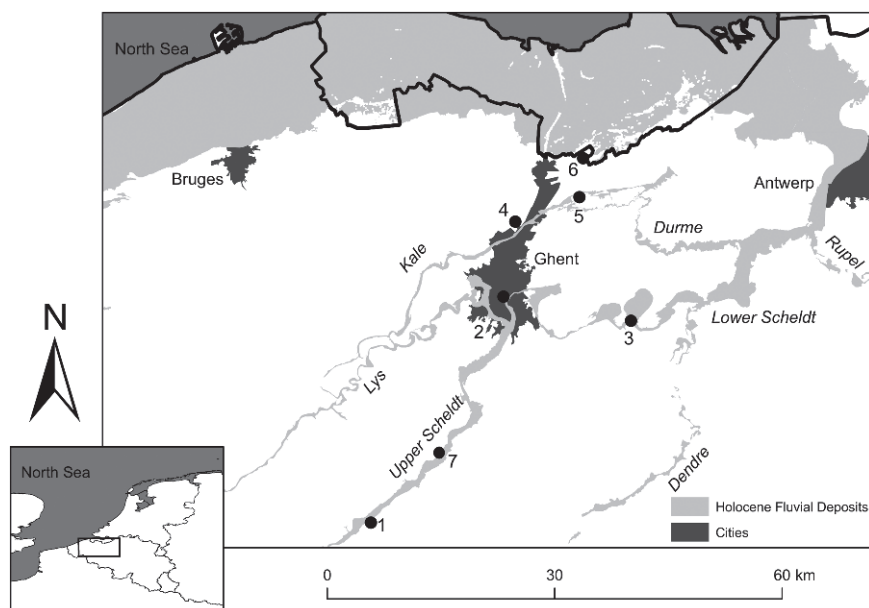


Fig. 2 – Distribution of the Younger Dryas/early Preboreal sites in the Scheldt basin.

Fig. 2 – Carte de répartition des gisements attribuables au *Dryas* récent ou au début du *Préboréal* dans le bassin de l'Escaut.

extensive site-complexes. On the other hand just four to maximum six sites can be tentatively attributed on the basis of techno-typological characteristics of the lithic industry to the YD or the first half of the Preboreal (PB). Despite their low number it is clear that their distribution differs from that of the preceding *Federmesser* techno-complex. The YD/PB sites are all situated along the Scheldt and its tributary the Kale/Durme river and no longer on the banks of former lakes and ponds (fig. 2). In addition, the reduced occupation of the Scheldt basin during the YD/PB contrasts sharply with the adjacent Belgian and Dutch Meuse basin, in which at least 40 (Epi)Ahrensburgian sites

have been reported, both in open-air and caves (Arts and Deeben, 1981; Dewez, 1987; Gob, 1988; Deeben et al., 2000; Crombé et al., 2014a).

In the present paper possible explanations for both the shift in settlement pattern within the Scheldt basin at the Allerød-YD transition and the marked difference in site density between the Scheldt and Meuse basin during the YD/PB will be explored. First it will be investigated whether the present site distributions in the Scheldt basin are not biased; secondly it will be examined if different environmental responses to the climatic deterioration of the YD might have impacted the human occupation in both basins differently.

THE HUMAN OCCUPATION OF THE SCHELDT BASIN DURING THE YOUNGER DRYAS/PREBOREAL

In absence of a sufficient number of radiocarbon dates, Lateglacial sites in the Scheldt basin can only be dated on typological and technological grounds. This is problematic especially for YD/PB sites as diagnostic artefacts typical of the north-European (Epi-)Ahrensburgian and southwest-European (Epi-)Laborian techno-complexes (Langlais et al., 2014), resp. tanged points, Malaurie points and Blanchères points, are completely lacking, a few rare and atypical exceptions aside. The known assemblages are dominated by microlithic armatures, *e.g.* mainly obliquely truncated points and a few atypical triangles, which do not differ substantially from the Mesolithic ones. The only difference is their manufacturing technique, as YD/PB microliths apparently were not produced by means of the microburin technique. However, surface sites generally yield mixed assemblages (Crombé et al., 2011) making the distinction between YD/PB and Mesolithic armatures as good as impossible. Hence, the only way so far to identify possible YD/PB sites is by means of a technological analysis.

Previous studies (Perdaen et al., 2008; Crombé et al., 2014a) have pinpointed both similarities and differences in the knapping techniques between YD and Early (Boreal) Mesolithic lithic assemblages. The most common feature of YD/PB sites is the refinement of the knapping, oriented towards the production of rather regular and straight (micro)blades, which contrasts with the rather irregular “Coincy” knapping style typical of the Early (Boreal) Mesolithic. This is particularly well-documented in the small lithic assemblage recovered at Ruien “Rosalinde” (Crombé et al., 2014b; here: fig. 2, no. 1; fig. 3), so far the only site in the Scheldt basin which is securely radiocarbon dated ($10,962 \pm 48$ BP; RICH-20143). This early YD assemblage is characterized by a blade(let) technology with a high investment in core preparation (intense platform preparation, numerous crested blades) and rejuvenation. The latter is done to obtain and maintain cores with rather sharp angles (mean 71°) and relatively flat to weakly convex exploitation tables. From these cores regular, narrow (mean 9.77 mm) and thin (mean 2.6 mm) bladelets and occasionally short blades (< 6 cm) were struck using a soft stone hammer. The latter is deduced from the predominance of linear (44%) and pointed butts (20%), the frequent occurrence of percussion undulations and butt splinters (30%), and the overall straight (41%) to slightly concave (38%) profiles of the blade(lets) (Crombé et al., 2014b). These straight and narrow blade(lets) were preferably used to produce microlithic armatures with backed edges and eventually truncated ends (fig. 3, nos. 7-10).

A similar set of technological features as Ruien was recovered at three excavated small sites along the Scheldt floodplain and its tributary the Kale/Durme river, *e.g.* at Gent “Tweekerkenstraat” (c. 1,300

artefacts; Ryssaert et al., 2003; fig. 2, no. 2), Wichelen “Bergenmeersen” (4,379 artefacts; Perdaen et al., 2013; fig. 2, no. 3) and Evergem “De Nest” (Devriendt et al. 2010; fig. 2, no. 4). In addition, there are two surface sites – Wachtebeke “Overslagdijk” (fig. 2, no. 6) and “Potdam” (fig. 2, no. 5; Van Vlaenderen et al., 2006) – which yielded numerous microliths but no microburins. Whether this is sufficient to correlate these sites with the YD/PB remains to be further investigated; however, the presence of numerous burins and Obourg-flint pleads in favor of a Lateglacial rather than an Early Holocene age (Crombé et al., 2011).

POSSIBLE BIASES

Before addressing the above questions concerning the transition from the Allerød to the YD in the Scheldt basin, we need to be sure that the current distribution maps are not biased. Above we already emphasized the risk that some YD/PB sites may remain unidentified due to admixture with Early Mesolithic artefacts. Furthermore taphonomic factors can be responsible to a certain degree for the scarcity of YD/PB sites. The deposition of later aeolian, lacustrine, alluvial or colluvial deposits may have resulted in a covering of some sites. This is corroborated by at least two YD/PB sites in the Scheldt basin. The site of Ruien “Rosalinde” (Crombé et al., 2014c) was situated below a packet of loamy sediments, interpreted as colluvial, while the site of Wichelen “Bergenmeersen” (Perdaen et al., 2013) was situated in a humiferous palaeosol at 30 cm below the top of a scroll-bar, which was sealed by Holocene alluvial sediments. It is assumed that the sandy layer covering the palaeosol dates to the YD. A similar observation has been done in 2016 during excavations in the city center of Oudenaarde (Crombé et al., 2018) (fig. 2, no. 7); a small number of clearly Final Palaeolithic artefacts was found in a sandy deposit of c.a. 50-60 cm thick, deposited on top of alluvial sediments, presumably of Pleniglacial age. The presence of soil capping on some artefacts indicates that (part of) the lithic industry has been exposed to severe frost. OSL-dating indicates that the deposition of these sands mainly occurred during the YD. Several interdisciplinary studies in the Scheldt basin (Bogemans and Vandenberghe, 2011; Bos et al., 2013; Crombé et al., 2012; Derese et al., 2010) have clearly demonstrated that during the YD aeolian activity increased considerably. Within the coversand region of the Lower Scheldt basin, called Sandy Flanders, this locally led to the deposition of 1.0 m to 3.5 m thick packets of sands on top of the existing sand dunes (fig. 4). In the Scheldt valley, on the other hand, local reworking of sandy sediments from the floodplain, which was dry at that time, led to the formation of new dunes just at the border of the floodplain (Bogemans and Vandenberghe, 2011).

However, if we assume that aeolian activity has sealed most of the YD sites, *Federmesser* sites in the same region must also have been affected by the same

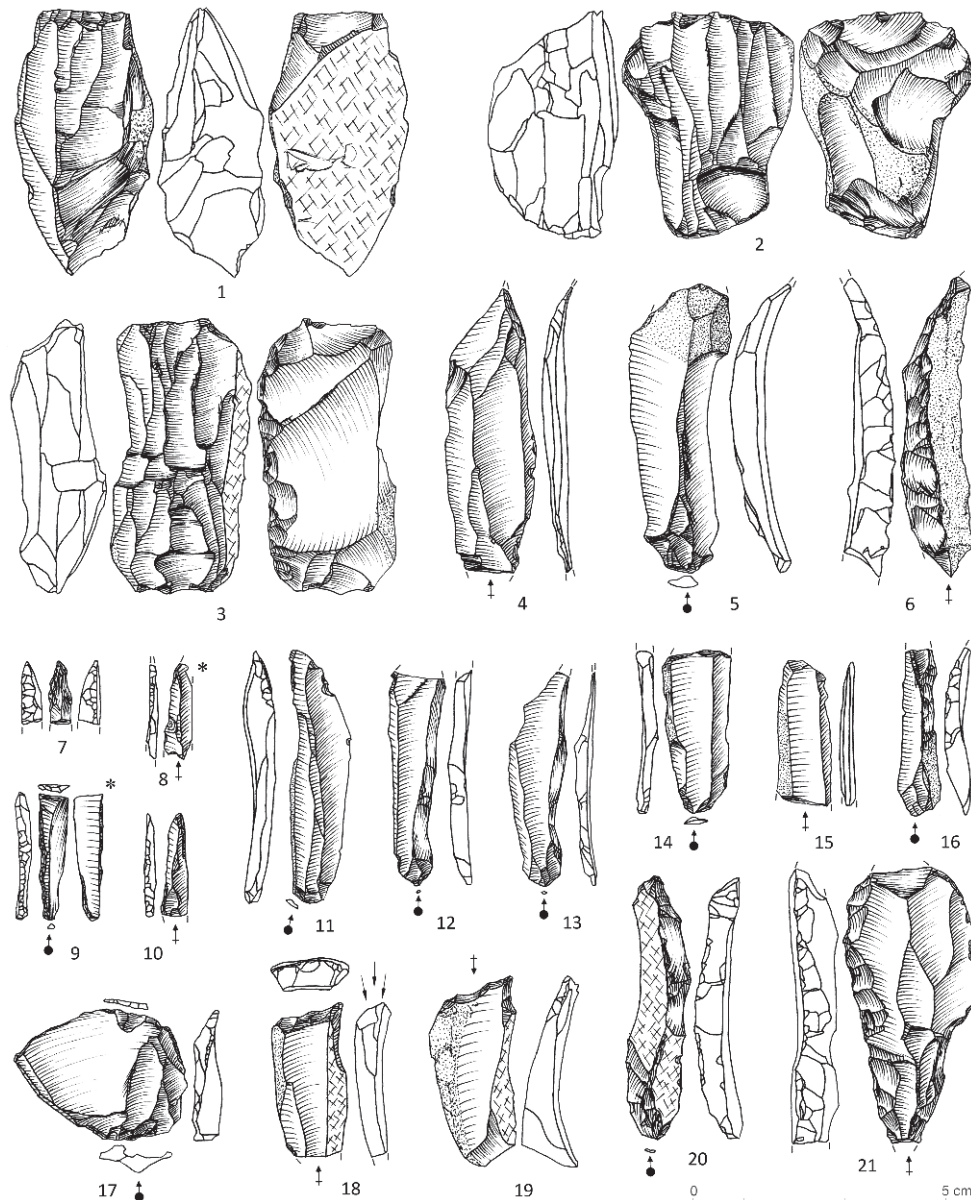


Fig. 3 – Lithic assemblage from the Younger Dryas site of Ruien “Rosalinde” (after Crombé et al., 2014c).
 Fig. 3 – Industrie lithique du gisement Dryas récent de Ruien “Rosalinde” (d’après Crombé et al., 2014c).

process. Yet, most of the 30 known *Federmesser* sites are ploughed surface-sites (Crombé, in press) lying at the present surface, suggesting that later sedimentation did not really affect the distribution map of this techno-complex. Only two *Federmesser* sites – Verrebroek “Dok 2” (fig. 1, no. 1; Crombé et al., 1999; Crombé, 2005) and Klein-Sinaai “Boudelo” (fig. 1, no. 4; Vanmoerkerke and De Belie, 1984) – were found covered by aeolian sands. So, it is very unlikely that many YD/PB sites are still to be expected, at least not in the coversand interior of the Lower Scheldt basin (Sandy Flanders).

On the contrary, there is still a potential to find YD/PB sites in the rivers valleys, despite the total absence of *Federmesser* sites. As argued in a recent paper (Crombé, in press), the latter most likely is not the

result of a bias. We believe that the Scheldt river during the Allerød was still too active and dynamic to be attractive for hunter-gatherers to settle their camps; river discharge was at least 3 to 5 times higher than today, leading to the formation of (very) large oxbows as river channels constantly moved laterally (Kiden, 1989 and 1991; Bogemans et al., 2012; Meylemans et al., 2013). Also, the coversand dunes along the margins of the river floodplains probably did not yet exist (cf. above), so no suited settlement locations were yet present during the Allerød. In contrast, the river discharge during the YD, or even earlier at the end of the Allerød, became much more stable (cf. below). This might have made the Scheldt river more attractive for human occupation. In conclusion, it is reasonable to expect much more (sealed)

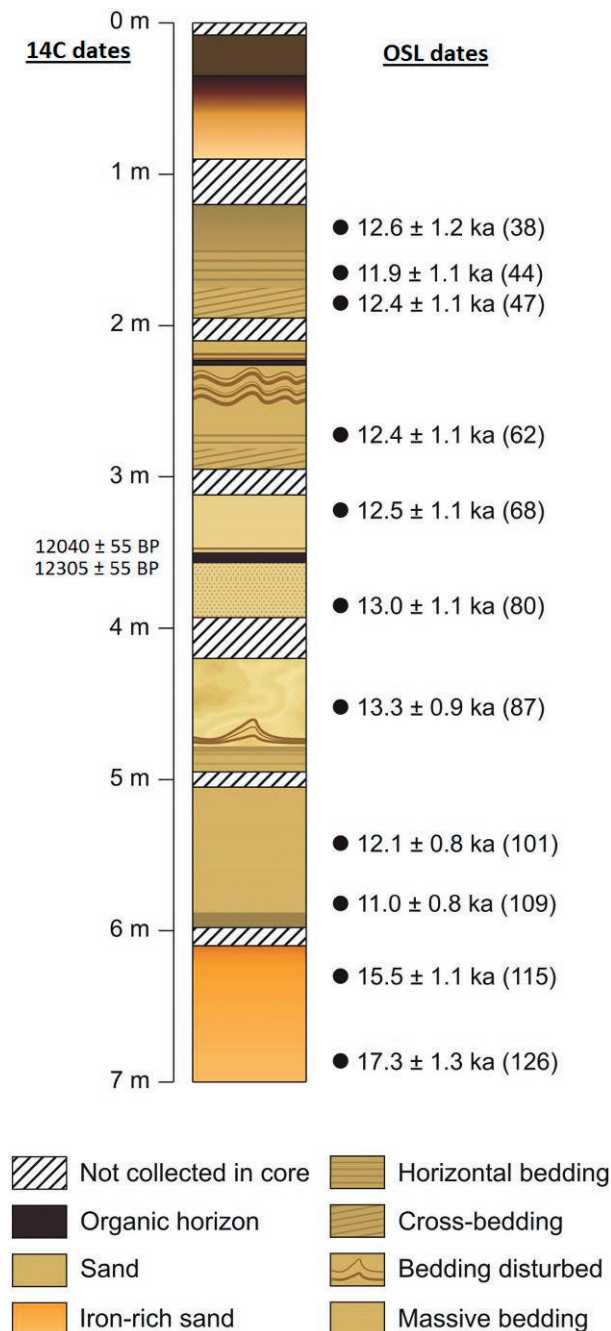


Fig. 4 – Cross-section of a deep coversand sequence at Wachtebeke “Heidebos” within the Lower Scheldt basin. To the left: two uncalibrated radiocarbon dates obtained on plant remains from an organic horizon, most likely belonging to the Bølling. To the right: a series of OSL dates performed on the coversand deposits (based on Derese et al., 2010 and unpublished data).

Fig. 4 – Profil stratigraphique d’une importante séquence de sables de couverture à Wachtebeke “Heidebos” dans le bassin de l’Escaut. À gauche : 2 dates radiocarbone non calibrées obtenues sur des restes de plantes provenant d’un horizon organique attribué à l’oscillation de Bølling. À droite : un ensemble de dates OSL obtenues sur des dépôts de sable de couverture (d’après Derese et al., 2010 et données non publiées).

YD/PB sites in the Scheldt floodplain than currently known, while in the dry interior away of the main rivers, in former *Federmesser* territory, the expectation is much lower. From this we can carefully

conclude that the occupation shift from lacustrine to riverine environments at the transition from the Allerød to the YD, as deduced from the current distribution maps, is most likely reliable.

ENVIRONMENTAL CHANGES AT THE ALLERØD-YD TRANSITION WITHIN THE SCHELDT BASIN

Following the above observations, we need to look for possible explanations for the proposed population shift. As mentioned earlier, most *Federmesser* sites cluster along former freshwater lakes and ponds in the coversand interior of the Lower Scheldt basin (fig. 1). This preference for lake edges probably relates to the high ecological value of these environments, which made them very attractive for both humans and animals during this period. The presence of permanent drinking water must have been one of the main attractions. However, near the end of the Allerød (*Pinus* stage) most of these lakes faced a considerable lowering of the water level, which ultimately led to their permanent disappearance. This hydrological event is marked by a change in the lake infilling from calcareous gyttja to organic to peaty deposits. In at least three palaeolakes – the Moervaart depression (Bos et al., 2017 and 2018; Crombé et al., 2013 and 2014b), Snellegem (Denys et al., 1990 and 1998), and Dourges (Deschodt et al., 2009) – it could be firmly determined that this hydrological change occurred well before the end of the Allerød, possibly in response to the Intra Allerød Cold Period (IACP) or GI-1b. This event is dated in the Greenland ice core record between c. 13,260 until c. 13,050 cal. BP (Blockley et al. 2012). At the same time most of the dune-slacks dried up and (later) disappeared under thick packets of blown sands (fig. 5; Crombé et al., 2012); only the most low-lying ones, situated below the actual sea level, situated in the northernmost part of the Scheldt basin (close to the Dutch border), continued to exist as shallow ponds until the first part of the YD, until c. 12,500 cal. BP. Afterwards these few dune-slacks too disappeared permanently from the landscape.

This strong reduction of open water, both in the lakes and dune-slacks, near the end of the Allerød and the transition to the YD definitely must have impacted the lifeway of both man and animals in the Scheldt basin. It even may have been the trigger for hunter-gatherers to move to the dry banks of rivers, such as the Scheldt and its tributary the Kale/Durme. Although these rivers were clearly also affected by the ground water drop, there was still water running through them. In the course of the final Allerød and YD the river palaeochannels gradually started to fill-in, first with calcareous gyttja and from the Early Holocene with peat, indicating a major decrease in fluvial activity (Bogemans et al., 2012; Meylemans et al., 2013; Crombé et al., 2013; Storme et al., 2017). The radiocarbon evidence from the Kale/Durme tributary (fig. 6) demonstrates this hydrological change

started around ca. 13,100/12,900 cal. BP at its earliest and continued during the YD, gradually changing the rivers from deep, stagnant or slow-running waters during the YD to shallow, small and marshy streams towards the Early Holocene. As shown by figure 7 this process of infilling and aggradation occurred very fast in the Kale/Durme tributary, reducing the depth

of the palaeochannel to less than 2.5/2.0 m below the actual ground level at the start of the Holocene. So it looks as if the rivers were the only sources of freshwater left in the Scheldt basin during the cold YD, explaining the occupation shift between the *Federmesser* and the “Ahrensburgian” techno-complex.

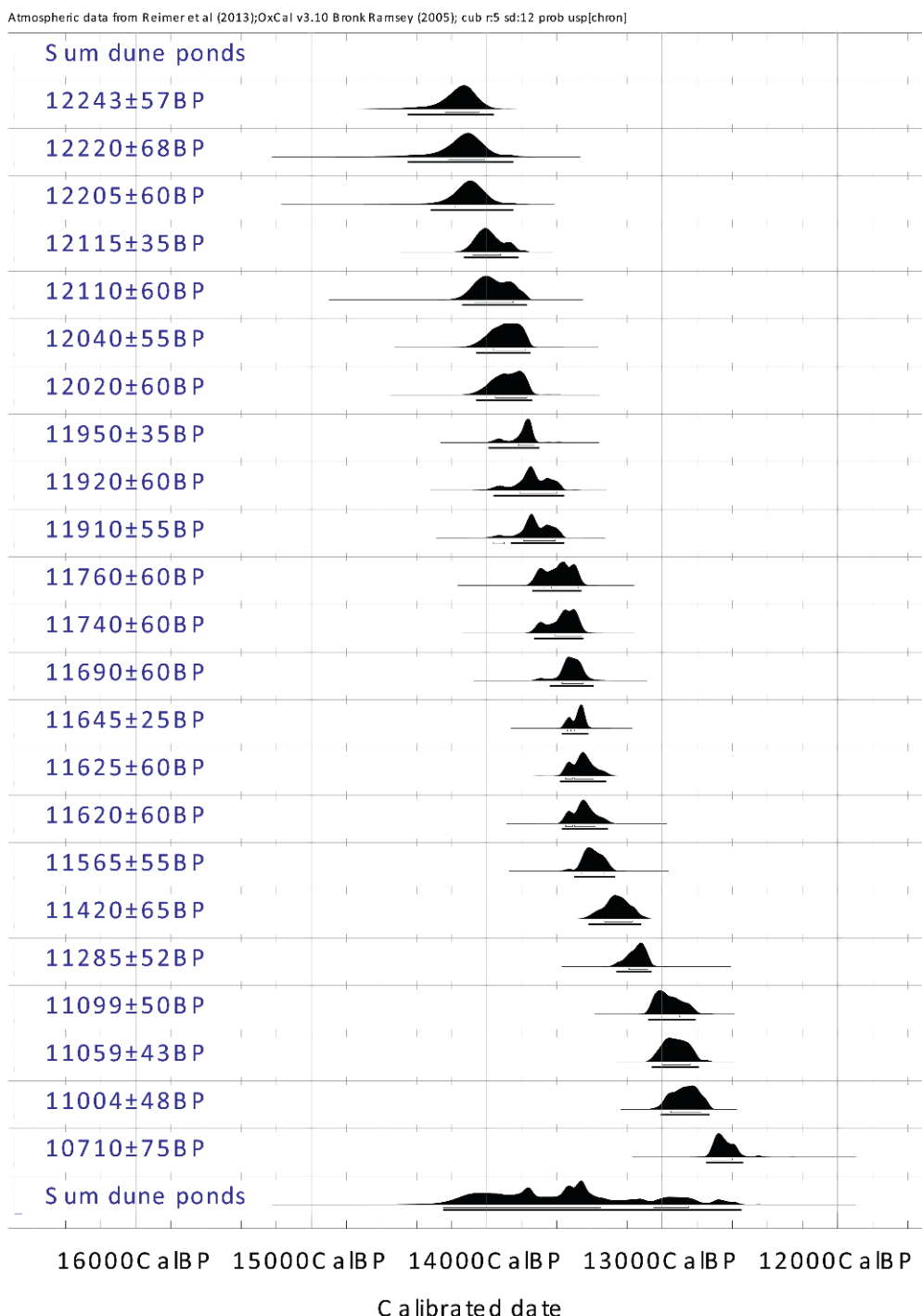


Fig. 5 – Calibration of all radiocarbon dates from the Lower Scheldt basin related to dune ponds and slacks (based on Crombé et al., 2014b and unpublished data). Calibration curve IntCal13 (Reimer et al., 2013).
Fig. 5 – Liste de l'ensemble des datations radiocarbones calibrées provenant des zones humides du système dunaire du bassin de l'Escaut (d'après Crombé et al., 2014b et données non publiées). Courbe de calibration : IntCal13 (Reimer et al., 2013).

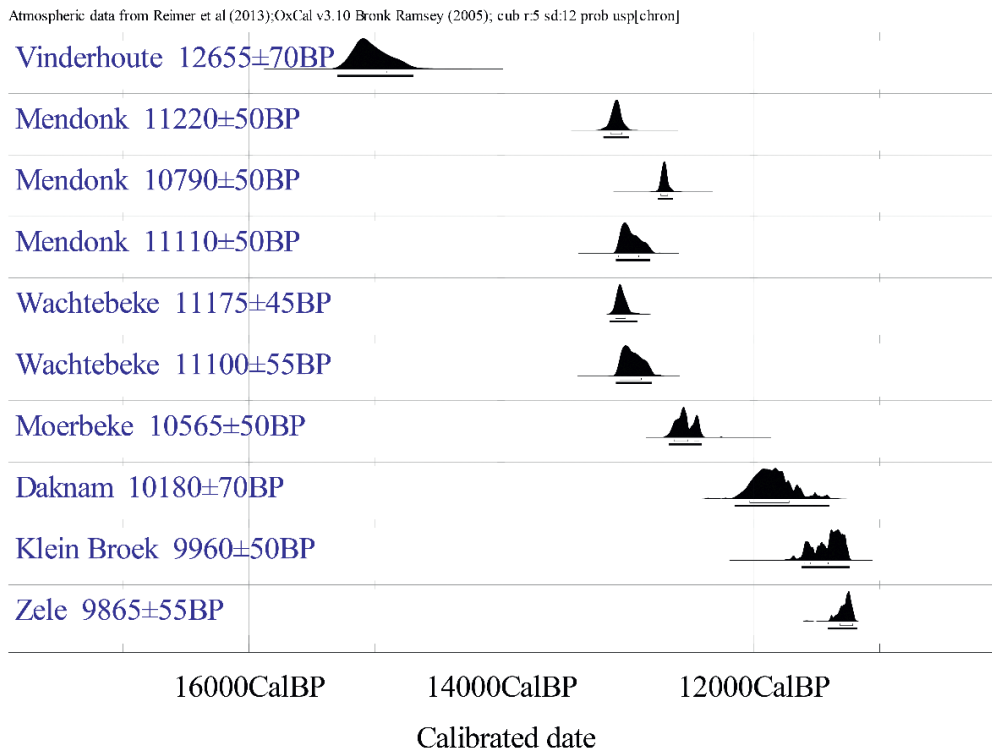


Fig. 6 – Calibrated dates from the basal infilling of the Kale/Durme palaeochannel, ordered from west (Vinderhoute) to east (Zele). The bulk date from Vinderhoute most likely is done on residual material.

Fig. 6 – Datations radiocarbones calibrées provenant du paléochenal Kale/Durme de Vinderhoute à Zele. La datation de Vinderhoute a été réalisée à partir de matériaux détritiques divers.

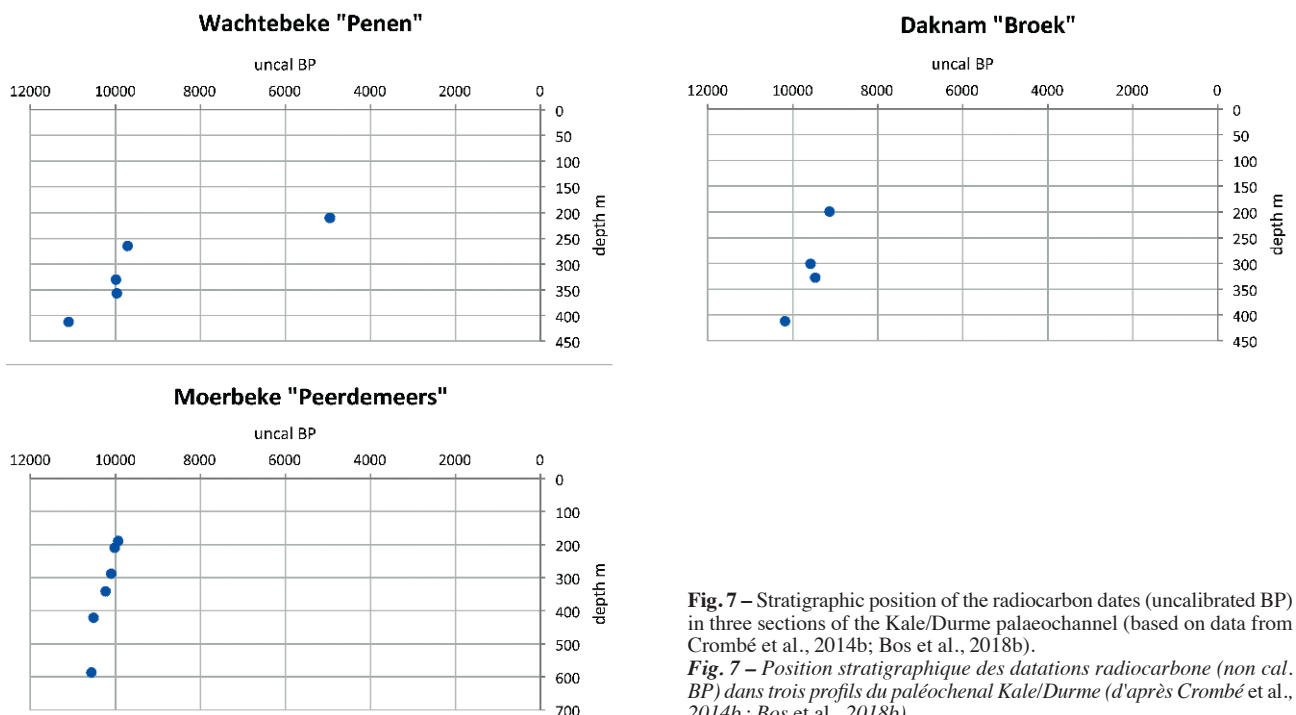


Fig. 7 – Stratigraphic position of the radiocarbon dates (uncalibrated BP) in three sections of the Kale/Durme palaeochannel (based on data from Crombé et al., 2014b; Bos et al., 2018b).

Fig. 7 – Position stratigraphique des datations radiocarbones (non cal. BP) dans trois profils du paléochenal Kale/Durme (d'après Crombé et al., 2014b ; Bos et al., 2018b).

SCHELDT-MEUSE COMPARISON

Although based on the above arguments new (covered) YD/PB sites in the Scheldt valley and floodplain can still be expected, it remains questionable whether site density will ever have been similar to the one attested in the Middle Meuse basin (cf. *supra*). According to several palaeoecological studies of Late-glacial palaeolakes situated within the dense (Epi) Ahrensburgian site cluster of SW Netherlands (Eindhoven region) – Milheeze (Bos et al., 2006), Mierlo Ven Hoenderboom (Hoek, 1997) and Gulickshof (Hoek et al., 1999) – the area was not confronted with the same hydrological changes as observed in the Scheldt basin. After a temporary drop of the water level in response to the IACP cooling event, a return to deeper lake water conditions is generally noticed during the first half of the YD, until c. 12,700/12,600 cal. BP. Synchronic with this, braided river systems were re-established in the Meuse basin, leading to large-scale flooding (Bohncke, 1993; Hoek et al., 2017). The final lowering of the lake levels took place later on during the second half of the YD, turning most shallow lakes dry. At the same time river activity seemed to have ceased. So, perhaps this delayed drop of the groundwater level in the Meuse basin compared to the Scheldt basin might have given hunter-gatherers the opportunity to remain settled in their territory longer at least until the middle of the YD. Interestingly the Middle Meuse basin seemingly is the only region within the southern North Sea basin in which Early Ahrensburgian sites, characterized by the presence of (numerous) tanged points, e.g. Vessem-Rouwven, Geldrop 1, Geldrop 3-1 and Remouchamps, occur (Crombé et al., 2014a). Maybe this part of the basin functioned as a refuge area during the first half of the YD, when the temperature was at its lowest. This, however, remains highly speculative since the chronology of the Ahrensburgian still is not well established due to dating problems (calibration problems,

lack of reliable dating materials, insecure contexts, etc.). The limited presence of raw materials originating from the Meuse and Rhine basin, such as chalcedony from the Muffendorf area (Crombé et al., 2014a) on YD/PB sites of the Scheldt basin, e.g. at Ruien and Gent, indicates a certain connection and mobility between the Scheldt and the Meuse/Rhine basins, which was much more intense compared to the preceding *Federmesser* Culture (Crombé et al., 2014c).

CONCLUSIONS

From the above it is clear that the floodplains of the Scheldt and its tributaries still possess a potential for both archaeological and palaeoenvironmental research into the YD and early PB. Knowing that severe aeolian erosion took place during the YD, leading to the formation of numerous sand dunes along the margins of the river floodplains and the potential covering of scroll-bars along former river channels, archaeological surveys should focus more on the deeper levels of these sandy elevations. To date surveys in the context of commercial archaeology too often are limited to the top part of the soil, leaving potentially lower archaeological levels unexplored. The few sites actually known in the Scheldt basin (Ruien, Wichelen and Oudenaarde) demonstrate that YD levels are often covered underneath 30/50 cm of later sediments.

In addition there is a need for more detailed multi-proxy palaeoenvironmental studies of the numerous lateglacial soil archives which are present within the Scheldt basin. To date most of these have only been studied in low-resolution and are generally insufficiently or badly dated. New programs of interdisciplinary research focusing on continuous soil sequences encompassing the Late Glacial and Early Holocene are highly recommended in view of fully understanding the environmental and human responses to changing climate. ■

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The “Dark Ages”: a brief survey of the Late Preboreal and earlier Boreal occupation in the Netherlands

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Abstract: The Late Palaeolithic Ahrensburgian is generally regarded as the direct predecessor of Mesolithic industries across the Netherlands. However, the transition from the Late or Epi-Ahrensburgian to the Mesolithic and the earliest (Boreal) Mesolithic industries is poorly documented, a situation not uncommon in other parts of northwestern Europe. This phase saw important changes in particularly the lithic industries, and must have taken place during the Late Preboreal. The Dutch Late Preboreal and earlier Boreal record, dated between approximately 11,250 and 10,350 cal. BP, consists of relatively few lithic scatters, a small number of human remains, a few bone or antler points, and a handful of hearth features. Only a limited number of ¹⁴C dates are available for this period, but the question is whether absence of evidence amounts to evidence of absence. In this paper three biasing factors contributing to the “invisibility” of the archaeology of the Pleistocene-Holocene boundary are identified: 1. owing to a lack of a distinct typological and technological signature, assemblages from this era are likely to be classified as “Mesolithic” and hence are underrepresented in the archaeological record, 2. the sites in question are often situated in different environmental contexts (river valleys, slopes of coversand ridges) as compared to most later Mesolithic occupations, where they have been subject to later sedimentation or erosion, which reduces their chances of discovery, 3. transitional sites escape detection as a result of absolute dating strategies for Mesolithic sites, which often focus on charred hazel nutshells. This paper briefly discusses the archaeological record from this time frame in the Netherlands as a prelude to further research into the typomorphological developments of the Mesolithic.

Keywords: The Netherlands, (Late) Preboreal, Earlier Boreal, (Late or Epi-) Ahrensburgian, Early Mesolithic, Radiocarbon dates, Lithic assemblages, Chronology.

Résumé : Les industries Ahrensburgiennes sont généralement considérées comme les prédécesseurs directs des industries mésolithiques aux Pays-Bas. À l’instar d’autres régions du nord-ouest de l’Europe, la transition entre les industries de la fin de l’Ahrensbourgien et du Mésolithique est mal documentée. Pourtant, c’est un moment charnière où de nombreux changements affectent les assemblages lithiques, en particulier vers la fin du Préboréal. En Hollande, la fin du Préboréal et le début du Boréal est daté entre environ 11 250 et 10 350 cal. BP. Des concentrations d’objets lithiques, des restes humains épars, des objets en os ou en bois de cervidés et des foyers isolés constituent les rares témoignages archéologiques pour cette période. Par ailleurs, nous dénombrons un nombre limité de dates ¹⁴C pour la période considérée. Toutefois, est-ce que la rareté des témoignages constitue-t-elle une preuve d’absence d’occupations humaines dans cette région à cette période ? Dans cet article, trois facteurs de biais contribuant à «l’invisibilité» de l’archéologie de la transition Pléistocène-Holocène sont identifiés : 1. L’absence de signature typologique et technologique caractéristique des assemblages de cette période, susceptibles d’être classés «mésolithiques» et sont donc sous-représentés dans les données archéologiques ; 2. les sites en question sont souvent situés dans des contextes environnementaux différents (vallées fluviales, bas de versants) par rapport à la plupart des occupations mésolithiques ultérieures où ils ont été affectés par des problèmes taphonomiques ; 3. les sites de transition échappent à la détection en raison de stratégies de datation absolue pour les sites mésolithiques, qui se concentrent souvent sur les noisettes carbonisées. Cet article examine brièvement les données archéologiques disponibles pour cette période aux Pays-Bas, en prélude à de recherches plus approfondies sur les industries lithiques du Mésolithique.

Mots-clés : Pays-Bas, Préboréal (récent), Boréal ancien, (Epi-) Ahrensbourgien, Mésolithique ancien, Datations radiocarbones, Industries lithiques, Chronologie.

INTRODUCTION

The current state of knowledge with respect to the Ahrensburgian in the Netherlands, as well as the transition from the Late Palaeolithic to the Mesolithic, is extensively discussed in two papers: Crombé et al. (2014) and Niekus et al. (2019). The former is mainly concerned with the southern Netherlands – *i.e.* south of the rivers Rhine and Meuse – and Belgium, while the latter takes a flint scatter from the city of Zwolle as a starting point for amongst other things a critical discussion and concise overview of Ahrensburgian and possibly Ahrensburgian sites in the Netherlands. The latter paper and the present one are intended as a starting point for renewed research into the typomorphological development of the Mesolithic in the Netherlands with special reference to the northern part of the country⁽¹⁾.

Most researchers consider the late phase of the Ahrensburgian, also known as “Epi-Ahrensburgian”, to be the predecessor of all or most of the earliest Mesolithic industries in the Low Countries (Johansen and Stapert, 2000; Perdaen et al., 2008). This phase is dated to the first half of the Preboreal (*c.* 11,530/11,500–11,270/11,210 cal. BP: Bos et al., 2007), but there are only few radiocarbon dates available.

Despite the fact that major changes occurred during the transition from the Late Glacial to the Early Holocene, such as the gradual replacement of tanged points by microlithic points, the invention of the microburin technique and the disappearance of large blades in favour of shorter and less regular blades (“Coincy” style), little is known about the transitional phase and the earliest Mesolithic industries. It is especially the developments in the material culture during the Late Preboreal and the first few hundred years of the Boreal that largely elude us. These “dark ages” are not unique to the Low Countries, but also occur in other areas in NW Europe (see Crombé et al., 2014), including the United Kingdom (Reynier, 2005; Conneller and Higham, 2015, but see Conneller et al., 2016 for a different view), Germany (Terberger, 2004; Tolksdorf et al., 2009; Zander, 2016) and southern Scandinavia (Brinch Petersen, 2009; Larsson, 2009; Jessen et al., 2014). It is estimated that this “gap” may have lasted up to 500 years (Crombe et al., 2014, p. 597).

The present paper systematically presents the available evidence for human occupation during the Preboreal, with an emphasis on the second half, after 11,270/11,210 cal. BP, and the earlier part of the Boreal in the Netherlands, until approximately 10,350 cal. BP⁽²⁾. This crucial period witnessed the Late or “Epi-Ahrensburgian” phase, transitional assemblages, and the earliest Mesolithic industries. Most of the relevant information is scattered throughout the literature and there is no comprehensive overview. Besides finds lacking an archaeological context, such as small numbers of human remains and bone/antler artefacts from the North Sea and river valleys, there are several pit-hearths and a few flint scatters that can be assigned to this time frame (fig. 1). Only one of the flint scatters,

the above-mentioned Zwolle site (see discussion below and Niekus et al., 2019), is radiocarbon-dated to the transition from the Preboreal to the Boreal. This fits the apparent absence of Late Preboreal–Early Boreal flint assemblages, as was noted by for instance Tolksdorf et al. (2009).

From approximately 10,350–10,200 cal. BP onwards the number of dated sites in the Low Countries increases (Niekus, 2006) and typomorphological developments are somewhat clearer. Later Boreal assemblages are usually characterised by a wider variety of microlithic points, both geometric (triangles and crescents) and non-geometric microliths (backed or partially backed points with an unretouched base also known as a- and b-points). Occasionally points with a retouched base (c-points) occur as well. Some of these later Boreal sites, including lithic scatters from Zutphen-Ooyerhoek (see below), show clear affinities with the Verrebroek microlith assemblage type (*e.g.* Crombé et al., 2009) which is seen as characteristic of the Belgian-Dutch coversand area.

THE AHRENSBURGIAN IN THE NETHERLANDS: A BRIEF OVERVIEW

As mentioned in the introduction, the Ahrensburgian in the Low Countries is extensively discussed in some recent papers (Crombé et al., 2014; Niekus et al., 2019, both with further references), so here some general remarks on particularly the Dutch situation should suffice. Since faunal remains are virtually absent from the Dutch record, most evidence pertains to different aspects of Ahrensburgian lithic technology, such as raw-material use, knapping techniques and the toolkit.

The Ahrensburgian in the LOW COUNTRIES can be divided into an early (Younger Dryas) phase and a late (Preboreal) phase, based on a small number of reliable radiocarbon dates coupled with armature composition, the relative frequency of truncated pieces and blade dimensions⁽³⁾. During the Early Ahrensburgian, which is found exclusively in the southern part of the country, such as at Vessem-Rouwven (Arts and Deeben, 1981) and Geldrop (*e.g.* Deeben, 1994 and 1995; Deeben et al., 2000), the group of armatures is dominated by tanged points and obliquely truncated points, supplemented with other types of geometric and non-geometric points and a small number of curved backed pieces. The available dates for this Early Ahrensburgian are 12,730/12,174 cal. BP (OxA-2563) for Geldrop-Mie Peels and 12,640/12,135 cal. BP (GrA-15177) for Geldrop 1. Recently more radiocarbon dates and OSL dates of the coversand have become available for Geldrop 1, bracketing the occupation between *c.* 12,730 and 12,418 cal. BP (Tump et al., 2014). The site Geldrop 3-1, dated to 12,116/11,620 cal. BP (GrA-15181) seems to be marked by an assemblage transitional between the Early and Late Ahrensburgian. For example, nearly a quarter of the armatures from this site are tanged

points which are common in Early Ahrensburgian assemblages, while at the same time truncated artefacts outnumber burins, a pattern more typical of the Late Ahrensburgian (Niekus et al., 2019). The Late Ahrensburgian is present in both the southern (e.g. Geldrop 3-2 Oost and Eersel-Panberg: Deeben, 1996; Deeben

et al., 2000) and the northern part of the country (e.g. Oudehaske and Gramsbergen: Johansen and Stapert, 2000). At this time, tanged points and curved backed pieces were largely replaced by microlithic points such as obliquely truncated points, triangles, elongated trapezes or notched points and other trapezoid shapes.

LEGEND

- (LATE) AHRENSBURGIAN SITES
- ⊠ TRANSITIONAL / EARLY MESOLITHIC SITES
- ◆ MODIFIED AND CUT-MARKED BONE & ANTLER
- ◇ FAUNAL REMAINS
- ▲ HUMAN REMAINS
- PIT-HEARTH FEATURES
- SURFACE HEARTHES
- ★ ZUTPHEN-OOYERHOEK
- MESOLITHIC SITES

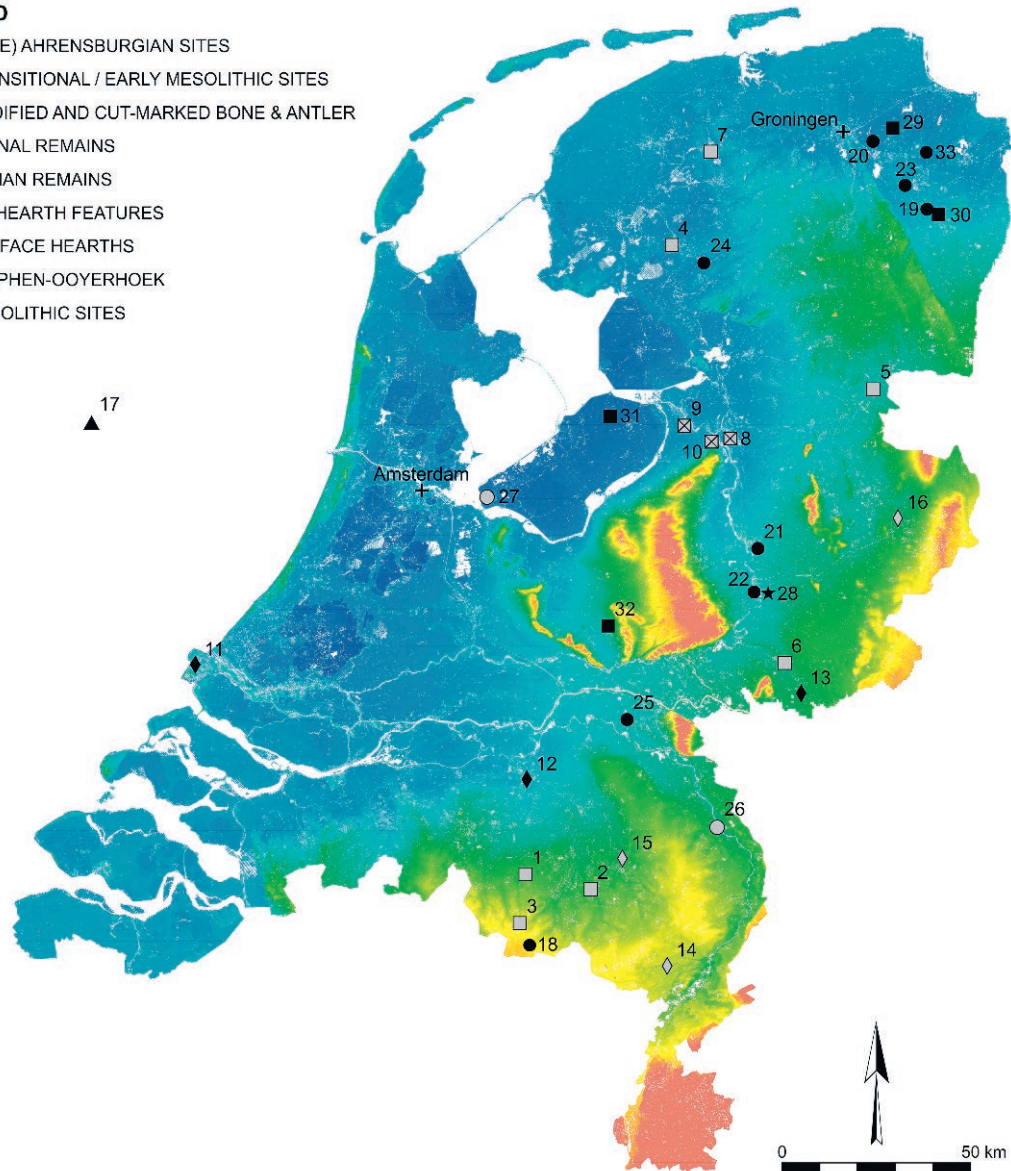


Fig. 1 – (Late) Ahrensburgian, transitional and Mesolithic sites in the Netherlands mentioned in the text plotted on a relief map: 1, Vessem-Rouwven; 2, Geldrop; 3, Eersel-Panberg; 4, Oudehaske; 5, Gramsbergen; 6, Doetinchem-Oostelijke Randweg; 7, Bergumermeer-De Tsjoenen; 8, Zwolle-Oude Deventerstraatweg (ODE); 9, Kampen-Reevediep site 9; 10, Hanzelijn-Oude Land; 11, Rotterdam-Maasvlakte 1/2 & Europoort; 12, Den Bosch “Vonk en Vlam”; 13, Ulft; 14, Tengelroyse Beek, Mildert; 15, River Bakelse Aa near Helmond; 16, Bornse Beek, Borne; 17, North Sea; 18, Luyksgestel; 19, Stadskanaal 1 (S-1); 20, Westerbroek-Roodharsterlaan (HS-30); 21, Epse Olthof-Noord 2005; 22, Zutphen-Oyshamme; 23, Hoogezand-Sappemeer (HS-16); 24, Oldeholtwolde; 25, Leur-Hernense Meer; 26, Well-Aijen; 27, Almere-Homerus “De Green”; 28, Zutphen-Ooyerhoek; 29, Slochteren-Hooilandspolder; 30, Nieuwe Pekela 9 (NP-9); 31, Dronten; 32, Ede-Kernhem; 33, Zuidbroek-Knooppunt N33. Map by E. Bolhuis, Groningen Institute of Archaeology.

