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Abstract

Northern France and the Near East play and have played a central role in the debate around the Lower Paleolithic (LP) to Middle Paleolithic (MP) boundary. In the early 1990s, the renewed Saalian record for Northern France began to outline a mosaic model of the LP to MP transition—mainly based on Tuffreau's works. It implied the coexistence of Upper Acheulean assemblages (numerous bifaces with few standardized retouched flakes), 'Epi-Acheulean' assemblages (rare bifaces and diversified retouched flakes) and Mousterian assemblages (Levalloisian industries) during the Marine Isotopic Stage (MIS) 8–6 period. Since the 2000s, the discovery of new key sites and enhanced field and laboratory methods are challenging this model. We present first a brief historical summary of previous approaches to the LP to MP boundary in Northern France. A large dataset of Saalian archaeological units available from previous works has been updated and expanded to include additional sites. This allows us to demonstrate that the current Saalian record from Northern France is both rich and sparse, as it is heterogeneously biased through time and space, and that these biases limit the accuracy of any attempt to model the LP to MP transition. Nevertheless, we describe the differences between pre-MIS 9 and MIS 9 and MIS 8–6 records for lithic industries and discuss whether the current periodization is still relevant considering new data on technological, behavioral, and cultural changes. The comparison between Northern France and Near Eastern records allow to distinguish regional cultural patterns from global trends in lithic trajectories of change and determine how they slotted together. Our review of the available data from these two distant regions confirms that the LP to MP transition is probably one of the major cultural shifts in human evolution.

Keywords: Cultural trajectories; Late Middle Pleistocene; Levant; North-western Europe; Lithic technology; Taphonomy

1. Introduction

The adoption of Levallois debitage at the onset of the Middle Paleolithic in a large part of the Old World occurred from MIS 9 onward, from Western Europe to the Near East, but precise timing of this appearance varies regionally from Marine Isotopic Stages (MIS) 9 and 6 (Fontana et al., 2010; van Baelen and Ryssaert, 2011; White et al., 2011; Moncel et al., 2012; Picin et al., 2013; Adler et al., 2014; Hérisson et al., 2016a; Malinsky-Buller, 2016a,b; Soriano and Villa, 2017). This implies that we need to focus our analysis on the Lower to Middle Paleolithic boundary across the continents, if we want to detect and understand the mechanisms involved. In this paper to aim to explore a long-distance comparison between two regional records, rarely compared. We show how can the archaeological record in Northwestern Europe, and more particularly in Northern France, contribute to enhancing our understanding of the Lower Paleolithic (LP) to Middle Paleolithic (MP) boundary in the Near East, even with distance separating Northwestern Europe from the Near East.

During the Pleistocene, Northwestern Europe and the Near East experienced very distinct anthropological and paleoenvironmental trajectories. In the current state of knowledge, a single lineage of hominins, referred to as the Neandertal lineage, is known in Western Europe during the Middle Paleolithic (Hublin 2009). The situation is more complex in the Near East, where at least two hominin lineages —*Homo sapiens* (anatomically modern humans [AMH]) and *Homo neanderthalensis* (Neandertals)—seem to have shared or to have successively occupied territories in this area during the whole Middle Paleolithic, and probably interbred several times (Simonti et al., 2016; Hershkovitz et al., 2018). From an environmental perspective, the Middle Pleistocene climatic oscillations had a profound impact in Northwestern Europe, as attested by the faunal record and other proxies. These paleoenvironmental changes greatly affected human settlement dynamics in the northern latitudes of Europe, and generated discontinuity in the settlement of these high European latitudes (Roebroeks et al., 1992; Tuffreau, 1992a; Tuffreau and Antoine, 1995; White and Schreve, 2000; Ashton and Lewis, 2002; Gamble, 2009; Roebroeks et al., 2011). At the same time in the Eastern Mediterranean area, environmental changes induced by climatic oscillations (Vaks et al., 2006;

Frumkin et al., 2011; Müller et al., 2011) were buffered compared to northern latitudes and are often difficult, or even impossible to detect by examining paleoenvironmental proxies in archaeological contexts. This environmental stability is particularly significant when we look at the constant faunal record in the Near East (Speth, 2012), unlike in Northern France where species migrations and replacements occurred at almost each climatic cycle (Auguste, 2009).

Such contextual differences must not be viewed as an obstacle to undertaking fruitful comparisons, but rather as a way of isolating evolutionary tendencies shared by these distant areas, especially in the field of technological repertoires. If common tendencies exist between the Near East and Northwestern Europe, then considering the nature and modalities of the transition between the Lower Paleolithic and the Middle Paleolithic may demonstrate that the weight of 'climatic driving', as viewed by Foley and Mirazón Lahr (1997, 2003; see also Mirazón Lahr and Foley, 1998) and/or the exclusive role of AMH in technological innovations at the LP to MP transition would be called into question. In this case and at the most, we could expect that the 'climatic driving' and the role of AMH only impacted regional cultural trajectories and not broader technological evolutionary trends. Thus, we must distinguish regional cultural patterns from global trends in lithic trajectories of change and determine how they slotted together.

In this paper, we propose examining the passage from the Lower Paleolithic to the Middle Paleolithic in Northern France with references to the broader Northwestern European record. Our review focuses on a narrow range, from MIS 9 to MIS 6, a period during which we observe the main changes in lithic repertoires in this region, moving from the Lower to Middle Paleolithic toolkit. This area is of particular interest for several purposes. Owing to the pioneering work of Commont (1913), Northern France has historically played a leading role in the recognition of Levallois debitage, which is now considered by numerous scholars as a hallmark of the Middle Paleolithic. The significance of Levallois debitage for the emergence of the Middle Paleolithic is a central issue of this paper.

Before the discovery and dating of Biache-Saint-Vaast in the mid-1970s (Sommé, 1978; Tuffreau, 1978), the Middle Paleolithic was thought to have begun no earlier than the Last Interglacial, in agreement with the chronocultural framework proposed several decades earlier by Bordes (1950, 1981, 1984). In this latter model, the Upper Acheulean, described in brickyards from the Paris Basin (Bordes, 1954), developed up to the end of the Riss. From a historical point of view, it is interesting to recall that Tuffreau (1982) challenged this view at the 1980 Haifa symposium edited by Ronen (1982). Tuffreau (1982) emphasized the discrepancy between this traditional view of Lower Paleolithic and Middle Paleolithic chronology and the results from excavations at Biache-Saint-Vaast, which revealed industries similar to more recent assemblages from the late Middle Paleolithic. But the Biache industries were recovered from Saalian deposits, and undoubtedly predated the Last Interglacial leached brown soil (Tuffreau, 1982). A systematic review of the evidence from Northern France and the results from excavations carried out at Biache-Saint-Vaast allowed Tuffreau (1987) to propose a revised model where the Early Middle Paleolithic (EMP) from Northern France included Upper Acheulean industries with numerous handaxes (Gouzeaucourt, Vimy), industries with scarce handaxes associated with evolved tools on flakes described as Epiacheulean (Bapaume), and others included in the Mousterian complex (Biache-Saint-Vaast). According to him, the Mousterian industries from Champvoisy and La Cotte-de-St. Brelade level G seemed to emerge as early as the beginning of the late Middle Pleistocene. Nevertheless, Tuffreau (1987) wrote that the chronology of the Upper Acheulean and Epiacheulean was still difficult to ascertain and it was problematic to assess whether or not they persisted up until the end of the late Middle Pleistocene.

Later, industries from Gouzeaucourt and Longavesnes, characterized by numerous handaxes with an Acheulean morphology, in association with stable types of retouched tools on flakes announcing the Middle Paleolithic toolkit (Tuffreau and Bouchet, 1985; Marcy, 1989; Ameloot-Van der Heijden, 1993) were called ‘Paléolithique moyen de facies cambrésien’ (PMC; Tuffreau et al., 1989). According to Lamotte (1992), the PMC industry from Gouzeaucourt associated technological and typological characters from both the Lower Paleolithic and Midde Paleolithic and could thus be considered to be transitional.

The Middle Paleolithic character of the PMC industries was not supported by Soriano either (2000), but he still considered that typical Middle Paleolithic industries and industries with a technological package inherited from the earlier Acheulean coexisted from MIS 8 to the end of the Saalian, and that this cultural diversity was also observed in the southwest of France (Soriano, 2005). As for Tuffreau (1987), he maintained that the transition from the Lower Paleolithic to the Middle Paleolithic involved a long coexistence of industries with very different toolkits.

The main problem is that this scenario allocates almost the same degree of confidence to all sites and their stratigraphy. The definition and chronology of the Upper Acheulean and Epiacheulean in Northern France rely exclusively on sites with stratigraphies and chronologies established 30 to 50 years ago, prior to the development of dating methods (i.e., thermoluminescence [TL], optically stimulated luminescence [OSL], electronic spin resonance [ESR] dating), geoarchaeological analysis, and the use of taphonomy in archaeological studies. Understanding and interpreting the timing of changes is directly linked to the accuracy of this chronological framework. For these early moments of human prehistory, we are confronted with qualitatively heterogeneous chronological data that need to be considered hierarchically in order to build a secure scenario (Hérisson et al., 2016a). The introduction of a hierarchy in the late Middle Pleistocene evidences from Northern France was recently proposed by Hérisson et al. (2016a), following the method introduced for the Middle Paleolithic record in Southwestern France (Guibert et al., 2008).

Northwestern Europe, especially Northern France has developed geological and geomorphological research programs on fluvial and loess archives over the past decades. The enhanced chronostratigraphic sequence, resulting from the renewed excavation of sites discovered in the 19th century and the development of large-scale rescue excavations in accordance with heritage management policies, provides a robust framework for the timing of changes (Antoine et al., 2016a; Locht et al., 2016). With the growing body of evidence and with the secure chronological framework established by the long pedostratigraphic sequence from Etricourt-Manancourt (Hérisson et al., 2016b), together with a discussion based on sites with the most accurate MIS correlations

(Hérisson et al., 2016a), we can ask whether most, if not all the evidence from Northern France previously described as Upper Acheulean, Epi-Acheulean or PMC and considered to date from MIS 8 to early MIS 6 might now be pushed back to MIS 9 or earlier. This would lead us to move from a long transitional model to a more abrupt shift from the Lower Paleolithic to Middle Paleolithic in Northern France, as we argue below.

Why is the Lower to Middle Paleolithic transition so difficult to understand? An accurate chronological framework is necessary but insufficient because it does not guarantee the continuity and the representativity of the archeological record. The question of the transition from the Lower to Middle Paleolithic, like others relative to changes during the Pleistocene, is largely dependent on the degree of continuity in the available archaeological record. We hypothesize that the late Middle Pleistocene record (from early MIS 9 to late MIS 6) in Northern France is both geographically and chronologically biased due to diverse geological factors. We need to address the problem of continuity vs. discontinuity of technological traditions in order to determine whether typological and technological changes in lithic assemblages are abrupt or gradual. Our ability to examine where the archaeological record stands between these two opposed cases depends on the quality and the continuity of the archaeological record itself. The more discontinuous the archaeological record, the more we tend to surmise that the LP/MP boundary is marked by total technotypological turnover. Is the archaeological record at the LP/MP boundary in Northwestern Europe dense enough to overlook this problem? We develop a macrotaphonomic analysis (as in Soriano, 2005, 2013) and demonstrate that for the period of time considered here, the archaeological record from Northern France is characterized by a heterogeneous density of data throughout time and space depending on the geological context. In most, if not all, cases, the archaeological record is patchy, highly biased and it is impossible to evaluate the gap between the original density of occupations, the portions preserved from erosion and dismembering, and the (small) parts discovered to date. Preservation biases in Northern France, Northwestern Europe, but also elsewhere, cannot be ignored as they probably alter our perception of the progressiveness of changes in lithic industries at the LP/MP boundary. They also call into question attempts to model population growth based on late Middle Pleistocene preserved and excavated sites.

2. Materials and methods

2.1. Materials

The main geographical area investigated in this paper is Northern France, as defined by Tuffreau (2001), less the southern part of the Seine Basin, in order to obtain a coherent area with the traditional intervention zones of research teams. Northern France thus defined includes the northern part of the Seine Basin, the basins of the Manche rivers (Somme, Authie, Canche) and the French part of the Escault and Lys basins (Fig. 1).

Rivers incised the calcareous plateau of the Paris Basin throughout the Pleistocene, forming an open landscape mainly made up of plateaus and valleys. Only the Boulonnais revealed Paleolithic occupations in rock shelter but the data from these old discoveries are no longer available (Fagnard, 1988). The whole Paleolithic record comes from alluvial sequences, loess sequences, dolines, and local slopes or aeolian deposits (notably in Tertiary foothills). The sites referred to in this paper have undergone taphonomic, chronostratigraphic, chronoclimatic and paleoenvironmental studies, and have been published and summarized in recent papers with site-by-site references (Hérisson et al. 2016a; Locht et al., 2016). The current corpus is based on a long process of data accumulation derived from sites discovered from the 19th century until today. Two complete regional summaries have also been established, including the early Middle Paleolithic (Tuffreau, 1987; Hérisson, 2012). The region includes reference sites for the end of the Lower Paleolithic and the beginning of the Middle Paleolithic, such as the Cagny complex, Biache-Saint-Vaast, Therdonne and Etricourt-Manancourt. These sites with high chronological resolution provide key evidence of the onset of the Middle Paleolithic and make a considerable contribution to the identification of all the facets of this crucial period. The record from Northern France is compared to the Northwestern European record based on the data collected and published in Hérisson et al. (2016a) and to the record in the Near

East, based on the data presented in recent publications (e.g., Malinsky-Buller 2016; Ron Shimelmitz et al., 2016a, b; Zaidner and Weinstein-Evron, 2016; Malinsky-Buller and Hovers, 2019; Meignen, Bar-Yosef, 2020; see also additional references papers cited below).

2.2. Methods

Building the regional chronoclimatic and paleoenvironmental scheme The chronoclimatic and paleoenvironmental framework for the Pleistocene in Northern France is founded on taphonomic and pedostratigraphic data, datings and environmental multiproxy analyses in continual development (Antoine et al., 2016). On the basis of the study and integration of hundreds of individual profiles, it has proved possible over the last thirty years to build a coherent pedostratigraphic scheme (Antoine et al., 1999, 2003, 2014, 2016; Locht et al., 2016) linking the alluvial terraces and associated deposits with the covering loess sequence. With this sequential regional scheme, a precise chrono-climatic phase can be assigned to the associated sites (Locht et al., 2014). According to Antoine et al. (2016a: 7), "Phases are structured on the basis of a chrono-climatic subdivision (Paepe and et Somme, 1970), relying on the definition of large and globally homogeneous periods from the perspective of the type of palaeoenvironmental and pedosedimentary response Interglacial/Early-glacial (EGL)/Lower Pleniglacial (LPG), Middle Pleniglacial (MPG), Upper Pleniglacial (UPG), Lateglacial (LGL)". The analysis and correlation of all the sequences and sites resulted in a rich and complex terrace and loess soil reference sequence in which accurate correlations can be established between many marker horizons. In this way, a summarized regional record can be correlated with the MIS of the LR04 stack (Lisiecki and Raymo, 2005).

Macrotaphonomy of the late Middle Pleistocene record in Northern France Taphonomy is a branch of paleontology designed to understand and describe why, how and to what extent, remnants of the past, material objects or structures, were altered, disorganized or biased as a result of the effects of natural processes (geological, biological…) throughout time (Efremov, 1940). For decades, this field of research focused on mammalian faunas, in particular to discriminate the contribution of carnivores and early hominins in bone accumulations (Boaz and Behrensmeyer, 1976; Shipman, 1981; Behrensmeyer and Hill, 1988; Lyman, 1994). It was later extended to all kinds of archaeological remains and not limited to the effects of natural processes on these remains (e.g., Théry-Parisot et al., 2010; Peresani et al., 2011), but also to anthropogenic modifications and their relationships with natural agents. This concept was also applied at the scale of archaeological sites themselves to evaluate their degree of reworking (Vallin et al., 2001), or even at a larger scale—landscape scale (Zilhão and d'Errico, 1999)—and can be considered in this case as macrotaphonomy. Our aim is to examine the late Middle Pleistocene sites from the area considered here (Fig. 1) using a macrotaphonomical approach in order to assess the representativeness of these sites and to determine to what extent the archaeological record is biased.

The dataset from North-eastern France in Hérisson et al. (2016a: Table 5) was marginally adjusted to match with a geographic area including the territories delimited by the course of the Seine River, then by the lower Aube River, as in Hérisson et al. (2015: Fig. 6) and completed by several archaeological units, with a low density of remains or with only a few remains, not included in this previous work. This dataset includes 68 archaeological units from 33 late Middle Pleistocene sites (Table 1). The archaeological levels were recorded using criteria available in the literature or determinable from available data, including chronological attribution, topographic position of the site at the time of occupation, chronoclimatic position (from Interglacial to Pleniglacial), excavated surface, density of lithic remains, sedimentary context (fluvial vs. loessic deposits) and number of archaeological levels of the site. Archaeological units with chronologies (MIS correlation) rated with a high degree of confidence (from 3 to 5) by Hérisson et al. (2016a) were treated separately from less confident ones (rated 1 or 2).

Technological approach Most of the lithic assemblages from Northern France presented here were studied by the authors. The same methodology was applied to all the lithic assemblages, and is explained in depth in Soriano (2000) and Hérisson (2012). We adopted a chaine opératoire approach in order to reconstruct the different steps of the lithic production systems and their internal links.

This concept derives from the “general proposition of Mauss (1968) to extend the field of ethnology to these humble and trivial human behaviors that are the techniques of the body, and, a fortiori, to any technical action. In order to understand how a material operation is specific to a particular group, first of all, we must try to decipher the way in which various elements (energies, tools, gestures, knowledge, actors, materials) are linked during processes that modify a material system" (Lemonnier, 2004: 1, our translation from the French language). In this paper, we apply a classification founded on the structure of cores and the technical characteristics of blanks, following Boëda (2013).

We also use the concept of ramification, recently developed in lithic studies in the French literature (Bourguignon et al., 2004; Mathias, 2016). It is pertinent to explain how it articulates with recycling. Schiffer (1987), then Shott (1996: 265), considered that “recycling extends the utility of tools beyond their original design or purpose”. On a broader level, a Paleolithic flint implement (retouched tool, blank, core) is recycled when it is treated almost in the same way as a raw material, i.e., independently of any previous structure and features of the object and planning. As explained by Rios-Garaizar et al. (2015), the term ramification was proposed as a way to bypass the usual rigid technological categories (cores, flakes, byproducts, tools, waste), aiming to describe a complex architecture of flint production where the status of any element can change to meet the functional and economic requirements of Middle Paleolithic societies. This was observed especially in Quina Mousterian industries where any volume of knappable material is managed as a matrix that can be exploited alternatively as a core or as a blank for tools, frequently transverse or déjeté scrapers (Bourguignon, 1997; Hiscock et al., 2009; Faivre, 2011). In this way, the term ‘ramification’ was retained to describe the treelike structure of blank production and use (Bourguignon et al., 2004). It is not opportunistic like recycling but planned within the frame of the lithic system. Not all Mousterian industries are structured that way so this can be considered as a particular feature of Middle Paleolithic technical identities. The whole lithic system can be ramified (as in the Quina

Mousterian) or only a component of the lithic system as evidenced by one of us in an EMP industry from Central Italy (Soriano and Villa, 2017).

With these technological elements, we can observe the temporal repartition of each chaîne opératoire in the Saalian record in Northern France and propose a schematic model of technological changes for the LP/MP boundary. This regional scheme is then compared to Northwestern Europe and the Near East and put into anthropological, sociocultural and environmental perspectives in order to interpret the observed changes and tendencies in the different regions.

3. Results

Most, if not all archaeological records are biased, including those from the most recent periods. Only small portions of archaeological occupations were fossilized and only some of them have been recovered to date. The preserved parts of these portions cannot necessarily be directly correlated with the age of the site (i.e., the oldest occupations are not always the least preserved). Due to the patchiness of Pleistocene deposits, we can also assume that site preservation is highly geographically variable. Our hypothesis is that the late Middle Pleistocene record (from early MIS 9 to late MIS 6) in Northern France is disparately biased. We aim to determine if this can alter our capacity to interpret changes in lithic traditions between the Lower and Middle Paleolithic.

The geological factor is the main source of depletion of the archaeological record, as it is responsible for the erosion of earlier deposits. Moreover, during some periods, there were no geological deposits to fossilize human occupations. However, other factors must also be taken into account. The strong impact of human activities on the landscape—notably since the beginning of the Industrial Revolution —induces more destruction of archaeological sites than geological factors. Heritage management policies and methods of preventive archaeology can also generate biases in our knowledge of the archaeological record when field research is intrinsically focused on specific geomorphological or topographical contexts, for example. More generally, the history of research has a non-neutral effect on the representativeness of the data we collect for Pleistocene periods.

3.1. Tracking biases in the record

We can first of all note that our data are unequally distributed throughout time and that this distribution is divided into two qualitative groups—one (Fig. 2A) clustering archaeological units from sites rated with a confident (5 to 3) MIS correlation value and the other (Fig. 2B) grouping archaeological units with uncertain chronological interpretations. This may mean that occupations and sites from certain periods of time provide more accurate chronologies than others. In particular, those from MIS 8 or 6 are more underrated than those from MIS 9 or 7. This could perhaps be explained by differences in depositional contexts as occupations preserved in fine-grained fluvial deposits, mostly those from MIS 9 or MIS 7, are much more represented in the first qualitative group (Fig. 2A). Occupations confidently dated to MIS 8 are very infrequent in Northern France compared to the previous MIS 9 period. On the other hand, MIS 7 occupations are just as represented as MIS 9 occupations.

The pattern appears to be clearer when archaeological units (only those with MIS correlation values from 5 to 3) are organized according to the corresponding chronoclimatic phases (Fig. 3). Occupations fossilized in fine fluvial deposits cluster from Late Glacial to Late Interglacial/Late Interstadial phases, whereas from the Early Glacial to the Pleniglacial, occupations are only documented in loess or loess-derived deposits. This means that during temperate or cold/temperate phases during the Saalian in Northern France, the possibility of discovering preserved occupations outside fluvial formations is reduced. If we consider that fluvial terraces are very patchily preserved and not preserved at all in some watercourse sections, we can begin to measure the extent of biases.

In addition to the deposition patterns of different types of Pleistocene sediments in Northern France according to chronoclimatic phases, the preservation of Paleolithic occupations can be due to natural hazards or to the very localized development of some deposits. We know that some types of geological deposits that occur during restricted periods of time under specific climatic conditions, as exemplified by observations from earlier or later periods, have not yet been observed in the region during the Saalian. Below, we describe cases of chronological and spatial unevenness of deposits for each chronoclimatic phase, illustrating the sources of the biases observed.

Early Glacial At Cagny–La Garenne 1 in the Somme Valley, excavations evidenced the preservation of remnant slope deposits with interbedded fluvial silt levels below the fluvial gravels from terrace IV (Antoine and Tuffreau, 1993; Antoine et al., 2007), along the chalky slope. They were deposited at the onset of fluvial aggradation in the early glacial phase of the MIS 12/11 cycle and they contained several archaeological levels from the Acheulean. Such deposits were usually dismembered before the deposition of gravels and in the Somme Valley they have only been observed at La Garenne 1 to date. Equivalent fluvial deposits from Early Glacial MIS 8 and MIS 6 are still unknown. Therefore, the fossilization potential of Early Glacial occupations is low in the valley bottom. The pedostratigraphic record of the Weichselian in Northern France is now extremely well documented and the Early Glacial is characterized by humic soil horizons and soil complexes (Antoine, 1989; Antoine et al., 1999, 2016). Former and more recent observations at La Longueville, Cagny-Ferme de l'Épinette or Therdonne, for example (Sommé and Tuffreau, 1976a; Tuffreau et al., 1997; Locht et al., 2010), suggest that earlier periods sometimes experienced similar pedologic developments for the Early Glacial phase. However, such soils were rarely observed for the Saalian. Recently, a grey forest soil on colluvial deposits confidently dated to MIS 9c was described in the long stratigraphic sequence from Etricourt-Manancourt with a preserved Acheulean occupation (Hérisson et al., 2016b). This soil was only preserved on the middle and lower part of the slope, as a result of being buried under thick later deposits and consequent modifications of the local topography. Generally, in Early Glacial loessic contexts, occupations appear to be reworked on erosional surfaces truncating the interglacial/interstadial soil and unconformably overlain by loess or colluvial deposits.

Pleniglacial In fluvial contexts, the in situ preservation of occupations under Pleniglacial conditions in Northern France is unlikely. Industries were recovered in the Somme Valley at the beginning of the 20th century in the bulky MIS 8 Pleniglacial gravels from Argoeuves terrace (alluvial formation III in Antoine et al., 2007; Agache, 1976), and in the early 1970s in contemporaneous gravels from La Selle

River, a tributary of the Somme River (Ameloot-Van der Heijden et al., 1996). In this latter site, industries with different degrees of alteration are clearly mixed together (D.H., pers. obs.) and some of them may be reworked from older deposits. Loess deposits from MIS 8 or 6 have been described in several sites from Northern France but up to mid-MIS 6; these deposits were mainly derived from local earlier sediments, especially Tertiary sands, and they are unevenly distributed and very discontinuous. In several cases, as in Gentelles (Tuffreau et al., 1999, 2008), it seems that industries included in MIS 8 and 6 Pleniglacial loess or loess-derived deposits are reworked. Nevertheless, at Saint-Valéry-sur-Somme, in the lower valley of the Somme River, an assemblage was recovered in aeolian sands dated to MIS 8, according to the pedostratigraphic record (Heinzelin and Haesaerts, 1983). Several refits were made from an assemblage collected from a small-scale excavation, suggesting that the occupation was preserved in primary position. This site is the only one considered to be in primary position in MIS 8 Pleniglacial deposits.

