**Connectivity between Northern Iberia and Western France (2900–1100 cal bc): The Flux of Metalwork in the Bay of Biscay Modelled by Multivariate Clustering**

**Juan Latorre-Ruiz**

**Supplementary Material 1: Chronological Discussion of the Regions of the Bay of Biscay**

**Introduction**

This document discusses the chronological framework employed in the main article regarding the chronology of the five regions of the Bay of Biscay.

**Chalcolithic (2900–2600/2300–2000 cal bc) & Early Bronze Age (2300–2000/1800–1600 cal bc)**

The Neolithic and Early Bronze Age have sometimes been considered two separate ‘compartments’ or periods of prehistory (see Bartelheim & Kraus, 2012) but, today, we know that burial traditions that started in the Neolithic were still followed in some regions in the Bronze Age (e.g, L’Helgouac’h, 1996: 421; Vilaseco et al., 2003: 285) and copper items have been found in Neolithic contexts (Roberts & Frieman, 2015). Moreover, copper items were sometimes widely used in the Early Bronze Age (or even later) as bronze itself was only adopted progressively (see e.g. Senna-Martinez, 2007: 130). It is thus useful to understand the Chalcolithic as a fluid period of transition in which the beginning of the end of previous Neolithic traditions (burials, settlements, etc.) and the appearance of new practices that characterize the entire Bronze Age or its earliest stages (such as the introduction of metalworking or Bell Beaker pottery) occurred. The term ‘Chalcolithic’ therefore does not imply socioeconomic connotations (see Lichardus-Itten, 2007) but is a useful ‘box’ for all the ‘stuff’ which can help us understand how what we call the Late Neolithic became what we call the Early Bronze Age.

In north-western Iberia, it seems that copper was introduced at some time around the twenty-eighth to twenty-fifth centuries cal bc (Jorge, 1990; Ruiz-Gálvez Priego & Fabregas Valcarce, 1997: 198; Comendador Rey, 1999b: 65; Van Schoor, 2003: 12). Around the same time, the Bell Beaker phenomenon reached the same region, with the relation between the introduction of copper and this phenomenon widely discussed (Comendador Rey, 1995: 123–26; Suárez Otero, 2005: 178–82). A few centuries later, around the twenty-secondto twenty-first centuries cal bc, individual burials accompanied by new metal types, both of which are discussed below, are considered to mark the beginning of the Early Bronze Age (Ruiz-Gálvez Priego, 1979; 152; Suárez Otero, 1997: 56; Bettencourt, 2010: 158; Fabregas Valcarce & Vilaseco Vázquez, 2011: 238). These individual burials have been labelled ‘Grupo Vilavella-Atios’ (Brandherm, 2007). Based on all this, it seems safe to differentiate between two phases. A Chalcolithic during which the first copper types and Bell Beaker pottery were introduced (as mentioned, the relation between these two is open to discussion) and an Early Bronze Age characterized by new copper types and individual burials but also probably the continuation of previous traditions.

In the Cantabrian region, researchers tend to attribute the use and manufacture of the first metal artefacts to a period between 3000 and 2250 cal bc and the beginning of the Early Bronze Age around the 2200 (Arias Cabal, 1995: 34; 1999: 262; Castro Martínez et al., 1996: 103; Arias Cabal & Armendáriz Gutiérrez, 1998: 48; Ontañon Peredo, 2003: 309). The last date is not based on changes in the archaeological record but only on the introduction of new metal types as there are no noticeable changes in the region between the Chalcolithic and the Early Bronze Age (Blas Cortina, 2011: 106; Armendáriz Gutiérrez, 2022). Furthermore, similar dates have been proposed in the eastern Cantabrian region, which overlaps the north of the Basque area, which have been the focus of a different set of studies. There, the Chalcolithic is divided into two phases dated to the first and second halves of the third millennium cal bc and the beginning of the Early Bronze Age, dated to the last centuries of that millennium (Alday Ruiz, 1992b; Armendáriz Gutiérrez, 1997; see also Ortiz Tudanca, 1990). Thus, it seems that in the Cantabrian region it is possible to differentiate between a Chalcolithic that lasted for most of the third millennium and an Early Bronze Age during which almost nothing changed except for the introduction of new metal types (see Ontañon Peredo, 2003: 273–74).

In south-western France or Aquitaine (not to be confused with the recently created political entity of Nouvelle-Aquitaine which also includes Poitou-Charentes and Limousin), the archaeological record of the Late Neolithic is well known and linked to the end of the Artenac group (Roussot-Larroque, 1996: 522–24). However, the transition between the Artenac group and the Bell Beakers and the transition between the Neolithic, Chalcolithic and Early Bronze Age is not well understood (Chevillot, 1989: 60; Roussot-Larroque, 1990; 2005: 162–64; Beyneix, 1997: 14–15; Couderc, 2014: 66). Furthermore, most of the metalwork was found without a context and radiocarbon dates are few. Based on this scarce information and the chronologies of nearby regions, scholars have proposed to set the beginning of the Chalcolithic in the twenty-fifth to twenty-fourth centuries cal bc and the beginning of the Early Bronze Age in the twenty-second to twentieth centuries cal bc (Roussot-Larroque, 2005: 162–64; Roussot-Larroque et al., 2001: 277; Beyneix, 1997: 11, 17; Cantet, 1991: 27, 42). Finds should be assigned to these periods carefully as these dates are provisional and open to changes. Despite this, that chronology is followed here. Finally, from an archaeological point of view, it might be possible to divide the region of Aquitaine in two parts. One to the north, around the Gironde estuary and river Garonne, and one to the south around the river Adour (see e.g. Marembert & Seigne, 2000; Nonat, 2022). Here, the entire region of Aquitaine, referred to as south-western France, is considered together.

In central-western France, the transition from the Neolithic Artenac group to the Chalcolithic Bell Beaker phase and the beginning of the Early Bronze Age is not well understood and several possibilities have been presented (e.g. Bailloud & Burnez, 1962; Burnez 1976; Pautreau, 1979b). Fortunately, a recent study by Laporte and Gomez de Soto (2008) proposes a chronology that is followed here. These authors understand the Artenac-Bell Beaker transition as a continuum where pottery traditions went through a ‘stylistic symbiosis’ (Laporte, 2001: 92–98) and set the end of the first and the start of the second around the second half of the third millennium cal bc (Laporte & Gomez de Soto, 2008: 564–66). Based on this, it is possible to suggest that the Bell Beaker phase, and consequently the Chalcolithic, started around the twenty-sixth to twenty-fifth centuries cal bc and set the beginning of the Early Bronze Age between the twenty-second to twentieth centuries cal bc (Laporte & Gomez de Soto, 2008: 561–67).

Finally, the original chronology devised for Brittany completely separated the Early Bronze Age, which started with the appearance of the first series of Armorican Tumuli, from the Late Neolithic, which was characterized by different collective burial groups and the Bell Beaker phenomenon, while a Chalcolithic intermediate period was not included (L’Helgouac’h, 1976: 371–373; Giot et al., 1979: 29; Briard, 1984). This model was revised by L’Helgouac’h, who pointed out some overlap between Bell Beakers, Late Neolithic burials, and the Early Bronze Age tumuli (L’Helgouac’h, 2001: 296–97). Similarly, Briard accepted some metal artefacts had been used in the ‘Late Neolithic-Bell Beaker’ period and the Early Bronze Age (Briard & Roussot-Larroque, 2002: 135). In the last decades, radiocarbon dates have shown that these ideas were broadly correct (see Salanova, 2011: 133; Nicolas, 2011: 116–18; Nicolas et al., 2015: 126) and at present this issue is the subject of ongoing investigation (e.g. Blanchet et al., 2015). While future studies will undoubtedly refine the chronology used here, this provisional solution is considered good enough. It seems that, in the period between 2500 and 2000 cal bc, the end of the last megalithic groups and Bell Beakers overlaps the beginning of the first and second series of Armorican Tumuli (now identified as contemporary, see Blanchet, 2022). Therefore, the end of the Neolithic and the beginning of the Chalcolithic (bearing in mind that these are just labels) are dated to just before the period between 2500 and 2000 cal bc and the beginning of the Early Bronze Age and the end of the Chalcolithic at its end.

In sum, it is possible to suggest some general limits for the Chalcolithic and the Early Bronze Age in the regions studied. First, it seems that between the twenty-ninth to twenty-seventh and the twenty-third to twenty-first centuries cal bc (2900–2600 to 2300–2000) there were changes in the archaeological record. For example, collective burials ceased to be the only or most common way of burying people and, more importantly, Bell Beaker pottery and copper artefacts were introduced. That period is labelled Chalcolithic, even though copper was used until the Middle Bronze Age in some places, or the archaeological evidence does not show noticeable change when compared with the previous millennium. Second, around the twenty-third to twenty-first centuries cal bc (2300–2000) other things changed. For example, new metal types were introduced and Bell Beaker pottery either disappeared or morphed into local styles. Furthermore, in some areas like Brittany and north-western Iberia, individual burial traditions appeared while in other regions collective burials were still the norm. These changes are understood as markers of the beginning of the Early Bronze Age. The end of this period is discussed in the next section since its ending is linked to the beginning of the Middle Bronze Age. Suffice to say here that the end of the Early Bronze Age is dated between the eighteenth and sixteenth centuries cal bc (1800–1600).

**Middle Bronze Age (1800–1600 to 1300–1100 cal bc)**

The Middle Bronze Age is an extremely complex period. Its origin is in the division of the Bronze Age into three stages in Britain that was later adopted in other places (Barrett, 1994: 105). In Atlantic France, the Middle Bronze Age is understood as a period linked to the Tréboul group, the numerous hoards of palstaves and Bignan bracelets, and the hoards around the Médoc grouped in the ‘Bronze Médocain’ (e.g. Briard, 1965: 298; Coffyn, 1976: 534–36; Blanchet, 1984: 188–92; Gomez de Soto, 1995: 27–29; for a recent synthesis, see Nordez, 2019). Its end is unanimously identified with the appearance of the Rosnoën group (Milcent, 2012: 33–62). Despite this consensus, the chronological order and relationship of the various Middle Bronze Age groups is a matter of discussion. This is partly the result of a lack of absolute dates, which makes the study and organization of Middle Bronze Age chronology very complicated (Voruz, 1996: 134).

In Iberia, the creation a Middle Bronze Age chronology is a challenge for different reasons. The main reason is that his period does not seem to coincide with radical changes in the archaeological record or the introduction of artefacts dated to the Middle Bronze Age outside Iberia such as palstaves, which only penetrate it slowly and in small quantities. Consequently the period between the Early and the Late Bronze Ages is referred to in different ways in each Iberian region (Roberts et al., 2013: 37). In some places, the issue of lack of evidence is solved by using the loose concept ‘Bronce Pleno’ to include everything between the Chalcolithic (i.e. the appearance of the very first metal items) and the Late Bronze Age. In other regions, the same term is used to refer to a period of time roughly equivalent to the Middle Bronze Age in north-western Europe, while in yet other regions the Middle Bronze Age is merged with the Early Bronze Age (e.g. Ruiz-Gálvez Priego, 2014) or the Late Bronze Age (e.g. Mederos Martín, 1997). Finally, some scholars have developed chronological frameworks using different methodologies that connect the chronology of Atlantic Iberia with the rest of Europe (e.g. Coffyn, 1985: 30; Castro Martínez et al., 1996: 252–54).

