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Stone Bracers in Continental Western Europe. New Insights from Bell Beaker and Early Bronze Age Contexts

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Abstract: This paper aims to collect and comment on up-to-date typological and contextual data for the study of items that are as problematic as they are emblematic of the Bell Beaker phenomenon: the so called ‘wrist-guards’ or stone bracers. The first stage presents the results, method and geographical distribution of a new critical inventory of continental Western Europe stone bracers (Netherlands, Luxemburg, Switzerland, France, Spain, Portugal). 186 stone bracers could be recognised while 79 items have been rejected as they do not meet the proposed criteria. The second step is a descriptive analysis of the recorded stone bracers’ typological features. These appear simple except in the most easterly regions where the typological pattern is richer. The third part deals with contextual reliability and relationships of the corpus. The vast majority of contexts are funerary; however, reliable assemblages are in a minority. Metallurgy and archery seem to be equally represented among associated grave goods, the former more particularly in the Iberian Peninsula and the latter in the Rhine basin. Both typological and contextual data can be compared to what occurs in Great Britain and Central Europe. Finally, chrono-cultural and functional issues remain unresolved and need further work.

Keywords: Archery, Copper, Function, Lithic, Metallurgy, Methodology, Typology, Wrist-guards

Introduction

Stone bracers, also called ‘wrist-guards’, ‘*Armschutzplatten*’ or ‘*brassards d’archer*’, are typical items of the Bell Beaker culture (Harrison 1980; Sangmeister 1974; Treinen 1970). Known from Central Europe to Portugal, they seem to appear with this phenomenon then disappear shortly afterwards, at the end of the Early Bronze Age; the latest contexts were discovered in Slovakia, northern Italy and south-eastern Spain (Grigoriev 2019; Aspes and Fasani 1976; Siret and Siret 1887).

They consist of polished stone plates whose rock type varies from region to region and whose length generally ranges from 6 to 13 cm (Ekemans 2009; Grisse and Schaack 2009; Woodward and Hunter 2011; Nicolas 2020a). More or less narrow or compact, they can also be distinguished from each other by both long sides and cross-section morphologies. Opposite holes must have supported a fastener at the forearm or the elbow, as evidenced by both contextual and use-wear analyses (Delgado Raack 2008: 398; Fokkens *et al.* 2008; Vaart-Verschoof 2009; Woodward and Hunter 2011; Muñoz Moro 2019; Nicolas 2016, 2020a, b).

The actual purpose of these abstruse plates has been debated from the 19th century to this day. Mere ornaments, archer’s wrist-guards, power, prestige, masculinity, martiality and/or archery symbols, sharpening-polishing tools for copper-based, bone or wooden objects and touchstones are among the several functional hypotheses that have arisen throughout the history of research (Ingram 1867; Evans 1872: 383; Siret

and Siret 1888: 32; Martin 1898; Castillo Yurrita 1928: 41; Degen 1976; Risch 1995: 221; Delgado Raack and Risch 2006; Smith 2006; Heyd 2007; Delgado Raack 2008: 398; Fokkens *et al.* 2008; Vaart-Verschoof 2009; Woodward and Hunter 2011; Turek 2015; Nicolas 2020a).

Thus, as the functional debate about stone bracers is still open (Muñoz Moro 2017), this calls for further investigation. Other questions are: where, when and by whom were these plates worn and how did they evolve through time, space and cultures?

Taking up these challenges, we thought a new critical inventory of all stone bracers discovered over continental Western Europe was necessary. Indeed, a systematic documentation of their morpho-technical characteristics as well as their archaeological background should help to prepare both functional and chrono-cultural studies. Moreover, while examples from Great Britain and Central Europe have benefited from recent works (Vaart-Verschoof 2009; Woodward and Hunter 2011; Nicolas 2020a, b), the latest inventories including the western part of the European continent were, as far as we knew, those published by Edward Sangmeister (1964, 1974).

In this paper, we will first present the outcome, method and geographical distribution of our critical inventory of Western Europe stone bracers. In a second step, we will draw up the typological patterns of the corpus. The third part deals with its contextual reliability and relationships. After having discussed the chrono-cultural and functional issues in a fourth stage, we will conclude our study then outline research perspectives.