Late Glacial–Early Interglacial/Interstadial In the Somme Valley, paleoenvironmental proxies suggest that the deposition of carbonated fluvial silts above gravels and coarse sands occurred under a cold to cool continental climate corresponding to the Late Glacial phase of the climatic cycle (Munaut 1988a, b; Tuffreau et al., 1986; Antoine, 1990; Antoine et al., 1995, 2003). The transition towards a wet land system in the valley bottom with the channeling of the watercourse resulted in the development of organic soils with the onset of milder conditions. These contexts provide the best conditions for the fossilization of late Middle Pleistocene occupations, as demonstrated by several well-known sites such as Cagny–L'Epinette (Tuffreau et al., 1986, 1995; Tuffreau and Ameloot-Van-der-Heijden, 1991), Biache-Saint-Vaast (Tuffreau and Sommé, 1988), or Soucy (Lhomme et al., 1996; Chaussé et al., 2000; Lhomme, 2007).

Interglacial/interstadial In the Somme Valley, the Last Interglacial optimum is recorded at Caours with the deposition of calcareous tufas (Antoine et al., 2006), but also in several localities (Saint-Acheul in the Somme Valley, La Celle in the Seine Valley) for the earlier MIS 11 interglacial optimum (Limondin-Lozouet et al., 2015). This type of deposit is still lacking or remains undocumented in

Northern France from MIS 9 to 6. Archaeological material has been recovered in this type of deposit in Europe (Brunnacker et al., 1982; Wagner, 1992; Mania, 1995; Preece et al., 2006). Under interglacial/interstadial conditions, brown soil developed on loessic deposits but the ensuing erosion towards the Glacial phase, associated with the degradation of climatic conditions, induced the systematic reworking of interglacial occupations, as observed in many sites: Roissel (inf.), Fransures, Combles, Sourdon, Busigny (Antoine, 1993). This is why so few fully interglacial late Middle Pleistocene occupations are known in Northern France (Tuffreau and Roebroeks, 2002).

3.2. When researchers themselves and research opportunities bias the record

Late Middle Pleistocene loess accumulation is much more developed in the eastern part of Northern France (e.g., Cambrésis, Vermandois) than in the western part (Sommé, 1976, 1977; Antoine, 1990; Antoine et al., 1998). From the beginning of the 1970s to the late 1980s, several late Middle Pleistocene sites were discovered and studied in this aera, frequently in brickyards with loessic stratigraphic sequences predating the Last Interglacial, as at Vimy (Sommé and Tuffreau, 1976b), Bapaume (Tuffreau, 1976), Beaumetz-lès-Loges (Hurtrelle et al., 1972), Gouzeaucourt (Tuffreau and Bouchet, 1985), Longavesnes (Ameloot-Van der Heijden, 1993), or further south, in the Tardenois at Champvoisy (Chertier and Hinout, 1988; Tuffreau, 1989). At the same time, a large rescue excavation was undertaken at Biache-Saint-Vaast in late Middle Pleistocene fluvial deposits from the Scarpe River (Tuffreau and Sommé, 1988). From the mid-1990s, the development of rescue archaeology, and then preventive archaeology, resulted in the displacement of most of the research and fieldwork to the western loessic area, particularly along major road and rail works (TGV railway, highway, bypass, etc.; Locht and Depaepe, 2011). As a consequence, the pedosedimentary record from the western province is now finely documented (Antoine et al., 2002), together with numerous late Middle Paleolithic sites (Locht and Depaepe, 2015; Locht et al., 2016), whereas our knowledge of the late Middle Pleistocene is still limited due to this disparate geographic development of fieldwork. This induces another type of bias. Fortunately, over the past decade, the Seine-Nord-Europe canal project allowed researchers to conduct large excavations in late Middle Pleistocene loessic deposits in the eastern province, filling this geographic bias in our data. At Havrincourt 2 (Goval and Hérisson, 2012; Antoine et al., 2014), a single late Middle Pleistocene level was discovered, whereas at Etricourt-Manancourt, now considered as a key site, the extensive excavation revealed a long pedosedimentary sequence covering the whole Saalian (Hérisson et al., 2016b).

Biases introduced by our methods of investigation can be less visible. Locht and Depaepe (2011) reminded us that the rules and regulations in effect in France in preventive archaeology impose maximum excavation depths in relation with future land use planning. Along large linear works, the excavation of sites where the route lies on embankments is prohibited as the sites are not destroyed by road and rail works. As a consequence, deeply buried sites cannot be excavated and downslope sites are never excavated. These biases regularly affect sites of the same age. Moreover, large linear works are often located in similar topographical contexts, thus providing access to Pleistocene formations of the same age or type. Human activities also impact the archaeological record. In the Somme Valley, town and country planning since the 19th century have definitively prevented access to some fluvial deposits bearing late Middle Pleistocene occupations. Furthermore, recent field observations near Amiens concluded that fluvial deposits from some pre-MIS 9 terraces were almost totally depleted to provide railway ballast in the late nineteenth to the early twentieth centuries, thus preventing or at least considerably limiting any reappraisal of the stratigraphic context of the Paleolithic occupations.

3.3 A gap in the archaeological record at a crucial moment

Based on the descriptions and analysis presented above, we can conclude that the archaeological record from the late Middle Pleistocene in Northern France is strongly biased. The preservation of occupations is directly linked to the development of geological formations under determined climatic conditions. Pleniglacial phases are marked by unfavorable conditions for the fossilization of occupations, especially in a fluvial context. On the one hand, settlement is expected to be more discontinuous in harsh environments, and on the other hand, occupations could hardly be fossilized. This explains the sharp contrast between the frequent occupations from early to late MIS 9 and the few occupations firmly dated to MIS 8 (Fig. 2). Unfortunately, it is precisely at this moment that a major change in technological repertoires is expected to occur according to the characters of industries before and after this cut-off point (Hérisson et al., 2015, 2016a). We can thus conclude that biases in the archaeological record in Northern France impact our comprehension and interpretation of cultural changes between the Lower Paleolithic and Middle Paleolithic. A reappraisal of the chronology and context of 19th and early 20th century discoveries through renewed fieldwork may improve our knowledge of this crucial moment.

3.4. Pre-MIS 9 archaeological record: an Acheulean world around Saint-Acheul

The oldest traces of human occupations in Northern France appear around the famous city of Abbeville and in the Somme Valley. From MIS 16 to 10, all the discoveries were classified as Acheulean, except for the site of Rue du Manège. The oldest lithic assemblage comes from the well-known site of Moulin-Quignon, studied by J. Boucher de Perthes in 1863–1864 (Hurel et al., 2016), where recent investigations and analysis are currently awaiting publication. At the Carpentier quarry, also situated in Abbeville, two Acheulean handaxes found in a karstic depression (Fig. 4) may be attributed to the end of MIS 15, or possibly MIS 14 (Antoine et al., 2014).

At Amiens, an excavation at Rue du Manège yielded 23 artifacts attributed to MIS 14/13, around 550 ka (Locht et al., 2013). Most of the assemblage consists of thick cortical flakes with unworked butts. The only core indicates discoid reduction (Fig. 4). A single scraper and a denticulate are the only retouched tools of the series (Fig. 4). Due to the absence of bifaces in this small assemblage, it was suggested that it is difficult to classify it as ‘classic Acheulean’, but the hypothesis cannot be definitively abandoned, as bifaces could originally have been part of this assemblage and may occur outside the excavation area (Locht et al., 2013). This is a recurring problem for assemblages from this time period (Wenban-Smith, 1998).

For MIS 12, our knowledge of human occupation stems from the site complex of Cagny-la Garenne. Cagny-la Garenne I is correlated with the beginning of MIS 12 at around 430–450 ka (Tuffreau et al., 1997), in an Early Glacial landscape (temperate wooded steppe, inhabited by large herbivores: bovids and cervids). In contrast, the occupation of la Garenne II could be placed in a Late Glacial context (Tuffreau et al., 2008). The characteristics of the assemblages of both sites are very similar, with a low percentage of bifaces with diversified morphologies depending on raw material block forms, flakes produced by a Clactonian system or 'système par surface de débitage alternée' (SSDA; Forestier, 1993), and retouched flakes dominated by denticulates and notches (Tuffreau et al., 2008; Fig. 4).

For MIS 11/10, an Acheulean occupation was identified in a slope context, in loess deposits overlying the alluvial sheet at Cagny-Ferme de l'Epinette during excavations by Tuffreau in 1994 and 1995, over an area of 2500 m². The archaeological level MS is attributed to the Early Glacial phase of the beginning of MIS 10 (Tuffreau et al., 1997). The assemblage consists of bifaces and refits showing the production of cortical thick flakes from short unipolar sequences (Tuffreau et al., 2008; Fig. 4). Level CO at Gentelles, preserved in a sinkhole, also appears to be contemporaneous with MIS 10 (Tuffreau et al., 2008, 2017). This excavation, led by Tuffreau between 1998 and 1999 over an area of 6177 m², yielded bifaces (nearly 25% of the lithic assemblage) and flakes produced by short unipolar sequences described as SSDA (Tuffreau et al., 2001).

3.5. The MIS 9 archaeological record: a Lower Palaeolithic technological toolbox with innovative elements

Bifacial shaping Bifacial shaping is represented in all the MIS 9 sites (Cagny-l'Epinette, Etricourt-Manancourt, Plachy-Buyon, Revelles and Clairy-Saulchoix). Bifacial shaping by-products account for a subsantial proportion of the assemblages, although bifaces always represent a very minor percentage (often around 1–2%). As shown in Figure 5, the morphology of bifaces varies drastically, even within the same level. This can be explained by the conception and the method used for obtaining the desired bifacial tools, as revealed by technofunctional analysis (i.e., Nicoud, 2013). The bifacial shaping chaîne opératoire appears to be highly spatiotemporally segmented and bifaces seem to be highly mobile elements, not just at the site scale, but also at the landscape scale.

Common flake production Up until recently, little attention was paid to flake production for MIS 9, or for older assemblages, due to the low number of debitage elements recovered on the main site (Cagny-l'Epinette) and the low degree of estimated technical investment visible on cores and end products. It therefore remains difficult to obtain an accurate idea of the methods used. However, the recent study of level HUD at Etricourt-Manancourt revealed a system of debitage producing standardized cortical backed knives (Hérisson et al., 2016; Fig. 5). These cortical backed knives were produced by short secant unipolar sequences (2 to 5 removals per sequence), repeated or not on different parts of the original block volume. The use-wear analysis on level HUD of Etricourt-Manancourt shows that a large proportion of the rough cortical knives were intensely used. A current question is to determine whether the same standardization and intense use also exist in other MIS 9 sites. Previous analyses seem to show that the same method, or a relatively similar method was used, with short secant unipolar sequences, but this remains to be confirmed by future reanalysis.

Earlier, but late, occurence of Levallois concept The use of the Levallois method was proposed at Cagny-la Garenne, with the presence of Levallois cores around 450 ka (Tuffreau et al., 2008; Moncel et al., 2020), but this appears to be a case of morphological convergence rather than an isolated example of this production system (Soriano, 2000). Unlike the la Garenne case, in level HUD of Etricourt-Manancourt, two refits show a completely different chaîne opératoire to the one producing cortical backed knives (Hérisson et al., 2016b). As all the criteria defining the Levallois according to

Boëda (1993) are present, these refits could be considered as the oldest convincing use of this concept in Northern France. This implies that the Levallois method was applied for the first time in typical Lower Paleolithic assemblages and represented a low percentage of flake production. It also suggests that the innovative Levallois process might be rooted in the 'regional' Acheulean and not imported by settlers from afar. It also suggests that the Levallois developed here independently and does not derive from bifaces recycled as cores (Degorce, 1992; Lamotte, 1992; Rolland, 1995; DeBono and Goren-Inbar, 2001).

Retouched blanks Very few blanks are retouched in MIS 9 assemblages, and retouched elements are mainly notches, denticulates and single scrapers (Fig. 5).

3.6. The MIS 8-6 record: the childhood and youth of the Middle Paleolithic

Levallois flake production All the EMP sites and levels contain Levallois flakes, apart from the site of Saint-Valéry-sur-Somme. Levallois flake production is thus a hallmark and a common component of these lithic assemblages, from the end of MIS 8 to the end of MIS 6. The Levallois concept was defined by Boëda (1994) after the study of Biache-Saint-Vaast and Bagarre, two Saalian sites in Northern France. Levallois flakes can be produced using a preferential method or a recurrent method. The latter method is divided into three modalities: unipolar, bipolar or centripetal. All the modalities are present in the EMP record but it is still difficult to establish a precise scenario for the first appearance of each schema. The preferential method was mainly used to obtain large suboval flakes by the centripetal preparation of the flaking surface in most cases (Fig. 6). The Levallois recurrent unipolar or bipolar schema produces elongated flakes and rectangular flakes, typical of the Biache-Saint-Vaast industries (Fig. 7). The Levallois recurrent centripetal schema is employed to obtain suboval flakes, mainly in a final phase of core reduction during the Saalian, as demonstrated for Biache-Saint-Vaast (Hérisson, 2012). Numerous Levallois flakes were left unretouched for direct use, as shown by technofunctional and use-wear analyses.

Blade production At the end of MIS 8, the first evidence of well-controlled blade production appears at Saint-Valéry-sur-Somme (Heinzelin and Haesaerts, 1983; Fig. 8). We use the term blades only for the end products from a specific chaîne opératoire dedicated to the production of blades from prismatic cores, as defined by Révillion (1994), notably to distinguish them from the elongated Levallois flakes stemming from the Levallois method (recurrent unipolar or bipolar). Blades are very rare in the EMP record compared to MIS 5 industries (Goval, 2012; Locht et al., 2016). Blade production is attested by the famous Saint-Valéry-sur-Somme refits and some other elements, including three cores at Therdonne (level N3; Locht et al., 2010, Hérisson, 2012). The core is initialized by preparing two opposed striking platforms, followed by the removals of elongated cortical flakes, thanks to the elongated form of the selected block (Fig. 8). Then, during blade production, the two opposed twisted striking platforms are used to turn around the block and maintain the curved and carinated profile of the flaked surface.

Levallois point production/Levallois recurrent unipolar convergent Levallois point production (Fig. 9) is only attested at Therdonne (level N3; Locht et al., 2010; Hérisson, 2012; Hérisson and Locht, 2014) and at le Pucheuil (level B; Delagnes and Ropars, 1996), at the end of MIS 7 and the beginning of MIS 6. Points are produced following a Levallois recurrent unipolar convergent schema. Sometimes, a second striking platform is used to better control or rectify the distal convexities and thus the distal morphology of the point, but this is a minor variation of the schema (Hérisson, 2012). As already pointed out by Hérisson et al. (2015), Levallois points are present in lithic assemblages without convergent retouched blanks and absent in lithic assemblages containing numerous convergent retouched blanks, such as Biache-Saint-Vaast (Hérisson, 2012). A similar function for these two tool types has been proposed. High mobility and a strong spatiotemporal fragmentation of the point chaîne opératoire have been established based on numerous refits and spatial distribution analysis from the site to landscape scale (Hérisson, 2012; Goval et al., 2016).

Discoid flake and point production Discoid production (Fig. 10) always forms a minor part of the few Saalian assemblages bearing this chaîne opératoire, namely Therdonne (Locht et al., 2010; Hérisson, 2012; Hérisson and Locht, 2014) and Plachy-Buyon (Locht et al., 1995). This method is only known at the end of the Saalian, from the end of MIS 7 to MIS 6. Discoid production in EMP assemblages is discreet and poorly used, compared to its later exclusive use at the MIS 4 site of Beauvais (Locht, 2004). Discoid cores, as defined by Boëda (1993, 1997) and Locht (2004), show one to three secant production surfaces, with a variability practically inherent to the method. The three main types of end products known for discoid production (Bourguignon, 1997; Locht, 2004) are present at Therdonne and Plachy-Buyon, i.e., backed flakes, large flakes and pseudo-Levallois points.

Ramification and small flake production Ramification is poorly documented in Lower Paleolithic assemblages in Northern France, and only the Kombewa method seems present (Tixier and Turq, 1999). In contrast, the organization of the EMP chaînes opératoires appears to be almost systematically ramified. In the EMP record in Northern France, only simple ramification is attested, according to the definition of Brenet (2011). The core-on-flake method is essentially used to obtain small flakes by recycling elements from a previous production stage of the chaîne opératoire (Fig. 11). Except the Kombewa method, which is frequently used on cortical flakes, the same schema is often reproduced in the second stage of production. If the same schema is not reproduced, slightly predetermined methods are employed. Another specific method was recognized by Delagnes (1993; see also Lazuén and Delagnes, 2014) at Le Pucheuil and some years later at Therdonne (Hérisson, 2012; Fig. 11). Small flake production and the systematic ramification of the chaînes opératoires (particularly in Levallois assemblages) appear to be a novel characteristic of the lithic assemblages, compared to those of the Lower Paleolithic.

Retouched blanks Blanks are rarely retouched in MIS 8–6 assemblages. Retouched blanks are dominated by single convex scrapers and a new tool type: double convergent scrapers. The toolkit is completed by a few denticulates, notches and rarely by Nahr Ibrahim, which was totally unknown during the Lower Paleolithic. The typology does not show any particular chronological distribution of tool types during the EMP.

Bifacial shaping If PMC sites are pushed back earlier than MIS 8 (see the Introduction), then the EMP record appears almost devoid of bifaces. Only levels C/A and B of le Pucheuil (Delagnes and Ropars, 1996) present sparse bifaces, dated to the end of MIS 7 or the beginning of MIS 6 for the latter and to the late MIS 8/early MIS 7 for the first one. There is absolutely no evidence of bifacial shaping at major sites like Biache-Saint-Vaast and Therdonne. The role and function of EMP bifaces is still poorly known and the evolutionary link with Acheulean bifaces remains an open question.

4. Discussion

Finally, we address the crucial questions we raised in the Introduction to discuss our current view of the LP/MP boundary based on the well-established record from Northern France, in the Northwestern European framework. We also propose a cross-interpretative view with the Near East record of this key period in human cultural evolution.

4.1. A revised model for the LP/MP boundary in Northern France

What are the consequences of the new discoveries, new studies and reanalyses on the previous transition model(s) established for Northern France? Since the previous models of transition for the LP/MP developed by Tuffreau from the 1970s to the 1990s (Fig. 12), discoveries of new sites, reanalyses and the inclusion of taphonomic and detailed litho-chronostratigraphic approaches have yielded new data. This renewed record offers the opportunity to reappraise the nature of the LP/MP boundary in Northern France with many more elements.

Tuffreau's (1982) model established that, after the Acheulean complex, Late Acheulean (Epi-Acheulean/Upper Acheulean) and Mousterian assemblages coexisted during the Saalian (oldest definition of the Saalian corresponding to MIS 8–6). He specified that "at present transitional industries […] are unknown" (Tuffreau, 1982: 148). He later inserted (Tuffreau et al., 1989) a transitional complex of industries called PMC in his model (Fig. 12), following discoveries of lithic assemblages comprising numerous handaxes with an Acheulean morphology in association with stable types of retouched tools on flakes announcing the Middle Paleolithic tool kit.

Currently, considering all the elements developed above, we can propose the following model or scenario for the Northern France (Fig. 13). The Lower Paleolithic assemblages mainly consist of 'Acheulean' bifaces, associated with thick and often cortical flakes mainly stemming from short secant unipolar sequences of production and rare retouched tools (mainly denticulates, notches and single scrapers). The Lower Paleolithic comes to an end at the close of MIS 9, around 277 ka (after Railsback et al., 2015 for the MIS 9a/8 boundary setting). After a long process of technical maturation, a more standardized flaking method seems to emerge at the end of MIS 9, producing normalized cortical backed-knives on one hand, and probably what can be considered as the first convincingly, if discreet use of the Levallois method, on the other hand. The PMC complex could perhaps be placed during this innovating cultural period of MIS 9, with all the limits explained above. No reliable archaeological data are available for the Pleniglacial phase of MIS 8 (277–250 ka), but Levallois-dominated industries are observed in secondary position in Pleniglacial fluvial gravels. After this Pleniglacial phase, the transformation of lithic assemblages is already totally completed. From around 250 ka onwards, lithic systems are based on well-predetermined flaking methods producing normalized end products (flakes, points and blades). Bifacial shaping does not disappear from the technical repertoire but becomes marginal in the EMP record. The LP/MP boundary and threshold could thus be situated, if it is really necessary to define a time frame for the shifting, between 277 and 250 ka. From 250 ka to 180 ka, we observe the development of several innovative knapping methods (Levallois method and its numerous modalities, blade, discoid), which compose the whole technical identity and variability of the Middle Paleolithic inventory. This growing diversity of knapping methods and end products reaches its apogee at the end of MIS 7 and the beginning of MIS 6. This phase can be interpreted as a technological radiation phase, following proposals by Boëda (2013) and Chazan (2016). In parallel, the internal organization of flaking methods evolves with the widespread development of the ramification process, mainly for producing small flakes. The spatiotemporal distribution of chaînes opératoires is also more fragmented than previously (and particularly than pre-MIS 9 chaînes opératoires). Evidence of the use of fire at EMP sites is also much more frequent than in Lower Paleolithic sites (Roebroeks and Villa, 2011; Hérisson et al., 2013).

Is our periodization still relevant in the light of new data on technological, behavioral and cultural changes? We still follow the proposal of Tuffreau (1982: 137), who defined periodization, not from a geological chronological viewpoint but "in terms of technological and typological characteristics of the lithic assemblages." He added that "other data (evidence concerning living floors, bone industries) are too poor to be used" (Tuffreau, 1982: 137). It is still true, despite new excavations, that other behavioral elements are too scarce to accurately chart changes. But these elements must necessarily be taken into account to propose a broader view of the sociocultural process, as recently demonstrated (Hérisson, 2012). This periodization appears to be the least worst option, considering current data from Northern France and the model we proposed, and also seems to be applicable and relevant at a broader scale.

4.2. The record from Northern France in a Northwestern European context

What does the record from Northern France tell us about settlement and innovative dynamics compared to neighboring areas, and in particular Northwestern Europe? The proposed scenario for Northern France does not seem so different from surrounding areas when we take a look at the Northwestern record (i.e., Scott and Ashton, 2011; Hérisson et al., 2016a). Nearby, the site of Saint-Illiers (Blaser and Chaussé, 2016) shows that bifaces can play a more important role in EMP assemblages, and moderate the near absence of bifaces observed in Northern France. The site of Kesselt Op-de-Schans, dated to the end of MIS 9 shows a combination of the Levallois flaking method with discoidal production systems, simple prepared core technology and a multiple platform core and other technoeconomic aspects of the assemblage, suggesting a Middle Paleolithic character (Van Baelen, 2014). If this dating is confirmed by future analysis, it could attest the coexistence of groups using the Lower Paleolithic package and others using the Middle Paleolithic package at the end of the MIS 9 in Northwestern Europe.

A brief look at the record from Southern France (Delpech et al., 1995; Djema, 2010; Turq et al., 2010; Soriano, 2005; Brenet et al., 2014a, b; Hérisson et al., 2016; Mathias, 2018) reveals that another scenario exists for the LP/MP boundary. It is not a remarkably different scenario, particularly as far as dating is concerned, but some technological elements differ, such as the use of the Quina method or the late presence of 'Acheulean' bifaces. This reinforces the impression of global trends through time in lithic trajectories of change in Western Europe but with strong regional cultural patterns.

4.3. A view of the Near East from Northern France

What does the recod from Northern France tell us about settlement and innovative dynamics compared to more distant regions suc as the Near East? We will not detail here each LP/MP boundary site in the Near East. They are fully presented in recently published syntheses (i.e., Chazan, 2016; Malinsky-Buller 2016; Shimelmitz et al., 2016a, b; Zaidner and Weinstein-Evron, 2016; Malinsky-Buller and Hovers, 2019).

The LP/MP boundary record from the Near East often comprises long sequences with numerous archaeological units, providing invaluable data on the relative succession of technological facies and assemblages in each site. Despite recent discoveries and huge efforts to produce dating sequences, the regional chronological framework of the Near East remains fragile (Chazan, 2016). This is due to the early excavation of reference sites, difficulties with dating methods in some fields, the rare opportunities for cross-checking dating results and biostratigraphy to reconstruct detailed paleoenvironments and thus establish chronoclimatic correlations with specific MIS. Correlations between sequences remain difficult and still hinder the construction of a regional chronoclimatic framework for human occupations and the development of secure detailed scenarios for the LP/MP boundary period at a regional scale (Bar-Yosef and Meignen, 2001). Moreover, the representativeness of currently available data is questionable, as the distribution of known sites is extremely disparate. Indeed, no data are available for vast geographical areas of whereas concentration of sites are recorded in other aera, such as the Mount Carmel.

After the widely diffused chronocultural model proposed by Bar-Yosef (1994, 2002; Fig. 12), Malinsky-Buller and Hovers (2019) recently published a revised model for the LP/MP boundary in the Levant (Fig. 13). According to this model, the Acheulo-Yabrudian (around 350–250 ka) follows the Late Acheulean (until around 400–350 ka). A shift is observed around 250 ka, marking the limit between Lower and Early Middle Paleolithic assemblages.