Fig. 1 – Carte des sites de l’Ahrensbourgien récent, de la transition Pléistocène-Holocène et du Mésolithique des Pays-Bas cités dans le texte, 1, Vessem-Rouwven; 2, Geldrop; 3, Eersel-Panberg; 4, Oudehaske; 5, Gramsbergen; 6, Doetinchem-Oostelijke Randweg; 7, Bergumermeer-De Tsjoenen; 8, Zwolle-Oude Deventerstraatweg (ODE); 9, Kampen-Reevediep site 9; 10, Hanzelijn-Oude Land; 11, Rotterdam-Maasvlakte 1/2 & Europoort; 12, Den Bosch “Vonk en Vlam”; 13, Ulft; 14, Tengelroyse Beek, Mildert; 15, River Bakelse Aa près de Helmond; 16, Bornse Beek, Borne; 17, North Sea; 18, Luyksgestel; 19, Stadskanaal 1 (S-1); 20, Westerbroek-Roodharsterlaan (HS-30); 21, Epse Olthof-Noord 2005; 22, Zutphen-Oyshamme; 23, Hoogezand-Sappemeer (HS-16); 24, Oldeholtwolde; 25, Leur-Hernense Meer; 26, Well-Aijen; 27, Almere-Homerus “De Green”; 28, Zutphen-Ooyerhoek; 29, Slochteren-Hooilandspolder; 30, Nieuwe Pekela 9 (NP-9); 31, Dronten; 32, Ede-Kernhem; 33, Zuidbroek-Knooppunt N33. Carte réalisée par E. Bolhuis, Groningen Institute of Archaeology.

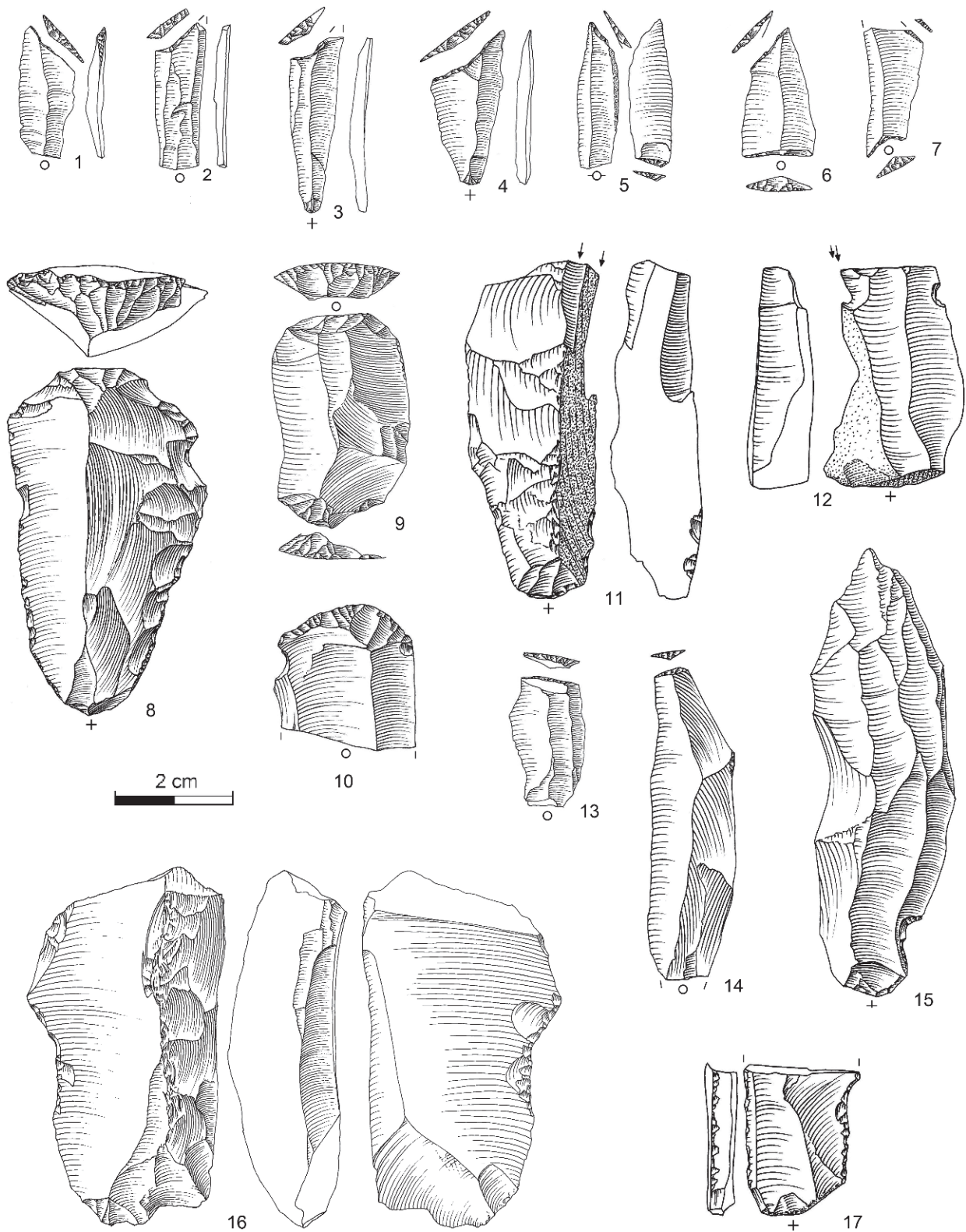


Fig. 2 – A selection of retouched tools from the Late Ahrensburgian site of Doetinchem-Oostelijke Randweg: 1-4, obliquely truncated points; 5-7, trapezoid points; 8-10, scrapers; 11-12, burins; 13-14, truncated pieces; 15, a notched blade; 16, a fragment of a possible flake axe on a bruised blade fragment; 17, a proximal fragment of a retouched blade (drawings by P. van der Kroft; source: Scholte Lubberink et al., 2016).

Fig. 2 – Sélection d'outils retouchés provenant du gisement ahrensbourgien récent de Doetinchem-Oostelijke Randweg. 1-4, Pointes à troncatures obliques; 5-7, pointes trapézoïdales; 8-10, grattoirs; 11-12, burins; 13-14, pièces tronquées; 15, lame à coche; 16, fragment d'une possible hache fabriquée sur une lame machurée; 17, fragment proximal d'une lame retouchée (dessins P. van der Kroft; source : Scholte Lubberink et al., 2016).

Truncated blades are especially characteristic of sites in the southern part of the country. Generally speaking, blades are longer in the Late Ahrensburgian as compared to the early phase. One explanation is that this is due to the increased visibility of raw material nodules in the more open landscape of the colder and drier Rammelbeek phase (*c.* 11,430/11,350–11,270/11,210 cal. BP; Bos et al., 2007) as compared to that during the earlier Ahrensburgian (see discussion in Niekus et al., 2019, p. 266). There are two dates for this late phase: 11,705/11,243 cal. BP and 11,403/10,887 cal. BP, for Geldrop 3-2 Oost and the “long blade” site of Eersel-Panberg, respectively⁽⁴⁾.

The Preboreal date of Oudehaske and Gramsbergen in the northern part of the Netherlands is primarily based on the stratigraphic position of the finds at the top of Younger Coversand II (Johansen and Stapert, 2000) since no radiocarbon dates are available. In 2013 a third Late Ahrensburgian site, consisting of two artefact scatters, was excavated near Doetinchem (Scholte Lubberink et al., 2016). In total a little over 4,000 flint artefacts were recovered, of which 38 are retouched tools such as points (obliquely truncated points and a few trapezoids), burins, scrapers and borers (fig. 2). Two possible flake axes are also reported. Although core and flake axes are usually seen as a purely Mesolithic phenomenon they do occur sporadically in Late Ahrensburgian contexts, for example at the long-blade site Nørregård VI (Sørensen and Sternke, 2004) and Bonderup (Fischer, 1982) in Denmark. A flake axe is also known from a collection of allegedly Late Ahrensburgian artefacts from a site known as De Tsjoege, situated to the west of the well-known Mesolithic site of Bergumermeer in the northern Netherlands (Henstra et al., 1997). Most of the points from Doetinchem-Oostelijke Randweg are obliquely truncated points, in addition to several trapezoids. The OSL dates from the artefact-bearing sediments have resulted in an average age of 11.1 ± 0.5 ka or *c.* 11,235–10,835 cal. BP, suggesting that the sediment was buried during the second half of the Preboreal. Consequently the occupation should be slightly older, most probably comparable in age to other Late Ahrensburgian sites in the Netherlands⁽⁵⁾.

THE TRANSITION FROM THE LATE PALAEOOLITHIC TO THE MESOLITHIC

The available data, including information on sites from other regions (see discussions in *e.g.* Lanting and Van der Plicht, 1996; Johansen and Stapert, 2000; Crombé et al., 2014), suggest that the transition from the Late Palaeolithic to the Mesolithic most probably started during the Late Preboreal, sometime around 11,250 cal. BP. This more or less coincides with the end of the Rammelbeek phase (Lanting and Van der Plicht, 1996, p. 83), which is dated to *c.* 11,270/11,210 cal. BP (Bos et al., 2007, fig. 13). The transition thus straddles the Preboreal-Boreal boundary as defined in the Netherlands (cf. Lanting

and Van der Plicht, 2000). The following sections present the evidence for human presence in the Netherlands during the Late Preboreal and earlier part of the Boreal, between *c.* 11,250 and 10,350 cal. BP, comprising faunal and human remains, organic artefacts and lithic assemblages. For completeness, a few dated finds from the Early Preboreal Late Ahrensburgian are mentioned as well, in addition to the flint scatters discussed in the previous section. The radiocarbon dates and their calibrated age ranges and associated information can be found in table 1.

Modified and cut-marked bone and antler

Artefacts made from bone or antler are especially well-known from beaches along the North Sea coast, among other places from De Zandmotor between Ter Heijde and Kijkduin, the beach at Hoek van Holland and Maasvlakte 1 (Europoort) and 2, the seaward extensions of the Port of Rotterdam. The finds originate from sands dredged from various areas in the North Sea which are generally located 10–20 km off the Dutch coast. Currently approximately 1,000 bone and antler points are known, most from Maasvlakte 1 (*e.g.* Verhart, 1988). Despite these large quantities, only a small number have so far been dated, all from Maasvlakte 1. Two of these points (fig. 3) have been dated: a large barbed point with spaced barbs (11,945/11,181 cal. BP) and a bi-serially barbed point (11,385/10,664 cal. BP) (Verhart, 1988; Amkreutz and Spithoven, in press). The specimens can be attributed to the (Late) Ahrensburgian and the Late Ahrensburgian/transition to the Early Mesolithic, respectively. Interesting in this connection is a probable – part of the supposed “tang” is damaged – tanged point of Ahrensburgian type (fig. 3 right) and several other, presumably Late Palaeolithic artefacts (including a few burins and scrapers) that have been found at Maasvlakte 2 over recent years. These finds probably point to (Late) Ahrensburgian occupation in the prehistoric landscapes now submerged in the North Sea. A third bone (or antler) point was found in the spoil from a building site in the city of Den Bosch. The find, classified as a point with oblique fine barbs (type 03.03, see Verhart, 1990), was dated to the Late Preboreal: 11,127/10,764 cal. BP (Verpoorte, 2016). A blade (length 7.6 cm) with a so-called “bulb flake” or “*esquillement du bulbe*” (Pelegrin, 2000) originates from the same site (fig. 4). This feature also occurs at the Late Ahrensburgian sites of Oudehaske and Gramsbergen (Johansen and Stapert, 2000, p. 23) and may be an indication of soft stone hammer percussion. Whether the point and the blade are associated is impossible to ascertain. A piece of a shed red-deer antler with a perforation, which is paralleled by finds from abroad and is interpreted as an axe sleeve (Verhart, 1998), was dredged up from the valley of the river Oude IJssel near Ulft in the east of the country (fig. 5). The piece was dated to 11,175/10,599 cal. BP, around the transition from the Preboreal to the Boreal.

Site	Lab code	BP-date	95.4% probability range CalBC	95.4% probability range CalBP	Material	Context	Reference	
LATE AHRENSBURGIAN FLINT ASSEMBLAGES Eersel-Paraberg	GA-15182	9,970 ± 60	9,756-9,717/9,698-9,294	11,705-11,666/11,647-11,243	calcined bone	surface hearth?	Dieben et al., 2000	
	GA-15175	9,810 ± 70	9,454-9,136/8,975-8,938	11,403-11,085/10,924-10,887	calcined bone	surface hearth?	Dieben et al., 2000	
	Uo-642	9,945 ± 115	9,996-9,940/9,883-9,232	11,945-11,879/11,832-11,181	bone or antler burbed point	unknown (wetland?)	Verhaat, 1988	
MODIFIED AND CUT-MARKED BONE & ANTLER Routemans-Europont Routemans-Europont Don Bosch 'Venk en Vlain' Uff	Uo-644	9,690 ± 125	9,436-9,431/9,402-8,715	11,385-11,380/11,351-10,664	bone or antler burbed point	unknown (wetland?)	Verhaat, 1988	
	GA-64680	9,598 ± 35	9,178-8,815	11,127-10,784	bone or antler burbed point	unknown (wetland?)	Verhaat, 1988	
	UIC-2643	9,530 ± 90	9,226-8,702/8,675-8,650	11,175-10,651/10,624-10,599	red deer antler (<i>Cervus elaphus</i>)	river valley	Verhaat, 1988	
ANTHROPOGENIC ASSSEMBLAGES OR BACKGROUND FAUNA Tongheuse Beck River Aa near Helmond	Poz-3739	9,650 ± 50	9,250-9,111/9,085-8,856	11,199-11,060/11,034-10,785	red deer antler (<i>Cervus elaphus</i>)	river valley	Roymans and De Nutte, 2012	
	GA-49237	9,610 ± 50	9,218-8,817	11,167-10,766	red deer skull (<i>Cervus elaphus</i>)	river valley	De Jong, 2012	
IULMAN REMAINS North Sea - Southern Bight North Sea - Brown Bank? North Sea - Southern Bight North Sea North Sea North Sea - Eurogeel North Sea - North of the Noord Hinder Bank	GA-42700	10,070 ± 50	9,991-9,934/9,879-9,394	11,940-11,883/11,828-11,343	<i>Homo sapiens</i> cranium	unknown (wetland?)	Van der Plicht et al., 2016	
	GA-23205	9,870 ± 70	9,655-9,578/9,550-9,230	11,604-11,527/11,499-11,179	<i>Homo sapiens</i> mandible	unknown (wetland?)	Glimmerveen et al., 2006	
	GA-42702	9,440 ± 50	9,114-9,079/9,053-9,020/8,842-8,566/8,572	11,603-11,028/11,002-10,969/10,791-10,545/10,535-10,521	<i>Homo sapiens</i> cranium	unknown (wetland?)	Van der Plicht et al., 2016	
	GA-57506	9,440 ± 45	9,110-9,086/9,046-9,029/8,838-8,610	11,059-11,035/10,995-10,978/10,787-10,559	<i>Homo sapiens</i> femur	unknown (wetland?)	Van der Plicht et al., 2016	
	GA-64659	9,220 ± 60	8,603-8,583/8,575-8,296	10,552-10,532/10,524-10,245	<i>Homo sapiens</i> femur	unknown (wetland?)	Van der Plicht et al., 2016	
	UIC-3750	9,640 ± 400	10,470-8,317/8,115-8,057/8,045-7,987	12,415-10,123/10,064-10,006/9,994-9,936	<i>Homo sapiens</i> calcane	unknown (wetland?)	Boscha Frdrink and Tacoma, 1997; Laning and Van der Plicht, 2000	
	PIJLAKRUI FLAUIKULS Luyksgesid Zuidbroek-Knooppunt N33 Suidskanaal 1 (S-1) Westerbreek-Roodharsterlaan (IIS-30) Zuidbroek-Knooppunt N33 Epepe Othof-Noord, 2005 Zuidbroek-Knooppunt N33 Zuidbroek-Knooppunt N33 Zuidbroek-Oyshanne Zuidbroek-Knooppunt N33 Zuidbroek-Knooppunt N33 Zuidbroek-Knooppunt N33 Iloogezand-Sappeneer (IIS-16) Zuidbroek-Knooppunt N33 Oudeboerwalle Zuidbroek-Knooppunt N33 Leur-Ileensse Meer	GN-1181	9,970 ± 115	10,007-9,921/9,888-9,252	11,956-11,870/11,837-11,201	charcoal, indet.	hearth	Laning and Van der Plicht, 2000
		IC-17C-0371	9,730 ± 40	9,293-9,174	11,242-11,123	charcoal, indet.	pit-hearth	Van der Kroft et al., 2018
		GN-28147	9,500 ± 30	9,119-9,006/8,916-8,901/8,863-8,714	11,068-10,955/10,865-10,850/10,812-10,663	charcoal, indet.	pit-hearth	Niekus, 2006
		GN-11996	9,470 ± 70	9,137-8,972/8,941-8,603/8,582-8,575	11,086-10,921/10,890-10,552/10,531-10,524	charcoal, indet.	pit-hearth	Laning and Van der Plicht, 2000
		IC-17C-02141	9,460 ± 40	9,113-9,081/9,052-9,022/8,841-8,627	11,062-11,030/11,001-10,971/10,796-10,576	charcoal, <i>Pinus</i>	pit-hearth	Van der Kroft et al., 2018
		GN-31406	9,435 ± 55	9,116-9,075/9,057-9,017/8,844-8,563	11,065-11,034/11,006-10,966/10,793-10,512	charcoal, indet.	pit-hearth	Hermans et al., 2015
		IC-17C-02147	9,380 ± 40	8,758-8,559	10,707-10,508	cone scale, <i>Pinus</i>	pit-hearth	Van der Kroft et al., 2018
		Beth-????	9,350 ± 50	8,754-8,471	10,703-10,420	charcoal, indet.	pit-hearth	Fermin, 2014
		IC-17C-02105	9,330 ± 40	8,731-8,532/8,517-8,478	10,680-10,481/10,466-10,427	charcoal, <i>Pinus</i>	pit-hearth	Van der Kroft et al., 2018
IC-17C-02119		9,270 ± 40	8,621-8,347	10,570-10,296	cone scale, <i>Pinus</i>	pit-hearth	Van der Kroft et al., 2018	
IC-17C-02120		9,260 ± 40	8,613-8,341	10,562-10,296	charcoal, <i>Pinus</i>	pit-hearth	Van der Kroft et al., 2018	
IC-17C-02116		9,260 ± 70	8,628-8,297	10,571-10,246	charcoal, <i>Pinus</i>	pit or pit-hearth	Laning and Van der Plicht, 2000	
GN-15311		9,240 ± 40	8,572-8,313	10,521-10,262	charcoal, <i>Pinus</i>	pit-hearth	Van der Kroft et al., 2018	
IC-17C-02125		9,240 ± 40	8,562-8,312	10,511-10,261	cone scale, <i>Pinus</i>	pit-hearth	Van der Kroft et al., 2018	
IC-17C-02121		9,230 ± 80	8,529-8,285	10,578-10,234	cone scale, <i>Pinus</i>	pit-hearth	Laning and Van der Plicht, 2000	
GN-11812	9,220 ± 40	8,552-8,309	10,501-10,238	cone scale, <i>Pinus</i>	pit-hearth	Van der Kroft et al., 2018		
IC-17C-02124	9,220 ± 40	8,556-8,304	10,501-10,233	charcoal, indet.	pit-hearth	Van der Kroft et al., 2018		
LIL-12180A	9,218 ± 45	8,556-8,304	10,501-10,233	charcoal, indet.	pit-hearth	Van der Kroft et al., 2018		
SURFACE HEARTHS Well-Aijen (site 331) Well-Aijen (site 47) Well-Aijen (site 331) Well-Aijen (site 47) Well-Aijen (site 33E) Well-Aijen (site 33F) Well-Aijen (site 331) Well-Aijen (site 33E) Well-Aijen (site 33H) Well-Aijen (site 33I) Well-Aijen (site 33J) Well-Aijen (site 33K) Well-Aijen (site 33L) Well-Aijen (site 33M) Well-Aijen (site 33N)	SUERC-62725	9,448 ± 34	8,812-8,632	10,761-10,581	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
	SUERC-62738	9,379 ± 34	8,746-8,566	10,695-10,515	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
	SUERC-62709	9,371 ± 31	8,742-8,562	10,689-10,511	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
	SUERC-62739	9,503 ± 34	8,737-8,554	10,686-10,503	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
	SUERC-62696	9,333 ± 34	8,720-8,508,506-8,487	10,694-10,489/10,458-10,436	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
	SUERC-62707	9,327 ± 34	8,703-8,698,696-8,528/8,520-8,474	10,694-10,618/10,605-10,477/10,466-10,423	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
	SUERC-62734	9,336 ± 34	8,698-8,688,694-8,476	10,642-10,624/10,608-10,476/10,476-10,422	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
	SUERC-62697	9,302 ± 31	8,698-8,688,694-8,450	10,642-10,620/10,590-10,465	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
	SUERC-62706	9,288 ± 34	8,693-8,688,694-8,450	10,642-10,624/10,598-10,383/10,312-10,305	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
	SUERC-62736	9,288 ± 34	8,693-8,688,694-8,450	10,642-10,624/10,598-10,383/10,312-10,305	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
	SUERC-62715	9,288 ± 34	8,615-8,418,8,410-8,348	10,564-10,367/10,359-10,297	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
	SUERC-62727	9,258 ± 34	8,606-8,344	10,555-10,293	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
	SUERC-62716	9,255 ± 34	8,605-8,381/8,575-8,338	10,554-10,530/10,524-10,287	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
	SUERC-62714	9,255 ± 34	8,605-8,381/8,575-8,338	10,554-10,530/10,524-10,287	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
	SUERC-62710	9,218 ± 34	8,547-8,313	10,496-10,261	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016	
SUERC-62704	9,207 ± 34	8,542-8,306,499-8,305	10,491-10,455/10,439-10,254	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016		
UIC-14108	9,200 ± 80	8,617-8,281	10,566-10,230	charred seeds <i>Corylus avellana</i>	surface hearth?	Pers. comm. W.J.H. Huggesijn		
SUERC-62698	9,200 ± 34	8,540-8,508,489-8,301	10,489-10,457/10,438-10,250	charred seeds <i>Corylus avellana</i>	surface hearth	Verhegge et al., 2016		
TRANSITIONAL FLINT ASSEMBLAGI Zwolle-Oude Dvenestraatweg (ODIE) ZUTPHEN-OOYERHOEK Zutphen-Ooyterhoek (site M) Zutphen-Ooyterhoek (site M) Zutphen-Ooyterhoek (site M) Zutphen-Ooyterhoek (site M)	GA-56013	9,605 ± 45	9,210-8,816	11,159-10,765	calcined red deer bone (<i>Cervus elaphus</i>)	surface hearth?	Niekus et al., 2019	
	GN-25536	9,410 ± 40	8,793-8,604/8,581-8,575	10,742-10,553/10,530-10,524	partially charred <i>Pinus</i> wood	dumpy?	Groenewoudt et al., 2001	
	GN-25698	9,390 ± 30	8,754-8,597/8,586-8,572	10,703-10,546/10,535-10,521	partially charred <i>Pinus</i> wood	dumpy?	Groenewoudt et al., 2001	
	GA-16811	9,380 ± 60	8,807-8,528/8,520-8,474	10,756-10,477/10,469-10,423	red deer bone (<i>Cervus elaphus</i>)	dumpy?	Groenewoudt et al., 2001	
	GA-16815	9,240 ± 60	8,611-8,305	10,560-10,254	roe deer bone (<i>Capreolus capreolus</i>)	dumpy?	Groenewoudt et al., 2001	

Table 1 – List of radiocarbon dates and associated contextual information for the Late Ahrensburgian, the transitional phase and the earliest Mesolithic industries in the Netherlands. The dates were calibrated (cal. BC and cal. BP) with OxCal version 4.3 (Bronk Ramsey, 2009) with the IntCal13 calibration curve (Reimer et al., 2013).

Tabl. 1 – Liste des datations radiocarbone des informations contextuelles associées pour l'Ahrensburgien récent, la phase de transition et les premières industries mésolithiques des Pays-Bas. Les dates (cal. BC and cal. BP) ont été calibrées avec OxCal version 4.3 (Bronk Ramsey, 2009) selon la courbe de calibration IntCal13 (Reimer et al., 2013).

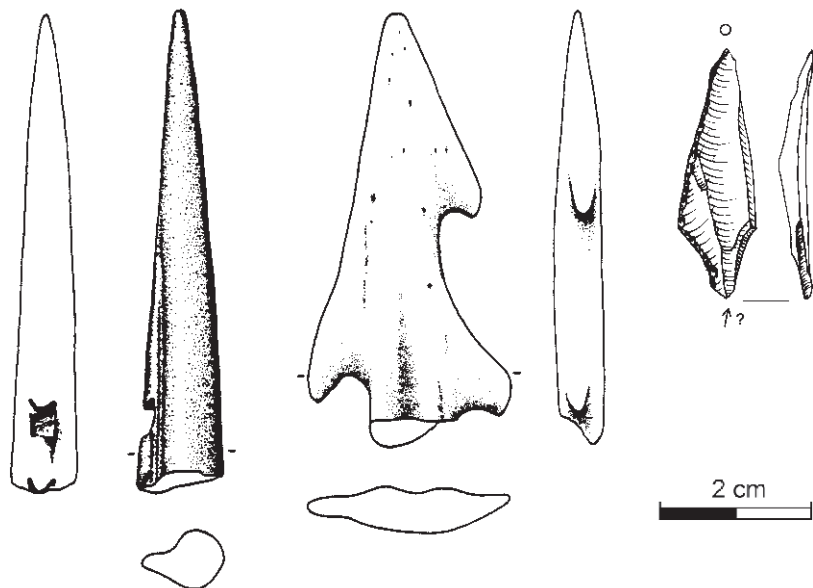


Fig. 3 – Two bone/antler points from Europort (Rotterdam): point with spaced barbs (left, no. 1982/6.6) and a bi-serially barbed point (right, no. MS 139) and a possible Ahrensburgian tanged point from Maasvlakte 2 (Rotterdam) (drawings of the bone/antler points by L. Verhart; source: Verhart, 1988; drawing of the flint point by L. Johansen, courtesy of BOOR, municipal archaeological service of Rotterdam).

Fig. 3 – Deux pointes en matières dures animales provenant d’Europort (Rotterdam) : pointe à barbelure espacée (gauche, n° 1982/6.6) et pointe à deux rangs de barbelures (droite, n° MS 139) et une possible pointe pédonculée ahrensbourgiennne provenant de Maasvlakte 2 (Rotterdam) (dessins des pointes par L. Verhart; source : Verhart, 1988; dessin de la pointe en silex par L. Johansen, avec l’autorisation du BOOR, Service municipal d’archéologie de Rotterdam).

Anthropogenic assemblages or background fauna?

In the case of three finds of faunal remains, caution is warranted in attributing the finds to Late Preboreal or Early Boreal human activity, given the lack of cutmarks and other modifications. Obviously the animals could still have been hunted and butchered

without it leaving a trace. At least these examples prove that such animals were present in the area within the time frame indicated by the radiocarbon dates and thus represent “potential game” (pers. comm. T. de Jong, Helmond).

The most important find is the partial skeleton of a red deer (*Cervus elaphus*) found in 2010 in the Tungelroyse Beek, a stream near Mildert in the province of Noord-Brabant (Roymans and De Nutte, 2012; Roymans, 2013; Woelders et al., 2016). The skeletal remains were found partially in anatomical articulation, with the front and hind legs missing as well as part of the vertebrae and ribs (fig. 6). The antler was dated to the Late Preboreal: 11,199/10,785 cal. BP. However, none of the bones of the red deer exhibit cutmarks or chopping marks – cutmarks are present on non-dated other bones from the site –, nor are there signs of burning. Nevertheless the find is interpreted as the remains of an animal that was skinned on the spot, with the less usable parts being left behind. A supposedly Mesolithic flint blade was found at a distance of six metres from the skeleton, for which reason this is with some reservation labelled a “kill site”⁽⁶⁾.

In 1967, a largely complete skeleton of an elk (*Alces alces*) was found during building activities for a retirement home at Borne in the province of Overijssel. The site was located on a defunct course of the Bornse Beek, a small stream. On the basis of analysis of pollen from sediment still present in the skull, a Preboreal age, more specifically the Rammelbeek phase, was proposed in 1978, although none of the bones was dated directly. The pelvis and hind legs of the elk were missing, there is no mention of cutmarks, and no flint artefacts were reported from the site. The researchers consider it very likely that the Borne elk had been hunted (Van Geel and Van Wijngaarden-Bakker, 2002, p. 141).



Fig. 4 – The blade with a “bulb flake” (find. no. 249) from Den Bosch (photograph by M. Hemminga; source: Verpoorte, 2016).
Fig. 4 – Lame présentant un esquilletlement du bulbe (find. n° 249) d’après Den Bosch (photo : M. Hemminga, d’après Verpoorte, 2016).

Another find is possibly even more questionable with respect to human involvement, namely a skull fragment of red deer (*Cervus elaphus*) from the river Aa near Helmond in the province of Noord-Brabant (De Jong, 2012). The Late Preboreal skull fragment was found in 1994 during the digging of a new canal on the east side of Helmond near the valley of the river Bakelse Aa (De Jong, 1994; De Jong et al., 2015, p. 79-80). Since the fragment is quite severely weathered and abraded, no traces of human involvement were recognized and it proved impossible to determine whether the antlers, which are missing, were shed or intentionally removed. The skull was dated to 11,167/10,766 cal. BP.

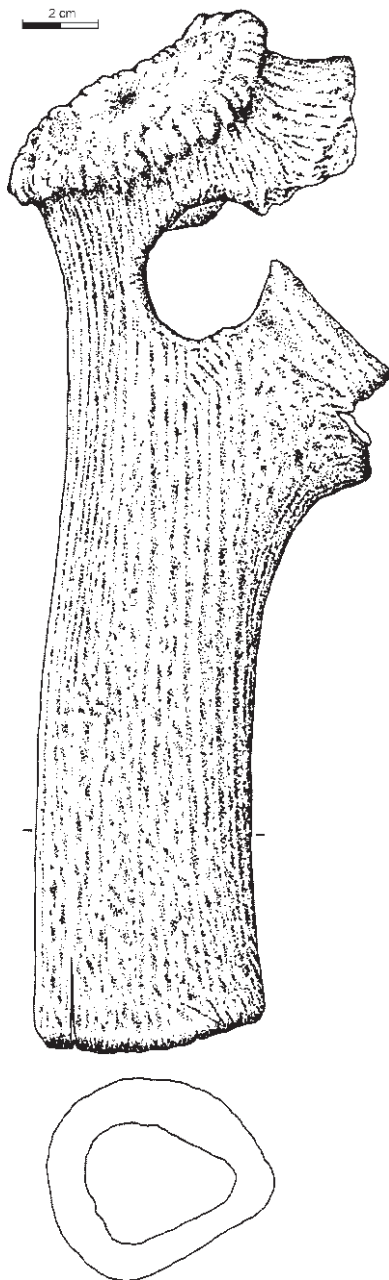


Fig. 5 – The axe sleeve from Ulft (length 27.5 cm) (drawing by L. Verhart; source: Verhart, 1998).

Fig. 5 – Manche de hache de Ulft (hauteur 27.5 cm) (dessin L. Verhart, d'après Verhart, 1998).

Human remains

In addition to the bone/antler points mentioned earlier, quite a few human remains are also known from the North Sea. These were either recovered by the fishing industry or found on new beaches raised with dredged-up sediments. Most of these remains, if dated and with available $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values, were published recently in a paper on the diet of Mesolithic hunter-gatherers in “Doggerland” (Van der Plicht et al., 2016, table 1). In addition to the four dates between 11,940/11,343 and 11,059/10,559 cal. BP listed in this paper, there are also two that were published earlier but which have incomplete $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values: 11,604/11,179 cal. BP (Glimmerveen et al., 2006) and 12,419/9936 cal. BP (Bosscha Erdbrink and Tacoma, 1997; Lanting and Van der Plicht, 2000). As can be seen in table 1, there are two bones (11,940/11,343 Cal. BP and 11,604/11,179 cal. BP) that can be attributed to the Late Ahrensburgian and three (11,063/10,521, 11,059/10,559 and 10,552/10,245 cal. BP) that must belong to the earliest Mesolithic inhabitants of the region (fig. 7).

Pit-hearth features and surface hearths

Charcoal or cone scales from 16 pit-hearths, a pit or pit-hearth and an undefined hearth (see table 1, with references) were radiocarbon dated to the time frame discussed in this paper. Except for the Early Preboreal radiocarbon date of a hearth from Luyksgestel, all dates are from 11,242/11,123 cal. BP (Zuidbroek-Knooppunt N33) and younger. It should be noted that the dates from Zuidbroek, Stadskanaal and Westerbroek are the oldest known pit-hearth dates from the Netherlands. The Luyksgestel site was excavated by Bohmers in 1961, and the excavation plan, showing several small flint scatters and three hearths, was published by Newell (1975, fig. 4; here: fig. 8). One of the hearths – it is not clear whether it is a surface hearth or a pit-hearth – was dated twice with the following results: 11,956/11,201 cal. BP (GrN-4181) and 11,071/10,248 cal. BP (GrN-5999). The second, younger date is considered less reliable owing to insufficient pre-treatment of the charcoal sample (Lanting and Van der Plicht, 2000, p. 147). A count of the armature types present was published by Gendel (1984, p. 212) but these do not conform to what may be expected with a date of 11,956/11,201 cal. BP, since eighteen triangles, mostly scalene specimens, and two crescents were found. The armatures are clearly unrelated to the hearth.

Besides a charred hazelnut shell dated to 10,566/10,230 cal. BP from a coring at Almere, possibly deriving from a surface hearth, there are 28 additional dates on charred hazelnut shells from the Mesolithic site complex of Well-Aijen. All of these samples are from latent surface hearths or at least from within the boundaries of the lithic scatters of a total of 12 sites (Verhegge et al., 2016, p. 106, table 2). Eighteen samples from seven different sites are



Fig. 6 – The Tungalroyse Beek red deer (photograph by L. Mulkens, Archeofotografie, Eindhoven; source: De Jong, 2012).
Fig. 6 – Squelette de cerf de Tungalroyse Beek (photo : L. Mulkens, Archeofotografie, Eindhoven, d’après De Jong, 2012).



Fig. 7 – Human remains from the North Sea in the collection of the National Museum of Antiquities (RMO, Leiden). The skull originates from the Southern Bight and was radiocarbon-dated to $10,070 \pm 50$ BP (GrA-42700) (photograph by National Museum of Antiquities, Leiden).

Fig. 7 – Restes humains provenant de la mer du nord provenant des collections du Musée National des Antiquités (RMO, Leiden). Le crâne originare de la baie sud a été daté par le radiocarbone (10070 ± 50 BP (GrA-42700) (photo : Musée National des Antiquités, Leiden).

relevant for the present study and date to the earlier part of the Boreal, between 10,761/10,581 cal. BP (site 33L) and 10,489/10,250 cal. BP (site 33E).

LATE PALAEOOLITHIC-EARLY MESOLITHIC FLINT SCATTERS

Zwolle-Oude Deventerstraatweg and Kampen-Reevediep

The only flint scatter that is radiocarbon dated to the transition from the Late Palaeolithic to the Mesolithic is the largely destroyed site of Zwolle-Oude

Deventerstraatweg (Niekus et al., 2019). The remains of the flint scatter were located on the eastern flank of a sand ridge, approximately 40 metres northeast of a cluster of Mesolithic pit-hearths. A piece of calcined red-deer (*Cervus elaphus*) bone from a probable surface hearth produced the following Late Preboreal date: 11,159/10,765 cal. BP. Approximately 12% of the lithic assemblage (n = 202, including a quartzite hammerstone) consists of retouched tools: points (n = 8), burins (n = 4), scrapers (n = 3), truncated pieces (n = 2), notched pieces (n = 2) and miscellaneous retouched pieces (n = 7). The armatures include an obliquely truncated point (b-point), several fragments of triangles or trapezes, a fragment of a

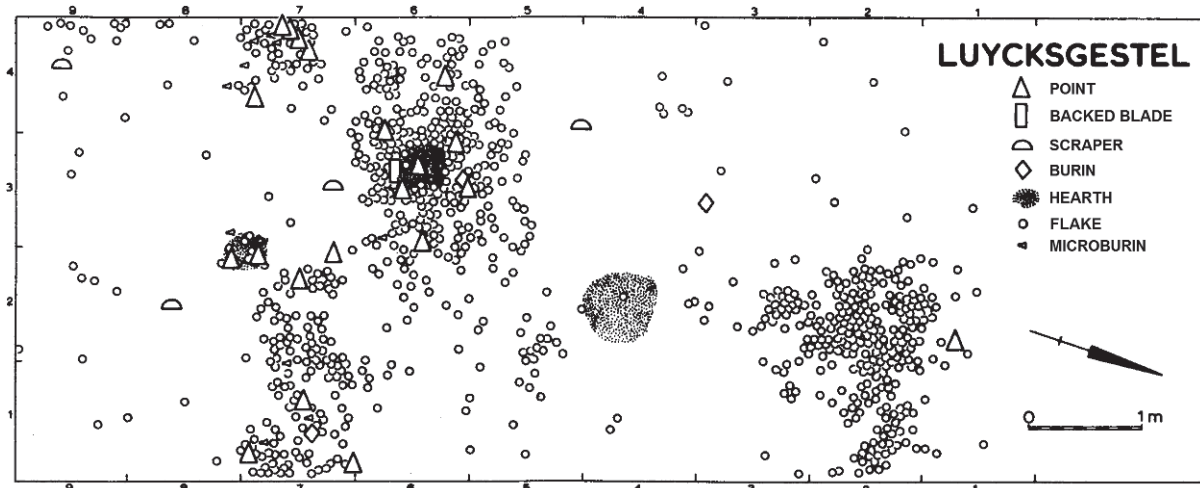


Fig. 8 – Excavation plan of the Luycksgestel site (drawing modified after Newell, 1975).
 Fig. 8 – Plan des fouilles du site de Luycksgestel (dessin modifié d'après Newell, 1975).



Fig. 9 – Flint artefacts from scatter P1 at Kampen-Reevediep site 9. From left to right: a trapezoid point, two burins and a scraper (photograph by ADC ArcheoProjecten [Amersfoort], modified after Geerts et al., 2016).
 Fig. 9 – Vestiges en silex de la concentration P1 de Kampen-Reevediep site 9. De la gauche vers la droite : pointe trapézoïdale, deux burins et un grattoir (cliché : ADC ArcheoProjecten [Amersfoort], modifié d'après Geerts et al., 2016).

backed piece and a fragment of a backed bladelet or unilaterally retouched microlithic point (a-point). One of the truncated pieces could alternatively be interpreted as a point fragment. One of the point fragments displays a *piquant trièdre* near the tip, pointing to the use of the microburin technique. A site that has many characteristics in common with the Zwolle site is lithic scatter P1 at Kampen-Reevediep site 9 (excavated 2016), situated 15-20 km northwest of Zwolle (Geerts et al., 2016). This concentration was discovered at some depth in the coversand after mechanical skimming of the topsoil from the coversand for examining the site for features and hence the flint scatter could not be excavated completely. The flint assemblage consists of c. 450 artefacts but has not yet been studied in detail, and the results presented here should be considered preliminary. Notably there are a small number of relatively large blades, burins and scrapers, as well as a few points (fig. 9). The latter include a trapezoid point that is sometimes referred to as a “Zonhoven point” (but see Lanting and Van der

Plicht, 2000, p. 117; Niekus et al., 2019), as well as a unilaterally backed point or a-point and a scalene triangle; some of these however may belong to a Mesolithic occupation at the same spot. Both sites are very similar in terms of several characteristics of the lithic assemblages, such as the presence of relatively large burins and scrapers, and the diverse composition of armature types. The occurrence of “bulb flakes” on some of the blades is a feature that both sites have in common with (Late) Ahrensburgian sites such as Oudehaske and Gramsbergen (Johansen and Stapert, 2000, p. 23).

Hanzelijn-Oude Land

One of the sites that might fill the gap between transitional sites, such as Zwolle and Kampen discussed in the previous section, and the (Early) Mesolithic industries from approximately 10,350 cal. BP onwards, was found in 2006/2007 during an

excavation prior to railway construction. The excavation was situated approximately 5 km southwest of Zwolle. As at Zwolle and Kampen, the discrete lithic scatter labelled “site 6.12” was discovered by chance and was only partially excavated (Verbaas et al., 2011). In total 28 square metres were excavated in 1x1 m squares, but not all spoil units were sieved and hence small artefacts, probably including point fragments, are underrepresented. A concentration of burnt flint suggests the presence of a surface hearth, but no charred hazel nutshell or burnt bone was recovered; only a few pieces of charcoal were found but these were not dated. A little over 1,600 flint artefacts were recovered, of which 65 are tools (fig. 10): points (n = 24), scrapers (n = 13), notched pieces (n = 5), truncated pieces (n = 5) and miscellaneous retouched pieces (n = 17). A burin on truncation is also present. The group of armatures is dominated by obliquely truncated points (n = 8) followed in number by

elongated trapezes and trapezoid points (n = 4), triangles (n = 2) and a crescent. One of the b-points is a relatively broad specimen with some additional retouching near the base and it may therefore also be described as a trapezoid point (“Zonhoven point”). The triangles consist of an isosceles and a scalene specimen. Microburins are present.

There are no radiocarbon dates for this concentration and its attribution to the Early Boreal is mainly based on characteristics of the armature composition (presence and absence of certain types) in comparison to foreign dated finds. A relatively early date was also suggested by the artefacts' position at some depth in the coversand, which was also the case at Kampen. In northwestern Europe there are several dated sites that are broadly comparable in terms of armature assemblage, more specifically the presence of elongated trapezes. Klaus Bokelmann (1971) considers these trapezes or trapezoids to be quite characteristic of the

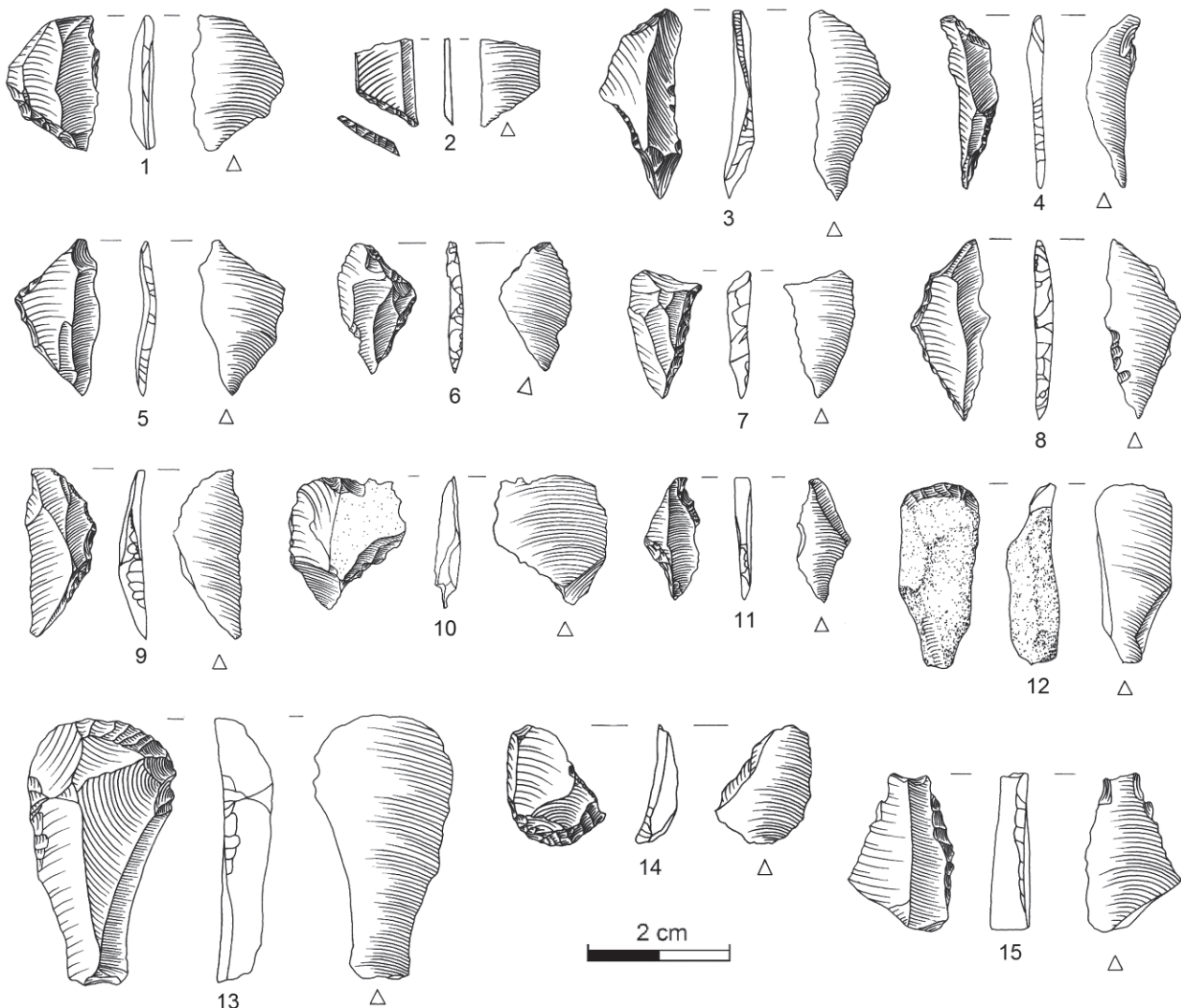


Fig. 10 – A selection of artefacts from the Early Mesolithic site of Hanzelijn-Oude Land. 1-2, obliquely truncated points; 3-6, elongated trapezes and trapezoid points; 7-8, triangles; 9, a crescent; 10-11, microburins; 12-14, scrapers; 15, burin (drawings by R. Timmermans; source: Verbaas et al., 2011).

Fig. 10 – Sélection d'artefacts provenant du site mésolithique ancien de Hanzelijn-Oude Land. 1-2, pointes à troncature oblique; 3-6, trapèzes allongés et pointes trapézoïdales; 7-8, triangles; 9, segment; 10-11, microburins; 12-14, grattoirs; 15, burin (dessins: R. Timmermans, d'après Verbaas et al., 2011).

Preboreal Mesolithic, as they occur for example at several Duvensee sites and at Starr Carr (*e.g.* Reynier, 2005). Duvensee *Wohnplatz* 2 (Bokelmann, 1971 and 1991) with an average date of 10,742/10,281 cal. BP (Bokelmann et al., 1981) seems to be a particularly good parallel for the Hanzelijn site. At Duvensee 2, several elongated trapezes were found in addition to triangles (scalene and isosceles), obliquely truncated points and a few crescents. The slightly older Haverbeck site (Tolksdorf et al., 2009) should also be mentioned in this context. The point assemblage is dominated by points with an unretouched base (a- and b-points) but a single elongated trapeze is present. Two radiocarbon dates are available for Haverbeck: 11,105/10,302 cal. BP (Hv-23306) and 11,075/10,606 cal. BP (GrA-38367). However, there are also sites which are more-or-less contemporaneous with Duvensee 2 and Haverbeck that are dominated by points with an unretouched base (a- and b-points) supplemented with an occasional crescent, but that lack elongated trapezes. Two examples are Duvensee 8 and 9, with average dates of 11,080/10,582 cal. BP and 11,070/10,591 cal. BP, respectively (Bokelmann, 1991). Possibly these sites represent functionally complementary assemblages, as is suggested for the Neerharen and Verrebroek microlith assemblage types in northwestern Belgium and adjacent areas (Perdaen et al., 2008).