I. Updating Western European data

I. 1. Results of the critical inventory

Our survey has resulted in a critical inventory of 186 actual stone bracers discovered in France, Luxemburg, the Netherlands, Portugal, Spain and Switzerland. These 186 confirmed stone bracers constitute the study corpus. Another 79 items have not met the proposed criteria (see below) and have therefore been rejected from the corpus.

We think the inventory is almost up-to-date for France, the Netherlands and central Spain. It is well advanced for Portugal and southern Spain. Northern and eastern Spain, Switzerland and Luxemburg would need further queries. It seems that no stone bracer is known in Belgium, which could mainly be the state of research (pers. com. E. Warmenbol, Dec. 2020).

I. 2. Methodology used for the critical inventory of stone bracers

The items of our critical inventory are divided into two main categories: stone bracers (SB), rejected items (RI). The proposed classification rules follow archaeological, analogical and functional criteria.

Bell Beaker archaeological contexts are the starting point for our definition of the study object. The Bell Beaker homogeneous assemblages we are aware of yielded stone plates with opposite holes. None of the reliable Bell Beaker contexts provided such plates with opposite holes which were made of a material other than stone. To be included in the study corpus, items from uncertain contexts must therefore have a lithic material and opposite holes. In addition, they must have a plate morphology and dimensions that allow them to be attached to the forearm or elbow through the opposite holes, as evidenced by the above-mentioned contextual and use-wear studies. The sum of these criteria defines the object of study as stone bracers (SB).

Items referred to as ‘stone bracers’ or ‘wrist-guards’, but which do not meet the proposed criteria, are rejected from the study. Rejected items (RI) are divided into four subcategories (R1, R2, R3, R4) following the reasons of their exclusion, from minor to major reasons (see Supplementary Information, ‘RANK’ column).

R1 items are stone plates with little or no fragmentation that cannot fully meet the above criteria. Some of them may be unfinished stone bracers as well as unfinished or re-worked pendants (or any other artefacts). Further R1 items have two opposite holes, one of which is broken, and morphometric features that are insufficiently knowable or characteristic of the known stone bracers to distinguish them from re-worked pendants.

R2 items are fragments of a stone plate perforated at the remaining end that could not be reconstructed into an actual stone bracer with other fragments. Fragments with a single hole could just as easily have been a stone bracer or a pendant. Fragments of lithic plates with more than one hole at the remaining end are often admitted to the study corpus (SB) as this feature, together with morphometric matches with the known stone bracers, make these fragments more characteristic. Fragments that have more than one hole but lack morphometric matches are classified as R2 items.

A further techno-functional analysis may recognise within R1 and R2 items actual stone bracer roughouts or fragments, hence the interest in distinguishing them from items with a more questionable identity.

R3 items are bracer-like plates made of a material other than stone. Made of bone (e.g., ID 259), amber, jet or gold (ID 189, 194, 195, 198), certain R3 items might be the same functional class as the Bell Beaker stone bracers, as well as copies with a different function, unless this similarity was merely accidental and neither functional nor mimetic in origin. None of the recorded R3 items have been documented as having been found near a deceased’s arm. Some of them may be prestigious imitations from the Early Bronze Age (Nicolas 2019: 132). Further works may prove that R3 items and stone bracers had the very same functionality, which is currently debated (Muñoz Moro 2017), hence our choice in keeping the first out and focusing on the latter to avoid dispersion.

R4 items have an even more questionable archaeological identity, either because they are unrecognisable fragments with no perforation, or they are bracer-like lithic items with possible anachronistic attributes and/or contexts that could suggest an off-topic or a fake (e.g., ID 227), or they are lost and never figured, or they may be documentary duplicates.

I. 3. Corpus geography

Geographical distribution of the 186 stone bracers (SB) recorded in Western Europe is not homogeneous at all (Figure 1). Eight main geographical groups can be delimited: southern Portugal, the Spanish Meseta, south-eastern Spain, Brittany, the lower Rhone Valley, the upper Rhine Valley, French Moselle/Luxemburg, the Netherlands. Four minor regional groups seem to be northern Portugal/Galicia, the Atlantic Loire, the Paris Basin, the Saone Valley.