The Late Acheulean of the Near East contains hierarchical cores, cores-on-flakes and, handaxes in relative low frequencies (Malinsky-Buller, 2016). This is not very different to Lower Paleolithic assemblages in Northern France or Western Europe (Fig. 13). Viewed from the Near East, the LP to MP transition in Northern France seems straightforward: the old-style Acheulean is replaced by fully Middle Paleolithic industries and this replacement matches with the onset of the Levallois method. The typological and technological variations observed in the latest Acheulean industries in Northern France appear minor when compared to what is described in the Near East from MIS 9 to MIS 7. With the Acheulo-Yabrudian, the Near East have experienced much more diversified assemblages than Europe at the end of the LP. Chazan (2016) perceived this episode as a ‘technological radiation’ which ended later than the Acheulean in Western Europe (Fig. 13). The Acheulo-Yabrudian shows huge variations between assemblages with numerous blades from unprepared cores usually referred to as Amudian, or with low frequencies of blades or no blades at all, closer to the Yabrudian. Nevertheless, it is now established that the Amudian and the Yabrudian shared common technological characters and Quina or demi-Quina scrapers are a major component of the tool kit (Zaidner and Weinstein-Evron, 2016). The frequency and typology of handaxes or bifacial pieces are highly variable. There is general agreement that Levallois methods are absent (Parush et al., 2016; Shimelmitz et al., 2016b). Use-wear studies at Qesem suggest that Quina/demi-Quina scrapers from the Acheulo-Yabrudian were either hand-held, hand-held with wrapping or hafting (Zupancich et al., 2016). It is considered that a sharp break occurs around 250 ka between the Acheulo-Yabrudian and the following Early MP (Malinsky-Buller and Hovers, 2019), but Shimelmitz et al. (2016b) suggest that there is some continuity between LP and MP assemblages, particularly looking in terms of blank production.

According to Meignen (2011), two groups of industries can be distinguished within the EMP (also called 'Early Levantine Mousterian'; Fig. 13). Both are blade-based, but Levallois blades can be dominant or not, alongside short blanks, flakes and points (Meignen, 2007). The toolkit is usually dominated by Mousterian types, including scrapers and above all, various types of elongated points (Zaidner and Weinstein-Evron, 2012). Upper Paleolithic types can be frequent, especially burins and nucleiform burins (Wojtczak, 2015). Classical Levantine Mousterian flake and point industries, almost produced with Levallois methods (Meignen, 1998), occur no earlier than 150/160 ka, as exemplified at Hayonim (Mercier et al., 2007).

Viewed from Northern France, the LP to MP transition appears less abrupt, with more gradual stages between the two periods. The degree of technological diversity also seems higher in the Acheulo-Yabrudian than in the Late LP in Northern France (Fig. 13). The importance of scrapers with scalar retouch and the association of several methods of blank production in the Acheulo-Yabrudian can be viewed as a preliminary step towards the MP, but blanks were not yet standardized. The standardization of blanks and toolkits occurred during a second step in the Early Levantine Mousterian. Not surprisingly, one of the oldest uses of bitumen for hafting was observed on a pointed blade from a Hummalian level at Hummal (Boëda et al., 1998).

In Northern France, in many respects, the transition involved an almost complete turnover of technical productions and elements of continuity are scarce, but they nonetheless exist. MIS 9 Acheulean groups experimented different solutions for the standardization of the flake component of their toolkits. In the HUD level from Etricourt-Manancourt (280 ka), debitage is structured in order to obtain flakes with thick cortical backs and use-wear analysis confirms their use as backed knives, mainly for butchery cutting (Hérisson et al., 2016b). In this case, standardization is oriented towards the handled part of the tool. At Gouzeaucourt (MIS 9/8?), especially in the most recent level R, several retouched tool types (transverse and déjeté scrapers, Mousterian points) are standardized (Lamotte, 1995; Devresse, 1997; Soriano, 2000). A low degree of blank predetermination was balanced by a high intensity of retouch. Some of these retouched tools seem to have been imported to the site with handaxes. Considered as a whole, these changes in flake tools can be viewed as an announcement of the oncoming Middle Paleolithic. Nevertheless, this shift occurred abruptly in Northern France and Acheulean efforts to fit with Middle Paleolithic standards were swept away by the sudden adoption of the Levallois system.

What is so special about the Levallois that its adoption resulted in the more or less rapid disappearance of handaxe-based industries in Northwestern Europe, when such toolkits had been a reference for at least 300 ka? Many scholars have emphasized the increased control of morphology, size, technical and functional features with Levallois flaking compared to other flake productions (Boëda, 1994, 2013; Dibble and Bar-Yosef, 1995; Bonilauri, 2015). The effectiveness of the cutting edges of retouched or unretouched tools on Levallois blanks might not be so different from tools on blanks from LP productions and overall, the daily tasks performed with lithic tools were not so different in the LP and in the MP, as shown by use-wear studies for decades (i.e., Beyries, 1988; Keeley, 1993; Lemorini et al., 2016). Through a combination of use-wear, residue analysis and the technofunctional analysis of a Levantine MP industry, Bonilauri (2015) proposed that the high degree of predetermination of the Levallois system allows for the control of the morphology and technical features of the cutting edges but also of the prehensive part of the tool. The standardization of this latter tool part is an early and direct response to forthcoming hafting constraints. There is a growing body of direct or indirect evidence for hafting tools on Levallois blanks, especially in the Near East (Boëda et al., 1996; 2008; Goval et al., 2016; Monnier et al., 2013; Rots, 2013; Rots et al., 2011; Rots, 2015; Roler and Clark, 1997). To date, undisputable evidence of hafted stone tools in the Acheulean in Northwestern Europe is lacking. Like Boëda (2013), we hypothesize that the standardization of hafting is the key issue in the emergence and successful adoption or diffusion of Levallois technology.

5. Conclusion

This comparison shows how different and similar the Near Eastern archaeological record and the record from Northern France are, considering the main chaînes opératoires and technocomplexes. The timing of changes and shifts between LP and MP technological packages in both regions seems to be between 280 and 250 ka, and follows a near-similar overall trend (White and Ashton, 2003; Shimelmitz et al., 2016b), even through it remains difficult to compare the two regional archaeo-chronosequences. But, when we go into more detail and examine the specific composition and proportions of each chaîne opératoire and their distribution through time, we observe marked differences between both regional repertoires. This trend is particularly well-expressed for the Late Acheulean period from 400 to 250 ka, with the Acheulo-Yabrudian period in the Near East, and the last occurrence of the Lower Paleolithic in Northern France.

On one hand, these elements seem to attest to a possible pseudosynchrony of technological trajectories at a continental scale for the LP/MP time period. On the other hand, and up until now, no convincing elements in the archaeological record allow us to propose a global explanation for this pseudosynchrony. In fact, each region shows specific technological traits and trajectories strongly linked to regional cultural patterns, in agreement with recent syntheses (i.e., Adler et al., 2014; Hérisson et al., 2016a; Malinsky-Buller, 2016; Malinsky-Buller and Hovers, 2019). The simultaneity of the timing of changes across Europe, Asia and Africa is perceived when we examine global data with an error margin of more or less 10 ka, a third of the duration of the Upper Paleolithic. Common or global drivers of evolution of these technological and cultural changes at the LP/MP boundary are still difficult to pinpoint, even if current data presented here tend to reduce the impact of biological human species (presence, arrival or not of AMH in certain regions) and environmental factors, and to highlight internal societal factors associated with behavioral and technical changes.

More detailed data (in particular, behavioral), sites, and accurate dates are still required to enhance our understanding of the mechanisms of this key period, currently called the Lower

Paleolithic to Middle Paleolithic boundary, and perceived as a major cultural shift in human evolution. However, when we look back to the cutting-edge research presented in Ronen (1982) and this volume, we can measure both the considerable advances and the potential future discoveries.

References

Adler, D.S., Wilkinson, K.N., Blockley, S., Mark, D.F., Pinhasi, R., Schmidt-Magee, B.A., Nahapetyan, S., Mallol, C., Berna, F., Glauberman, P.J., Raczynski-Henk, Y., Wales, N., Frahm, E., Joris, O., MacLeod, A., Smith, V.C., Cullen, V.L., Gasparian, B., 2014. Early Levallois technology and the Lower to Middle Paleolithic transition in the Southern Caucasus. Science 345, 1609–1613.

Agache, R., 1976. Argoeuves (Somme). In: Verron, G. (Ed.), Nord-Ouest de La France (Bassin de La Seine, de la Somme et Nord). Livret-Guide de l'Excursion A10, IXème Congrès UISPP, pp. 140–145.

Ameloot-Van der Heijden, N., 1989. Les séries lithiques des niveaux E et de la couche D0 du gisement paléolithique moyen de Biache-Saint-Vaast (Pas-de-Calais). In: Tuffreau, A. (Ed.), Paléolithique et Mésolithique du Nord de la France. CERP, Université des Sciences et Techniques de Lille Flandres Artois, Lille, pp. 43–50.

Ameloot-Van der Heijden, N., 1991. Méthodes d'acquisition et signification des industries lithiques au Paléolithique moyen : l'exemple des gisements de plein air du nord de la France. Ph.D. Dissertation, Université des Sciences et Technologies de Lille.

Ameloot-Van der Heijden, N., 1993. L'ensemble lithique du gisement de Longavesnes (Somme) : illustration d'un problème de reconnaissance du débitage Levallois dans une industrie à bifaces de la phase ancienne du Paléolithique moyen. Bulletin de la Société Préhistorique Française 90, 257–264.

Ameloot-Van der Heijden, N., Dupuis, C., Limondin, N., Munaut, A.-V., Puissegur, J.-J., 1996. Le gisement paléolithique moyen de Salouël (Somme, France). L'Anthropologie 100, 555–573.

Antoine, P., 1989. Le complexe de sols de Saint-Sauflieu (Somme), micromorphologie et stratigraphie d'une coupe type du début Weichselien. In: Tuffreau, A. (Ed.), Paléolithique et Mésolithique du Nord de la France. Nouvelles Recherches. Publications du CERP, Lille, pp. 51–60.

Antoine, P., 1990. Chronostratigraphie et Environnement du Paléolithique du Bassin de la Somme, Publications du CERP, Lille.

Antoine, P., 1993. L'environnement des occupations humaines au Paléolithique moyen récent dans la France septentrionale. Bulletin de la Société Préhistorique Française 90, 320–323.

Antoine, P., Tuffreau, A., 1993. Contexte stratigraphique, climatique et paléotopographique des occupations acheuléennes de la moyenne terrasse de la Somme. Bulletin de la Société Préhistorique Française 90, 243–250.

Antoine, P., Rousseau, D.-D., Lautridou, J.-P., Hatté, C., 1999. Last interglacial-glacial climatic cycle in loess-palaeosol successions of north-western France. Boreas 28, 551–563.

Antoine, P., Munaut, A.-V., van Kolschoten, T., Limondin, N., 1995. Une occupation du Paléolithique moyen en contexte fluviatile dans la séquence de la très basse terrasse de la Somme à Saint-Sauveur (Somme). Bulletin de la Société Préhistorique Française 92, 201–212.

Antoine, P., Lautridou, J.-P., Sommé, J., Auguste, P., Auffret, J.-P., Baize, S., Clet-Pellerin, M., Coutard, J.-P., Dewolf, Y., Dugué, O., Joly, F., Laignel, B., Laurent, M., Lavolle, M., Lebret, P., Lécolle, F., Lefebvre, D., Limondin-Lozouet, N., Munaut, A.-V., Ozouf, J.-C., Quesnel, F., Rousseau, D.-D., 1998. Les formations quaternaires de la France du Nord-Ouest : limites et corrélations. Quaternaire 9, 227–241.

Antoine, P., Frechen, M., Locht, J.-L., Depaepe, P., Munaut, A.-V., Rousseau, D.-D., Sommé, J., 2002. Eemian and weichselian early glacial pedosedimentary records in Northern France: the background of Middle Palaeolithic occupations during OIS 5 and early OIS 4. In: Tuffreau, A., Roebroeks, W. (Eds.), Le Dernier Interglaciaire et les Occupations Humaines du Paléolithique Moyen. Publications Du CERP, Lille, pp. 75–88.

Antoine, P., Auguste, P., Bahain, J.-J., Coudret, P., Depaepe, P., Fagnart, J.-P., Falguères, C., Fontugne, M., Frechen, M., Hatté, C., Lamotte, A., Laurent, M., Limondin-Lozouet, N., Locht, J.-L., Mercier, N., Moigne, A.-M., Munaut, A.-V., Ponel, P., Rousseau, D.-D., 2003. Paléoenvironnements pléistocènes et peuplements paléolithiques dans le bassin de la Somme (nord de la France). Bulletin de la Société Préhistorique Française 100, 5–28.

Antoine, P., Limondin-Lozouet, N., Auguste, P., Locht, J.-L., Galheb, B., Reyss, J.-L., Escude, É., Carbonel, P., Mercier, N., Bahain, J.-J., Falguères, C., Voinchet, P., 2006. Le tuf de Caours (Somme, France): mise en évidence d'une séquence eemienne et d'un site paléolithique associé. Quaternaire 17, 281–320.

Antoine, P., Limondin Lozouet, N., Chaussé, C., Lautridou, J.-P., Pastre, J.-F., Auguste, P., Bahain, J.-J., Falguères, C., Galehb, B., 2007. Pleistocene fluvial terraces from northern France (Seine, Yonne, Somme): synthesis, and new results from interglacial deposits. Quaternary Science Reviews 26, 2701–2723.

Antoine, P., Goval, E., Jamet, G., Coutard, S., Moine, O., Hérisson, D., Auguste, P., Guérin, G., Lagroix, F., Schmidt, E., Robert, V., Debenham, N., Meszner, S., Bahain, J.-J., 2014. Les séquences loessiques pléistocène supérieur d'Havrincourt (Pas-de-Calais, France) : stratigraphie, paléoenvironnements, géochronologie et occupations paléolithiques. Quaternaire 25, 321–368.

Antoine, P., Moncel, M.-H., Locht, J.-L., Limondin-Lozouet, N., Auguste, P., Stoetzel, E., Dabkowski, J., Voinchet, P., Bahain, J.-J., Falgueres, C., 2015. Dating the earliest human occupation of Western Europe: New evidence from the fluvial terrace system of the Somme basin (Northern France). Quaternary International 370, 77–99.

Antoine, P., coutard, S., Guerin, G., Deschodt, L., Goval, E., Locht, J.-L., Paris, C., 2016a. Upper Pleistocene loess-palaeosol records from Northern France in the European context: Environmental background and dating of the Middle Palaeolithic. Quaternary International 411A, 4–24.

Antoine, P., Moncel, M.-H., Limondin-Lozouet, N., Locht, J.-L., Bahain, J.-J., Moreno, D., Voinchet, P., Auguste, P., Stoetzel, E., Dabkowski, J., Bello, S.M., Parfitt, S.A., Tombret, O., Hardy, B., 2016b. Palaeoenvironment and dating of the Early Acheulean localities from the Somme River basin (Northern France): New discoveries from the High Terrace at Abbeville-Carrière Carpentier. Quaternary Science Reviews 149, 338–371.

Ashton, N., Lewis, S., 2002. Deserted Britain ; declining populations in the British Late Middle Pleistocene. Antiquity 76, 388–396.

Auguste, P., 1988. Apports paléontologiques et archéozoologiques de l'étude de la faune des grands mammifères de Biache-Saint-Vaast (Pas-de-Calais). Revue Archéologique de Picardie 1, 63–68.

Auguste, P., 1990. Contribution à l'étude des grands mammifères du site pléistocène moyen de Biache-Saint-Vaast (Pas-de-Calais, France). Etudes paléontologique, taphonomique et palethnologique du niveau IIbase. DEA Dissertation, Muséum National d'Histoire Naturelle.

Auguste, P., 1994. Relations entre la taphocénose et l'évolution géologique d'un site préhistorique: l'apport du gisement Pléistocène Moyen de Biache-Saint-Vaast (Pas-de-Calais, France) : Actions climatique et édaphique. In: Patou-Mathis, M. (Ed.), Taphonomie/Bone Modification. Outillage Peu Élaboré en Os et Bois de Cervidés, Artefacts. Editions du Centre d'études et de documentation archéologiques, Treignes, pp. 29–40.

Auguste, P., 1995a. Chasse et charognage au Paléolithique moyen : l'apport du gisement de Biache-Saint-Vaast (Pas-de-Calais). Bulletin de la Société Préhistorique Française 92, 155–168.

Auguste, P., 1995b. Cadres biostratigraphiques et paléoécologiques du peuplement humain dans la France septentrionale durant le Pléistocène. Apports de l'étude paléontologique des grands mammifères du gisement de Biache-Saint-Vaast (Pas-de-Calais). Ph.D. Dissertation, Museum National d'Histoire Naturelle.

Auguste, P., 2003. La chasse à l'ours au paléolithique moyen : mythes, réalités et état de la question. In: Patou-Mathis, M., Bocherens, H. (Eds.), Le Rôle de l'Environnement dans les Comportements des Chasseurs-Cueilleurs Préhistoriques. Archaeopress, Liège, pp. 135–142.

Auguste, P., 2009. Évolution des peuplements mammaliens en Europe du Nord-Ouest durant le Pléistocène moyen et supérieur. Le cas de la France septentrionale. Quaternaire 20, 527–550.

Auguste, P., 2012. L'homme et l'animal au Pléistocène en France septentrionale. Un quart de siècle de recherches paléontologiques et archéozoologiques dans le nord de la France. H.D.R. Dissertation, Université Lille 1.

Auguste, P., Patou-Mathis, M., 1994. L'Aurochs au Paléolithique. In: Aurochs, Le Retour. Aurochs, Vaches & Autres Bovins de la Préhistoire à Nos Jours. Centre jurassien du patrimoine, Lons-le-Saunier, pp. 13–26.

Auguste, P., Lamotte, A., Locht, J.-L., Tuffreau, A., 2005. Le traitement de la matiere premiere lithique et osseuse au Paléolithique inférieur et moyen dans le nord de la France: état des recherches récentes. In: Molines, N., Moncel, M.-H., Monnier, J.-L. (Eds.), Les Premiers Peuplements en Europe: Données Récentes sur les Modalités de Peuplement et sur le Cadre Chronostratigraphique, Géologique et Paléoanthropologique des Industries du Paléolithique Inférieur et Moyen en Europe. John and Erica Hedges Ltd, Oxford, pp. 419–431.

Bahain, J.-J., 2007. La méthode de datation par résonance de spin électronique (ESR) au Muséum national d'histoire naturelle. Vingt ans de recherches méthodologiques et d'applications géochronologiques. H.D.R. Dissertation, Université Michel de Montaigne - Bordeaux III.

Bahain, J.-J., Sarcia, M.N., Falguères, C., Yokoyama, Y., 1993. Attempt at ESR dating of tooth enamel of French Middle Pleistocene sites. Applied Radiation and Isotopes 44, 267–272.

Bahain, J.-J., Falguères, C., Laurent, M., 2001. Datation par résonance paramagnétique électronique (RPE) de sédiments et par combinaison des méthodes RPE/U-Th de restes paléontologiques (provenant des sites paléolithiques de Cagny). In: Tuffreau, A. (Ed.), L'Acheuléen dans la Vallée de la Somme : Données Récentes. Centre d'Etudes et de Recherches Préhistoriques, Lille, pp. 37–40.

Bahain, J.-J., Falguères, C., Laurent, M., Voinchet, P., Dolo, J.-M., Antoine, P., Tuffreau, A., 2007. ESR chronology of the Somme River Terrace system and first human settlements in Northern France. Quaternary Geochronology 2, 356–362.

Balescu, S., 1988. Apports de la thermoluminescence à la stratigraphie et à la sédimentologie des loess saaliens du NW de l'Europe. Ph.D. Dissertation, Université libre de Bruxelles.

Balescu, S., Tuffreau, A., 2004. La phase ancienne du Paléolithique moyen dans la France septentrionale (stades isotopiques 8 à 6) : apports de la datation par luminescence des séquences loessiques. Archaeological Almanac 16, 5–22.

Bar-Yosef, O., 1994. The Lower Paleolithic of the Near East. Journal of World Prehistory 8, 211–265.

Bar-Yosef, O., 2002. The chronology of the Middle Paleolithic of the Levant. In: Akazawa, T., Aoki, K., Bar-Yosef, O. (Eds.), Neandertals and Modern Humans in Western Asia. Springer US, Boston, pp. 39–56.

Bar-Yosef, O., Meignen, L., 2001. The chronology of the Levantine Middle Palaeolithic period in retrospect. Bulletins et Mémoires de la Société d'Anthropologie de Paris 13, 269–289.

Behrensmeyer, A.K., Hill, A.P., 1988. Fossils in the Making: Vertebrate Taphonomy and Paleoecology. University of Chicago Press, Chicago.

Beyries, S., 1988. Functional variability of lithic sets in the Middle Paleolithic. In: Dibble, H.L., Montet-White, A. (Eds.), Upper Pleistocene Prehistory of Western Eurasia. University Museum of Pennsylvania, Philadelphia, pp. 213–223.

Beyries, S., 1988. Etude tracéologique des racloirs du niveau IIA. In: Tuffreau, A., Sommé, J. (Eds.), Le Gisement Paléolithique Moyen de Biache-Saint-Vaast (Pas-de-Calais). Volume I : Stratigraphie, Environnement et Études Archéologiques (1ère Partie). Société Préhistorique Française, Paris, pp. 215–230.

Blaser, F., Chaussé, C., 2016. Saint-Illiers-la-Ville and the Micoquian of Weichselian sequences of the Paris Basin. Quaternary International 411A, 163–178.

Blondiau, L. (dir), Coutard, S., Ducrocq, T., Locht, J.-L., Sellier-Segard, N., 2009. Ailly-sur-Noye (Somme). “La Voirie de Guyencourt,” (Rapport de diagnostic). Institut National de Recherches Archéologique Préventives, Service Régional de l’Archéologie de Picardie, Amiens.

Boaz, N.T., Behrensmeyer, A.K., 1976. Hominid taphonomy: Transport of human skeletal parts in an artificial fluviatile environment. American Journal of Physical Anthropology 45, 53–60.

Boëda, E., 1986. Le débitage Levallois de Biache-Saint-Vaast (Pas-de-Calais) : première étude technologique. In: Tuffreau, A., Sommé, J. (Eds.), Chronostratigraphie et Faciès Culturels du Paléolithique Inférieur et Moyen Dans l’Europe du Nord-Ouest. Bulletin de l’Association Française pour l’Etude du Quaternaire supplement, 209–218.

Boëda, E., 1988a. Analyse technologique du débitage du niveau IIa. In: Tuffreau, A., Sommé, J. (Eds.), Le Gisement Paléolithique Moyen de Biache-Saint-Vaast (Pas-de-Calais). Volume I : Stratigraphie, Environnement et Études Archéologiques (1ère Partie). Société Préhistorique Française, Paris, pp. 185–214.

Boëda, E., 1988b. Le concept laminaire : rupture et filiation avec le concept Levallois. In: Otte, M. (Ed.), L’Homme de Néandertal. Volume 4 : La Mutation. Université de Liège, Liège, pp. 41–59.

Boëda, É., 1993. Le débitage discoïde et le débitage Levallois récurrent centripède. Bulletin de la Société Préhistorique Française 90, 392–404.

Boëda, E., 1994. Le Concept Levallois : Variabilité des Méthodes. CNRS éditions, Paris.

Boëda, É., 1997. Technogenèse de systèmes de production lithique au Paléolithique inférieur et moyen en Europe occidentale et au Proche-Orient. Habilitation à diriger des recherches Dissertation, Université Paris X - Nanterre.

Boëda, É., 2013. Techno-logique & Technologie. Une Paléo-histoire des Objets Lithiques Tranchants. @rchéo-éditions.com. ed., Paris.

Boëda, É., Connan, J., Dessort, D., Muhesen, S., Mercier, N., Valladas, H., Tisnerat, N., 1996. Bitumen as hafting material on Middle Palaeolithic artefacts. Nature 380, 336–338.

Boëda, É., Connan, J., Muhesen, S., 1998. Bitumen as hafting material on Middle Paleolithic artifacts from the El Kowm basin, Syria. In: Akazawa, T., Aoki, K., Bar-Yosef, O. (Eds.), Neandertals and Modern Humans in Western Asia. Plenum Press, New York, pp. 181–204.

Boëda, É., Bonilauri, S., Connan, J., Jarvie, D., Mercier, N., Tobey, M., Valladas, H., Sakhel, H. al, 2008. New Evidence for Significant Use of Bitumen in Middle Palaeolithic Technical Systems at Umm el Tlel (Syria) around 70,000 BP. Paléorient 34, 67–83.

Bonilauri, S., 2015. Le débitage Levallois : un concept de préhension normalisé et varié ? Exemples de productions levalloiso-moustériennes issues du site d’Umm el Tlel, Syrie centrale. Paléorient 41, 83–115.

Bordes, F., 1950. L’évolution buissonnante des industries en Europe occidentale. Considérations théoriques sur le Paléolithique ancien et moyen. L’Anthropologie 54, 393–420.

Bordes, F., 1954. Les Limons Quaternaires du Bassin de la Seine : Stratigraphie et Archéologie Paléolithique. Masson, Paris.

Bordes, F., 1981. Vingt-cinq ans après : le complexe moustérien revisité. Bulletin de la Société Préhistorique Française 78, 77–87.

Bordes, F., 1984. Leçons sur le Paléolithique. Tome II : Le Paléolithique en Europe. CNRS, Paris.

Bordes, F., Fitte, P., 1953. L’Atelier Commont. L’Anthropologie 57, 1–45.

Bouchet, J.-P., 1986. Les gisements du Paléolithique moyen de Biache St Vaast et Seclin : Organisation spatiale des vestiges archéologiques. D.E.A. Dissertation, EPHE.

Bourdier, F., 1969. Excursion dans le bassin de Paris de l’Association Internationale pour l’Etude du Quaternaire du 18 au 28 août 1969: Etude comparee des depôts quaternaires des bassins de la Seine et de la Somme. Bulletin d’Information des Geologues du Bassin de Paris 21, 169–220.

Bourdier, F., Munaut, A.-V., Prat, F., Puisségur, J.-J., 1974. Les dépôts du complexe rissien de la Somme. Quaternaire 11, 219–227.

Bourguignon, L., 1997. Le Moustérien de type Quina : nouvelles définitions d’une entité technique. Ph.D. Dissertation, Université Paris 10.

