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HABITUS?

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Contents

The production and use of archery-related items as a reflection of social changes during the Late Neolithic and the Early Bronze Age in Europe

*Clément Nicolas**

Abstract

Dates ranging from 2500 to 1700 BCE are a period of major social and economic change in western and central Europe, with the spreading of the Bell Beaker Culture and the introduction or the development of metalworking (copper then bronze). At that time, archery-related items became peculiarly significant for the Bell Beaker and some Early Bronze Age communities. They include especially specific types of arrowheads and an original item, the stone bracer, thought to have adorned organic wristguards. Technological studies point to the objects that were more or less easily made during the Bell Beaker period, suggesting that each warrior was able to shape his own set, while during the Early Bronze Age, the level of know-how as well the context of production suggests that these items were manufactured by craftsmen for the elite. Use-wear analysis shows that these objects might be commonly worn. During the Bell Beaker period, part of the arrowhead and, to a lesser extent, some bracers were used for shooting. However, in some regions during the Early Bronze Age, these objects were intended for display only. These two types of production and uses of archery-related items illustrate a shift from the object-signs of the Bell Beaker warriors towards items alienated from their primary function or sacred objects of the Early Bronze Age elites. Finally, the wide distribution of Bell Beaker arrowheads and bracers allow considering the relevance of the circulation of ideas, objects and individuals in adopting a European fashion.

Keywords: Bell Beaker, Early Bronze Age, Europe, flint arrowheads, stone bracers, technology, use-wear analysis

** Postdoctorate position, UMR 8215 Trajectoires, Maison de l'Archéologie et de l'Ethnologie, 21 allée de l'Université, F-92023 Nanterre Cedex, France. clement.nicolas@wanadoo.fr*

Introduction

The time ranging from 2500 to 1700 BCE is a period of major changes in western and central Europe, with the introduction or the development of metalworking (copper

then bronze). The spreading in large parts of Europe of the Bell Beaker Culture from the mid 3rd millennium BCE onwards led to large networks, allowing a large-scale mobility of people, objects, ideas and technologies. This networking contributed to the circulation of an exponential amount of metal ores and likely to the rise of new elite and structured societies during the Early Bronze Age.

Between these dates, specific objects were produced, including in particular archery-related items: flint arrowheads and stone bracers (wristguards). These objects regularly found in graves have been long considered indicators of warriors who would have invaded Europe and spread the Bell Beaker Culture (Childe 1929). From the 1970s, these objects are thought to be part of a prestigious set resulting from long-distance exchanges (Shennan 1977). They are now considered more likely to be objects highlighting the social status of the individuals (Bailly 2002; Lemercier 2011; Fokkens *et al.* 2008). These assumptions are mainly based on literature without properly examining the artefacts. However, recent studies on bracers pointed to their quite long life cycles (Vaart 2009; Woodward and Hunter 2011), while little attention has been paid to the arrowheads. Thus we will examine different case studies in several parts of Europe (Brittany, Britain, Denmark, Czech Republic, Hungary) in order to investigate how these objects were produced and used, how they reflect social changes. A large-scale analysis allows us to identify regional and international trends particularly relevant to appreciate the diverse expressions of the Bell Beaker Culture in Europe. In this paper, we will present the main results on technology in a broad sense, from raw materials to final use, and then discuss their role among other triggers of social transformation. Finally, we will evaluate the importance of migrations in the adoption of this warrior set.

Bell Beaker arrowheads (*c.*2500-2100 BCE)

Bell Beaker arrowheads include piercing varieties, differing among European regions (Fig. 1). To the west (France, Britain), the main type is the arrowhead with squared barbs and a squared tang and its derivatives (barbs or tangs being rounded or pointed). In parallel coexist cruder barbed-and-tanged arrowheads (Nicolas 2017). The main type finds close similarities in projectiles produced by early 3rd-millennium communities in western France, especially the Artenac Culture, where it probably originates (ibid.). To the east (Denmark, Czech Republic, Hungary), few arrowheads with squared barbs and tangs occur in the early stage of the Bell Beaker Culture (Nicolas 2017; Heyd 2001). But there, arrowheads are mainly hollow-based, probably following a Corded Ware tradition (Budziszewski and Tunia 2000; Kolář 2006). In Denmark, hollow-based points might have various shapes but barbs are generally rounded or pointed. There are only two pieces with slanted or squared barbs. In central Europe, hollow-based arrowheads have essentially squared barbs (and to a lesser extent rounded or pointed). This original type with squared barbs probably results from the acculturations between the Corded Ware technical tradition (hafted arrowheads with a concave basis) and the new fashion promoted by the Western Bell Beaker Culture (squared barbs). Whatever the base (barbed-and-tanged or hollow-based), once hafted, these different Bell Beaker arrowheads should have looked quite similar.

The supplies of raw materials show quite different patterns according to the geological setting. In areas where usable flints occur (Cretaceous or Danian flint in England and Denmark), procurement is local. This observation could be applied as well for southern Moravia, where Krumlovský cherts have been widely used but in a limited area around the sources (up to 50 km; Kopacz *et al.* 2009). Elsewhere (NW France, Czech Republic), flint networks have been set up in order to compensate for the low quality of local raw materials (small-sized, poor knapability). In north-wes-

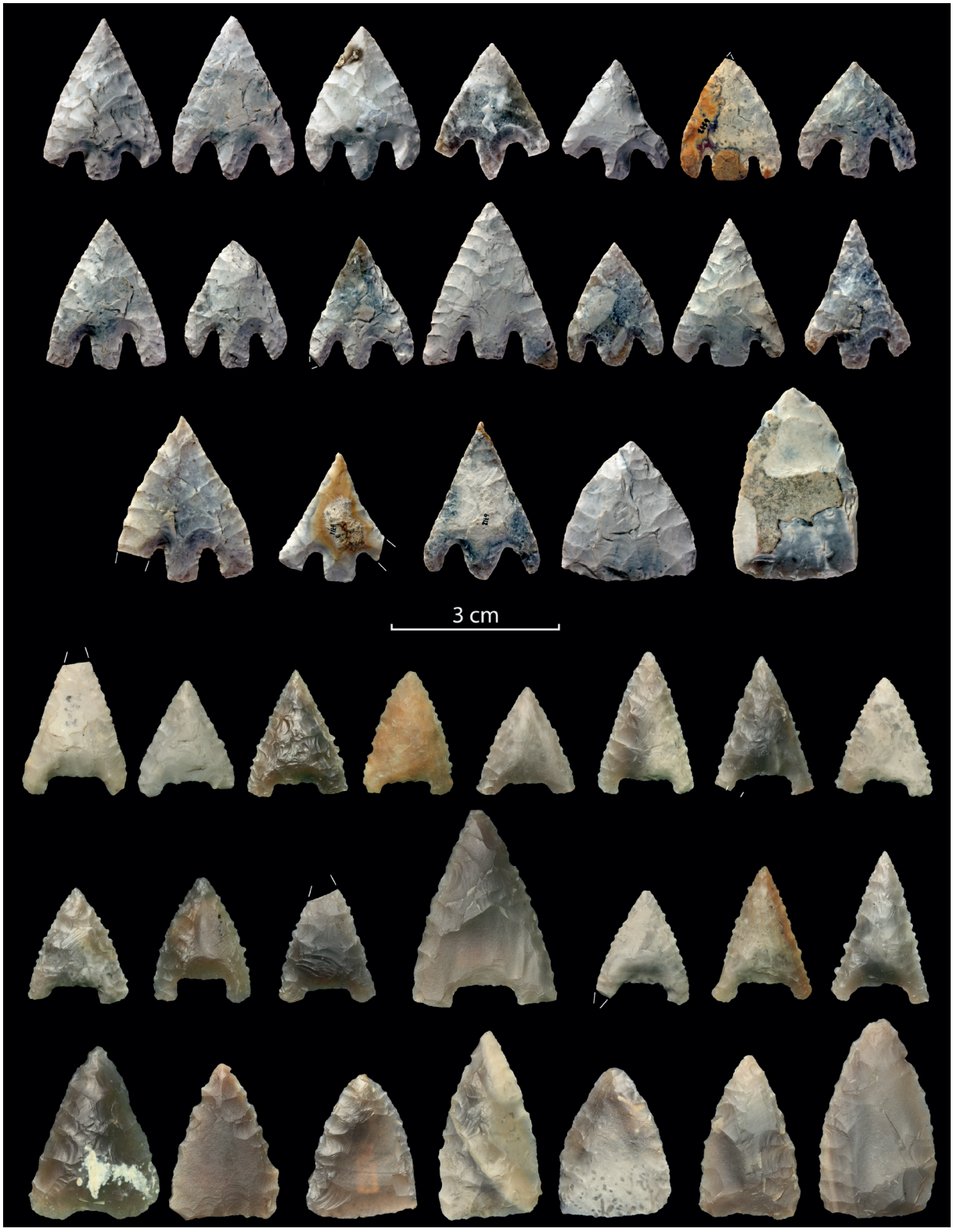

Figure 1. The two largest funerary sets of Bell Beaker flint arrowheads from western and central Europe.
Above: Barbed-and-tanged arrowheads and two rough-outs from the Amesbury Archer's burial (Wiltshire, United-Kingdom (SSWM)).
Below: Hollow-based arrowheads and seven rough-outs from burial 2 at Stehelčeves III (Bohemia, Czech Republic (VMS)). Photos C. Nicolas.