The Early Mesolithic Neerharen and Verrebroek microlith assemblage types are also relevant to the discussion, since both show typomorphological affinities to sites in northern Germany and southern Scandinavia (Crombé et al., 2009). It is thought that these two assemblage types developed from the Ahrensburgian, given their typological and technological similarities and geographical distribution (Perdaen et al., 2008).

The Neerharen group, which is radiocarbon dated between *c.* 10,654/10,303 and 10,229/9,795 cal. BP, is characterised by an absolute dominance of points with an unretouched base (a- and b-points), supplemented with isosceles and scalene triangles, crescents and points with a retouched base. The Verrebroek assemblage type, dated between *c.* 10,500/10,234 and 10,168/9,710 cal. BP, is characterized by points with an unretouched base, in combination with scalene triangles. Other types, such as points with a retouched base and crescents, may be present in small numbers.

Despite overall similarities in microlith assemblage types between the aforementioned Duvensee sites and sites attributed to the Neerharen-Verrebroek group, there are some important differences as well. Elongated trapezes have been reported neither from the site of Verrebroek nor from the Early Mesolithic artefact concentrations at Well-Aijen (Verhegge et al., 2016, 105; Devriendt pers. comm. 31-05-2017); apparently this type does not occur in Late Preboreal/Early Boreal contexts in the southern part of the Netherlands and adjacent Belgium, at least not in significant numbers⁽⁷⁾. On the other hand, points with a retouched base, which are present in the Neerharen-Verrebroek type assemblages, do not seem to be present in the

earliest Duvensee sites. As far as can be judged from the illustrations provided by Bokelmann (1991) this type of point is present at Duvensee from *c.* 10,245/10,225 cal. BP onwards (*Wohnplatz* 6, Zone A) or perhaps slightly earlier, around 10,386/10,255 cal. BP, at *Wohnplatz* 1.

The armature assemblage from the Hanzelijn site, especially the presence of elongated trapezes, combined with the lack of certain types that are characteristic of later Boreal occupations in the region, suggests a relatively early age. Based on the armature assemblages of the dated sites discussed in this section the Hanzelijn site most probably dates to sometime between 11,000/10,500 and 10,350 cal. BP.

Zutphen-Ooyerhoek

One of very few Mesolithic faunal assemblages was excavated in 2000 from a stream valley near Zutphen, next to a river dune with several Early Mesolithic flint scatters (Groenewoudt et al., 2001; Bos et al., 2005). Faunal remains (some with cutmarks) and artefacts of bone and antler as well as a small flint assemblage (see below) were found in the valley (contexts 1-5). In total eleven radiocarbon dates are available for bone, antler, charred wood and charcoal from the valley context, which was labelled site "M" (fig. 11). All bone and antler pieces derive from contexts 1-4 (channel fill of the valley). Lithics were found in these contexts as well as in context 5, the foot of the river dune. The dates range between 10,742/10,524 and 8,346/8,197 cal. BP (Groenewoudt et al., 2001, table 1). Leaving aside the few Early Atlantic dates and two unreliable outcomes, we seem to be dealing with two Early Mesolithic phases. The older one dates from between 10,742/10,524 and 10,560/10,254 cal. BP and the younger between 10,179/9,708 and 9,905/9,545 cal. BP.

The earlier phase, represented by four dates, is of special interest here. There are two dates on partially charred *Pinus* wood (10,742/10,524 cal. BP and 10,703/10,521 cal. BP), possibly the result of human activity, and two dates on bone: red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*) dated 10,756/10,423 cal. BP and 10,560/10,254 cal. BP, respectively. Site M was interpreted as the remains of a spatially discrete dump consisting of bone/antler, lithics, charred wood and charcoal, in an old channel at the foot of a river dune which saw Mesolithic occupation as well. It is of interest to note that the early phase from the valley is not represented in the radiocarbon dates associated with the flint concentrations on the adjacent river dune; the younger phase (10,179/9,708 and 9,905/9,545 cal. BP) however is. The lithic assemblage from site M consists of 244 pieces, mostly flint artefacts. Approximately two-thirds of these finds derive from contexts 1-4, the channel fill in the stream valley, and are associated with the bone and antler finds. The sediment from the foot of the river dune (context 5) contains 79 pieces of flint. Among the flint tools, of which the majority

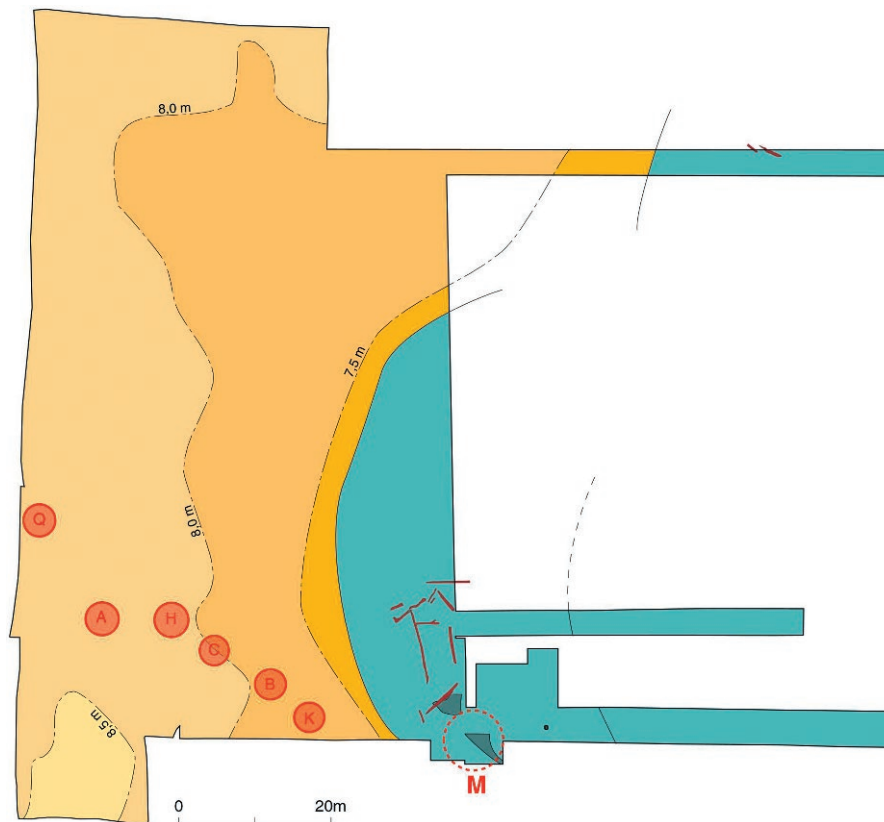


Fig. 11 – Map of the investigated area of Zutphen-Ooyerhoek showing the Mesolithic flint scatters on the river dune (A, B, C, H, K and Q) as well as site M, in an old channel at the foot of a river dune, with preserved tree-trunks shown in black (drawing by the Cultural Heritage Agency of the Netherlands [RCE, Amersfoort]; source: Groenewoudt et al., 2001).

Fig. 11 – Carte de Zutphen-Ooyerhoek montrant les concentrations de vestiges lithiques mésolithiques sur la dune (A, B, C, H, K et Q). La concentration M est localisée dans un paléochenal au pied de la dune et a livré des troncs d'arbres (en noir) (dessin : Cultural Heritage Agency of the Netherlands [RCE, Amersfoort] d'après Groenewoudt et al., 2001).

derive from contexts 1-4, there are several points with an unretouched or natural base such as unilaterally backed microlithic points or a-points ($n = 2$) and obliquely truncated points or b-points ($n = 4$). An elongated trapeze derives from context 1, which probably yielded the oldest finds, as mentioned above. Furthermore there are three burins, a scraper, five miscellaneous retouched pieces and the tip of a microlithic point. It is of relevance that triangles and crescents and microburins, which are common on the river-dune sites, are absent from site M (Groenewoudt et al., 2001, p. 336) while the only elongated trapeze was found in the channel fill. This type of armature is not present in the river-dune assemblages (pers. comm. by the late J. Deeben and pers. observation by the author) that are dated between 10,513/9,960 and 10,180/9,599 cal. BP. These Early Boreal river-dune assemblages are characterised by backed and partially backed points with an unretouched base, points with a retouched base, crescents, triangles (isosceles and scalene) and small numbers of backed bladelets⁽⁸⁾. At any rate site H displays clear similarities to the Verrebroek microlithic assemblage type (e.g. Bats et al., 2010, p. 121; Deeben and Niekus, 2016, p. 133).

DISCUSSION AND CONCLUDING REMARKS

The rarity of archaeological finds and sites in the Netherlands dating to the transition from the Late Palaeolithic to the Mesolithic is to a certain extent in line with observations elsewhere in NW Europe (but see various contributions in the present volume). However, the question is whether absence of evidence should be taken as evidence of absence; or are there biasing factors, for example relating to taphonomy or dating strategy (see also the discussion in Crombé et al., 2014, p. 597-599), that should be taken into account? The Dutch record suggests that there are at least three factors contributing to the “invisibility” of the archaeology of the Pleistocene-Holocene boundary. First of all, lithic assemblages from this era and the preceding Late Ahrensburgian may simply be under-represented because they tend to be classified as Mesolithic, given their lack of tanged points in favour of microlithic points, the absence of large and regular “Late Palaeolithic” blades and the generally poorer quality of the exploited flint nodules (Niekus and

Stapert, 1994; Johansen and Stapert, 2000). Second, this overview also suggests that although transitional and very early Mesolithic sites, be it flint scatters (see discussion below) or early pit-hearths, may be present in the same areas as later Mesolithic occupations, the former tend to be situated in different environmental contexts. In fact, nearly all of these sites are located in relatively low-lying positions such as river valleys (e.g. Zutphen) or other wetland situations, or on the slopes of coversand ridges rather than the highest parts (e.g. Zwolle, Hanzelijn and probably Kampen as well as the pit-hearths from Zuidbroek). These early flint scatters – in fact the same goes for Late Ahrensburgian sites such as Oudehaske, Gramsbergen and Doetinchem – seem to represent single occupation events and there is little if any evidence of significant admixture of later Mesolithic artefacts. This again emphasizes the difference between these and the subsequent Mesolithic occupations, which are often extensive palimpsests. These preferences for low-lying areas will certainly have reduced their visibility and chance of discovery, not least because of the chance of their being covered by sedimentation or peat growth, or being eroded away (Groenewoudt et al., 2001). This is certainly the case at the Hanzelijn and Kampen sites. At both locations the artefacts were found at some depth within the coversand instead of the top layers, which is a clear indication that coversand was deposited after the occupation, *i.e.* during the Late Preboreal and Early Boreal. So contrary to the opinion expressed by Crombé et al. (2014, p. 599), these transitional sites will indeed be more difficult to find. The absolute dating strategy employed may also be a third biasing factor. The authors (*ibid.* 2014, p. 599) argue that owing to the lack of charred hazel nutshells, which are the preferred material for dating the Early Mesolithic, and in nearly all cases of antler, bone and wood as well, the transitional sites in the Low Countries have so far largely escaped detection by absolute dating. We should also consider the possibility that many transitional sites remain undetected because charcoal and possibly burnt bone from surface hearths was blown away or otherwise obliterated during later sedimentation or erosion. In such cases burnt flint may be the only indication for the presence of a surface hearth, since the classic pit-hearth features that we know so well from the Mesolithic in the Netherlands appear only from c. 11,000 cal. BP (Zuidbroek-Knooppunt N33 and Stadskanaal 1) onward (see also Niekus, 2006). ■

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NOTES

- (1) In the text dates are presented as 95.4% probability ranges cal. BP. The raw radiocarbon dates (years BP) and the 95.4% probability ranges CalBC and cal. BP can be found in table 1.
- (2) In the Netherlands the Preboreal is dated between c. 11,530/11,500 and 10,770/10,700 cal. BP (Bos et al., 2007). The Boreal lasted until c. 8,995/8,780 cal. BP (Lanting and Van der Plicht, 2000, p. 102-103).
- (3) In Crombé et al. (2014, p. 592) a threefold partition of the Ahrensburgian into a classic, intermediate and Epi-Ahrensburgian assemblage type is suggested. In order to avoid discussions on the meaning of “classic” and “Epi” we prefer using the terms Early (including intermediate assemblages) and Late Ahrensburgian (Niekus et al., 2019).
- (4) The only certain evidence for the presence of a “bruised blade” assemblage in the Netherlands is the undated find of a bruised blade from the province of Drenthe in the northern part of the country. The blade fits to a second blade; the combined length of this refit group is > 160 mm (Niekus et al., 2018; Niekus et al., 2019). A blade fragment from the Late Ahrensburgian site at Doetinchem (Scholte Lubberink et al., 2016) is interpreted as a probable fragment of a *lame machurée* (here: fig. 2, no. 16; see Niekus et al., 2018 for further discussion).
- (5) It should be noted that the sections as well as the vertical artefact distribution indicate bioturbation and the OSL dates should be interpreted with caution; they are merely an indication of age (pers. comm. P. van der Kroft, 17-05-2017).
- (6) This stands in contrast to the Late Mesolithic aurochs “kill and butchery” sites of Jardinga and Balkweg, where quite a few bones exhibit butchering marks (cutmarks and chopping marks). At Jardinga a small flint assemblage was found associated with the bones. Another argument for human involvement is the fact that a few bones as well as the flint blade from the Balkweg site show traces of burning (Prummel and Niekus, 2011).
- (7) According to I. Devriendt (pers. comm. 31-05-2017) all Early Mesolithic sites from Well-Aijen consist of multiple occupations and hence it is a pointless exercise to calculate the proportions of the different microlith types (mostly points with an unretouched or natural base, supplemented by points with a retouched base, triangles and crescents) in order to assign the concentrations to different microlith assemblage types *sensu* Crombé et al. (2009).
- (8) This is not to say that no earlier sites were present on the river dune. According to B. Groenewoudt (pers. comm. 26-04-2017) only part of the river dune was excavated in “Stone Age mode” and more finds were certainly present to the west of the excavated area.

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

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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'Ahrensbourgien 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'Ahrensbourgien. La présence d'une série à « grandes lames » (Klein Nordende) associée à des armatures clairement ahrensbourgiennes 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, Ahrensbourgien, 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 Ahrensbourgien (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 Ahrensbourgien was succeeded by the early Mesolithic.

The focus of this paper and, thus far, of our investigations lies on the Ahrensbourgien, 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 Ahrensbourgien, we have chosen to analyse techno-economic and typological aspects of four assemblages belonging to the Ahrensbourgien 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 Ahrensbourgien 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 Ahrensbourgien 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.



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).

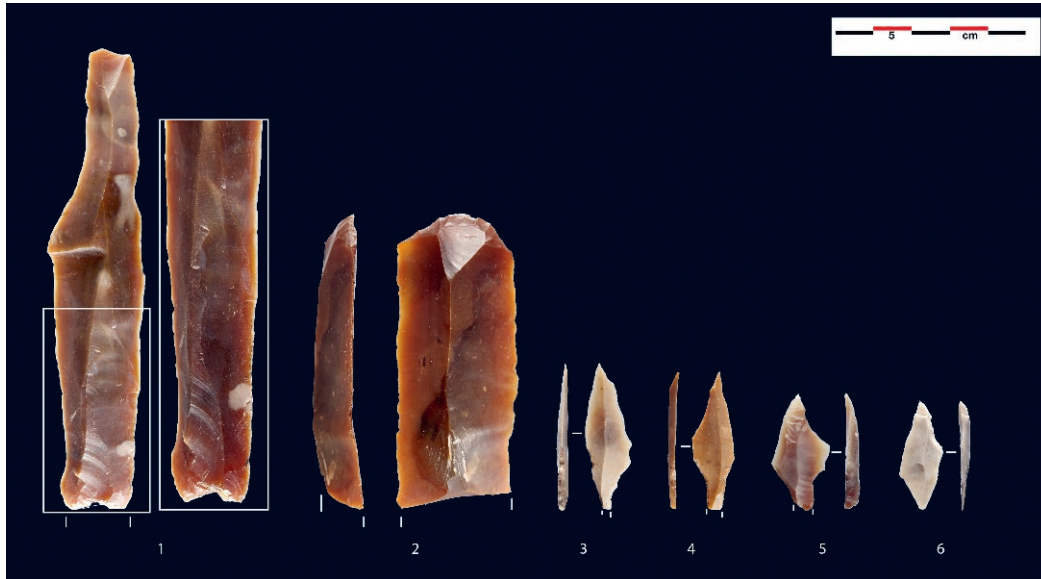


Fig. 4 – Teltwisch 2. 1, unretouched blade with potential use-wear traces; 2, end scraper; 3-5, Ahrensburgian points; 6, Zonhoven point (Pictures: Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, CAD: L. Mevel).

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

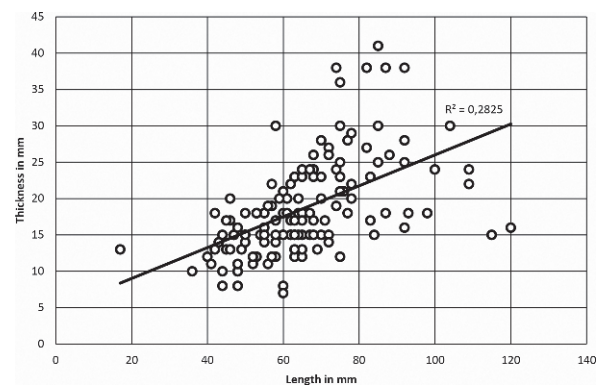


Fig. 8 – Teltwisch-Mitte. Length/thickness ratio of the corpus of studied blades (459 retouched and unretouched blanks).

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).

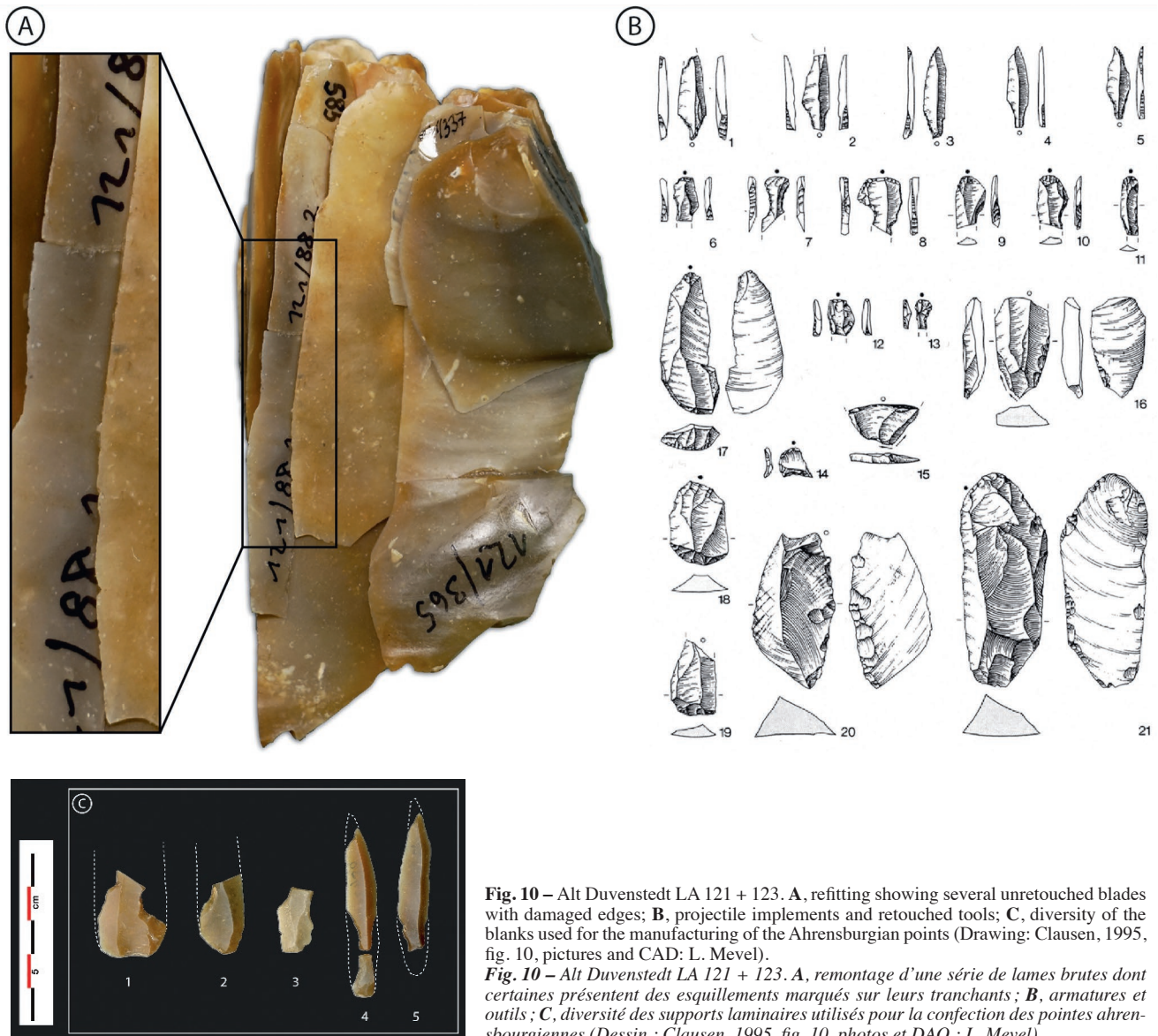


Fig. 10 – Alt Duvenstedt LA 121 + 123. **A**, refitting showing several unretouched blades with damaged edges; **B**, projectile implements and retouched tools; **C**, diversity of the blanks used for the manufacturing of the Ahrensburgian points (Drawing: Clausen, 1995, fig. 10, pictures and CAD: L.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

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The Late Palaeolithic and Early Mesolithic in (north)eastern Germany

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Abstract: *The late Palaeolithic and early Mesolithic in (north)eastern Germany provide good insights into cultural aspects of hunter-gatherer-communities due to the amount and density of key-sites. Representing different geographical zones like coast, lowlands, or middle range mountains, the areas inhabited by Late Pleistocene and Early Holocene hunter-gatherers show a distinct variety within their ecological constraints. Likewise other regions in Europe, these shifted in the area under investigation as a consequence of the repeated ecological changes. Regarding the archaeological finds, the presented area has been settled by several archaeological cultures or groups synchronously or diachronically. Therefore it serves as a good area for investigating contacts and changes in the archaeological record. Sites with fairly high significance (e.g. Abri Fuchskirche, Golßen, Friesack, Hohen Viecheln, Kleinlieskow, Reichwalde, Wustermark 22) render possible the link of archaeological finds and palaeo-environmental investigations and hence provide much better insights into the life of prehistoric foragers than many other regions. When it comes to regionalism, eastern Germany provides the opportunity to trace the connections or interferences of the “lowland-cultures” with those from higher elevations and serve as a bridging area between eastern, western, and southern traditions in Central Europe, both in the Palaeolithic and Mesolithic. In this paper we present summaries of some extraordinary sites and overarching cultural developments. Specific differences between Late Pleistocene and Early Holocene communities as well as alterations in the course of their existence are discussed. The changes during the Late Palaeolithic seem to be influenced by constraints proper to each tradition and perhaps reflecting the transition from one cultural entity to another whereas changes during the Mesolithic seem to follow common trends on a supra-regional level but with more regional specifications.*

Keywords: *Ahrensburgian, Federmessergruppen, Mesolithic, North European Plain, Mid-Range Mountains.*

Résumé : *En Allemagne du (nord)-est, il existe beaucoup d'informations culturelles sur les communautés de chasseurs-cueilleurs du Paléolithique final et du Mésolithique ancien en raison de l'abondance de sites de référence. Correspondant à différentes zones géographiques comme les côtes, les plaines ou les montagnes de moyenne altitude, les zones occupées par les chasseurs-cueilleurs du Pléistocène final et du début de l'Holocène présentent des contraintes écologiques diverses. Comme dans d'autres régions d'Europe, ces contraintes se sont modifiées dans la zone étudiée à la suite des changements écologiques répétés.*

En ce qui concerne les découvertes archéologiques, la région présentée a été occupée par plusieurs cultures ou groupes archéologiques de façon synchrone ou diachronique. Par conséquent, elle constitue un espace propice à l'étude des contacts et des changements. Les sites d'importance (p.ex. Abri Fuchskirche, Golßen, Friesack, Hohen Viecheln, Kleinlieskow, Reichwalde, Wustermark 22) permettent d'établir le lien entre les découvertes archéologiques et les études paléoenvironnementales, fournissant de bien meilleurs aperçus de la vie des chasseurs-cueilleurs préhistoriques que dans beaucoup d'autres régions. En ce qui concerne les problématiques régionales, l'Allemagne de l'Est offre la possibilité de retracer les connexions ou les interférences entre cultures « des plaines » et celles des régions plus élevées et de servir de pont entre les traditions orientales, occidentales et méridionales d'Europe centrale, à la fois au Paléolithique et au Mésolithique.

Dans cet article, nous présentons des résumés synthétiques sur quelques sites très importants et sur les développements culturels globaux. Des différences spécifiques entre les communautés du Pléistocène final et de l'Holocène ancien ainsi que des transformations au cours de leur existence sont discutées. Les changements au Paléolithique final semblent être influencés par les contraintes propres à chaque tradition ou refléter la transition d'une entité culturelle à une autre alors que les changements au Mésolithique semblent suivre des tendances globales, avec toutefois des spécificités plus régionales.

Mots-clés : *Ahrensbourgien, Groupes à Federmesser, Mésolithique, Plaine nord-européenne, Moyennes montagnes.*

GEOMORPHOLOGICAL CONTEXT

Eastern Germany is primarily characterized by two geomorphological areas: On the one hand there are large lowland areas, which are framed by the Baltic Sea in the North, and on the other hand the southern part is characterized by the fringes of the Middle Range Mountains.

While the lowland was formed by the Saalian and Weichselian glaciers and appears today with corresponding geomorphological situations, the southern half of eastern Germany is a 600-1,200 m high mountainous area with the Hercynian Mountain, the Thuringian Forest, the Ore Mountains, the Elbe Sandstone

Mountains and the Zittau Mountains. The northern foreland of these mountain ranges is crossed by the rivers Ilm, Saale, Weiße Elster or Mulde that flow into the Elbe. Today, this area is part of Thuringia, Saxony and the southwestern half of Saxony-Anhalt. The Elbe River forms the border to the large North European Plain, part of which is Lower Lusatia in most southern Brandenburg. This is where Saalian glacier melt waters formed the extensive ice margin valleys that characterize large parts of the lowlands in eastern Germany. Due to the more limited extension of the Weichselian glacier, its ice margin valleys are located further north, but follow a similar east-west orientation (fig. 1). The valleys are connected by several smaller channels and are characterized by fens today. Thus, good

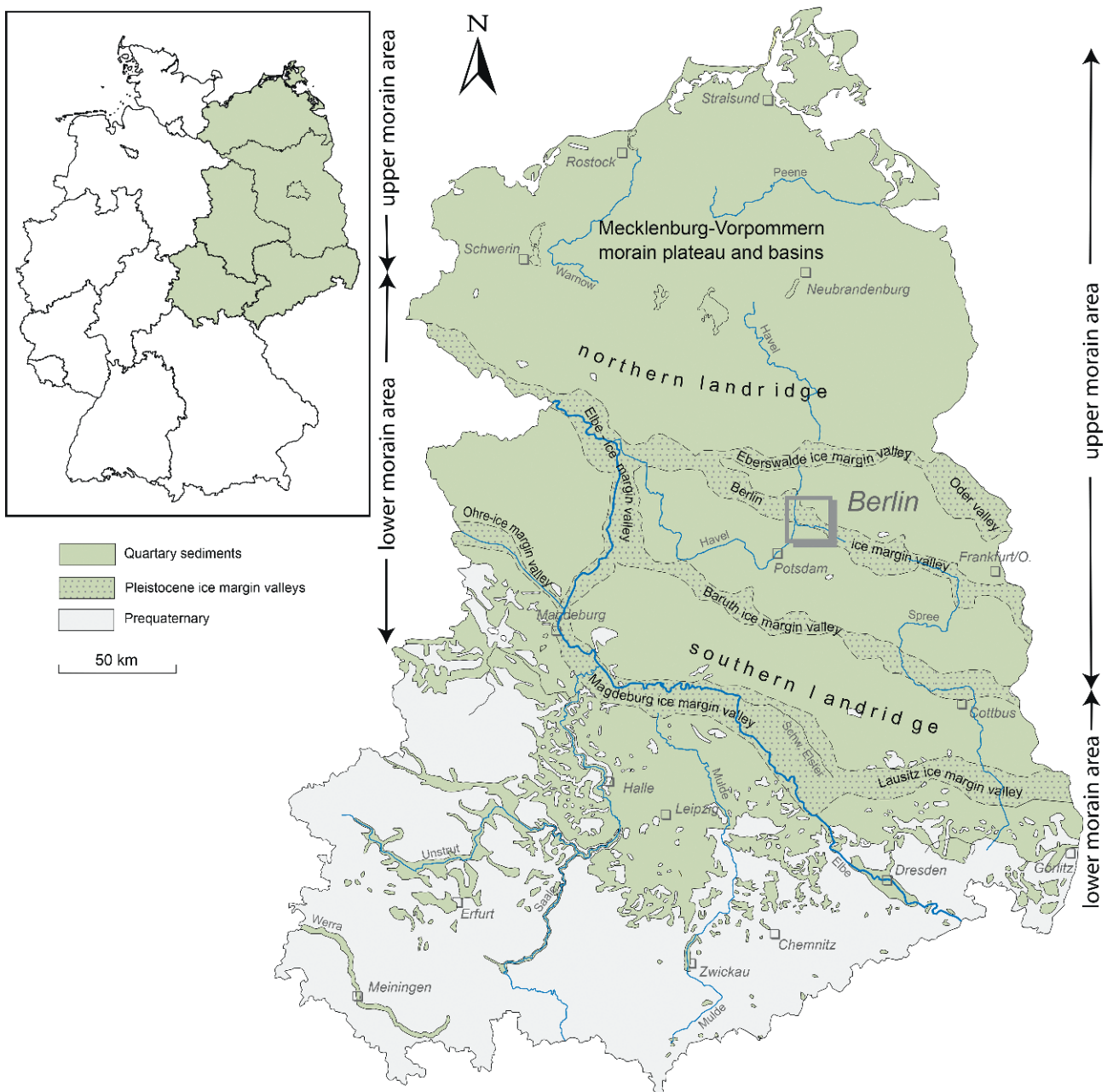


Fig. 1 – Geomorphology of eastern Germany (after Franke, 2015, fig. 24).
Fig. 1 – Géomorphologie de l’Allemagne de l’Est (d’après Franke, 2015, fig. 24).

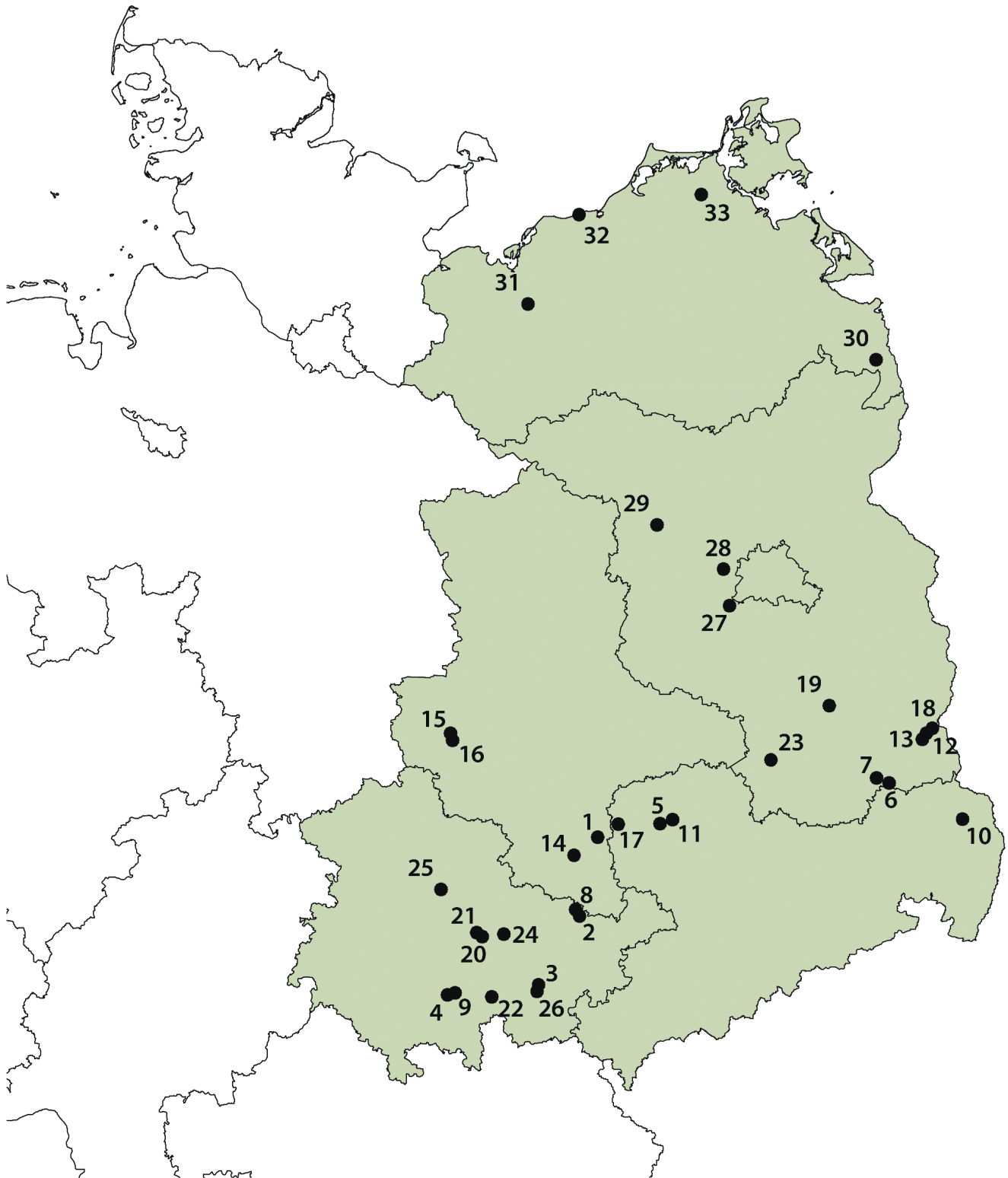


Fig. 2 – Mentioned and other relevant sites in this study. 1, Wallendorf; 2, Hartmannsdorf; 3, Ranis; 4, Bärenkeller; 5, Taucha; 6, Bergheide; 7, Finsterwalde; 8, Etzdorf; 9, Abri Fuchskirche; 10, Reichwalde; 11, Groitzsch; 12, Groß Lieskow; 13, Kleinlieskow; 14, Braunsbedra; 15, Blankenburg; 16, Westerhausen; 17, Schkeuditz; 18, Weißagk/Grötsch; 19, Golßen; 20, Kranichfeld; 21, Hohenfelden; 22, Pöllnitz; 23, Malitschkendorf; 24, Göttern; 25, Haßleben; 26, Urdhöhle; 27, Potsdam Schlaatz; 28, Wustermark 22; 29, Friesack; 30, Rothenklempenow; 31, Hohen Viecheln; 32, Nienhagen; 33, Endingen.

Fig. 2 – Gisements étudiés ou mentionnés dans cette étude. 1, Wallendorf; 2, Hartmannsdorf; 3, Ranis; 4, Bärenkeller; 5, Taucha; 6, Bergheide; 7, Finsterwalde; 8, Etzdorf; 9, Abri Fuchskirche; 10, Reichwalde; 11, Groitzsch; 12, Groß Lieskow; 13, Kleinlieskow; 14, Braunsbedra; 15, Blankenburg; 16, Westerhausen; 17, Schkeuditz; 18, Weißagk/Grötsch; 19, Golßen; 20, Kranichfeld; 21, Hohenfelden; 22, Pöllnitz; 23, Malitschkendorf; 24, Göttern; 25, Haßleben; 26, Urdhöhle; 27, Potsdam Schlaatz; 28, Wustermark 22; 29, Friesack; 30, Rothenklempenow; 31, Hohen Viecheln; 32, Nienhagen; 33, Endingen.

preservation conditions are typical for Late Palaeolithic and Early Mesolithic sites from the eastern German lowland – predominantly those from the ice margin valleys. However, less ground water saturated areas and uplands provide less favourable opportunities for finding organic artefacts (fig. 2).

The area presented here is well-known for its Magdalenian and early Holocene sites (Geupel, 1985 and 1987; Gramsch, 2010; Küßner, 2009; Küßner and Jäger, 2015). According to a radiocarbon date of 15,290-14,834 cal. BP (12,685 ± 55 BP – OxA-13849; Grünberg, 2006) the last Magdalenian occupation may be represented by the site of Wallendorf (Weinberg), formerly Friedensdorf and Kriegsdorf, in the Saale valley of southern Saxony-Anhalt (Küßner, 2009, p. 69-73). Here, only remains of horses have been found. Among the ca. 880 lithics 35% represent blades and bladelets, among the ca. 70 lithic tools backed bladelets predominate and burins as well as end scrapers are the most common domestic tools.

FINAL PALAEOOLITHIC

At the end of GS-2 (table 1) in the mountainous area of eastern Germany, river incision started to change fluvial dynamics from braided to meandering systems (Friedrich et al., 2001a; Mol et al., 2000). Soil development started in GI-1e in loess covered areas (Meszner et al., 2013, p. 105) as well as in lower areas covered by aeolian sand (Friedrich et al., 2001a). With the onset of the Holocene, the Late Weichselian terrace was covered by 4-6 m of loam (Bischoff, 1999; Hiller et al., 1991 and 2003; Steinmüller, 2002, p. 292) making the discovery of Final Palaeolithic sites in river valleys a rare exception. Many surface collections with backed points and short end scrapers are known from Saxony (Geupel, 1985), Lower Lusatia (Geupel, 1987) as well as Thuringia and Saxony-Anhalt (Küßner, 2007). Unfortunately, many are mixed

with Mesolithic and/or Neolithic artefacts. Only few sites have been excavated and fewer are published. Here, only recently excavated sites as well as re-investigated assemblages are presented.

Some assemblages are very small, for example the Thuringian sites Hartmannsdorf-Caaschwitzer Berg or Ranis and Bärenkeller (Feustel et al., 1972; Hülle, 1977; Feustel and Musil, 1977a; Bergmann et al., 2012). At Ranis the longest Palaeolithic stratigraphy in Central Germany was excavated by Werner Hülle (1977) between 1932 and 1938 but his excavation strategy and documentation methods confuse recent re-investigators (Grünberg, 2006, p. 107-109; Weiß, 2013). Therefore, two radiocarbon dates of 12,615 ± 50 (OxA-12052) and 10,145 ± 50 (OxA-12051) ¹⁴C BP (15,192-14,725 and 12,046-11,413 cal. BP⁽¹⁾; Grünberg 2006, table 4) indicate a late Weichselian age but lithic tool types do not indicate whether a Late Magdalenian, a *Federmesser* industry or Ahrensburgian is present. The cave site Bärenkeller was excavated in different episodes from the 1950s up until 1975 (Feustel, 1963; Feustel and Musil, 1977a; Feustel et al., 1972; Küßner, 2009, p. 187). During the Pleistocene the cave was mainly used by cave bear. Linear Banded Pottery sherds found inside as well as in the humic soil outside of the cave show that it was also used during the Neolithic. In front of the cave, the loessic horizon below this soil contained only few non-diagnostic artefacts and horse bones. A probable fireplace in the cave was used by Pleistocene humans, fuelled with shrub willow, hazel, maple and beech. However, only 43 lithics and 28 organic artefacts indicate activities of Pleistocene humans: one end scraper, some backed bladelets, a few long points made out of ivory and six (up to 40 cm) long antler points with a double bevelled base may indicate a Magdalenian occupation. Human presence in GS-2.1a/b is supported by a date of 13.7 ¹⁴C-ka BP on charcoal. Additionally, a handful of curve-backed points and 11.2 ¹⁴C-ka BP old charcoal may be seen as a Final Palaeolithic occupation in GI-1c1 to GI-1a.

Rasmussen et al., 2014 (INTIMATE events, years BP)		Litt et al., 2007 (biozones, warve years BP)	
Preboreal	11,703 ± 4	Preboreal	11,590
GS-1	12,896 ± 4	Younger Dryas	12,680
GI-1a	13,099	Allerød	13,350
GI-1b	13,311		
GI-1c1	13,600	Older Dryas	13,540
GI-1c2	13,660	Bølling	13,670
GI-1c3	13,954		
GI-1d	14,075	Oldest Dryas	13,800
GI-1e	14,692 ± 4	Meiendorf	14,450

Note: see comments by Rasmussen et al. (2014, p. 25). Radiometric dates are calibrated with IntCal 13 (Reimer et al., 2013) and correlated with the INTIMATE event stratigraphy (Rasmussen et al., 2014).

Table 1 – Comparison of the INTIMATE event stratigraphy (after Rasmussen et al. 2014) and biozones (after Litt et al. 2007). Note: see comments by Rasmussen et al. (2014, p. 25). Radiometric dates are calibrated with IntCal 13 (Reimer et al., 2013) and correlated with the INTIMATE event stratigraphy (Rasmussen et al., 2014).

Tab. 1 – Comparaison de la stratigraphie de l'événement INTIMATE (d'après Rasmussen et al. 2014) et des biozones (d'après Litt et al., 2007). Note : voir les commentaires de Rasmussen et al. (2014, p. 25). Les dates radiométriques sont étalonnées avec IntCal 13 (Reimer et al., 2013) et corrélées avec la stratigraphie de l'événement INTIMATE (Rasmussen et al., 2014).

In contrast, other excavations contain many lithics but have never been finally published. One example is Taucha, where ca. 1,400 lithics were excavated in three clusters in a 2,000 m² large area (Dunkel and Dunkel, 1977). Here, curve- and angle-backed points, as well as short end scrapers and different borer types, indicate a Final Palaeolithic age. Other sites, such as Bergheide and Finsterwalde in southern Lower Lusatia, are mentioned in connection with the Final Palaeolithic but their exact age is difficult to interpret. Bergheide was excavated in 1981 (Wechler and Wetzel, 1987). Among the ca. 4,500 lithics, flakes (68%) and chunks (25%) are most common. Cores (1.5%) and blades (2%) occur rarely. Pit-like features are interpreted as evidence of primitive mining for moraine flint but, due to a lack of distinct lithic tool types, the age of this site is difficult to estimate (Gayck, 2000, p. 239; Wechler and Wetzel, 1987, p. 25-27). The other site, Finsterwalde, was excavated in 1983 (Wechler, 1988). Just below the surface, in a bleached, grey sand, ca. 2,800 lithics were found in an area of ca. 50 m². Refitting of breaks as well as of burins and burin spalls was possible. Several shaft smoothers and grindstone fragments were found. 60 cm below this layer another archaeological horizon was found in a yellow, aeolian sand. The lower layer contained ca. 2,100 lithics and several grindstones. Many refittings were possible here, too. However, like Bergheide, due to a lack of diagnostic lithic tool types the age of this site remains unknown (Cziesla, 2008, p. 35; Wechler, 1988, p. 14).

At Etdorf in Thuringia, an amateur archaeologist collected several hundred artefacts in the 1930s. Until recently, this assemblage was classified as early Final Palaeolithic (Holzkämper et al., 2013, p. 131). However, a re-investigation of this assemblage (Bergmann et al., 2011) did not reveal the presence of curve-backed points and short end scrapers. In contrast, shouldered points and many burins are present. Among the other tools are only end scrapers on blades as well as borers and *Zinken*. The presence of backed bladelets is far from sure. Ca. 30% of all blanks are blades/bladelets and the lithic *chaîne opératoire* is focused on the production of blades. The technological characteristics of the blanks are similar to the local Magdalenian, for example blanks with an épéron butts are present. Thus, Etdorf may be a "Late Magdalenian" site with shouldered points.

Two sites, one in Thuringia the other in Lower Lusatia, indicate that the Final Palaeolithic and mammals associated with forest habitats started in GS-1e/GS-1d. The first site is Abri Fuchskirche, situated in the Thuringian Slate Mountains, which was excavated in 1962 by Rudolf Feustel (Museum of Prehistory in Thuringia). 50 m² were excavated and approximately 490 lithics were found (fig. 3). A revision of the finds was recently done (Benecke et al., 2006). The lithics were found in all layers, from the top soil (layer 1) as well as mixed with Mesolithic microliths in layer 2. 219 lithics were found in layer 3, which has to be seen as an early Final Palaeolithic/early *Federmessergruppen* assemblage: backed

retouched pieces (n = 16) are the most common tool type. Among them, there are at least four curve-backed points and three trapezoidal backed points, but only one of them resembles a Kent-type or Creswell point (cf. Barton et al., 2003). The amount of blades is low (8%), but blades have been modified into borers (n = 3), burins (n = 2) and end scrapers (n = 2). Also laterally retouched blades are present (cf. Bodu and Mevel, 2008). Layer 3 is further characterized by the presence of horse, elk, aurochs, red deer, roe deer, wild boar, brown bear and red fox, all indicating a forest environment. Three radiocarbon dates on two elk teeth and one bovid bone range between 12.2-12.0 ¹⁴C-ka BP, corresponding with GI-1d to GI-1c3. However, a fourth radiocarbon dated horse bone dates to 12.7 ¹⁴C-ka BP, which correlates with the periods GS-2.1a/GI-1e. This may indicate that the presence of older elements from a Late Glacial tundra/steppe environment cannot be ruled out.

The second early Final Palaeolithic site is Reichwalde in southernmost Lower Lusatia. It was excavated by Jürgen Vollbrecht (2005; Friedrich et al., 2001) between 1997 and 2000. Reichwalde consists of two archaeological layers in humic soils. By

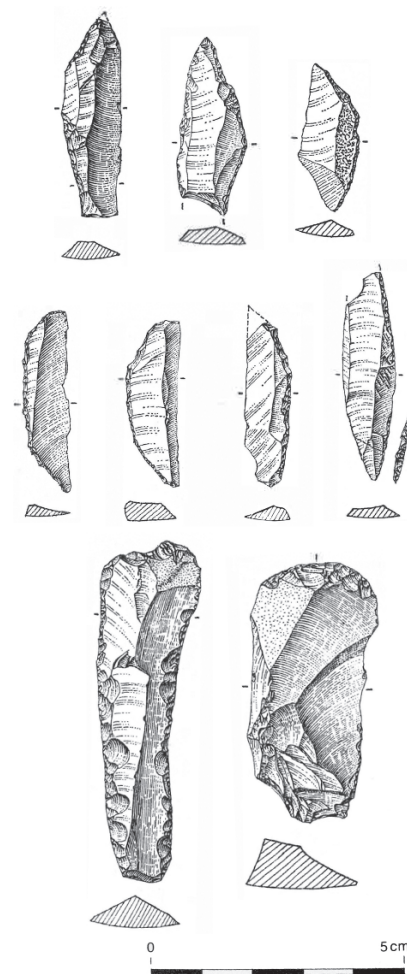


Fig. 3 – Artefacts from Abri Fuchskirche (after Feustel and Musil, 1977b, fig. 8-10).

Fig. 3 – Industrie lithique de l'abri Fuchskirche (d'après Feustel et Musil, 1977b, fig. 8-10).

combining bio-, litho- and chronostratigraphy the older layer is dated to the Bølling climate interval. After the first occupation an aeolian dune accumulated, on which a soil developed that contains the younger layer. Radiocarbon dates of charcoal of a tree-fall indicate that the human occupation of the upper layer took place in the Bølling as well. Impressive remains of a forest are preserved on top of the younger soil. This forest consisted of pine, most of them younger than 110 years, with a few birch trees. Organic remains in the soil burnt in forest fires about every ten years, but most trees survived these. Since the growth of the oldest trees started in the Allerød, the forest remains support the Bølling dating of the younger archaeological layer. Radiocarbon dates of both archaeological layers cluster between 12.3-12.1 ^{14}C -ka BP, indicating the period of GI-1e to GI-1c3. Among the ca. 230 excavated bones, roe deer and red deer are present, again showing the presence of forest mammals during a phase of the early Final Palaeolithic.