Bourguignon, L., Faivre, J.-P., Turq, A., 2004. Ramification des chaînes opératoires : une spécificité du Moustérien ? Paleo 16, 37–48.

Brenet, M., 2011. Variabilité et signification des productions lithiques au Paléolithique moyen ancien : l'exemple de trois gisements de plein-air du Bergeracois (Dordogne, France). Ph.D. Dissertation, Université Bordeaux 1.

Brenet, M., Bourguignon, L., Jarry, M., 2014a. Emergence et diversité des techno-complexes au Paléolithique moyen ancien. Relations entre productions de débitage et de façonnage. In: Jaubert, J., Fourment, N., Depaepe, P. (Eds.), Transitions, Ruptures et Continuité en Préhistoire. Vol. 2 : Paléolithique et Mésolithique. Société Préhistorique Française, Paris, pp. 141–178.

Brenet, M., Bourguignon, L., Colonge, D., Folgado, M., Jarry, M., Lelouvier, L.-A., Mourre, V., Turq, A., 2014b. Les techno-complexes au début du Paléolithique moyen en Aquitaine septentrionale : complexité, complémentarité des productions de débitage et de façonnage et implications comportementales. In: Jaubert, J., Fourment, N., Depaepe, P. (Eds.), Transitions, Ruptures et Continuité en Préhistoire. Vol. 2 : Paléolithique et Mésolithique. Société Préhistorique Française, Paris, pp. 81–101.

Brunnacker, K., Hennig, G.J., Juvigné, E., Löhr, H., Urban, B., Zeese, R., 1982. Der Kartstein-Travertin in der nördlichen Westeifel. Decheniana 135, 179–204.

Burie, H., 1992. Etude de l'industrie lithique du niveau II alpha du gisement paléolithique moyen de Biache-Saint-Vaast (Pas-de-Calais). Maîtrise Dissertation, Université des Sciences et Technologies de Lille I.

Burie, H., 1996. Etude de la répartition spatiale des vestiges du Paléolithique inférieur et moyen intrasite et inter-sites. DEA Dissertation, Université des Sciences et Technologies de Lille I.

Chaussé, C., Limondin-Lozouet, N., Occhietti, S., Voinchet, P., Bacon, J.-C., 2000. La nappe alluviale de Soucy-les-Grandes-Pièces (Yonne, France) : reconstitution pluridisciplinaire du fonctionnement d'un cours d'eau du Pléistocène moyen. Géographie Physique et Quaternaire 54, 187–208.

Chaussé, C., 2003. Les nappes alluviales de la basse vallée de l'Yonne, approche géométrique et chronostratigraphique et l'apport de l'étude de la Nappe de Soucy à la compréhension des occupations du Paléolithique inférieur de Soucy. Ph.D. Dissertation, Université de Lille 1.

Chazan, M., 2016. Technological radiation and the process of technological change at the end of the Levantine Lower Paleolithic. Quaternary International 411, 59–66.

Chertier, B., Hinout, J., 1988. Le gisement moustérien de Champvoisy (Marne), lieu-dit Les Petits-Bâtis. Etude du mobilier lithique. Préhistoire et Protohistoire en Champagne-Ardenne 12, 9–30.

Commont, V., 1909a. Saint-Acheul et Montières. Notes de Géologie, de Paléontologie et de Préhistoire, Mémoires de la Soc. Géol. Nord. Imprimerie Liégois-Six, Lille.

Commont, V., 1909b. Saint-Acheul et Montières (Compte-rendu de l'excursion du 11 juillet 1909). Revue Préhistorique 4° année, 297–319.

Commont, V., 1911. Les Gisements préhistoriques de Saint-Acheul et de Montières. Impr. Grau, Amiens.

Commont, V., 1913. Moustérien à faune chaude dans la vallée de la Somme à Montières-les-Amiens. In: Compte-Rendu de La 14è Session Du Congrès International d'Anthropologie et d'Archéologie Préhistorique, Impr. Albert Kündig, Genève, pp. 291–300.

Commont, V., 1913. Les Hommes Contemporains du Renne dans la Vallée de la Somme. Imprimerie Yvert & Tellier, Amiens.

Coudenneau, A., 2013. Éléments triangulaires et armes de chasse au Paléolithique moyen: Constats et réflexions à travers l'étude techno-morpho-fonctionnelle de quatre séries d'Europe occidentale. Ph.D. Dissertation, Université d'Aix-Marseille.

DeBono, H., Goren-Inbar, N., 2001. Note on a link between Acheulian handaxes and the Levallois method. Journal of the Israel Prehistoric Society 31, 9–23.

Degorce, J.-P., 1992. Sur une corrélation possible entre le biface et la technique Levallois. Bulletin de la Société Préhistorique Française 89, 228–229.

de Givenchy, P., 1911. Les grands Éclats Moustériens et les Pièces Acheuléo-moustériennes de la carrière du Tillet, près La Ferté-sous-Jouarre (Seine-et-Marne). Bulletin de la Société Préhistorique Française 8, 257–264.

Delagnes, A., 1993. Un mode de production inédit au Paléolithique moyen dans l'industrie du niveau 6e du Pucheuil (Seine-Maritime). Paleo 5, 111–120.

Delagnes, A., Ropars, A., 1996. Paléolithique Moyen en Pays de Caux (Haute-Normandie). Le Pucheuil, Etoutteville : Deux gisements de Plein Air en Milieu Lœssique. Éditions de la Maison des Sciences de l'Homme, Paris.

Delpech, F., Geneste, J.-M., Rigaud, J.-P., Texier, J.-P., 1995. Les industries antérieures à la dernière glaciation en Aquitaine septentrionale : chronologie, paléoenvironnements, technologie, typologie et économie de subsistance. In: Les Industries à Pointes Foliacées d'Europe Centrale. Paléo 7(S1), 133–164.

Devresse, K., 1997. Étude de l'industrie du niveau R du gisement paléolithique moyen de Gouzeaucourt (Nord). Master 2 Dissertation, Université des Sciences et Technologies de Lille.

Dibble, H.L., Bar-Yosef, O. (Eds.), 1995. The Definition and Interpretation of Levallois Variability. Prehistory Press, Madison.

Dibble, H.L., Chase, P.G., McPherron, S.P., Tuffreau, A., 1997. Testing the reality of a "living floor" with archaeological data. American Antiquity 62, 629–651.

Dibble, H.L., 1995. Middle paleolithic scraper reduction: Background, clarification, and review of the evidence to date. Journal of Archaeological Method and Theory 2, 299–368.

Djema, H., 2010. Résumé de thèse : Hélène Djema (2008) – Le Paléolithique moyen ancien de la Corniche cantabrique et du Bassin aquitain ou le phénomène culturel des premiers Néandertaliens. Analyse techno-économique comparative des gisements cantabriques et périgourdins. Bulletin de la Société Préhistorique Française 107, 388–390.

Durbet, G., Rodriguez, P., Badalian, L., Hadjouis, D., Gauthier, A., Laurent, M., Ricard, J.-L., Wattez, J., 1997. Découverte d'un site Paléolithique moyen dans des alluvions saaliennes du confluent

Seine-Marne à Maisons-Alfort (Val-de-Marne. Comptes Rendus de l'Académie des Sciences. Paris 324, série II a, 505–512.

Efremov, I.A., 1940. Taphonomy: a new branch of paleontology. Pan-American Geology 74, 81–93.

Fagnard, J.-P., 1988. Les grottes de la vallée Heureuse à Rinxent (Pas-de-Calais). Revue Archéologique de Picardie 7, 46–47.

Faivre, J.-P., 2011. Le « Moustérien à denticulés » de la couche 20 de Combe-Grenal : implications techniques, économiques et fonctionnelles au sein du système de production Quina en Périgord. Paleo 21, 135–162.

Foley, R., Mirazón Lahr, M., 1997. Mode 3 technologies and the evolution of modern humans. Cambridge Archaeological Journal 7, 3–36.

Foley, R., Mirazón Lahr, M., 2003. On stony ground: Lithic technology, human evolution, and the emergence of culture. Evolutionary Anthropology 12, 109–122.

Fontana, F., Nenzioni, G., Peretto, C., 2010. The southern Po plain area (Italy) in the mid-late Pleistocene: Human occupation and technical behaviours. Quaternary International 223–224, 465–471.

Forestier, H., 1993. Le Clactonien : mise en application d'une nouvelle méthode de débitage s'inscrivant dans la variabilité des systèmes de production lithique du Paléolithique ancien. Paleo 5, 53–82.

Frumkin, A., Bar-Yosef, O., Schwarcz, H.P., 2011. Possible paleohydrologic and paleoclimatic effects on hominin migration and occupation of the Levantine Middle Paleolithic. Journal of Human Evolution 60, 437–451.

Gadebois, G., 2006. Therdonne. Etude technologique et technique de la production de pointe Levallois et d'eclats triangulaires : un aspect comportemental des modalités de gestion lithique des Néanderthaliens. Master Dissertation, Université des Sciences et Technologies de Lille.

Gamble, C., 2009. Human display and dispersal: A case study from biotidal Britain in the Middle and Upper Pleistocene. Evolutionary Anthropology 18, 144–156.

Goubel, H., 2011. Analyse de contour dentaire des ursidés pléistocènes et actuels : caractérisation et étude des causes de la variabilité morphologique des dents jugales. Ph.D. Dissertation, Université de Lille 1.

Goval, É., 2005. Contribution à l’identification du passage du Paléolithique inférieur au Paléolithique moyen via les comportements techniques : le cas du gisement du Mont de l’Evangile de Gentelles (Somme, France). Master 2 Dissertation, Université des Sciences et Technologies de Lille.

Goval, É., 2012. Peuplements néandertaliens dans le nord de la France. CNRS Editions, Paris.

Goval, É., Hérisson, D., 2012. Découverte inédite de trois occupations du Pléniglaciaire moyen du Weichselien à Havrincourt «Les Bosquets» (Pas-de-Calais, France). Bulletin de la Société Préhistorique Française 109, 342–345.

Goval, É. (Ed.), 2013. Des Derniers Néandertaliens aux Premiers *Homo sapiens* : Les Occupations Paléolithiques d’Havrincourt « Les Bosquets » (Pas-de-Calais). Rapport de Fouille, Canal Seine-Nord Europe, Fouille 22, Nord-Pas-de-Calais, Pas-de-Calais, Havrincourt. Institut National de Recherches Archéologiques Préventives, Croix-Moligneaux.

Goval, É., Hérisson, D., Locht, J.-L., Coudenneau, A., 2016. Levallois points and triangular flakes during the Middle Palaeolithic in northwestern Europe: Considerations on the status of these pieces in the Neanderthal hunting toolkit in northern France. Quaternary International 411, 216–232.

Goval, É., Hérisson, D. (Eds.), 2018. Les Chasseurs des Steppes durant le Dernier Glaciaire en France Septentrionale: Paléoenvironnement, Techno-économie, Approche Fonctionnelles et Spatiale du Gisement d’Havrincourt. Université de Liège, Liège.

Guerlin, O., Deschodt, L., Lamotte, A., 2005. Le Gisement de Revelles « les Terres Sellier ». Inrap, Amiens.

Guibert, P., Bechtel, F., Bourguignon, L., Brenet, M., Couchoud, I., Delagnes, A., Delpech, F., Detrain, L., Duttine, M., Folgado, M., Jaubert, J., Lahaye, C., Lenoir, M., Maureille, B., Texier, J.-P., Turq, A., Vieillevigne, E., Villeneuve, G., 2008. Une base de données pour la chronologie du

Paléolithique moyen dans le Sud-Ouest de la France. In: Jaubert, J., Bordes, J.-G., Ortega I Cordelat, I. (Eds.), Les Sociétés Paléolithiques d'un Grand Sud-Ouest: Nouveaux Gisements, Nouvelles Méthodes, Nouveaux Résultats. Société Préhistorique Française, Paris, pp. 19–40.

Guipert, G., 2005. Reconstitution et position phylétique des restes crâniens de l'Homme de Tautavel (Arago 21-47) et de Biache-Saint-Vaast 2. Apports de l'imagerie et de l'analyse tridimensionnelle. Ph.D. Dissertation, Université Paul Cézanne Aix-Marseille III.

Hadjouis, D., 1998. Le cheval de Maisons-Alfort (Val-de-Marne, France) et ses rapports avec les chevaux du Pléistocène moyen et supérieur d'Europe. Quaternaire 9, 337–343.

Heinzelin, J. de, Haesaerts, P., 1983. Un cas de débitage laminaire au Paléolithique ancien : Croix-l'Abbé à Saint-Valery-sur-Somme. Gallia Préhistoire 26, 189–201.

Hershkovitz, I., Weber, G.W., Quam, R., Duval, M., Grün, R., Kinsley, L., Ayalon, A., Bar-Matthews, M., Valladas, H., Mercier, N., Arsuaga, J.L., Martinón-Torres, M., Bermúdez de Castro, J.M., Fornai, C., Martín-Francés, L., Sarig, R., May, H., Krenn, V.A., Slon, V., Rodríguez, L., García, R., Lorenzo, C., Carretero, J.M., Frumkin, A., Shahack-Gross, R., Bar-Yosef Mayer, D.E., Cui, Y., Wu, X., Peled, N., Groman-Yaroslavski, I., Weissbrod, L., Yeshurun, R., Tsatskin, A., Zaidner, Y., Weinstein-Evron, M., 2018. The earliest modern humans outside Africa. Science 359, 456–459.

Hérisson, D., Goval, E., 2013. Du Paléolithique inférieur au début du Paléolithique supérieur dans le Nord de la France : lumière sur les premières découvertes du Canal Seine-Nord Europe. Notae Praehistoricae 33, 91–104.

Hérisson, D., Locht, J.-L., Auguste, P., Tuffreau, A., 2013. Néandertal et le feu au Paléolithique moyen ancien. Tour d'horizon des traces de son utilisation dans le Nord de la France. L'Anthropologie 117, 541–578.

Hérisson, D., Locht, J., 2014. Le niveau N3 de Therdonne : reflet de la diversité des technocomplexes du Paléolithique moyen ancien du Nord de la France ? In: XXVIIe Congrès Préhistorique de France : Transitions, Ruptures et Continuité en Préhistoire, Paléolithique et Mésolithique. Société Préhistorique Française, Paris, pp. 43–58.

Hérisson, D., Goval, É. (Eds.), 2015. Etricourt-Manancourt. Les Occupations du Paléolithique Inférieur et du Paléolithique Moyen d'Etricourt-Manancourt. Inrap Canal Seine-Nord Europe, Croix-Moligneaux.

Hérisson, D., Goval, É., Lefèvre, B., 2015. Éléments de réflexion sur la place et le rôle de la France septentrionale en Europe du Nord-Ouest durant la phase ancienne du Paléolithique moyen. In: Depaepe, P., Goval, É., Koehler, H., Locht, J.-L. (Eds.), Les Plaines du Nord-Ouest : Carrefour de l'Europe au Paléolithique Moyen ? Société Préhistorique Française, Paris, pp. 41–59.

Hérisson, D., Brenet, M., Cliquet, D., Moncel, M.-H., Richter, J., Scott, B., Van Baelen, A., Di Modica, K., De Loecker, D., Ashton, N., Bourguignon, L., Delagnes, A., Faivre, J.-P., Folgado-Lopez, M., Locht, J.-L., Pope, M., Raynal, J.-P., Roebroeks, W., Santagata, C., Turq, A., Van Peer, P., 2016a. The emergence of the Middle Palaeolithic in north-western Europe and its southern fringes. Quaternary International 411A, 233–283.

Hérisson, D., Coutard, S., Goval, E., Locht, J.-L., Antoine, P., Chantreau, Y., Debenham, N., 2016b. A new key-site for the end of Lower Palaeolithic and the onset of Middle Palaeolithic at Etricourt-Manancourt (Somme, France). Quaternary International 409, 73–91.

Hérisson, D., 2012. Étude des comportements des premiers Néandertaliens du Nord de la France. Les occupations saaliennes des gisements de Biache-Saint-Vaast et de Therdonne. Ph.D. Dissertation, Université Charles de Gaulle - Lille III.

Hiscock, P., Turq, A., Faivre, J.-P., Bourguignon, L., 2009. Quina Procurement and Tool Production. In: Lithic Materials and Paleolithic Societies. Wiley-Blackwell, Chichester, pp. 232–246.

Hurel, A., Bahain, J.-J., Moncel, M.-H., Vialet, A., Antoine, P., Auguste, P., Charlier, P., Coye, N., Favin-Lévêque, J.-C., Froment, A., Lebon, M., Limondin-Lozouet, N., Orliac, R., Tombret, O., Vercoutère, C., Voinchet, P., Zazzo, A., 2016. Moulin Quignon : la redécouverte d'un site. L'Anthropologie 120, 428–438.

Hurtrelle, J., Monchy, E., Tuffreau, A., 1972. Le gisement paléolithique ancien de Beaumetz-les-Loges (Pas-de-Calais). Annales de la Société Géologique du Nord 92, 147–153.

Huxtable, J., Aitken, M.J., 1988. Datation par thermoluminescence. In: Tuffreau, A., Sommé, J. (Eds.), Le Gisement Paléolithique Moyen de Biache-Saint-Vaast (Pas-de-Calais). Volume I : Stratigraphie, Environnement et Études Archéologiques (1ère Partie). Société Préhistorique Française, Paris, pp. 107–108.

Keeley, L.H., 1993. The Utilization of Lithic Artifacts. In: Singer, R., Gladfelter, B.G., Wymer, J.J. (Eds.), The Lower Paleolithic Site at Hoxne, England. The University of Chicago Press, Chicago and London, pp. 129–149.

Koehler, H., 2008. L'apport du gisement des Osiers à Bapaume (Pas-de-Calais) au débat sur l'émergence du Paléolithique moyen dans le Nord de la France. Bulletin de la Société Préhistorique Française 105, 709–735.

Koehler, H., 2011. Blade production in the early phase of the Middle Paleolithic at Bapaume-Les Osiers (Pas-De-Calais, France): comments on the distinction between the early and late phases of the Middle Paleolithic. In: Conard, N.J., Richter, J. (Eds.), Neanderthal Lifeways, Subsistence and Technology: One Hundred Fifty Years of Neanderthal Study. Springer Netherlands, Dordrecht, pp. 111–120.

Lamotte, A., 1992. Le gisement paléolithique moyen de faciès cambrésien de Gouzeaucourt (Nord). Essai de reconstitution des chaînes opératoires. Bulletin de la Société Préhistorique Française 89, 37–41.

Lamotte, A., 1994. Les industries à bifaces du pléistocène moyen de l'Europe du Nord-Ouest : données nouvelles des gisements du bassin de l'Escaut, de la Somme et de la baie de Saint-Brieuc. Ph.D. Dissertation, Université Lille 1.

Lamotte, A., 1995. Données nouvelles sur l'Acheuléen de l'Europe du Nord-Ouest. Bulletin de la Société Préhistorique Française 92, 193–200.

Lamotte, A., 1999. L'apport des remontages dans la compréhension des méthodes de débitage et de façonnage des gisements acheuléens de la Somme. Bulletin de la Société Préhistorique Française 96, 117–131.

Lamotte, A., Tuffreau, A., 2001. Les industries lithiques de la séquence fluviatile fine de Cagny-l'Epinette (Somme). In: Tuffreau, A. (Ed.), L'Acheuléen dans la Vallée de la Somme et Paléolithique Moyen dans le Nord de la France : Données Récentes. Publications du CERP, Lille, pp. 113–134.

Laurent, M., 1993. Datation par résonance de spin électronique (ESR) de quartz de formations quaternaires : comparaison avec le paléomagnétisme. Ph.D. Dissertation, Museum National d'Histoire Naturelle, Paris.

Lazuén, T., Delagnes, A., 2014. Lithic tool management in the Early Middle Paleolithic: an integrated techno-functional approach applied to Le Pucheuil-type production (Le Pucheuil, northwestern France). Journal of Archaeological Science 52, 337–353.

Leblanc, E., 1999. Etude des séries IIA, II alpha, II base du gisement paléolithique moyen de Biache-Saint-Vaast (Pas-de-Calais): synthèse et complément des études typologiques et plans de répartition du chantier de 1976. Maîtrise Dissertation, Université des Sciences et Technologies de Lille I.

Lemonnier, P., 2004. Mythiques chaînes opératoires. Techniques & Culture 43-44, 1-17.

Lemorini, C., Bourguignon, L., Zupancich, A., Gopher, A., Barkai, R., 2016. A scraper's life history: Morpho-techno-functional and use-wear analysis of Quina and demi-Quina scrapers from Qesem Cave, Israel. Quaternary International 398, 86–93.

Leroy, G., 1990. Définition d'une méthode de reconstitution graphique de paléoenvironnements et son application à la séquence pléistocène moyen de Biache-Saint-Vaast. Maîtrise Dissertation, Université des Sciences et Technologies de Lille I, Villeneuve-d'Ascq.

Lhomme, V., 2007. Tools, space and behaviour in the Lower Palaeolithic: discoveries at Soucy in the Paris basin. Antiquity 81, 536–554.

Lhomme, V., Connet, N., Chaussé, C., David, F., Guadelli, J.-L., 1996. La gravière des Grandes Pièces et les sites paléolithiques inférieurs de Soucy (Yonne). Premiers résultats. Bulletin de la Société Préhistorique Française 93, 482–493.

Lhomme, V., Bemilli, C., Chaussé, C., Connet, N., Kolfschoten, T. van, Limondin-Lozouet, N., 2000. Le gisement paléolithique inférieur de Soucy 5 (Yonne). Revue Archéologique de l'Est 49, 5–30.

Lhomme, V., Rocca, R., Sellier, N., 2002. Clairy-Saulchoix - A.29 Le Champ Mugotte - Au Chemin de Pissy. In: Bilan Scientifique de La Région Picardie - 2002. Service Régional de l'Archéologie de Picardie, Amiens, p. 104.

Lhomme, V., Connet, N., Chaussé, C., 2003. Le gisement de Soucy 6 (Yonne) et son industrie lithique dans le contexte des industries à éclats du Paléolithique inférieur en Europe du Nord-Ouest. Bulletin de la Société Préhistorique Française 100, 241–251.

Lhomme, V., Connet, N., Chaussé, C., Bemilli, C., Bahain, J.-J., Voinchet, P., 2004. Les sites et les industries lithiques du Paléolithique inférieur, moyen et supérieur de la basse vallée de l'Yonne dans leurs contextes chronostratigraphiques. Bilan de dix ans d'activité archéologique pluridisciplinaire dans le sud-est du Bassin parisien. Bulletin de la Société Préhistorique Française 101, 701–739.

Limondin-Lozouet, N., Antoine, P., Bahain, J.-J., Cliquet, D., Coutard, S., Dabkowski, J., Ghaleb, B., Locht, J.-L., Nicoud, E., Voinchet, P., 2015. North-West European MIS 11 malacological successions: a framework for the timing of Acheulean settlements. Journal of Quaternary Science 30, 702–712.

Liouville, M., 2007. Variabilité du Cerf Elaphe (Cervus elaphus Linné 1758) au cours du Pléistocène moyen et supérieur en Europe occidentale : approches morphométriques, paléoécologiques et cynégétiques. Ph.D. Dissertation, Muséum National d'Histoire Naturelle, Paris.

Lisiecki, L.E., Raymo, M.E., 2005. A Pliocene-Pleistocene stack of 57 globally distributed benthic δ18 O records. Paleoceanography 20, PA1003.

Locht, J., Antoine, P., Swinnen, C., 1995. Le gisement paléolithique de Plachy-Buyon (Somme). Revue Archéologique de Picardie 1995 (3/4), 3–33.

Locht, J.L., Guerlin, O., Antoine, P., Debenham, N., 2000. Therdonne. Le Mont de Bourguillemont. Association pour les Fouilles Archéologiques Nationales, Service Régional de l'Arcéhologie de Picardie, Amiens.

Locht, J., 2004. Le gisement paléolithique moyen de Beauvais (Oise). Contribution à la connaissance des modalités de subsistance des chasseurs de Renne du Pléniglaciaire inférieur du Weichsélien. Ph.D. Dissertation, Université Lille-I.

Locht, J.-L., Kiefer, D., 2009. Drucat (Somme). Au bout de Drucat. Institut National de Recherches Archéologiques Préventives, Service Régionale de l'Archéologie de Picardie, Amiens.

Locht, J.-L., Antoine, P., Hérisson, D., Gadebois, G., Debenham, N., 2010. Une occupation de la phase ancienne du Paléolithique moyen à Therdonne (Oise). Chronostratigraphie, production de pointes Levallois et réduction des nucléus. Gallia Préhistoire 52, 1–32.

Locht, J., Depaepe, P., 2011. Picardie. Le Paléolithique inférieur et moyen. Revue Archéologique de Picardie 3, 65–84.

Locht, J.-L., Depaepe, P., 2015. Le Paléolithique moyen récent en France septentrionale. In: Depaepe, P., Goval, É., Koehler, H., Locht, J.-L. (Eds.), Les Plaines Du Nord-Ouest : Carrefour de l'Europe Au Paléolithique Moyen ? Société Préhistorique Française, Paris, pp. 61–74.

Locht, J.-L., Coutard, S., Antoine, P., Sellier, N., Ducrocq, T., Paris, C., Guerlin, O., Kiefer, D., Defaux, F., Deschodt, L., Limondin-Lozouet, N., 2013. Données inédites sur le Quaternaire et le Paléolithique du Nord de la France. Revue Archéologique de Picardie 2013 (3/4), 5–70.

Locht, J.-L., Goval, É., Antoine, P., Coutard, S., Auguste, P., Paris, C., Hérisson, D., 2014. Palaeoenvironments and prehistoric Interactions in Northern France from the Eemian Interglacial to the End of the Weichselian Middle Pleniglacial. In: Foulds, F.W.F., Drinkall, H.C., Perri, A.R., Clinnick, D.T.C., Walker, J.W.P. (Eds.), «Wild Things» Recent Advances in Palaeolithic and Mesolithic Research. Foulds, Oxford, pp. 70–78.