tern France, flints from the Armorican Massif margins (*e.g.* Le Grand-Pressigny flint, Cher Valley flint) circulated over a distance of 400 km, whereas the domestic industries are made up of sea flint pebbles or local siliceous rocks (Nicolas 2017). In the Czech Republic, two main imported flints were used: silicite from glacial sediments (north to Ore Mountains and Sudetes Mountains) mostly in Bohemia, Jurassic flint from the Krakow-Częstochowa plateau (Lesser Poland) mainly in Moravia (Kopacz *et al.* 2009; Přichystal 2013). Besides them, a few local siliceous rocks or imported flint were used as well (ibid.; Nicolas 2016). A specific case is provided by Hungary in the Budapest area where the easternmost Bell Beaker community is (Csepel group). Located on the Csepel Island (Hungary) and its surroundings, this Bell Beaker group is surrounded by different contemporary cultures (Endrődi 2013). Here, networks of raw materials seem to be much more restricted (< 85 km) and the local Buda hornstone has been mainly used. Fine quality radiolarites (Gerecse, Szentgál), even regionally present (40 to 85 km), are in a minority (Horváth 2017). Arrowheads from Szigetszentmiklós-Felső-Ürge-hegyi dűlő cemetery are made of a variety of fissured Buda hornstones, which is far from optimal for knapping. This quite restricted supply might be related to the relative isolation of the Csepel group in the Bell Beaker networks.

All Bell Beaker arrowheads are made from full débitage flakes, sometimes cortical or Kombewa (with two bulbar faces). Some patinated blanks suggest that parts of them could have been recovered on earlier settlements or flint workshops. Although in the minority, several graves in Europe yielded arrowheads, blanks and preforms (Nicolas 2016, Fig.1). The latter are generally ogive-shaped and slightly bigger than the finished products. According to progress, they could be shaped by one or two rows of the retouch. The final retouch is bifacial, low-angle and quite regular. Its extent is from marginal to covering, highlighting diverse investment in making arrowheads. Hollow bases are knapped by short retouching, while barbs and tang are shaped with a combination of short retouches and small notches.

For pressure flaking, both animal bone or antler tools and copper awls could have been used. In Britain and central Europe, several antler tools known as 'spatulae' associated with Bell Beaker arrowheads could have been used as pressure flakers even if other, more debatable uses have also been proposed (see Nicolas 2017). Copper awls had probably been used, as well as those of bone or antler. Indeed, a few copper awls have been found in graves containing Bell Beaker arrowheads in north-western France and also in Scotland (ibid.).

The function of Bell Beaker arrowheads as projectiles is well attested. Although organic remains are generally poorly preserved in Bell Beaker graves, there is much evidence of hafting. In Denmark and central Europe, up to 10% of arrowheads yield some black residues, likely to be glue remains. The best examples are two pieces from grave A at Prosiměřice (Moravia): they are covered in the central part by black, matt and dry residues (birchbark tar?) with woody prints left by the shaft (Fig. 2, 1-2). Furthermore, one of them showed at the time of discovery larger residues with prints of the binding threads wound around the shaft (Pernička, 1961; Fig. 2, 1). Regularly, blunt parts could be observed on the barbs. They are somewhat grained and located on the removal ridges. They are rarely visible to the naked eye but can be felt with the fingertips. When they are well developed, they might be more frequent, bright and visible (Nicolas 2016). However, their origin remains unclear (Gassin 1996, 117-118): intentional abrasion preventing the cut of binding threads or use-wear due to the hafting or the transport in the quiver? One answer is possibly provided by the further blunt parts on the tips of numerous Bell Beaker arrowheads from central Europe (Fig. 2, 3-4). Under a low-magnification microscope they look similar to the ones observed on the barbs. But they could be much more intense to round the tips and affect their piercing properties. Investigations of Early Bronze Age arrowheads (Nitra Culture, Moravia) revealed similar patterns.

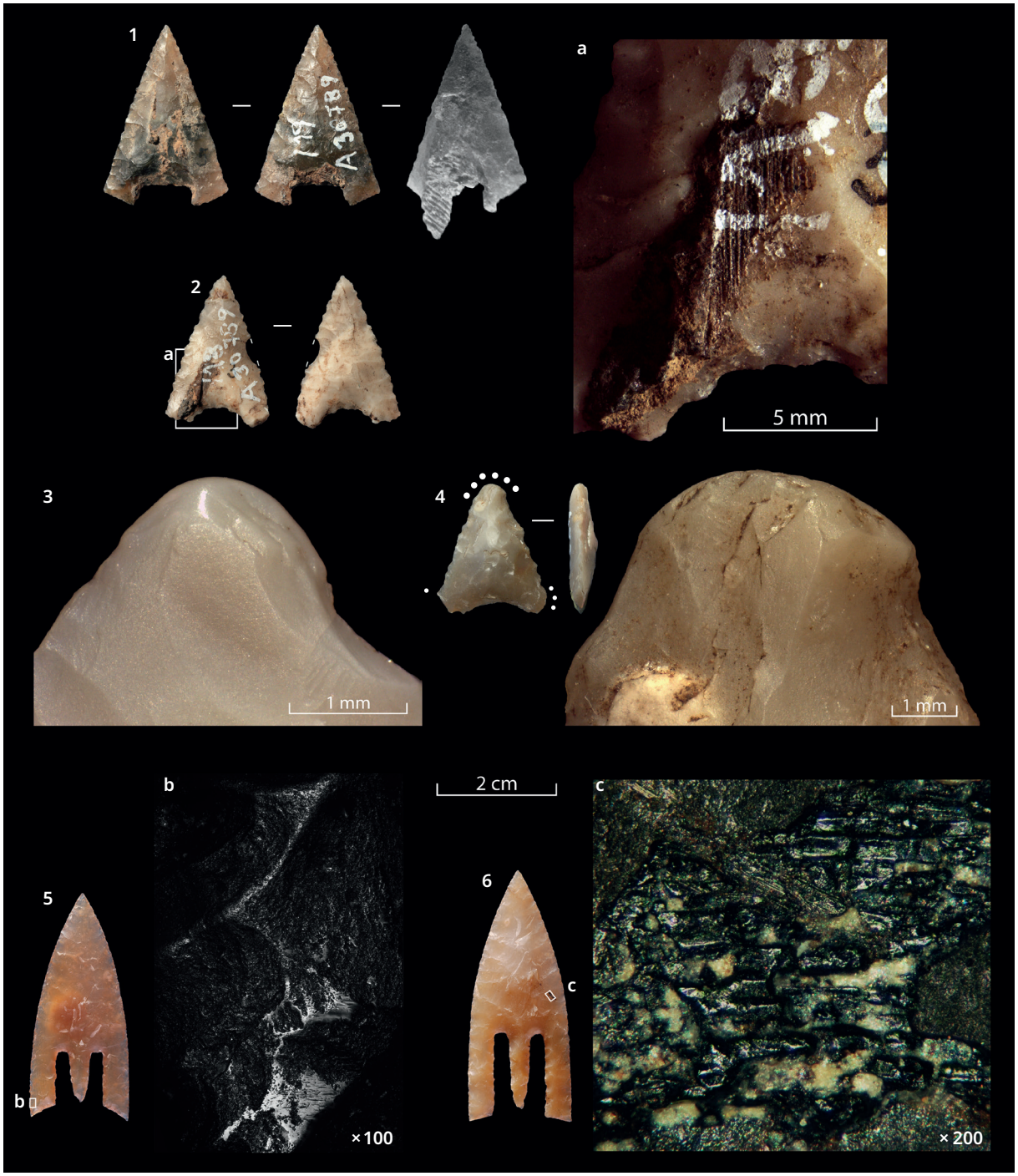

Figure 2. Hafting use-wears on Eastern Bell Beaker arrowheads (1-4) and Early Bronze Age Armorican arrowheads (5-6). (1, 2 & a) Glued arrowheads with woody prints and remains of the binding thread. (3 & 4) Blunting on the tips of arrowheads. (5 & b) Blunt and bright spots with striations on the long barbs of the arrowheads. (6 & c) Glue residue with linear prints of the binding threads. (1 & 2) Prosiměřice, grave A (Moravia, Czech Republic, (JMZ)). (3) Hulín. (2) 'Pravčice', grave H59 (Moravia, Czech Republic (ACO)). (4) Neratovice I, grave 16 (Bohemia, Czech Republic (NMP)). (5 & 6) Prat ar Simon Pella grave (Lannilis, Brittany, Finistère (CDAF)). (1-4 & a) Photos C. Nicolas & Masaryk University archives, Brno. (5 & 6) Photos S. Oboukhoff. (b & c) Photos C. Guéret.