The lower layer was excavated only in two small areas. Circa 530 lithics, among them 20% blades but only one oblique truncation, were excavated in 6 m² at location 5064. At location 5042, ca 680 lithics, among them short end scrapers, were excavated in 35 m². In contrast, the upper layer is a vast Final Palaeolithic occupation surface. It contains ca. 22,200 lithics but, due to sieving, three quarters of the 30 kg lithics are artefacts < 1 cm. These finds cluster in a dozen distinct concentrations scattered over ca. 2,000 m² (fig. 4). Numerous refittings indicate that the lithic concentrations are contemporaneous. Flakes dominate by far; blades represent only 5% of the assemblage. Up to 200 lithic tools are present. Laterally retouched pieces, short end scrapers, truncations and borers are the most common domestic tools. Only eleven burins are present and backed retouched pieces dominate. Among them are ca. 50 large and small, curved and angle-backed pieces (fig. 5). Some of these points are named Taucha points by Cziesla and

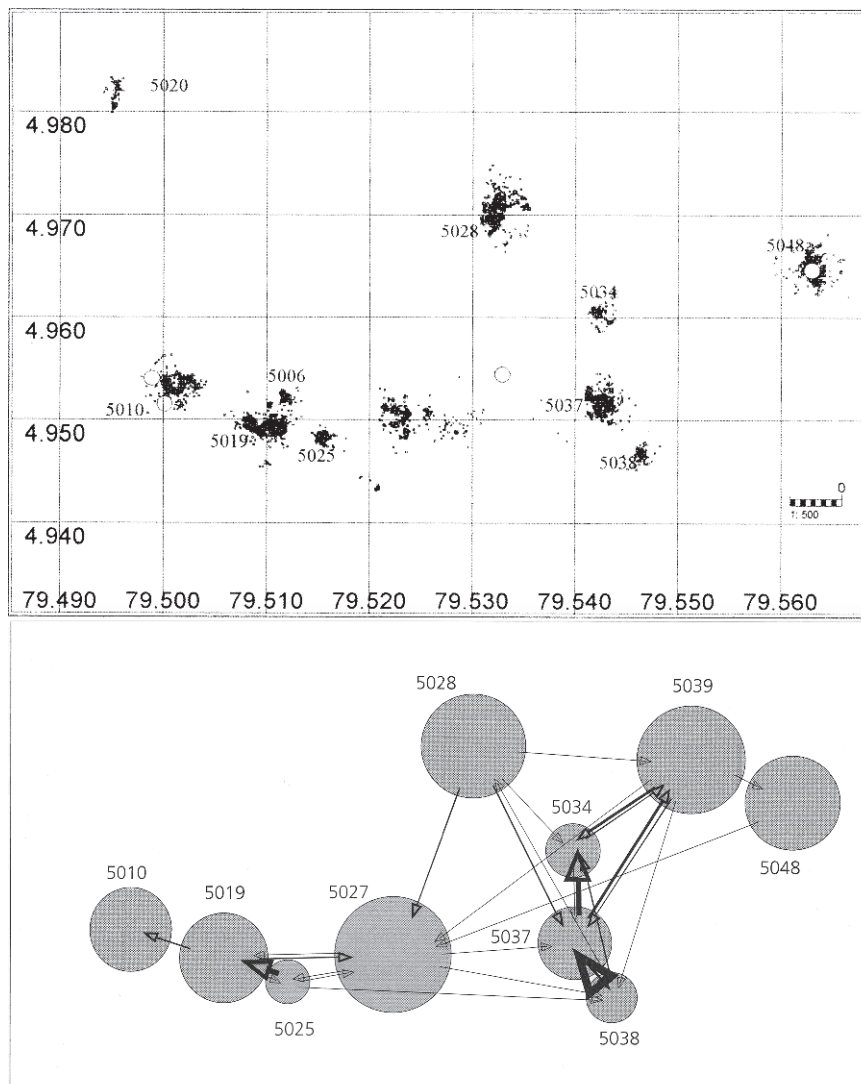


Fig. 4 – Site plan of the upper layer of Reichwalde (above; after Friedrich et al., 2001, fig. 36) and relations between the different concentrations (below; Vollbrecht, 2005, fig. 17-18).

Fig. 4 – Plan du niveau supérieur du gisement de Reichwalde (au-dessus; d'après Friedrich et al., 2001, fig. 36) et liaisons entre les différents locus (en-dessous; Vollbrecht, 2005, fig. 17-18).

Masojć (2007, p. 37) after the site Taucha, which was mentioned above.

These halfmoon-shaped points also occur at Grotzsch, a site in the Mulde valley. At Grotzsch, the largest Late Pleistocene lithic assemblage in eastern Germany, ca. 180,000 lithics were excavated by Helmut Hanitzsch (1957 and 1972) in 1952-1961. Numerous refittings indicate a well-preserved site, but a re-investigation may be necessary to evaluate the distinction of sub-assemblages due to different patinations. Among the lithics, many blades as well as typical tool types of the central German Magdalenian occur but, despite the low amount of short end scrapers (Hanitzsch, 1972, table 4; plate 69: 2, 9), a faint presence of early *Federmessergruppen* cannot be ruled out as few Taucha points are present (Hanitzsch, 1972, plate 30: 25, 27, 29).

The brown coal open-cast mines of Lower Lusatia are a well-known archive of Late Weichselian landscape history. Together with Reichwalde, the open-cast mine Cottbus-Nord may be the best researched area

for the Late Palaeolithic in eastern Germany, as huge Final Palaeolithic sites have been excavated there (Gautier, 2001; Kayser, 1999). Nonetheless, most of these remains await archaeological analysis, but data from lithological, botanical, radiometric and archaeological investigations are available (Kühner et al., 1999). The period of GI-1e to GI-1c3 is well represented by a distinct band of turf but, in contrast to Abri Fuchskirche and Reichwalde, no archaeological remains have been found in that layer. However, only 10-20 km to the east in Poland a barbed harpoon was found that is radiocarbon dated to that period (Cziesla and Masojć, 2007). As at Reichwalde, after GI-1c3 aeolian activity resulted in the accumulation of up to 5 m high dunes at Cottbus-Nord. A faint humic soil with pine charcoal developed on top of these dunes in GI-1a/GS-1. In this soil, *Federmessergruppen* sites have been excavated (Gautier, 2001), for example at Groß Lieskow (Bittmann and Pasda, 1999): here ca. 1,900 lithics were found in a 10 cm thick layer. Straight and curve-backed points, as well as burins,

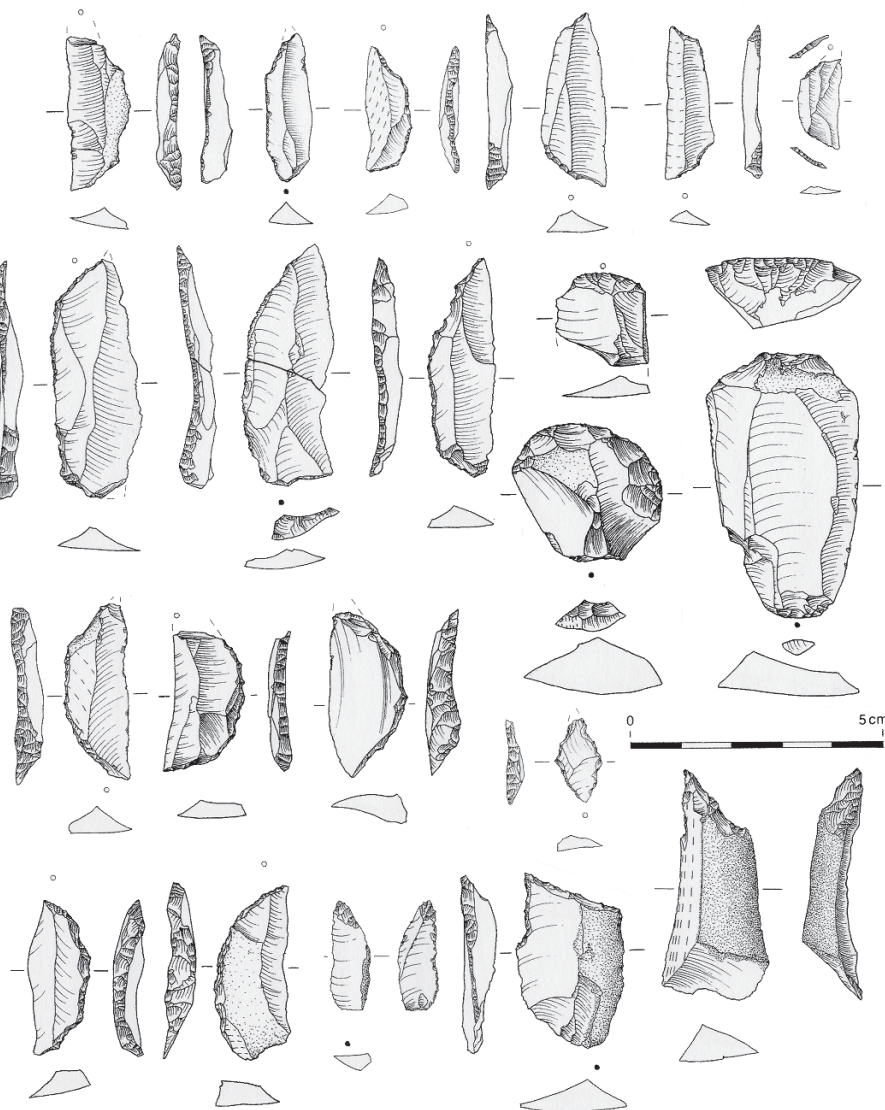


Fig. 5 – Artefacts from Reichwalde (upper layer; after Vollbrecht, 2005).

Fig. 5 – Industrie lithique du niveau supérieur du gisement de Reichwalde (d'après Vollbrecht, 2005).

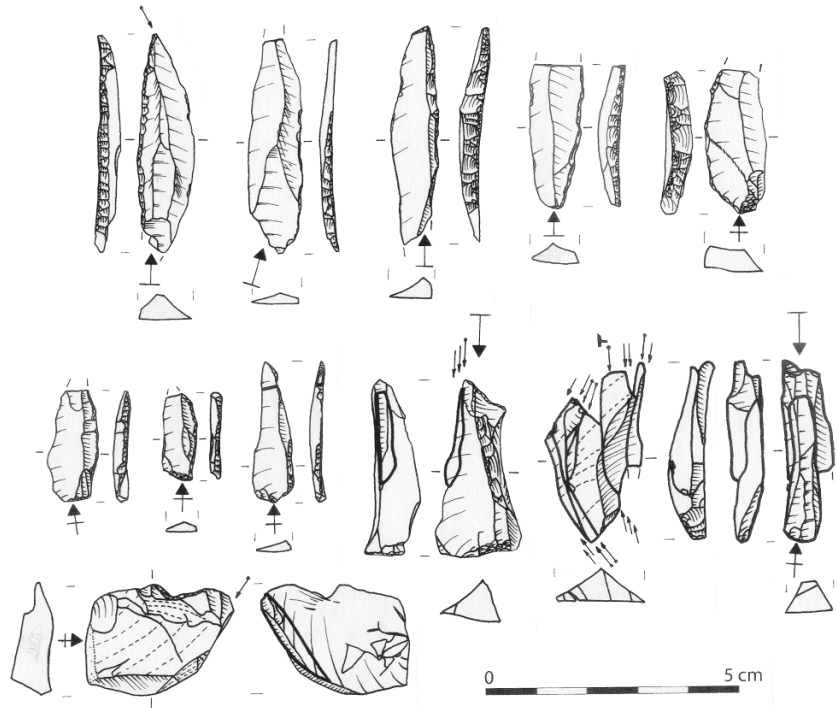


Fig. 6 – *Federmessergruppen* artefacts from Groß Lieskow (after Pasda, 2002).
Fig. 6 – *Industrie à Federmesser du gisement de Groß Lieskow (d'après Pasda, 2002).*

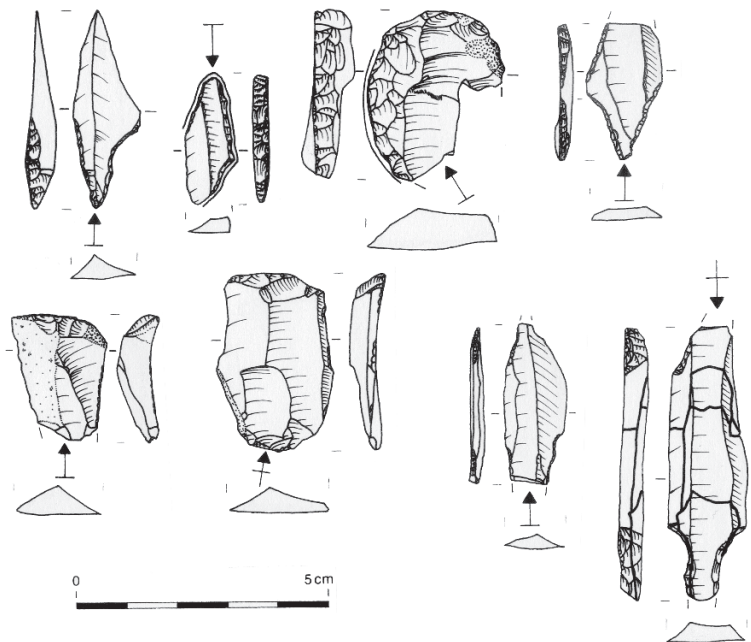


Fig. 7 – Ahrensburgian artefacts from Groß Lieskow (after Pasda, 2002).
Fig. 7 – *Industrie ahrensbourgienne de Groß Lieskow (d'après Pasda, 2002).*

indicate a Final Palaeolithic occupation (fig. 6). Refitting and a large number of small lithics represent a well-preserved site that was only destroyed on the highest part of the dune during the Late Bronze/Early Iron Age. This destruction may explain why no short end scrapers are present. More importantly, at the site of Groß Lieskow tanged points, long blades and short end scrapers (fig. 7) were found in the upper most

parts of the humic soil as well as in the sand above, indicating that an Ahrensburgian occupation followed the *Federmessergruppen* occupation but was more or less completely destroyed in the Mid- and Late Holocene. At Groß Lieskow, the Late Allerød/early Younger Dryas humic soil extends to the foot of the dune where it is represented by a turf which is a distinct lithological layer in the open-cast mine. At

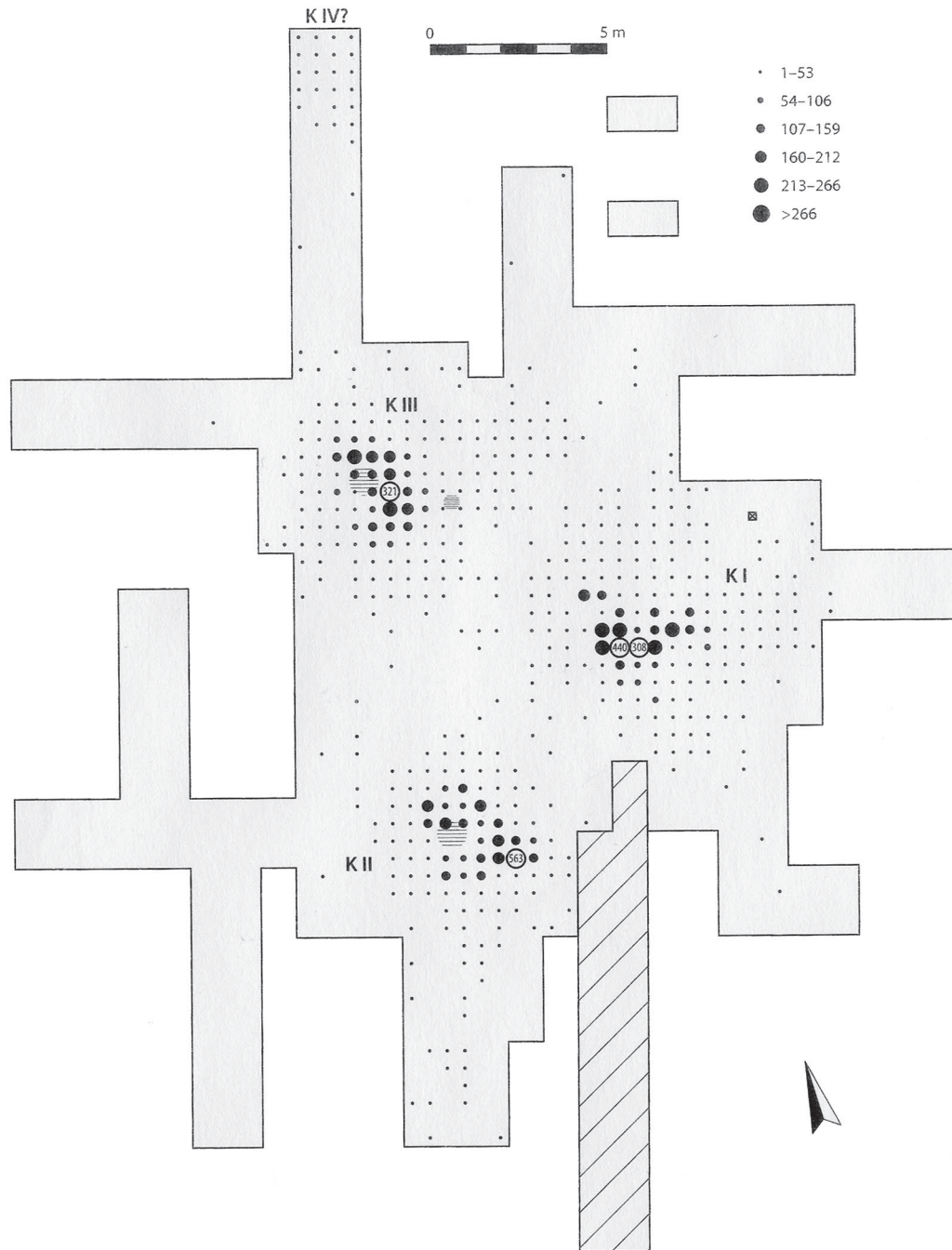


Fig. 8 – Site plan with find concentrations of Kleinlieskow (after Pasda, 2001, fig. 1).
 Fig. 8 – Plan des locus du gisement de Kleinlieskow (d'après Pasda, 2001, fig. 1).

certain spots just some centimeters above the flood plain, this layer was a humic soil.

In this humic soil a huge Final Palaeolithic site was excavated at Kleinlieskow (Neubeck, 2014; Pasda, 2007) only 1.5 km south-west of Groß Lieskow. At Kleinlieskow, in an area of 360 m², nearly 16,000 lithics were found in three distinct concentrations (fig. 8). Reddish sand with small burnt bone fragments indicate a hearth in between two of these concentrations. Refitting of lithics was successful, but in contrast to Reichwalde, did not reveal connections between the concentrations. In contrast, refitting of rocks, of which

only a few occur in each concentration, indicate that non-flint objects were much more mobile, connecting at least two concentrations. Among the burnt bones, a fragment of a fishhook was found (Pasda, 2001). Besides fishing with a line, multiple skeletal elements from *e.g.* roe deer, hare, a large dog or wolf, a carnivore and an animal of the size of a fox as well as undetermined fragments of crania, teeth, ribs, long bones and feet indicate hunting of forest mammals not far from the site. Kleinlieskow is a *Federmes-sergruppen* site because, among the domestic tools, short end scrapers predominate and burins as well as

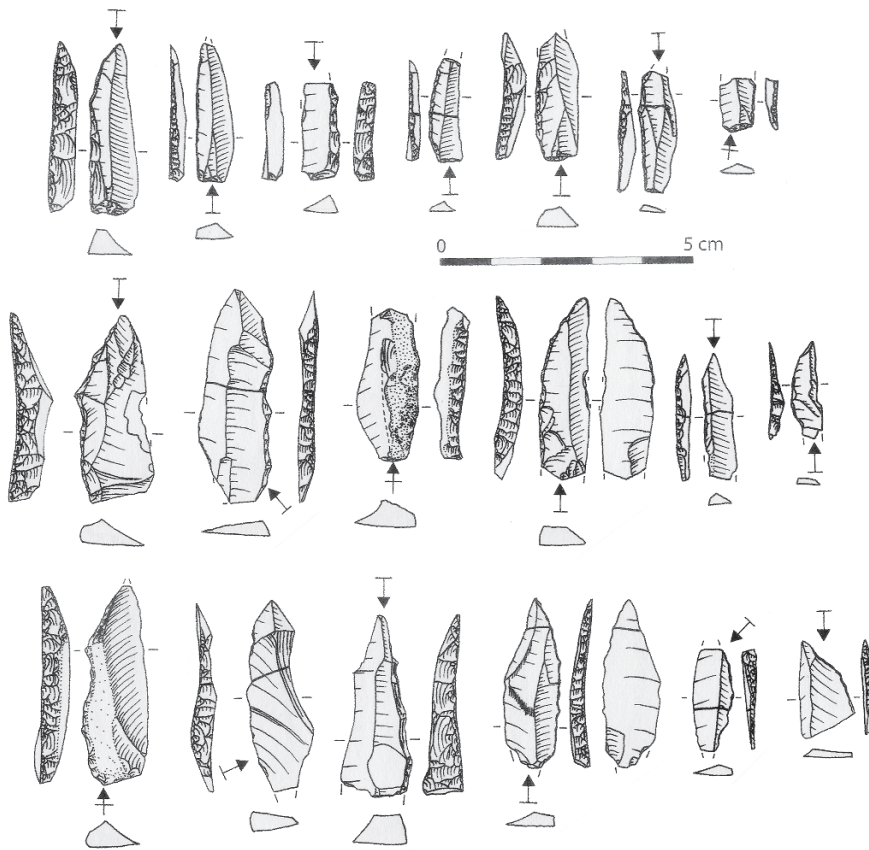


Fig. 9 – Artefacts from Kleinlieskow (after Pasda, 2007, figs. 3 and 4).
Fig. 9 – Industrie du gisement de Kleinlieskow (d'après Pasda, 2007, fig. 3 et 4).

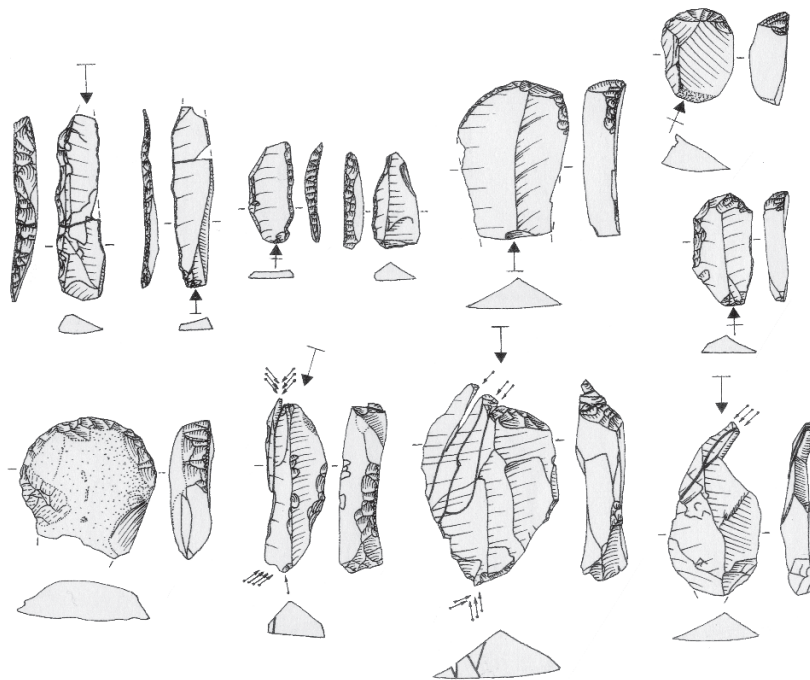


Fig. 10 – Artefacts from Kleinlieskow (after Pasda, 2001, fig. 2).
Fig. 10 – Industrie du gisement de Kleinlieskow (d'après Pasda, 2001, fig. 2).

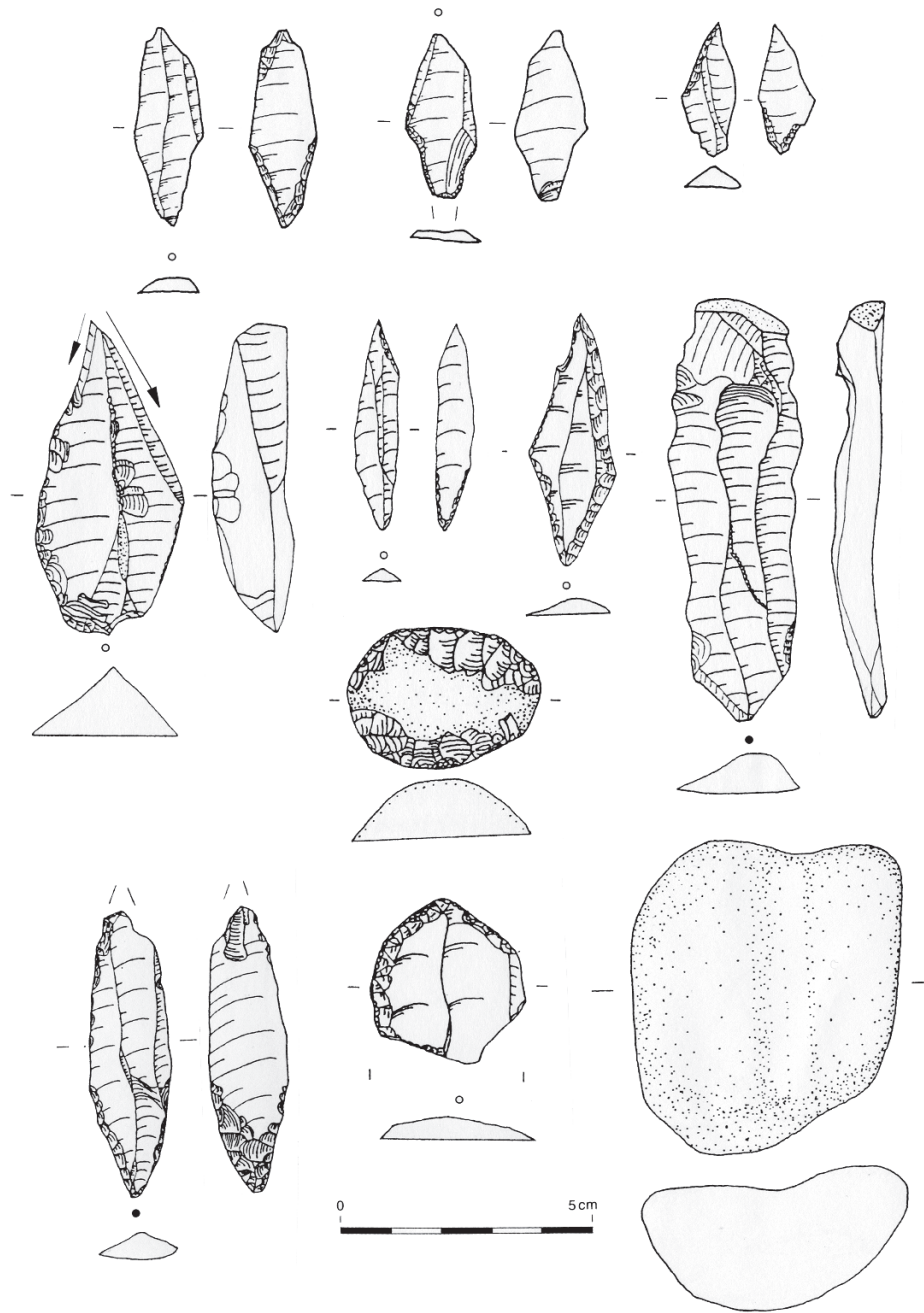


Fig. 11 – Artefacts from Weißagk/Grötsch (Stapel, 2000).
 Fig. 11 – Industrie du gisement de Weißagk/Grötsch (Stapel, 2000).

lateral retouched pieces are rare. Only four truncations, borers and splintered pieces are present. The lithic tool assemblage is characterized by a dominance of backed retouched pieces, among them small and large angle-backed as well as curve-backed pieces (figs. 9 and 10). In contrast to Reichwalde, a few truncated backed points reminiscent of Malaurie points are present. This may indicate a Final *Federmessergruppen* occupation of the late Allerød/early Younger Dryas. At Kleinlieskow, like at Reichwalde, the soil where the *Federmessergruppen* occupation was deposited was covered some centuries later at the very end of the

Younger Dryas by a forest predominantly of pine, with some birch, willow/poplar and alder (Kühner et al., 1999; Gautier, 2001). Despite the presence of 250 year old and more than 10 m tall pines, the forest was not dense. It was destroyed by flooding which resulted in perfect preservation.

Fishing with hook and line is present from the final *Federmessergruppen* period of GI-1a/GI-1b, as shown at Kleinlieskow. This is supported by the 11.4 ¹⁴C-ka BP radiocarbon dated fishhook collected in 1953 in a brown coal open-cast mine near Braunsbedra in Saxonia-Anhalt (Grünberg, 2006, p. 102). At Wuster-

mark, a ca. 300 m² large site that was excavated in 1998 and 1999, approximately 60 lithics, 25 organic tools and 350 animal bones were discovered in the basal sandy layers of a fluvial stream (Gramsch et al., 2010; Gramsch et al., 2013). These layers were accumulated in a shallow depression covered by water. Within the lithic inventory, three end scrapers, three burins and one oblique truncation are recorded. Additionally, nine bone points, four bone awls, one bone dagger, an elk antler manufactured into a smoother-like tool or axe blade with zig-zag ornaments as well as six fishhooks were found, which prove that fishing with hook and line was also present in the last period of the Late Pleistocene. Furthermore, many bones of large pike (n = 123), elk (n = 67), reindeer (n = 49) and red deer (n = 23) represent the most common animal species. Wild boar (n = 14) and lynx (n = 10) occur more rarely. Horse, aurochs, roe deer, bear, wolf, beaver and dog are represented by one to five bones each. Pollen analysis as well as three of six radiocarbon dates (two on wood, one on a bone fishhook) indicate that the main part of the bones and artefacts are connected with the GS-1/Younger Dryas. The tool made of elk antler, which is dated to 10,050 ± 80 ¹⁴C BP (Bln-5645) – the Pleistocene/Holocene border, may confirm this. The only known fishhook manufactured from ivory is dated to 15,825 ± 180 ¹⁴C BP (Ua-24105), which may indicate the use of fossil ivory in the Younger Dryas. However, two bones – one of wild boar that was dated to 11,719 ± 45 ¹⁴C BP (KIA-32463), the other of horse dated to 9,135 ± 75 ¹⁴C BP (Ua-24700) –, indicate both older and Holocene uses of the site (Gramsch et al., 2013, p. 2462). Due to the depositional context of the organic layers at Wustermark 22 and the wide range of radiocarbon ages, it is clear that the area was occupied during several phases.

Further north, we find an important site in Mecklenburg-Vorpommern at Endingen, where some 40 animal remains, bark fragments, and a tree-fungus were found already in 1899. Though no lithic artefacts were recovered, the spectrum of bones and some rib-knives make this assemblage quite important. Among the finds, nine pieces show cutmarks and can therefore be seen as remains of food procurement or tool production (Street, 1996; Terberger et al., 1996, p. 18-19). Special emphasis is assigned to a horse-rib which was modified to become a rib-knife. Since no other horse remains have been found on the spot, it is assumed that this artefact was brought by humans to the site. Another relevant osseous tool is a shed antler of giant deer that was worked to produce splinters for tool blanks (Street, 1996; Terberger et al., 1996, p. 20-22). Radiocarbon measurements assign the material to a middle Allerød/GI-1a-b occupation that is suspected to have been located near the finds, since these were deposited at a lakeshore and thus represent refuse layers of the settlement. The site is assigned to the backed point assemblages (Terberger et al., 1996, p. 29).

The site presented here that is closest to the Baltic Sea is Nienhagen, which dates to the Late Pleistocene

or, more specifically, the Late Ahrensburgian. It was discovered during construction of a gas pipeline in 1993, when during profile analysis a tanged point was found. Following this, a small excavation was started and 120 lithic artefacts were recorded (Kaiser and Terberger, 1995, p. 7-22). Due to probable re-deposition of some of the finds, it was difficult to evaluate at first sight if the artefacts represent a single or multiple events. Nevertheless, re-fitting of artefacts and geomorphological analyses showed that the inventory was, though fragmented, most likely from a single-event. The wide vertical distribution of finds is due to fluvial activity during the deposition of artefacts (Kaiser and Terberger, 1995, p. 22-26). Complementary to the tanged point (Bromme type), several flakes and blades were found. Other tools found are a simple point, one backed point, four micro-burins, two burins, and one fragment of a backed blade or simple point. During the excavation, some small bone and tooth fragments were recovered in the find layers, but due to their small size it was not possible to determine them to species. Only two teeth fragments could be recorded belonging to the group of larger Cervidae (Kaiser and Terberger, 1995, p. 32-38). Due to some lithic production debris and cores recovered on the site, it is regarded as a short-term hunting camp where hafting-and-retooling was done (Kaiser and Terberger, 1995, p. 39-41).

While many more sites with tanged points are known in the lowlands between the rivers Elbe and Oder (Baales, 1996, p. 307-317), the most southern Ahrensburgian sites in eastern Germany are situated north of the Hercynian Mountain where surface collections from Blankenburg und Westerhausen (Baales, 1996, p. 302-303) prove the presence of humans in GS-1. At Schkeuditz, near the airport Halle-Leipzig, Stefan Ertmer conducted a short excavation on a new Ahrensburgian site in September 2015. As mentioned previously, the Ahrensburgian is present in southern Lower Lusatia at Groß Lieskow, but three other sites of that time period have been excavated by Bernhard Stapel (2000) nearby, at Weißagk and Grötsch. These are large assemblages, containing up to 100,000 lithics, among them tanged points, burins, short end scrapers and few long blades (fig. 11). The artefacts were found just below the recent soil in distinct concentrations. It must be noted that at one site early and late Neolithic ceramics and lithics were found together with the Pleistocene lithics. This is the case at another site, Golßen, which is the *Federmessergruppen* type-site of Brandenburg (Gramsch, 1988, p. 512). Bernhard Gramsch excavated Golßen over an area of 66 m² in 1968. According to the recent investigation (Winkler, 2010), ca. 3,100 lithics occurred within a distinct brown soil. End scrapers, most of them short scrapers, are the most common tool type (26%). Backed implements, among them curve-backed points, occur more often (21%) than burins (19%) and truncations (9%). The amount of burnt lithics is high (32%). Additionally, a shaft smoother made of sandstone was found. However, besides the *Federmessergruppen* lithics, 270 small sherds of Late Bronze/Early Iron Age

ceramics have been found within the brown soil which is covered by < 50 cm aeolian sand. This is strange because preservation, refitting and spatial distribution of the artefacts indicate a well-preserved Final Palaeolithic site (Winkler, 2010). Also, more recent pit-like disturbances reach the brown soil only rarely. However, a small pit-like structure is interpreted as a Final Palaeolithic hearth, although it is situated on the far periphery of the spatial distribution of lithics. Perhaps Late Holocene aeolian processes with deflation and re-covering, which are well-known in Lower Lusatia (Poppschütz et al., 2010; Raab et al., 2016), resulted in the occurrence of both Stone Age lithics and prehistoric ceramics in a single layer (Bartholomé et al., 2002). At other sites catastrophic rainfall in medieval times resulted in erosion of lithic artefacts (Berg-Hobohm, 2000). Consequently, the brown soil at Golßen might not be a Late Glacial soil, but is instead connected with Late Holocene soil development (see references in Pasda, 2002, p. 21).

EARLIEST AND EARLY MESOLITHIC

Processes that altered the sedimentological situation were also detected in Burow 3, where a Mesolithic campsite was excavated in 1975 and 1976 (Wechler, 1998). During investigations of a Late Palaeolithic site in its direct vicinity (Gramsch, 1973a), the site was discovered by test pitting. Four concentrations of Early Mesolithic artefacts were found that were associated with fireplaces. In combination with the Late Boreal/Early Atlantic inventory, a few ceramic sherds and burnt animal bones were found, but based on spatial analysis they are not interpreted as being connected to the concentration. Even though partly covered by aeolian sands, the vertical distribution of finds renders possible that some displacement of artefacts took place (Wechler, 1998, p. 29-31).

As usual in Germany, numerous Mesolithic sites are known by surface collections (Feustel, 1957, 1958 and 1961; Geupel, 1985 and 1987), but only few have been re-investigated recently, e.g. Kranichfeld and Hohenfelden (Bock, 2015). Others, for instance Pöllnitz, where Early and Late Mesolithic microliths have been found, were published by a palaeontologist (Diedrich, 2012). Erwin Cziesla (2009) has made a critical discussion of Mesolithic research in Lower Lusatia. According to him, at Malitschkendorf and further north at the city Brandenburg, an earliest Mesolithic site may be present (Cziesla, 2009, p. 381). However, it is quite possible that the site represents a palimpsest due to an artefact spectrum that can be assigned to *Federmessergruppen*, Ahrensburgian/Sviderian and Early Mesolithic techno-complexes (cf. Geupel, 1987, plate 79-84). At Göttern in Thuringia, a doline was excavated by the State Archaeological Office between 2005 and 2008 (Karl et al., 2011). Remains of animal bones, fire-cracked stones and charcoal were found in the lowest layer. Among the animals are wild boar, elk, roe deer, aurochs, wild horse, wolf and brown bear. A radiocarbon date gave

an age of 9.5 ¹⁴C-ka BP. Above the dated layer ca. 40 lithics have been found and ca. 50 additional lithics were collected without a stratigraphic context. Among the lithics are one end scraper, one truncation, one borer, one splintered piece and the fragment of a backed microlith and a truncation. Aurochs may have been more widespread in the Preboreal as is shown by the more or less complete skeleton of a large aurochs found in 1821 in a bog near Haßleben in Thuringia, which was described by Johann Wolfgang von Goethe in 1822 and recently radiocarbon dated to 9.8/9.7 ¹⁴C-ka BP (Benecke, 2009).

At Urdhöhle and Ranis human bones have been radiocarbon dated, indicating the presence of Mesolithic humans in the Boreal period. The cave site Urdhöhle is situated next to the well-known Magdalenian site Kniegrotte in Thuringia. Urdhöhle was excavated by an amateur archaeologist between 1946 and 1959 and in 1968 by Rudolf Feustel. A recent re-investigation (Terberger et al., 2003) showed that few Magdalenian lithics are present but that, besides Neolithic, Bronze Age and Medieval human bones, Mesolithic humans were here too, indicated by two radiocarbon samples from human bones dating around 8.4 ¹⁴C-ka BP. Within the finds from Ranis there are microliths and perforated teeth of wild boar, as well as bones of a human child that have been radiocarbon dated to 8.3 ¹⁴C-ka BP (Grünberg, 2006, p. 109).

Other human bones have been dated to the Atlantic period, e.g. Bad Dürrenberg and Unseburg (Terberger et al., 2003, p. 10) but also at Abri Fuchskirche: here, layer 2 contains >100 lithics, among them a few microliths as well as a few Palaeolithic ones, a fireplace with charcoal of oak, pine, elm, lime-tree and hazel as well as remains of a human child that was radiocarbon dated to 7.7 ¹⁴C-ka BP (Küßner and Birkenbeil, 2008/2009).

Radiocarbon dated Mesolithic sites from the Pleistocene/Holocene border are still missing from eastern Germany. Extensive dating programs were applied to the sites of Friesack 4 and Friesack 27a, with the first settlement phases proven to date to the Middle and Late Preboreal (Gramsch, 2002; Groß, 2017; Sørensen et al., 2018). Providing a vast amount of lithic material, animal bones and organic tools, the Friesack sites give a good insight into the material culture of the Early Mesolithic and the surrounding landscape (Benecke et al., 2016; Gramsch, 1989, 1990, 1993, 2002, 2007, 2011, 2012 and 2014; Groß, 2017 and in press).

Friesack 4 is a large Mesolithic-Neolithic site on a sandy hill with associated subaquatic deposits in the Rhinluch, a bog area within the Berlin-Warsaw glacial valley close to the town of Friesack in Brandenburg. It was excavated during the 1970s and 1980s by Bernhard Gramsch (former Landesmuseum für Ur- und Frühgeschichte Potsdam; later Brandenburgisches Landesamt für Denkmalpflege), who has already published ample information on the site and the organic implements (Gramsch 1990, 1993, 1998, 2002, 2003, 2006, 2011, 2012, 2014, 2016a and 2016b). The excavations by B. Gramsch concentrated mainly on the subaquatic layers. In 2000 and 2001, Stefan Wenzel

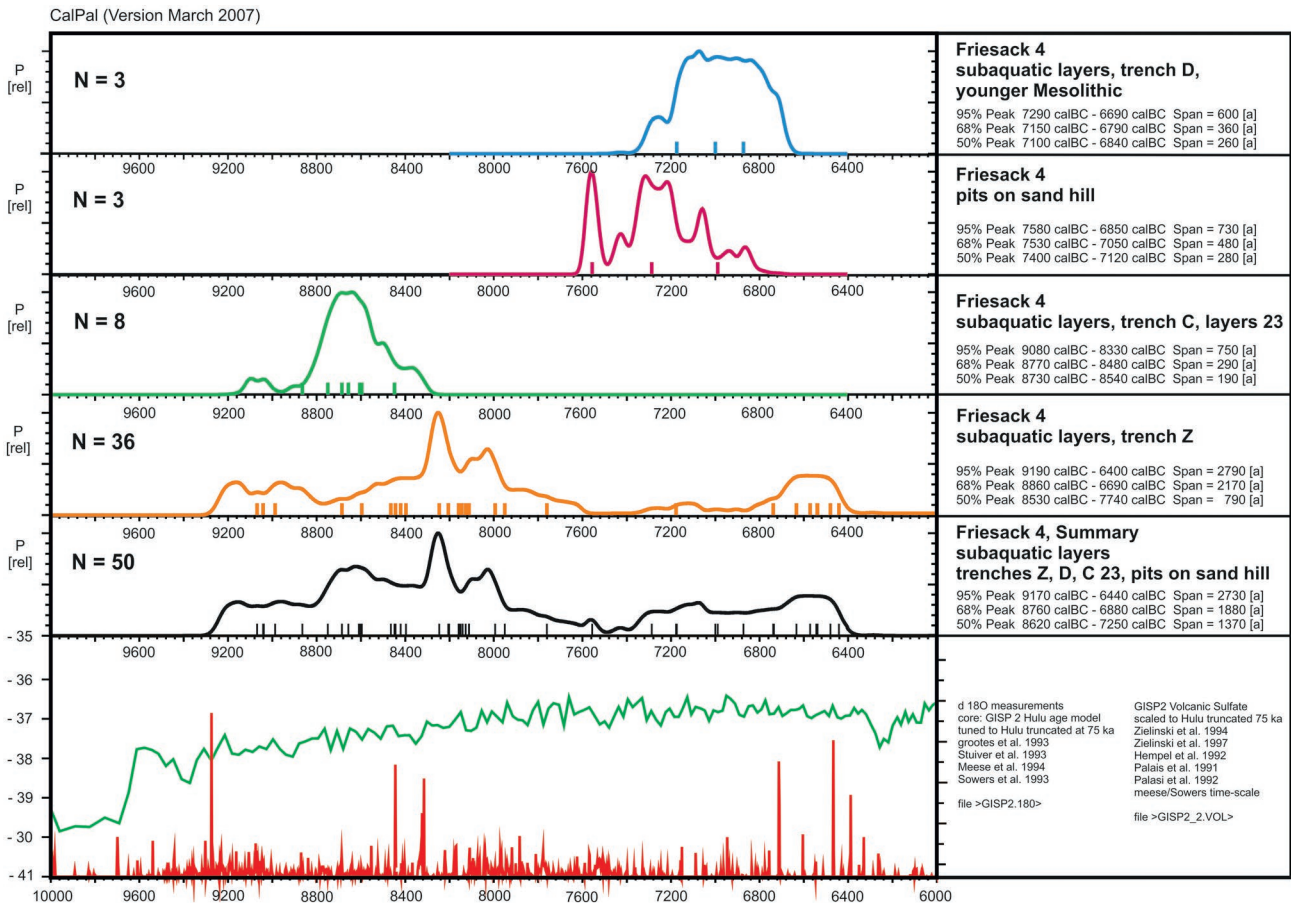


Fig. 12 – Calibrated radiocarbon dates for the Mesolithic settlement in Friesack 4, Brandenburg. The dates for the merged stratigraphy from trenches Z, D and C show a nearly continuous sequence from 9,000 to 6,400 cal. BC onwards. The dates from three pits on the sand hill fill in the hiatus during the middle to late Boreal period between 7,500 and 7,000 cal. BC. Please mind that the date ranges are given in cal. BC.

Fig. 12 – Datations radiocarbones calibrées du gisement de Friesack 4, Brandebourg. Les mesures d'âge de la stratigraphie des tranchées Z, D et C montrent une séquence presque continue de 9000 à 6400 cal. BC. Les dates de trois fosses localisées sur la butte sableuse comblent le hiatus entre le milieu et la fin du Boréal entre 7500 et 7000 cal. BC. Attention, ces datations sont exprimées cal. BC.

excavated a larger area on the sandy hill (Wenzel, 2002 and 2003).

Friesack 4 displays the most complex subaquatic stratigraphy of a Mesolithic bog site in Europe. From the Early Mesolithic (around 10.0 ^{14}C -ka BP) to the late Mesolithic (approx. 7.5 ^{14}C -ka BP), hunter-gatherers repeatedly visited this former lakeside. Neolithic settlers lived there during the younger Atlantic period. Only during the middle Boreal period between ca. 8.7 and 8.1 ^{14}C -ka BP does the stratigraphy of the subaquatic deposits show a remarkable hiatus even though an occupation is proven between 8.4 and 8.0 ^{14}C -ka BP by radiocarbon dates from three pits from the settlement area (see below; fig. 12).

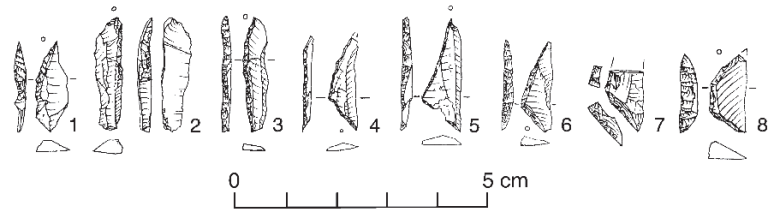
Approximately 120 archaeological layers from five trenches along the former shoreline contain around 140,000 Mesolithic lithic artefacts and thousands of animal remains and other organic finds. Several erosional and alluvial processes influenced the development of the complex stratigraphic sequence at the site, which are partly caused by the Mesolithic people themselves and partly by changes in water level over time. Nevertheless, the stratigraphy is consistent with

regard to the interpretation of the settlement sequence. The site is famous for its numerous bone and antler artefacts, some of them ornamented, and the remains of Mesolithic nets and wooden implements (Gramsch, 1990, 2002, 2012 and 2016b). Until now, 91 radiocarbon dates by the laboratories of Berlin and Cologne have been published (Görsdorf and Gramsch, 2004; Gramsch, 2016a).

Three projects funded by the “Deutsche Forschungsgemeinschaft” were conducted over the last 15 years: one excavation in 2000/2001 and analysis of features and finds by St. Wenzel as well as two research projects on the lithic artefacts by B. Gehlen from 2007-2011.

St. Wenzel excavated larger areas and test trenches on the sandy hill (Wenzel, 2002 and 2003). The most intriguing finds from this area are six storage or garbage pits and three waterholes (fig. 13); the latter were already excavated by B. Gramsch during the 1980s (Gramsch, 1998). Two of them yielded water containers made from birchbark.