Locht, J.-L., Hérisson, D., Goval, E., Cliquet, D., Huet, B., Coutard, S., Antoine, P., Feray, P., 2016. Timescales, space and culture during the Middle Palaeolithic in northwestern France. Quaternary International 411A, 129–148.

Louguet, S., 2004. Les très grands herbivores (éléphantidés et rhinocérotidés) au Paléolithique moyen en Europe du Nord-Ouest : Paléoécologie, taphonomie et aspects palethnographiques. D.E.A. Dissertation, Université Lille 1.

Louguet-Lefebvre, S., 2005. Les Mégaherbivores (Eléphantidés et Rhinocérotidés) au Paléolithique Moyen en Europe du Nord-Ouest: Paléoécologie, Taphonomie et Aspects Palethnographiques. Archaeopress, Oxford.

Louguet, S., 2006. Determining the age of death of proboscids and rhinocerotids from dental attrition. In: Ruscillo, D. (Ed.), Recent Advances in Ageing and Sexing Animal Bones. Proceedings of the 9th ICAZ Conference, Durham 2002. Oxbow Books, Oxford, pp. 179–188.

Lyman, R.L., 1994. Vertebrate Taphonomy. Cambridge University Press, Cambridge.

Malinsky-Buller, A., 2016a. Lost and found: Technological trajectories within Lower/Middle Paleolithic transition in Western Europe, North of the Pyrenees. Quaternary International 409B, 104–148.

Malinsky-Buller, A., 2016b. The Muddle in the Middle Pleistocene: The Lower–Middle Paleolithic Transition from the Levantine Perspective. Journal of World Prehistory 29, 1–78.

Malinsky-Buller, A., Hovers, E., 2019. One size does not fit all: Group size and the late middle Pleistocene prehistoric archive. Journal of Human Evolution 127, 118–132.

Mania, D., 1995. The earliest occupation of Europe : the Elbe-Saale region (Germany). In: Roebroeks, W., van Kolfschoten, T. (Eds.), The Earliest Occupation of Europe. Publications of the Institute of Prehistory, Leiden, pp. 85–101.

Marcy, J.-L., 1984. Aperçu sur les sols d'habitat du gisement paléolithique moyen de Biache-Saint-Vaast (Pas-de-Calais). Cahiers de Géographie physique. Travaux du Laboratoire de Géomorphologie et d'Etude du Quaternaire 5, 59–76.

Marcy, J.-L., 1985. Les sols d'habitat du gisement paléolithique moyen de Biache- Saint-Vaast (Pas-de-Calais). Maîtrise Dissertation, Université des Sciences et Technologies de Lille I.

Marcy, J.-L., 1986. Les séries lithiques du gisement moustérien de Biache-Saint- Vaast (Pas-de-Calais): variations morphométriques et technologiques. D.E.A. Dissertation, Université des Sciences et Technologies de Lille I.

Marcy, J.-L., 1988. Le débitage de cinq des séries lithiques de Biache-Saint-Vaast (Pas-de-Calais). Revue Archéologique de Picardie 1, 125–132.

Marcy, J.-L., 1989. L'outillage sur éclat du gisement acheuléen de la vallée du Muid à Gouzeaucourt (Nord) : Premiers résultats. In: Tuffreau, A. (Ed.), Paléolithique et Mésolithique du Nord de la France. Nouvelles Recherches. Publications du CERP, Lille, pp. 31–41.

Marcy, J.-L., Tuffreau, A., 1988a. Le niveau D1. In: Tuffreau, A., Sommé, J. (Eds.), Le Gisement Paléolithique Moyen de Biache-Saint-Vaast (Pas-de-Calais). Volume I. Société Préhistorique Française, Paris, pp. 263-289.

Marcy, J.-L., Tuffreau, A., 1988b. Le niveau D. In: Tuffreau, A., Sommé, J. (Eds.), Le Gisement Paléolithique Moyen de Biache-Saint-Vaast (Pas-de-Calais). Volume I : Stratigraphie, Environnement et Études Archéologiques (1ère Partie). Société Préhistorique Française, Paris, pp. 291–299.

Marx, O., 2001. Fracturation des os longs d'Ursidés : étude du gisement paléolithique moyen ancien de Biache-Saint-Vaast (Pas-de-Calais, France). Master 2 Dissertation, Université de Lille I.

Mathias, C., 2016. After the Lower Palaeolithic: Lithic ramification in the early Middle Palaeolithic of Orgnac 3, layer 2 (Ardèche, France). Quaternary International 411B, 193–201.

Mathias, C., 2018. Les phases anciennes du Paléolithique moyen dans le Sud-Est et le Sud-Ouest de la France : étude des systèmes techniques lithiques. Ph.D. Dissertation, Université de Perpignan.

Mauss, M., 1936. Les techniques du corps. Journal de Psychologie 32, 271–293.

Meignen, L., 1998. Hayonim Cave lithic assemblages in the context of the Near Eastern Middle Paleolithic. In: Akazawa, T., Aoki, K. and Bar-Yosef, O. (Eds.), Neandertals and Modern Humans in Western Asia. Plenum Press, New York, pp. 165–180.

Meignen, L., 2007. Middle Paleolithic blady assemblages in the Near East: a reassessment. In: Amirkhanov, K. A., Vasil'ev, S.A. and Belyaeva, E.V. (Eds.), Caucasus and the Initial Dispersals in the Old World, Proceedings. Russian Academy of Sciences, St. Petersburg Centre for Oriental Studies Publishers, St Petersbourg, pp. 133–148.

Meignen, L., 2011. The contribution of Hayonim Cave assemblages to the understanding of the so-called Early Levantine Mousterian. In: Otte, M., Le Tensorer, J.-M., Jagher, R. (Eds.), The Lower and Middle Palaeolithic in the Middle East and Neighbouring Regions: Basel Symposium, Mai 8-10 2008. ERAUL, Liège, pp. 85–100.

Meignen, L., Bar-Yosef, O., 2020. Acheulo-Yabrudian and Early Middle Paleolithic at Hayonim Cave (Western Galilee, Israel): Continuity or break? Journal of Human Evolution 139.

Mercier, N., Valladas, H., Froget, L., Joron, J.-L., Reyss, J.-L., Weiner, S., Goldberg, P., Meignen, L., Bar-Yosef, O., Belfer-Cohen, A., Chech, M., Kuhn, S.L., Stiner, M.C., Tillier, A.-M., Arensburg, B., Vandermeersch, B., 2007. Hayonim Cave: a TL-based chronology for this Levantine Mousterian sequence. Journal of Archaeological Science 34, 1064–1077.

Mirazón Lahr, M., Foley, R.A., 1998. Towards a theory of modern human origins: Geography, demography, and diversity in recent human evolution. American Journal of Physical Anthropology 107, 137–176.

Moncel, M.-H., Moigne, A.-M., Combier, J., 2012. Towards the Middle Palaeolithic in Western Europe: The case of Orgnac 3 (southeastern France). Journal of Human Evolution 63, 653–666.

Moncel, M.-H., Ashton, N., Arzarello, M., Fontana, F., Lamotte, A., Scott, B., Muttillo, B., Berruti, G., Nenzioni, G., Tuffreau, A., Peretto, C., 2020. Early Levallois core technology between Marine Isotope Stage 12 and 9 in Western Europe. Journal of Human Evolution 139, .

Monnier, G.F., Hauck, T.C., Feinberg, J.M., Luo, B., Le Tensorer, J.-M., Sakhel, H. al, 2013. A multi-analytical methodology of lithic residue analysis applied to Paleolithic tools from Hummal, Syria. Journal of Archaeological Science 40, 3722–3739.

Müller, U.C., Pross, J., Tzedakis, P.C., Gamble, C., Kotthoff, U., Schmiedl, G., Wulf, S., Christanis, K., 2011. The role of climate in the spread of modern humans into Europe. Quaternary Science Reviews 30, 273–279.

Munaut, A.V., 1988a. Etude palynologique. In: Tuffreau, A., Sommé, J. (Eds.), Le Gisement Paléolithique Moyen de Biache-Saint-Vaast (Pas-de-Calais). Volume I : Stratigraphie, Environnement et Études Archéologiques (1ère Partie). Société Préhistorique Française, Paris, pp. 77–88.

Munaut, A.V., 1988b. L'environnement végétal de quelques dépôts quaternaires du bassin de la Somme (France). In: Tuffreau, A. (Ed.), Cultures et Industries Lithiques en Milieu Loessique. Revue Archéologique de Picardie 1988(1/2), 45–56.

Nicoud, E., 2013. Le Paradoxe Acheuléen. Comité des Travaux Historiques et Scientifiques/Bibliothèque des Écoles françaises d'Athènes et de Rome, Paris and Roma.

Parush, Y., Gopher, A., Barkai, R., 2016. Amudian versus Yabrudian under the rock shelf: A study of two lithic assemblages from Qesem Cave, Israel. Quaternary International 398, 13–36.

Peresani, M., Fiore, I., Gala, M., Romandini, M., Tagliacozzo, A., 2011. Late Neandertals and the intentional removal of feathers as evidenced from bird bone taphonomy at Fumane Cave 44 ky BP, Italy. Proceedings of the National Academy of Sciences USA 108, 3888–3893.

Picin, A., Peresani, M., Falguères, C., Gruppioni, G., Bahain, J.-J., 2013. San Bernardino Cave (Italy) and the appearance of Levallois technology in Europe: results of a radiometric and technological reassessment. PLoS One 8, e76182.

Piningre, J.-F., 1978. Quelques caractéristiques du débitage du site paléolithique de Biache-Saint-Vaast (Pas-de-Calais). Quaternaire 15, 56–59.

Preece, R.C., Gowlett, J.A.J., Parfitt, S.A., Bridgland, D.R., Lewis, S.G., 2006. Humans in the Hoxnian: habitat, context and fire use at Beeches Pit, West Stow, Suffolk, UK. Journal of Quaternary Science 21, 485–496.

Railsback, L.B., Gibbard, P.L., Head, M.J., Voarintsoa, N.R.G., Toucanne, S., 2015. An optimized scheme of lettered marine isotope substages for the last 1.0 million years, and the climatostratigraphic nature of isotope stages and substages. Quaternary Science Reviews 111, 94–106.

Révillion, S., 1994. Les Industries Laminaires du Paléolithique Moyen en Europe Septentrionale : L'Exemple des Gisements de Saint-Germain-des-Vaux/ Port-Racine (Manche), de Seclin (Nord) et de Riencourt-lès-Bapaume (Pas-de-Calais). Publications du CERP, Lille.

Rios-Garaizar, J., Eixea, A., Villaverde, V., 2015. Ramification of lithic production and the search of small tools in Iberian Peninsula Middle Paleolithic. Quaternary International 361, 188–199.

Rocca, R., 2005. Approche des comportements territoriaux des hommes fossiles, nouveau critère de définition de l'Acheuléen dans le nord ouest de la France ? Etude appliquée à deux séries lithiques issues des niveaux supérieurs des sites de Soucy 5 et Soucy 3 dans l'Yonne. D.E.A. Dissertation, Université Paris X, Nanterre.

Roebroeks, W., Villa, P., 2011. On the earliest evidence for habitual use of fire in Europe. Proceedings of the National Academy of Sciences USA 108, 5209–5214.

Roebroeks, W., Conard, N.J., van Kolfschoten, T., 1992. Dense forests, cold steppes, and the Palaeolithic settlement of Northern Europe. Current Anthropology 33, 551–586.

Roebroeks, W., Hublin, J.-J., MacDonald, K., 2011. Continuities and discontinuities in Neandertal presence: a closer look at northwestern Europe. In: Ashton, N., Lewis, S.G., Stringer, C. (Eds.), Developments in Quaternary Sciences. Elsevier, Amsterdam, pp. 113–123.

Roler, K.L., Clark, G.A., 1997. Use-wear analysis of Levallois points from the 'Ain Difla rockshelter, west-central Jordan. In: Gebel, H.G.K., Kafafi, Z., Rollefson, G.O. (Eds.), The Prehistory of

Jordan, II. Perspectives from 1997, Studies in Early Near Eastern Production, Subsistence, and Environment. Ex oriente, Berlin, pp. 101–109.

Rolland, N., 1995. Levallois technique emergence: single or multiple? A review of the Euro-African record. In: Dibble, H.L., Bar-Yosef, O. (Eds.), The Definition and Interpretation of Levallois Technology. Prehistory Press, Madison, pp. 333–359.

Ronen, A. (Ed.), 1982. The Transition from Lower to Middle Palaeolithic and the Origin of Modern Man. British Archaeological Report, Oxford.

Rots, V., 2013. Insights into early Middle Palaeolithic tool use and hafting in Western Europe. The functional analysis of level IIa of the early Middle Palaeolithic site of Biache-Saint-Vaast (France). Journal of Archaeological Science 40, 497–506.

Rots, V., 2015. Keys to the Identification of Prehension and Hafting Traces. In: Marreiros, J.M., Gibaja Bao, J.F., Ferreira Bicho, N. (Eds.), Use-Wear and Residue Analysis in Archaeology. Springer International Publishing, Cham, pp. 83–104.

Rots, V., Van Peer, P., Vermeersch, P.M., 2011. Aspects of tool production, use, and hafting in Palaeolithic assemblages from Northeast Africa. Journal of Human Evolution 60, 637–664.

Rougier, H., 1999. Les dents supérieures de Biache-Saint-Vaast 1 (Biache-Saint-Vaast, Pas-de-Calais, France). Master 2 Dissertation, Université Bordeaux 1.

Rougier, H., 2003. Etude descriptive et comparative de Biache-Saint-Vaast 1 (Biache-Saint-Vaast, Pas-de-Calais, France). Ph.D. Dissertation, Université Bordeaux 1.

Schiffer, M.B., 1987. Formation Processes of the Archaeological Record. University of New Mexico Press, Albuquerque.

Scott, B., Ashton, N., 2011. The Early Middle Palaeolithic: The European context. In: Ashton, N., Lewis, S.G., Stringer, C. (Eds.), The Ancient Human Occupation of Britain. Elsevier, Amsterdam, pp. 91–112.

Sellier, N., 2005. Clairy-Saulchoix - A.29 Le Champ Mugotte - Au Chemin de Pissy. In: Bilan Scientifique de La Région Picardie. Service Régional de l'Archéologie de Picardie, Amiens, pp. 102–103.

Shimelmitz, R., Barkai, R., Gopher, A., 2016a. Regional variability in late Lower Paleolithic Amudian blade technology: Analyzing new data from Qesem, Tabun and Yabrud I. Quaternary International 398, 37–60.

Shimelmitz, R., Weinstein-Evron, M., Ronen, A., Kuhn, S.L., 2016b. The Lower to Middle Paleolithic transition and the diversification of Levallois technology in the Southern Levant: Evidence from Tabun Cave, Israel. Quaternary International 409, 23–40.

Shipman, P., 1981. Life History of a Fossil: An Introduction to Taphonomy and Paleoecology. Harvard University Press, Cambridge.

Shott, M.J., 1996. An exegesis of the curation concept. Journal of Anthropological Research 52, 259–280.

Simonti, C.N., Vernot, B., Bastarache, L., Bottinger, E., Carrell, D.S., Chisholm, R.L., Crosslin, D.R., Hebbring, S.J., Jarvik, G.P., Kullo, I.J., 2016. The phenotypic legacy of admixture between modern humans and Neandertals. Science 351, 737–741.

Sommé, J., 1976. Les limons quaternaires dans les plaines du Nord. In: Lumley, H. de (Ed.), La Préhistoire Française. Ed. CNRS, Paris, pp. 173–176.

Sommé, J., 1977. Les Plaines du Nord de la France et leur Bordure : Étude Géomorphologique. Librairie Champion, Paris.

Sommé, J., 1978. Le gisement paléolithique de Biache-Saint-Vaast (Pas-de-Calais). Quaternaire 15, 27–34.

Sommé, J., Tuffreau, A., 1976a. Le gisement acheuléen supérieur de Vimy (Pas-de-Calais). In: Verron, G. (Ed.), Nord-Ouest de La France (Bassin de La Seine, Bassin de La Somme et Nord). Livret-Guide de l'Excursion A10. IXème Congrès UISPP, 13-18 Septembre 1976. UISPP, Nice, pp. 191–194.

Sommé, J., Tuffreau, A., 1976b. Loess et paléosols de La Longueville (Nord). In: Verron, G. (Ed.), Nord-Ouest de La France (Bassin de La Seine, Bassin de La Somme et Nord). Livret-Guide de l'Excursion A10. IXème Congrès UISPP, 13-18 Septembre 1976. UISPP, Nice, pp. 214–217.

Sommé, J., Tuffreau, A., 1976c. Le gisement paléolithique ancien de Beaumetz-les-Loges. In: Verron, G. (Ed.), Nord-Ouest de La France (Bassin de La Seine, Bassin de La Somme et Nord). Livret-Guide de l'excursion A10. IXème Congrès UISPP, 13-18 Septembre 1976. UISPP, Nice, pp. 195–199.

Soriano, S., 2000. Outillage bifacial et outillage sur éclat au Paléolithique ancien et moyen. Coexistence et interaction. Ph.D. Dissertation, Université Paris X-Nanterre.

Soriano, S., 2005. Le Sud : une plate-forme pour le peuplement des espaces septentrionaux pendant le Pléistocène moyen récent ? In: Jaubert, J., Barbaza, M. (Eds.), Territoires, Déplacements, Mobilité, Échanges durant la Préhistoire. Terres et Hommes du Sud. Éditions du CTHS, Paris, pp. 63–83.

Soriano, S., 2013. L'impact des facteurs taphonomiques sur la connaissance du Paléolithique supérieur ancien du Bassin parisien. In: Bodu, P., Chehmana, L., Klaric, L., Mevel, L., Soriano, S., Teyssandier, N. (Eds.), Le Paléolithique Supérieur Ancien de l'Europe Du Nord-Ouest : Réflexions et Synthèses à Partir d'un Projet Collectif de Recherche sur le Paléolithique Supérieur Ancien du Bassin Parisien. Société Préhistorique Ffrançaise, Paris, pp. 21–35.

Soriano, S., Villa, P., 2017. Early Levallois and the beginning of the Middle Paleolithic in central Italy. PLoS One 12, e0186082.

Speth, J., 2012. Middle Palaeolithic subsistence in the Near East. Before Farming 2(2), 1–45.

Théry-Parisot, I., Chabal, L., Chrzavzez, J., 2010. Anthracology and taphonomy, from wood gathering to charcoal analysis. A review of the taphonomic processes modifying charcoal assemblages, in archaeological contexts. Palaeogeography, Palaeoclimatology, Palaeoecology 291, 142–153.

Tixier, J., Turq, A., 1999. Kombewa et alii. Paleo 11, 135–143.

Tuffreau, A., 1971. Quelques aspects du Paléolithique ancien et moyen dans le Nord de la France (Nord, Pas-de-Calais). Bulletin de la Société Préhistorique du Nord 8, 1–100.

Tuffreau, A., 1974. Contribution à l'etude du Paléolithique ancien et moyen dans le nord de la France et le bassin oriental de la Somme. Ph.D. Dissertation, Université Paris 1.

Tuffreau, A., 1976. Les fouilles du gisement Acheuléen supérieur des Osiers à Bapaume (Pas-de-Calais). Bulletin de la Société Préhistorique Française 73, 231–243.

Tuffreau, A., 1978. Les fouilles du gisement paléolithique de Biache-Saint-Vaast (Pas-de-Calais) : années 1976 et 1977 - premiers résultats. Bulletin de l'Association Française pour l'Etude du Quaternaire 15, 46–55.

Tuffreau, A., 1979. Les débuts du Paléolithique moyen dans la France septentrionale. Bulletin de la Société Préhistorique Française 76, 140–142.

Tuffreau, A., 1982. The transition Lower/Middle Palaeolithic in Northern France. In: Ronen, A. (Ed.), The Transition from Lower to Middle Palaeolithic and the Origin of Modern Man. British Archaeological Report, Oxford, pp. 137–149.

Tuffreau, A., 1983. Les industries à débitage laminaire du Paléolithique moyen de la France septentrionale. Studia Praehistorica Belgica 3, 135–141.

Tuffreau, A., 1986. Biache Saint-Vaast et les industries moustériennes du Pléistocène moyen récent dans la France septentrionale. In: Tuffreau, A., Sommé, J. (Eds.), Chronostratigraphie et Faciès Culturels du Paléolithique Inférieur et Moyen dans l'Europe du Nord-Ouest, Bulletin de l'Association Française pour l'Etude du Quaternaire supplement, pp. 197–207.

Tuffreau, A., 1987. Le Paléolithique inférieur et moyen du nord de la France (Nord, Pas-de-Calais, Picardie) dans son cadre stratigraphique. Thèse de doctorat d'Etat Dissertation, Université des Sciences et Techniques de Lille Flandres-Artois.

Tuffreau, A., 1988a. Historique des fouilles effectuées à Biache-Saint-Vaast. In: Tuffreau, A., Sommé, J. (Eds.), Le Gisement Paléolithique Moyen de Biache-Saint-Vaast (Pas-de-Calais). Volume I :

Stratigraphie, Environnement et Études Archéologiques (1ère Partie). Société Préhistorique Française, Paris, pp. 15-24.

Tuffreau, A., 1988b. Les habitats du Paléolithique inférieur et moyen dans le Nord de la France (Nord, Pas-de-Calais, Somme). In: Tuffreau, A. (Ed.), Cultures et Industries Lithiques en Milieu Loessique. Revue Archéologique de Picardie 1-2, 91–104.

Tuffreau, A., 1989. Le gisement paléolithique moyen de Champvoisy (Marne). In: Tuffreau, A. (Ed.), Paléolithique et Mésolithique du Nord de la France. Nouvelles Recherches. Publications du CERP. CERP, Lille, pp. 69–78.

Tuffreau, A., 1992a. Middle Paleolithic settlement in Northern France. In: Dibble, H.L., Mellars, P. (Eds.), The Middle Paleolithic: Adaptation, Behavior and Variability. University of Pennsylvania, Philadelphia, pp. 60–73.

Tuffreau, A., 1992b. L'Acheuléen en Europe occidentale d'après les données du bassin de la Somme. In: Peretto, C. (Ed.), I Primi Abitanti Della Valle Padana : Monte Poggiolo. Jaca Book, Milano, pp. 41–49.

Tuffreau, A. (Ed.), 1993. Riencourt-les-Bapaume (Pas-de-Calais). Un gisement du Paléolithique moyen. Ed. de la Maison des sciences de l'Homme, Paris.

Tuffreau, A., 2001. Contextes et modalités des occupations humaines au Paléolithique moyen dans la France septentrionale. In: Conard, N.J. (Ed.), Settlement Dynamics of the Middle Paleolithic and Middle Stone Age. Kern Verlag, Tübingen, pp. 293–314.

Tuffreau, A., Zuate Y Zuber, J., 1975. La terrasse fluviatile de Bagarre (Etaples, Pas-de-Calais) et ses industries : note préliminaire. Bulletin de la Société Préhistorique Française 72, 229–235.

Tuffreau, A., Munaut, A.-V., Puisségur, J.-J., Sommé, J., 1981. Les basses terrasses dans les vallées du Nord de la France et de la Picardie : stratigraphie et paléolithique. Bulletin de la Société Préhistorique Française 78, 291–305.

Tuffreau, A., Antoine, P., 1995. The earliest occupation of Europe: Continental Northwestern Europe. In: Roebroeks, W., Kolfschoten, T. van (Eds.), The Earliest Occupation of Europe. Publications of the Institute of Prehistory, Leiden, pp. 147–163.

Tuffreau, A., Ameloot-Van der Heijden, N., Marcy, J.-L., 1989. La fin du courant acheuléen et les différentes industries de la phase ancienne du Paléolithique moyen du Nord de la France. In: Résumé Des Communications, Colloque « l'Acheuléen Dans l'Ouest de l'Europe », Saint-Riquier, Juin 1989, pp. 17–18.

Tuffreau, A., Bouchet, J.-P., 1985. Le gisement acheuléen de la Vallée du Muid à Gouzeaucourt (Nord). Bulletin de la Société Préhistorique Française 82, 291–306.

Tuffreau, A., Marcy, J.-L., 1988. Le niveau II base. In: Tuffreau, A., Sommé, J. (Eds.), Le Gisement Paléolithique Moyen de Biache-Saint-Vaast (Pas-de-Calais). Volume I : Stratigraphie, Environnement et Études Archéologiques (1ère Partie). Société Préhistorique Française, Paris, pp. 231-261.

Tuffreau, A., Sommé, J. (Eds.), 1988. Le Gisement Paléolithique Moyen de Biache-Saint-Vaast (Pas-de-Calais). Volume I. Stratigraphie, Environnement, Études Archéologiques (1ère partie). Société Préhistorique Française, Paris.

Tuffreau, A., Roebroeks, W. (Eds.), 2002. Le Dernier Interglaciaire et les Occupations Humaines du Paléolithique Moyen. Publications du CERP, Lille.

Tuffreau, A., Bouchet, J.-P., Moigne, A.-M., Munaut, A.V., 1986. Les niveaux acheuléens de la moyenne terrasse du Bassin de la Somme à Cagny-l'Epinette (Somme). L'Anthropologie 90, 9–27.

Tuffreau, A., Ameloot-Van-der-Heijden, N., 1991. L'Acheuléen de la séquence fluviatile fine de Cagny-l'Epinette (Somme). In: Tuffreau, A. (Ed.), Paléolithique et Mésolithique du Nord de la France. Nouvelles Recherches II. Publications du CERP, Lille, pp. 27–34.

Tuffreau, A., Antoine, P., Chase, P.G., Dibble, H.L., Ellwood, B.B., van Kolfschoten, T., Lamotte, A., McPherron, S.P., Moigne, A.-M., Munaut, A.-V., 1995. Le gisement acheuléen de Cagny-l’Epinette (Somme). Bulletin de la Société Préhistorique Française 92, 169–191.