The Middle Bronze Age in France and Iberia thus represents, for different reasons, a complex period of study. Here, in order to create a common chronological framework for the metalwork analysed, the features and problems of each of the regions studied are discussed separately and then combined. In short, the start of the Middle Bronze Age is dated to 1800–1600 cal bc and its end between 1300 and 1100 cal bc. These dates mostly refer to changes in the metalwork as the settlement, burial, and other traditions are transformed (or remain the same) in different ways in each region. The Middle Bronze Age is tentatively divided into a first and second phase, the first Middle Bronze Age being a transitional period, identified by metalwork, between the Early Bronze Age and the metal types used in the Middle Bronze Age.

In north-western Iberia, the Middle Bronze Age is especially problematic. Generally, it is accepted that around 1700 to 1500 cal bc regional traditions changed (e.g. Bradley & Fabregas Valcarce, 1995: 157; Fabregas Valcarce, 1995: 108; Suárez Otero, 1997: 57; Ruiz-Gálvez Priego, 1998; Bettencourt, 2010: 142). Although it was assumed that the Middle Bronze Age marked the disappearance of burials, today researchers agree that several funerary traditions coexisted, none of which included metalwork (Nonat et al., 2022). This represents a change from the individual and quite sumptuous Early Bronze Age Vilavella-Atios burials (Fabregas Valcarce, 1995: 108–11; Bettencourt, 1997; Vilaseco et al., 2003: 288–89; Brandherm, 2007: 75; Bettencourt, 2010: 158–160). Moreover, at this time, metalwork is not deposited in burials but in hoards in liminal places, such as crevices and watery environments, which are also strategic spots controlling seasonal pasture areas. This is a practice that started in the previous period but now becomes the norm (Bradley & Fabregas Valcarce, 1995: 159–60; Ruiz-Gálvez Priego & Fabregas Valcarce, 1997: 206–07). Additionally, the settlement evidence ‘disappears’ from the archaeological record apart from small, short-lived encampments with evidence of repeated use which resemble others dated to the Neolithic (Ruiz-Gálvez Priego & Fabregas Valcarce, 1997: 202–05; Parcero Oubiña & Criado Boado, 2013: 255–56). Finally, the archaeometallurgical evidence from different sites suggests bronze metalworking; although already marginally present in the Early Bronze Age, it became generalized during the first half of the second millennium cal bc, coexisting with copper for some time (Comendador Rey, 1999a; Bettencourt, 2001: 14–15; Comendador Rey & Bettencourt, 2011: 19–23, 27). European Middle Bronze Age types are extremely rare and Chalcolithic-Early Bronze Age types were probably used until late (Comendador Rey, 1998b: 119; Comendador Rey & Bettencourt, 2004: 348). Based on all this, the Middle Bronze Age of north-western Iberia is understood in three different ways:

1. Traditionally, the lack of settlements, individual burials, European metalwork types and the late introduction of bronze was interpreted as a ‘dark age’ or time of crisis.
2. Other scholars take the Middle Bronze Age to have been a period characterized by an intensification of Neolithic practices that are difficult to identify in the archaeological record, like transhumance and slash-and-burn agriculture; this would explain the absence of settlement sites and should not be considered ‘backward’ (Bradley & Fabregas Valcarce, 1995: 157; Ruiz-Gálvez Priego, 1995; Fabregas Valcarce, 1995: 108–11; Ruiz-Gálvez Priego & Fabregas Valcarce, 1997).
3. Some researchers have solved the problem of the lack of evidence during the Middle Bronze Age by considering it an extension of the Early Bronze Age and merging the evidence from both periods into a single one (Parcero Oubiña & Criado Boado, 2013: 254–55; Ruiz-Gálvez Priego, 2014).

Here, the second option is favoured. Either way, agreement exists on the end of the Middle Bronze Age around 1200–1100 cal bc, which saw the beginning of new archaeological traditions that signal the start of the Late Bronze Age (e.g. Bradley & Fabregas Valcarce, 1995: 157; Suárez Otero, 1997: 57; Ruiz-Gálvez Priego, 1998; Bettencourt, 2010: 142).

In the Cantabrian region, there is a continuation of the Early Bronze Age traditions during the Middle Bronze Age (Blas Cortina & Fernández Manzano, 1992: 408; Arias Cabal & Armendáriz Gutiérrez, 1998: 47–48; Ontañon Peredo, 2013: 208). Indeed, it is only possible to differentiate between the two periods in relation to the introduction of new metal types such as riveted blades and palstaves (the few recovered in this region at this time) that nonetheless are found in contexts similar to those of the earlier period (Alday Ruiz, 1992a: 43–44; Arias Cabal, 1999: 262–63; Blas Cortina, 2011: 106–08). With this in mind and despite the absence of evidence and absolute dates, researchers speak of a ‘Bronce Pleno’ or Middle Bronze Age between 1700–1500 and 1300–1100 cal bc (Ortiz Tudanca, 1990: 139; Arias Cabal, 1999: 262–63; Blas Cortina, 2011: 106; Ontañon Peredo, 2013: 209). Nevertheless, that period is mostly defined by new metal types as other Early Bronze Age traditions continued without major change (Arias Cabal & Armendáriz Gutiérrez, 1998: 67–70; Ontañon Peredo, 2013: 208; Armendáriz Gutiérrez, 2022).

In south-western France or Aquitaine, like in the Cantabrian region, there is a lack of absolute dates and studies about the Middle Bronze Age, which is mostly known and dated through its metalwork (e.g. Coffyn, 1976: 534–36; Roussot-Larroque, 2001). At that time, metalwork evidence around the Médoc increases hugely with the appearance of a large number of hoards that have been divided into different phases and grouped into the ‘Bronze Médocain’ (Coffyn, 1971: 28–64; Roussot-Larroque, 2007: 40–41; Lagarde-Cardona, 2012: 89–91). However, a similar transformation cannot be seen in the settlement and funerary traditions that, despite the absence of studies (see nonetheless Nonat, 2022), seem to continue without change. With regard to burials, different types, including the tumuli of the Médoc and Lot-et-Garonne and the cave burials of the Dordogne, continue, as does the practice of burying the deceased in collective inhumations without metalwork (Roussot-Larroque, 1989: 413–17; Chevillot, 1989: 124–25; 2010: 207; Lagarde-Cardona, 2012: 23–24). Thus, based on the metalwork, the Middle Bronze Age is dated between 1700–1500 and 1400–1200 cal bc and subdivided into different horizons (see Chevillot, 1989: 83–84; Cantet, 1991: 85; Beyneix, 1997: 37; Lagarde-Cardona, 2012: 88–89; Couderc, 2014: 54).

The situation in central-western France is similar. Although its metalwork is well known, this is not the case of other elements of the archaeological record. There are many publications about burials but a lack of monographs (Briard et al., 2001: 259), but this situation is changing (see Boulud-Gazo et al., 2022). The metalwork has been well studied and employed to date the Middle Bronze Age (e.g. Cordier, 1976: 544–48). While there are difficulties, the Middle of Bronze Age is dated between 1500 and 1200 bc in relative chronology, which corresponds to 1800–1100 cal bc (Pautreau, 1979a: 131–32; Gomez de Soto, 1980: 88; see also Gomez de Soto, 1995: 73–85).

The start of the Middle Bronze Age in Brittany is marked by the end of the first and second series of Armorican Tumuli (Blanchet, 2022) and the appearance of new metal types and hoards, most of which are grouped in the ‘Groupe de Tréboul’. In the traditional model developed in the 1950s, the first series of Armorican Tumuli was dated to the Early Bronze Age and the second to the Middle Bronze Age (e.g. Giot et al., 1979: 91–94; Briard, 1984: 191–92; Balquet, 2001: 8). However, recent studies have criticized that division and the idea that one group preceded the other (Nicolas, 2011: 118–21; 2015: 377; Nicolas et al., 2015: 126; see also Needham, 2000). It seems that both series were contemporary, and, in the Middle Bronze Age, metalwork ceased to be deposited in burials, being deposited instead in hoards. The Breton hoards of the Middle Bronze Age were thoroughly studied by Briard who linked that period to a group of hoards he named the Tréboul group and other metalwork, such as the Bignan bracelets, the Atlantic rapiers, and later the palstaves of the ‘groupe de haches à talon’. Recently, this evidence has been carefully reorganized into several phases by Gabillot (2003: 87–95; see also Brun, 1991: 13–16; Villard, 2009). Based on those works and recent proposals about the chronology of the Armorican Tumuli, a provisional ‘streamlined’ sequence is proposed. In this sequence, the end of the Early Bronze Age and the beginning of the Middle Bronze Age in Brittany are simplified in three phases:

1. A first phase covers the first half of the second millennium cal bc. It includes the last elements of the Early Bronze Age, such as flat axes and Armorican Tumuli, and the generalized presence of elements that probably appeared before, such as the earliest types of flanged axes.
2. A second phase dated to the middle centuries of the second millennium cal bc includes the Tréboul group and the first palstaves.
3. A third phase dated to the second half of the second millennium bc includes the ‘groupe de haches à talon’, the hoards of Bignan bracelets, the Atlantic rapiers, and the end of the Tréboul group.

In sum, the Bay of Biscay’s Middle Bronze Age represents a long span of time mostly understood through the metalwork, given that other evidence is not well known (this, however, varies considerably between regions). Moreover, the internal chronology of the period and how its regional traditions are linked to each other are issues that also remain unclear and a matter of discussion. Nevertheless, it is possible to date the beginning of the Middle Bronze Age to 1800–1600 cal bc and its end around 1300–1100 cal bc. These dates mostly refer to changes in metalwork while the rest of the evidence (burials, hoards, settlements, etc.) follows patterns of continuity or rupture that vary between regions.

**Supplementary Material 2: Artefact Categories Studied**

This document discusses the nature of the eighteen artefact categories included in the cluster analysis and others that, for reasons explained in each case, were not included in the study.

**Chalcolithic and/or Early Bronze Age Archaic Tanged Blades**

This category groups similar types of short blades of around 100–150 mm long, traditionally linked to the Bell Beaker phenomenon and/or the Chalcolithic-Early Bronze Age in the study area. In English, a typical label for these items is ‘copper-alloy daggers’. In Iberia and France, they have been given different names including, ‘puñales campaniformes cortos’ (Almagro-Gorbea, 1976: 464), ‘puñales occidentales’ (López Plaza & Santos Yanguas, 1984: 259), ‘puñales de espigo’ (Blas Cortina, 1983: 112), ‘puñales de lenguëta’ (Delibes de Castro et al., 1982), ‘poignards chalcolitiques’ (Briard & Mohen, 1974: 11–24), ‘poignards à languette’ (Roussot-Larroque, 2005: 167) and ‘poignards occidentaux’ (Pautreau, 1979a: 51–52). In England, similar blades have been included in Needham’s ‘Series 1: tanged daggers/knives’ (Needham, 2014: 23). In Iberia they were traditionally dated to the Bell Beaker horizon, and the Montelavar group around the Chalcolithic (Harbison, 1967: 106–10; Almagro-Gorbea, 1976: 465). Similarly, in France they used to be associated with the Bell Beakers and the Late Neolithic cultures that preceded the Early Bronze Age (Briard, 1959: 38). In the Bay of Biscay area, they were most likely to have still been used during the Early Bronze Age, in south-western France around the region of Nouvelle-Aquitaine and in the Cantabrian region (approximately present-day Asturias, Cantabria, and the Basque Country). In the latter region, it is possible that a few were still being used during the Middle Bronze Age (‘Bronce Pleno’). Evidently, although they share certain features that allow them to be ascribed to the same category, they are not a completely homogenous group of artefacts. Three subcategories are identified: short daggers (like a dagger from the burial of Kerandrèze in Brittany), daggers with rounded tangs (like an exemplar from the Dolmen of Terrier du Cabut), and daggers with concave and convex triangular tangs (such as the object from Glaneuse in Soulac-sur-Mer). The first category is by far the more numerous, while the latter two only include a few items that nonetheless are very similar to each other.