Their examination under a high-magnification microscope allowed identification of friction against dry skin (Kaňáková *et al.* 2016). Similar use-wear was obtained while experimenting with the transport of arrowheads in quivers (Wolski and Kalita 2015). If such an interpretation is correct, the most intense blunt parts observed on Bell Beaker arrowhead tips could have resulted from transport over quite a long time (many years?). Nonetheless, there is evidence of the use of arrowheads as projectiles, underlined by a small number of examples with diagnostic impacts (2 to 5%; Nicolas 2016). In some cases, the arrowheads show signs of repair after shooting (retouch fresher or abrupt). Interestingly, only three cases of deadly arrows are recorded over the entire Bell Beaker Europe (*i.e.* over thousands of burials; Schröter 1997; Nicolas 2017).

After this quick overview, several trends could be underlined for the Bell Beaker arrowheads. Except in Denmark (see below), there is no specific production between objects found in graves, settlements or the countryside, that could be highlighted by differences in size or manufacture. They do not show a high level of technical expertise, even though they appear to have been worked significantly better than the rest of the lithic industry. In some areas (in Brittany for instance), they are the only items produced by bifacial reduction. However, the simplest examples (flakes shaped by short retouching) do not require specific know-how. With a good copper pressure flaker, almost everybody (the author included) was able to knap such arrowheads. However, more elaborate pieces with covering retouching required more practice but probably not a long apprenticeship. This pattern does not exclude the possibility that some knappers acquired greater skill than others (Wiessner 1983); in these cases one could speak of 'experts' as defined by Pelegrin (2007). They could derive a certain prestige from this competence and could exchange some of their arrowheads, but without getting a real benefit in return for their (low) investment. The existence of this kind of skilled knappers could then be a step towards the craft organization of arrowhead production. Moreover, the fact that some of the deceased were buried with arrowheads and part of the arrow maker kits (blanks, preforms, antler or copper pressure flakers as well as arrowshaft smoothers) argues not necessarily for craftsmen's graves but more likely for a low-scale production quite widely mastered in the Bell Beaker societies (Nicolas 2017). The recurrence of archery equipment in graves and its depiction on the stelae of the cemeteries of Le Petit-Chasseur (Sion, Switzerland; Gallay 1995) and Saint-Martin-de-Corléans (Val d'Aoste, Italy; Zidda 1997) suggests the existence of a warrior class identifying itself through manufacture of its hand-made objects (Bailly 2002; Lemercier 2011). In southern France and central Europe, archaeozoological remains highlight that the economy was largely based on farming and wild species were fairly marginal in the food supply (Lemercier 2011; Kyselý 2012). Thus Bell Beaker 'warriors' could have been involved in some prestigious hunting (Nicolas 2017) or warfare, presumably ceremonial due to the low rate of violent deaths (Turek 2015).

Danish Late Neolithic 1 arrowheads (*c.*2350-1950 BCE)

In the Danish Late Neolithic 1 (including Bell Beaker Culture), arrowheads show specific patterns. First of all, they are rarely associated with Bell Beakers elsewhere in Europe but mainly with the Danish flint daggers, being highly symbolic, whose first production involved Bell Beaker communities (Sarauw 2007b, Fig. 3). Such associations once again seem to represent the personal equipment of warriors (Sarauw 2007a).

There are many known Bell Beaker settlements (Sarauw 2007b; 2008) and they yielded hollow-based arrowheads, like the ones found in contemporary graves (see detailed references in Nicolas 2016). Their dimensions are similar but slightly

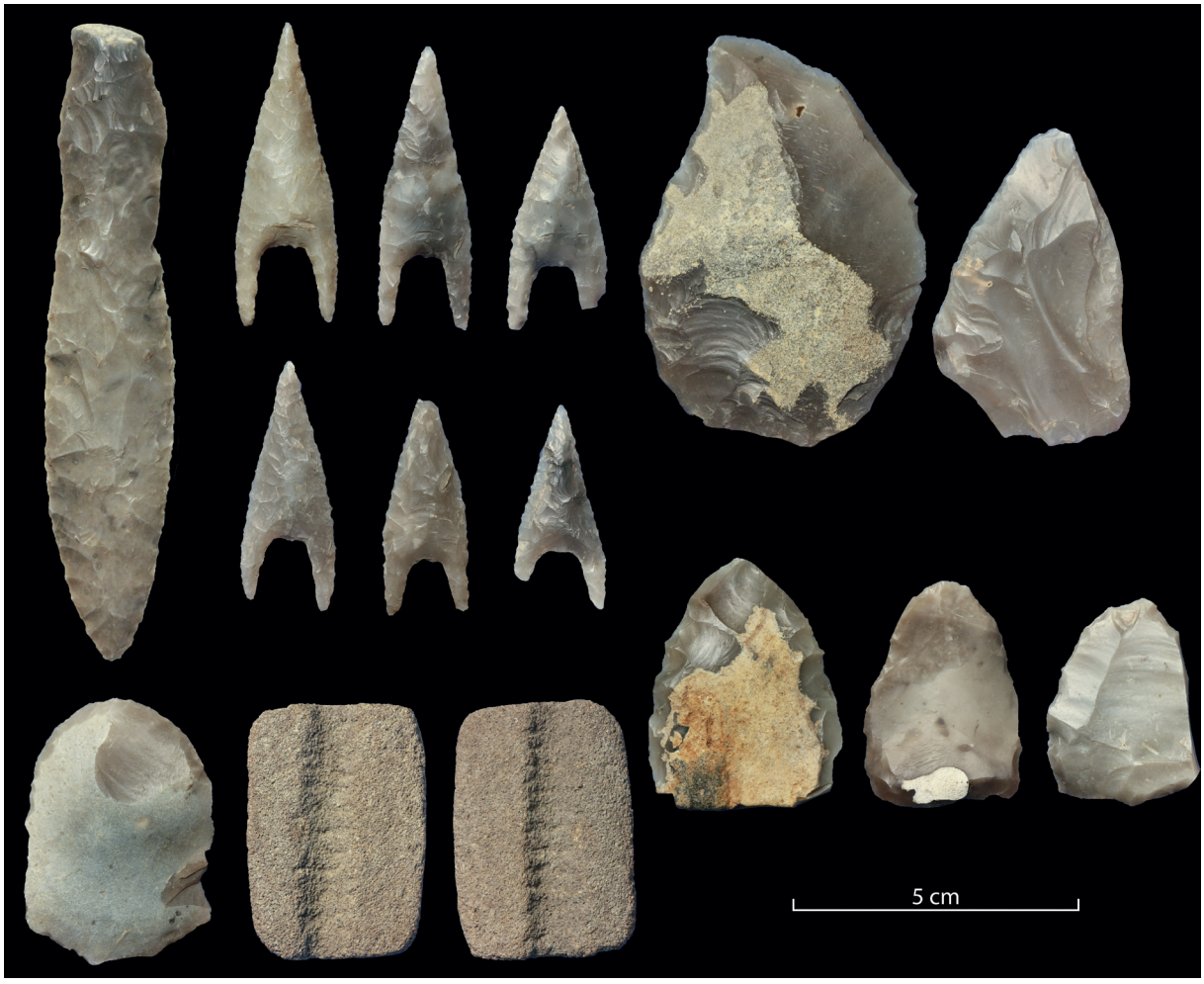

Figure 3. Arrow maker grave from Vorbasse 2a, Ribe, Denmark (NMK), including arrowheads, rough-outs, sandstone arrowshaft smoothers, dagger and scraper. Photos C. Nicolas.

smaller in the settlements (ibid.). A similar pattern has been observed for the flint daggers (Sarauw 2006; 2008). In settlements, additional arrowhead types are known, such as transverse arrowheads, triangular points, or points with concave proximal edges. Thus at least a selection or specific production could have occurred for the arrowheads found in burials.