Tuffreau, A., Lamotte, A., Antoine, P., Marcy, J.-L., 1997. Le gisement acheuléen de la Ferme de l’Epinette à Cagny (Somme, France). Archäologisches Korrespondenzblatt 27, 513–530.

Tuffreau, A., Antoine, P., Marcy, J.-L., Segard, N., 1999. Le gisement paléolithique inférieur et moyen du Mont de l’Evangile à Gentelles (Somme). In: Les Industries à Outils Bifaciaux Du Paléolithique Moyen d’Europe Occidentale. Table-Ronde de Caen, 14-15 Octobre 1999. Résumés Des Communications. SRA Basse-Normandie, Caen, pp. 28–29.

Tuffreau, A., Antoine, P., Marcy, J.-L., Segard, N., 2001. Les industries paléolithiques à nombreux bifaces du Mont de l’Evangile à Gentelles (Somme). In: Les Industries à Outils Bifaciaux Du Paléolithique Moyen d’Europe Occidentale. Les Editions de l’Université de Liège, Liège pp. 29–41.

Tuffreau, A., Lamotte, A., Goval, É., 2008. Les industries acheuléennes de la France septentrionale. L’Anthropologie 112, 104–139.

Tuffreau, A., Auguste, P., Balescu, S., Bahain, J.-J., 2017. Gentelles-Le Mont de l’Evangile (département de la Somme, France) : un site de plateau occupé de l’Acheuléen au Micoquien. L’Anthropologie 121, 394–427.

Turq, A., Brenet, M., Colonge, D., Jarry, M., Lelouvier, L.-A., O’Farrell, M., Jaubert, J., 2010. The first human occupations in southwestern France: A revised summary twenty years after the Abbeville/Saint Riquier colloquium. Quaternary International 223–224, 383–398.

Vaks, A., Bar-Matthews, M., Ayalon, A., Matthews, A., Frumkin, A., Dayan, U., Halicz, L., Almogi-Labin, A., Schilman, B., 2006. Paleoclimate and location of the border between Mediterranean climate region and the Saharo–Arabian Desert as revealed by speleothems from the northern Negev Desert, Israel. Earth and Planetary Science Letters 249, 384–399.

Vallin, L., Masson, B., Caspar, J.P., 2001. Taphonomy at Hermies, France : A Mousterian knapping site in a loessic context. Journal of Field Archaeology 28, 419–436.

Vandermeersch, B., 1978. Le crâne pré-würmien de Biache-Saint-Vaast (Pas-de-Calais). In: Les Origines Humaines et les Époques de l'intelligence. Masson, Paris, pp. 153–157.

Van Baelen, A., 2014. Kesselt-Op de Schans (Limburg, Belgium) and the Lower / Middle Palaeolithic transition in Northwestern Europe. Ph.D. Dissertation, Katholieke Universiteit Leuven.

Van Baelen, A., Ryssaert, C., 2011. The Early Middle Palaeolithic of Belgium. In: Toussaint, M., Ulrix-Closset, M. (Eds.), Le Paléolithique Moyen en Belgique: Mélanges Marguerite Ulrix-Closset. Université de Liège, Liège, pp. 197–212.

Wagner, E., 1992. Les découvertes paléolithiques des travertins de Stuttgart Bad Cannstatt. L'Anthropologie 96, 71–86.

Wenban-Smith, F.F., 1998. Clactonian and Acheulian industries in Britain: their chronology and significance reconsidered. In: Ashton, N., Healy, F., Pettitt, P. (Eds.), Stone Age Archaeology. Essays in Honour of John Wymer. Oxbow Books, Oxford, pp. 90–97.

White, M.J., Schreve, D.C., 2000. Island Britain - Peninsula Britain : palaeogeography, colonisation, and the Lower Palaeolithic settlement of the British Isles. Proceedings of the Prehistoric Society 66, 1–28.

White, M.J., Ashton, N.M., 2003. Lower Palaeolithic core technology and the origins of the Levallois method in North-Western Europe. Current Anthropology 44, 598–609.

White, M., Ashton, N., Scott, B., 2011. The emergence, diversity and significance of the Mode 3 (prepared core) technologies. In: Ashton, N., Lewis, S.G., Stringer, C.B. (Eds.), The Ancient Human Occupation of Britain. Elsevier, Amsterdam, pp. 53–66.

Wojtczak, D., 2015. Cores on flakes and bladelet production, a question of recycling? The perspective from the Hummalian industry of Hummal, Central Syria. Quaternary International 361, 155–177.

Yokoyama, Y., 1989. Direct gamma-ray spectrometric dating of anteneandertalian and neandertalian human remains. In: Giacobini, G. (Ed.), Hominidae. Jaca Book, Milano, pp. 387–390.

Zaidner, Y., Weinstein-Evron, M., 2012. Making a point: the Early Middle Palaeolithic tool assemblage of Misliya Cave, Mount Carmel, Israel. Before Farming 2012, 1–23.

Zaidner, Y., Weinstein-Evron, M., 2016. The end of the Lower Paleolithic in the Levant: The Acheulo-Yabrudian lithic technology at Misliya Cave, Israel. Quaternary International 409, 9–22.

Zilhão, J., d'Errico, F., 1999. The chronology and taphonomy of the earliest Aurignacian and its implications for the understanding of Neandertal extinction. Journal of World Prehistory 13, 1–68.

Zupancich, A., Lemorini, C., Gopher, A., Barkai, R., 2016. On Quina and demi-Quina scraper handling: Preliminary results from the late Lower Paleolithic site of Qesem Cave, Israel. Quaternary International 398, 94–102.

Figure captions:

Figure 1. Distribution map of sites in Northern France from MIS 9 to MIS 6. Background map: image Landsat, courtesy of the U.S. Geological Survey.

Figure 2. Chronological distribution of archaeological units (i.e., individual archaeological levels) from late Middle Pleistocene sites from Northern France relative to their depositional context (dataset in Table 1). A) Archaeological units with a MIS correlation value from 5 to 3 after Hérisson et al. (2016a). B) Archaeological units with a MIS correlation value of 2 or 1 after Hérisson et al. (2016a). The accuracy of each correlation is assessed and expressed as a score between 0 and 5 (Hérisson et al., 2016a): 0 = no correlation; 1 = uncertain correlation, very scant proof; 2 = uncertain correlation, some proof; 3 = good correlation but lack of convergent proof; 4= precise and convergent correlation; 5 = perfect, precise and convergent correlation. The highest accuracy is reached for occupation levels in primary position that are preserved in long sedimentary sequences and where different independent proxies are available for relative, indirect and direct dating. Taking these

elements into account, each occupation is assigned to an isotopic stage or, where possible, substage (question marks are used in case of uncertainties). 'MIS 7c-7a' means occupations from both these substages, 'late MIS7a/early MIS 6' means occupations from one or the other of these stages/substages.

Figure 3. Chronoclimatic distribution of archaeological units (i.e., individual archaeological levels) from late Middle Pleistocene sites (MIS 9 from MIS 6) from Northern France relative to their depositional context (dataset in Table 1). Archaeological units are stacked according to their chronoclimatic context independently of their MIS age. A MIS 9 interglacial archaeological unit is recorded in the same category than a MIS 7 interstadial. Only archaeological units with a MIS correlation value (Hérisson et al., 2016a) from 5 to 3 are considered here. 'MIS 7c-7a' means occupations from both these substages, 'late MIS7a/early MIS 6' means occupations from the one or the other of these stages/substages.

Figure 4. Pre-MIS 9 lithic industries from Northern France. a) Carrière Carpentier (Abbeville), biface in flint recovered in unit 3D1 overlying the White Marl (drawing A. Theodoropoulou, after Antoine et al., 2016b). b) Cagny la Garenne 2, biface from level I4 (drawing A. Lamotte, after Tuffreau et al., 2008). c) Cagny la Garenne 1, biface from level CXV (drawing A. Lamotte, after Lamotte, 1995). d–f) Rue du Manège: d) discoid core; e) denticulate; f) cortical backed flake (drawing S. Lancelot, after Locht et al., 2013). g, h) Cagny la Garenne 1: g) SSDA core; h) cortical backed flake from the level CXV (drawing A. Lamotte, after Lamotte, 1994), i) Ferme de l'Epinette, flake refitting on a unipolar core from level MS (drawing A. Lamotte, after Lamotte, 1994).

Figure 5. MIS 9 lithic industries from Northern France. a, b) Cagny-l'Epinette: a) biface in allochthonous flint from level I1 (Tuffreau et al., 1995); b) refits showing bifacial shaping from levels I (Lamotte, Tuffreau, 2001). c–g) Etricourt-Manancourt, level HUD: c, d) bifaces; e) core exploited by short unipolar secant sequences; f) cortical backed knife; g) single convex scraper on cortical flake (drawing E. Boitard, after Hérisson et al., 2016b and unpublished).

Figure 6. MIS 8–6 lithic industries from Northern France, Levallois preferential flake production. a–e, g) Levallois preferential flakes: a) Biache-Saint-Vaast, level IIA; b, c) Biache-Saint-Vaast, level D0; d) Biache-Saint-Vaast, level D1; e) Therdonne, level N3 (drawing S. Lancelot, after Hérisson, 2012); g) Etricourt-Manancourt, level LRS (drawing E. Boitard, after Hérisson et al., 2016b). f, h) Levallois preferential core: f) Therdonne, level N3 (drawing S. Lancelot, after Hérisson, 2012); h) Etricourt-Manancourt, level LRS (drawing E. Boitard, unpublished).

Figure 7. MIS 8–6 lithic industries from Northern France, Levallois recurrent flake production. a) Biache-Saint-Vaast, level IIA, Levallois recurrent opposed bipolar core (drawing J. Airvaux, after Hérisson, 2012). b, c) Biache-Saint-Vaast, level IIbase, elongated Levallois flakes (drawing J. Airvaux, after Hérisson, 2012). d–i) Etricourt-Manancourt, level LRS: d) Levallois recurrent unipolar core; e–g) elongated Levallois flakes; h) Levallois recurrent opposed bipolar core; i) refits of elongated flakes from Levallois recurrent opposed bipolar schema (drawings E. Boitard, after Hérisson et al., 2016b and unpublished).

Figure 8. MIS 8–6 lithic industries from Northern France, blade production. a, b) Croix-l'Abbé at Saint-Valéry-sur Somme, refits showing blade production (de Heinzelin and Haesaerts, 1983). c) Therdonne, level N3, blade core (drawing S. Lancelot, after Locht et al., 2010).

Figure 9. MIS 8–6 lithic industries from Northern France, Levallois point production. a–e) Le Pucheuil, level B: a, b) Levallois recurrent convergent unipolar cores; c–e) Levallois points (Delagnes and Ropars, 1996). f–h) Therdonne, level N3, Levallois points (drawings S. Lancelot, after Locht et al., 2010).

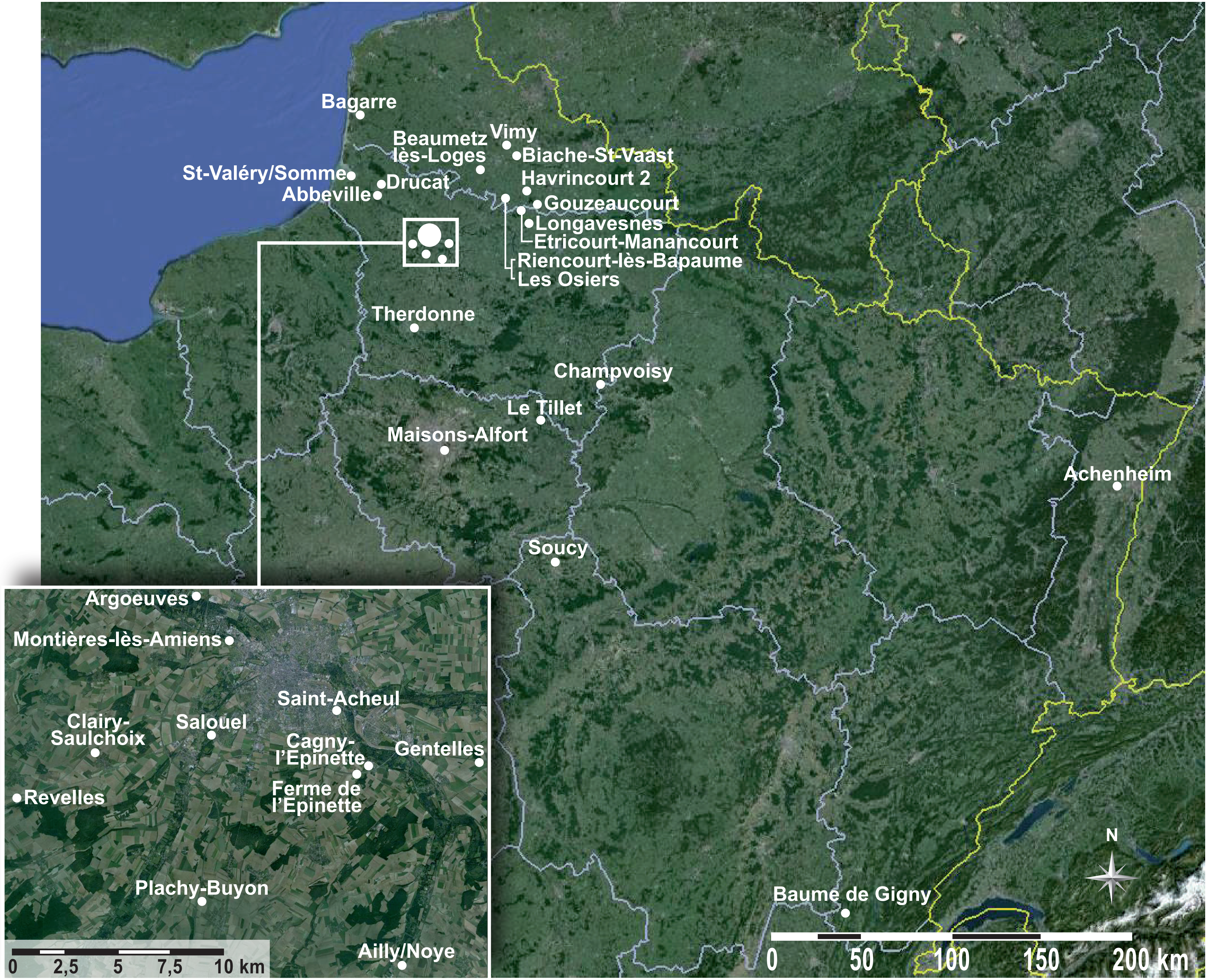
Figure 10. MIS 8–6 lithic industries from Northern France, discoid production. a–f) Therdonne, level N3: flakes (a–c) stemming from discoid refits e, f and d respectively (drawings S. Lancelot, after Hérisson, 2012).

Figure 11. MIS 8–6 lithic industries from Northern France, small flake production and ramification. a–k) Le Pucheuil, level B: a) refits of a cortical flake exploited after a le Pucheuil schema; b–j) le Pucheuil type flakes from the refit a; k) le Pucheuil core from refit a (Delagnes, 1993). l–r) Therdonne, level N3:

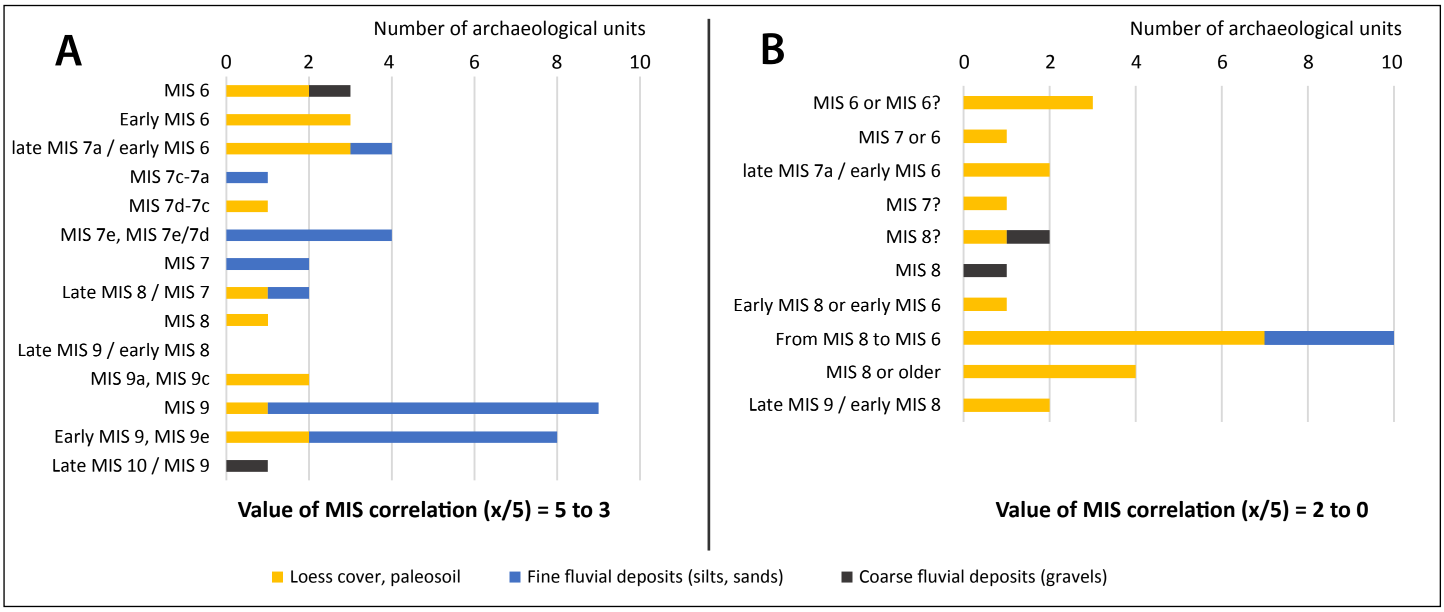
l-n) le Pucheuil type flakes; o) refits of a Levallois flake exploited by a le Pucheuil schema; p) le Pucheuil core from refit o; q, r) le Pucheuil type flakes from refit o (drawings S. Lancelot, after Hérisson, 2012). s–v) Biache-Saint-Vaast, level E: s, t) cores on flakes exploited by a unipolar sequence of removals; u, v) small flakes produced by ramification (drawing J. Airvaux, after Hérisson, 2012).

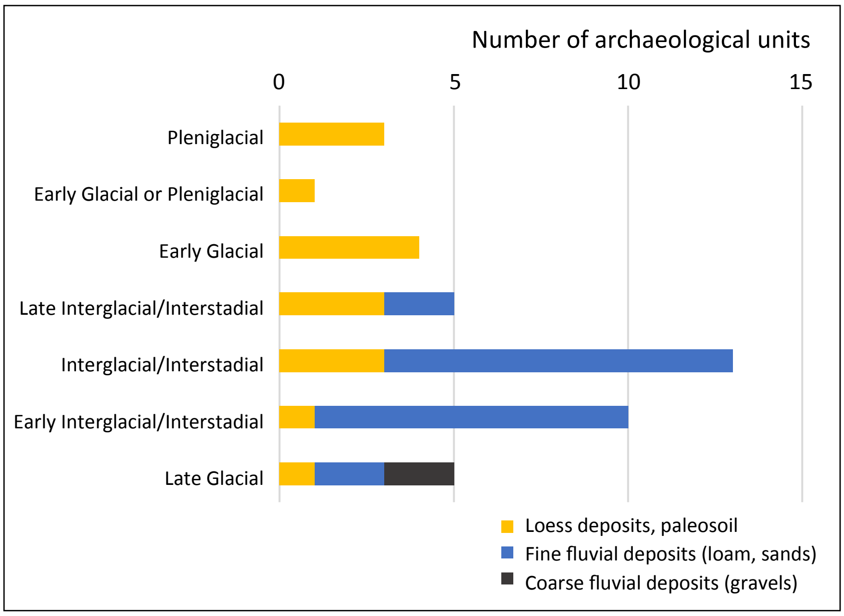
Figure 12. A) Schematic model of the LP to MP boundary period in Northern France after Tuffreau (1982) and Tuffreau et al. (1989). B) Schematic model of the LP to MP boundary period in Near East after Bar-Yosef (1994, 2002). C) Extract of the LR04 benthic stack of $d^{18}O$ ($^{o}/_{oo}$) after Lisiecki and Raymo (2005), ages and ages of MIS boundaries expressed in ka after Lisiecki and Raymo (2005).

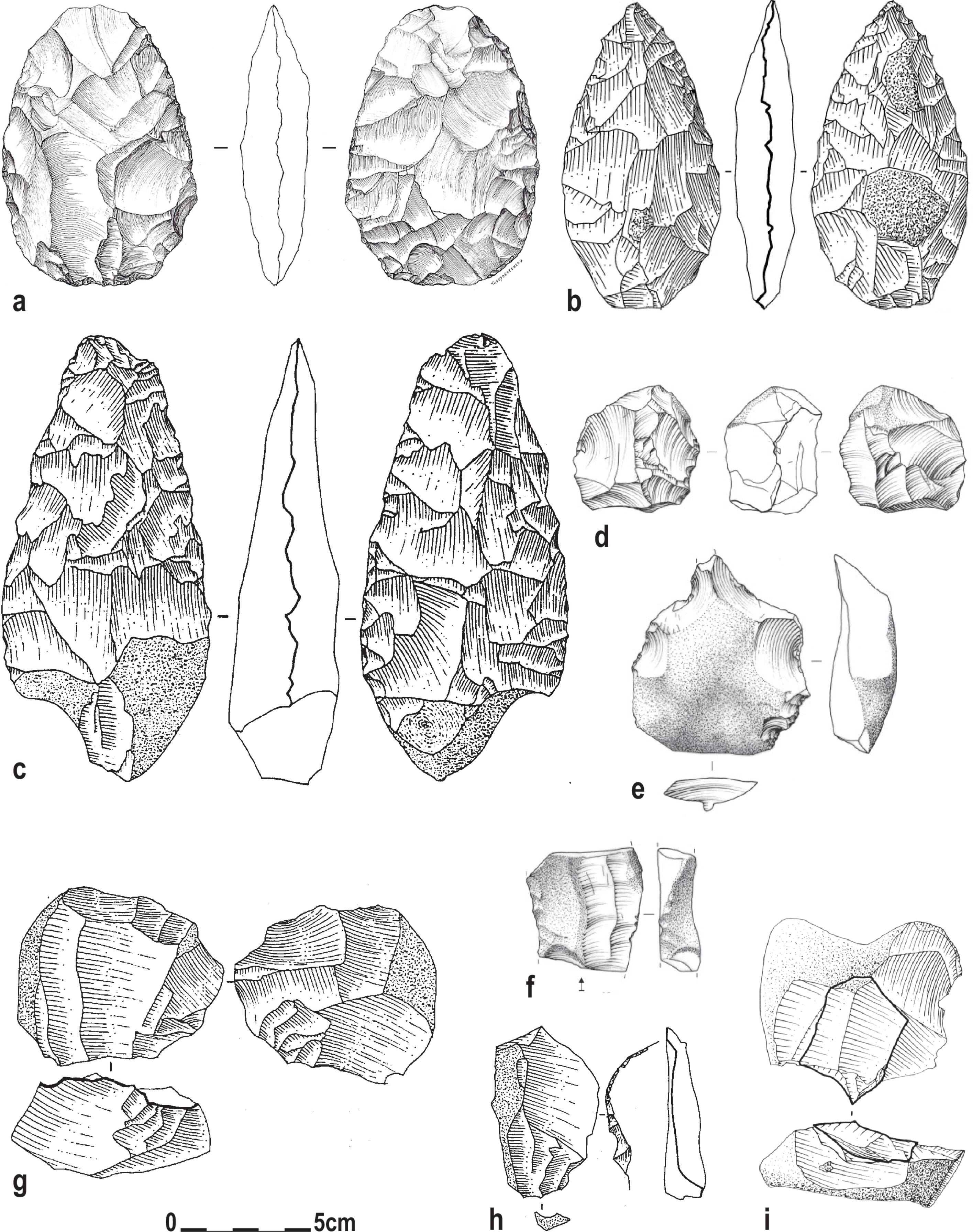
Figure 13. A) Current schematic model of the LP to MP boundary period in Northern France after Hérisson et al. (2016a ,b). B) Schematic model of the LP to MP boundary period in Near East mainly after Malinsky-Buller and Hover (2019), and also after Meignen (2011), Shimelmitz et al. (2016a), Chazan (2016). C) Extract of the LR04 benthic stack of $d^{18}O$ ($^{o}/_{oo}$) after Lisiecki and Raymo (2005), ages and ages of MIS boundaries expressed in ka after Lisiecki and Raymo (2005).