**Palmela Points**

Palmela points are a kind of arrowhead found all over Iberia and some areas of France. They are dated to the Late Chalcolithic and the Early Bronze Age and have been traditionally linked to the Bell Beaker phenomenon (Rovira Llorens et al., 1992; Briard & Roussot-Larroque, 2002). Different typologies have been proposed for Palmela points in France (Briard & Mohen, 1983; Labaune, 2010) and Iberia (Delibes de Castro, 1977; Rovira Llorens et al., 1992). To put it simply, it is possible to differentiate between rhomboid, rounded, spearheaded, and ‘arrowhead-like’ shapes. Many points are fragmented and their contexts are unknown, making their study challenging.

**Chalcolithic Decorative Items**

This category includes six kinds of items that started to be used in the area studied at the beginning of the Metal Ages and do not seem to have any non-aesthetic function. They seem to be more common in in the inner regions of the Bay of Biscay area (northern Spain and present-day Nouvelle-Aquitaine) and some of them were still employed in the Middle Bronze Age. The first kind are rectangular gold plates found in northern Iberia (Alday Ruiz, 1992a) and France (Éluère, 1982: 35) that can be dated between the Chalcolithic and the Early Bronze Age. The second are spiral rings in gold and copper or bronze found in a few sites such as the burial of Pago de la Peña in Iberia or the Dolmen of Trizay and the Dolmen of Pierre-Levée in France. The third are light and thin spiral bracelets made of gold and silver such as those found in the Dolmen de Thiré in France and the Cairn of Meninas do Crasto 4 in Iberia. They should not be confused with similar but bulkier and heavier precious bracelets included in the group of Early Bronze Age decorative items that are usually found in individual burials. The fourth group are copper and bronze rings found mostly in burials such as the Grotte du Phare in Biarritz in southern France and the dolmen of Kalparmuñobarrena in Gipuzkoa in northern Iberia. The fifth group comprises several precious necklace beads (‘perles’ in French and ‘cuentas’ in Spanish) in gold and copper or bronze found on sites such as the Pauilhac burial in south-western France and Buraco da Pala in northern Portugal. Finally, the sixth group only contains one artefact: a rare copper item originally classified as a pin (‘épingle’) found in Commequiers (Chaigneau & Sacchi, 1965: 391, fig. 4.1).

**Flat Axes**

Traditionally the label ‘flat axe’ (‘hacha plana in Spanish, ‘hache plate’ in French) has been a loosely employed to refer to different types of axes used between the Chalcolithic and the transition to the Middle Bronze Age (e.g. Briard, 1965: 54; Blas Cortina, 1983: 116). Concerning their chronology, a few are found associated with artefacts of later date but, statistically speaking, these are rare cases assumed to represent ‘vintage’ or heirloom items used long after they were manufactured. An example is the dubious hoard of Pleubian (Briard, 1965: 306, no. 86) that allegedly contained two Late Bronze Age axes and one flat axe. In terms of morphology, it is important to differentiate between regular flat axes and low and long flanged axes (see Briard & Verron, 1976: 37; Needham, 2017: 7). The latter two are sometimes labelled ‘developed flat axes’ (‘hachas de rebordes’ in Spanish, ‘haches à rebords’ in French) and they have slimmer and sinuous shapes and flanges on their sides. The regular flat axes are bulkier and have smooth surfaces with no flanges (hence ‘flat’). Oversimplifying, regular flat axes can be divided between rectangular, trapezoid, chisel-shaped, and ‘Argaric’ flat axes. Despite the differences between regular and developed flat axes, they are all included in the same general category of flat axe because the developed flat axes are rarely found with the palstaves and flanged axes employed in the Middle Bronze Age. The regular flat axes were probably manufactured during the Chalcolithic-Early Bronze Age and the developed flat axes during the Early Bronze Age and the beginning of the Middle Bronze Age. Future systematic archaeometallurgical, contextual, and morphological analysis could confirm this.

**Early Bronze Age Decorative Items**

This category comprises twelve kinds of precious items without an apparent practical function that were used between the Late Chalcolithic and the Early Bronze Age. Importantly, the massive gold bracelets and cups that are sometimes dated in north-western Iberia to the Early Bronze Age (see Comendador Rey, 1998a: 68) are not included in this study as they are thought to belong to the Late Bronze Age. The first of the twelve kinds of items included here are the well-known lunulae (Taylor, 1970), a few of which are found in the Bay of Biscay. The second are several gold gorgets (neck ornaments) named ‘gargantillas’ that are rare outside the Bay of Biscay (Armbruster et al., 2004). The third and fourth types are similar gold bands and diadems that can be considered a single type of item (Briard, 1965; Hernando Gonzalo, 1983: 100–01). The fifth includes several gold, silver and bronze spiral chains like those found in the burial of Lothéa in Brittany (Éluère, 1982: 32). The sixth and seventh are gold rings and heavy gold bracelets. Importantly, these two categories have counterparts among Chalcolithic decorative items. Gold rings are very similar to several gold copper or bronze rings also found in the Bay of Biscay area and the heavy gold bracelets are very similar to other lighter gold bracelets also found in the Bay. The reason why these items are not grouped together is because their contexts and distribution lead us to believe that gold rings and heavier gold bracelets appeared slightly later in the Early Bronze Age. This was only apparent during the study of the database using the clustering Latent Class Analysis and motivated their separation. Other precious items, i.e. a few precious cups from Brittany, a few ‘torcs à palette’ also from Brittany, a few gold archer bracelets, and a few gold discs have been well analysed in other studies (Éluère & Gomez de Soto, 1990: 120–22; Fernández Moreno et al., 2018). Finally, several metal pins (‘épingles’ in French) found in the Armorican Tumuli of Brittany are also included in this category (Balquet, 2001: 67).

**Metal Awls**

Under the label ‘awls’, artefacts of different composition but with similar shapes and probably function have been classified all over Europe. They all share features that allow us to consider them part of the same group but also have a high degree of variability which makes their typological classification difficult. Moreover, it is challenging to date them because their shapes are simple and similar models were probably used for a long time. Even though they probably were some of the first metal artefacts manufactured (Rovira Llorens & Gomez Ramos, 1994: 371), they have never been the subject of major studies, which renders their discussion problematic (Hunter & Woodward, 2014: 89). In the area of study, it seems that they were used between the Chalcolithic and the Middle Bronze Age and they are more common in northern Iberia (Asturias, Cantabria, the Basque Country) and south-western France, around Aquitaine.

**Early Bronze Age Advanced Blades**

By ‘advanced’, not only for this category of blade but for all the blades discussed here, I refer to ‘stylized’ blades as opposed to ‘non-stylized’ blades. Non-stylized blades are defined by two attributes. First, they present tangs whose length is between a third or quarter of the total length of the object, i.e. they have very long tangs in relation to the length of the artefact. Second, the width of the blade at its widest point must also be longer than the length of the tang. These two attributes give non-stylized blades oval-rhomboid shapes. By contrast, advanced or stylized blades have narrow, sleek silhouettes.

The Early Bronze Age advanced blades include different groups of advanced and long blades (longer than 200 mm) usually dated to the last centuries of the third millennium cal bc and the first few centuries of the second millennium. These are the sword-like daggers (‘puñales-espada’ in Spanish) of north-western Iberia (Comendador Rey, 1997: 341), the blades found in the Armorican Tumuli (Briard, 1984: 81–88), the tanged-riveted daggers of Asturias and Cantabria (Blas Cortina, 1983: 111–113), a few ‘poignards rhodaniens’ found around the Médoc (Briard & Mohen, 1983: 31), and several long and different blades that are difficult to classify in any of the other groups. All these groups of blades differ from each other but share morphological attributes that distance them from the blades classified in the group of Chalcolithic and/or Early Bronze Age archaic tanged blades and place them closer to the Middle Bronze Age blades. Oversimplifying, they have ‘stylized shapes’, meaning their silhouettes tend to be narrow and long and ‘sword-like’. Conversely, the Chalcolithic and/or Early Bronze Age archaic tanged blades tend to have rhomboid or oval shapes. Moreover, these two different but partially contemporary groups of blades tend to appear in different contexts and regions of the Bay of Biscay area as shown by the cluster analysis.

**Halberds (Metal and Rock Art Depictions)**

For over 150 years, the label ‘halberd’ has been used to classify similar artefacts found all over Europe (O’Flaherty, 1998). Halberds have been defined as ‘strong metal blades with stout midribs, riveted at right angles to the shaft’ (Harbison, 1969: 35). They are traditionally dated around the Early Bronze Age although the exact time of their emergence is under discussion (Schuhmacher, 2002: 262–64). Some recent studies have proposed to date them to the Late Chalcolithic and consider them to be contemporary with the Bell Beaker phenomenon (Needham, 2016; see also Garrido-Pena et al., 2022). The halberds of France and Iberia have been classified in different overlapping typologies. In Iberia, it is possible to separate classic typologies (Schubart, 1973; Senna-Martinez, 1994; Delibes de Castro et al., 2002; Schuhmacher, 2002: 264) from detailed ones (Brandherm, 2003), while in France several different typologies have been proposed (Gallay, 1981; Briard & Mohen, 1983; Needham, 2016: 71–73). The halberds of both regions have been included in the last general study of European halberds (Horn, 2014), in a major category which encompasses all its different types. Additionally, in this article, the depiction of halberds in rock art in north-western Iberia is also included. These are considered to be representations of halberds of Carrapatas type, contemporary with the use of metal halberds (Peña Santos, 1980; Costas Goberna et al., 1997: 90; Díaz-Guardamino Uribe, 2010: 160; for a different view, see Santos Estévez, 2007: 40). The representation of halberds can be explained in different ways: for example, they might had been depicted because they were used in the area but recycled instead of hoarded (see Needham, 2016: 64). In relation to hoarding, it has been proposed that some rock art representations of weapons, which include halberds and daggers, are depictions of hoards (Güimil-Fariña & Estévez, 2013: 13–14). A few hoards have indeed been found very close to rock art stations (Calo Lourido & Reboredo, 1980).

**Copper or Bronze Bracelets**

The European Middle Bronze Age is marked by the appearance of different copper and bronze bracelets. Briard (1965: 129–35) classified many of them in his ‘Bignan’ type, named after several bracelets in the hoard of Kéran in Bignan; those from western France have been the subject of a recent study (Nordez, 2019). Although the exemplars found in France vary morphologically, researchers tend to classify them all as ‘Bignan’, which has caused some scholars to criticize this label as simplistic (Éluère & Gomez de Soto, 1990: 41) and propose new typologies (Nordez, 2015, 2019). Despite this critique and the new typologies, here all bracelets have been classified in the same category.

**Middle Bronze Age Advanced Short Riveted Blades**

For a definition of ‘advanced’ see above. The label ‘Middle Bronze Age advanced short riveted blade’ is used to group several items with similar features that distinguish them from the contemporary longer blades of Cuevallusa or Tréboul types and the Chalcolithic and/or Early Bronze Age archaic tanged blades discussed above. They have riveted (2–4 rivets) and short (around 100–200 mm long) blades with stylized, sword-like shapes and a tendency towards trapezoid tangs. The latter two attributes differentiate them in particular from other blades labelled Middle Bronze Age archaic short riveted blades (see below). On the French side of the Bay of Biscay, where they are more common in comparison with Iberia, they have been referred to as ‘poignards à languette trapézoïdale et arrondie’ (e.g. Briard & Mohen, 1983: 39, 41; Gabillot, 2003: 54; Lagarde-Cardona, 2012: 70).