Other scattered bracers occur in the western Gulf of Lion, the Massif Central, northern France, south-western Alps, Corsica, the Swiss Plateau, northern, southern and eastern Spain. The latter Swiss and Spanish regions are, however, less known than the

previous ones. By contrast, it appears fairly certain that a wide ‘vacuum diagonal’ crosses France from the Pyrenees to Belgium.

II. Typological analysis

II. 1. Choice of a typology

In order to describe stone bracers morphological and mechanical features, we have decided to use Smith’s (2006) typology as slightly developed by Harry Fokkens *et al.* (2008; Figure 2: A; see Supplementary Information, ‘TYPE’ column). This system is an innovative reinterpretation of Atkinson’s typology (Clarke 1970; Figure 2: B). While the latter created standard types adapted to British stone bracers, Smith’s descriptive

system makes immediately clear, by means of transparent and universal encodings, the modalities of the three variables among the most characteristic of a stone bracer: total number of opposite holes, long sides morphology, cross-section morphology.

Nevertheless, Smith’s typology does not take into account the general plate morphology (rectangular, oval, spindle-shaped, etc) nor its dimensions and proportions. Including these variables following the same encoding system would be too much. Together with the previous three ones, these features were taken into account in Sangmeister’s (1974) typology (Figure 2: C). Certain types of the latter remain effective (B, D, E, F). However, some of the recorded bracers do not match Sangmeister’s types (ID 9-10, 22-23, 37, 45, 59, 61, 70,