Bagarre
Beaumetz
lès-Loges
Vimy
Biache-St-Vaast
St-Valéry/Somme
Drucat
Abbeville
Havrincourt 2
Gouzeaucourt
Longavesnes
Etricourt-Manancourt
Riencourt-lès-Bapaume
Les Osiers
Therdonne
Champvoisy
Le Tillet
Maisons-Alfort
Achenheim
Soucy
Baume de Gigny
N
0 50 100 150 200 km
Argoeuves
Montières-lès-Amiens
Saint-Acheul
Clairy-
Saulchoix
Salouel
Cagny-
l'Epinette
Gentelles
Ferme de
l'Epinette
Revelles
Plachy-Buyon
Ailly/Noye
0 2,5 5 7,5 10 km


A
Number of archaeological units
0
2
4
6
8
10
MIS 6
Early MIS 6
late MIS 7a / early MIS 6
MIS 7c-7a
MIS 7d-7c
MIS 7e, MIS 7e/7d
MIS 7
Late MIS 8 / MIS 7
MIS 8
Late MIS 9 / early MIS 8
MIS 9a, MIS 9c
MIS 9
Early MIS 9, MIS 9e
Late MIS 10 / MIS 9
Value of MIS correlation (x/5) = 5 to 3
B
Number of archaeological units
0
2
4
6
8
10
MIS 6 or MIS 6?
MIS 7 or 6
late MIS 7a / early MIS 6
MIS 7?
MIS 8?
MIS 8
Early MIS 8 or early MIS 6
From MIS 8 to MIS 6
MIS 8 or older
Late MIS 9 / early MIS 8
Value of MIS correlation (x/5) = 2 to 0
Loess cover, paleosoil
Fine fluvial deposits (silts, sands)
Coarse fluvial deposits (gravels)


Number of archaeological units
0
5
10
15
Pleniglacial
Early Glacial or Pleniglacial
Early Glacial
Late Interglacial/Interstadial
Interglacial/Interstadial
Early Interglacial/Interstadial
Late Glacial
Loess deposits, paleosoil
Fine fluvial deposits (loam, sands)
Coarse fluvial deposits (gravels)



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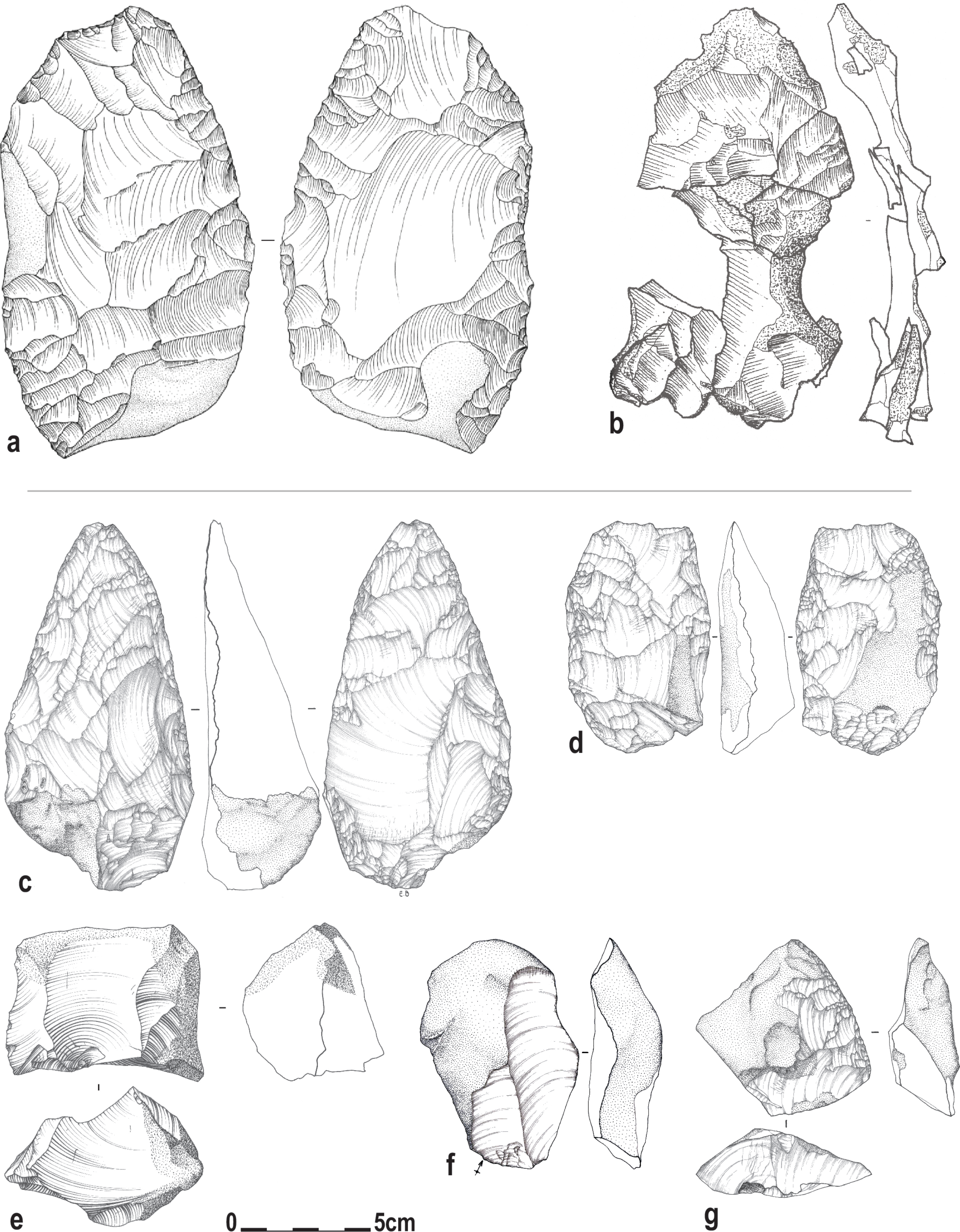
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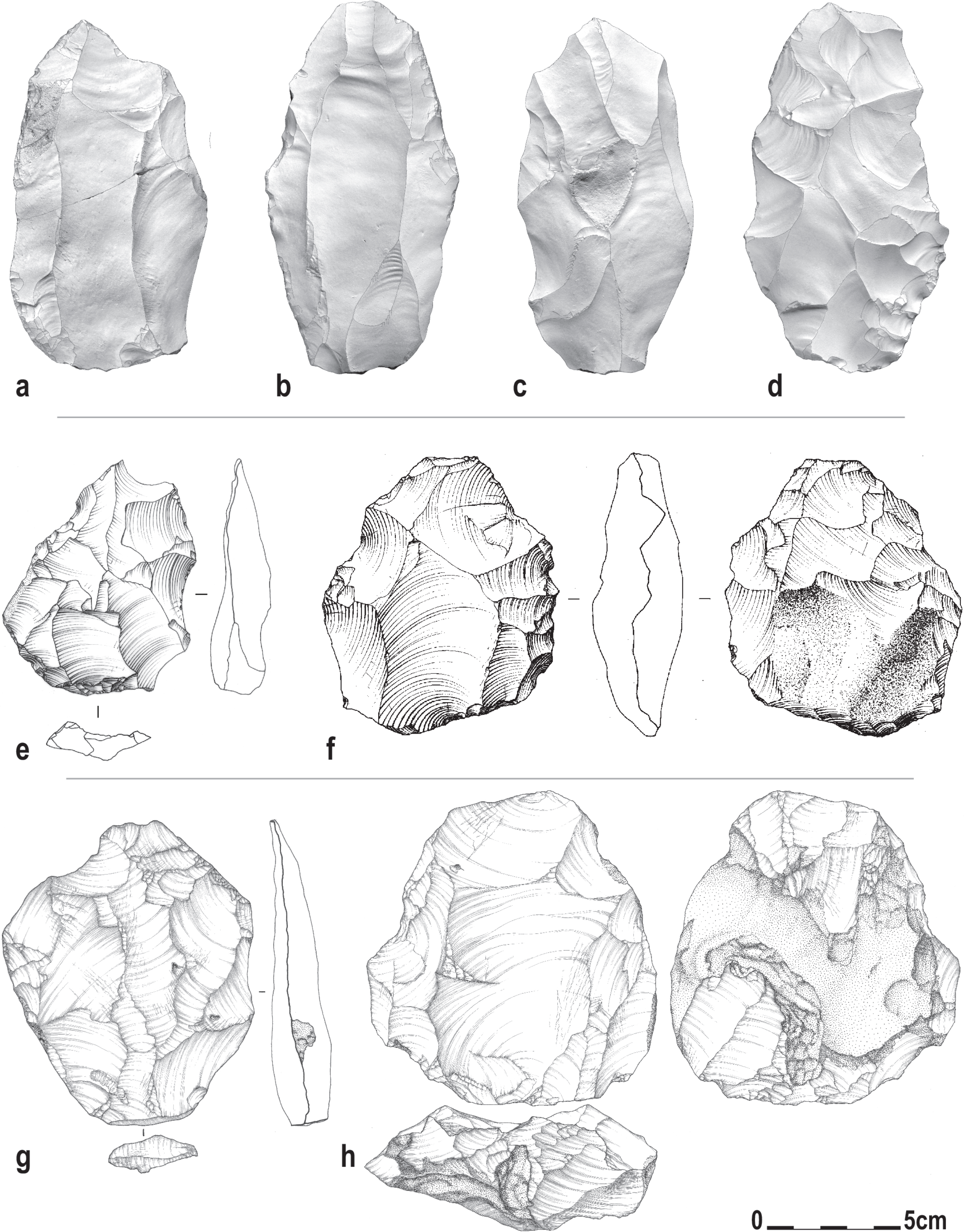
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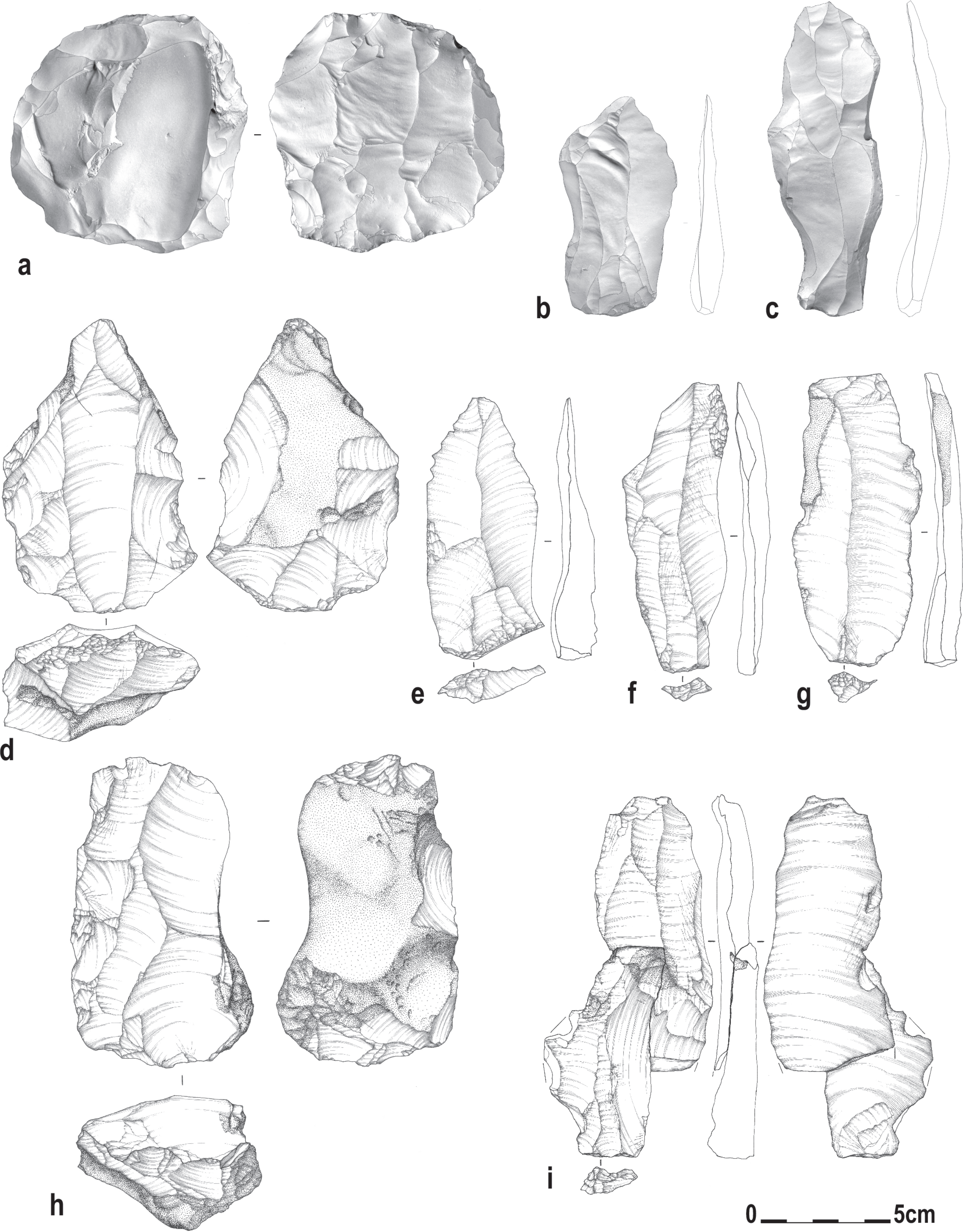
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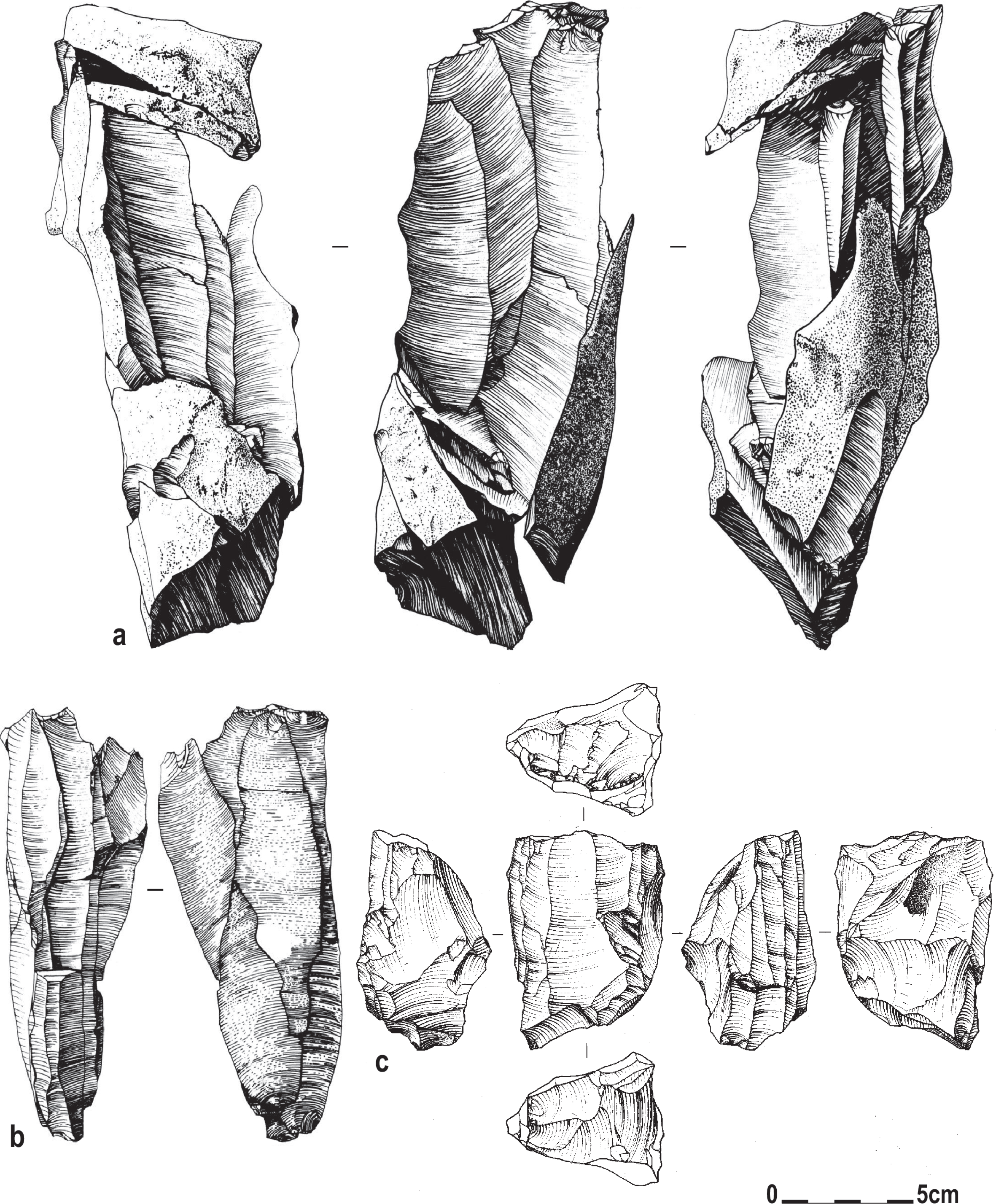
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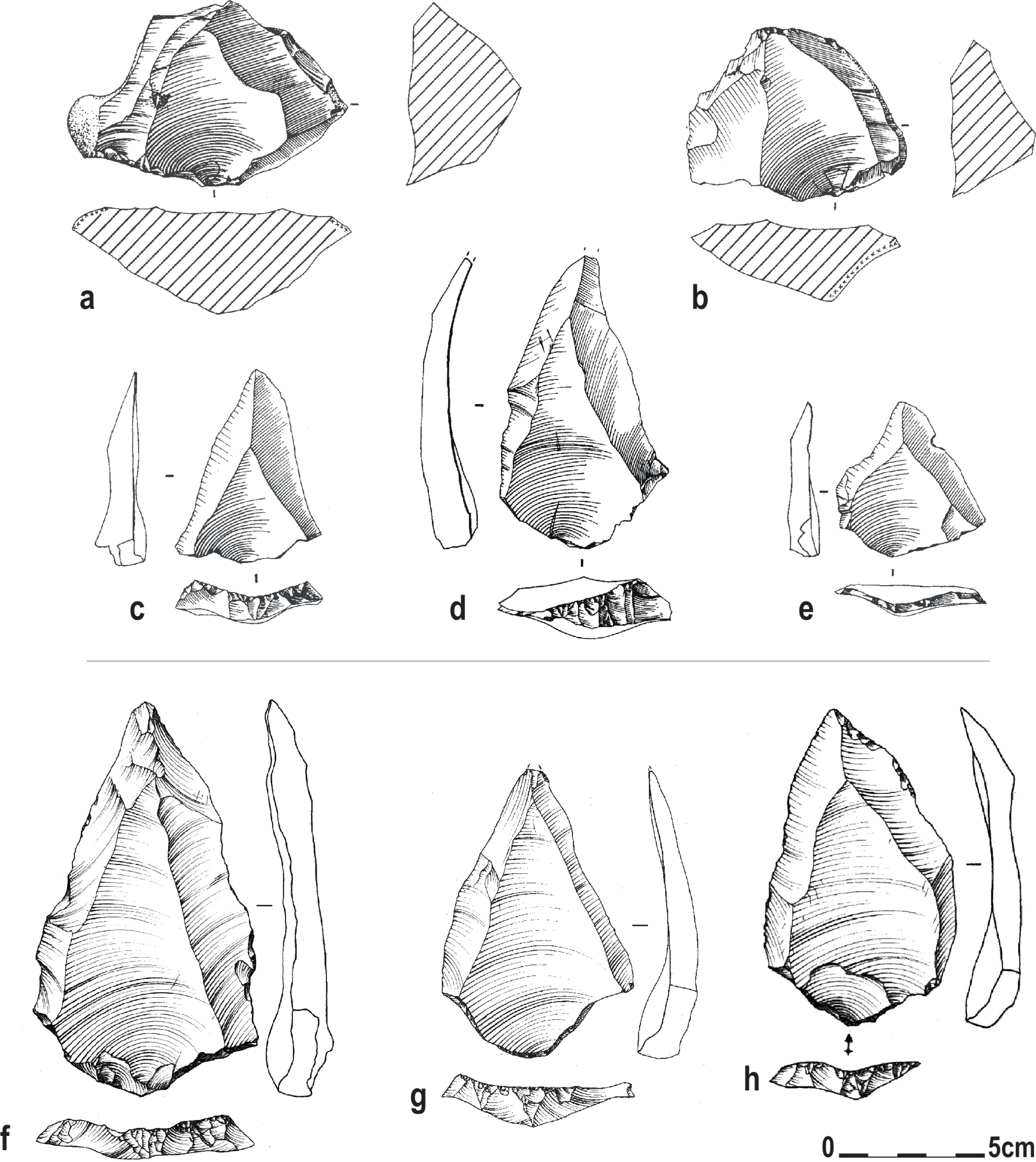
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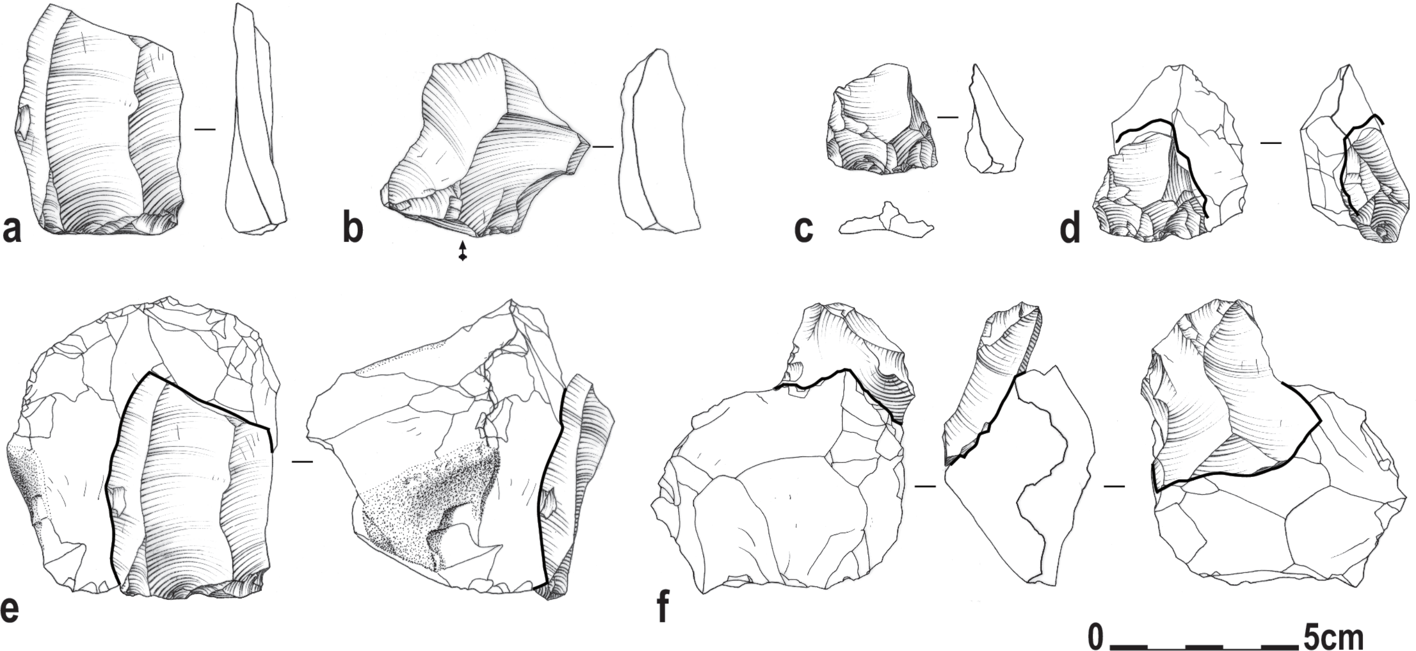
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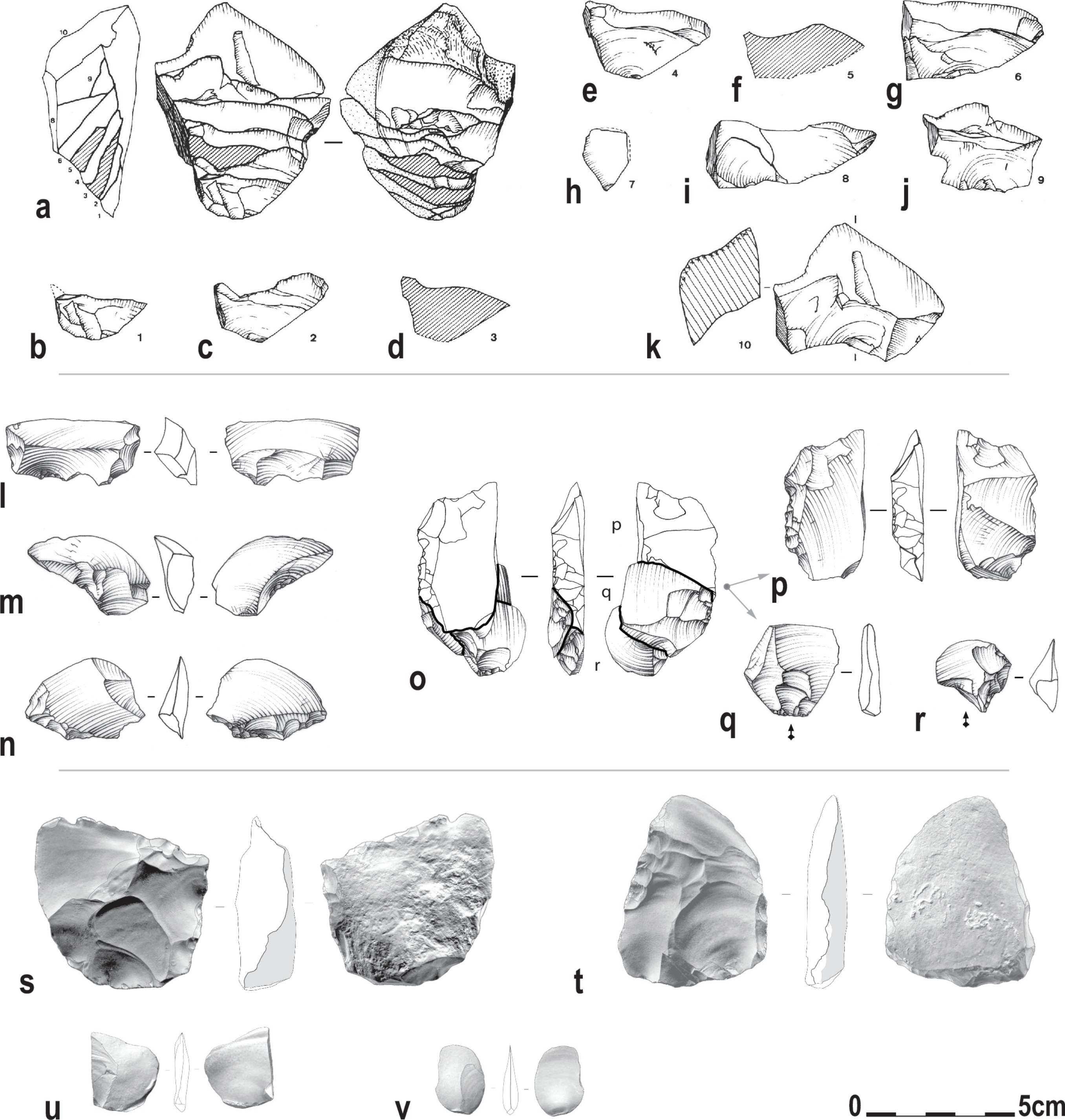
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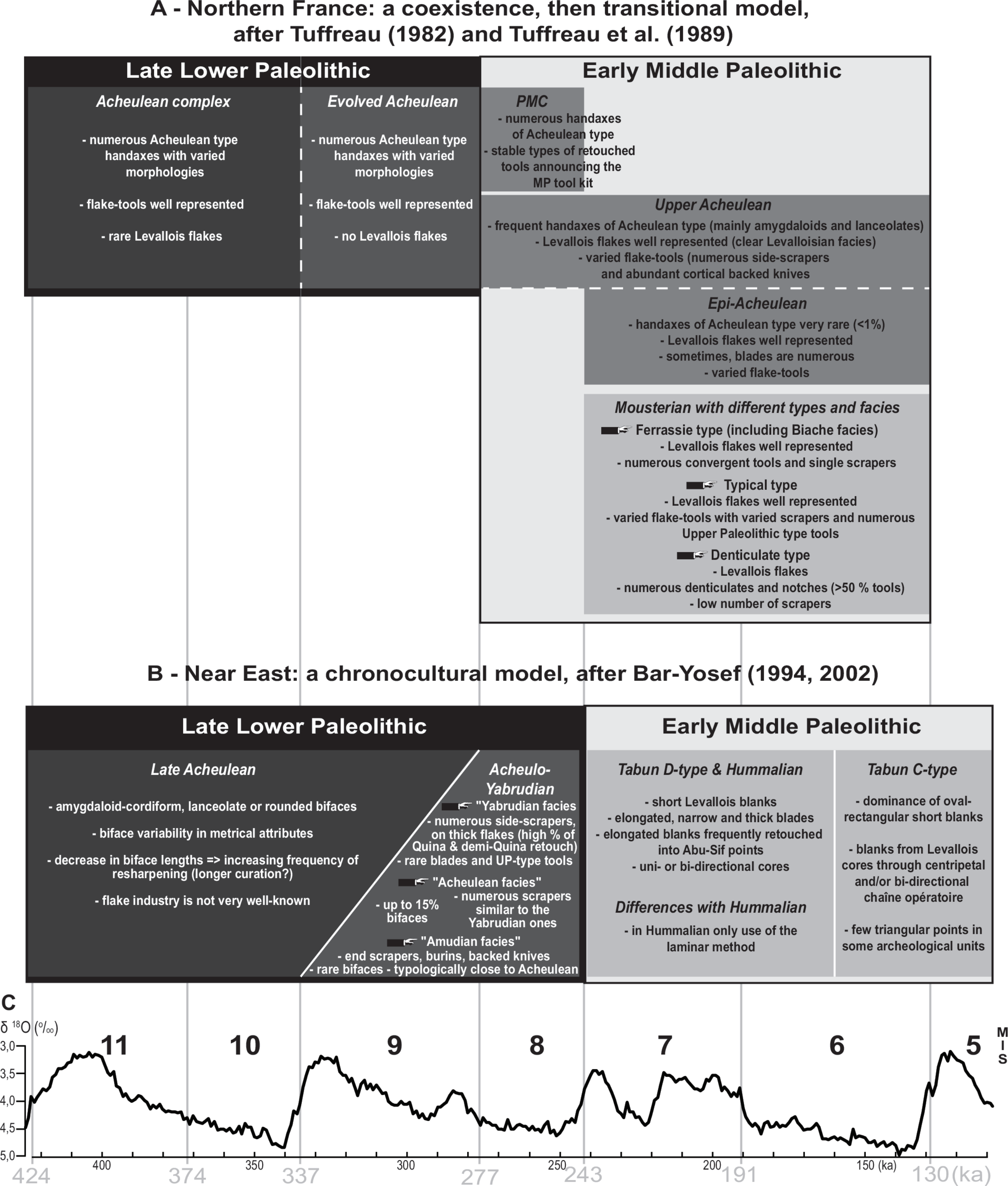
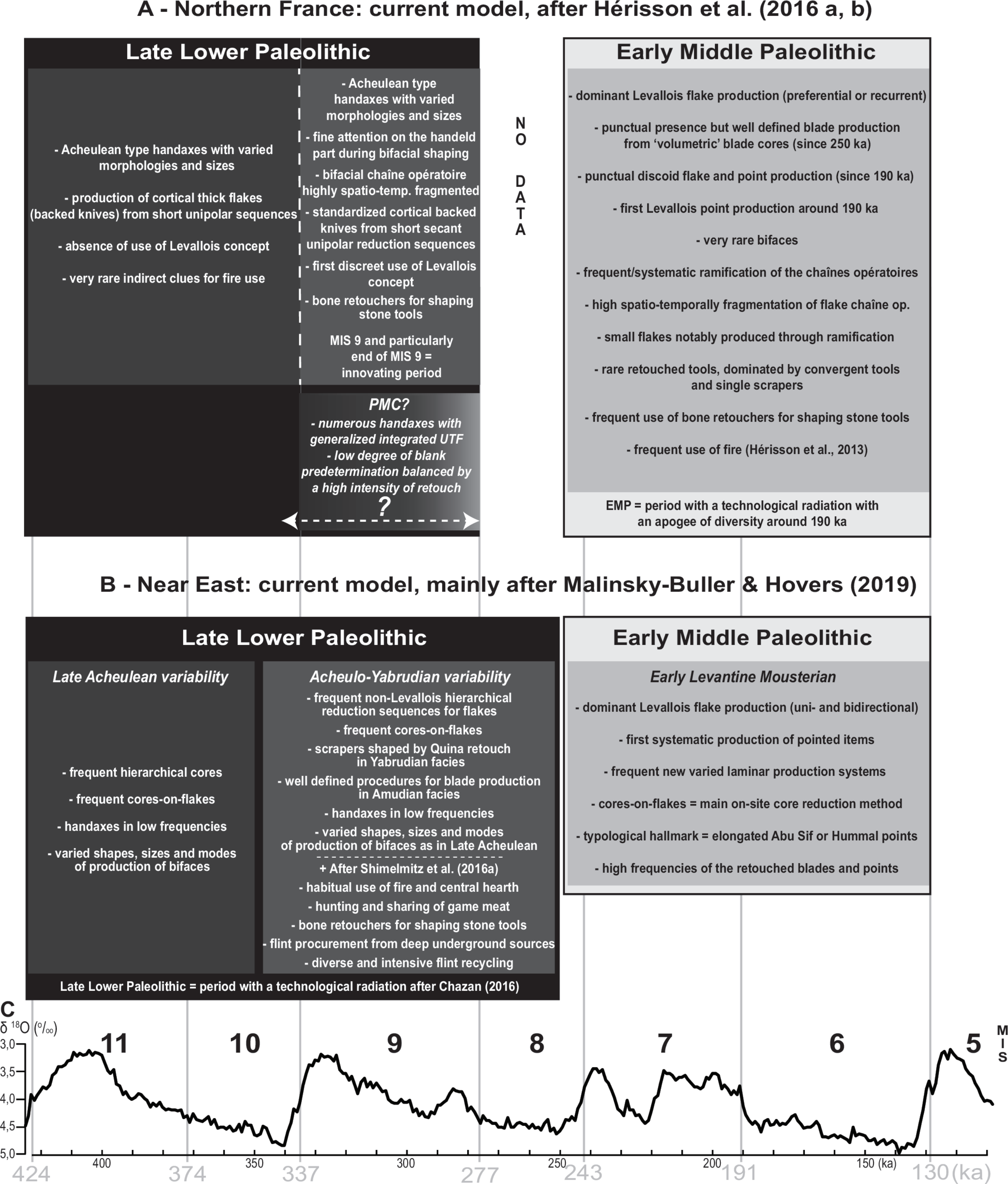