**Iberian Long Riveted Blades of Cuevallusa-Emtrambasaguas Type**

This category groups several blades found in Iberia that can be dated between the late Early Bronze Age and the Middle Bronze Age (‘Bronce Pleno’ in Spain). Despite their chronological and contextual similarities (many were recovered in hoards, not burials), it is possible to identify two major subcategories based on their morphology: Cuevallusa (Almagro-Gorbea, 1976: 464) and Emtrambasaguas-Forcas blades (Almagro-Gorbea, 1976: 465). Both subcategories are long (minimum of 400–600 mm), but the Cuevallusa blades are slightly shorter and have a characteristic hourglass shape. The others are longer and tend to have straighter edges. If we accept that the Emtrambasaguas-Forcas blades were a development of the Cuevallusa type, the culmination of this process is the sword found in Forcas in Galicia. This sword is usually dated to the Late Bronze Age because it has a ‘perfect’ straight shape abandoning the hourglass shape of the Cuevallusa blades. Nevertheless, it is included here and considered to be a Middle-Late Bronze Age transitional form that is difficult to date precisely. Despite these differences, all blades in this group are considered to share a common history and represent a ‘singularitas hispana’ (Almagro-Gorbea, 1972; Gómez Ramos, 2001), which is why they are grouped in the same category. Gómez-Ramos (2001: 5) refers to these items as swords with a ‘unique hilt design in the shape of a double-arch’. This is probably the best way to refer to these items, but I have preferred to use the more traditional name ‘Cuevallusa-Emtrambasaguas’ as a reference to Almagro-Gorbea’s 1976 classification. A couple of very similar blades have also been found in southern France (Gomez de Soto, 1990).

**Cypriot Hook-Tang Weapons (‘Cypriot Daggers’)**

The fifteen items of this category found in the Bay of Biscay area have not been included in this study because the blades commonly known as ‘Cypriot daggers’ are artefacts whose classification, chronology, distribution and, most importantly, authenticity have never been clear and consequently have been considered ‘an irritating problem’ (Gomez de Soto & Bourhis, 1974: 50). They have been found in Cyprus, France, Central Europe, and Great Britain at a time when contact between western Europe and the eastern Mediterranean are mostly looked upon with scepticism by many researchers. They have been traditionally considered to be daggers, but some researchers have suggested that they could be spearheads. As for their authenticity, it has been suggested they are fakes or authentic items brought by antiquarians from Cyprus to the European countries where they were allegedly found. Finally, although they have been usually dated to the Early Bronze Age based on the chronology of the few items with which they were (allegedly) found, their morphology and links with Cyprus is more likely to indicate a date in the Middle Bronze Age. It is therefore preferable not to include these items and the few metal artefacts with which they were supposedly recovered in the cluster analysis; perhaps, in future, they could be incorporated in a study, if new discoveries make their nature clearer (see Brandherm, 2017; Harding, 2022).

**Unidentified Axes**

Some axe finds have been noted in one or several works but have been lost and were never properly described or illustrated. Unlike other axes, these axes were not even ascribed to a broad category by their finders (e.g. ‘flat axe’ or ‘palstave’), which means that we know nothing about them except that they were axes and where they were found. Sometimes they were found with other items that may or not be better known; in that case, the unidentified axes have not been included in the cluster analysis but the other items, if they are better known, have been included. At other times, the axes were the only artefacts found, in which case finds have not been included in the study.

**Ingots**

Ingots have not been included in the cluster analysis. ‘Ingot’ refers to metal artefacts with different ‘basic’ shapes, cylindrical and rectangular among others, that are assumed to be ingots. It is assumed that ingots were transported from one place to another and could be transformed into any metal artefact. However, this is only one out of two possibilities (see Hauptmann, 2020: 307–08):

* One possibility is that ingots were made of ‘pure copper’ (today’s standards are at 99.99% but we should not expect this level of purity in prehistory), being the result of processing the ‘impure’ copper ore ‘rock’ extracted from the mine. In such a scenario, ingots from the same ore district should have similar compositions.
* The other possibility is that ingots were also produced by melting several metal artefacts (axes, blades, etc.) and reforge them into ingots. The most logical reason for the shape of an ingot, from our modern perspective, is it makes its transport easier. In this scenario, the composition of the ingots would vary, depending on the composition of the melted artefacts. In other words, the first possibility that assumes that all ingots were the result of processing copper ore directly extracted from the mine would be incorrect.

In either case, it is extremely difficult to date ingots based on their composition (see Gandois et al., 2019). This is also the case in relation to their various shapes. They do not seem to follow an evolution that would allow to order them chronologically. Moreover, ingots are rarely found associated to other items, which makes dating them even more challenging. I have therefore decided not to include them in the analysis. For metal finds that only contain ingots, this decision does not represent a problem as they have just been left out of the study. However, three metal finds (an insignificant percentage in the dataset) include ingots and other metal items. One find, from Asturias in Spain, contains one flat axe and several ingots; this find has not been included in the study. Another two finds from Aquitaine in France contain several metal artefacts and one ingot each; in these two cases, the finds have been included in the study, but the ingots left out of the cluster analysis, that is, these two finds have been compared and classified with other finds as if they did not contain an ingot.

**Rock Art Representations of Unidentified Metal Artefacts**

On a few occasions, rock art stations with well-known and recognizable depictions of metal halberds have been included in the database and the cluster analysis alongside their equivalents made of copper or bronze. However, the very same rock art stations also include rock art depictions of (metal?) items which cannot be classified, or their classification is the subject of discussion. In these cases, the depicted artefacts have not been included in the study. This means that some of the rock art stations included in the cluster analysis because they have depictions of rock art halberds have been compared with other finds as if they did not contain the unidentified rock art depictions.

**Middle Bronze Age Archaic Short Riveted Blades**

This category includes two groups of mostly short blades (100–150 mm) with rivets, dated around the middle of the Early Bronze Age and the Middle Bronze Age (‘Bronce Pleno’ in Spain), that are common in Iberia; there, they are labelled ‘puñales de remaches’ and ‘puñales de escotaduras’ (e.g. González Sainz & González Morales, 1986: 328; Comendador Rey, 1997: 332–33; Rodríguez de la Esperanza, 2005: 112). The first group is formed by blades with two rivets that are similar to the Chalcolithic and/or Early Bronze Age archaic tanged blades discussed above. Traditionally, their origins were located around the El Argar area (see for example Ruiz-Gálvez Priego, 1979: 157). The second group comprises various blades whose common feature is that they have notched tangs, an attribute that has been used to classify all of them in the same category instead of different types, as Brandherm (2003) and Gallay (1981) do. These two groups of blades are probably some of the first riveted blades used in the regions studied. Although they were undoubtedly still employed in the Middle Bronze Age, the origin of some lies probably in the middle of the Early Bronze Age.

**Middle Bronze Age Decorative Items**

This category includes four subcategories of items but, most importantly, it does not include the massive gold bracelets found in Agolada in Galicia (Pingel, 1992: no. 159) or Matignon in Brittany (Briard, 1965: 319), which are dated there to the Late Bronze Age or shortly before that. An exception is the hoard of Lanrivoaré in Britanny which contains a few gold bracelets but also decorative items dated to the Middle Bronze Age. In this special case, the latter decorative items are included in the cluster analysis, but not the gold bracelets. This decision only affects one metal find (an insignificant percentage in the dataset) and it is considered an acceptable solution. Concerning the four subcategories of Middle Bronze Age decorative items, they comprise razors, gold twisted earrings (usually labelled ‘ring money’ in English: Taylor, 1980: 64; and ‘boucles d’oreilles à jonc torsadé’ in French: Briard, 1965: 139), the single gold sheet cone of Avanton (other gold cones or ‘Goldblechkegel’ are known in Central Europe, e.g. Schauer, 1986), and different types of metal pins (‘épingles’ in French) (Audouze & Gaucher, 1981).

**Arrowheads**

This category refers to the various types of metal arrowheads usually dated to the Middle Bronze Age, around the mid-second millennium cal bc, in France and Iberia. Unlike the Palmela arrow points discussed above and traditionally dated to the Chalcolithic-Early Bronze Age, these arrowheads have shapes which are closer to the arrows used in historical times and hence named ‘arrowheads’. In Iberia, these metal arrowheads have been studied in detail by Kaiser (2003), while in France they were analysed in one of the typological studies published by the Société Préhistorique Française (Briard & Mohen, 1983: 79–108). These artefacts have traditionally been dated based on the idea that, while Palmela points were used in the Chalcolithic-Early Bronze Age, arrowheads were manufactured in the Middle Bronze Age (see e.g. Arias Cabal & Armendáriz Gutiérrez, 1998: 52; Kaiser, 2003: 87–89; Rodríguez de la Esperanza, 2005: 116–19). Arrowheads found in Early Bronze Age contexts and Palmela points recovered in Middle Bronze Age contexts suggest that the use of these two items overlapped, at least to a degree. There is no reason to doubt that, while Palmela points were more popular during the Chalcolithic-Early Bronze Age, the arrowheads only became generalized in the Middle Bronze Age. The reason for this change is, however, unclear, and we must also remember that stone arrowheads similar to the metal arrowheads were also used during the Bronze Age (see e.g. Nicolas, 2017).

**Unidentified Blades, Decorative Items, and Fragmented Items**

Around one hundred finds include one or several items (always less than a third of the total number of items) that cannot be identified for different reasons (fragmented or lost being the most common). These finds include other items that have been properly studied and recorded and can be classified into well-known artefact groups. These finds have been included in the cluster analysis but as if they did not contain the unidentified items. The unidentified items that have not been included in the analysis can be grouped into three broad categories: unidentified blades, unidentified decorative items, and metal fragments. Unidentified blades are a group of fragmented items that can be identified as the remains of a dagger or a sword but cannot be ascribed to a particular type or category. The label unidentified decorative item is assigned to small trinkets with various unique shapes and unidentifiable fragmented items made of gold and silver but also of copper and bronze. Finally, some metal fragments not only cannot be assigned to one of the broad artefact categories discussed here but also cannot even be attributed to a general class of artefact (e.g. axe, blade, etc.).

**Bujões-Barcelos Axes**

The Bujões-Barcelos axes are a group of slightly different but nonetheless homogenous Iberian axes with attributes that distinguish them from the flat axes of the Early Bronze Age but also differ from the Middle Bronze Age axes used in Atlantic Europe. Although they have been classified and named in different ways (Monteagudo, 1977; Arias Cabal & Armendáriz Gutiérrez, 1998: 51; Senna-Martinez et al., 2013: 594), these axes have always been dated to the ‘Bronce Pleno’, i.e. between the Early Bronze Age and the Late Bronze Age. In other words, they could be considered as constituting a bridge between the flat axes and the axes of the Late Bronze Age. From a typological perspective, these artefacts have been traditionally divided into the Barcelos type in Spain, originally identified by MacWhite (1951), and the Bujões type in Portugal, which was named after the axes found in the hoard of that name (see Harbison, 1967: 110). The two types are quite similar, and they are sometimes discussed as a single category (e.g. Harbison, 1967: 112; Ruiz-Gálvez Priego, 1984: 335; Comendador Rey, 1999c: 520), which is why here they are merged into one group labelled Bujões-Barcelos.