The hollow-based arrowheads in Denmark show a low degree of similarity (*i.e.* great morphological diversity) and highly variable levels of technical expertise, ranging from those that had been produced quickly to others that had been carefully worked. Several contexts of production show that they were firstly roughed out in workshops and then finished in settlements, with mined flint being used in some cases (see detailed references in Apel 2001; Nicolas 2016). Arrowhead rough-outs are always accompanied by other bifacially reduced preforms for larger pieces (daggers, axe-heads and sickles). Arrowheads are generally in the minority in these industries and so they were not the main objective of the production. Moreover, arrowheads might have been knapped from flakes resulting from the production of the larger bifacial objects (Apel 2001), implying that they would have been a by-product. Arrowhead production in Denmark thus seems to be a secondary craft, with little effort invested owing to the low gain from production. Apel (2001) proposed that the dagger production was based on an apprenticeship system and was the privilege of specific lineages or clans, as was access to flint sources of pure quality and sufficiently large. And so arrowhead production could have served to provide training for apprentices learning the skill of bifacial knapping. This is not, however, to deny the

existence of exceptional examples that had been made by master knappers (Nicolas 2017). By the way, three graves from the Ribe county yielded preforms and, in one case, arrowheads and a pair of arrow shaft smoothers (Fig. 3). The contexts of production as well as the high level of know-how involved for some noteworthy workpieces underline that we are probably dealing with craftsmen's graves.

Early Bronze Age arrowheads around the English Channel (*c.*2150-1600 BCE)

In some parts of Europe and especially around the Channel, production of socially valued arrowheads took place in post-Bell Beaker time, that is, the Early Bronze Age. Their shape clearly derived from Bell Beaker models: they are mostly ogive-shaped with pointed tangs and slanted barbs in north-western France (the so-called 'Armorican arrowheads') and more likely triangular with squared tang and slanted, squared or bevelled barbs in Britain (Nicolas 2017). In Brittany, such arrowheads were, with few exceptions, buried in large numbers (up to 60) in rich graves and found together with further prestigious items (bronze daggers, goldwork, exotic adornment and so on; Nicolas 2016). Although in Britain the Early Bronze Age arrowheads could be part of the elite burials, they are always found in smaller amounts.

North-western France

In north-western France, several types of Early Bronze Age arrowheads have been defined according to the shape, the length/width ratio and the length of the barbs (Nicolas 2016; Nicolas and Guéret 2014). At an early stage, short and subtriangular arrowheads tend to develop towards short or medium-length ogive-shaped forms (Fig. 4). At a middle stage, the previous arrowheads evolve towards ogive-shaped and elongated points with short barbs or more spectacular long barbs (up to 23 mm). Arrowheads with longer barbs are mainly found in north-western Brittany, suggesting the existence here of a local workshop of the finest arrowheads. During the final stage, the arrowheads are triangular in shape with a tang or alternatively a concave base. The latter could be interpreted as the result of the loss of the tang while knapping, rather than as an intentionally hollow-based form; indeed some examples have a tiny 'stump' instead of a true tang. Two triangular specimens made from sheet copper alloy may be interpreted as being imitations of flint arrowheads (Nicolas 2017). This loss of know-how that is expressed by the inability to knap a long tang and by making metal copies seems to mark the end of the production of Armorican arrowheads.

The Armorican arrowheads are made of a quite large variety of facies, ranging from translucent or semi-translucent colours (colourless, grey, honey-coloured, orange, red, brown) to more opaque colours (grey or honey-coloured). However, most of these varieties seem to stem from a single source, the flint of Meusnes lying in the Lower Turonian levels in the Cher Valley (Fig. 4). If some of the varieties occur in the primary deposits, the reddish or orange pieces result from coloured patina, probably acquired on river terraces. This aside, further flints were used, maybe collected as well, in a similar area (along the Loire? Nicolas 2016). At the early stage of production, all varieties were used but then a high quality honey-coloured translucent facies, with rare inclusions, was used, preferably for making the long ogive-shaped arrowheads.

Reconstructing the operational sequence of the Armorican arrowheads is a difficult task because only finished, highly retouched products are known. As with the Bell Beaker arrowheads, different flakes have been used as blanks: full débitage, cortical, Kombewa and patinated flakes. The production and the use of the blanks were apparently not determined by a strict operational scheme. The adaptation of

Figure 4. Possible arrow makers' graves from Britain.
Above: Flint grave goods from Breach Farm Barrow (Llanbleddian, Wales (NMW)).
Below: Rough-outs from Barrow 13, Petersfield Heath cemetery (Hampshire) (People of the Heath project, directors S. Needham & G. Anelay)). Photos C. Nicolas.

the volume of the blank to the planned arrowhead seems to be the most important. The shaping of the Armorican arrowheads apparently starts with a preform made by soft organic percussion as is suggested by the small and scaled removals observed on several pieces. The shaping is then continued by pressure flaking, as attested by clearly concave first negatives of removals, fine and regular removals and sharp micro-overhangs left on either side of the pressure point. The use of an awl made from copper alloy is demonstrated through the presence of small pressure points (< 1 mm) and of slight greyish green traces left by unsuccessful retouching (Nicolas 2016). Moreover, bronze awls, harder and possibly thinner, may allow being more accurate and making the tiniest retouch easier.

The retouch types are generally coverings and more rarely invasive or short. Most of the pieces manufactured in this way are perfectly biconvex. The edges were systematically regularized by particularly fine micro retouching (< 2 mm long). The most critical moment in the manufacture of an Armorican arrowhead is the knapping of the tang and the barbs. Each removal requires controlled pressure that is sufficient to remove the flake and to avoid plunging. The shaping of the tang and the long barbs requires the use of high-quality material (translucent honey-coloured flint from Meusnes) as well as sophisticated knapping in shaping an arrowhead that is both slender and thin. The Armorican arrowheads with the longer barbs are extremely slender and thin, measuring generally between 2.6 and 4.1 mm in thickness. It clearly appears that more appreciable thinness was required in order to shape the tang and the long barbs. Thus the knapper has less thickness to remove with less pressure and therefore the preform is more manageable and less likely to break.

The Armorican arrowheads doubtlessly required a high level of skill in order to master all the stages of the operational sequence and to control pressure flaking with maximum accuracy. Experiments were carried out by Frédéric Leconte according to an operational sequence similar to the one observed on the archaeological specimen (Nicolas 2016). These experiments revealed that a self-taught knapper, after two years of daily practice, will master the knapping of arrowheads with barbs of a 12-mm length and of arrowheads with barbs of a 16-mm length after several additional months of training. Yet Frédéric Leconte was not a complete novice in flint knapping and he practised for about ten years (knapping mostly hand-axes). Two to three years could be therefore the minimum time span to master the manufacturing of Armorican arrowheads. This apprenticeship period is certainly different from that of prehistoric times. The teaching provided by the knapping masters probably encouraged the progress of the apprentice. As argued for the Danish Late Neolithic, the evidence suggests that we are dealing with a specialized craftsmanship but with strong differences: Armorican arrowheads were the only highly crafted flint goods in north-western France and its diffusion is much more restricted to some elite burials.

While excavating, several archaeologists observed the survival of shafts, glue and binding threads (see Nicolas 2016). The remnants of shaft bindings have disappeared since the excavation but the traces of glue were better preserved. These are visible to the naked eye in the form of brown-black deposits, sometimes associated with a brown film and can be identified as remnants of glue. In most cases, this brown-black matter can be observed only occasionally on the surface of the arrowheads. Preliminary analyses (infrared spectroscopy) made it possible to confirm that the brown-black matter attached to the three arrowheads is indeed remnants of glue. The signal obtained matches that of plant tar or resin, perhaps of birchbark tar (study Rageot; Nicolas and Guéret 2014). When remnants of glue are well preserved, it can be stated that the brown-black matter covers not only the barbs but also the entire arrowhead: the remnants of glue are present close to or on the edges of the arrowheads and sometimes near the tip. Under the microscope, one glue deposit bears linear and parallel marks possibly left by a non-braided binding thread (Fig. 2, 6).

Almost all the arrowheads observed under the microscope bear bright spots visible to the naked eye. These are located on the high points, mainly on the arris of the negatives (Fig. 2, 5). Where they are particularly large, they may slightly recover the cavities. They are located in the lower zone of the arrowhead, on the barbs and above, rarely exceeding half of the pieces. Where they are well developed, the bright deposits are marked by short and large striations without polished ground. The striations are triangular with one end larger than the other. They are parallel but transversal with regard to the orientation of the arrowheads. These stigmata are often associated with blunted pieces. On a microscopic scale, these latter are systematically marked along the barbs and more particularly their denticulations. They overflow only very little, except for the end of the barbs where they tend to cover the sides, associated with bright spots on the ridges of the removals. They are very matt, coarse and often without polished components.