A - Northern France: a coexistence, then transitional model, after Tuffreau (1982) and Tuffreau et al. (1989)
Late Lower Paleolithic
Early Middle Paleolithic
Acheulean complex
- numerous Acheulean type handaxes with varied morphologies
- flake-tools well represented
- rare Levallois flakes
Evolved Acheulean
- numerous Acheulean type handaxes with varied morphologies
- flake-tools well represented
- no Levallois flakes
PMC
- numerous handaxes of Acheulean type
- stable types of retouched tools announcing the MP tool kit
Upper Acheulean
- frequent handaxes of Acheulean type (mainly amygdaloids and lanceolates)
- Levallois flakes well represented (clear Levalloisian facies)
- varied flake-tools (numerous side-scrapers and abundant cortical backed knives
Epi-Acheulean
- handaxes of Acheulean type very rare (<1%)
- Levallois flakes well represented
- sometimes, blades are numerous
- varied flake-tools
Mousterian with different types and facies
Ferrassie type (including Biache facies)
- Levallois flakes well represented
- numerous convergent tools and single scrapers
Typical type
- Levallois flakes well represented
- varied flake-tools with varied scrapers and numerous Upper Paleolithic type tools
Denticulate type
- Levallois flakes
- numerous denticulates and notches (>50 % tools)
- low number of scrapers
B - Near East: a chronocultural model, after Bar-Yosef (1994, 2002)
Late Lower Paleolithic
Early Middle Paleolithic
Late Acheulean
- amygdaloid-cordiform, lanceolate or rounded bifaces
- biface variability in metrical attributes
- decrease in biface lengths => increasing frequency of resharpening (longer curation?)
- flake industry is not very well-known
Acheulo-Yabrudian
"Yabrudian facies"
- numerous side-scrapers, on thick flakes (high % of Quina & demi-Quina retouch)
- rare blades and UP-type tools
"Acheulean facies"
- up to 15% bifaces
- numerous scrapers similar to the Yabrudian ones
"Amudian facies"
- end scrapers, burins, backed knives
- rare bifaces - typologically close to Acheulean
Tabun D-type & Hummalian
- short Levallois blanks
- elongated, narrow and thick blades
- elongated blanks frequently retouched into Abu-Sif points
- uni- or bi-directional cores
Differences with Hummalian
- in Hummalian only use of the laminar method
Tabun C-type
- dominance of oval-rectangular short blanks
- blanks from Levallois cores through centripetal and/or bi-directional chaîne opératoire
- few triangular points in some archeological units
C
δ 18O (‰)
MIS
11
10
9
8
7
6
5
3,0
3,5
4,0
4,5
5,0
400
350
300
250
200
150 (ka)
424
374
337
277
243
191
130 (ka)



A - Northern France: current model, after Hérisson et al. (2016 a, b)
Late Lower Paleolithic
- Acheulean type handaxes with varied morphologies and sizes
- production of cortical thick flakes (backed knives) from short unipolar sequences
- absence of use of Levallois concept
- very rare indirect clues for fire use
- Acheulean type handaxes with varied morphologies and sizes
- fine attention on the handeld part during bifacial shaping
- bifacial chaîne opératoire highly spatio-temp. fragmented
- standardized cortical backed knives from short secant unipolar reduction sequences
- first discreet use of Levallois concept
- bone retouchers for shaping stone tools
MIS 9 and particularly end of MIS 9 = innovating period
PMC?
- numerous handaxes with generalized integrated UTF
- low degree of blank predetermination balanced by a high intensity of retouch
?
NO DATA
Early Middle Paleolithic
- dominant Levallois flake production (preferential or recurrent)
- punctual presence but well defined blade production from 'volumetric' blade cores (since 250 ka)
- punctual discoid flake and point production (since 190 ka)
- first Levallois point production around 190 ka
- very rare bifaces
- frequent/systematic ramification of the chaînes opératoires
- high spatio-temporally fragmentation of flake chaîne op.
- small flakes notably produced through ramification
- rare retouched tools, dominated by convergent tools and single scrapers
- frequent use of bone retouchers for shaping stone tools
- frequent use of fire (Hérisson et al., 2013)
EMP = period with a technological radiation with an apogee of diversity around 190 ka
B - Near East: current model, mainly after Malinsky-Buller & Hovers (2019)
Late Lower Paleolithic
Late Acheulean variability
- frequent hierarchical cores
- frequent cores-on-flakes
- handaxes in low frequencies
- varied shapes, sizes and modes of production of bifaces
Acheulo-Yabrudian variability
- frequent non-Levallois hierarchical reduction sequences for flakes
- frequent cores-on-flakes
- scrapers shaped by Quina retouch in Yabrudian facies
- well defined procedures for blade production in Amudian facies
- handaxes in low frequencies
- varied shapes, sizes and modes of production of bifaces as in Late Acheulean
+ After Shimelmitz et al. (2016a)
- habitual use of fire and central hearth
- hunting and sharing of game meat
- bone retouchers for shaping stone tools
- flint procurement from deep underground sources
- diverse and intensive flint recycling
Late Lower Paleolithic = period with a technological radiation after Chazan (2016)
Early Middle Paleolithic
Early Levantine Mousterian
- dominant Levallois flake production (uni- and bidirectional)
- first systematic production of pointed items
- frequent new varied laminar production systems
- cores-on-flakes = main on-site core reduction method
- typological hallmark = elongated Abu Sif or Hummal points
- high frequencies of the retouched blades and points
C
δ 18O (°/oo)
3,0
3,5
4,0
4,5
5,0
11
10
9
8
7
6
5
MIS
424
400
374
350
337
300
277
250
243
200
191
150 (ka)
130
(ka)

Table 1

Dataset included in the study, including site name, archaeological level, topographical position of the site at the time of occupation, sedimentary context of the archaeological level, chronology based on Marine Isotope Stage (MIS), value of MIS correlation, climatic phase of the occupation, taphonomic context of the site, number of archaeological levels of the site, excavated surface of the archaeological level (m²), number of lithic remains (excluding chips, usually <15–20 mm), and density of lithics.

Site	Level	Topography[a]	Sedimentary context[b]	Chronology (MIS)	Value of MIS correlation[c]	Climatic phase[d]	Taphonomic context	Number of levels	Surface (m²)	Number of lithics	Lithic density	References
Abbeville, Rte de Paris/rue de l'abreuvoir		J	2a	7	3	IS	P	1	na.	na.	na.	Locht et al., 2013
Ailly-sur-Noye	N3	J	2b	late 6/early 5	5	TGL	P	3	na.	316	na.	Blondiau et al., 2009; Locht et al., 2013
Argoeuves		J	2b	8	2		S	na.	na.	na.	na.	Bourdier, 1969; Bourdier et al., 1974; Agache, 1976; Tuffreau, 1979; Tuffreau et al., 1981; Antoine, 1990; Soriano, 2000
Bagarre	c.5	J	2a	8 to 6	1		S	3	20	521	26.1	Tuffreau and Zuate Y Zuber, 1975; Tuffreau et al., 1981; Boëda, 1994
Bagarre	c.7	J	2a	8 to 6	1		S	3	na.	na.	na.	
Bagarre	c.10	J	2a	8 to 6	1		S	3	na.	na.	na.	
Bapaume, Les Osiers	C.8 sér. B2	A	1	late 7a/early 6?	2		S	1	15	499	33.3	Tuffreau, 1971, 1976, 1979, 1987; Balescu and Tuffreau, 2004; Koehler, 2008, 2011
Beaumetz	sér. Lustrée	B	1	8 to 6	1		S	1	na.	na.	na.	Hurtrelle et al., 1972; Tuffreau, 1974, 1987; Sommé and Tuffreau, 1976c
Beaumetz	sér. Jaune	B	1	8 to 6	1		S	1	na.	na.	na.	
Biache-saint-Vaast	C	D3	1	6	2		S?	8	na.	na.	na.	Piningre, 1978; Vandermeersch, 1978; Marcy, 1984, 1985, 1986, 1988; Boëda, 1986, 1988a,
Biache-Saint-Vaast	D	D3	1	early 6	4	DGL	P	8	260	431	1.7	

Biache-Saint-Vaast	D1	D3	1	early 6	4	DGL	P	8	260	3071	11.8	1988b, 1994; Bouchet, 1986; Tuffreau, 1986, 1988a, 1988b; Auguste, 1988, 1990, 1994, 1995a, 1995b, 2003, 2012; Beyries, 1988; Huxtable and Aitken, 1988; Marcy and Tuffreau, 1988a, 1988b; Tuffreau and Marcy, 1988; Ameloot-Van der Heijden, 1989, 1991; Yokoyama, 1989; Leroy, 1990; Burie, 1992, 1996; Bahain et al., 1993; Auguste and Patou-Mathis, 1994; Dibble, 1995; Leblanc, 1999; Rougier, 1999, 2003; Marx, 2001; Louguet, 2004, 2006; Auguste et al., 2005; Guipert, 2005; Louguet-Lefebvre, 2005; Bahain, 2007; Liouville, 2007; Goubel, 2011; Hérisson, 2012; Hérisson et al., 2013; Rots, 2013
Biache-saint-Vaast	D0	J	2a	7e/7d	4	late IS	P	8	107	1186	11.1	
Biache-Saint-Vaast	IIbase	J	2a	7e	5	IS	P	8	340	3772	11.1	
Biache-Saint-Vaast	IIA	J	2a	7e	5	IS	P	8	170	25105	147.7	
Biache-saint-Vaast	E	J	2a	7e	4	IS	P	8	114	5570	48.9	
Biache-saint-Vaast	H	J	2a	8/7	5	TGL	P	8	45	1082	24	
Cagny L'Epinette	H	D3	1	early 8?	2		P	9	180	2174	12.1	Antoine and Tuffreau, 1993; Laurent, 1993; Tuffreau et al., 1995, 2008; Dibble et al., 1997; Lamotte, 1999; Bahain et al., 2001, 2007
Cagny L'Epinette	I	J	2a	early 9	5	early IGL	P	9	72	223	3.1	
Cagny L'Epinette	I0	J	2a	early 9	5	early IGL	P	9	40	716	17.9	
Cagny L'Epinette	I1	J	2a	early 9	5	early IGL	P	9	75	776	10.3	
Cagny L'Epinette	I1A	J	2a	early 9	5	early IGL	P	9	37	544	14.7	
Cagny L'Epinette	I1B	J	2a	early 9	5	early IGL	P	9	32	647	20.2	
Cagny L'Epinette	I1B/I2	J	2a	early 9	5	early IGL	P	9	23	167	7.3	
Cagny L'Epinette	J	J	2b	10/9	4	TGL	P	9	na.	na.	na.	

Champvoisy		A	1	early 8 or early 6?	2		S	1	na.	na.	na.	Balescu, 1988; Chertier and Hinout, 1988; Tuffreau, 1989; Balescu and Tuffreau, 2004
Clairy Saulchoix	inf	B	1d	9e	3	IGL	S	1	530	443	0.84	Lhomme et al., 2002; Rocca, 2005; Sellier, 2005
Drucat		J	2a	7	3	IS	P	1	na.	na.	na.	Locht and Kiefer, 2009; Locht et al., 2013
Etricourt-Manancourt	LGS	D	1	7/6	5	late IS	P	13	1500	52	0.039	Hérisson and Goval, 2013, 2015; Hérisson et al., 2016
Etricourt-Manancourt	LRS	D	1	7d/7c	5	early IS	P	13	2100	96	0.046	
Etricourt-Manancourt	HUD	D	1	9a	5	late IGL	P	13	4200	1894	0.45	
Etricourt-Manancourt	HUZ	BD	1d	9c	5	IGL	P	13	300	185	0.62	
Gentelles	LBN	B	1d	late 7a/early 6	2		S	7	na.	na.	na.	Tuffreau et al., 1999, 2001, 2008, 2017; Balescu and Tuffreau, 2004; Goval, 2005
Gentelles	LGC	B	1d	6?	2		S	7	na.	na.	na.	
Gentelles	LBP	B	1d	7?	2		S	7	na.	na.	na.	
Gentelles	CLG	B	1d	8?	2		S	7	na.	na.	na.	
Gentelles	CSI	B	1d	late 9/early 8	2		S	7	na.	na.	na.	
Gouzeaucourt	D	BD	1d	6	2		S	5	na.	na.	na.	Tuffreau and Bouchet, 1985; Marcy, 1989; Tuffreau et al., 1989; Tuffreau, 1992b; Lamotte, 1995; Soriano, 2000
Gouzeaucourt	R	BD	1d	8 or >8	2		S	5	38	1394	36.7	
Gouzeaucourt	G	BD	1d	8 or >8	2		S	5	186	10042	54.0	
Gouzeaucourt	H	BD	1d	8 or >8	2		S	5	183	5467	29.9	
Gouzeaucourt	I	BD	1d	8 or >8	2		S	5	na.	na.	na.	
Havrincourt 2	N0	D	1	late 6	5	PGL	P	3	na.	na.	na.	Goval and Hérisson, 2012, 2018; Goval, 2013; Hérisson and Goval, 2013
Le Pucheuil	série B	AB	1d	7/6	3	DGL	S	2	na.	na.	na.	Delagnes, 1993; Delagnes and Ropars, 1996; Lazuén and Delagnes, 2014
Le Pucheuil	série C/A	B	1d	late 8/early 7?	3	TGL	S	2	na.	na.	na.	
Le Tillet	Série grise	B	1	8 to 6	1		S	2	na.	na.	na.	de Givenchy, 1911; Bordes, 1954
Le Tillet	Série blanche	B	1	8 to 6	1		S	2	na.	na.	na.	
Longavesnes		B	1d	8 to 6	1		S	1	na.	na.	na.	Tuffreau et al., 1989; Ameloot-Van der Heijden, 1991, 1993

Maisons-Alfort		J	2a	late 7a/early 6	3	late IS	P	1	350	168	0.48	Durbet et al., 1997; Hadjouis, 1998
Montières - Boutmy Muchembled		J	2a	7c/7a	4	IGL	na.	1 ?	na.	na.	na.	Commont, 1913; Tuffreau et al., 1981; Tuffreau, 1983; Bordes, 1984; Antoine, 1990; Laurent, 1993
Plachy-Buyon	N1	D	1	6	4	PGL	P	3	525	na.	na.	Locht et al., 1995
Plachy-Buyon	N2	D	1	early 6?	4	DGL or PGL	P	3	525	na.	na.	
Plachy-Buyon	N3	D	1	9	3	DGL	P/S	3	525	206	0.39	
Revelles, Les Terres-Sellier	niv. 3	B	1d	9e	3	IGL	P	3	980	339	0.35	Guerlin et al., 2005
Riencourt-lès-Bapaume, chantier Sud	niv. III	A	1	7 or 6?	1		S	2	na.	na.	na.	Tuffreau, 1993
Saint-Acheul, Atelier Commont		D3	1	8 to 6	2		na.	1	na.	na.	na.	Commont, 1909a, 1909b, 1911; Bordes and Fitte, 1953
Saint-Valéry-sur-Somme	SO	D	1	8	3	PGL	P+S	1	3	133	44.3	Heinzelin and Haesaerts, 1983
Salouël	1974/1976	J	2b	late 8?	2		S	1	na.	na.	na.	Antoine, 1990; Ameloot-Van der Heijden, 1991; Ameloot-Van der Heijden et al., 1996
Soucy 1		J	2a	9	5	IGL	P	1	394	1790	4.5	Chaussé et al., 2000; Lhomme et al., 2000, 2003, 2004; Chaussé, 2003; Lhomme, 2007)
Soucy 2		J	2a	9	5	IGL	P	1	2	180	90	
Soucy 3	niv. S	J	2a	9	5	IGL	P	2	92	58	0.6	
Soucy 3	niv. P	J	2a	9	5	early IGL	P	2	510	11980	23.5	
Soucy 5	niv. 0	J	2a	9	5	IGL	P	3	170	99	0.6	
Soucy 5	niv. I	J	2a	9	5	early IGL	P	3	110	1595	14.5	
Soucy 5	niv. II	J	2a	9	5	early IGL	P	3	80	1433	17.9	
Soucy 6		J	2a	9	5	TGL	P	1	24	137	5.7	
Therdonne	N3	E	1	late 7a/early 6	5	late IS	P	4	305	9989	32.8	Locht et al., 2000, 2010; Gadebois, 2006; Hérisson, 2012; Coudenneau, 2013; Hérisson et al., 2013; Hérisson and Locht, 2014

Vimy	c.17	B	1	8 to 6	1		S	1	na.	na.	na.	Tuffreau, 1974, 1979; Sommé and Tuffreau, 1976b

Abbreviations: na. = non-available data.

[a] Coding for topographical position: A = plateau; B = depression; D = slope; D3 = lower portion of slope; E = hill foot; J = valley bottom.

[b] Coding for sedimentary context: 1 = loess, loess-derived deposits, or paleosol; 1d. = same as 1 but infilling a sinkhole; 2a = fine fluvial deposit; 2b = coarse fluvial deposit.

[c] Value of MIS correlation. Each occupation is assigned to an isotopic stage or, when possible, substage. The accuracy of each correlation is assessed and expressed as a score between 0 and 5: 0 = no correlation; 1 = correlation uncertain, very scant proof; 2 = correlation uncertain, some proof; 3 = good correlation but lack of convergent proof; 4 = precise and convergent correlation; 5 = perfect, precise and convergent correlation. See Hérisson et al. (2016a) for further details.

[d] Code for climatic phase (only for occupations with MIS correlation from 5 to 3): PGL = Pleniglacial; TGL = Late Glacial; DGL = Early Glacial; IGL = Interglacial; IS = Interstadial

[e] Coding for taphonomic context: P = primary; S = secondary.