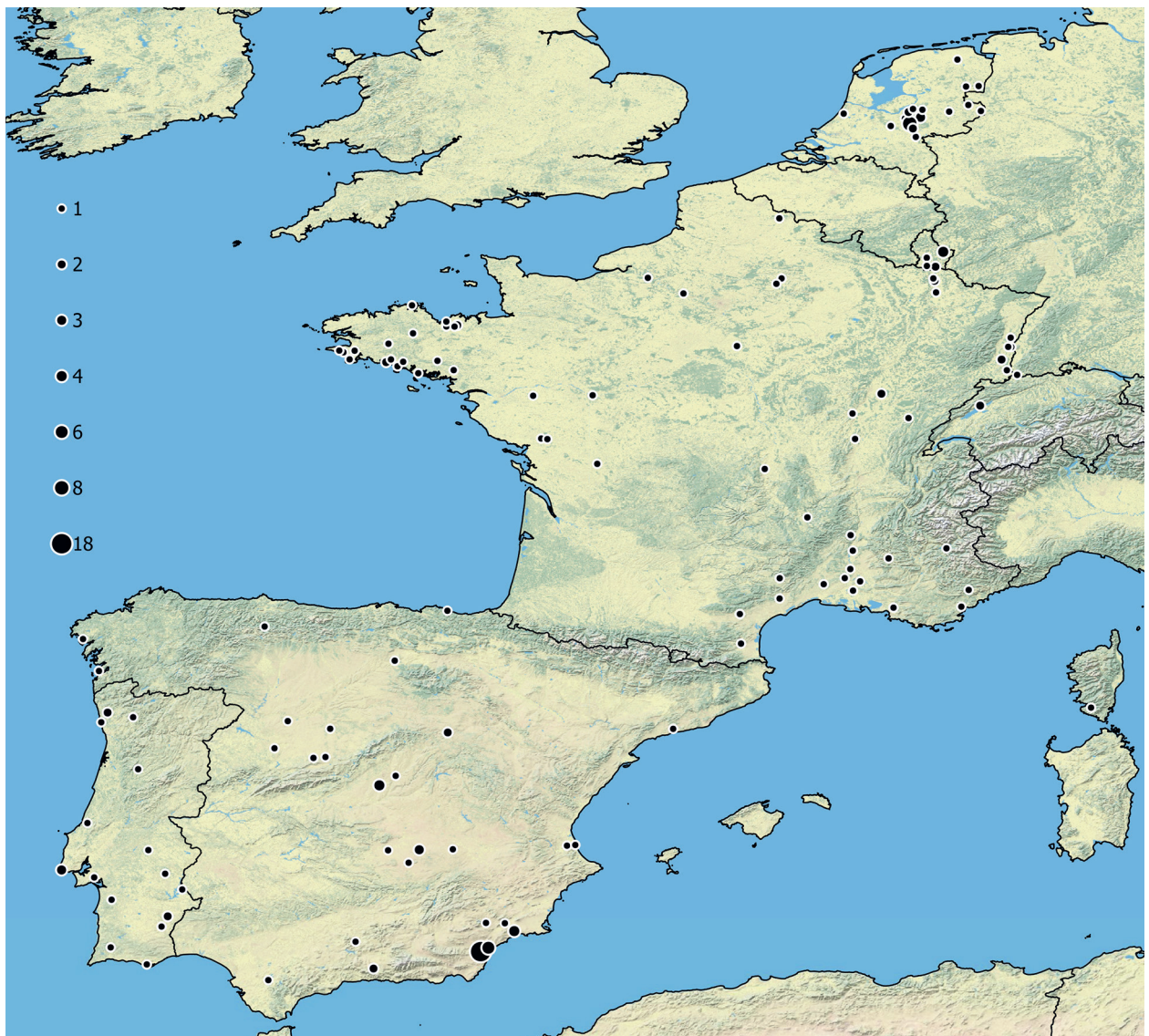
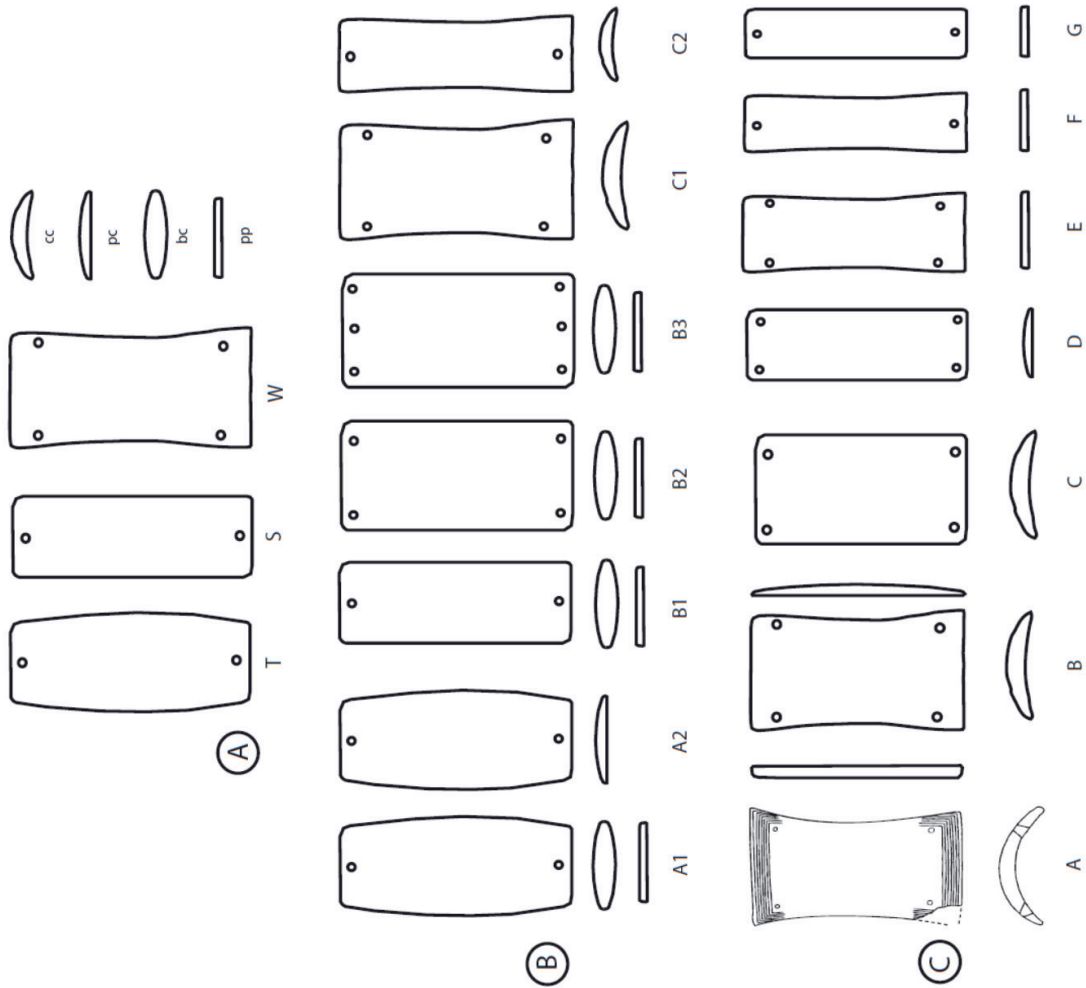