**Hachettes**

These unique items have not been included in the cluster analysis. This category includes the so-called ‘hachettes’ (meaning small axes), which comprises around three hundred copper axes with very particular but homogenous morphologies recovered out of context around the Médoc region in the Garonne estuary. They have been interpreted as copper ingots; while exceptional in both France and Atlantic Europe, they are not very well known and little discussed (Roussot-Larroque, 2005 and Couderc, 2017 being exceptions). Hachettes are usually dated to the Early Bronze Age because of their copper composition but this cannot be confirmed on the basis of being found associated with items unequivocally dated to that time. Our lack of knowledge about this unique group of artefacts precludes them from being included in the cluster analysis.

**Spearheads**

Middle Bronze Age spearheads represent a new category of artefact common in the French regions of the Bay of Biscay area. Bronze Age spearheads are difficult to date typo-chronologically due to the similarities between the models used in the Middle and Late Bronze Ages. Here, the view that Middle and Late Bronze Age exemplars differed in certain attributes is accepted and some spearheads without context (and chronology) have been included in the study based on this. Middle Bronze Age spears have short tangs and long blades, while Late Bronze Age spearheads have longer tangs and shorter blades (see e.g. Briard, 1965: 86; Delibes de Castro, 1983: 72–73). Two important recent works have developed typologies for spearheads in Britain (Davis, 2012) and Italy (Bruno, 2012), while in France typologies have been proposed in different works, most of which have a regional scope (e.g. Gabillot, 2003: 56; Lagarde-Cardona, 2012: 71). Although all the spearheads in the analysis have been grouped into a single category, it is possible to distinguish five major subcategories. Briard’s Tréboul spearheads (Briard, 1965: 86), basal-looped spearheads (Davis, 2006), the so-called ‘pointe de lance à longue douille et flame foliacée’ (Lagarde-Cardona, 2012: 72), the ‘Sucy’ spearheads originally found around the Paris Basin (Blanchet, 1984: 172), and spears that, although they have attributes that situate them in the Late Bronze Age, have been found in contexts that can be dated to the Middle Bronze Age, or vice versa.

**Palstaves and Flanged Axes of Types Dated to the Middle Bronze Age**

Between the end of the Early Bronze Age and the end of the Middle Bronze Age, several types of axes were in use around the Bay of Biscay area. The typology of the various types of flanged axes and palstaves is not presented here, although the general grand groups are outlined. It is important to note that some of the flat axes discussed above were probably still in use at the beginning of the Middle Bronze Age. Thus, they should be considered contemporary with the earliest flanged axes and palstaves. Moreover, the Iberian Bujões-Barcelos axes are contemporary to the axes grouped in this category. Simplifying, eight subcategories of palstaves and flanged axes are identified: the ‘Vendée’ flanged axes; the ‘Tréboul’ flanged axes; the ‘Thonac’ flanged axes; the ‘Médoc’ flanged axes; the ‘Tréboul’ palstaves; the ‘Breton’ palstaves; the ‘Centre-Ouest’ palstaves; the ‘Normand’ palstaves; and the ‘Bais’ palstaves (for the latter, see Mélin & Nordez, 2019). Importantly, many of the palstaves from Brittany come from dispersed old finds that are not well known but could be assigned, not without difficulties, to the ‘Breton’ group.

**Atlantic and Central European Long Riveted Blades**

This category contains different Middle Bronze Age blades linked either to Atlantic Europe or Central Europe. Their common characteristic is that they are contemporary and only occur in the French areas of the Bay of Biscay area, which is why they are grouped together. They can be classified into four well-known types: the Tréboul-Saint-Brandan swords (Gabillot, 2003: 53), the trapezoid rapiers (‘rapières à base trapézoidale’; Gaucher & Mohen, 1972: 22), the swords of Haguenau type (Briard & Mohen, 1983: 24), and the swords of Cheylouet type (Briard, 1965: 103). Moreover, several fragmented blades cannot be classified into any specific category but, based on their context and surviving morphology, they can be interpreted as Middle Bronze Age blades contemporary with the four types named above.

**Late Bronze Age Items**

In less than ten finds (an insignificant percentage in the dataset), Middle Bronze Age items were found with up to three Late Bronze Age items (mostly axes). These finds have been included in the cluster analysis although they should be dated to the latest stages of the Middle Bronze Age or the beginning of the Late Bronze Age. The few Late Bronze Age items in these finds have not been included in the analysis, that is, the few finds that include Late Bronze Age artefacts have been compared and classified with other ones as if they did not contain them.

**Supplementary Material 3: Why 5 Clusters?**

the cluster analysis datasheet has been divided into five clusters. The number five was chosen after computing the same model with LCA for two to ten clusters. As discussed in the article, five clusters was considered the solution that makes most sense *archaeologically*. The aim of this final commentary is to discuss briefly why the other solutions were not considered acceptable.

**Two, Three, and Four Clusters**

When the LCA analysis was carried out with two to four clusters the results were mostly (as expected) simplified versions of the clusters presented in the article. In other words, LCA just packed the five clusters of the article into larger clusters.

When asked to divide the datasheet into two clusters, LCA divided all finds into two groups: one was the cluster labelled in the article TAU and the other included all the other clusters in the article. The logic of LCA is simple. TAU represents a large number of findings (it is the biggest of the clusters in the article), therefore it makes sense to isolate it as soon as possible from all the other finds in the study.

When asked to divide the datasheet into three clusters something similar happened. The TAU cluster was again identified as one of the three clusters. The other two were a mix of clusters CHI and IOTA and of clusters KAPPA and GAMMA, respectively. The reason why LCA did that is not entirely clear. It is evident that it can identify four groups that are clustered into two (because it is asked to do so), but why IOTA is not paired with KAPPA or vice versa is not clear. The key factor is that CHI, GAMMA, IOTA, and KAPPA finds were classified together.

Finally, when LCA was asked to divide the datasheet into four clusters a result very similar to that presented in the article was provided. The TAU and GAMMA clusters were identically defined. Curiously, the finds classified in the article in the clusters CHI and IOTA were grouped together into a single cluster. However, between 10 and 20 of the finds classified in the article as IOTA were included in the fourth cluster that included all the finds in the paper classified in the KAPPA cluster.

**Six to Ten Clusters**

When the LCA was asked to find between six and ten clusters, the five clusters presented in the article were subdivided into "sub-clusters". For example, the TAU cluster was divided into two, one including only axes and the other holding the rest of the TAU finds. Similarly, the GAMMA cluster was divided into the single burials of the Armorican Tumulus tradition in Brittany and the Vilavella-Atios group in NW Iberia (two already known archaeological groups defined in other studies, as discussed in the article). It is important to highlight that these sub-clusters have overlapping chronologies and distributions and show patterns that, although important and worthy of exploration in future studies, serve only to reinforce the broad patterns identified in the paper.

**References**

Alday Ruiz, A. 1992a. La primera industria del oro en el País Vasco y La Rioja. *Munibe Antropologia-Arkeologia*, 44: 43–55.

Alday Ruiz, A. 1992b. Síntesis sobre la secuencia cultural neolítico-edad del bronce en el País Vasco. *Sancho el sabio: Revista de cultura e investigación vasca*, 2: 19–50.

Almagro-Gorbea, M. 1972. La espada de Guadalajara y sus paralelos peninsulares. *Trabajos de Prehistoria*,29: 55–82.

Almagro-Gorbea, M. 1976. La espada de Entrambasaguas. Aportación a la secuencia de las espadas del Bronce en el Norte de la Península Ibérica. In: *XL aniversario del Centro de Estudios Montañeses*. Santander: Institución Cultural de Cantabria, pp. 453–77.

Arias Cabal, P. 1995. La cronología absoluta del Neolítico y el calcolítico de la región cantábrica: estado de la cuestión. *Isturitz: Cuadernos de Prehistoria-Arqueología*, 6: 15–40.

Arias Cabal, P. 1999. Esquisse chronologique de la préhistoire post-paléolithique de la région cantabrique (Espagne). In: J. Évin, C. Oberlin, J.-P. Daugas & J.F. Salles, eds. *14C et archéologie (3ème congrès international)*. Paris: Société Préhistorique Française, pp. 259–63.

Arias Cabal, P. & Armendáriz Gutiérrez, Á. 1998. Aproximación a la Edad del Bronce en la región cantábrica. In: R. Fabregas Valcarce, ed. *A Idade do Bronce en Galicia: novas perspectivas*. A Coruña: Edicios do Castro, pp. 47–80.

Armbruster, B., Bello Diéguez, J.M., Comendador-Rey, B. & Perea, A. 2004. Relaciones Atlánticas en los inicios de la metalurgia. La gargantilla de tiras y el conjunto de Cícere, Santa Comba, A Coruña. In: A. Perea, I. Montero Ruiz & O. García-Vuelta, eds. *Tecnología del oro antiguo: Europa y América*. Madrid: Consejo Superior de Investigaciones Científicas, pp. 173–87

Armendáriz Gutiérrez, Á. 1997. Neolítico y Calcolítico en el País Vasco Peninsular. *Isturitz: Cuadernos de Prehistoria-Arqueología*, 7: 23–36.

Armendáriz Gutiérrez, Á. 2022. Bronze Age Burials and Funerary Practices in Cantabrian Spain. In: L. Nonat & M. P. Prieto-Martínez, eds. *Funerary Practices in the Second Half of the Second Millennium bc in Continental Atlantic Europe*. Oxford: Archaeopress, pp. 101–27.

Audouze, F. & Gaucher, G. 1981. *Typologie des objets de l’âge du Bronze en France VI: épingles*. Paris: Société Préhistorique Française.

Bailloud, G. & Burnez, C. 1962. Le Bronze ancien dans le Centre-Ouest de la France. *Bulletin de la Société Préhistorique Française*, 59: 515–24.

Balquet, A. 2001. *Les tumulus armoricains du Bronze ancien*. Rennes: Institut culturel de Bretagne.

Barrett, J. 1994. The Bronze Age. In: B. Vyner, ed. *Building on the Past: Papers Celebrating 150 Years of the Royal Archaeological Institute*. London: Royal Archaeological Institute, pp. 123–48.

Bartelheim, M. & Kraus, R. 2012. Sense and Non-Sense of the Term ‘Chalcolithic’. In: M. Allen, J. Gardiner & A. Sheridan, eds. *Is There a British Chalcolithic? People, Place and Polity in the Later 3rd* *Millennium*. Oxford: Oxbow, pp. 85–97.

Bettencourt, A.M.S. 1997. Expressões funerárias da Idade do Bronze no Norte de Portugal. In: *Actas do II congreso de Arqueología Peninsular*. Zamora: Fundación Rei Alfonso Henriques, pp. 621–22.

Bettencourt, A.M.S. 2001. Aspectos da metalurgia do bronze no Entre-Douro-e-Minho, no quadro da Proto-História do Noroeste Peninsular. *Arqueologia*, 26: 13–40.

Bettencourt, A. 2010. La edad del bronce en el Noroeste de la Península Ibérica: un análisis a partir de las prácticas funerarias. *Trabajos de Prehistoria*, 67: 139–73.

Beyneix, A. 1997. *Les cultures de l’âge du Bronze en pays de Moyenne-Garonne*. Montagnac: Monique Mergoil.

Blanchet, J.-C. 1984. *Les premiers métallurgistes en Picardie et dans le nord de la France: Chalcolithique, âge du Bronze et début du premier âge du Fer*. Paris: Société Préhistorique Française.

Blanchet, S. 2022. Les pratiques funéraires du Bronze moyen et du Bronze final en Bretagne: un premier bilan. In: L. Nonat & M. P. Prieto-Martínez, eds. *Funerary Practices in the Second Half of the Second Millennium BC in Continental Atlantic Europe*. Oxford: Archaeopress, pp. 29–46.