The bright spots are very similar to taphonomic alterations, often visible on archaeological material. Their distribution and the pattern of the striations, however, leave no doubt about their functional origin. These stigmata are closely related to blunted pieces and seem to occur during the same time span (Fig. 2, 5). Most probably they result from transversal and repeated movements of the implement during hafting. Equally, the absence of a clear directional sign, the smoothness and the location of the blunting are rather indicative of progressive development, certainly linked with the binding threads. This assumption would imply quite a loose hafting which enabled the arrowhead to move in a transversal manner according to the direction of the striations. It should therefore be admitted that the hafting of these arrowheads was of poor quality and not destined for accurate aiming. This statement is supported by the fact that no diagnostic break indicative of an impact could be observed on the Armorican arrowheads. The hafting of the Armorican arrowheads thus seems to be symbolic rather than functional and lasted long enough to cause bright spots and blunted parts. According to the distribution of the bright spots and the blunt zones, the arrowheads were hafted with a thread passing around the barbs. In one case, this binding thread was applied on the glue (Fig. 2, 6). Glue was placed on the internal edges of the barbs and the tang but also on the external edges of the barbs. It is thought it was to totally cover the binding threads, the lower part of the arrowheads and sometimes their tip. With such a type of hafting, the long barbs of the Armorican arrowheads became perfectly invisible.

The analysis of the traces reveals that these artefacts were widely used before they became grave goods. There is evidence to suggest that all or at least a very large number of the Armorican arrowheads were loosely and poorly hafted, in such a way that use-wear appeared (Nicolas 2016). Such an inoperative hafting together with the absence of impact marks make these Armorican arrowheads non-functional objects, mounted on shafts for their exhibition only. This display is in itself contradictory because the long barbs of the arrowheads become invisible when the arrowhead is hafted. If our observations are right, what was important was not that their owner displayed them, but rather that it was known that he owned them. In many respects, the Armorican arrowheads are prestige items alienated from their primary function.

The Armorican arrowheads, manufactured from exogenous flint by highly skilled knappers, certainly craftsmen, were apparently intended for display only. There is no doubt that these objects were reserved for the Early Bronze Age elite. These are in addition the most numerous and the most distinctive objects in the tombs of these chiefs. The Armorican arrowheads therefore can be considered to be an insignia of power. These Early Bronze Age chiefs probably controlled the manufacturing of the arrowheads through the supplying of the raw material, by supporting the craftsmen and/or by controlling the circulation of the arrowheads (Nicolas and Guéret 2014; Nicolas 2016).

Britain

In southern Britain, the mode of production is less obvious for the Early Bronze Age: in graves, sets of arrowheads are smaller, and fewer examples exist than in Brittany. Without being dominant, arrowheads are some of the prestige objects of the Wessex elites (Fig. 5). These distinctive patterns by comparison to Brittany result probably from a different way of consumption and use_of the arrowheads. Large amounts of barbed-and-tanged arrowheads, presumably related to the Early/Middle Bronze Age, occur in British museums, attesting a fairly large production of these artefacts. Furthermore, some arrows were clearly deposited in non-funerary hoards. At Kingsmead Quarry (Horton, Berkshire), a hoard has been found at the base of an oven, within one of the Early/Middle Bronze Age farmsteads. The hoard includes, among other things, eight flint barbed-and-tanged arrowheads, a piece of sandstone (an abrader?) and a copper alloy awl. Beyond the interpretation of such a deposition, this set_could be considered part of the toolkit of an arrow producer (Wessex Archaeology 2009). At Holloway Lane (London), a hoard includes six barbed-and-tanged arrowheads, made by covering retouch, and parts of an aurochs (thought to be an endangered species at that time in Britain). This symbolic hoard highlights a symbolism around hunting (Cotton *et al.* 2006).

Large amount of barbed-and-tanged arrowheads shaped by covering retouching could point towards a quite specialized production. Moreover, the noteworthy character of some arrowheads (accurately knapped, peculiarly thin) suggests a craft specialization similar to that underlined for Brittany (Fig. 5). By the way, several British examples show some patterns (ogive-shaped or long barbs) which do not fit the local tradition of fancy triangular arrowheads and might be considered copies, more or less successful, of Armorican arrowheads (Nicolas 2016). In addition to the Kingsmead Quarry hoard, there is further evidence of a specialized craftsmanship of arrowheads. The recent excavations of a barrow cemetery at Petersfield Heath (Hampshire, England) yielded two graves with arrowhead rough-outs. In Barrow 11, a probable cremation within a wooden coffin contained a bronze dagger and a perforated whetstone related to the Wessex 2 period and, above all, a pile of nine pieces of flint and two pieces of sandstone (abraders?); an additional strike-a-light flint was found alongside (Needham and Anelay 2014). In Barrow 13, a pit grave partially destroyed by an antiquarian trench, revealed a heap of cremated bones. It includes in particular ten arrowhead rough-outs arranged in a pile. A possible eleventh rough-out was found beneath an item of sandstone, a possible abrader (Needham and Anelay 2015). The rough-outs correspond to different stages of processing and their sizes are much larger and thicker than previously in Bell Beaker times (Fig. 5). They are made from bigger blanks worked by several series of removals by soft percussion. The next stage would have been probably final shaping by pressure flaking. Such manufacture is more time-consuming and reveals a greater investment in obtaining regular and biconvex products. Thus the knappers would have presumably been quite specialized, dedicating part of their time to producing arrowheads. Such discoveries evoke the previously mentioned graves from south-eastern Jutland, yielding arrowhead preforms as well, and could correspond to graves of arrowhead craftsmen. The fact that at Petersfield Heath no finished products were found with the arrowhead rough-outs might suggest a major economic change with a greater distinction between the producers (craftsmen) and the recipients than during the Bell Beaker period.

This interpretation should be qualified with the famous Early Bronze Age grave from Breach Farm (Llanbleddian, Wales). It contained a cremation buried under a quite large barrow and yielded one of the most exquisite set of arrowheads of the British Isles (Fig. 5). Beside the 13 arrowheads, six flint bifacial pieces were found (probably arrowhead rough-outs), a flint scraper and a flint planoconvex knife, an