Figure 1: Geographical distribution of the 186 stone bracers inventoried in Western Europe. The list of the sites can be accessed in the Supplementary Information section. A further 79 bracer-like items have been rejected from the study and are therefore not mapped (see section I and Supplementary Information). Map © Julien Vitani (Paris I – Trajectoires) & Guy André (CNRS – LAMPEA)

D. Western Europe stone bracers typological matrix (Smith's typology)

Plate morphology		Number of opposite holes						TOTALS	
LONG SIDES	CROSS-SECTION	2	3	4	4#	6	6#		
"CONVEX (Tapered bracer)"	Tcc	1	1	0	0	0	0	2	
	Tpc	14	0	0	0	0	0	14	
	Tbc	25	0	0	0	0	0	25	
	Tpp	6	0	0	0	0	0	6	
	Tx	24	0	0	0	0	0	24	
	Total Tapered		70	1	0	0	0	0	71
			70	1					
STRAIGHT	Scc	0	0	0	0	0	0	0	
	Spc	8	1	4	2	0	0	15	
	Sbc	2	0	0	0	0	0	2	
	Spp	5	0	0	0	0	0	5	
	Sx	12	0	1	0	0	0	13	
	"Total Straight-sided"		27	1	5	2	0	0	35
			27	8					
"CONCAVE (Waisted bracer)"	Wcc	0	0	7	3	1	0	11	
	Wpc	18	0	2	1	0	0	21	
	Wbc	17	1	1	1	0	0	20	
	Wpp	5	0	1	1	0	0	7	
	Wx	13	0	1	1	0	3	18	
	Total Waisted		53	1	12	7	1	3	77
			53	24					
UNDEFINED	Xpc	1	0	0	0	0	0	1	
	Xx	2	0	0	0	0	0	2	
TOTALS		153	3	17	9	1	3	186	
		153	33						

Figure 2: Stone bracers typological scheme and matrix. Scheme first published by H. Fokkens *et al.* (2008: 111; modified). A: Smith's typology (Smith 2006). B: Atkinson's typology (Clarke 1970). C: Sangmeister's typology (Sangmeister 1974). D. Typological matrix of the 186 stone bracers recorded in Western Europe. Modalities of three typological variables are distributed and correlated by using Smith's descriptive encodings (this figure: A; see section II).



95, 106, 134), while type G, admitting both convex and straight long sides, accepted too many varied bracers. Furthermore, Sangmeister's typology was mostly adapted to a 50-year-old Central Europe corpus. We therefore think the Smith's system will be here suitable as a first descriptive, consensual step, and preliminary to an in-depth typological study.

Smith's descriptive encodings work as follows: **#Xx** (Figure 2: A). The quantitative variable **#**, placed at the beginning of the code, gives the total number of opposite holes. The qualitative variable **X** refers to the long sides morphology and has three modalities: **W** (*Waisted*: concave long sides), **S** (*Straight-sided*), **T** (*Tapered*: convex long sides). The qualitative variable **x** refers to the cross-section morphology and has four modalities: **bc** (*biconvex*), **pc** (*plano-convex*), **pp** (*plano-plano*), **cc** (*concavo-convex*). We will use the **#**, **X** and **x** signs as undefined or uncertain modalities. II. 2. Typological distribution of the corpus

II. 2. 1. General pattern

Total number of opposite holes, an essential feature of the pre-established definition (section I. 1.), logically does not include any undefined numbers (Figure 2: D). It does, however, have some uncertain numbers due to the fragmentation of a few stone bracers. 153 stone bracers obviously have two holes (82.26%). On the other hand, 33 stone bracers (17.74%) have or certainly had more than two opposite holes. Of these, 17 are whole stone bracers with four holes (9.14%) and 9 further ones (4.76%) are fragments of stone bracers that probably had four opposite holes, if one admits a symmetry of the device, which cannot be assured (4#). One stone bracer obviously has 6 holes (ID 186) and three fragmented stone bracers maybe had 6 opposite holes (ID 129, 130, 143: 6#). Three further stone bracers have three holes (ID 61, 70, 95).