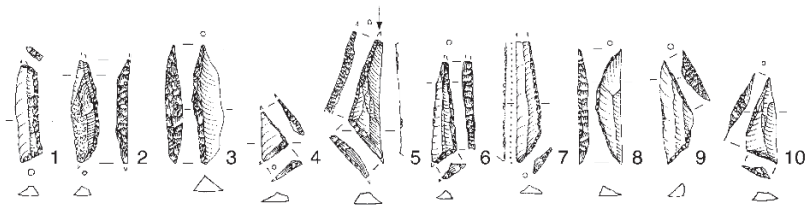
B. Gehlen worked out the stratigraphy using a Harris-matrix of the documented layers and analyzed



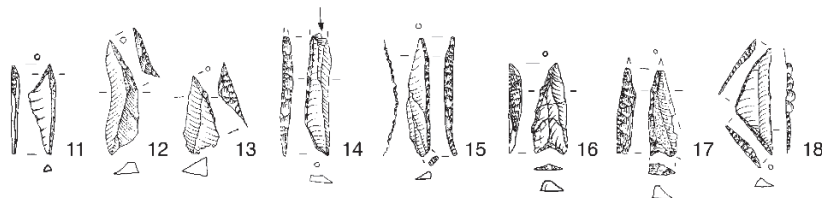
Friesack 4, pits : 7600 - 7000 calBC

Fig. 13 – Microliths from the pits on the sand hill of Friesack 4, dated to the middle to late Boreal period.

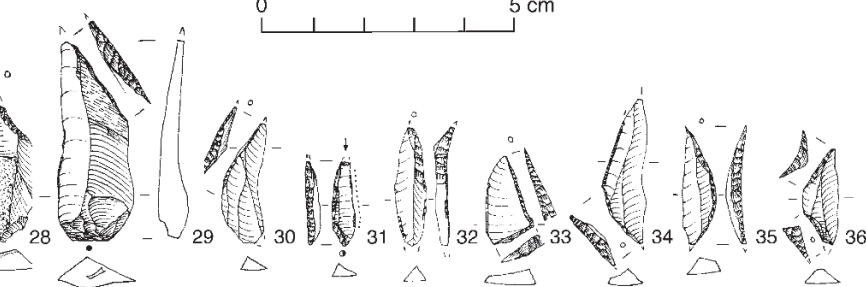
Fig. 13 – Armatures microlithiques de Friesack 4 provenant des fosses de la butte sableuse datées de la seconde moitié du Boréal.



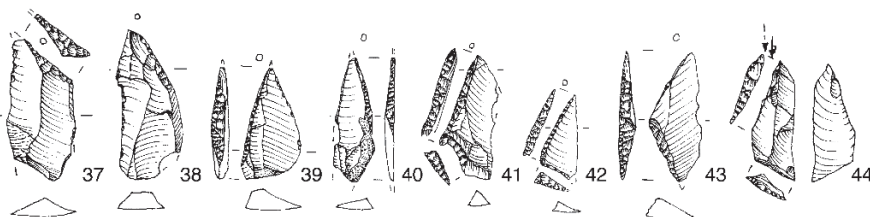
c. 6400 - 7200 calBC



c. 7800 - 8200 calBC



c. 8400 - 8800 calBC



c. 8800 - 9100 calBC

Fig. 14 – Typical microliths for the dated sequence of the subaquatic stratigraphy from Friesack 4 (tranches Z, C layers 23x and D, Younger Mesolithic).

Fig. 14 – Armatures microlithiques caractéristiques provenant de la séquence stratigraphique en milieu humide de Friesack 4 (tranchées Z, C, couches 23x et D, Mésolithique récent).

ca. 3,000 microliths and micro-burins from the site. The merged stratigraphy of undisturbed and dated deposits from three trenches (Z, D and C) contains 114 layers with typologically identifiable microliths ($n = 980$). The microlithic inventory was typologically analyzed (Gehlen, 2009) with respect to the stratigraphy and the radiocarbon dates. According to the results of the seriation, the stratigraphic sequence can be subdivided into 17 layer complexes, which correspond to shorter chronological phases than the four main complexes (Gramsch 2002, 2006 and 2016a; fig. 14). This differentiation into several short chronological periods is an important basis for the general typo-chronology of the Mesolithic in Central Europe. In the late Preboreal the first narrow lanceolate points occur, which are very variable in early Boreal times. During the early Boreal, the first broader trapezes on irregular bladelets appear. However, there are only single trapeze-shaped microliths of this type, and they are even rarer in the late Mesolithic complex IV. The lanceolate points are especially characteristic of the complexes III and IV in Friesack 4. It is very probable that these slender microliths are typical for Mesolithic groups in the eastern and central parts of Germany. The very small number of microliths characteristic for Mesolithic assemblages in Denmark and Southern Sweden reveals only very loose relationships between the Mesolithic people from Friesack 4 to those in southern Scandinavia from the late Preboreal onwards. Contacts to the sites in the Duvensee bog in Holstein (e.g. Bokelmann, 1980 and 1991; Bokelmann et al., 1981 and 1985; Holst, 2014; Groß et al., 2018) were probably sparse from that time on as indicated by a typological comparison of the microliths so far published from the Duvensee.

The second project by B. Gehlen focussed on attribute analysis and microwear studies of the lithic artefacts. It showed a more or less continuous development in terms of typology and style of the microliths and other tools from the middle Preboreal to the Early Atlantic. The measurements of microliths and micro-burins, the mode of blade technology, and the concepts of core processing revealed a similar continuity. Nonetheless, a continuous introduction of new elements and techniques is traceable. The concepts of core processing seem to have been similar during the entire time. A very few specialized cores for bladelets (handle cores) occur only in the late Mesolithic layers at around 7.5 ^{14}C -ka BP. There are almost no regular bladelets in the assemblages of Friesack 4 either, and – except during the late Preboreal when a hard hammer technique was used – the knapping technique was direct percussion with a soft hammer during the major part of the Mesolithic occupation.

The microwear studies on 306 lithic artefacts were conducted by Alfred Pawlik (2010). Predominantly the processing of wood, bone or antler for activities such as hafting and retooling could be proven. Tar was identified on many of the studied artefacts. Retouched tools and blanks were used for several purposes. The usage of the tools only partly coincides with the expectations from tool typology. Many objects –

especially the burins – were identified as broken arrowheads or inserts in wooden weapons or tools.

Recently, the archaeobotanical and zooarchaeological studies on the material from Friesack 4 were published (Benecke et al., 2016). Not only the new assessment of the pollen samples from the site by S. Jahns (Jahns et al., 2016), originally taken, analyzed and published by K. Kloss (1987a and 1987b), but also the examination of numerous plant macro-remains by S. Wolters (2016) illustrate very well the local ecology as well as use of plants by the Mesolithic settlers. The analysis of the fauna was done by N. Benecke (2016), H. K. Robson (2016), U. Schmölcke (2016), L. Teichert (1993a and 1993b), and H. Ullrich (2016). The multiple results of the natural scientists' research cannot be presented here, but they deliver a very rich dataset for the reconstruction of the ecology and economy during the Mesolithic in north-eastern Germany and will be discussed in context with the results of lithic analyses in the near future (Gehlen et al., in prep.).

A recent re-investigation of the organic material from Hohen Viecheln has revealed an occupation of the site already in the Late Preboreal, whilst most activity is proven for the Boreal (Groß et al., 2019). The site is located on the northern shore of Lake Schwerin in Mecklenburg-Vorpommern and ca. 70 km west of the sites at Duvensee (see Groß et al., 2018). It was excavated in the 1950s and due to a large number of bone points quickly regarded as a reference site for the Early Mesolithic of the Northern European Lowland (Schuldt, 1961b). The number of bone points resembles the quantity from Friesack and extends the typo-chronology for this tool type to the end of the Boreal and Early Atlantic.

Another relevant site in this context is Rothenklempenow 17 where Preboreal layers at an ancient shore were excavated amongst younger Mesolithic settlements and a Late Mesolithic burial (Schacht, 1993; Bach and Bruchhaus, 1994; Schacht and Bogen, 2001). Unfortunately, so far only preliminary reports are published.

The vast number of organic finds on archaeological sites in the Lowland areas is commonly due to the fact that excavations have taken place in the ancient lakeshore areas, where better preservation conditions were present than on the settlements themselves. Consequently, it is not possible to derive any spatial organizational patterns from these excavations. Nevertheless, a more profound understanding of the material culture and subsistence patterns has developed. Furthermore, research in eastern Germany is traditionally focused on site-specific studies (Gramsch, 2010, p. 168) and therefore regional studies are rarely done (Faasch, 2017; Schülke, 2011).

WHAT CHANGES?

The transition from the Pleistocene to the Holocene brought vast environmental changes (cf. Boettger et al., 2009; Coope et al., 1998; Fahlke, 2009; Steffensen et al., 2008; Usinger, 2004; van Asch et al., 2012) but

also the archaeological preservation conditions change. This is best exemplified by the finds from the lowlands where extensive wetlands formed in the Preboreal. The reforestation and silting up of lakes and oxbows provided different habitats and probably changed settlement patterns as well. From the Early Holocene, some of Germany's most extensive collections of organic artefacts are known (*e.g.* Friesack, Hohen Viecheln) while spatial analyses of site structures are predominantly connected to Late Pleistocene sites (*e.g.* Burow, Golßen, Reichwalde). As a consequence, the understanding of both eras differs significantly: Since the main (scientific) focus for the younger epochs is laid on the lakeshore excavations, analyses of spatial patterns are carried out less often. In contrast, examples have shown that the distribution of finds gives a good understanding of the differences in settlement organization: During the Allerød the sites of the *Federmessergruppen* are usually characterized by small and very distinct lithic patterns, which probably indicate only short-term stays (Bartholomé et al., 2002; Pasda, 2002), while some authors interpret bigger artefact scatters as latent evidence of huts (Gelhausen et al., 2015). The different appearance of the sites comprises the representativeness for processes that happened. The small and distinct concentrations represent short-term occupations and thus can be used to reconstruct internal settlement organization and processes like hafting and retooling. The other type of excavations usually only show the refuse zone of settlements and are therefore of less use for analyzing internal processes. However, they do give further information on long-term developments and, as for instance at Friesack, provide the opportunity to analyze micro-regional developments over time.

Apart from the source critical aspects, there are further significant changes in the archaeological evidence around the Pleistocene/Holocene border that need to be addressed here. From a typological perspective, the Late Pleistocene techno-complexes of Ahrensburgian and Sviderian character are replaced by simple microliths and geometrical forms. Even though there are different interpretations of this archaeological-cultural change, it remains as yet unclear exactly why and when this change occurred. While some researchers find arguments that the ecological change caused a re-organization of settlement systems (*e.g.* Gramsch, 1980 and 1992, p. 72; Groß, 2017, p. 166-167) and argue for the Mesolithic techno-complexes of eastern Germany being rooted in the *Federmessergruppen*, others find arguments for cultural continuity (cf. Cziesla and Pettit, 2003; Cziesla, 2004, p. 178-179 and 2009, p. 380-381; Jöris and Thiessen, 1997; Terberger, 2006, p. 127-132). Until further evidence is provided (cf. Terberger et al., 2004, p. 163) all explanations have to be seen as hypotheses. Relevant in this respect is the lack of stratified sites that show a cultural continuity like Ahrenshöft (cf. Clausen, 1998), and the fact that radiometric dating is faced with imprecision at the Pleistocene/Holocene transition due to a radiocarbon plateau. Nevertheless, there are still no sites known from

eastern Germany with Early Mesolithic assemblages that are radiometrically dated to the Earliest Holocene, which is therefore different from Western Germany (cf. Heinen, 2014; Street et al., 2001; Street et al., this volume).

Though there are significant changes in the lithic typology and technology around the Pleistocene/Holocene transition, it seems increasingly unlikely that the same is true for the organic artefact spectrum. Antler mattocks or axe blades are only known from Holocene assemblages (*e.g.* Wustermark 22 [Gramsch et al., 2010]; Hohen Viecheln [Schuldt, 1961a]; Friesack 4 [Pratsch, 2011]). However, it cannot be excluded that this picture might change if more osseous artefacts are directly dated in the future. As is exemplified by bone points, which were subject to some direct dating programs that provided absolute ages for them (Cziesla, 1999; Cziesla and Pettit, 2003; Groß et al., 2019) In this respect, the analysis done by Cziesla and Pettit (2003) highlights that the type-fossil approach has proven unreliable with respect to bone points. Their results show that the common assignment of bi-serially harpoons to the Pleistocene and finely barbed points to the Holocene is not unambiguously possible. Nevertheless, it also needs to be considered, especially when dealing with old excavations or legacy material, that the radiocarbon age of such artefacts may be influenced by external factors (*e.g.* preservatives; *e.g.* Meadows et al., in prep.).

Another relevant tool type when discussing chronological aspects are hooks made from osseous material. They are usually seen as fishhooks with partly very extensive dimensions (> 20 cm length; Cziesla, 2004, p. 177; cf. Gramsch et al., 2013) and have been recorded in large numbers in Brandenburg (Cziesla, 2004, p. 169-178). Interestingly, it can be noted that the earliest fishhooks that are reliably dated from the area under investigation are found on Late Palaeolithic sites connected to the *Federmessergruppen* and the Ahrensburgian (*e.g.* Kleinlieskow (Pasda, 2001); Wustermark 22 (Gramsch et al., 2013)). Further insights to their chronology can be expected from the Havelland area where the vast majority of these tools are found, but usually without context (Cziesla, 2004, p. 169-178). Surprisingly, no fishhooks have been found on the Early Holocene sites of Friesack or Hohen Viecheln (cf. Cziesla, 2001, p. 484). Since the excavations have mainly investigated the ancient shoreline where hundreds of bone points were found on each site, it would be expected that fishhooks are present in the assemblages as well. However, merely two artefacts from Friesack 4 might be double-pointed gorges (Gramsch, 2012, p. 17-20). The reason for this may be that fishhooks were not used in the direct vicinity of the camps (Cziesla, 2001, p. 484), but it seems equally likely, especially with respect to the dated specimen, that this tool type was not part of the Early Mesolithic toolkit in our area of focus. Consequently, most of the hooks found might be from younger or Late Palaeolithic contexts. In contrast, the first remains of nets found at Friesack 4 and Rothenklempenow 17 (Kernchen and Gramsch, 1989; Schacht and Bogen, 2001, p. 7) are so

far the oldest artefacts of this type. Despite the uncertainty if they were used as fishing nets at all (Kernchen and Gramsch, 1989). ■

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NOTE

(1) All calibrated radiocarbon dates in this paper are given with a 2 σ standard deviation (95.4%) and are calibrated with OxCal 4.2 (Bronk Ramsey and Lee, 2013; IntCal13 atmospheric curve from Reimer *et al.*, 2013).

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Choice of osseous raw materials for tool production at the Pleistocene/Holocene transition in north-western Central Europe: an approach addressing zooarchaeology and material properties

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Abstract: This paper focuses on the effects of environmental change, particularly of faunal replacement, on acquisition strategies and use of osseous raw materials for the production of tools around the Pleistocene/Holocene transition in north-western Central Europe. It is therefore a contribution to the overall question “10,000 BP (11,600 cal. BP) – what changes?”, which is discussed along three lines of argumentation: 1) Pleistocene/Holocene archaeology, 2) material properties of osseous raw materials and 3) the relationship between tool type and selected raw material. For typological classification and comparability, the osseous tools are partitioned into three functional classes: A – striking objects, B – hooking objects and C – perforating objects, which are further subdivided into hafted perforating tools (C1), and hand-held perforating tools (C2). The advantage of this very basic classification scheme is that it can be applied to compare assemblages from different cultural entities. From north-western Central Europe, only well preserved osseous assemblages securely dated to the Younger Dryas or the Preboreal that have been zooarchaeologically analysed were included (n = 5). The analysis led to the following results: Striking tools are exclusively produced from antler. Barbed tools are predominantly made of antler. The preferred raw material for perforating tools is bone. We explain this clear picture by the different mechanical properties of osseous raw materials. Though heterogeneous and incomplete, the currently available experimental data suggest that antler is flexible and tough whereas bone is rather stiff. Taking these archaeological and experimental observations into account, we postulate that no change in the general raw material choices took place at the Pleistocene/Holocene transition. However, what changed were the raw material sources: Instead of migrating reindeer herds, more sedentary taxa provided antler and bone.

Keywords: Ahrensburgian, Mesolithic of the Preboreal, Osseous raw material, Material properties.

Résumé : Cet article discute des effets des changements environnementaux, plus particulièrement du remplacement de la faune, sur les stratégies d'acquisition et l'utilisation des matières premières osseuses pour la production d'outils, autour de la transition Pléistocène/Holocène en Europe centrale du Nord-Ouest. Il s'agit donc d'une contribution à la question plus large des changements intervenant autour de 10000 BP (11 600 cal. BP), en les déclinant selon trois domaines : 1) l'archéologie de la transition Pléistocène/Holocène ; 2) les propriétés des matières premières osseuses et 3) la relation entre type d'outil et matière première sélectionnée. Pour la classification typologique et les comparaisons, les outils osseux ont été répartis en trois classes fonctionnelles: A – objets percutants, B – objets accrochants et C – objets perforants. Cette dernière classe a été subdivisée en outils emmanchés (C1), et en outils tenus à la main (C2). Cette classification simple présente l'avantage de pouvoir être appliquée à des assemblages appartenant à des entités culturelles différentes. Pour l'Europe centrale du Nord-Ouest, seuls des assemblages osseux bien préservés, datés du Dryas récent ou du Préboréal et qui ont fait l'objet d'une analyse archéozoologique, ont été inclus dans l'étude (n = 5). Les résultats de cette analyse sont les suivants : les objets percutants sont exclusivement en bois de cervidé ; les objets accrochants sont principalement en bois de cervidé ; et la matière première prédominante pour les objets perforants est l'os. Nous expliquons ces distinctions nettes par les propriétés mécaniques respectives des différentes matières premières osseuses. Bien qu'hétérogènes et incomplètes, les données expérimentales actuellement disponibles suggèrent que le bois de cervidé présente une relative flexibilité et une certaine dureté, alors que l'os est plus rigide. Prenant en compte ces observations archéologiques et expérimentales, nous postulons qu'aucun changement vis-à-vis des choix globaux en matières premières n'est survenu lors de la transition Pléistocène/Holocène. Cependant, les sources de matières premières ont bel et bien changé : les espèces sédentaires ont remplacé les troupeaux de rennes mobiles pour fournir des bois et des os.

Mots-clés : Ahrensbourgien, Mésolithique du Préboréal, Matières premières osseuses, Propriétés des matières.

INTRODUCTION

During most of human history, domestic as well as hunting tools have been produced out of only a few raw materials. Although originally tools were made predominantly from lithics (cf. Floss, 2012) and wood (e.g. Thieme, 1997), at least since the beginning of the Upper Palaeolithic bone, antler and other osseous materials have also been utilized regularly in the production of tools (Liolios, 1999).

Through time it can be observed that certain species' elements have been used preferentially, while others were chosen less frequently. This is most probably related to general morphometrical characteristics of the different elements. However, how did human populations respond if the preferred source of raw material became extinct or was replaced by other species?

Such a replacement occurred at the Pleistocene/Holocene transition in most areas of the North European Plain. Large herds of reindeer (*Rangifer tarandus*) migrated through the lowlands and gave rise to, and sustained, an osseous industry that relied on reindeer antler during the Ahrensburgian and Sviderian (Rust, 1943; Wild, 2017). With the warming trends of the Holocene, these herds disappeared and were replaced by more sedentary taxa. Contemporaneously with this faunal replacement occurred the proliferation of an archaeological culture with new types of tools: the Early Mesolithic. The replacement of the Ahrensburgian and Sviderian hunter-gatherers by Mesolithic hunter-fisher-gatherers with a possible hiatus of a few hundred years is scientific consensus (Kobusiewicz, 2004). However, it is still debated whether the Ahrensburgian and Sviderian hunter-gatherers followed the reindeer (Hartz et al., 2010; Sørensen et al., 2013), which migrated into more northeastern areas (Aaris-Sørensen, 2009), while the Mesolithic hunter-fisher-gatherers populated the abandoned area after the Preboreal Oscillation (PBO) (Conneller and Higham, 2015; Groß, 2017; Wild et al., unpublished) or whether a more gradual development from Final Palaeolithic to Mesolithic cultures took place (cf. Czesla and Pettitt, 2003; Czesla, 2004). Therefore, the question of whether the cultural changes are related to population drifts or represent adaptations to environmental changes remains unanswered.

This paper focuses on the effects of faunal replacement and environmental change on acquisition strategies and use of osseous raw material for the production

of tools around the Pleistocene/Holocene transition in north-western Central Europe. It is therefore a contribution to the overall question “10,000 BP (10,600 cal. BP) – what changes?” and employs two strands of argumentation – Pleistocene/Holocene archaeology and material properties.

MATERIAL AND METHOD

We argue here that people selected specific raw materials because of clear functional requirements (Margaris, 2014) and that therefore the osseous toolkits of prehistoric hunter-gatherers can be divided into several distinct functional groups. The typology of Ahrensburgian and Mesolithic utilitarian osseous tools is very different (fig. 1). From a functional point of view, however, both entities used axes, projectiles – barbed and un-barbed – and awls. Therefore, we can establish three functional groups: striking implements used to modify wood and perhaps osseous tissues (A), tools with barbs that are designed to penetrate and hook to an object (B) and tools whose only mechanical function is perforation (C). The latter group can be subdivided based on the mode of delivery: Group C1 is made up of perforating tools that were hafted while group C2 consists of hand-held perforating tools (table 1). While most of the tools can be classified easily, there is one group of projectiles, the notched points (cf. Clark, 1936, p. 117), probably leister prongs, for which a classification within the scheme presented here is not clear. Most of the notched points have a unilateral row of small notches. These notches do not protrude from the main body nor are they angled towards the base of the tool. Therefore, they cannot be classified as hooking elements (B) and instead, we prefer to characterize them as hafted perforating elements (C1).

For archaeological material to be included in the present study, a number of conditions had to be met. As the study concentrates on the Pleistocene/Holocene transition in north-western Central Europe, only assemblages that fulfil these chronological requirements were chosen. In other words, only unmixed assemblages securely dated to the Younger Dryas or the Preboreal were included. In addition, good preservation of osseous remains is a prerequisite for raw material determination of osseous tools. As this paper aims to identify raw material preferences for certain tools, it is important to understand the availability of these raw materials on site. Therefore, only assemblages that

A	B	C1	C2
Stand-alone axes	Leister prongs	Notched points	Needles
Mattocks	Side prongs	Simple points	Awls
Axe heads	Barbed points		Pointed tools

Table 1 – Classification of tools from the Ahrensburgian and Mesolithic of the Preboreal of north-western Central Europe.

Tabl. 1 – Classification des outils de l’Ahrensbourgien et du Mesolithique du Préboréal de l’Europe centrale du Nord-Ouest.

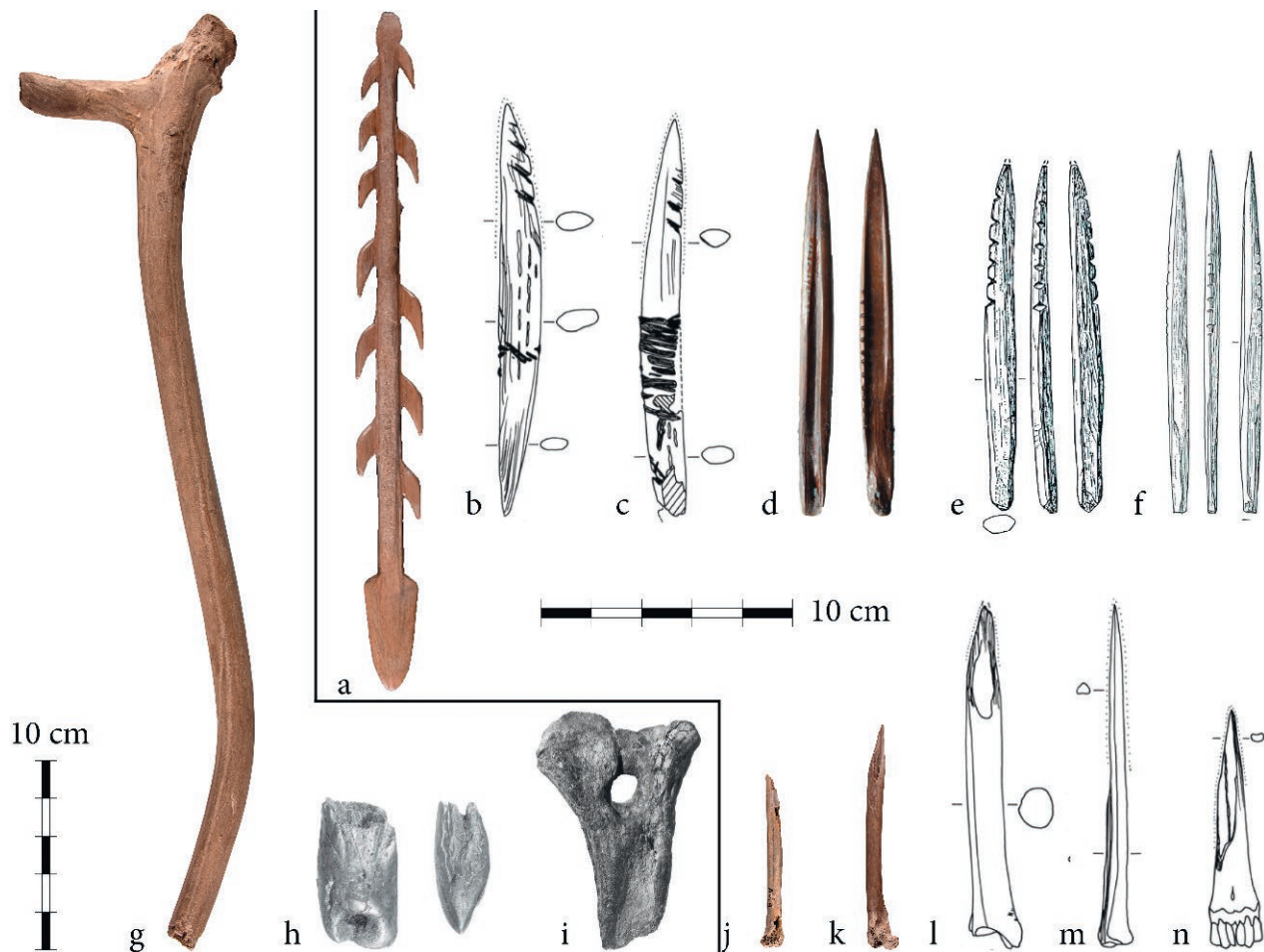


Fig. 1 – Osseous artefacts from north-western Central Europe. Group B tools: a (SH1950-32.1) Ahrensburgian biserial barbed point with shield-like base from Bistoft (Kr. Schleswig-Flensburg/D), b-c (K516-7) Mesolithic barbed points of the Pritzerbe type from Friesack 4-II, group C1 tools: d (C7s20) Mesolithic notched point from Friesack 27, e-f (K314, K148) Mesolithic notched points from Friesack 4-I, group A tools: g (SH1935-5.244) Ahrensburgian reindeer antler cube from Stellmoor, h (K233) Mesolithic axe blade from Friesack 4-II, i (K714) Mesolithic elk antler mattock from Friesack 4-I, group C2 tools: j (SH1935-5.253) Ahrensburgian awl on hare bone from Stellmoor, k (SH1935-5.251) Ahrensburgian awl on bird bone from Stellmoor, l-n (K232, K502, 863/88) Mesolithic awls from Friesack 4-II.

References: a Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf C. Janke; b-c David, 2005, p. 529 plate 55, nos. 7 and 8; d Groß, 2017, p. 218 plate 21, no. 3; e-f Gramsch, 1990, p. 10 fig. 3, no. 9; p. 14 fig. 6, no. 11; g Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf C. Janke; h Pratsch, 2011 fig. 3, no. 4; i Pratsch, 2011, fig. 2; j Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf C. Janke; k Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf C. Janke; l-n David, 2005, p. 529 plate 55, nos. 9-11.

Fig. 1 – Productions en matières osseuses en Europe centrale du Nord-Ouest. Outils du groupe B : a (SH1950-32.1) Pointe barbelée ahrensbourgeoise de Bistoft (Kr. Schleswig-Flensburg/D), b-c (K516-7) Pointes barbelées mésolithiques de type Pritzerbe de Friesack 4-II, outils du groupe C1 : d (C7s20) Pointe à cran mésolithique de Friesack, e-f (K314, K148) Pointes à cran mésolithiques de Friesack 4-I, outils du groupe A : g (SH1935-5.244) Bois de renne ahrensbourgeois de Stellmoor, h (K233) Lame de hache mésolithique de Friesack 4-II, i (K714) Herminette en bois d'élan mésolithique de Friesack 4-I, outils du groupe C2 : j (SH1935-5.253) Poinçon sur os de lièvre ahrensbourgeois de Stellmoor, k (SH1935-5.251) Poinçon sur os d'oiseau ahrensbourgeois de Stellmoor, l-n (K232, K502, 863/88) Poinçons mésolithiques de Friesack 4-II.

Références : a Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf C. Janke, b-c David, 2005, p. 529 pl. 55, n^{os} 7 et 8, d Groß, 2017, p. 218 pl. 21, n^o 3, e-f Gramsch, 1990, p. 10 fig. 3, n^o 9; p. 14 fig. 6, n^o 11, g Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf C. Janke, h Pratsch, 2011 fig. 3, n^o 4, i Pratsch, 2011, fig. 2, outils du groupe C2 : j Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf C. Janke, k Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf C. Janke, l-n : David, 2005, p. 529 pl. 55, n^{os} 9-11.

have been zooarchaeologically analysed can help to answer this question, while AMS-dated single finds lack important contextual information and were thus excluded from this analysis.

The Ahrensburgian layer at Stellmoor (Kr. Stormarn, Germany) in the Ahrensburg tunnel valley in the North of Hamburg is the only site that yielded a sufficient number of osseous tools dating to the Younger Dryas (Rust, 1943). Since its discovery in 1934, the faunal assemblage has undergone several zooarchaeological studies (Krause and Kollau, 1943;

Sturdy, 1975; Grønnow, 1987; Bratlund, 1991, 1996 and 1999; Weinstock, 2000; Pasda, 2009). Although already well-published (Rust, 1943), one of the authors (M.W.) was provided access to the osseous tools of the Ahrensburgian layer for a re-evaluation and determination. The excavator Alfred Rust distinguished a stratigraphy of four different occupations. Unfortunately, it was not possible to assign singular finds from the kettle hole to single layers. Nevertheless, the available ¹⁴C-dates are rather homogenous and date the site to the end of the Younger Dryas at the

transition to the Preboreal (fig. 2; table 2). A clear focus on reindeer exploitation and the typology of lithic and osseous tools suggests for an attribution to the Final Palaeolithic Ahrensburgian culture. The osseous assemblage includes notched antlers with a possible function (cf. Wild, 2017), reindeer antler or

“Lyngby” axes, barbed points of various types, and awls (Rust, 1943; table 3).

The site of Lundby Mose (Sjælland, Denmark) is located at the north-eastern margin of the silted-up palaeolake nowadays called Køng Sværdborg bog (Jessen et al., 2015). Deposited in the former lake

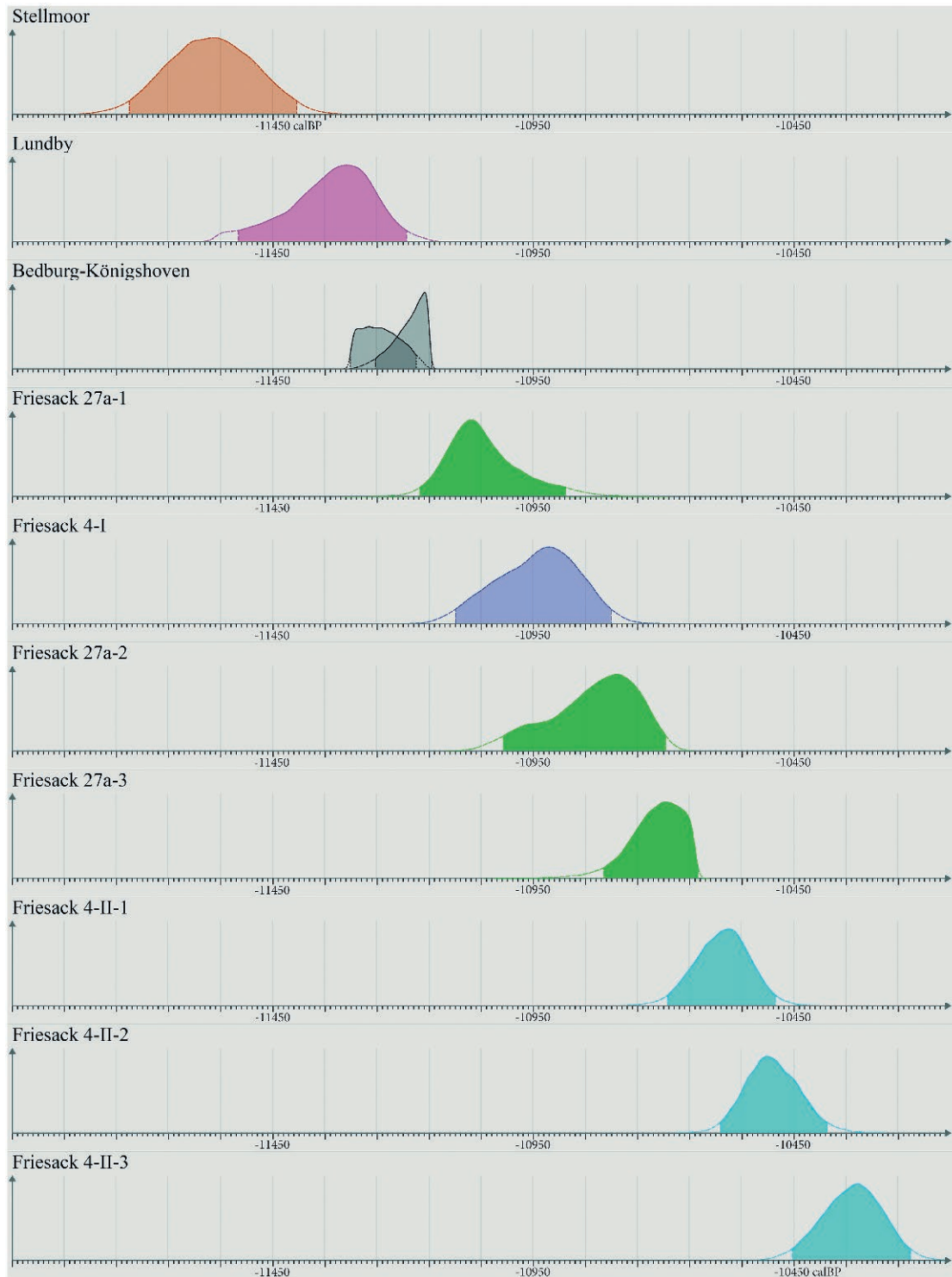


Fig. 2 – Calibrated ^{14}C -dates for the presented sites (modified plot from Chronomodel version 1.1; calibrated using the calibration curve IntCal13 [Reimer et al., 2013]).

Fig. 2 – Calibration des données radiocarbones des sites présentés (modifié d'après Chronomodel version 1.1; calibré par IntCal13 [Reimer et al., 2013]).

site/layer	lab code	¹⁴ C yr BP	std	mat	calBP (95%)	Literature
Stellmoor	KN-2222	10,160	90	bone	12,142-11,358	Weber et al., 2011
	K-4327	10,130	105	antler	12,125-11,292	Fischer and Tauber, 1986
	K-4262	10,110	105	antler	12,077-11,284	Fischer and Tauber, 1986
	K-4326	10,140	105	bone	12,146-11,293	Fischer and Tauber, 1986
	K-4578	10,100	100	bone	12,049-11,288	Fischer and Tauber, 1986
	K-4330	10,110	85	bone	12,037-11,636	Fischer and Tauber, 1986
	KN-2221	10,080	80	bone	11,995-11,317	Weber et al., 2011
	K-4325	10,010	100	bone	11,957-11,238	Benecke, 2004
	K-4581	9,990	105	antler	11,951-11,221	Fischer and Tauber, 1986
	K-4579	9,980	105	antler	11,943-11,213	Fischer and Tauber, 1986
	K-4323	9,930	100	antler	11,801-11,186	Fischer and Tauber, 1986
	K-4324	9,900	105	antler	11,800-11,138	Fischer and Tauber, 1986
K-4580	9,870	100	antler	11,751-11,104	Fischer and Tauber, 1986	
Lundby	AAR-15630	10,127	33	antler	11,996-11,613	Jessen et al., 2015
	AAR-5470	9,930	70	bone	11,701-11,214	Hansen et al., 2004
Bedburg	KN-3999*	9,780	100	wood	11,600-11,553(1.6%) 11,478-11,436(1.3%) 11,411-10,773(92.5%)	Street, 1991
	KN-3998**	9,600	100	wood	11,210-10,672	Street, 1991
FS 27a-1	KIA-46296	9,775	45	bone	11,256-11,135	Groß, 2017
	KIA-46297	9,645	65	bone	11,200-10,773	Groß, 2017
	KIA-48733	9,635	32	bone	11,178-10,791	Groß, 2017
	KN-5848	9,545	50	wood, charcoal	11,100-10,702	Groß, 2017
	KIA-49734	9,565	32	bone	11,090-10,740	Groß, 2017
	KN-5846	9,400	60	bark	11,057-10,432	Groß, 2017
FS 27a-2	KN-5845(?)	9,530	55	charcoal	11,101-10,669	Groß, 2017
	KN-5845	9,458	64	wood	11,075-10,522	Groß, 2017
	Bln-3215	9,400	70	peat	11,066-10,414	Groß, 2017
FS 27a-3	KIA-46298	9,565	40	bone	11,097-10,736	Groß, 2017
	KN-5843	9,480	60	charcoal	11,081-10,574	Groß, 2017
	KIA-46735	9,488	45	bone	11,071-10,589	Groß, 2017
FS 4-I	BLN-2756	9,630	100	charcoal	11,222-10,706	Gramsch, 1987
	BLN-3026	9,670	60	charcoal	11,216-10,785	Gramsch, 1987
	BLN-3019	9,640	70	charcoal	11,200-10,762	Gramsch, 1987
	BLN-2828	9,630	70	charcoal	11,196-10,756	Gramsch, 1987
	BLN-3036	9,630	70	charcoal	11,196-10,756	Gramsch, 1987
	BLN-3020	9,640	60	charcoal	11,195-10,776	Gramsch, 1987
	BLN-2761	9,560	100	charcoal	11,188-10,596	Gramsch, 1987
	BLN-3001	9,580	60	charcoal	11,153-10,725	Gramsch, 1987
	BLN-2753	9,490	100	charcoal	11,146-10,517	Gramsch, 1987
	BLN-1914	9,450	65	charcoal	11,072-10,518	Gramsch, 1987
FS 4-II.1	BLN-2760	9,420	100	charcoal	11,097-10,306	Gramsch, 1987
	BLN-3018	9,400	70	charcoal	11,066-10,414	Gramsch, 1987
	BLN-3025	9,340	70	charcoal	10,727-10,298	Gramsch, 1987
	BLN-2758	9,250	100	charcoal	10,677-10,234	Gramsch, 1987
	BLN-2752	9,190	100	charcoal	10,649-10,194	Gramsch, 1987
	BLN-3000	9,220	60	charcoal	10,553-10,246	Gramsch, 1987
FS 4-II.2	BLN-3705	9,420	80	charcoal	11,076-10,422	Gramsch, 1987
	BLN-3358	9,340	70	charcoal	10,727-10,298	Gramsch, 1987
	BLN-3297	9,340	60	charcoal	10,717-10,302	Gramsch, 1987
	BLN-3356	9,220	70	charcoal	10,562-10,244	Gramsch, 1987
FS 4-II.3	BLN-2751	9,280	100	charcoal	10,707-10,241	Gramsch, 1987
	BLN-2750	9,190	100	charcoal	10,649-10,194	Gramsch, 1987
	BLN-3009	9,240	70	charcoal	10,578-10,247	Gramsch, 1987
	BLN-3024	9,180	70	charcoal	10,521-10,226	Gramsch, 1987

*marks lower end of the find horizon; **marks upper end of the find horizon

Table 2 – ¹⁴C-data from sites studied in north-western Central Europe.
Tabl. 2 – Datations radiocarbone des sites étudiés en Europe centrale du Nord-Ouest.

	Dating	A	B	C1	C2	sum
Stellmoor/Ahrensburgian	Dryas III/Early Preboreal	20	4	–	3	27
Lundby Mose	Early Preboreal	1	–	–	–	1
Bedburg-Königshoven	Middle Preboreal	–	–	1	–	1
Friesack 4	Late Preboreal	11	22	102	17	152
Friesack 27	Late Preboreal	2	–	17	–	19
sum		34	26	120	20	200
# of layers where this group's tools are present		5	3	8	2	–

Table 3 – Studied material from north-western Central Europe.
Tabl. 3 – Matériel étudié de l'Europe centrale du Nord-Ouest.

were several remains of elk (*Alces alces*). Alongside the concentration of bones within deposition 1 an antler mattock (cf. fig. 1) was recovered (Leduc, 2014). This deposition has been dated to the first half of the Preboreal (fig. 2; table 2). Due to the lack of diagnostic lithic tools, the site was attributed to the Mesolithic solely on the basis of the elk antler mattock (Hansen et al., 2004), an artefact whose attribution to Final Palaeolithic or Early Mesolithic cultures is nevertheless still debated (Larsson, 2015; table 3).

Bedburg-Königshoven (Lkr. Rhein-Erft-Kreis, Germany) is an archaeological discard zone in a silted-up palaeochannel of the river Erft in the southern margins of the North European Plain. The faunal assemblage is dominated by aurochs (*Bos primigenius*), but also includes other species typical for the Early Holocene (Street, 1993). The single-layer site is dated through palynological (Behling and Street, 1999) and radiocarbon evidence to the Middle Preboreal (Street et al., 1994; fig. 2; table 2). The small Mesolithic assemblage contains two antler headdresses, a lissoir, and a simple point (Street, 1989; Wild, in press; table 3).

Friesack 4 (Lkr. Havelland, Germany) is a multi-occupation site located at the shoreline of a small Early Holocene island in the Rhinluch (Groß, in press). This study concentrates on the four lower sub-horizons (I and II.1 to II.3) that date to the second half of the Preboreal (fig. 2; table 2). The zooarchaeological analysis of the horizons I and II documented the dominance of red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*) within the mammal remains, while other typical Early Holocene species have also been identified (Schmölcke, 2016). The osseous tools from the Friesack 4 site include heavy tools like mattocks and adzes (Pratsch, 1994 and 2006), typical Mesolithic projectiles (Gramsch, 1990 and 2011) as well as awls (David, 2005; table 3).

The site of Friesack 27a (Lkr. Havelland, Germany) is located 400 m north-eastwards of Friesack 4 on another island in the Rhinluch (Groß, in press). The archaeological material of the three horizons (27a-1 to 27a-3) accumulated contemporary to the lower horizons at the neighbouring site of Friesack 4 during the second half of the Preboreal (fig. 2; table 2). There are

few faunal remains in the single layers and none of the layers is dominated by a single species (Groß, 2017). The assemblage of osseous tools resembles that of Friesack 4 with heavy tools (Pratsch, 2006), projectiles, and awls (Groß, 2017; table 3).

RESULTS

For striking tools, we see a predominant use of antler. While at Stellmoor antler of elk was not used (cf. Wild and Weber, 2017), reindeer antler was the raw material of choice. During the Preboreal, a more diverse picture emerges with the replacement of reindeer and the proliferation of a more diverse cervid fauna. Beams and tines of all available cervid species were utilized in the production of striking elements. While for most of the raw materials only one or two artefacts were determined, eight group A tools were made of red deer antler beams (fig. 3).

A mere three excavated layers of the Pleistocene/Holocene sites yielded artefacts belonging to the group of hooking elements. Likewise in A tools, we see a predominance of reindeer antler in the production of group B tools at Stellmoor. During the Preboreal, a regular use of red deer and roe deer long bones in the production of barbed elements can be observed within two layers at Friesack: At Friesack 4-II-1, six tools made from red deer long bones were identified compared to only three made from roe deer long bones. In contrast, in the younger of the two Friesack layers (Friesack 4-II-3), six out of twelve B tools were made from red deer antler, while only two were made of red deer and roe deer long bones (fig. 4).

While no hafted perforating elements (C1) are present at Stellmoor, they dominate the Preboreal assemblages with a number of 120 pieces (60% of the overall tools included in this study). All but two of them are made from cervid long bones. Only Bedburg-Königshoven yielded one C1 tool made from aurochs long bone, while Friesack 4-I yielded one tool made from a red deer antler beam. Long bones of elk or red deer were predominantly used in the first half of the Late Preboreal, while long bones of roe deer were preferentially chosen for the production of these tools in the latter half (fig. 5).

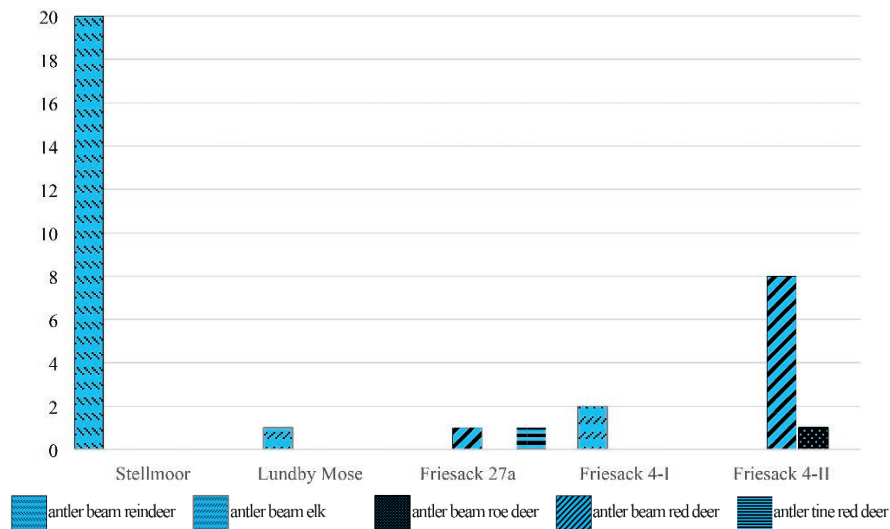


Fig. 3 – Raw materials used in north-western Central Europe for group A (striking tools).

Fig. 3 – Matières premières utilisées dans l'Europe centrale du Nord-Ouest pour les outils du groupe A (objets percutants).

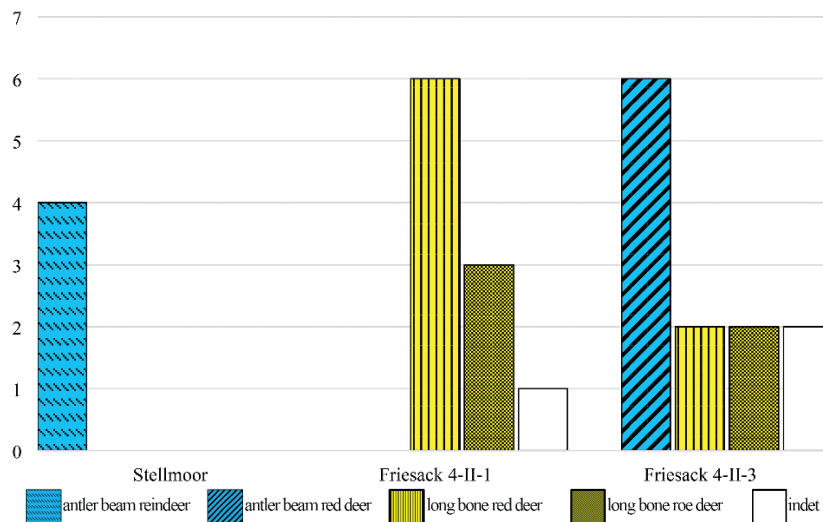


Fig. 4 – Raw materials used in north-western Central Europe for group B (barbed tools).

Fig. 4 – Matières premières utilisées dans l'Europe centrale du Nord-Ouest pour les outils du groupe B (objets barbelés).

The handful of group C2 tools unearthed at Stellmoor and the complex of Friesack 4-II is almost exclusively made of long bones of bird and hare. Only one pointed tool is made from a fragmented reindeer metacarpus. While Stellmoor shows only a single artefact for each of the three raw materials, Friesack 4-II is dominated by eight tools made of long bones of hare versus three artefacts made of long bones of bird. Six of the tools of group C2 were not determined to species level (fig. 6).