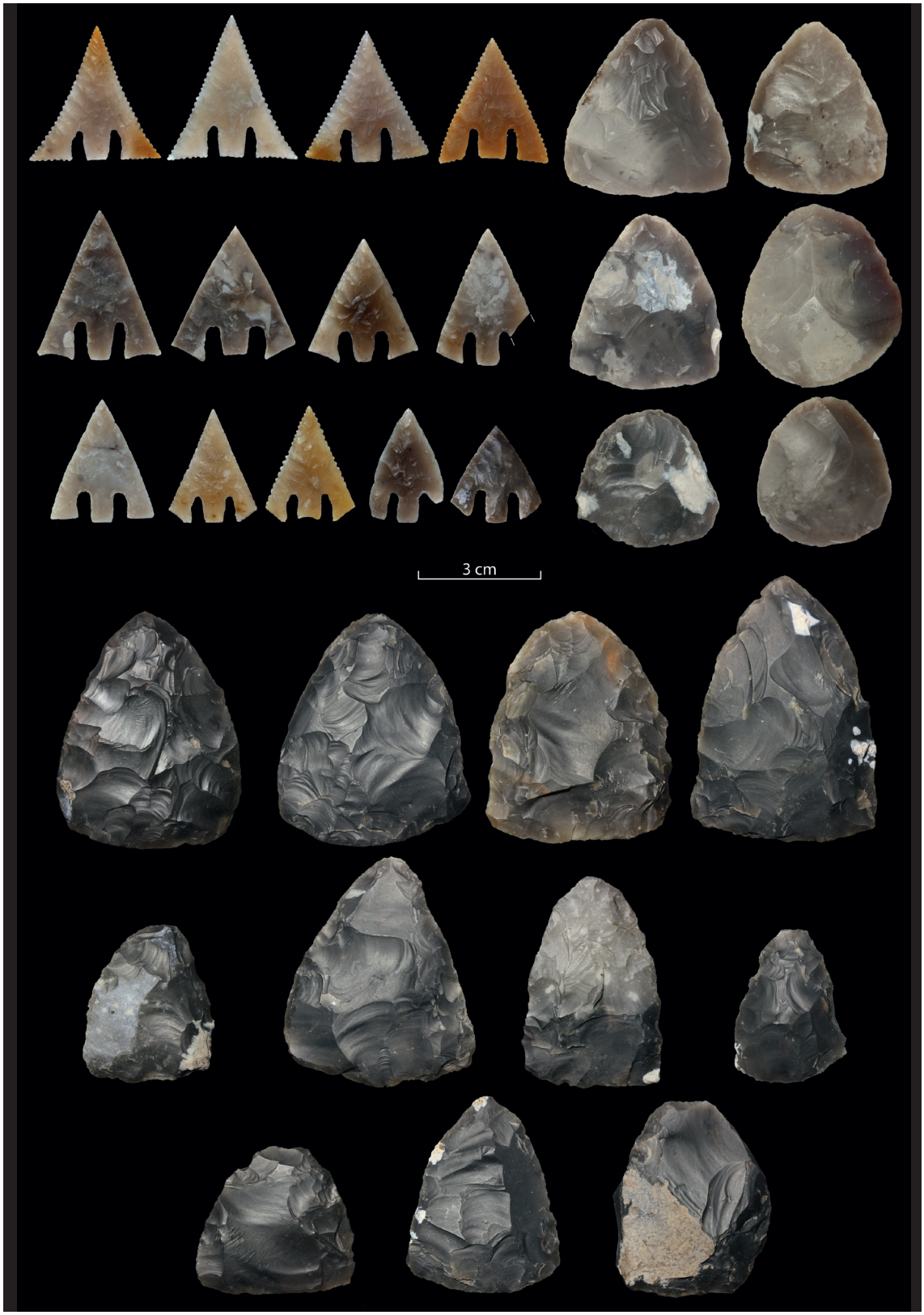

Figure 5. Early Bronze Age Armorican arrowheads. Above: Half of the arrowheads from the Kernonen barrow (Plouvorn, Brittany, France). Below: Arrowheads from the Limbabu grave (Saint-Thégonnec, Brittany, France (MPF)). Photos: C. Nicolas.

axe, two sandstone arrowshaft smoothers, a dagger and a chisel made of bronze as well as a pigmy cup (Grimes 1938). Again, the association of finished arrowheads, probable rough-outs and arrowshaft smoothers suggest that part of the Breach Farm grave goods could correspond to the set of an arrow producer. The difference from the Petersfield Heath burials lies in a joint collection of half-products and finished examples. These latter show stylistic parallels with Armorican arrowheads and highlight connections between elites across the Channel (Nicolas 2016). The rest of the grave goods (bronze dagger, axe and chisel, pigmy cup) liken the Breach Farm barrow to the Wessex 1 series and underline too the high status of the deceased. In this case, we can question whether instead of being an arrow producer his status allowed him to control this craftsmanship.

Bell Beaker bracers

Intrinsically tied to the arrowheads, the bracers or wristguards are part of the Bell Beaker warrior set (Fig. 6). However, this functional and symbolic association is not evident at first glance from the archaeological records. A minority of burials (< 5%) yielded both arrowheads and bracers and, in some countries like Austria or Denmark, they are never found together (Sarauw 2007a; Bosch 2008). This presumably results from a selective deposition in burials, expressing maybe the different status of warriors.

Like arrowheads, the two main traditions have been identified between Western and Eastern Bell Beakers (Fig. 6). In Atlantic Europe, the bracers are generally flat, narrow and two-holed. Such types occur in central Europe as well, apparently in an early stage of the Bell Beaker Culture (Heyd 2001). Then to the east, a new type appears with a curved section and four holes which constitute the majority of the corpus. They occur also in Britain (Woodward and Hunter 2011). Beyond these two main types (flat two-holed and curved 4-holed), there is a wide diversity according to the shape of the edges (straight, convex, concave), the number of holes, the section (rectangular, biconvex, planoconvex, more or less curved) and the presence of some carved ornamentation (cup-marks, parallel incised lines and so on).

Bell Beaker bracers in continental Europe are generally made of a wide range of soft rocks (sandstone, claystone, siltstone, slate and so on), differentiated by their grain size, their colour or their bedding (Fig. 6). Whatever the stone, specific colours (beige, black, green, red) seem to have been selected. Within a single region, these rocks could be quite diverse, limiting any attempt at provenience studies. However, when petrographic analysis has been carried out, the rocks stem most likely from local to regional sources (Přichystal 2000). But this pattern should be qualified with wider investigations carried out in the Anglo-Celtic Isles, where specific products made of harder rocks have been identified: curved bracers made of Great Langdale tuff, largely diffused in Britain, or flat amphibolite pieces (Woodward and Hunter 2011). In Brittany or the Czech Republic, different blanks were used, such as small blocks or slabs and pebbles (Fig. 7, 5-6).

The first stages of bracers shaping are unknown. However, some rough-outs unpolished or ready to be holed or in the process of drilling are known from settlements and graves (Turek 2015). In Brittany, some slate pieces show negatives of removals, suggesting that they were roughed out by knapping (Nicolas 2016), while in the Czech Republic this technique seems to be unused. However, in both areas, oblique or longitudinal striations on the edges suggest less coarse shaping by abrasion than sawing. Thus it is likely that the first stage was to saw a blank of the required volume. The rough-out is then shaped by abrasion. For the most complex pieces with a deeply curved section, this stage represented the main task using long and convex abraders. Then, a finer abrasion, generally longitudinal, allowed

Figure 6. Bell Beaker stone bracers from western Europe (above) and central Europe (below). Brittany: (1) Plobannalec-Lesconil stone-cist, (Finistère (MPF)). (2) Nelhouët passage grave (Caudan, Morbihan (MAN)). (3) Coatjou-Glas barrow (Plonéis, Finistère (MAN)). (4) Finistère (MAN). (5) L'Estridiou passage grave (Plomeur, Finistère (MAN)). (6) Kerandrèze gallery grave (Moëlan-sur-Mer, Finistère (MAN)). (7) Kerody (Saint-Nicolas-du-Pélem, Côtes-d'Armor (DAG)). (8) Lothéa barrow (Quimperlé, Finistère (MAN)). (9) Tišice, grave 77/99 (Bohemia (ARUP)). (10) Hulín 1 'U Isidorka', grave H95 (Moravia (ACO)). (11) Luleč grave (Moravia (MV)). (12) Souš grave (Bohemia (RMT)). (13) Předmostí grave 2 (Moravia (MKP)). (14) Němčice nad Hanou, grave 33 (Moravia (MZMB)). (15) Praha 'Ruzyně' (Bohemia (NMP)). Photos C. Nicolas.