Blanchet, S., Nicolas, C., Nicolas, T. & Pailler, Y. 2015. Towards a New Deal of the Beaker Culture and the Genesis of the Early Bronze Age in Brittany. Unpublished paper presented at the 21st annual meeting of the European Association of Archaeologists, Glasgow

Blas Cortina, M.Á. 1983. *La prehistoria reciente en Asturias*. Oviedo: Fundación Pública de Cuevas y Yacimientos Prehistóricos de Asturias.

Blas Cortina, M.Á. 2011. De la caverna al lugar fortificado. *Quaderns de prehistòria I Arqueologia de Castelló*, 29: 105–34.

Blas Cortina, M.Á. & Fernández Manzano, J. 1992. Asturias y Cantabria en el 1 milenio a.C. *Complutum*, 2: 399–416.

Boulud-Gazo, S., Gomez de Soto, J., Mélin, M. & Nordez, M. 2022. Que peut-on actuellement dire des pratiques funéraires du Centre-Ouest de la France au Bronze moyen? In: L. Nonat & M.P. Prieto-Martínez, eds. *Funerary Practices in the Second Half of the Second Millennium bc in Continental Atlantic Europe*. Oxford: Archaeopress, pp. 47–67.

Bradley, R. & Fabregas Valcarce, R. 1995. El silencio de las fuentes: prácticas funerarias en la Edad del Bronce del Noroeste y su contexto europeo. *Complutum*, 6: 153–66.

Brandherm, D. 2003. *Die Dolche und Stabdolche der Steinkupfer- und der älteren Bronzezeit auf der Iberischen Halbinsel* (Prähistorische Bronzefunde, Abteilung VI, 12). Stuttgart: Steiner.

Brandherm, D. 2007. Algunas reflexiones sobre el bronce inicial en el noroeste peninsular. *Cuadernos de prehistoria y arqueología*, 33: 69–90.

Brandherm, D. 2017. Zyprische Griffangelklingen & Co. aus West- und Mitteleuropa? Noch einmal zur Problematik einer Quellengruppe der frühen und mittleren Bronzezeit. In: D. Brandherm, ed. *Memento dierum antiquorum ... Festschrift für Majolie Lenerz-de Wilde zum 70. Geburtstag*. Hagen: Curach Bhan, pp. 45–70.

Briard, J. 1959. *L’âge du Bronze*. Paris: Presses Universitaires de France.

Briard, J. 1965. *Les dépôts bretons et l’âge du Bronze atlantique*. Rennes: Laboratoire d’Anthropologie préhistorique.

Briard, J. 1984. *Les tumulus d’Armorique*. Paris: Picard.

Briard J. & Mohen, J.-P. 1974. Le tumulus de la forêt de Carnoët à Quimperlé. Antiquités Nationales, **6:** 46–60.

Briard, J. & Mohen, J.-P. 1983. *Typologie des objets de l’âge du Bronze en France II: poignards, hallebardes, pointes de lance, pointes de flèche, armement défensi*f. Paris: Société Préhistorique Française.

Briard, J. & Roussot-Larroque, J. 2002. Les débuts de la métallurgie dans la France atlantique. In: M. Bartelheim, E. Pernicka & R. Krause, eds. *Die Anfänge der Metallurgie in der alten Welt / The Beginnings of Metallurgy in the Old World*. Rahden: Marie Leidorf, pp. 135–60.

Briard, J. & Verron, G. 1976. *Typologie des objets de l’âge du Bronze en France III: haches* (1). Paris: Société Préhistorique Française.

Briard, J., Gomez de Soto, J., Milcent, P.-Y. & Pautreau, J.-P. 2001. Les recherches sur l’âge du Bronze en Poitou-Charentes, Centre, Pays de Loire, Bretagne et Basse Normandie. *Documents d’Archéologie Méridionale*, 24: 259–66. <https://journals.openedition.org/dam/1001>

Brun, P. 1991. Le Bronze atlantique et ses subdivisions culturelles: essai de définition. In: C. Chevillot & A. Coffyn, eds. *L’âge du Bronze atlantique: ses faciès, de l’Écosse à l’Andalousie, et leurs relations avec le Bronze continental et la Méditerranée*. Beynac-et-Cazenac: Association des musées du Sarladais, pp. 11–24.

Bruno, A. 2012. Spears in Context: Typology, Life-Cycles and Social Meanings in Bronze Age Italy (unpublished PhD dissertation, University of Manchester.

Burnez, C. 1976. *Le Néolithique et le Chalcolithique dans le centre-ouest de la France*. Paris: Société Préhistorique Française.

Calo Lourido, F. & Reboredo, X. 1980. Estación de arte rupestre de Leiro (Rianxo-A Coruña). *Gallaecia: revista de arqueoloxía e antigüidade*, 6: 207–16.

Cantet, J.-P. 1991. *L’âge du Bronze en Gascogne Gersoise*. Périgueux: Éditions Vésuna.

Castro Martínez, P.V., Lull, V. & Micó Pérez, R. 1996. *Cronología de la prehistoria reciente de la Península Ibérica y Baleares (c. 2800–900 cal ANE)*. Oxford: Tempus Reparatum.

Chaigneau, P.-R. & Sacchi, D. 1965. Les mobiliers archéologiques de quelques dolmens de la Vendée. *Bulletin de la Société Préhistorique Française*, 62: 386–96.

Chevillot, C. 1989. *Sites et cultures de l’âge du Bronze en Périgord: du groupe d’Artenac au groupe de Vénat*. Périgueux: Éditions Vésuna.

Chevillot, C. 2010. L’âge du Bronze en Aquitaine. In: V. Mistort, ed. *De Néandertal à l’homme moderne: l’Aquitaine préhistorique vingt ans de découvertes (1990–2010)*. Bordeaux: Éditions Confluences, pp. 200–29.

Coffyn, A. 1971. Le Bronze final et le début du premier âge du Fer autour de l’estuaire girondin (unpublished PhD dissertation, University of Bordeaux).

Coffyn, A. 1976. Les civilisations de l’âge du Bronze en Aquitaine. In: J. Guilaine, ed. *La Préhistoire Française Tome II*. Paris: CNRS, pp. 532–42.

Coffyn, A. 1985. *Le Bronze final atlantique dans la Péninsule Ibérique*. Paris: de Boccard.

Comendador Rey, B. 1995. Caracterización de la metalurgia inicial gallega: una revisión. *Trabajos de Prehistoria*, 52: 111–29.

Comendador Rey, B. 1997. Los inicios de la metalurgia en el noroeste de la Península Ibérica (unpublished PhD dissertation, University of Santiago de Compostela).

Comendador Rey, B. 1998a. *El tesoro desencantado: As Silgadas (Caldas de Reis).* Santiago de Compostela: Concello de Caldas de Reis.

Comendador Rey, B. 1998b. Unha lectura da Idade do Bronce según a tecnoloxía metalúrxica. In: R. Fabregas Valcarce, ed. *A Idade do Bronce en Galicia: Novas perspectivas*. A Coruña: Edicios do Castro, pp. 105–29.

Comendador Rey, B. 1999a. Noroeste. In: G. Delibes de Castro & I. Montero Ruiz, eds. *Las primeras etapas metalúrgicas en la península ibérica II: Estudios regionales*. Madrid: Fundación José Ortega y Gasset & Ministerio de Educación y Cultura, pp. 9–39.

Comendador Rey, B. 1999b. The Early Development of Metallurgy in the North-West of the Iberian Peninsula. In: S.M.M. Young, M. Pollard, P. Budd & R.A. Ixer, eds. *Metals in Antiquity* (BAR International Series, 792). Oxford: Archaeopress, pp. 63–67.

Comendador Rey, B. 1999c. Cambios en la escala de producción metalúrgica durante las fases finales de la edad del bronce en el noroeste peninsular. *Revista de Guimarães*, volume especial, 2: 515–37.

Comendador Rey, B. & Bettencourt, A.M.S. 2004. Los inicios de la metalurgia del bronce en el noroeste peninsular. In: J.M. Mata Perelló, ed. *Actas del IV congreso internacional sobre patrimonio geológico y minero*. Teruel: Museu do Instituto Geológico e Mineiro de Utrillas, pp. 343–57.

Comendador Rey, B. & Bettencourt, A.M.S. 2011. Nuevos datos sobre la primera metalurgia del Bronce en el Noroeste de la Península Ibérica: la contribución de Bouça da Cova da Moura (Ardegães, Maia, Portugal). *Estudos do Quaternário / Quaternary Studies*, 7: 19–31.

Cordier, G. 1976. Les civilisations de l’âge du Bronze dans le Centre-Ouest et les pays de la Loire Moyenne. In: J. Guilaine, ed. *La Préhistoire Française Tome II*. Paris: CNRS, pp. 543–60

Costas Goberna, F.J., Hidalgo Cuñarro, J.M., Novoa Alvarez, P. & Peña Santos, A. 1997. La representación de armas en el grupo galaico de arte rupestre. In: F.J. Costas Goberna & J. M. Hidalgo Cuñarro, eds. *Los motivos de fauna y armas en los grabados prehistóricos del continente europeo* Vigo: Asociación Arqueológica Viguesa, pp. 87–113.

Couderc, F. 2014. Analyse culturelle et territoriale de l’âge du Bronze en Médoc (unpublished MA dissertation, University of Bordeaux-Montaigne).

Couderc, F. 2017. Synthèse sur la pratique des dépôts métalliques au Bronze moyen en Médoc. *Bulletin de la Société Préhistorique Française*, 114: 529–52.

Davis, R. 2006. *Basal-Looped Spearheads: Typology, Chronology, Context and Use* (BAR International Series, 1497). Oxford: Archaeopress.

Davis, R. 2012. *The Early and Middle Bronze Age Spearheads of Britain* (Prähistorische Bronzefunde, Abteilung V, 5). Stuttgart: Steiner:

Delibes de Castro, G. 1977. *El vaso campaniforme en la Meseta Norte española.* Valladolid: Departamento de Prehistoria y Arqueología, Universidad de Valladolid.

Delibes de Castro, G. 1983. Un conjunto de lanzas de bronce de Cisneros, Palencia. In: *Homenaje al Prof. Martín Almagro Basch, Tomo 2*. Madrid: Ministerio de Cultura, pp. 69–79.

Delibes de Castro, G., Avello, J.L. & Rojo Guerra, M. 1982. Espadas del Bronce Antiguo y Medio halladas en la provincia de León. *Zephyrvs*, 34: 153–63.

Delibes de Castro, G., Fernández Ibáñez, C., Herrán, J.I. & Rovira Lloréns, S. 2002. The Atlantic Halberds of the Beginning of the Bronze Age in the Iberian Peninsula: Typology, Context, and Archaeometallurgical Study. In: M. Bartelheim, E. Pernicka & R. Krause, eds. *Die Anfänge der Metallurgie in der alten Welt / The Beginnings of Metallurgy in the Old World*. Rahden: Marie Leidorf, pp. 245–54

Díaz-Guardamino Uribe, M. 2010. Las estelas decoradas en la Prehistoria de la Península Ibérica (unpublished PhD dissertation Complutense University, Madrid).

Éluère, C. 1982. *Les ors préhistoriques*. Paris: Picard.

Éluère, C. & Gomez de Soto, J. 1990. *Typologies des objets de l’âge du Bronze en France VII: bracelets, colliers, boucles*. Paris: Société Préhistorique Française.