DISCUSSION

We argue that there is an obvious connection between functional-gestural tool class and selected raw material in north-western Central Europe. We propose that three major factors influenced the choices of

different raw materials for the osseous tool kit described above. Apart from continuity/discontinuity in technological traditions, they include mechanical properties of the raw material (table 4) and the availability of these different materials – as shown by zooarchaeological analyses. To identify the unknown variable ‘continuity/discontinuity’ at the Ahrensburgian/Early Mesolithic transition, one has to determine the two other variables in the data set.

Mechanical properties of osseous raw materials are usually determined by two variables: stiffness (*Young's modulus of elasticity*) and longitudinal bending strength (cf. Albrecht, 1977; MacGregor, 1984; Christensen, 2004; Margaris, 2009; Krey, 2013; Pfeifer, 2016). The hitherto available experimental data are very heterogeneous, even within the same species. For example, in reindeer antler the bending strength varies by over 300%, given a relatively coherent

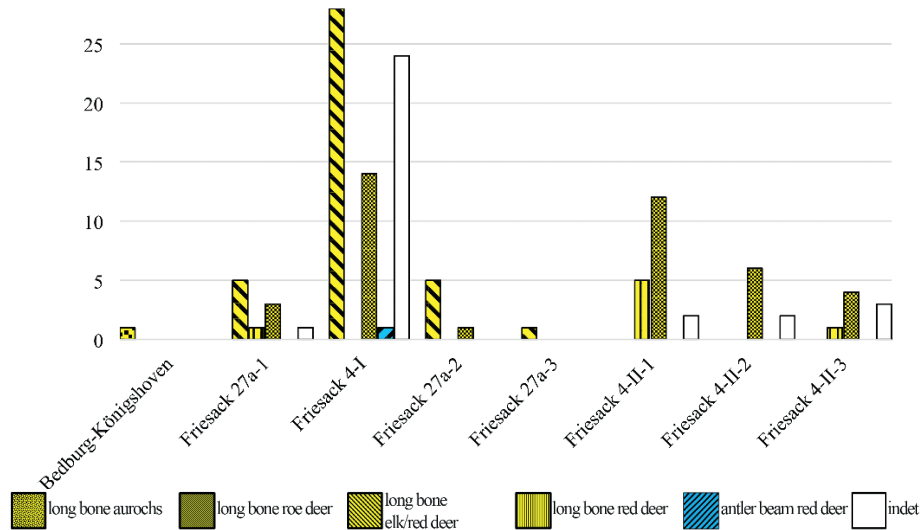


Fig. 5 – Raw materials used in north-western Central Europe for group C1 (perforating tools delivered).
Fig. 5 – Matières premières utilisées dans l'Europe centrale du Nord-Ouest pour les outils du groupe C1 (objets perforants lancés).

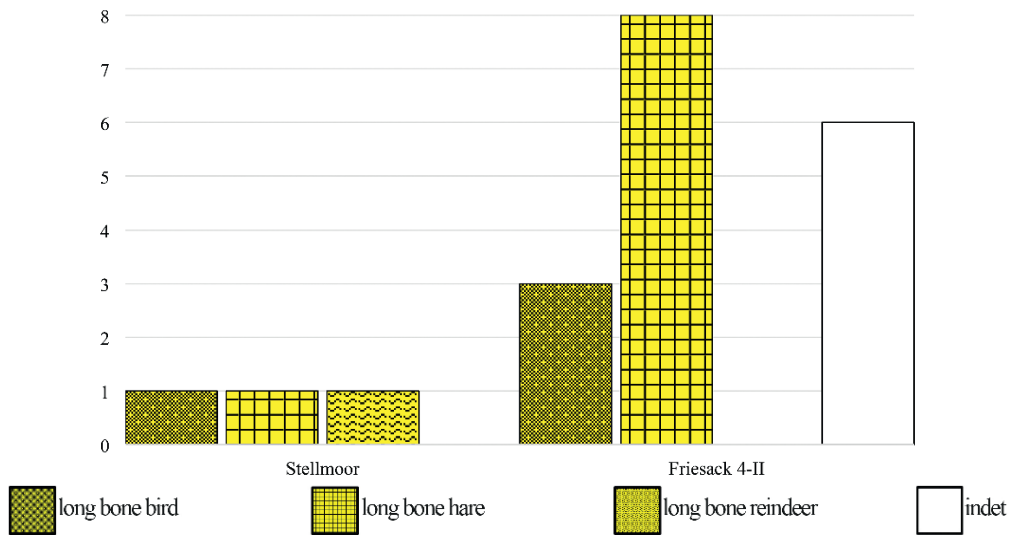


Fig. 6 – Raw materials used in north-western Central Europe for group C2 (perforating tools hand-held).
Fig. 6 – Matières premières utilisées dans l'Europe centrale du Nord-Ouest pour les outils du groupe C2 (objets perforants tenus à la main).

modulus of elasticity between 5 and 8 GPa. The reasons for that may be found in varying moisture contents of the samples, different experimental set-ups and individual characteristics of a biological raw material.

Despite of these method-related variations, there are two emerging clusters (fig. 7): Antler is quite easy to deform as shown by a rather low modulus of elasticity, whereas mammal bone is substantially stiffer. The greatest stiffness appears to be found in bird bones. A relatively high modulus of elasticity (9.7–21.0 GPa) was also recorded by Cubo and Casinos, who tested a large sample of different long bones from various bird species (Cubo and Casinos, 2000a and 2000b). However, since Cubo and Casinos tested whole bones, geometric considerations of artefact morphology come into play – a problem we do not face within this study. Nevertheless,

the direct result of the inclusion of geometric properties is that the data obtained by Cubo and Casinos (2000a and 2000b) is not directly comparable to those obtained from standardized compacta bone blanks.

The highest bending strength is always observed in the antler samples with no substantial difference between reindeer and red deer. When used in striking elements like axes and mattocks (group A), the raw material had to withstand impacts. Currey et al. (2009) have shown that dry antler can absorb more than six times as much impact energy than bone, so that its preference in the northern Pleistocene/Holocene inventories is not astonishing.

The hooking elements (group B) served as hunting tools whose function was to remain inside the hit prey or to hook to it. Antler's flexibility and great fracture toughness (Chapman, 1975, p. 131; Currey, 1999,

p. 3287, table 2; Launey et al., 2010) were obviously the main qualities required for that purpose.

In contrast, the main function of perforating elements like simple points, awls or needles (group C) is to penetrate. Long bone's stiffness thus ensured an effective energy transmission.

However, to understand thoroughly the archaeological picture in the Lowlands the zooarchaeological

context for the different groups and sites has to be taken into consideration. As we have demonstrated, antler is the best raw material for striking tools, which is why it was used at all studied sites.

In contrast, for tools of group B, antler of reindeer and red deer seemed to be the first choice at Stellmoor and Friesack 4-II-3, while it had not been used at Friesack 4-II-1. Why is that? Schmölcke (2016, p. 84 table

	species	element	status	Modulus of elasticity [GPa]	Bending strength [MPa]	Reference
antler	<i>A. alces</i>	beam	?	11.8	-	Blob and Snelgrove, 2006
	<i>C. canadensis</i>	beam	dry	7.6 ± 0.3	197.3 ± 24.0	Chen et al., 2009
	<i>C. canadensis</i>	beam	hydrated	7.0 ± 0.3	145.1 ± 9.0	Chen et al., 2009
	<i>C. elaphus</i>	beam	dry	7.4	179.4	Currey, 1979
	<i>C. elaphus</i>	beam	dry	13.6	342.8	MacGregor and Currey, 1983
	<i>C. elaphus</i>	beam	hydrated	7.2	158	Currey, 1990
	<i>C. elaphus</i>	beam	?	10	250	Currey, 1999
	<i>C. elaphus</i>	beam	?	5.3	81.9	Landete-Castillejos et al., 2007
	<i>C. elaphus</i>	beam	dry	7.5	115.4	Chen et al., 2008
	<i>C. elaphus</i>	beam	dry	17.5 ± 0.5	352.2 ± 8.8	Currey et al., 2009
	<i>R. tarandus</i>	beam	hydrated	6.4	-	Currey, 1988
	<i>R. tarandus</i>	beam	hydrated	8.1	95	Currey, 1990
	<i>R. tarandus</i>	beam	hydrated	5.8 ± 0.4	-	Shah et al., 2008
	<i>R. tarandus</i>	beam	hydrated	6.0 ± 1.0	130 ± 20.0	Margaris, 2009
<i>R. tarandus groenlandicus</i>	beam	dry	5.0 ± 1.0	336.6 ± 43.0	Krey, 2013	
mammal bones	<i>Bos sp.</i>	femur	hydrated	26.1	238	Reilly and Burstein, 1975
	<i>Bos sp.</i>	femur	hydrated	13.5	-	Currey, 1979
	<i>Bos sp.</i>	femur	hydrated	26.1	148	Currey, 1990
	<i>Bos sp.</i>	femur	hydrated	22.4	263	Currey, 2009
	<i>C. capreolus</i>	femur	hydrated	18.4	150	Currey, 1990
	<i>C. elaphus</i>	femur	hydrated	15	250	Margaris, 2009
	<i>D. dama</i>	radius	hydrated	25.5	213	Currey, 1990
	<i>Eq. caballus</i>	femur	hydrated	21.2	-	Currey, 1988
	<i>Eq. caballus</i>	femur	hydrated	24.5	152	Currey, 1990
	<i>H. sapiens</i>	femur	hydrated	16.7	166	Currey, 2002
bird bones	<i>A. patagonicus</i>	ulna	?	22.9	193	Currey, 1999
	<i>G. antigone</i>	tibiotarsus	?	23.5	254	Currey, 1999
	Phoenicopter sp.	tibiotarsus	?	28.2	212	Currey, 1999

Table 4 – Published experimental data for antler and long bone of different species using standard bending tests. Unknown parameters: “?”.
Tabl. 4 – Données expérimentales publiées pour le bois de cervidé et les os longs des différentes espèces en utilisant des tests de flexion standard. Paramètres inconnus : “?”.

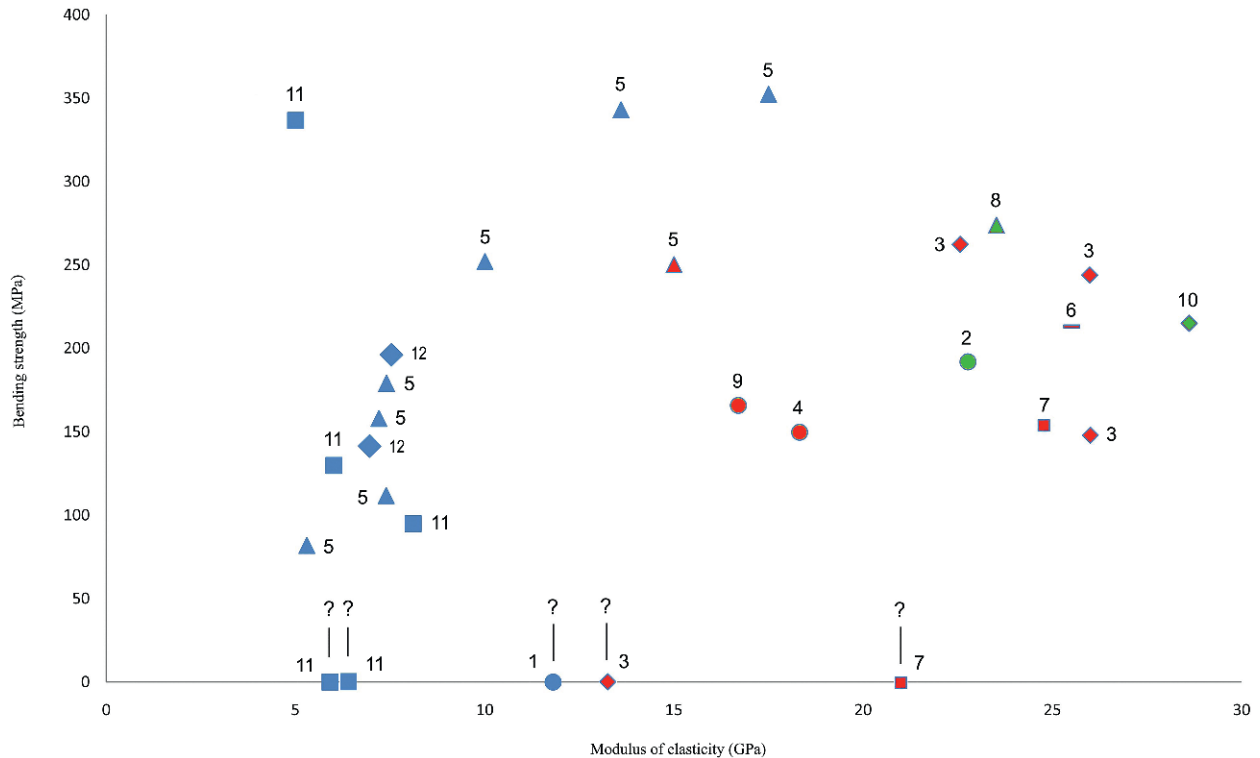


Fig. 7 – Bending strength and modulus of elasticity of different osseous raw materials. Blue: antler; red: mammal bone; green: bird bone. 1: *A. alces*; 2: *Aptenodytes patagonicus*; 3: *Bos* sp.; 4: *C. capreolus*; 5: *C. elaphus*; 6: *Dama dama*; 7: *Equus caballus*; 8: *Grus Antigone*; 9: *Homo sapiens*; 10: *Phoenicopterus* sp.; 11: *R. tarandus*; 12: *Cervus canadensis*?; MPa not published.

Fig. 7 – 1 : Résistance à la flexion et indice d'élasticité des différentes matières premières osseuses. Bleu : bois de cervidé ; rouge : os de mammifère ; vert : os d'oiseau. 1 : *A. alces* ; 2 : *Aptenodytes patagonicus* ; 3 : *Bos* sp. ; 4 : *C. capreolus* ; 5 : *C. elaphus* ; 6 : *Dama dama* ; 7 : *Equus caballus* ; 8 : *Grus Antigone* ; 9 : *Homo sapiens* ; 10 : *Phoenicopterus* sp. ; 11 : *R. tarandus* ; 12 : *Cervus canadensis* ; ? : MPa non publiée.

21, p. 85-86) reports only 13, mainly young, red deer for the whole complex II of Friesack 4. Suggesting that 50% were male, and adding the few reported shed antlers from this complex, we would have to deal with only very few antler beams during the three occupation phases in complex 4-II. Thus, people might sometimes have been forced to sidestep and use bone for tools of group B.

The results from group C1 tools are more complex. Stiff cervid long bones seem to be the most important raw material for these tools. Apart from minor changes there is a general tendency that long bones belonging to either elk or red deer had only been used in the early Late Preboreal layers Friesack 27a-1, Friesack 4-I and Friesack 27a-2 while they are absent from the slightly younger layers Friesack 4-II-1, Friesack 4-II-2 and Friesack 4-II-3. Within these three younger layers, we observe, for the first time, the presence of long bones that had been determined securely as red deer. These represent 6 out of 28 tools for which a species determination is reported (22 roe deer long bones; fig. 5). On the other hand, roe deer was used almost continuously through time. This might be the result of a shift in the economical choices of Mesolithic hunter-gatherers at Friesack. Long bones of red deer might have been fractured during marrow processing in the earlier phase and therefore have not been used in C1 tool production. This is in contrast with

the younger phase, where long bones of other taxa were preferentially utilized or long bone marrow extraction might have stopped altogether. If so, we would expect an increase in the average weight in red deer fragments between the two complexes Friesack 4-I and 4-II, as the bones in the younger phase were predominantly used for the production of tools. However, Schmölcke (2016, p. 83) reports that the average weight of bone fragments belonging to red deer ranges between 25 g and 27 g and does not differ between the individual complexes. Thus, an ecological shift appears unlikely and instead, we believe this to be the result of a technological shift.

The few group C2 tools from Stellmoor and Friesack 4-II give a homogenous impression. With the exception of an opportunistic sharpening of a marrow-fractured reindeer metatarsus at Stellmoor, all awls and needles are made from long bones of birds and hare. This seems to be a deliberate choice as bones of these taxa are not numerous on either of the sites.

Some general conclusions can be made:

- There is a clear link between material property and proposed tool function. The use of appropriate raw materials helped to maximize the functional efficiency and longevity of a tool.
- Ahrensburgian hunter-gatherers at Stellmoor hunted for subsistence and acquisition of raw material (cf.

Sturdy, 1975; Bratlund, 1991) while hunting at the analysed Mesolithic sites was carried out primarily for subsistence purposes. In one case of Mesolithic hunting activities at Friesack, this resulted in a lack of adequate raw material for the production of hooking tools.

- c) Hunter-gatherers were able to adapt to the non-availability of previously favoured raw materials.
- d) There is continuity in the general choice of raw materials for certain tool types from Dryas III to the Early Mesolithic. In this respect, we postulate that no clear change took place. On the other hand and apart from typological differences, a clear technological discontinuity can be observed within the

Preboreal at Friesack displaying a shift from the use of large cervid long bones to red deer bones for the production of hafted perforating tools. ■

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Archaeology across the Pleistocene-Holocene boundary in western Germany:

Human responses to rapid environmental change

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Abstract: *In recent years, new insights into the Final Palaeolithic and Mesolithic in North Rhine-Westphalia have been gained. The Early Mesolithic human remains of the Blätterhöhle in Hagen should be mentioned specifically as they even attracted international attention. Here, a stratigraphic sequence containing hearth remains and lithic assemblages from the Early to Late Mesolithic has been excavated for the first time in this region. Recent results of excavations demonstrate that the sequence even dates back to the Late Pleistocene. Moreover, newly dated sites and single finds of the Final Palaeolithic – Early Mesolithic transitional period from this region suggest varying influences from northern and southern as well as western regions on the development of the Westphalian Mesolithic. Several sites, which have been assigned to the broad blade complexes or the “Long Blade industries”/the Belloisien due to the distinct blade technology and microlithic projectile points, seem to represent the initial stage of the Mesolithic in the Rhineland and in Westphalia.*

Keywords: *Younger Dryas, Preboreal, Long Blades, Early Mesolithic, Western Germany, Radiocarbon dating.*

Résumé : *De nouvelles découvertes en contexte mésolithique ont été réalisées en Rhénanie-du-Nord-Westphalie au cours des dernières années. Il faut mentionner, par exemple, les restes humains du Mésolithique ancien de la grotte de Blätterhöhle à Hagen qui ont suscité un intérêt important. En outre, et pour la première fois, une séquence stratigraphique comportant des vestiges de foyers associés à des vestiges lithiques couvrant l'ensemble du Mésolithique ancien, moyen et final a été découverts sur ce même site. D'autres nouveaux sites, ainsi que des analyses radiométriques menées sur des découvertes isolées de la transition Paléolithique final – Mésolithique ancien semblent indiquer que le Mésolithique de la Westphalie a été influencé par différents courants culturels originaires des régions septentrionales et méridionales ainsi que celui des zones occidentales. Plusieurs sites, attribués aux Long Blade Assemblages, ou Belloisien, en raison de leur caractéristique technique et de la présence d'armatures microlithiques, représentent la première phase du Mésolithique de Rhénanie et de Westphalie.*

Mots-clés : *Dryas récent, Préboréal, Industries à longues lames, Mésolithique ancien, Allemagne de l'ouest, Datations radiocarbone.*

ARCHAEOLOGY ACROSS THE PLEISTOCENE – HOLOCENE BOUNDARY IN WESTERN GERMANY

We present 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 type specimen for Neandert(h)al hominins (Schmitz, 2006). Many limestone caves, particularly those in the Höhne 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 et al., 1995; Bosinski, 2008).

The archaeological events of interest here fall together with the last period of major climatic and ecological change, the Pleistocene – Holocene boundary around 11,600 cal. BP (calibrated values are based on 1950 AD). 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 (fig. 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).

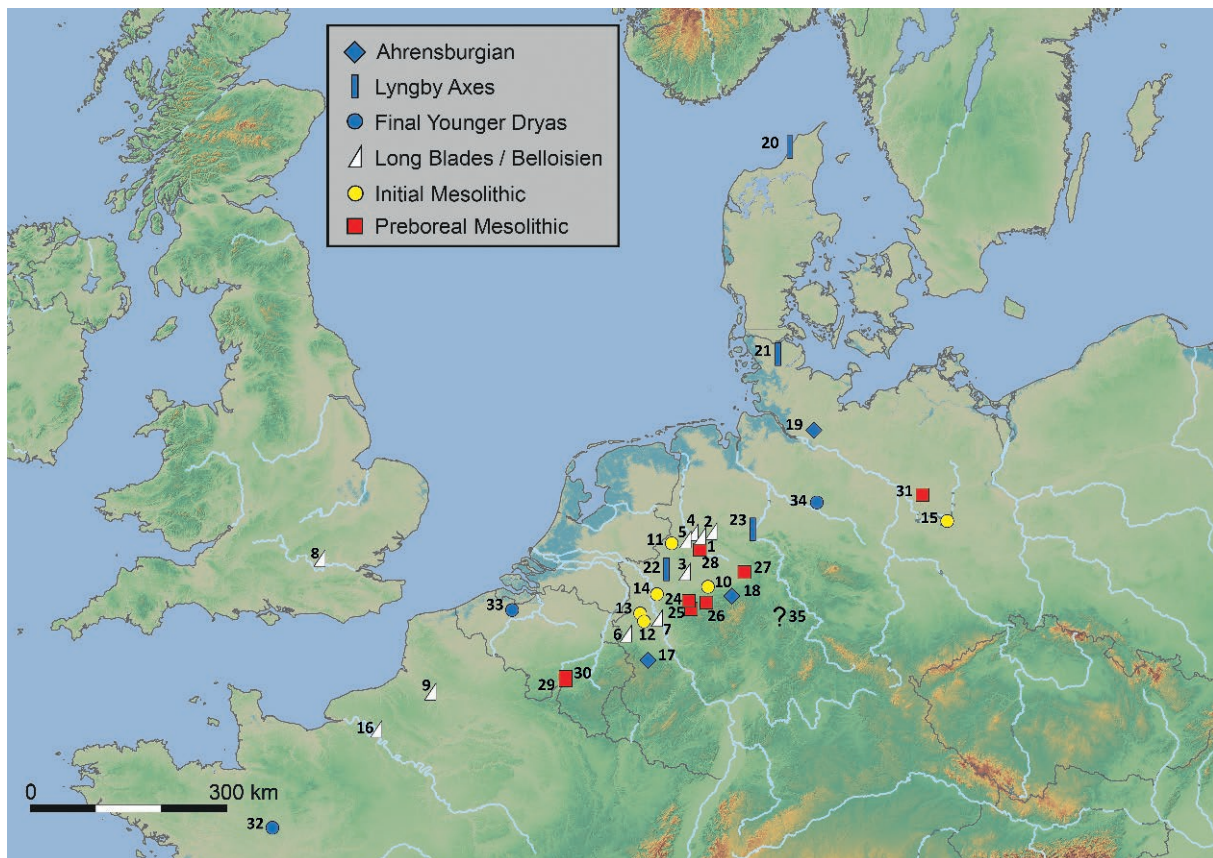


Fig. 1 – Rhineland and Westphalia consist of different landscapes: their northern regions are part of the North European Lowland, while the southern regions consist of upland landscapes. Sites mentioned in the text: 1 Saerbeck-Sinningen; 2 Westerlipp-Brennesch; 3 Lüdinghausen-Emkum II; 4 Rheine-Altenrheine; 5 Wettringen; 6 Übach-Palenberg; 7 Dormagen-Nievenheim; 8 Three Ways Wharf; 9 Belloy-sur-Somme; 10 Werl-Büderich; 11 Heck-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 (illustration: University of Cologne/B. Gehlen, N. Schneid, K. Vogl, M. Zickel).

Fig. 1 – La Rhénanie et la Westphalie sont composées de différents paysages : leurs régions septentrionales font partie de la plaine nord-européenne tandis que leurs régions méridionales consistent en paysages de moyenne montagne. Sites mentionnés dans le texte : 1 Saerbeck-Sinningen ; 2 Westerlipp-Brennesch ; 3 Lüdinghausen-Emkum II ; 4 Rheine-Altenrheine ; 5 Wettringen ; 6 Übach-Palenberg ; 7 Dormagen-Nievenheim ; 8 Three Ways Wharf ; 9 Belloy-sur-Somme ; 10 Werl-Büderich ; 11 Heck-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 (illustration : Université de Cologne/B. Gehlen, N. Schneid, K. Vogl, M. Zickel).

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 are the Kartstein rock shelter in the northern Eifel uplands (Baales, 1996) and the



Fig. 2 – Three Ahrensburgian tanged points from the site of Hohler Stein at Rütten-Kallenhardt (photo: LWL/M. Baales, A. Müller).

Fig. 2 – Trois pointes pédonculées ahrensbourgiennes du site de Hohler Stein à Rütten-Kallenhardt (cliché : LWL/M. Baales, A. Müller).

Hohler Stein cave near Rütten-Kallenhardt in the Westphalian uplands (fig. 2; Baales, 2013a; Baales et al., 2013a; 2019). 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 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.* Clausen, 2004; Weber et al., 2011; Fischer et al., 2013). 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 (fig. 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



Fig. 3 – Three certain “Lyngby axes” are known from Westphalia, all probably dating to the Ahrensburgian (Tanged Point complex). – 1 Minden; 2 “Hohler Stein” near Rütten-Kallenhardt; 3 Marl-Sickingmühle. Minden and Marl-Sickingmühle show similar traces from their manufacture and/or use (photo: LWL/S. Brentführer and A. Müller).

Fig. 3 – Trois « haches de Lyngby » certaines sont connues en Westphalie, toutes les trois datant probablement de l’Ahrensburgien (complexe à pointes pédonculées). – 1 Minden; 2 « Hohler Stein » à Rütten-Kallenhardt; 3 Marl-Sickingmühle. Les deux « haches de Lyngby » de Minden (en haut) et de Marl-Sickingmühle (en bas) montrent des traces similaires de leur fabrication et/ou de leur utilisation (cliché : LWL/S. Brentführer, A. Müller).

Site	Context	Material	Species	Lab ID	14C date	(CalPal)			(OxCal)	
						SD	cal BC	SD	cal BC 1σ	cal BP 1σ
Balver Höhle	old find	bone	<i>Homo sapiens</i>	GrA-19538	9,160	50	8,385	67	8,538-8,281	10,488-10,231
Hagen-Riegerbusch	find layer	charcoal	<i>Salix</i> sp.	MAMS 14123	9,333	36	8,603	40	8,711-8,477	10,661-10,427
Paderborn-Sande	dredging find	antler	<i>Alces alces</i>	MAMS 14119	9,591	30	8,993	116	9,157-8,814	11,107-10,764
Blätterhöhle / platform	BV 07 - SU 3 - 4	charcoal	Pomoideae	COL 2667	8,116	48	7,120	51	7,307-7,032	9,257-8,982
Blätterhöhle / platform	BV 08 - SU 4	charcoal	<i>Corylus avellana</i>	COL 1443	8,122	32	7,111	37	7,183-7,047	9,133-8,997
Blätterhöhle / platform	BV 07 - SU 3 - 4	charcoal	<i>Quercus</i> sp.	COL 2668	8,210	47	7,224	81	7,419-7,072	9,369-9,022
Blätterhöhle / platform	BV 08 - SU 3 - 4	charcoal	<i>Corylus avellana</i>	COL 1444	8,227	35	7,249	61	7,356-7,082	9,305-9,032
Blätterhöhle / platform	BV 09, SU 4 - 6	charcoal	<i>Quercus</i> sp.	COL 1451	8,240	36	7,264	63	7,450-7,085	9,400-9,035
Blätterhöhle / platform	BV 06 - SU 4	bone	<i>Sus scrofa</i>	KIA 37513	8,330	45	7,411	59	7,522-7,196	9,472-9,146
Blätterhöhle / platform	BV 09, SU 4	charcoal	<i>Corylus avellana</i>	COL 1926	8,335	49	7,413	63	7,526-7,195	9,476-9,145
Blätterhöhle / platform	BV 08, SU 4	charcoal	<i>Corylus avellana</i>	COL 1440	8,438	32	7,528	22	7,576-7,478	9,526-9,428
Blätterhöhle / platform	BV 08, SU 4	charcoal	<i>Corylus avellana</i>	COL 1445	8,441	34	7,530	24	7,578-7,478	9,528-9,428
Blätterhöhle / platform	BV 08, SU 4	charcoal	<i>Corylus avellana</i>	COL 1446	8,473	35	7,550	21	7,584-7,499	9,534-9,449
Blätterhöhle / platform	BV 08, SU 4	charcoal	<i>Corylus avellana</i>	COL 1442	8,529	31	7,571	16	7,595-7,536	9,545-9,486
Blätterhöhle / platform	BV 08, SU 6a	charcoal	<i>Quercus</i> sp.	COL 1441	8,618	31	7,625	26	7,712-7,581	9,662-9,531
Blätterhöhle / platform	BV 11 - SU 6a	bone	<i>Sus scrofa</i>	AAR 15713	8,732	38	7,754	79	7,938-7,608	9,888-9,558
Blätterhöhle / platform	BV09/11 - SU 6a	bone	<i>Sus scrofa</i>	AAR 15714	9,036	38	8,267	17	8,292-8,227	10,242-10,177
Blätterhöhle / platform	BV 09, SU 6b	charcoal	<i>Corylus avellana</i>	COL 1928	9,215	50	8,436	84	8,560-8,300	10,510-10,250
Blätterhöhle / platform	BV 11 - SU 6a - 6b	charcoal	<i>Betula</i> sp.	COL 1454	9,243	37	8,458	78	8,572-8,319	10,522-10,269
Blätterhöhle / platform	BV 09 - SU 6b	charcoal	<i>Corylus avellana</i>	COL 1449	9,244	39	8,458	58	8,596-8,320	10,546-10,270
Blätterhöhle / platform	BV 12 - SU 6a - 6b	charcoal	unbest.	COL 1973	9,274	52	8,497	90	8,634-8,324	10,584-10,274
Blätterhöhle / interior	BV 06 - CSU 3	bone	<i>Homo sapiens</i>	KIA 37511	9,275	45	8,506	77	8,626-8,340	10,576-10,290
Blätterhöhle / platform		charcoal	<i>Betula</i> sp.	COL 1447	9,301	36	8,553	55	8,697-8,353	10,647-10,303
Blätterhöhle / platform	BV 11 - SU 6b	charcoal	<i>Corylus avellana</i>	COL 1453	9,329	68	8,585	101	8,758-8,347	10,708-10,297
Blätterhöhle / interior	BH 07 - CSU 3	bone	<i>Homo sapiens</i>	KIA 37516	9,355	40	8,638	56	8,744-8,544	10,694-10,494
Blätterhöhle / interior	BH 04, probably CSU 3	bone	<i>Homo sapiens</i>	KIA 37509	9,370	45	8,652	58	8,762-8,546	10,712-10,496
Blätterhöhle / platform	BV 12 - SU 6a - 6b	charcoal	<i>Betula</i> sp.	COL 1971	9,371	46	8,653	59	8,767-8,491	10,716-10,441
Blätterhöhle / platform	BV 12 - SU 6a - 6b	charcoal	<i>Betula</i> sp.	COL 1972	9,379	51	8,660	63	8,788-8,491	10,738-10,441
Blätterhöhle / interior	BH 04, probably CSU 3	bone	<i>Homo sapiens</i>	KIA 24689	9,389	36	8,676	44	8,838-8,626	10,788-10,576
Blätterhöhle / platform	BV 11 - SU 6a - 6b	charcoal	<i>Betula</i> sp.	COL 1455	9,414	36	8,696	45	8,789-8,615	10,739-10,565
Blätterhöhle / interior	BH 04, probably CSU 3	bone	<i>Homo sapiens</i>	KIA 26265	9,435	40	8,713	51	8,805-8,606	10,755-10,556
Blätterhöhle / interior	BH 08 - CSU 3	bone	<i>Homo sapiens</i>	KIA 37515	9,460	45	8,748	67	8,846-8,622	10,796-10,572
Blätterhöhle / platform	BV 11 - SU 6b	charcoal	<i>Corylus avellana</i>	COL 1452	9,511	38	8,931	149	9,126-8,714	11,076-10,664
Blätterhöhle / interior	BH 08 - CSU 3	bone	<i>Homo sapiens</i>	KIA 45012	9,700	30	9,210	29	9,247-9,179	11,197-11,129
Blätterhöhle / platform	BV 09 - disturbed	charcoal	<i>Betula</i> sp.	COL 1448	10,981	40	10,949	96	11,027-10,779	12,977-12,729
Werl-Büderich	find horizon	charcoal	deciduous species	MAMS 15941	9,923	33	9,369	45	9,641-9,287	11,591-11,237
MG-Geneicken	Area 169-4 (aurochs site)	plant remain		COL 2616	9,770	58	9,246	38	9,340-8,936	11,290-10,886
MG-Geneicken	Area 181-193	charcoal		COL 2886.1.1	9,803	56	9,276	28	9,376-9,180	11,326-11,130
MG-Geneicken	Area 178-35a	charcoal		COL 2882.1.1	9,806	57	9,278	30	9,385-9,176	11,335-11,126
MG-Geneicken	Area 169-361a (aurochs site)	bone	<i>Bos primigenius</i>	COL 2681.2.1	9,925	55	9,431	105	9,659-9,277	11,609-11,227
MG-Geneicken	Area 169-361 (aurochs site)	bone	<i>Bos primigenius</i>	COL 2681	9,948	51	9,468	124	9,664-9,291	11,614-11,241
MG-Geneicken	Area 181-184	charcoal		COL 3098.1.1	9,987	42	9,513	117	9,747-9,317	11,697-11,267
MG-Geneicken	Area 178-35b	charcoal		COL 3201.1.1	10,021	46	9,585	155	9,802-9,363	11,752-11,313
Bedburg-Königshoven	preliminary sample	peat		KN-3883B	9,540	120	8,933	190	9,252-8,611	11,202-10,561
Bedburg-Königshoven	101/103 Vt 3/4	wood		KN-3998	9,600	100	8,998	163	9,260-8,722	11,210-10,672
Bedburg-Königshoven	preliminary sample	peat		KN-3883A	9,660	120	9,038	177	9,318-8,711	11,268-10,661
Bedburg-Königshoven	93/105	peat		KN-4001	9,690	85	9,074	156	9,290-8,820	11,240-10,770
Bedburg-Königshoven	100/107 Vt4	wood		KN-3999	9,780	100	9,176	174	9,461-8,823	11,411-10,773
Bedburg-Königshoven	87/108-4	bone	<i>Bos primigenius</i>	COL 2669.2.1			9,560		9,544	11,494
Bedburg-Königshoven	83-85/106-110	wood		KN-3997	10,010	85	9,598	192	9,981-9,292	11,931-11,242
Bedburg-Königshoven	85/105-3	bone	<i>Bos primigenius</i>	COL 2674.1.1			9,574		9,562	11,512
Bedburg-Königshoven	91/107-1	bone	<i>Bos primigenius</i>	COL 2672.1.1			9,579		9,569	11,519
Bedburg-Königshoven	96/108-1	bone	<i>Bos primigenius</i>	KN-4136	10,020	100	9,626	213	9,892-9,292	11,842-11,242
Bedburg-Königshoven	104/102-1 (Streu 33)	bone	<i>Bos primigenius</i>	COL 2680.2.1			9,608		9,592	11,542
Bedburg-Königshoven	93/110-1	bone	<i>Bos primigenius</i>	COL 2675.1.1			9,617		9,595	11,545
Bedburg-Königshoven	93/106-2	bone	<i>Bos primigenius</i>	COL 2948.1.1			9,641		9,593	11,543
Bedburg-Königshoven	97/107-3	bone	<i>Bos primigenius</i>	COL 2673.1.1			9,668		9,624	11,574
Bedburg-Königshoven	83-85/106-110	wood		KN-3996	10,070	95	9,701	233	10,043-9,324	11,993-11,274
Bedburg-Königshoven	97/107-4, 7	bone	<i>Bos primigenius</i>	COL 2671.2.1			9,758		9,747	11,697
Bedburg-Königshoven	93/106-2	bone	<i>Bos primigenius</i>	COL 2974.1.2			9,763		9,749	11,699
Bedburg-Königshoven	80/100	wood		KN-3995	10,270	90	10,134	255	10,466-9,695	12,416-11,645
Dormagen-Nievenheim	38-15-733	charcoal	<i>Betula</i> sp.	KIA 51665	10,136	73	9,792	214	10,098-9,451	12,048-11,401
Hohler Stein	excavation 1920/30s	bone	<i>Rangifer tarandus</i>	MAMS 11804	10,174	46	9,894	146	10,106-9,680	12,056-11,630
Hohler Stein	excavation 1920/30s	bone	<i>Rangifer tarandus</i>	MAMS 11805	10,198	39	9,947	127	10,129-9,804	12,079-11,754
Rhünda (Hesse)		bone	<i>Homo sapiens</i>	GrA-15947	10,200	60	9,939	158	10,180-9,676	12,130-11,626
Kartstein		bone	<i>Rangifer tarandus</i>	OxA-9031	10,220	75	9,988	192	10,428-9,665	12,378-11,615
	SU = Sedimentary Unit									
	CSU = Cave Sedimentary Unit									

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.

Tabl. 1 – Datations radiocarbones de la transition Pléistocène – Holocène (Paléolithique final – Mésolithique ancien) en Allemagne de l'ouest. Seules les dates considérées comme fiables (pour des raisons de contexte, de méthodologie, de précision...) figurent dans cet inventaire.

the upland zone to overwinter somewhere in 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 (fig. 3; Baales, 2013b).

Although none of the Lyngby antler axe specimens contained sufficient dateable collagen, it was possible

(“Zonhoven”) points created by oblique retouch (cf. Taute, 1968; Richter, 1981; Baales, 1996). 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 oblique retouched 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 southern England (Barton, 1998; Lewis and Rackham, 2011) and northern France (here also referred to as the “Belloisien”: Fagnart, 1997; 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 (Barton, 1986; Fagnart and Plisson, 1997).

Western German sites assigned to the “Long Blade industries” include Saerbeck-Sinningen (Stapel, 2006, 2013a and 2016), Westerkappeln-Brennesch (fig. 4, nos. 2-10; Stapel, 2010 and 2013b), Lüdinghausen-

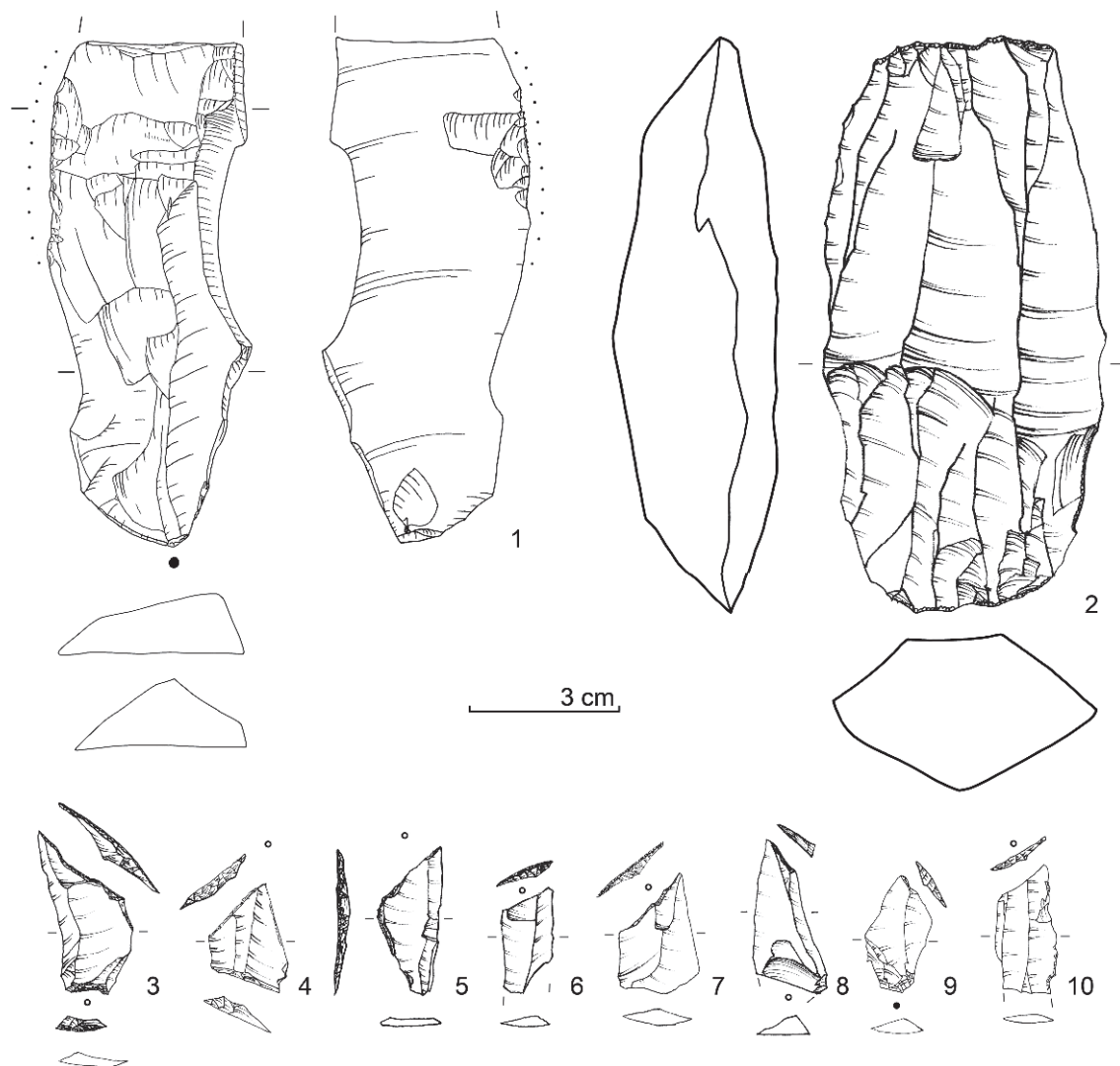


Fig. 4 – Westphalian “Long Blade” finds from Wettringen (1) and Westerkappeln-Brennesch (2-10): 1 bruised blade; 2 large blade core; 3-10 microliths; all made of Baltic flint (drawings: LWL/K. Koana, M. Kloss).

Fig. 4 – Vestiges lithiques des séries de type « Long Blade » de Westphalie à Wettringen (1) et Westerkappeln-Brennesch (2-10) : 1 lame mâchurée ; 2 nucléus à lames larges ; 3-10 armatures ; tous en silex baltique (dessins : LWL/K. Koana, M. Kloss).

Emkum II, Rheine-Altenrheine (Stapel, 2013b), and Wettringen (which produced a bruised blade; fig. 4, no. 1; 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 and microlithic Zonhoven points in some Ahrensburgian contexts (e.g. in Rissen 14a, Stellmoor, Teltwisch 2, Borneck-Ost and Borneck-Nord; Taute, 1968) in which case they are assigned to the Younger Dryas-Preboreal transition. 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 phenomenon⁽¹⁾.

At most western German “Long Blade” sites no organic 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, p. 613-615, fig. 3) since the “Long Blade” assemblage here lay within cover sands but stratigraphically below the numerous Mesolithic assemblages.

DORMAGEN-NIEVENHEIM

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 settlement structures located close to a channel of the late Pleistocene Rhine braided river system (Heinen, 2017). 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 m apart, which together produced 2,355 lithic artefacts. Both areas contained burnt artefacts and bone fragments suggestive of hearths and yielded the same range of tool types (fig. 5): 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 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 350 km and Nievenheim appears to be the most southern evidence for Heligoland flint in

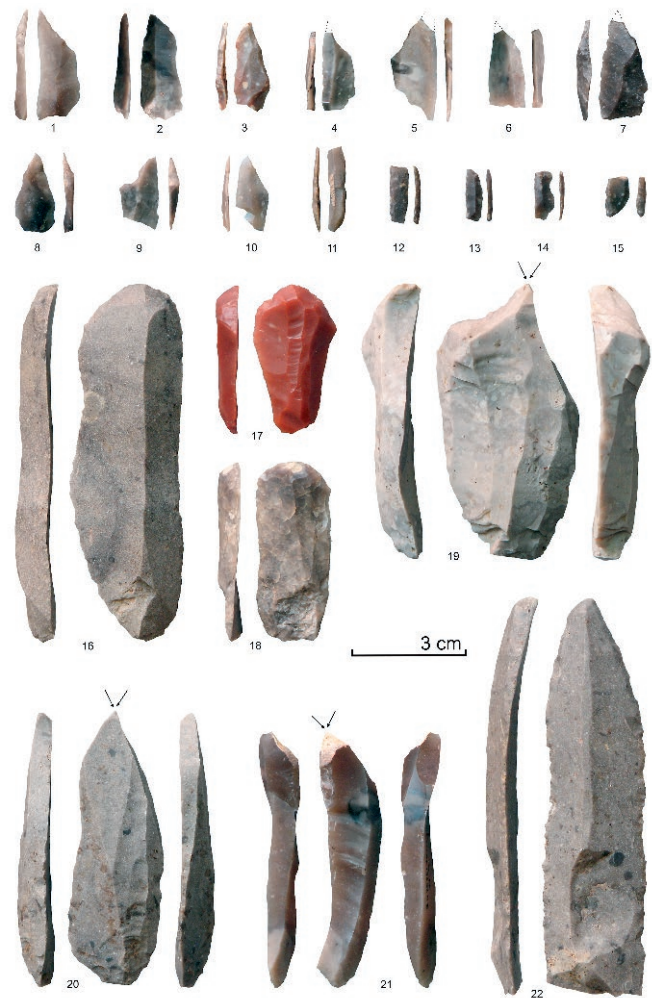


Fig. 5 – Dormagen-Nievenheim, “Long Blade” artefacts including a specimen manufactured of characteristic red Heligoland flint (photo: M. Heinen).

Fig. 5 – Dormagen-Nievenheim, Industrie de type “Long Blade” comprenant un exemplaire en silex rouge caractéristique de Heligoland (cliché : M. Heinen).

Europe known to date. Alongside the northern raw material, Cretaceous flint of western origin (~ 21%) was used, among which are materials derived from Meuse river gravels and of Rijckholt type transported over distances of 40-80 km. A few artefacts are made of Lousberg Flint obtained from an outcrop which today lies at the centre of the city of Aachen some 80 km to the southwest. The combination of Zonhoven points with very long rectilinear blades would on its own identify Nievenheim as a “Long Blade” industry from the end of the late Palaeolithic. Moreover, the techno-typological attribution of the site is supported by an AMS date for birch-charcoal from the middle of one concentration (KIA 51665: $10,136 \pm 73$ BP/ $\sim 11,750$ cal. BP) 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, 1997).

BLÄTTERHÖHLE

Mesolithic horizons uncovered in the rock shelter platform in front of the Blätterhöhle, a small cave at Hagen in the northern Sauerland region, have been under investigation for several years (see below). Excavations have also provided hints for an older, late glacial occupation (fig. 6). Birch wood charcoal (*Betula*) from a disturbed area (possibly due to animal burrowing) was radiocarbon dated (COL 1448: 10,981 ± 40 BP) to ~ 12,900 cal. BP (table 1) and a few lithics recovered from disturbed sediments belong to a pre-Mesolithic context.

The 2016 to 2019 excavations of a small area of deposits from the very end of the Pleistocene produced beside some flint blades several small and/or slender backed points, distinct from Mesolithic types, mostly linked to a greyish sediment layer (fig. 7). Of special interest is a small bi-pointed piece resembling a tanged point (Heuschen et al., 2017 and 2018; Orschiedt et al., 2017). The variety of points most possibly correspond to similar elements from French (Épi-Laborien) or Belgian assemblages with further distinct backed elements variously described as Blanchères- or Auvours-type points and small tanged pieces (Naudinot, 2008 and 2013, fig. 1, no. 2; Naudinot and Jacquier, 2009; Devriendt et al., 2010).