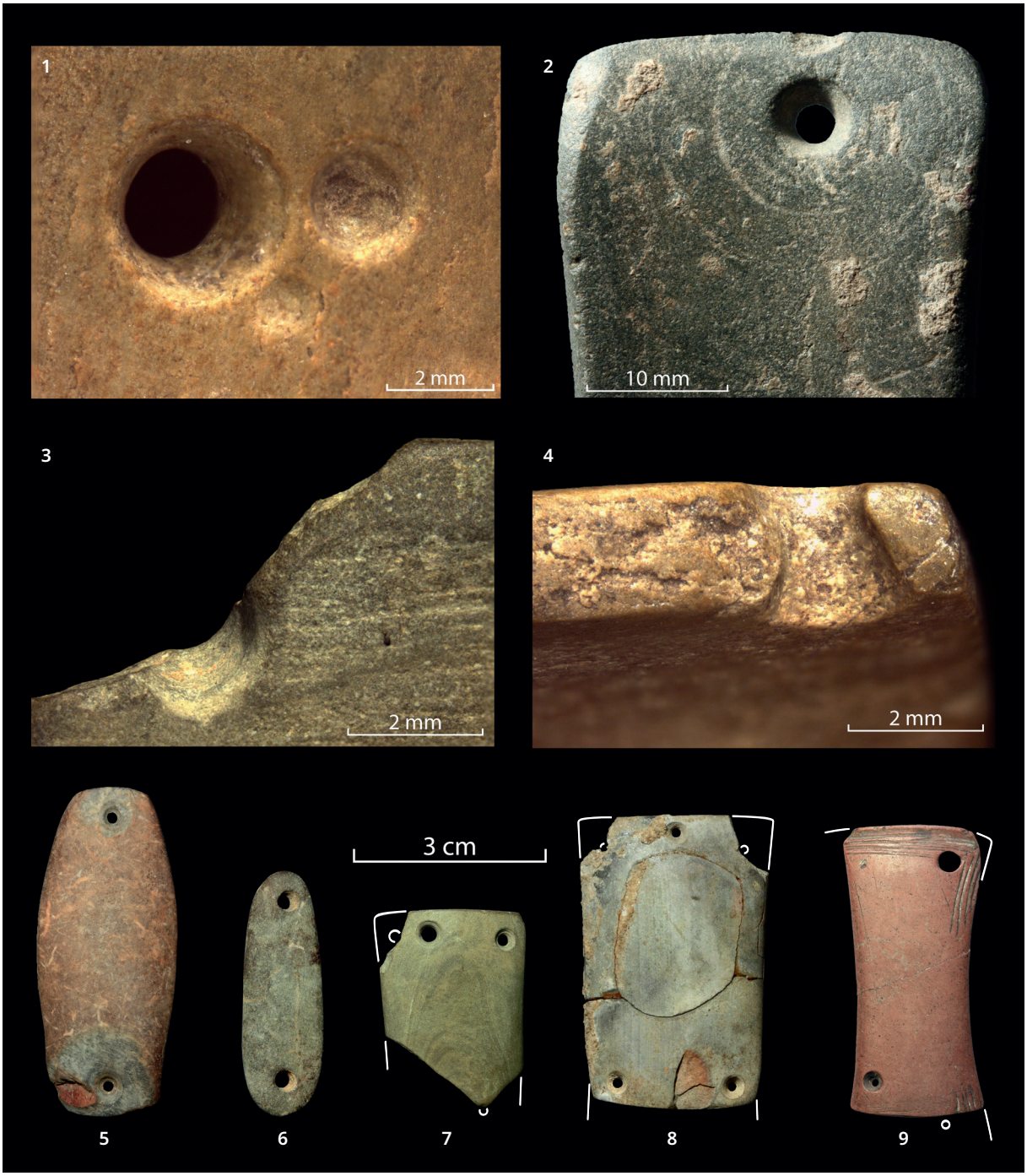

Figure 7. Details of stone bracers and unsuitable pieces for wristguards in Czech Republic. (1) Two aborted perforations close to a hole. (2) Bow drill striations around a perforation. (3-4) Broken and blunted holes. (5-6) Perforated pebbles. (7-9) Broken and reshaped bracers. (1 & 4) Grave 53/80-I, Radovesice-Bílina III (Bohemia (RMT)). (2) Třebovle, Bohemia (RMK). (3 & 7) Grave 1 at Stehelčeves III (Bohemia, Czech Republic (VMS)). (5) Grave 11, Praha 'Kobylis' XV (Bohemia (MHMP)). (6) Grave, 841/02, Hoštice IV (Moravia (MV)). (8) Grave 1/50, Bohutice II (Bohemia (NMP)). (9) Velké Žernoseky (Bohemia (RMT)). Photos C. Nicolas.

smoothing of the faces. The flat bracer could have been polished by longitudinal, transversal or oblique abrasion. Greater care is devoted to work on the outer side of the bracer, while the inner face is more coarsely abraded or even left raw. Holes are mainly hourglass-shaped, sometimes preferentially drilled from the inner side. In a few cases, funnel-shaped holes led to small scars on the opposite face during drilling. Frequently, hourglass-shaped holes are not perfectly face to face and one or several abandoned perforations could be observed. Striations in and around holes are very regular, circular and point towards the use of a bow drill (Fig. 7, 2). Some pieces are ornamented with cup-marks, similarly drilled like the holes. Further bracers are decorated with grooved lines. Such ornamentation could be carried out before or after drilling.

Making bracers does not require special skills. Sawing, abrading, polishing could be time-consuming but are possible for anyone with a basic know-how. The critical stage is probably drilling, as shown by the numerous abandoned holes (Fig. 7, 1) and broken pieces during piercing. However, such breaks were not definitive and several specimens were reshaped in order to make new holes (Fig. 7, 7-9). Experiments reproducing the simplest flat bracers suggest that they could be done in two to four hours only (Smith 2006; Vaart, 2009). Moreover, a few bracers are simple pebbles perforated at their ends that should have been done even more quickly. Nevertheless, curved pieces would have required more time for hollowing out the inner side. As with Bell Beaker arrowheads, everyone should have been able to produce their own bracers. But this does not mean that everyone has the same talent and it is likely that different skills were expressed in the balance of the shapes or the symmetry of the perforations. However, an exception could be made for the most complex bracers, trapezoidal in shape, with curved section, carved ornamentation and flanges on the ends. Such pieces required the mastering of the volumes of the rough-out in order to optimize the working time. Above all, the symmetry of the forms and the regularity of the engravings of certain examples show a certain skill, acquired only by experience. These fancy bracers were probably produced only by experts, or even craftsmen.

The biographies of bracers suggest that these perforated stones were used as ornaments and not proper archers' wristguards. In central Europe, most of them are profiled to be adjusted on the forearm (*c.*10 cm long, *c.*0.5 cm thick, curved section, even a trapezoidal shape). However, different specimens are likely incompatible with the use of a wristguard. As previously argued by Fokkens *et al.* (2008), small bracers (< 5 cm) are not sufficiently long to protect the forearm during bowstring release (Fig. 7, 5-6). Equally, flange-ended bracers could be 1 cm thick, increasing the risk of the bowstring catching on the bracer (Fig. 6, 12). Nonetheless, experiments recently demonstrated that small removals could occur when the bowstring impacts on the wristguard (Muñoz and Moro 2017). Such use-wears are quite common as similar marks occur frequently on both polished faces due to erosion. But very few bracers show evidence of use as wristguards, suggesting in return that most of the bracers were slightly or not used as such. Several studies have shown a regular pattern of more or less intensely blunted bracers throughout Europe (Vaart 2009; Woodward and Hunter 2011; Nicolas 2016, Fig. 7, 3-4), suggesting that some of them could have been worn quite a long time (during the life of the individuals, over generations?). Repeatedly, some bracers are broken, reshaped, holed again to such an extent that at the end of their life cycles they were not suitable to be used as wristguards (Fig. 7, 7-9). Furthermore, Fokkens *et al.* (2008) have pointed out that most of the bracers were worn on the outer side the forearm, suggesting that they were more than likely an ornament than a proper wristguard. And so, if some of them were used in such a way, it could be the exception rather than the rule.

Early Bronze Age bracers

During the Early Bronze Age, bracers were still in use in some regions. Some late Bell Beaker bracers could be made in luxury versions, as stone bracers riveted with gold studs in Britain (Woodward and Hunter 2011) or gold-sheet bracers copying the funnel-shaped holes (Spindler 1993). In the meanwhile, several original products belong to Early Bronze Age cultures. For instance, in the Nitra Culture (Moravia, Slovakia), some bracers were no longer holed at the end but grooved, involving a new way of wearing them (Ondráček and Šebela 1985). In the Únětice, Polada and El Argar Cultures, two-holed or four-holed bracers occur in relatively quite large numbers (Aspes and Fasani 1976; Bartelheim 1998; Muñoz Moro 2017). However, in the El Argar, bracers were likely used as sharpeners (Muñoz Moro 2017). In Brittany, four small bracers with a distinctive shape (concave edges) are made of precious raw materials (Baltic amber, gold sheet or Whitby Jet; Fig. 8). The latter is in particular made of a jet spacer bead, typical ornament of the crescentiform necklaces produced in northern England (Sheridan and Davis 2002), highlighting long-distance networks and quite complex biographies for such objects. Once arrived in Brittany, this jet spacer bead was reshaped, the edges carved in order to make them concave, following the local fashion of the Early Bronze Age bracers. The raw materials and the size of such bracers definitely do not fit a use as wristguards. However, there is some use-wear on the holes, suggesting that they were worn, probably as bracer ornaments. These four bracers were found together with the Armorican arrowheads in rich graves, forming a symbolical set of archery-related items.

Discussion

Bell Beaker and Early Bronze Age arrowheads and bracers result from specific technologies and constitute socially valuable artefacts that reflect transformations of social practices.

The development of barbed-and-tanged arrowheads is rooted in a long-lasting tradition. Except for_early examples occurring in Solutrean societies in Spain (*c.*23000-17000 BCE; Javier Muñoz *et al.* 2012), they appear in the western Mediterranean during the early 4th millennium BCE (Vaquer and Bordreuil 2013). From the early 3rd millennium BCE, they were adopted in more northern areas but the Bell Beaker Culture introduced this new type in northernmost Europe (Ireland, British Isles, and Scandinavia). Even though copper tools are not necessary for producing such arrows, as underlined by Solutrean examples, they probably made it easier to execute the preform shaping and the knapping of barbs and tang (copper awls offer a smaller point of pressure). Indeed, the development of barbed-and-tanged arrowheads occurred at the same time as the introduction of copper awls in southern France (Thiercelin-Ferber 2013). Until the Early Bronze Age, there is much evidence to show the use of such copper alloy tools for producing barbed-and-tanged arrowheads.