Fabregas Valcarce, R. 1995. La realidad funeraria en el Noroeste del Neolítico a la Edad del Bronce. In: R. Fabregas Valcarce, F. Pérez Losada & C. Fernández Ibáñez, eds. Arqueoloxía da morte na Península Ibérica desde as Orixes ata o Medievo. Xinxo de Limia: Concello de Xinxo de Limia, pp. 95–126.

Fabregas Valcarce, R. & Vilaseco Vázquez, X.I. 2011. Manifestaciones funerarias entre el III y II milenios A.C. en el Noroeste Ibérico. In: M. P. Prieto Martínez & L. Salanova, eds. *Las comunidades campaniformes en Galicia: cambios sociales en el III y II milenios BC en el NW de la Península Ibérica*. Pontevedra: Diputación Provincial de Pontevedra, pp. 212–40.

Fernández Moreno, J.J., Garcia Alonso, B., Álvarez Garcia, R. & Fernández González, M.Á. 2018. Los discos de oro del Museo Arqueológico de Asturias: algunas observaciones sobre la orfebrería prehistórica. *Zephyrvs,* 82: 65–92.

Gabillot, M. 2003. *Dépôts et production métallique du Bronze moyen en France nord-occidentale* (BAR International Series, 1174). Oxford: Archaeopress.

Gallay, G. 1981. *Die kupfer- und altbronzezeitlichen Dolche und Stabdolche in Frankreich* (Prähistorische Bronzefunde, Abteilung VI, 5). München: Beck.

Gandois, H., Burlot, A., Mille, B. & Le Carlier de Veslud, C. 2019. Early Bronze Age Axe-Ingots from Brittany: Evidence for Connections with South-West Ireland*? Proceedings of the Royal Irish Academy: Archaeology, Culture, History, Literature*, 119: 1–36.

Garrido-Pena, R., Flores Fernández, R., Herrero-Corral, A.M., Muñoz Moro, P., Gutiérrez Saez, C. & Paulos-Bravo, R. 2022. Atlantic Halberds as Bell Beaker Weapons in Iberia: Tomb 1 of Humanejos (Parla, Madrid, Spain). *Oxford Journal of Archaeology*, 41: 252–77. <https://doi.org/10.1111/ojoa.12250>

Gaucher, G. & Mohen, J.-P. 1972. *Typologie des objets de l’âge du Bronze en France I: épées.* Paris: Société Préhistorique Française.

Giot, P.-R., Briard, J. & Pape, L. 1979. *Protohistoire de la Bretagne*. Rennes: Ouest-France.

Gomez de Soto, J. 1980. *Les cultures de l’âge du Bronze dans le bassin de la Charente*. Périgueux: Pierre Fanlac.

Gomez de Soto, J. 1990. Intégration atlantique et exotisme au Bronze ancien. Le cas du glaive de Cissac en Médoc (Gironde). *Revue Archéologique de l’Ouest, Supplément,* 2: 221–25.

Gomez de Soto, J. 1995. *Le Bronze moyen en Occident: la culture des Duffaits et la civilisation des tumulus (L'âge du Bronze en France*, 5). Paris: Picard.

Gomez de Soto, J. & Bourhis, J. 1974. Les poignards chypriotes, dits de Taillebourg, du Musée Municipal d’Angoulême. *Bulletin de la Société préhistorique française*, 71: 49–52.

Gómez Ramos, P. 2001. La espada de La Perla: estudio de las empuñaduras de remaches con doble arco. Un unicum en la serie de armas europeas de la Edad del Bronce. *Gladius*, 21: 5–30.

González Sainz, C. & González Morales, M. 1986. *La prehistoria en Cantabria*. Santander: Ediciones Tantin.

Güimil-Fariña, A. & Estévez, M.S. 2013. Territorialidad en la Edad del Bronce del noroeste de la Península Ibérica. *Revista d’arqueologia de Ponent*, 23: 9–25.

Harbison, P. 1967. Mediterranean and Atlantic Elements in the Early Bronze Age of Northern Portugal and Galicia. *Madrider Mitteilungen*, 8: 100–22.

Harbison, P. 1969. *The Daggers and the Halberds of the Early Bronze Age in Ireland* (Prähistorische Bronzefunde, Abteilung VI, 1). München: Beck.

Harding, A. 2022. Mycenaean Greece and Europe. Interconnections and Exchanges in the Light of Recent Research. *Studia Hercynia*, 26: 21–43.

Hauptmann, A. 2020. *Archaeometallurgy: Material Science Aspects*. Cham: Springer.

Hernando Gonzalo, A. 1983. La orfebrería durante el Calcolítico y el Bronce Antiguo en la Península Ibérica. *Trabajos de Prehistoria*, 40: 85–138.

Horn, C. 2014. *Studien zu den europäischen Stabdolchen*. Bonn: Habelt.

Hunter, J. & Woodward, A. 2014. Items of equipment II: stone, bone, copper alloy and miscellaneous objects. In: J. Hunter & A. Woodward, eds. *Ritual in Early Bronze Age Grave Goods: An Examination of Ritual and Dress Equipment from Chalcolithic and Early Bronze Age Graves in England.* Oxford: Oxbow, pp. 69–140.

Jorge, S.O. 1990. Desenvolvimiento da hierarquização social e da Metalurgia. In: J. Alarçao, ed. *Nova Historia de Portugal .1*. Lisboa: Presença, pp. 163–212.

Kaiser, J.M. 2003. Puntas de flecha de la Edad del Bronce en la Península Ibérica. Producción, circulación y cronología. *Complutum*, 14: 73–106.

L’Helgouac’h, J. 1976. Les civilisations néolithiques en Armorique. In: J. Guilaine, ed. *La Préhistoire Française Tome II*. Paris: CNRS, pp. 365–74.

L’Helgouac’h, J. 1996. Mégalithes armoricains: stratigraphies, réutilisations, remaniements. *Bulletin de la Société Préhistorique Française*, 93: 418–24.

L’Helgouac’h, J. 2001. Le cadre culturel du campaniforme armoricain. In: F. Nicolis, ed. *Bell Beakers Today: Pottery, People, Culture, Symbols in Prehistoric Europe*. Trento: Servizio dei Beni Culturali, pp. 288–99.

Labaune, M. 2010. Le métal et la métallurgie campaniforme en France au IIIe millénaire av. n.è. (unpublished MA dissertation, Université de Bourgogne-Dijon).

Lagarde-Cardona, C. 2012*. Production métallique en Aquitaine à l’âge du Bronze moyen: techniques, usages et circulation*. Pessac: Ausonius.

Laporte, L. 2001. Du Néolithique au Bronze ancien sur la façade atlantique du Centre-Ouest de la France. *Bulletin de la Société Préhistorique Française*, 98: 83–101.

Laporte, L. & Gomez de Soto, J. 2008. Du Néolithique final au tout premier Bronze ancien dans le Centre-Ouest de la France et plus généralement sur sa façade atlantique: des données encore très lacunaires pour la seconde moitié du IIIe millénaire av. J.-C. *Bulletin de la Société Préhistorique Française*, 105: 555–76.

Lichardus-Itten, M. 2007. Le chalcolithique: une époque historique de l’Europe. In: J. Guilaine, ed. *Le Chalcolithique et la construction des inégalités: le continent européen*. Paris: Errance, pp 11–22.

López Plaza, M.S. & Santos Yanguas, J. 1984. Alabarda y puñales de lengüeta y remaches procedentes del S.O. de la Cuenca del Duero. *Zephyrus*, 37: 255–266.

MacWhite, E. 1951. *Estudios sobre las relaciones atlánticas de la Península Hispánica en la Edad del Bronce*. Madrid: Seminario de historia primitiva del hombre.

Marembert, F. & Seigne, J. 2000. Un faciès original: le groupe du Pont-Long au cours des phases anciennes de l’âge du Bronze dans les Pyrénées nord-occidentales. *Bulletin de la Société Préhistorique Française*, 97: 521–38.

Mederos Martín, A. 1997. Nueva cronología del Bronce Final en el Occidente de Europa. *Complutum*, 8: 73–96.

Mélin, M. & Nordez, M. 2019. Entre influences armoricaines et normandes: le dépôt du Bronze moyen atlantique 2 de Bais (Mayenne). *Gallia Préhistoire*, 59: 151–80.

Milcent, P.-Y. 2012. *Le temps des élites en Gaule atlantique: chronologie des mobiliers et rythmes de constitution des dépôts métalliques dans le contexte européen, XIIIe–VIIe s. av J.-C*. Rennes: Presses Universitaires de Rennes.

Monteagudo, L. 1977. *Die Beile auf der Iberischen Halbinsel* (Prähistorische Bronzefunce, Abteilung IX, 6). München: Beck

Needham, S. 2000. Power Pulses Across a Cultural Divide: Cosmologically Driven Acquisition Between Armorica and Wessex. *Proceedings of the Prehistoric Society*, 66: 151–207.

Needham, S. 2014. Items of equipment I: daggers, pommels and belt fittings. In: J. Hunter & A. Woodward, eds. *Ritual in Early Bronze Age Grave Goods: An Examination of Ritual and Dress Equipment from Chalcolithic and Early Bronze Age Graves in England.* Oxford: Oxbow, pp. 23–68.

Needham, S. 2016. The Lost Cultures of the Halberd Bearers: A Non-Beaker Ideology in Later 3rd Millennium Atlantic Europe. In: J.T. Koch & B. Cunliffe, eds. *Celtic from the West*. Oxford: Oxbow, pp. 40–81.

Needham, S. 2017. *The Classification of Chalcolithic and Early Bronze Age Copper and Bronze Axe-Heads from Southern Britain*. Oxford: Archaeopress.

Nicolas, C. 2011. Artisanats spécialisés et inégalités sociales à l’aube de la métallurgie: les pointes de flèches de type armoricain dans le nord du Finistère. *Bulletin de la Société Préhistorique Française*, 108: 93–125.

Nicolas, C. 2015. Actualités scientifiques: symboles de pouvoir au temps de Stonehenge. Les productions d’armatures de prestige de la Bretagne au Danemark (2500-1700 av. J.-C.). Thèse de doctorat soutenue le 12 décembre 2013 à l’université Paris I – Panthéon-Sorbonne. *Bulletin de la Société Préhistorique Française*, 112: 376–77.

Nicolas, C. 2017. Arrows of Power from Brittany to Denmark (2500–1700 bc). *Proceedings of the Prehistoric Society*, 83: 247–87.

Nicolas, C., Stevenin, C. & Stéphan, P. 2015. L’artisanat à l’âge du Bronze ancien en Basse Bretagne. In: S. Boulud-Gazo & T. Nicolas, eds. *Artisanats et productions à l’âge du Bronze* (Actes de la journée de la Société Préhistorique Française, Nantes, 8 octobre 2011). Paris: Société Préhistorique Française, pp. 123–53.

Nonat, L. 2022. Les vases décorés à la cordelette dans les contextes funéraires du bassin de l’Adour à l’âge du Bronze. In: L. Nonat & M.P. Prieto-Martínez, eds. *Funerary Practices in the Second Half of the Second Millennium BC in Continental Atlantic Europe*. Oxford: Archaeopress, pp.76–100.

Nonat, L., Prieto Martínez, M.P. & Vázquez Liz, P. 2022. Les contextes funéraires et le dynamisme culturel du nord-ouest de la péninsule ibérique entre le XVIIIe siècle et le VIIIe siècle av. J.-C. In: L. Nonat & M. P. Prieto-Martínez, eds. *Funerary Practices in the Second Half of the Second Millennium bc in Continental Atlantic Europe: From Belgium to the North of Portugal*. Oxford: Archaeopress, pp. 128–56.