THE INITIAL MESOLITHIC OF THE EARLY PREBOREAL

A number of further lithic assemblages from western Germany and adjacent regions of north-western Europe are characterized by obliquely 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), base retouched micropoints 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; Baales, 1996, p. 318) or Gramsbergen and Swalmen in the northern Netherlands (Stapert, 1979; Johansen and Stapert, 2000) 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

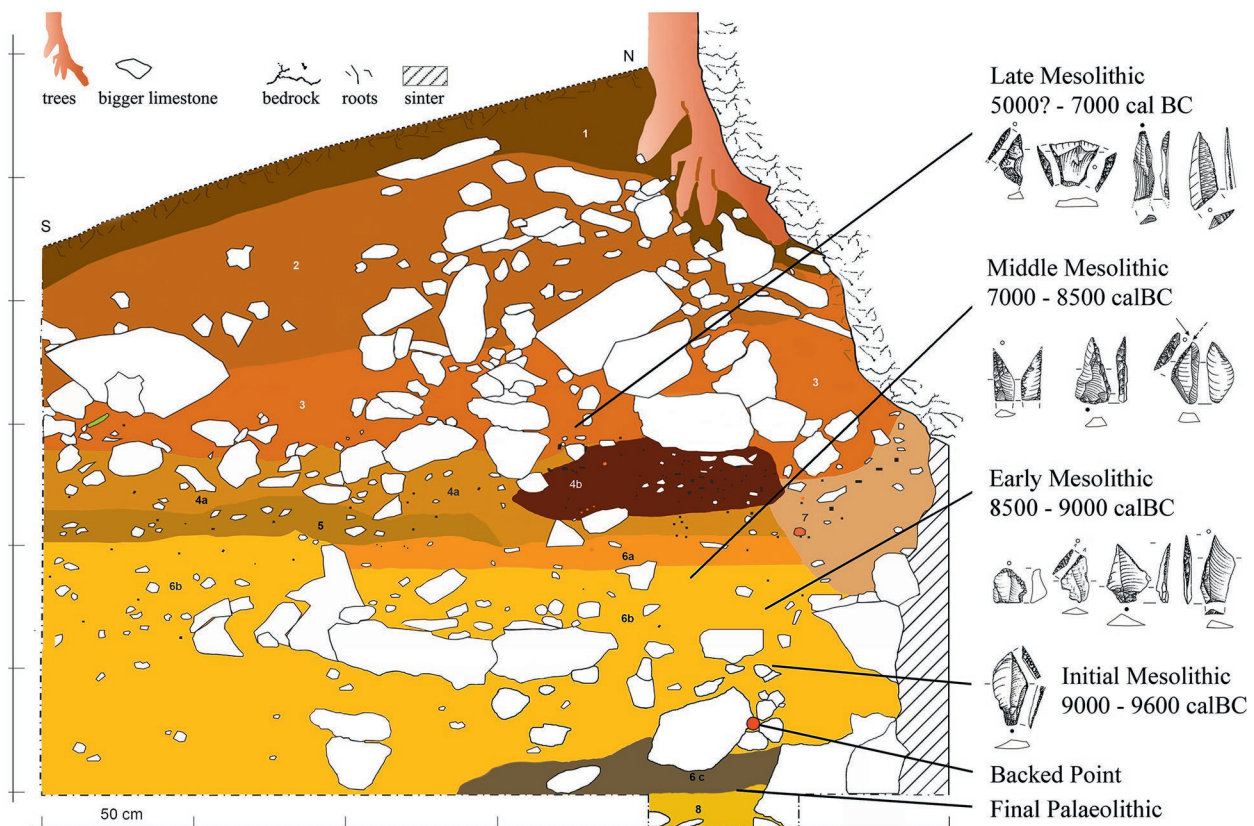


Fig. 6 – Idealized stratigraphy of the Blätterhöhle cave platform “Vorplatz” (drawing: LWL/W. Heuschen, S. Grunwald; University of Cologne/B. Gehlen, J. Orschiedt).

Fig. 6 – Stratigraphie synthétique du porche de la grotte de « Blätterhöhle » (dessin : LWL/W. Heuschen, S. Grunwald; Université de Cologne/B. Gehlen, J. Orschiedt).

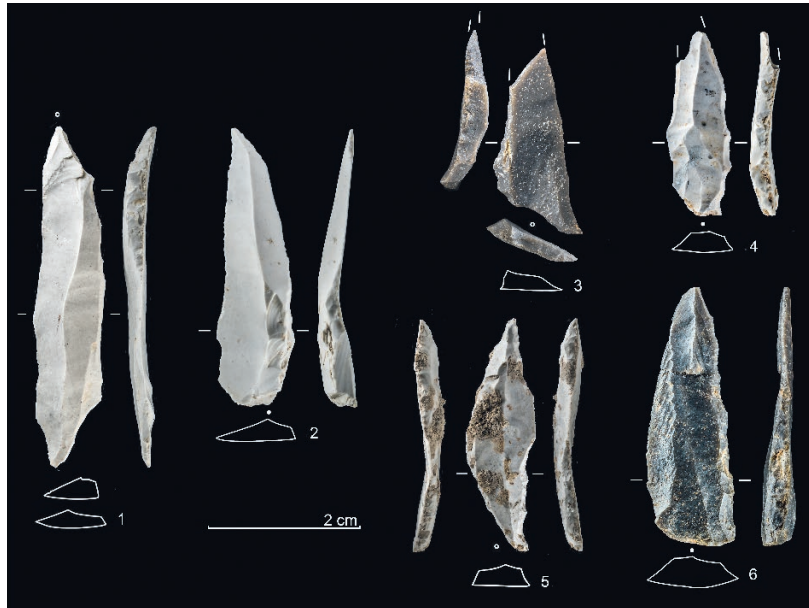


Fig. 7 – Lithic projectile points of the Blätterhöhle Final Palaeolithic sediments. Sediment 6b: 1 partially backed, slender point (moraine-transported flint); 3 basal retouched, broken backed point (Malaure point-like, lydite); 6 straight backed point (lydite). Sediment 6c: 2 partially backed point (moraine-transported flint); 4 curved backed point with impact fracture (erratic flint); 5 slender atypical tanged point (moraine-transported flint) (photos: LWL/H. Menne, A. Müller).

Fig. 7 – Pointes de projectiles lithiques provenant des niveaux du Paléolithique final de Blätterhöhle. Couche 6b : 1 pointe à dos partiel (silex transporté par les moraines) ; 3 pointe à dos à base retouchée fragmentée (« pointe de Malaure », lydite) ; 6 pointe à dos rectiligne (lydite). Couche 6c : 2 pointe à dos partiel (silex transporté par les moraines) ; 4 pointe pédonculée atypique à dos courbe portant une fracture d'impact (silex transporté par les moraines) ; 5 pointe pédonculée atypique (silex transporté par les moraines) (clichés : LWL/H. Menne, A. Müller).

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 (attributed to the Belloisien; 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 pretreatment 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

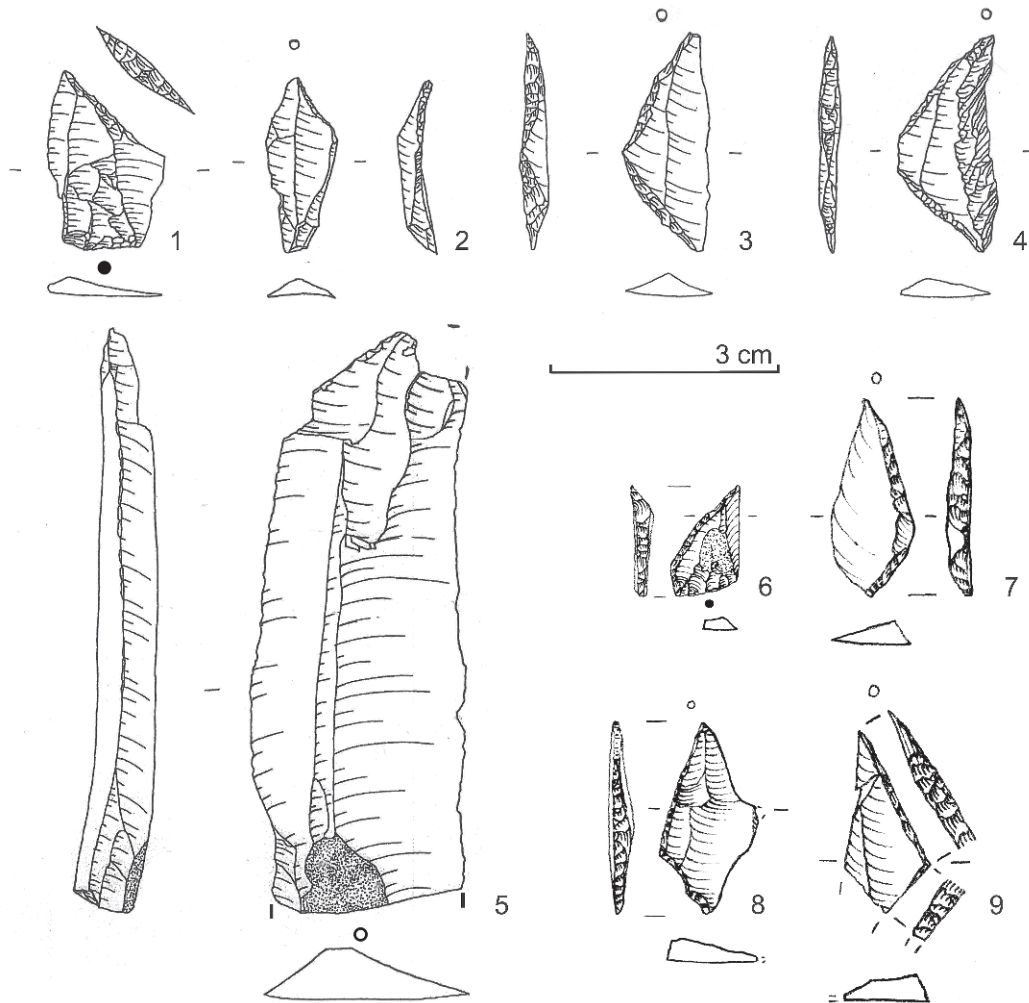


Fig. 8 – “Broad Blade” lithic artefacts from Heek-Nienborg (1-5) and Werl-Büderich (6-9): 1 Zonhoven point; 2 concave truncated point; 3 scalene triangular point; 4 elongated trapeze; 5 one of the broad blades; 6 Zonhoven point with a unilateral edge retouch; 7 rhombic slightly bent point; 8 slightly notched point; 9 fragment of a triangular point (drawings: LWL/J. Piesniewski; University of Cologne/B. Gehlen, A. Zander, K. Vogl).

Fig. 8 – Industrie de type « Broad Blade » provenant de Heek-Nienborg (1-5) et Werl-Büderich (6-9): 1 pointe de Zonhoven; 2 pointe à troncature concave; 3 triangle scalène; 4 pointe trapézoïdale; 5 lame large; 6 pointe de Zonhoven avec retouche marginale unilatérale; 7 pointe rhomboïdale légèrement anguleuse; 8 pointe à faible cran; 9 fragment d'armature triangulaire (dessins : LWL/J. Piesniewski; Université de Cologne/B. Gehlen, A. Zander, K. Vogl).

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 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 (fig. 8, nos. 1-5).

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 at least some of these pieces were made of flint deriving

from southern 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 (Heinen, 2015) uncovered Final Palaeolithic and early Mesolithic finds and features in several locations over a total area of 2,723 m² (fig. 9). 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 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 12th millennium BP (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 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 excavated 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, unburnt animal remains was discovered by chance on 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. 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 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 of 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 ± 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 11,320 cal. BP Werl-Büderich is one of the oldest dated Mesolithic assemblages in Germany, or indeed in the whole of the north-west European Lowlands.

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 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. 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 (fig. 8, nos. 6-9) are made of Baltic flint and comprise a Zonhoven point with unilateral edge retouch, 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, layer 8 in Brandenburg in the northern German Lowlands (Gramsch, 2002; Groß, 2017; Groß et al., this volume). However, the inventory from Friesack 27a, seems to be slightly younger than Werl-Büderich, as it is dated to around 11 ky cal. BP at the beginning of the middle Preboreal.

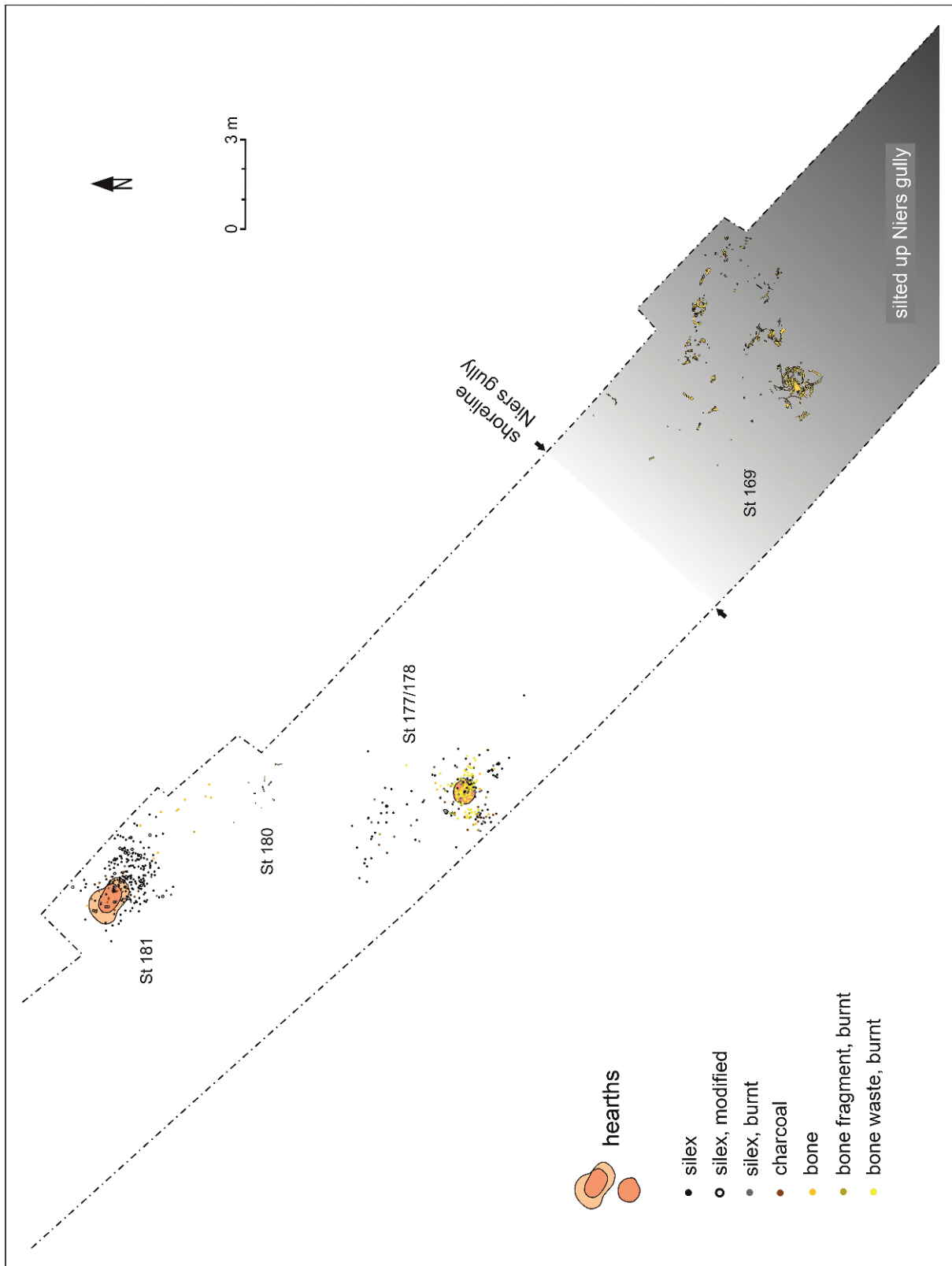


Fig. 9 – Plan of the early Holocene Mesolithic site Mönchengladbach-Geneicken (drawing: M. Heinen).
 Fig. 9 – Plan d'ensemble du gisement mésolithique de Mönchengladbach-Geneicken attribué à l'Holocène ancien (dessin : M. Heinen).

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 (fig. 10) 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 11 ky cal. BP (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 10.7 cal. BP (MAMS 18465: 9,402 ± 32 BP) and therefore to the late Preboreal-early Boreal transition (Stapel and Schösser, 2014). This fragment is similar to those from the Early Mesolithic of Friesack (Gramsch, 2011, p. 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: Heinen, 2005, p. 154-156; Gehlen, 2009, p. 373), 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



Fig. 10 – 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 11.0 ky cal. BP (photo: LWL/S. Brentführer, A. Müller, from: M. Baales et al., 2015, fig. 7).

Fig. 10 – Pic de bois d'élan caractéristique du Mésolithique ancien provenant de Paderborn-Sande. De tels outils sont typiques du Mésolithique ancien d'Europe du nord (sites Maglemosiens, Star Carr), datée à ca 11.0 ky cal. BP (cliché : LWL/S. Brentführer, A. Müller ; d'après M. Baales et al., 2015, fig. 7).

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., 2017), 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 2017), while some of the charcoal determined as willow by Ursula Tegtmeier (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 10.6 ky cal. BP provides a Late Preboreal context for the lithic assemblage (Stapel et al., 2013).

The presence of basally-retouched micro-points alongside triangular microliths shows that some influence from regions to the west 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, 2017).

The Blätterhöhle – a unique Mesolithic stratigraphy in Westphalia

Although the presence of hundreds of open-air sites demonstrates 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 like in the sandstone areas of the Göttingen forest (Lower Saxony; Grote, 1994) and northern Bohemia (Svoboda et al., 2007 and 2013). In our region the Westphalian cave and rock shelter site Blätterhöhle (see above) is of special interest for the question of Early to Late Mesolithic settlement in the northern Central European upland zone. The discovery of human remains in 2004 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, 2017 and 2018).

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 lithic artefacts and faunal remains 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 due to the existence of former hearths located at different parts of the site are dated exclusively to the Middle Mesolithic. The amount of charcoal in earlier and later levels indicate further structures which were destroyed by taphonomic processes. Microlithic spectra here correspond to the chronological periods suggested by the radiocarbon dates, and thus represent the first stratified sequence of Mesolithic artefacts to be identified at a single Westphalian site (fig. 6). Oblique retouched microliths and irregular specimens 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 – including some superficially retouched microliths of the older Rhine-Meuse-Schelde Mesolithic (RMS A; cf. Baales et al., 2013b, p. 217-218) – showing this to be the main phase of occupation at the site, as was already indicated by most dates for the hearths. 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 10.5 ky and 10.8 ky cal. BP (see table 1) and can therefore be attributed to the middle and late Preboreal (Orschiedt et al., 2010 and 2012; Bollongino et al., 2013).

An additional small human cranial fragment with an age of 11,150 cal. BP (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.

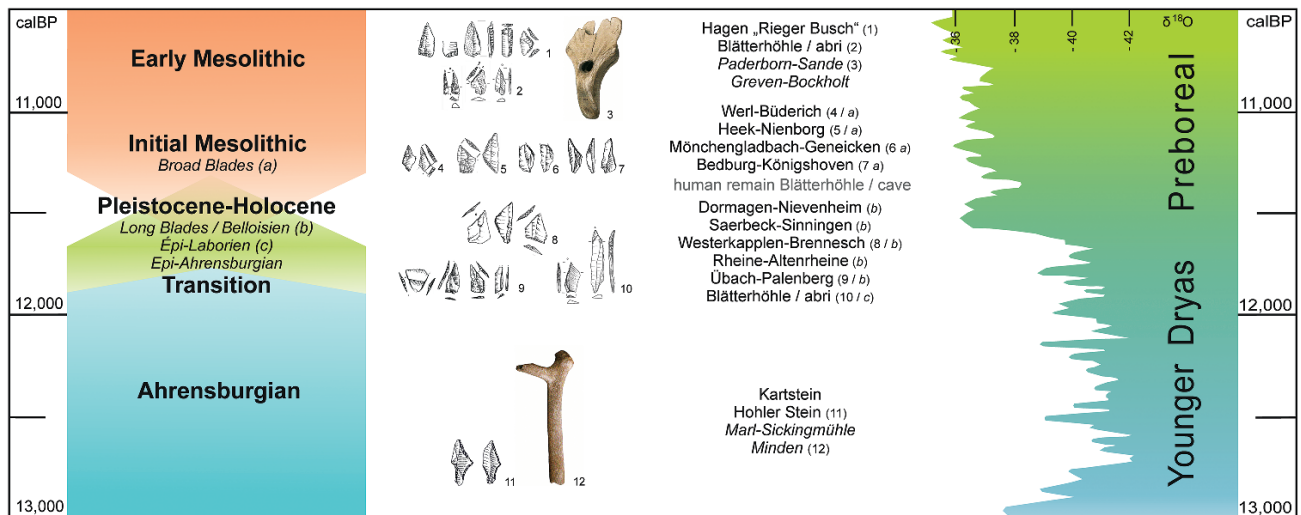


Fig. 11 – Proposed chronology for the archaeology of the Pleistocene-Holocene interface (terminal Palaeolithic – early Mesolithic) in western Germany based on the few radiocarbon dated sites and occurrence of distinct “Long Blade”, “Broad Blade” and younger microlithic inventories (illustration: University of Cologne/B. Gehlen).

Fig. 11 – Proposition chronologique de la séquence des industries attribuées à la transition entre le Pléistocène et Holocène (Paléolithique terminal – Mésolithique ancien) en Allemagne de l’ouest, basée sur les quelques sites datés par le radiocarbone et la présence de séries indiscutables de type “Long Blade”, “Broad Blade” et du Mésolithique plus récent (illustration : Université de Cologne/B. Gehlen).

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 older 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 some 10,350 cal. BP (table 1) means that this 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 produced 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 derive instead 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 (fig. 11).

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 (late) Younger Dryas. The

Final Pleistocene finds containing backed points found below Mesolithic horizons in the Blätterhöhle rock shelter are indications of perhaps sporadically westerly influences.

Sites from the region dated to the very beginning of the Preboreal appear to fall into a tradition recognised across some parts of early Holocene northern and north-western Europe, the “Broad Blade” Mesolithic (Jacobi, 1978; Street, 1998; Zander, 2016b)⁽²⁾. 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. Street, 1991 and 1999; Benecke et al., 2002; Bémilli et al., 2014⁽³⁾) 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 Hansen 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. ■

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NOTES

- (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 (Bang-Andersen, 2003; Fuglestedt, 2007; Wygal and Heidenreich, 2014; Ballin, 2016). At La Fosse in northwestern France, Naudinot (2013, fig. 2, nos. 23-27) also describes a few points as tanged points and puts them in relation to the “Epi-Ahrensburgian”.
- (2) Scandinavian and northern German sites have not been attributed to the “Broad Blade” tradition yet.
- (3) For Alizay, the chronological attribution is not completely clear, with radiocarbon dates covering the late Younger Dryas as well as the early Holocene and the sediments comprising the finds being attributed to the Younger Dryas (Bémilli et al., 2014, p. 172.).

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Swiderian lithic assemblages from Poland – some new observations and ideas

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Abstract: This paper seeks to provide an overview of lithic inventories in the Swiderian culture, sometimes also called the Mazovian, developing in areas of Poland in the Late Palaeolithic. It discusses selected aspects of typology, technology and utilization of lithic artefacts on the basis of several inventories recovered from different areas, characterized by the occurrence of both high and poor quality raw materials (i.e. Cichmiana 2, Lubrza 10, Kraków-Bieżanów 15, Suchodółka 3 and Żuławka 13).

The applied research methodology combined a morphological analysis, debitage refitting, the experimental method, use-wear analysis and quantitative approach. Typological, technological, raw material and functional characteristics of the analyzed lithic artefacts have enabled us to indicate some interesting correlations between manufacturing techniques, the morphology of lithic tools and their usage.

In general, Swiderian inventories are typified by the presence of willow leaf and tanged points, burins or end-scrapers made on thin blades. Tanged points are characterized by flat retouching on the ventral side, which was made using some stone tools.

Our studies have revealed that the distribution and usage of Swiderian lithic artefacts was well planned and focused on the production of good quality blanks, from which retouched forms (such as tanged points, end-scrapers or burins) were fashioned. Ad hoc production is fairly nonexistent in the Swiderian material culture. The technological analysis, based on the morphological features of the core reduction products, has shown that the Swiderian debitage was generally concentrated on the detachment of intended blades. The technology was associated mostly with opposed platform cores, very intensive and precise preparation of cores, reduction, renovation of cores and blade production, and the application of the soft hammer stone technique. Such types of cores are generally considered typical of assemblages attributable to the Swiderian occupation, yet sites with restricted access to good quality raw material also yielded cores almost unprepared for working. Use-wear studies performed on formal tools and a sample of unretouched products of core reduction (flakes and blades) have suggested that the implements were usually used for hunting and butchering activities, and in individual cases also for plant and wood processing. We were particularly interested in Swiderian points, which were employed as components of projectile weapons. A quantitative approach was applied in order to precisely determine the function of willow leaf points – whether they were used as arrowheads, dart-tips or spear-points.

Keywords: Swiderian, Late Palaeolithic, Projectiles, Lithic technology, Use-wear traces, TCSA analysis.

Résumé : Cet article présente un aperçu synthétique des ensembles lithiques attribués à la culture swidérienne (Swidérien) – parfois nommée masovienne (Masovien) – bien représentée sur l'ensemble du territoire polonais durant le Paléolithique final. Les caractéristiques techniques et typologiques de plusieurs assemblages provenant de différentes régions (i.e. Cichmiana 2, Lubrza 10, Kraków-Bieżanów 15, Suchodółka 3 et Żuławka 13), combinées aux approches fonctionnelles et aux problématiques d'acquisition à la matière première sont ici analysées.

La méthodologie d'étude utilisée dans le cadre de cet article combine l'analyse technologique, les remontages lithiques, l'expérimentation et les analyses fonctionnelles des assemblages. Ces analyses complétées par l'étude de l'origine des matières premières ont permis de dégager quelques corrélations intéressantes entre les modalités de débitage, la morphologie des outils et leur utilisation.

Les ensembles swidériens se caractérisent par la présence d'armatures pédonculées à retouche plate sur la face inférieure, de burins et de grattoirs généralement réalisés sur lames minces.

Les études ont révélé que la circulation et l'utilisation des artefacts lithiques swidériens étaient bien planifiées et que les objectifs du débitage étaient orientés vers la production des supports de bonne qualité pour la fabrication d'outils. La production « ad hoc » est quasiment inexistante dans le Swidérien. Les modalités du débitage témoignent d'une mise en forme particulièrement élaborée et soignée de nucléus le plus souvent à deux plans de frappe opposés pour la production de supports laminaires bien calibrés. L'utilisation du percuteur en pierre

tendre est attestée tout au long de la chaîne opératoire de la production laminaire. Cette production considérée comme caractéristique des ensembles swidériens, présente néanmoins – dans les gisements où la qualité de la matière première est moindre – des nucléus beaucoup plus sommairement préparés.

Les études tracéologiques réalisées sur les supports transformés en outils, mais également sur les produits bruts de débitage (éclats et lames) ont montré que les outils étaient généralement utilisés pour les activités de chasse et de boucherie, et dans quelques cas pour travailler des matériaux d'origine végétal et du bois. Une attention particulière a été portée aux armatures swidériennes. Une approche quantitative a été menée afin de déterminer précisément la fonction de ces pointes pédonculées à retouche plate et de déterminer s'il s'agit de pointes de flèches, de sagaies ou de javelots.

Mots-clés : Swidérien, Tardiglaciaire, Projectiles, Technologie lithique, Analyse tracéologique, Analyse TCSA.

The purpose of the presented paper is to characterize the Swiderian lithic inventories derived from Poland. As a result of the presented research, we would like to interpret Late Palaeolithic artefacts in terms of their functions and adapted technology. To characterize the technological aspect, we applied morphological analysis together with debitage refitting and microscopic analysis. To investigate the usage of lithic artefacts we combined the use-wear and tip cross-sectional area (TCSA henceforth) analysis with the experimental method. Based on the results of our investigations we made some general statements related to manufacturing techniques, the morphology of lithic tools and their function.

In our studies, we refer both to the Swiderian inventories which were excavated in the recent years and to well-known flint assemblages widely published in the literature – like Rydno (Schild et al., 2011) or Całowanie (Schild, 2014a). The group of sites linked to the Swiderian groups which were investigated in the last years includes among others Cichmiana 2 (Kabaciński et al., 2009), Suchodółka 3 (Gruźdź et al., 2012), Kraków-Bieżanów 15 (Byrska et al., 2006; Stefański and Wilczyński, 2012), Żuławka 13 (Dmochowski, 2005) and Lubrza 10 (Sobkowiak-Tabaka et al., 2018). These sites are localized in different zones – on the Polish Lowland and Upland with various access to poor (such as local erratic Cretaceous Baltic flint) and good quality raw materials (such as chocolate and Turonian flint).

SWIDERIAN

The appearance of hunter gatherers that used different forms of tanged points occurred during the last Pleistocene climatic deterioration, which took place between 12,800 and 11,400 cal. BP on a large area, from the North European Plain to southern Scandinavia, and from the Doggerland to the middle Volga river (Kozłowski, 1999; Schild, 2014b; here: fig. 1). This cultural complex called *Stielspitzen-Gruppen* – Tanged Point Groups (Taute, 1968), Pedunculated Point Technocomplex (Schild, 1984), Tanged Points Complex (Kozłowski, 1999), Tanged Points Technocomplex (Burdukiewicz, 2011) consisted of several entities, e.g. Ahrensburgian culture (Weber et al., 2011), Belloisian (Barton et al., 1991; Fagnart, 1997;

Valentin et al., 2014), Swiderian culture/Masovian (Schild, 1975; Kozłowski, 1999) and as some authors suggest Desna culture (cf. Schild, 1990; Kozłowski, 1991; Schild, 1990). The tanged points seem to have lasted in the limited area during the early Holocene which points to a complex cultural change during this time period (Stefański, 2017).

Tanged points were discovered in Poland in 1851 in Leżajsk (south-eastern Poland), published for the first time five years later in the journal *Czas* (Talar, 1968). In the early 1920s the name *Swiderian* was introduced by S. Krukowski (1921, p. 165), after the site Świdry Wielkie in the vicinity of Warsaw. Then this term was used by L. Sawicki (1923) to describe all inventories containing tanged and willow leaf points. The name Swiderian Culture was recommended by J. G. D. Clark (1936, p. 62) to label the materials similar to the Ahrensburg-Lavenstedt Culture but existing between Vistula and Bug river and also by L. Kozłowski (1936).

Up till now, only from the area of present-day Poland, more than 1,000 have been registered, located both on the Polish Plain and Uplands and even in the high mountains (Schild, 1975; Sulgostowska, 1989; Szymczak, 1991 and 1995; Sobkowiak-Tabaka, 2011).

In general, Swiderian inventories are characterised by the presence of ventrally retouched willow leaf and tanged points, end-scrapers and burins. *Swiderian points* are typified by the presence of ventral retouching of the tang. However many Swiderian inventories comprise tanged points only with a lateral retouch on both sides of the tang, the so-called Ahrensburgian point *i.e.* Wojnowo a (Kobusiewicz, 2016; Taute, 1968). Within end-scrapers both forms made on thin blades and flakes (including short specimens of the so-called Tarnowian) are present. Symmetric and asymmetric specimens occur with both flat and abrupt retouch. Burins are quite a variable category in terms of types: dihedral, on truncation, angle burins on a break, single blow burins and multiple burins. Truncations played a less significant role (with transversal, oblique or doubled truncation) as did micro-points (called Zonhoven-points). In the category of tools, perforators, borers, composite tools, notches and retouched blades and flakes are also registered. Another characteristic element of Swiderian assemblages are opposed platform cores used for blade technology, which are presented in another part of this paper (Schild, 1984; Szymczak, 2000).

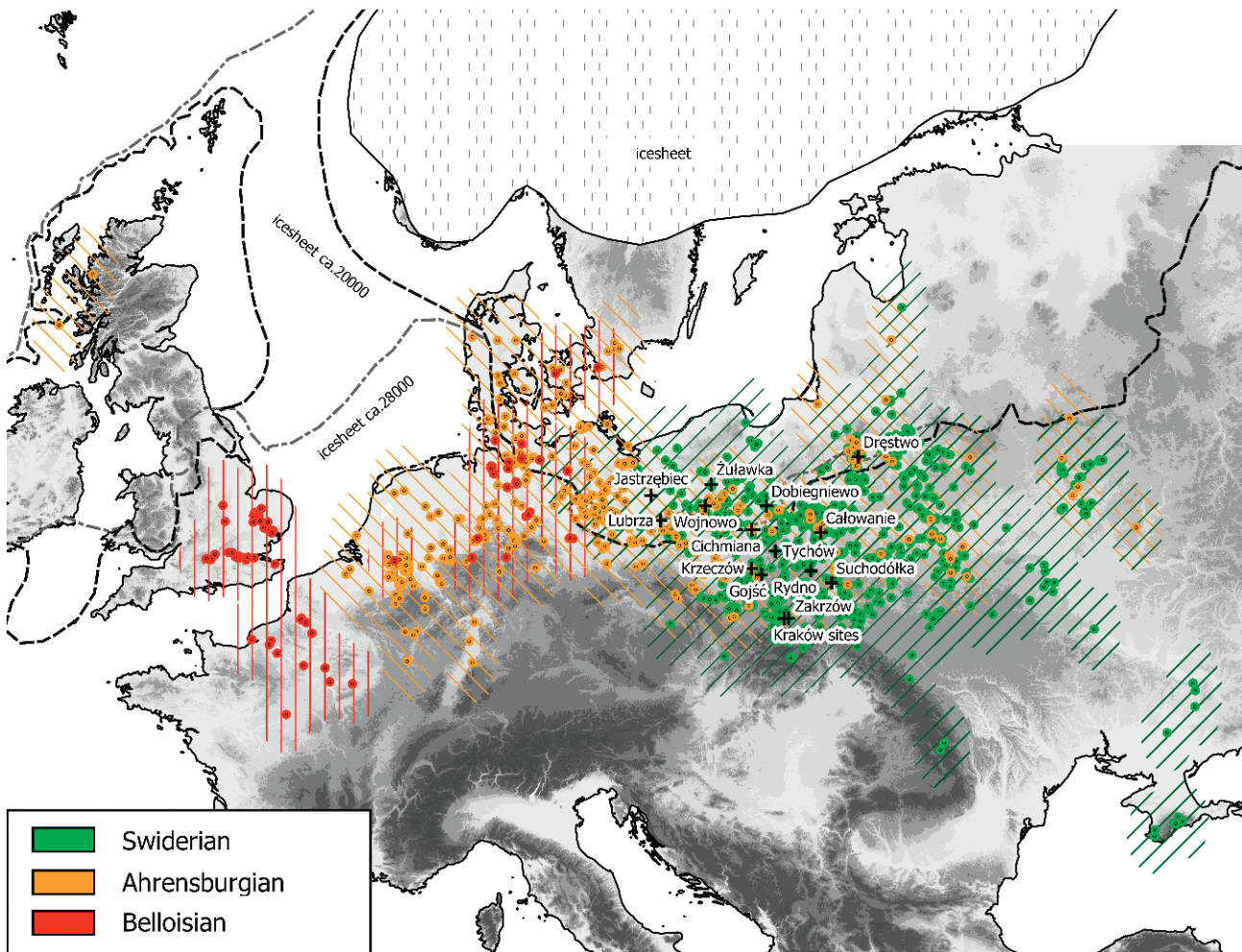


Fig. 1 – Map of Swiderian sites selected for the presented studies (drawing D. Stefański).

Fig. 1 – Carte de répartition des gisements swidériers étudiés dans le cadre de l'étude (dessin D. Stefański).

METHODS

In the course of our studies we applied three main methods – refitting, use-wear and TCSA to investigate technology and function of the tools used in Swiderian societies. Our research was based on samples from sites that were selected for analysis from different parts of Poland (table 1).

Lithic reduction was studied with the application of the refitting method. For that purpose we used materials that we had access to and lithics conjoining from sites that were already published (Dziewanowski, 2006; Fiedorczuk, 2006; Płaza, 2012a and 2012b). It is worth noting that Swiderian technology was analyzed both with the use of this method and dynamic classification quite often. Although the results of dynamic classification are useful when it comes to comparison of different distribution models of economy, this method is not designed on the level of precision (Schild, 1980) that could allow the study of characteristic features (*e.g.* flaking angles, bulbs of percussion and types of butts) giving more precise

insight into lithic reduction. The technology in our analyses was interpreted through the perspective of refittings that were attributed on typological and technological grounds to the Swiderian culture. We did not take into account assemblages of the Older Tanged Point Assemblages (Schild et al., 2011) and Wolkushian culture (Przeździecki, 2014) that are considered by certain authors as different from Swiderian. Additionally, we wanted to emphasise that most examples of reduction sequences presented on refittings we were working on were completed with the use of other assemblages in case of features that were absent in our materials.

Microscopic analysis was used to investigate technological and functional aspects of Swiderian assemblages. The work was carried out with a metallographic microscope – Nikon LV150 with magnification from 50x to 500x. The detailed interpretation of microscopic traces observed on lithics was based on the results of comparative studies – the combination of the experimental method with the microwear analysis of selected flint artefacts (*cf.* Keeley, 1980; Moss, 1983; Vaughan, 1985; Juel Jensen, 1988; Van Gijn, 1990; Levi Sala,

Site	Reffittings analysis	TCSA analysis	Use-wear analysis	References
Całowanie , lvl IVb, cut. IX			x	Winiarska-Kabacińska, 2014
Całowanie , lvl VI, cut. I	x	x	x	Fiedorczuk, 2006; Fiedorczuk, 2014; Winiarska-Kabacińska, 2009 and 2014
Cichmiana 2		x	x	
Dobiegiewo	x		x	Fiedorczuk, 2006
Dreństwo 37	x			Dziewanowski, 2006
Gojsć 1/81	x			Klimek, 2006
Grabek 11	x			Papiernik, Wąs, 2002
Jastrzębiec 2	x			Pyżewicz, 2010
Krzeczów 9	x			Plaża 2012a; Plaża 2012b
Lubrza 10			x	Sobkowiak-Tabaka, 2018; Sobkowiak-Tabaka, Kufel-Diakowska 2019
Kraków-Biechanów 15		x	x	
Kraków-Kurdwanów 10			x	Winiarska-Kabacińska, 2002
Rydno, Łyżwy Droga, Cut IV/1959		x		Schild et al., 2011
Rydno, Michałów-Piaska	x			Schild et al., 2011
Rydno, Pastwisko, IV/57	x	x	x	Fiedorczuk, 2006; Schild et al., 2011
Rydno, Sandro, I/1957	x	x		Schild et al., 2011
Rydno, U Wygonu, XI/59	x			Fiedorczuk, 2006; Schild et al., 2011
Rydno Za Rzeką VII/1959	x			Schild et al., 2011
Rydno Za Rzeką I/1980	x	x		Schild et al., 2011
Tychów	x			Chmielewska, 1978
Suchodółka 3	x		x	Gruźdź et al., 2012
Wojnowo a			x	Winiarska-Kabacińska, 1992
Zakrzów		x		
Żuławka 13	x			Dmochowski, 2005

Table 1 – List of Swiderian inventories used in the presented studies.

Tabl. 1 – Liste des inventaires swidériens utilisés dans le cadre de l'étude.

1996; Rots, 2010). The analyses were made on materials from the selected sites and were then compared with Swiderian use-wear data from literature.

The last method applied in our studies was TCSA. This method is one of the most frequently used for estimating the propulsion devices of prehistoric lithic projectile tips and is based on the comparison of the tip cross-sectional area values (Hughes, 1998; Shea, 2006; Sisk and Shea, 2011). Tip cross-sectional area is a ballistically significant dimension that can be used to differentiate between projectile weaponry types, such as arrowheads, dart-tips and spear-points. Cross-sectional areas simply inform on how much force must be used for a point to achieve penetration. Assuming that weapons delivering more kinetic energy will be armed with tips having greater TCSA values it is possible to approximately indicate their propulsion device. The method of calculating the cross-sectional area is simple and it consists of multiplying the maximal width and thickness of an artefact and then dividing the ratio by two. The TCSA measures are compared with the TCSA values of ethnographic projectile points, whose function as projectile implements is known. Extensive data on TCSA values for ethnographic projectile points is included in the works of Thomas (1978), Shott (1997) and Shea (2006). Their datasets serve as a comparative standard in this

study. For the purpose of this study a total number of 120 Swiderian points from 5 sites was analyzed. To ensure the reliability of the quantitative data, we have used sites containing 15 or more points exclusively. Fragments, which were too small to acquire the measurement of maximal width or thickness, were not included in the analysis.

DEBITAGE REFITTINGS OF SWIDERIAN ASSEMBLAGES

The studies on Swiderian lithic technology have long been the subject of numerous papers in Polish literature. One of the reasons for this is the specific production that resulted in numerous waste products that were discarded after obtaining blanks. The mentioned flint processing economy and the fact that Swiderian assemblages are the most common Palaeolithic materials recorded in Poland created a good opportunity for the application of the refitting method. There is still need for new data from further research in this field, however. In this part of our work we present an attempt to summarize our technological knowledge of the Swiderian resulting from an investigation that was carried out on refittings done by different researchers (including authors of this paper)

and published in several separate papers (Fiedorczuk, 1992 and 2006; Papiernik and Wąs, 2002; Dziewanowski, 2006; Klimek, 2006; Przeździecki, 2006; Schild et al., 2011; Grużdź et al., 2012; Płaza 2012a and 2012b). The aim of this study is to focus on methods of reduction, without broader discussion of blade production that has been presented in a separate work (Grużdź, 2018).

The Swiderian lithic technology consists of four main methods of blade production (fig. 2) that were executed with the application of direct soft stone percussion (Dziewanowski, 2006; Migal, 2007). The most common one is based on obtaining blanks from opposed-platform cores, and comes in two variants. The first one shows a dominant striking platform and the second an opposed-platform core with simultaneous blade detachment. The less frequently occurring methods are based on single-platform cores and nuclei-form burins, and are recorded usually on smaller pieces of raw material.

We would like to present each stage of the *chaîne opératoire* mainly associated with the more common methods based on obtaining blanks from opposed-platform cores.

During the first stage of debitage, the flaking surface was usually placed on the narrower side of the worked piece of flint. In some cases, when the raw material nodule was irregular, it was crested on one or both sides. Striking platforms were prepared at an acute flaking angle by removing core tablets consisting of one or a couple of flakes (fig. 3-5). Usually core tablets were crested on one or both sides. These crests were worked from the front of the core and were knapped very often to the back of the form to make it narrower

and obtain a suitable shape for the detachment of spalls that would create the desired flaking angle (fig. 3-5). During the later stages of core processing both platforms could have been rejuvenated (fig. 3-5). The first series of blades were usually massive with big butts and large, pronounced bulbs and trimming of the edge (fig. 3 and 6). This kind of blades were most common when the flaking surface was prepared on a regular but natural surface of the flint such as cortex. On some examples, usually those cores that were crested, the first blades were prepared more precisely and corresponded to forms from the advanced phase of debitage. Blade production that was performed on opposed-platform cores was aimed at obtaining blanks in two ways (fig. 7). This division was proposed by two different authors separately: W. Migal (2007) and M. Dziewanowski (2006). Both researchers found that flint production from such opposed-platform cores was done to obtain certain blanks. These blades described by the mentioned authors could be done by two strategies, a *preferential/predetermined* or as *serial* blade detachment. The first category of blade is characterized by intended shaping of the flaking surface before knapping the desired blank (fig. 7, no. 1). In this reduction, most of the detached pieces apart from the intended blade were left at the knapping site and were treated as waste products. Although authors suggest this strategy (Dziewanowski, 2006; Migal, 2007) shares some features with the Levallois concept (Boëda, 1994), there are some major differences in it when it comes to treatment of the surfaces of debitage – the flaking surface was not flat and convexities were not worked in the same way. This concept and its features correspond in our opinion more to navi-form core-and-

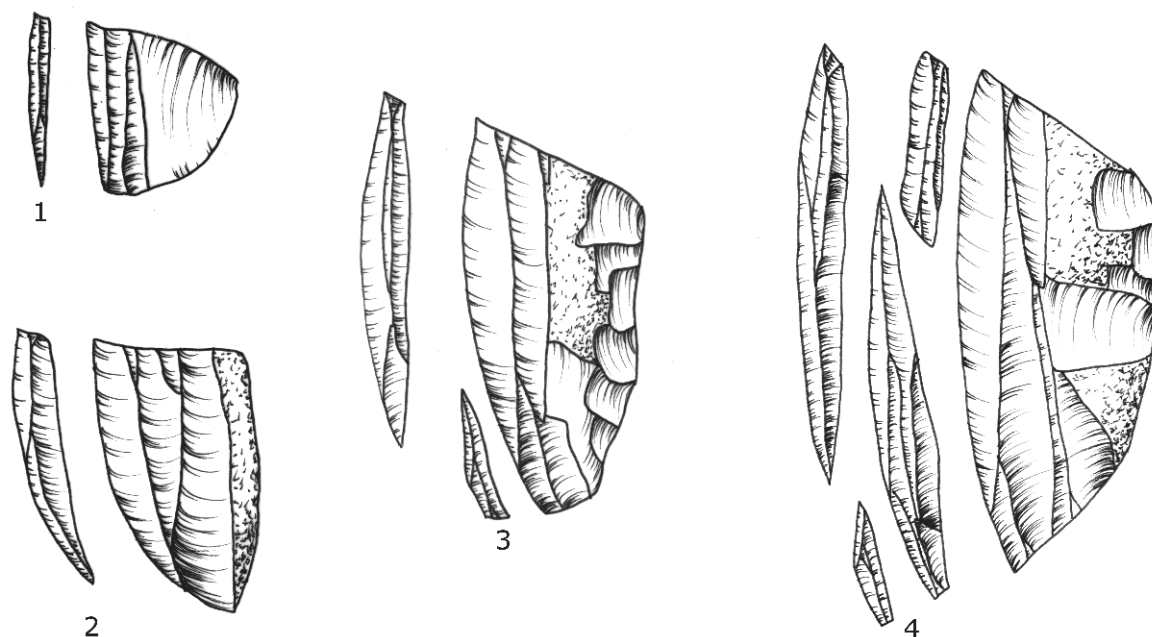


Fig. 2 – Scheme depicting methods of blade reduction in the Swiderian. 1 – nucleiform burins; 2 – single-platform core; 3 – opposed-platform core with one dominant striking platform; 4 – opposed-platform core with simultaneous blade detachment (drawings K. Pyżewicz).
Fig. 2 – Schéma illustrant les méthodes de la production laminaire dans le Swidérien. 1 – « burins nucléiformes » ; 2 – nucléus à un seul plan de frappe ; 3 – nucléus à deux plans de frappe opposés et surface de débitage principale ; 4 – nucléus à deux plans de frappe opposés et débitage alternatif (dessins K. Pyżewicz).

blade technology known from the Pre-Pottery Neolithic cultures in the Near East (Wilke and Quintero, 1994), but with a more extensive shaping pattern. The second strategy is focused on the production of blades in the most efficient manner when it comes to the blade amount per flint nodule (fig. 7, no. 2). As was already mentioned (Gruźdź, 2018), this division seems

reasonable, although it is difficult to distinguish it in an assemblage that does not have a precise context and has not been studied with more accurate methods, such as refittings or use-wear analysis. Blades detached in an advanced stage were precisely shaped by both strategies in order to maintain a proper flaking surface and to avoid eventual overshooting of the opposed platform

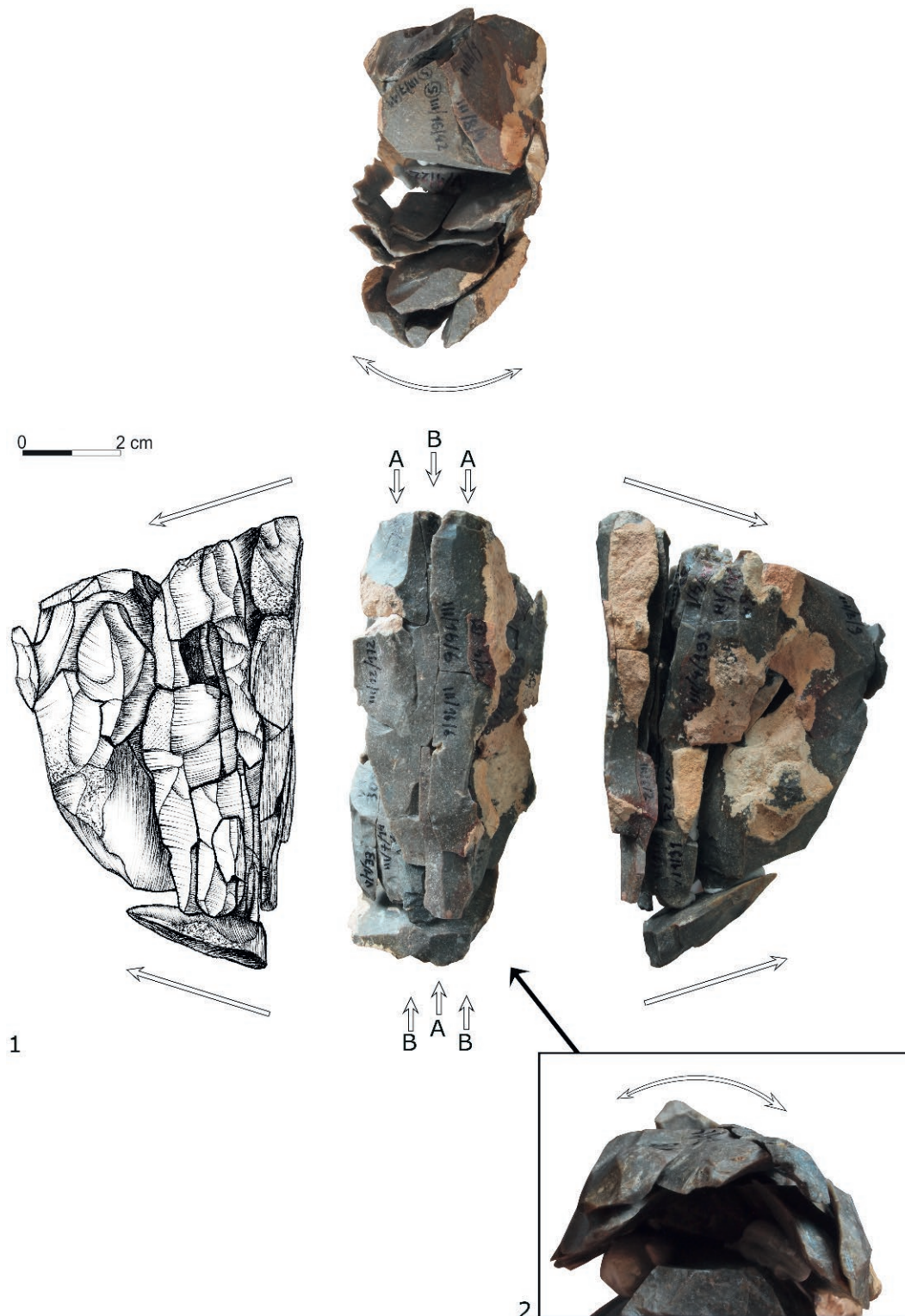


Fig. 3 – Suchodółka 3. Refitted block I. 1 – first stage of reduction; 2 – knapping progression.
Fig. 3 – Suchodółka 3. Remontage lithique du bloc I. 1 – initialisation du débitage; 2 – progression du débitage.