Barbed-and-tanged arrowheads require a more time-consuming production than the simpler types (*e.g.* transverse arrowheads) but they offer a greater efficiency, limiting the removal of the arrows and causing greater injuries. As suggested by ethnographic studies carried out by P. and A.-M. Pétrequin (1990), complex arrowheads were intended for war, as it was more important to kill a human than an animal. Thus it is conceivable that the spread of barbed-and-tanged arrowheads was linked with warfare development. Indeed for the first half of the 3rd millennium BCE in France, there is much evidence of violent deaths (Guilaine and Zammit 2001), sometimes by arrows (Dias-Meirinho 2008). In the meanwhile, there is an increasing number of enclosed sites. One of them, the fence enclosure defending a spur at Basly (Calvados) was burnt down and dozens of arrowheads (transverse

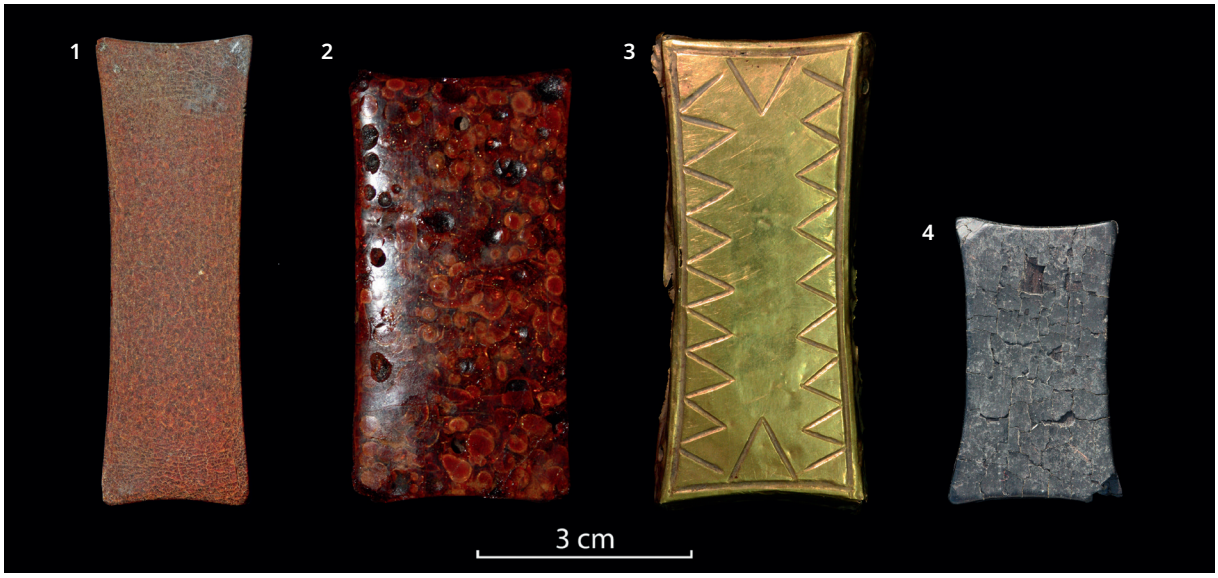

Figure 8. Early Bronze Age bracers from Brittany made of Baltic amber, gold sheet and Whitby Jet spacer bead. (1) Kernonen barrow (Plouvorn (MPF)). (2) Saint-Fiacre barrow (Melrand (AM)). (3) La Motta barrow (Lannion (MAN)). (4) Kerguévarec barrow (Plouyé (MPF)). Photos C. Nicolas.

and barbed-and-tanged) were found along the fence (Fromont *et al.* 2014). Nevertheless, for the Bell Beaker period we recorded only three cases of individuals killed by arrows, representing less than 0.1% of the graves at that time. Except around the Mediterranean where Bell Beaker communities occupied previously fortified sites, the Bell Beaker settlements are open all over Europe (Vander Linden 2006). Thus violence during the Bell Beaker period is less tangible and might suggest a more peaceful time, allowing large networks all over Europe. Nonetheless, archery equipment did not disappear then and it became the object sign of warrior status. The arrowheads aside, new objects appeared according to the regions: stone bracers, as well as bow-shaped pendants (Růžičková 2009). These archery-related items were socially valuable, intended for display or used from time to time (prestige hunting, ceremonial warfare?). In some parts of Europe, these objects gained a new value during the Early Bronze Age. The fancy Armorican arrowheads, which were not designed to be shot but to be displayed, as well the bracers made of gold, amber or jet definitely count as 'precious objects' as defined by Maurice Godelier (1999). Furthermore, these display items were kept exclusively for the use of chiefs (no classical Armorican arrowheads having been found outside the graves) and they were not exchanged. In these respects, Armorican arrowheads could be considered sacred objects, that is to say, inalienable goods which do not fit into the logic of a gift economy (ibid.). These sacred objects generally have a mythical origin, as items reportedly inherited from distant ancestors or given by divinities. In this respect, Armorican arrowheads, derived from earlier patterns, could be interpreted as a clear reference to the ancestors and the representation of the Bell Beaker warrior. In some historical contexts when social hierarchy exceeds divisions on the basis of sex, family and clan, these kinds of sacred objects become for the elite a real means of social reproduction and of intercession with the gods (Godelier 1999; Pétrequin *et al.* 2012), which would explain the prominent place of Armorican arrowheads in elite burials.

This long-time perspective underlines the evolution of the role played by arrowheads and bracers, from objects for war or hunting to display items. In this respect, they reflect social changes observed during the 3rd millennium BCE. Considering western France, there is very little evidence for the Late Neolithic social organizations, as collective burials in megaliths make it difficult to define the structures of the societies. With the introduction of the Bell Beaker Culture appear the first individual graves, underlining the privileged status of some people. But there are no large diffe-

rences in grave goods and no specific products: arrowheads found inside or outside graves are similar. The richest Bell Beaker graves could be at best considered those of local chiefs (Jeunesse 2016). Furthermore, anyone with basic manual skills would be able to produce arrowheads and bracers more or less elaborate according to their know-how. With the Early Bronze Age in Brittany, funerary arrowheads and bracers become much more important and the result of specialized craftsmanship. They belong to wealthy graves as sacred objects.

Archery-related items and their technologies could not be considered proper triggers for social changes but they reflect them. The main social and economic transformations between the Bell Beaker period and the Early Bronze Age rest on more stratified societies, development of long-distance networks, the growing importance of metalworking in everyday life, and above all new land management with the appearance of the first field systems (Marcigny 2012; Nicolas 2016). Nonetheless, copper and bronze awls as well as craftsmanship organization allowed the production of new symbols of power and therefore legitimate new elites and a new social organization.

Regarding the diffusion of the Bell Beaker archery equipment, evidence for long-distance exchange of goods is scarce. More probably, it is the ideas, the related techniques and those who master them that have travelled. As argued by anthropological morphometry, isotope and DNA analysis (Price *et al.* 2004; Desideri 2011; Olalde *et al.* 2018), at least individuals, small bands or larger groups spread the Bell Beaker Culture and the warrior ideology around archery. However, these migrations were not one-way and stopped once the people were established. During all the Bell Beaker period, we observe material culture evidence and regular contacts between distant regions. By the way, in many parts_of Europe, the legacies of the local cultures have been recognized, involving the process of acculturation. In this respect, western barbed-and-tanged and eastern hollow-based arrowheads are a clear example. New fashions (squared barbs) were adopted eastwards from the west and adapted to the local model of the hollow-based arrowheads, with no changes in the local way of hafting. Elsewhere as in Britain, barbed-and-tanged arrowheads and all their manufacture were transferred. These two ways of transfer (imitation, technical diffusion) occurred for further artefacts (*e.g.* pottery, metal) and led to diverse expressions of the Bell Beaker Culture in Europe (Taylor 1978; Salanova 2000; Vander Linden 2006). Then, during the Early Bronze Age, material cultures including the production of arrowheads and bracers are much more regionalized, expressing strong cultural identities, although some large-scale trends could be observed (Nicolas 2017). However, this pattern did not preclude the mobility of people (*e.g.* trade, matrimonial exchange), as suggested by isotope analysis in some regions (Frei *et al.* 2015; Knipper *et al.* 2017). If some copies could be noted for arrowheads, they are mainly not subject to long-distance exchanges or technical transfers. Therefore for the Armorican arrowheads, everything happens as if this high technology was kept jealously by those who controlled it. As 'sacred objects', Armorican arrowheads were of such great relevance for the chiefs at that time that they were not exchanged.

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Notes on contributor

Clément Nicolas is a postdoctoral researcher at the laboratory UMR 8215 Trajectoires (Nanterre, France). His research focuses on the first metalworking societies during the 3rd and the 2nd millennia BCE in Europe. As a lithic specialist, he has led studies on the productions and functions of fancy archery-related items (arrowheads, bracers and so on) in several countries in order to track their biographies and their relations to social hierarchies: in France, Britain and Denmark during his PhD, in central Europe as a postdoctoral fellow of the Foundation Fyssen. He also works on the questions concerning craftsmanship and Atlantic exchange networks through the studies of a range of grave goods (metal artefacts, jewellery).

In the meanwhile, he has developed a field approach in Brittany, leading or participating in several surveys and excavations on Neolithic and Early Bronze Age periods. This research aims to study the territories and the structures of human settings (graves, settlements, field systems) to provide a clearer understanding of the rise of highly stratified societies.