Nordez, M. 2015. Parures annulaires massives à décor incisé du Bronze moyen au Nord-Ouest de la France (Bretagne, Pays de la Loire, Basse-Normandie). Pour une remise en question du type de Bignan. *Bulletin de la Société Préhistorique Française*, 112: 75–116.

Nordez, M. 2019. *La parure en métal de l’âge du Bronze moyen atlantique* (Mémoires de la Société Préhistorique Française, 65). Paris: Société Préhistorique Française.

O’Flaherty, R. 1998. The Early Bronze Age Halberd: A History of Research and a Brief Guide to the Sources. *The Journal of the Royal Society of Antiquaries of Ireland*, 128: 74–94.

Ontañon Peredo, R. 2003. *Caminos hacia la complejidad: el Calcolítico en la región cantábrica*. Santander: Universidad de Cantabria.

Ontañon Peredo, R. 2013. Social Dynamics in the Recent Prehistory of Northern Iberia. In: M. Cruz Berrocal, L. García Sanjuán & A. Gilman Guillén, eds. *The Prehistory of Iberia*. London: Routledge, pp. 203–30.

Ortiz Tudanca, L. 1990. Ordenación de la Secuencia Cultural del Calcolítico y la Edad del Bronce en el País Vasco. *Munibe Antropologia-Arkeologia*, 42: 135–39.

Parcero Oubiña, C. & Criado Boado, F. 2013. Social Change, Social Resistance: A Long-Term Approach to the Process of Transformation of Social Landscapes in the Northwest Iberian Peninsula. In: M. Cruz Berrocal, L. García Sanjuán & A. Gilman Guillén, eds. *The Prehistory of Iberia*. London: Routledge, pp. 249–66.

Pautreau, J.-P. 1979a. *Le Chalcolithique et l’âge du Bronze en Poitou: Vendée, Deux Sèvres, Vienne*. Poitiers: Centre d’archéologie et d’ethnologie poitevines, Musée Sainte-Croix.

Pautreau, J.-P. 1979b. Les rapports entre Artenaciens et Campaniformes et les débuts de la métallurgie du cuivre dans le Centre-Ouest de la France. *Bulletin de la Société Préhistorique Française*,76: 110–18.

Peña Santos, A. 1980. Las representaciones de alabardas en los grabados rupestres gallegos. *Zephyrvs*, 30: 115–29.

Pingel, V. 1992. *Die vorgeschichtlichen Goldfunde der iberischen Halbinsel: eine archäologische Untersuchung zur Auswertung der Spektralanalysen*. Berlin: Walter de Gruyter.

Roberts, B.W. & Frieman, C. 2015. Early Metallurgy in Western and Northern Europe. In: C. Fowler & J. Harding, eds. *The Oxford Handbook of Neolithic Europe*. Oxford: Oxford University Press, pp. 712–28.

Roberts, B.W., Uckelmann, M. & Brandherm, D. 2013. Old Father Time: The Bronze Age Chronology of Western Europe. In: H. Fokkens & A. Harding, eds. *The Oxford Handbook of the European Bronze Age*. Oxford: Oxford University Press, pp. 17–46.

Rodríguez de la Esperanza, M.J. 2005. *Metalurgia y metalúrgicos en el Valle del Ebro (c. 2900–1500 cal. A.C.).* Madrid: Real Academia de la Historia.

Roussot-Larroque, J. 1989. Le Bronze moyen d’Aquitaine et la culture des Tumulus. In: C. Mordant, ed. *Dynamique du Bronze moyen en Europe occidentale*. Paris: CTHS, pp. 396–427

Roussot-Larroque, J. 1990. Paradigmes perdus, paradigmes retrouvés… Le Campaniforme atlantique et les sociétés du Néolithique final de l’Ouest. In: *La Bretagne et l’Europe préhistoriques: mémoire en hommage à Pierre-Roland Giot*. Rennes: Revue archéologique de l’Ouest, pp. 189–204.

Roussot-Larroque, J. 1996. Le Bronze ancien dans le Sud-Ouest de la France. In C. Mordant & O. Gaiffe, eds. *Cultures et sociétés du Bronze ancien en Europe*. Paris: CTHS, pp. 509–26.

Roussot-Larroque, J. 2001. Bronze moyen et final autour de l’estuaire de la Gironde. In: J. Helgouac’h & J. Briard, eds. *Systèmes fluviaux estuaires et implantations humaines de la préhistoire aux grandes invasion*s. Paris: CTHS, pp. 253–71.

Roussot-Larroque, J. 2005. Première métallurgie du Sud-Ouest Atlantique de la France. In: P. Ambert & J. Vaquer, eds. *La première métallurgie en France et dans les pays limitrophes* (Actes du colloque international Carcassonne, 28–30 septembre 2002). Paris: Société Préhistorique Française, pp. 159–85.

Roussot-Larroque, J. 2007. Bronze Moyen récent du Médoc et Middle Bronze Age II: des connexions atlantiques. In: C. Burgess, P. Topping & F. Lynch, eds. *Beyond Stonehenge: Essays on the Bronze Age in Honour of Colin Burgess*. Oxford: Oxbow, pp. 38–48.

Roussot-Larroque, J., Bourhis, J.-R. & Briard, J. 2001. Une production originale de l’âge du Cuivre dans le Médoc: pointes de Palmela et hachettes minces de Vendays-Montalivet (Gironde). In: J. Briard & J. L’Helgouac’h, eds. *Systèmes fluviaux, estuaires et implantations humaines de la préhistoire aux grandes invasions*. Paris: CTHS, pp. 273–84.

Rovira Llorens, S. & Gomez Ramos, P. 1994. Punzones y varillas metálicas en la Prehistoria reciente española: un estudio tecnológico. *Espacio Tiempo y Forma. Serie I, Prehistoria y Arqueología*, 7: 371–402.

Rovira Llorens, S., Montero-Ruiz, I. & Consuegra, S. 1992. Archaeometallurgical Study of Palmela Arrow Heads and Other Related Types. In: E. Antonacci, ed*. Archeometallurgia: richerche e prospecttive* (Atti del Colloquio di Archeometallurgia Bologna 1988). Bologna: CLUEB, pp. 269–89.

Ruiz-Gálvez Priego, M. 1979. El Bronce Antiguo en la fachada atlantica peninsular: un ensayo de periodizacion. *Trabajos de Prehistoria*, 36: 151–73.

Ruiz-Gálvez Priego, M. 1984. Reflexiones terminológicas en torno a la Edad del Bronce peninsular. *Trabajos de Prehistoria*, 41: 323–42.

Ruiz-Gálvez Priego, M. 1995. El Noroeste de la Península Ibérica en el contexto de la prehistoria reciente de Europa Occidental. In*: Actas del XXII Congreso Nacional de Arqueología Vigo 1993*. Vigo: Xunta de Galicia, pp 11–18.

Ruiz-Gálvez Priego, M. 1998. *La Europa atlántica en la Edad del Bronce: un viaje a las raíces de la Europa occidental*. Barcelona: Crítica.

Ruiz-Gálvez Priego, M. 2014. The Atlantic Iberia: A Threshold between East and West. In: M. Almagro-Gorbea, ed. *Iberia. Protohistory of the Far West of Europe: From Neolithic to Roman Conquest*. Burgos: University of Burgos, pp. 161–80.

Ruiz-Gálvez Priego, M. & Fabregas Valcarce, R. 1997. El noroeste de la Península Ibérica en el IIIer y II o Milenios: propuestas para una síntesis. *Saguntum*, 30: 191–216.

Salanova, L. 2011. Chronologie et facteurs d’évolution des sépultures individuelles campaniformes dans le nord de la France. In*:* L. Salanova & Y. Tchérémissinoff, eds. *Les sépultures individuelles campaniformes en France*. Paris: CNRS, pp. 125–42.

Santos Estévez, M. 2007. *Petroglifos y paisaje social en la prehistoria reciente del noroeste de la península Ibérica*. Santiago de Compostela: Instituto de Estudios Gallegos Padre Sarmiento.

Schauer, P. 1986. *Die Goldblechkegel der Bronzezeit: Ein Beitrag zur Kulturverbindung zwischen Orient und Mitteleuropa*. Bonn: Habelt.

Schubart, H. 1973. Las alabardas de tipo Montejicar. In: J. Maluquer de Motes, ed. *Estudios dedicados al profesor Dr. Luis Pericot*. Barcelona: Instituto de Prehistoria y Arqueología, pp. 247–69.

Schuhmacher, T. 2002. Some Remarks on the Origin and Chronology of Halberds in Europe. *Oxford Journal of Archaeology*, 21: 263–88.

Senna-Martinez, J.C. 1994. Subsídios para o estudo do Bronze pleno na Estremadura atlântica: (1) A alabarda de Tipo ‘Atlântico’ do habitat baûtas (Amadora). *Zephyrus,* 46: 161–82.

Senna-Martinez, J.C. 2007. Aspectos e problemas das origens e desenvolvimento da metalurgia do bronze na fachada atlântica peninsular. *Estudos Arqueológicos de Oeiras*, 15: 119–34.

Senna-Martinez, J.C., Luis, E., Reprezas, J. Lopes, F.M.P., Figuereido, E., Araújo, M.F. & Silva, R.J.C. 2013. Os machados Bujões/Barcelos e as origens da metalurgia do bronze na fachada atlântica peninsular. In: J. Arnaud, A. Martins & C. Neves, eds. *Arqueologia em Portugal, 150 Anos*. Lisboa: Associaçao dos arqueólogos portugueses, pp. 591–600.

Suárez Otero, J. 1997. La Edad del Bronce en Galicia. In: *Galicia castreña y romana*. Lugo: Consellería de Cultura e Comunicación Social, pp. 54–61.

Suárez Otero, J. 2005. Una nueva región Campaniforme: el Noroeste Hispánico. Una propuesta de síntesis desde la causística gallega. In: M.A. Rojo-Guerra, R. Garrido-Pena & I. García-Martínez de Lagrán, eds. *El Campaniforme en la Península Ibérica y su context Europeo*. Valladolid: Universidad de Valladolid, p.177–186.

Taylor, J. 1970. Lunulae Reconsidered. *Proceedings of the Prehistoric Society*, 36: 38–81.

Taylor, J. 1980. *Bronze Age Goldwork of the British Isles*. Cambridge: Cambridge University Press.

Van Schoor, M.L. 2003. Arqueometalurgia do Calcolítico e do Bronze Inicial no norte de Portugal. In: J. Férnández Manzano & J.I. Herrán Martínez, eds. *Mineros y fundidores en el inicio de la Edad de los Metales: el midi francés y el norte de la Península Ibérica*. Léon: MIC, pp. 82–98.

Vilaseco, X.I., Fabregas Valcarce, R. & Gonçalves, V.S. 2003. El Neolítico y el Megalitismo en Galicia: problemas teórico-metodológicos y estado de la cuestión. In: V. Gonçalves ed. *Muita gente, poucas antas? Orígens, espaços e contextos do Megalitismo* (Trabalhos de Arqueologia, 25). Lisboa: Instituto Português de Arqueologia, pp. 281–304.

Villard, J.-F. 2009. Le dépôt de l’âge du Bronze moyen de Keravel en Lannilis (Finistère). *Revue Archéologique de l’Ouest*, 26: 43–55.

Voruz, J.-L. 1996. Chronologie absolue de l’âge du Bronze ancien et moyen. In: C. Mordant & O. Gaiffe, eds. *Cultures et sociétés du Bronze ancien en Europe*. Paris: CTHS, pp. 97–164.