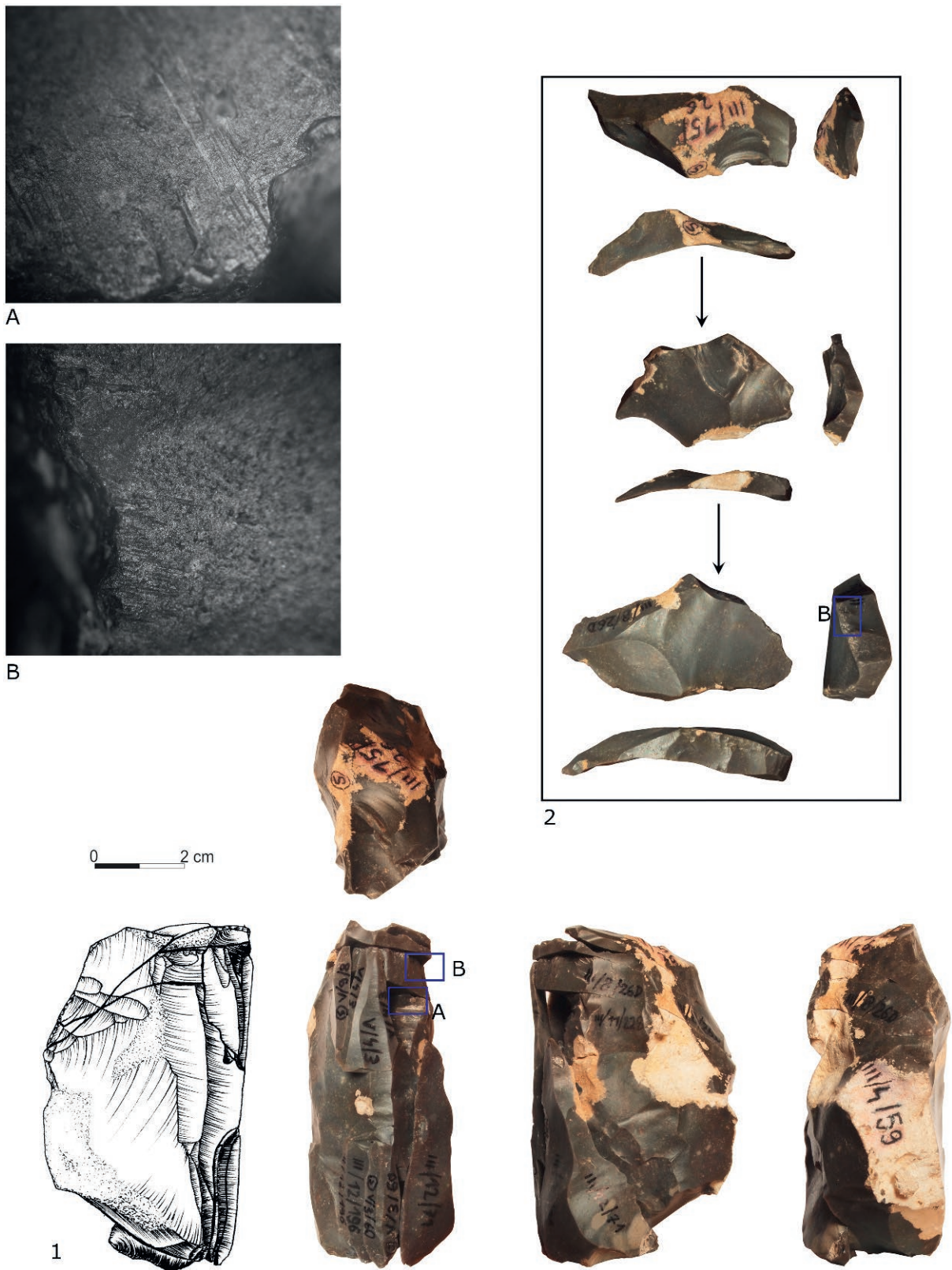


Fig. 4 – Suchodółka 3. Refitted block IV. 1 – late stage of reduction; 2 – initial crested platform flake, faceted platform rejuvenation flake, platform rejuvenation flake. A-B – technological microwear traces, original magnification 100× (photos W. Grużdź, K. Pyżewicz).
Fig. 4 – Suchodółka 3. Remontage lithique du bloc IV. 1 – dernière étape du débitage; 2 – tablettes successives d'avivage. A-B – microtraces observées, grossissement × 100 (clichés W. Grużdź, K. Pyżewicz).

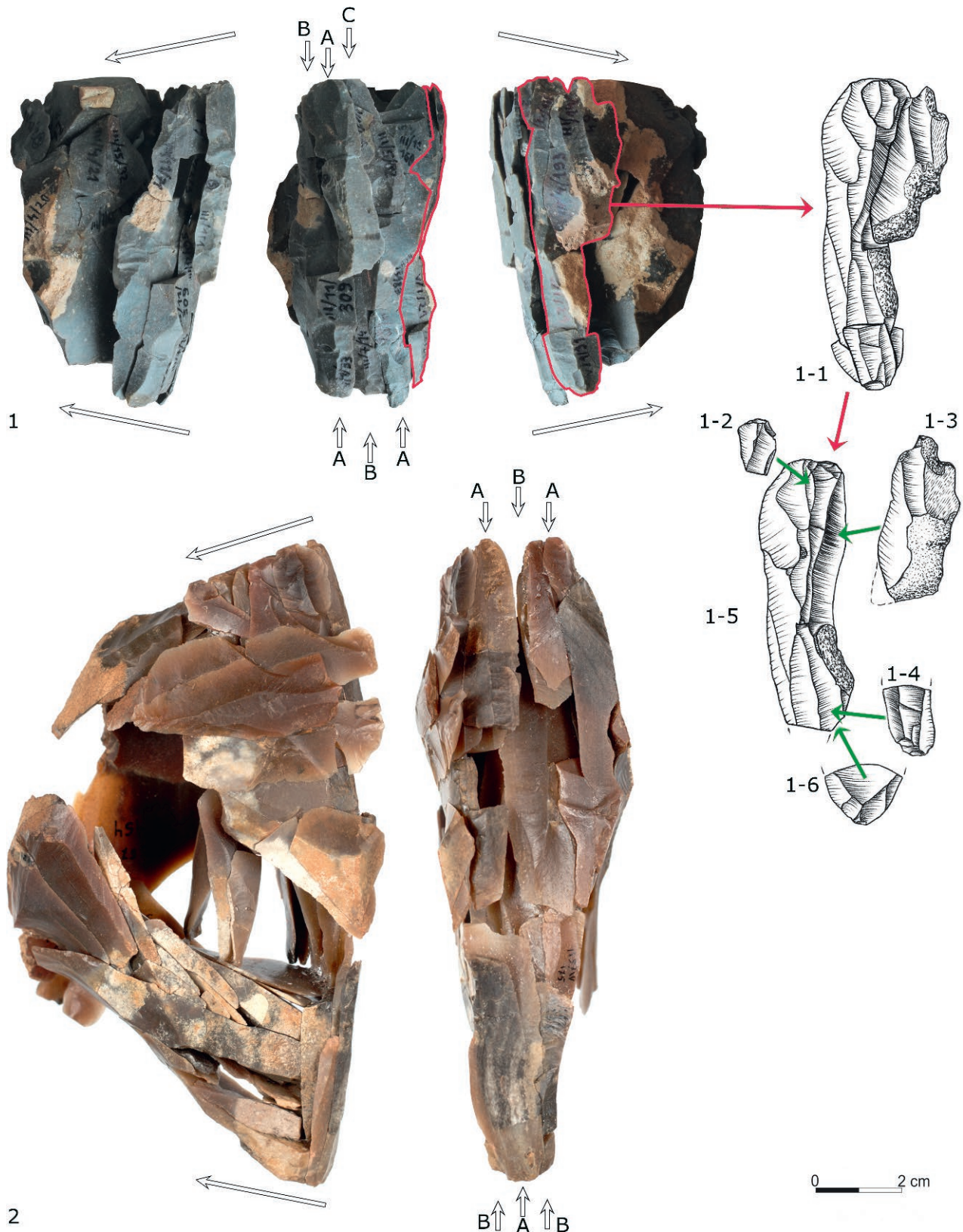


Fig. 5 – Refitted blocks. 1 – Suchodółka 3, block I. Advanced stage of reduction. 1.1 – preparation of blade and its by-products; 1.2 – flake from dorsal reduction; 1.3 – blade straightening the ridge and the edge of the future blade; 1.4 – ridge-straightening bladelet obtained to shape the distal part of the blade; 1.5 – the *intended blade* (blank shaped in the intended manner, but discarded due to its irregularity?); 1.6 – flake straightening the ridge on the striking surface (drawings Ł. Kamiński, W. Grużdź). 2 – Rydno, Pastwisko IV/57. Block 3 – knapping progression (Fiedorczuk, 2006, fig. 6; Schild et al., 2011, fig. 10.124; with authors' modification).

Fig. 5 – Remontages lithiques. 1 – Suchodółka 3, bloc I. Étape avancée du débitage. 1.1 – préparation à l'extraction laminaire et ses sous-produits; 1.2 – éclat résultant de la suppression de la corniche; 1.3 – lame de régularisation du prochain support débité; 1.4 – lamelle de régularisation de l'extrémité du prochain support débité; 1.5 – lame de première intention (mais abandonnée à cause de son irrégularité?); 1.6 – éclat régularisant une arête sur la surface de débitage (dessins Ł. Kamiński, W. Grużdź). 2 – Rydno, Pastwisko IV/57. Bloc 3 – progression du débitage (Fiedorczuk, 2006, fig. 6; Schild et al., 2011, fig. 10.124; documents originaux modifiés par les auteurs).

to the one that was currently used for obtaining the blade. During that process, producers were knapping the corrective blades, bladelets, flakes and chips to adjust the core volume (fig. 5, no. 1). Platform rejuvenation flakes in this phase of reduction were carefully trimmed and abraded, with plain, punctiform or linear butts and slightly marked or diffused bulbs. The sequence of detachment occurred in two variants. The first one, recorded on most refittings (linked with the indented shaping) – especially those made on narrow nodules of flint – was based on the detachment of blades, bladelets and flakes from the outer sides of the block and then the inner blanks keeping the flaking surface narrow (fig. 3-5). The second variant of reduction took place when the knapper removed blades from one side of the core to another (fig. 6). It seems that this sequence could be performed in the beginning of production when the producers were processing broad pieces of flint or in the last stages of debitage when the

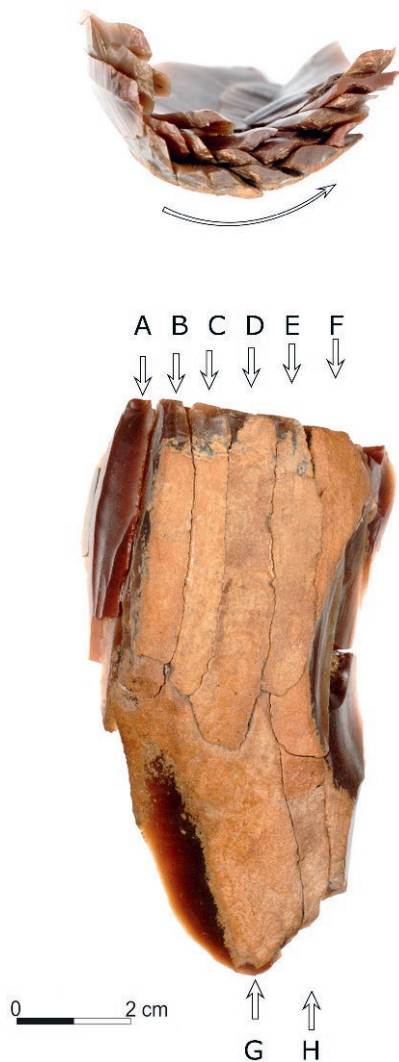


Fig. 6 – Rydno, Pastwisko IV/57. Refitted block 14a – knapping progression (Fiedorczuk, 2006, fig. 8; Schild et al., 2011, fig. 10.126; with authors' modification).
Fig. 6 – Rydno, Pastwisko IV/57. Remontage lithique du bloc 14a – progression du débitage (Fiedorczuk, 2006, fig. 8; Schild et al., 2011, fig. 10.126; documents originaux modifiés par les auteurs).

flaking surface was extended to the side. A recently published paper by B. Valentin, M.-J. Weber and P. Bodu (2014) about initialisation and progression in the Belloisian tradition may suggest modes which refer to the above presented reduction as symmetric – the first variant – and dissymmetric progression – the second variant. When it comes to the Swiderian, both blade production sequences could be influenced by modifications in some of the stages of reduction. This could occur due to the shape of the worked piece of raw material that could be irregular or have natural flaws (cracks, fossils) in it, or because of mistakes occurring in the flint knapping process. In the last stages of production, the opposed-platform cores were usually discarded because of their small size, mistakes such as hinges, overshooting of flakes/blades or exhausting of the flaking surface. In some cases, opposed-platform cores could turn into single-platform or flake cores. The last sequence of blades also might have been detached on the side of the core in the final stage of reduction resulting in a slightly twisted morphology of the core. As the previous researchers already stated (*e.g.* Kozłowski and Sachse-Kozłowska, 1976) analysing exhausted cores from the last phase of production might lead to false judgments about their affiliation to different industries or cultures occurring in the Late Palaeolithic assemblages from Poland. Nevertheless, some authors still claim that the size of the core could be an attribute of cultural affiliation (Cyrek, 1996).

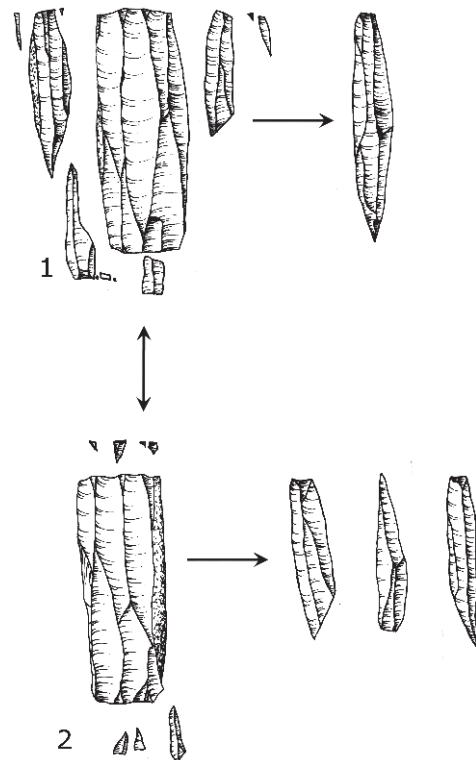


Fig. 7 – Scheme depicting strategies of reduction in the Swiderian. 1 – preferential blade production; 2 – serial blade production (drawings K. Pyżewicz).
Fig. 7 – Schéma illustrant les processus du débitage dans le Swidérien. 1 – production de lames de première intention; 2 – production de lames en série (dessins K. Pyżewicz).

MICROSCOPIC ANALYSIS

Technological traces

To confirm and complete our technological studies made on the macroscopic level, we performed some microscopic analyses of technological traces. To create a reference database we produced some experimental forms using a mineral stone hammer and antler billets by indirect or direct percussion and we characterized the diagnostic features for the listed techniques (ref. Keeley, 1980, p. 28; Vaughan, 1985, p. 41-42; Ibáñez et al., 1990; Byrne et al., 2006; Vergès and Andreu, 2011; Rots et al., 2011; Pyżewicz, 2013). To sum up, we can conclude that the observed traces (primarily the linear traces and polishes) clearly differ depending on the technique applied in the debitage. In general it can be stated that traces that were left by a hammer stone are characterized by linear striations visible as deep scratches and polishes which appear on flint surfaces as very intensive, abrasive, very bright “metallic” areas. Their orientation depends on the trajectory of the hammer. On surfaces of experimental lithics produced by antler billets by indirect or direct percussion we recognized clearly different traces. These deformations look like bright, flat and smooth areas – stripes and spots. Most polishes have a linear character, which can be explained by the trajectory of the antler billet.

In the next stage of research, we analyzed the surfaces of blade and flake butts as well as the striking platforms of cores derived from the lithic inventory from the Suchodółka site. The detailed data regarding these microscopic analyses of lithics from Suchodółka have been presented in a separate article (Grużdź et al., 2012). In general, based on experimental research and microscopic analysis of materials from Suchodółka we can confirm that the flints were produced by direct percussion with a hammer stone technique. We registered the characteristic microscopic traces on the surfaces of the cores and on the butts of the debitage products (fig. 4, nos. A-B). Additionally, using the data resulting from the application of the refitting method, we can confirm that direct percussion with a hammer stone was used at each stage of the *chaîne opératoire* (cf. Inizan et al., 1999; Pelegrin, 2000). Analogue technological traces were registered on artefacts associated with the initial stage of knapping as well as with the actual blade debitage process. The mineral hammer was also used to make some corrections, reparations or to perform the abrading process. It should be added that we noticed similar traces on the butts of some artefacts derived from Kraków-Biezanów as a result of use-wear analysis.

Use-wear traces

One of the aims of our research is to present a functional aspect of the selected Swiderian artefacts. In the recent years use-wear traces were analyzed on

Swiderian lithic inventories derived from Wojnowo (Winiarska-Kabacińska, 1992), Kraków-Kurdwanów (Winiarska-Kabacińska, 2002), Cichmiana (Winiarska-Kabacińska, 2009), Całowanie (Winiarska-Kabacińska, 2018) and Lubrza (Sobkowiak-Tabaka et al., 2018; Sobkowiak-Tabaka, Diakowska 2019). Some single Swiderian artefacts were analyzed also from Nobel, Woźna Wieś, Rudawa, Czerniejów, Kunin, Tolkmicko, Tur and Noski (Winiarska-Kabacińska, 2005). We also made some new microwear analyses relating to the lithics from Kraków-Biezanów. The detailed functional research was performed on lithic tools and some samples of unretouched products of debitage (mainly blades).

Summarizing the results of traces observed on Swiderian points it can be stated that this group of tools is mainly associated with one function (cf. Winiarska-Kabacińska, 1992, 2002, 2005, 2009 and 2014). The distinctive macroscopic and microscopic traces observed on the surfaces of Swiderian points suggest that they were components of throwing weapons. Based on results of use-wear analysis from Kraków-Biezanów (Pyżewicz et al., 2018), it can be stated that from the group of 43 tanged points, 14 were used as projectiles (10 were unused and 19 were destroyed due to post-depositional deformations). Some of these Swiderian points are characterized by distinctive macro-fractures. The analyzed group of traces includes longitudinal and transverse breaks of tips. There are some step or hinge terminating bending fractures, burin-like or spin-off fractures. Furthermore, a lot of micro-traces were noted on some artefacts, mainly polishes in the form of long, shining (in some parts disappearing) bands or short or long scratches running on one or both surfaces of flint artefacts (fig. 8, nos. 1-3 and A-C). Both types of micro-traces overlap each other. The location and direction of linear traces suggest the way of hafting Swiderian points – there is a clear relationship between the axis of shaft symmetry and the axis of the Swiderian point. Based on these data it can be suggested that Swiderian points used as projectiles were hafted parallel or slightly aslant to the axis of symmetry.

There is a possibility that also some blades without retouching from Lubrza were used as projectiles. On these artefacts similar microscopic traces as on Swiderian points were observed.

The surfaces of some Swiderian points were covered by another type of trace that resulted from contact with animal tissue, mainly hide. These polishes are visible mainly on protruding parts and usually are accompanied by rounding of these parts (fig. 8, nos. 2 and B). They can be interpreted in two ways. Firstly, these marks can be hafting traces. Simultaneously, some traces could be formed during the transportation of tools. Some hide and other organic polishes visible on some Swiderian points probably should be treated as an effect of a more permanent contact with some kinds of containers which used to carry weapons during hunting. The interpretation of the presented types of traces is confirmed by the results of experimental studies which refer to storage and transport of

lithic tools in various types of containers (*i.a.* quivers, pouches) made from skin and bone (Pyżewicz and Grużdź, 2014).

It should be added that some tanged points from the analyzed typological group were not interpreted as components of throwing weapons. They were used for animal carcasses treatment, drilling or as knives or for wood processing like some examples from Wojnowo, Cichmiana, Całowanie and Noski (Winiarska-Kabacińska, 1992, 2005, 2009 and 2014).

The results of microwear analysis clearly indicate that the end-scrapers were mainly used for hide treatment. Based on microwear analysis of 41 end-scrapers from Kraków-Bieżanów, most of them were used for scraping (16 artefacts) and some single tools (4 specimens) were associated with butchering activities (the others were unused or covered by significant post-depositional traces). Usually the retouched surfaces of the end-scraper fronts are heavily rounded and polished (fig. 9, nos. 1 and A). The same type of

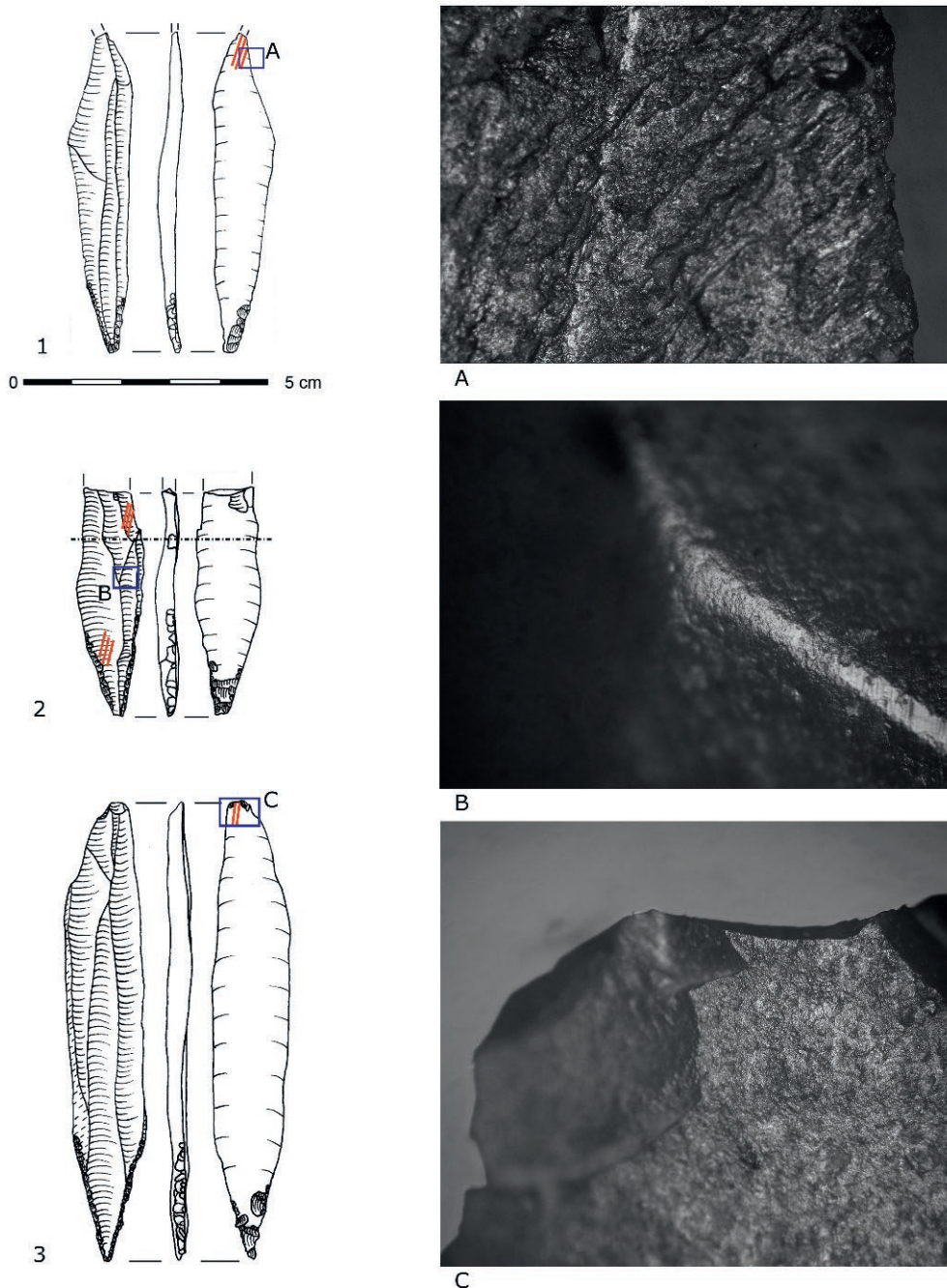


Fig. 8 – Kraków-Bieżanów 15. 1-3 – Swiderian points. A, C – linear impact traces, original magnification 50×; B – hafting traces, original magnification 100× (drawings A. Klimek; photographs K. Pyżewicz). Red lines – use-wear traces. Black interrupted line – border of hafting traces. Blue rectangle – location of the microscopic photo.

Fig. 8 – Kraków-Bieżanów 15. 1-3 – armatures swidériennes. A, C – stries linéaires d'impact, grossissement x 50; B – traces d'emmanchement, grossissement x 100 (dessins A. Klimek; clichés K. Pyżewicz). Traits rouges – traces d'utilisation. Trait noir interrompu – limite des traces d'emmanchement. Rectangle bleu – localisation de la micro-photographie.

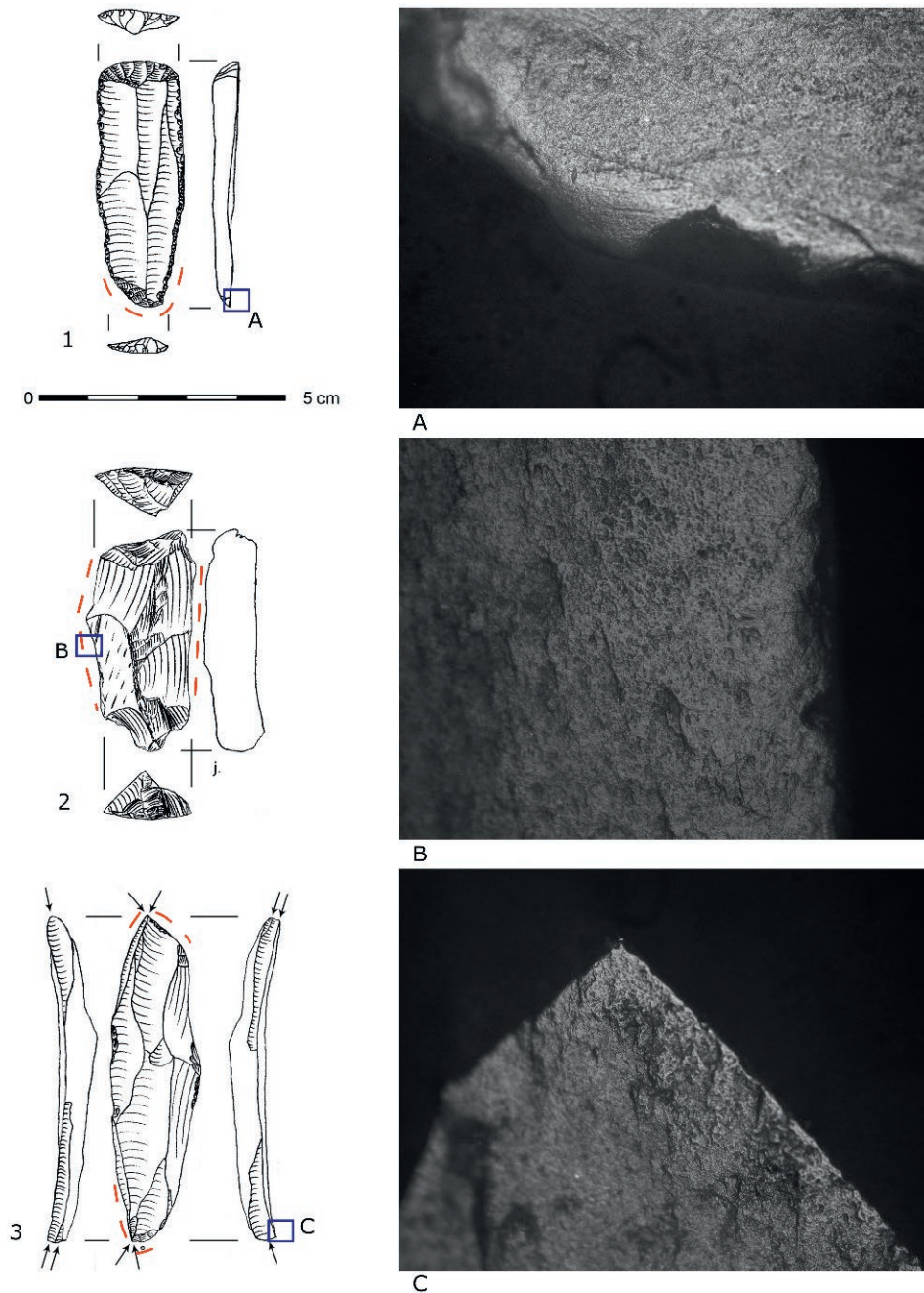


Fig. 9 – Kraków-Biezanów 15. 1-2 – end-scrapers; 3 – burin. A-B – use-wear traces (processing of skin), original magnification 100×; C – use-wear traces (working of antler/bone), original magnification 100× (drawings A. Klimek; photographs K. Pyżewicz). Red lines – use-wear traces. Blue rectangle – location of the microscopic photo.
Fig. 9 – Kraków-Biezanów 15. 1-2 – grattoirs; 3 – burin. A-B – traces d'utilisation (travail de la peau), grossissement x 100; C – traces d'utilisation (travail du bois de cervidé/de l'os), grossissement x 100 (dessins A. Klimek; clichés K. Pyżewicz). Traits rouges – traces d'utilisation. Rectangle bleu – localisation de la microphotographie.

polish was observed along the lateral edges of some end-scrapers (fig. 9, nos. 2 and B). However, there are some differences regarding the arrangement of linear traces located on polished edges. In case of tools used as scrapers, striations are arranged more or less perpendicularly to the working edge – this was recorded on the surface of end-scrapers fronts. Along the longer edges, the linear traces are usually parallel and aslant to the edge, which suggest that

these tools were probably used for cutting. Additionally, some of these artefacts are covered by single traces resulting from contact with antler or bones, so we can assume that these tools were used for butchering activities. Similar results of use-wear traces are associated with end-scrapers derived from Wojnowo, Cichmiana, Całowanie, Tur and Noski (Winiarska-Kabacińska, 1992, 2002, 2005, 2009 and 2014) – these tools were mainly used for scraping

and tanning skin, rarely processing bones and soft tissue or other activities.

The analyzed burins are a relatively diversified functional group. The burins from Kraków-Biezanów were used for scraping, polishing, grooving and cutting bone, antler or soft tissue (from 25 analyzed artefacts 14 were used in that manner, others were covered by a significant patina). The microwear traces very often cover the surfaces of the negatives of detached burin spalls (fig. 9, nos. 3 and C) and unretouched longitudinal edges. We can presume that these artefacts were used for processing, cutting animal soft tissue as well as bone or antler. At the same time, there are some examples which manifest use-wear traces only on the tips of the burin spalls of tools, which suggest grooving movements. Burins from Cichmiana were used in a similar manner, some of them were associated with wood processing (Winiarska-Kabacińska, 2009). Equally, burins from Całowanie were covered by traces which suggest various types of actions including drilling hide, graving bone, scraping antler or hide (Winiarska-Kabacińska, 2014). The individual burins from Noski and Tur were used to scraping hide (Winiarska-Kabacińska, 2005). – However, the burins from Wojnowo were used in a different way – for boring and piercing holes – (Winiarska-Kabacińska, 1992), which also identifies this group of tools as a highly diverse one in the functional context.

As an effect of microscopic analysis of unretouched blades and flakes derived from various inventories, different data were gained. As the result of microscopic analysis of the material from Biezanów, it can be concluded that none of the blades or flakes were covered by clear marks of using, whereas artefacts from Lubrza were used for herbaceous plant and wood processing (Sobkowiak-Tabaka et al., 2018; Sobkowiak-Tabaka and Kufel-Diakowska, 2019). This is a rather unusual function of tools from the Swiderian inventories. Usually lithic artefacts associated with the Swiderian inventories were used for hunting strategies and butchering activities. It is worth adding that some retouched and unretouched blades and flakes from Wojnowo, Cichmiana, Całowanie and Noski were used for work related to both the processing of animal carcasses and sometimes wood (Winiarska-Kabacińska, 1992, 2002, 2005, 2009 and 2014).

Only a small number of other types of Swiderian artefacts were analyzed, therefore the functional data are not reliable.

TCSA AND FUNCTION OF TANGED POINTS

One of the main issues raised by this study is the function of Swiderian points. Swiderian points are often considered as projectile tips, specifically arrowheads, but this assumption is usually based on morphological criteria and the similarity to other artefacts of the tanged point complex, such as Ahrensburgian points (Rust, 1958; Bratlund, 1991). Furthermore,

Site	n=
Kraków-Biezanów 15	28
Cichmiana 2	30
Całowanie VI, cut 1	19
Rydno, Grzybowa Góra, Sandro, Cut I/1957	8
Rydno, Grzybowa Góra, Pastwisko, Cut IV/1957	3
Rydno, Łyżwy Droga, Cut IV/1959	2
Rydno, Nowy Młyn, Za Rzeką, Cut I/1980	2
Zakrzów	28
	Σ=120

Table 2 – List of the specimens used in the tip cross-sectional area analysis.

Tabl. 2 – Liste des spécimens utilisés dans l'analyse TCSA.

Swiderian points are highly variable in terms of shapes and sizes, which is rather unlikely for arrowheads in terms of their aerodynamic and mechanical requirements (see the following conclusion).

For the purpose of this study we gathered a sample comprising 120 Swiderian points from eight sites (table 2). The main criteria for the selection of archaeological sites was the presence of a large number of Swiderian points in an undisturbed context with absolute dates if possible. It was not an easy task, since the number and the state of preservation of lithic points varies from site to site. The other problem was that very few Swiderian sites containing a large number of points possess reliable absolute dates. Fortunately, among the studied sample there are points from well dated sites like Całowanie, level VI, cut I and selected sites from the Rydno complex (see references in table 1), which constitute a chronological benchmark for other sites.

Aside of the use-wear analysis conducted in this study, the macroscopic observations show that 36% of the analysed Swiderian points bear the traces of diagnostic impact fractures (Fischer et al., 1984). This result yields another question, namely whether these artefacts were used as arrowheads, dart tips, or maybe as an element of some other projectile weapon system.

Microwear traces cannot be used to determine the weapon system a stone point was propelled with, since the wear traces are the same for arrowheads, spear and dart tips (Hutchings, 2015, p. 6). In order to estimate the weapon mechanism connected with the Swiderian points we used a method based on the measurement of the tip cross-sectional area (fig. 10).

The results of the TCSA analysis indicate that most Swiderian points fall into the range estimated for arrowheads. Points from Całowanie, level VI, cut I and sites from the Rydno complex (fig. 11) have higher TCSA values, which could correspond to small dart tips. This could be due to the relatively small sample size deriving from these sites (Rydno n = 19, Całowanie n = 15). Interestingly, TCSA of pointed artefacts from Kraków-Biezanów and Cichmiana are significantly below the optimal values predicted for arrowheads.

In order to ensure the statistical significance of our results we conducted a t-test for all Swiderian points

	n=	SD	Mean	Vs. Arrowheads	Vs. Dart tips
Swiderian points	120	13.15	23.26	t = -1.43; p = 0.15	t = -12.34; p < 0.005

Table 3 – Results of the t test of TCSA values conducted for Swiderian points versus ethnographic arrowheads and dart tips.
Tabl. 3 – Résultats du test t pour les valeurs TCSA des armatures swidériennes en comparaison aux armatures de flèches et de sagaies ethnographiques.

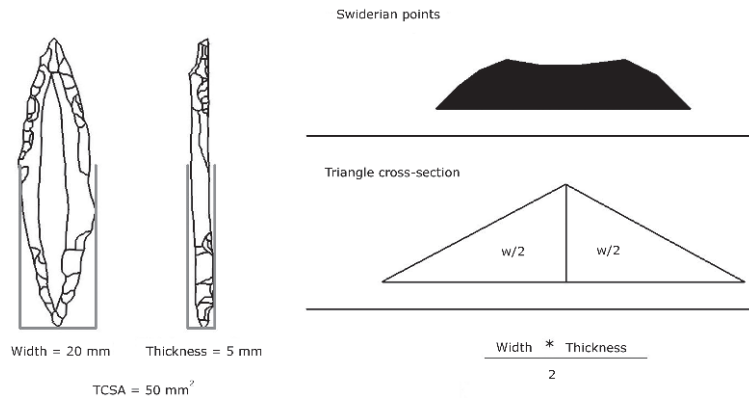


Fig. 10 – Schematic diagram showing the measurement and calculation of the tip cross-sectional area (TCSA) on a Swiderian willow leaf shaped point (after Shea, 2006).

Fig. 10 – Diagramme schématique montrant les mesures et les calculs de la section transversale de l'apex (TCSA) d'une armature swidérienne (d'après Shea, 2006).

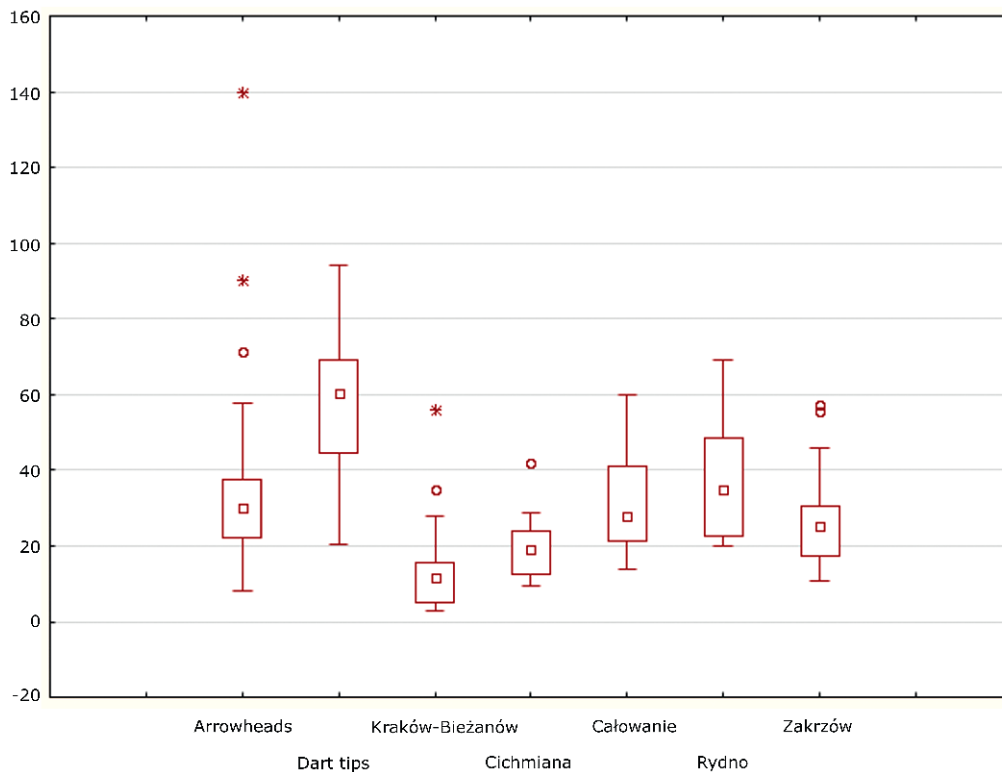


Fig. 11 – Box and whisker plot of TCSA values for Swiderian points from five sites compared to ethnographic arrows and dart tips. Data for ethnographic points taken from Thomas (1978) and Shott (1997).

Fig. 11 – Diagramme des mesures TCSA des armatures swidériennes issues de cinq sites en comparaison avec les mesures issues de flèches et sagaies ethnographiques (données des armatures ethnographiques d'après Thomas, 1978 et Shott, 1997).

versus ethnographic arrowheads and dart tips (table 3). The results of the test indicate that there are no statistically significant differences between the Swiderian points and ethnographic arrowheads with respect to their cross-sectional area.

A statistically significant difference with $t = -12.34$ occurred between Swiderian points and ethnographic dart tips (see table 3).

The results of the TCSA analysis clearly indicate that Swiderian points were most likely used as

arrowheads. This confirms the previous assumptions made about their function. The obtained results do not however solve the problem of the morphometric variability of Swiderian points. Arrowheads should be rather uniform in terms of shape and size to meet the aerodynamic and mechanical requirements of projectile weapons (Beckhoff, 1966; Cotterell and Kamminga, 1990; Kooi and Bergman, 1997). Such variability in projectile tips is probably due to the performance characteristics of Swiderian arrows – an issue which has not yet been explored.

CONCLUSIONS

The occurrence of Swiderian assemblages merely reflects the life of societies that existed on the investigated territory by the end of the Late Pleistocene, but with the given data and applied methods, we tried to shed some light from a new perspective mostly based on flint technology, tool function and its impact on the differentiation between the sites.

One of the key issues in the discussion concerning the Swiderian culture is the blank production method and technique and the aim of reduction, especially since most refittings conjoin a lot of fragments from debitage with the blades. The most current hypothesis associated with this issue is the idea of the *preferential blade*, the form being the desired aim of knapping from opposed platform cores and usually designated to be a blank for transforming into a tanged point (cf. Migal, 2007; Dziewanowski, 2012a and 2012b). The above mentioned concept does not fit into the Swiderian frame of blade detachment, which was very often characterized as a *standardized* product of core processing, done with the application of a punch technique (Schild, 1969; Ginter, 1974). With regard to the degree of the standardization we can conclude that Swiderian debitage is distinctive in comparison to the lithic inventories from other periods and derived from characterized territories. Simultaneously the blades resulting from reduction are more diversified among the Swiderian assemblages than in the case of e.g. Early Neolithic blade cores. Although Swiderian blades can be standardized (very regular and straight) this, as refittings exhibit, might be a result of skills and the quality of raw material. Our analyses confirmed that direct soft stone percussion was used during debitage (cf. Dziewanowski, 2006; Migal, 2007; Grużdź et al., 2012). This technique needs more experience and time in mastering it to the level of a repetitive gesture allowing controlled detachment of the desired products from the flaking surface in comparison to the punch or pressure technique. Additionally, maintaining two opposed platforms on a proper (sharp) angle to each other with the right convexities on the flaking surface might also result in shaping procedures which were carried out to correct this alignment. The results of these shaping procedures

are debitage pieces such as flakes and blades which are morphologically different from the intended blank.

Another factor that can influence the Swiderian core processing is the quality of raw material. Our analyses on refitted blocks from different parts of Poland exhibit that on Polish Lowland sites such as Żuławka, with restricted access to raw material of good quality, yielded cores minimally prepared for working. In such cases preparation was basically limited to the formation of the striking platform and the regularisation of the striking platform edge. The selection of blades for tools was also different and less demanding than in flint rich regions.

Microscopic analyses carried out during our studies suggest that there are also differences between sites when it comes to the use of certain groups of artefacts. Swiderian sites, where extensive flint production took place (e.g. Kraków-Bieżanów, Suchodółka), usually are characterized by tools that were used and the lack of micro-wear traces on blades linked with opposed platform core reduction. Most probably what was left at these sites were worn out tools and debitage – the waste product from their daily activities. This may indicate that blanks were produced and carried out of the site for further use and at the same time people living within the camp were using tool kits which were brought to the place from previous spots that they were occupying. Leaving behind such amounts of flint may suggest that the need for blade-blanks having certain properties was more important than raw material, which could have been easy to access. Usually flint workshops were not localized far away from outcrops which might have been linked with the seasonal visits of Swiderian populations in such areas (Ginter, 1974; Schild 1984; Fiedorczuk, 1997; Schild et al., 2011). At sites such as Lubrza and Żuławka, located far away from outcrops of good raw material, blades are covered with use-wear traces more often. What is not so surprising, but worth noting, is that the tanged points were usually used as projectiles and end-scrapers as tools for processing hide at different sites from the analysed group. In contrast, burins were tools for processing hard materials like antler, bone and wood and retouched blades and flakes had diversified use-wear traces and were probably multi-task tools. Both of the applied functional analyses (use-wear and TCSA) helped to strengthen the hypothesis that Swiderian tanged points were arrowheads used with bows. All of the mentioned arguments from functional studies and technology strongly suggest that the Swiderian population relied economically on hunting activities and a mobile style of living. ■

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Planche 1 – Quelques clichés de l’excursion « Préhistoire et Quaternaire du bassin de la Somme » réalisée le 2 juin 2016 dans le cadre du XXVIII^e congrès préhistorique de France. Excursion organisée sous la direction de P. Antoine, C. Paris et J.-L. Lochet avec la collaboration de P. Auguste, N. Limondin-Lozouet et d’É. Goval. 1 à 4 : Carrière de Cagny-la Garenne (Acheulén); 5 à 8 : gisement gravettien d’Amiens-Renancourt (photos D. Hérisson et P. Coudret).



Planche 2 – Quelques clichés de l'excursion « Préhistoire et Quaternaire du bassin de la Somme » réalisée le 2 juin 2016 dans le cadre du XXVIII^e congrès préhistorique de France. Excursion organisée sous la direction de P. Antoine, C. Paris et J.-L. Locht avec la collaboration de P. Auguste, N. Limondin-Lozouet et d'É. Goval. 1 à 4 : Carrière à Abbeville ; 5 à 8 : gisement paléolithique moyen de Caours (photos D. Hérisson).

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