In order to reduce the risk of error, we will group these 33 stone bracers together in the same modality 'bracers with more than 2 holes' (>2 holes bracers'), as opposed to the 'two-holed bracers' modality.

Long sides morphology could be defined for 183 stone bracers, i.e., 98.39% of the corpus (Figure 2: D). Out of the 186 recorded stone bracers, 71 have convex long sides; these tapered bracers represent 38.17% of the corpus. 35 other stone bracers have straight long sides (18.82%). 77 further stone bracers have concave long sides; these waisted bracers represent 41.40% of the corpus. Due to gaps in the documentation, 3 stone bracers (1.61%) have undefined long sides (ID 43, 117, 119).

Cross-section morphology is much less known than the previous variable, with 129 defined cross-sections,

i.e., 69.35% of the corpus (Figure 2: D). Only 13 stone bracers have a concavo-convex cross-section (6.99% of the corpus). The cross-section is plano-convex for 51 bracers (27.42%). It is biconvex for 47 bracers (25.27%) and plano-plano for 18 further ones (9.68%). Due to gaps in the documentation, the cross-section could not be defined for 57 stone bracers, i.e., 30.65% of the corpus.

II. 2. 2. Number of holes and long sides morphology

II. 2. 2. 1. Correlation patterns

70 two-holed bracers have convex long sides (2T), i.e., 45.75% of the 153 two-holed bracers (Figure 2: D). This rate is somewhat higher than the proportion of these 2T bracers within the corpus (37.63%). In contrast, only one bracer with more than 2 holes and convex long sides is known (>2T), i.e., 3.03% of the 33 bracers with >2 holes and 0.54% of the corpus.

27 two-holed bracers have straight long sides (2S), i.e., 17.65% of the two-holed bracers. This rate is a little higher than the proportion of these 2S bracers within the corpus (14.52%). Among >2 holes bracers, straight long sides are even better represented, with a total of 8 which represents 24.24% of the bracers with >2 holes. These >2S bracers form 4.30% of the corpus. This is only 3.4 times less than the rate of 2S bracers within the corpus (14.52%), considering that >2 holes bracers are 4.6 times less numerous than two-holed bracers (153:33).

53 two-holed bracers have concave long sides (2W), i.e., 34.64% of the two-holed bracers. This rate is somewhat lower than the proportion of these 2W bracers within the corpus (28.49%). Among >2 holes bracers, concave long sides are much better represented, with a total of 24 which represents 63.64% of the bracers with >2 holes. These >2W bracers form 12.90% of the corpus. This is only 2.7 times less than the rate of 2W bracers within the corpus (34,64%), considering that >2 holes bracers are 4.6 times less numerous than two-holed bracers.

Thus, if we try to detect typological preferences within our corpus, we can assume that straight long sides are more characteristic of >2 holes bracers than two-holed bracers. We then see that concave long sides are even more characteristic of >2 holes bracers than are the straight long sides. On the contrary, it appears that convex long sides are an almost exclusive attribute of the two-holed stone bracers: in our corpus, this morphology tends to exclude bracers with more than 2 holes, as a single >2T bracer is known (ID 70).

Finally, if we simply rank the typological numbers from largest to smallest, the first combination is 2T with 70 examples. The next most numerous combinations of holes devices and long sides morphologies are 2W,

2S and >2W with 53, 27 and 24 specimens respectively (Figure 2: D).

II. 2. 2. 2. Typological geography

Two-holed bracers are present in every region of the corpus (Figures 1 and 3). Among them, this is also the case of 2T bracers, which are proportionally well represented everywhere (Figure 3). 2T bracers especially concentrate in the Netherlands, Brittany, Moselle/Luxemburg and south-eastern Spain; they are in majority in the latter three regions. 2S bracers are more scattered and do not concentrate in any particular area, except in south-eastern Spain where numerous stone bracers of all long sides morphologies could be recorded. 2W bracers are scattered north of

the Pyrenees, except in the Netherlands where they are as well represented as the 2T bracers. South of the Pyrenees, 2W bracers concentrate in the Spanish Meseta, south-western Portugal and north-western Portugal/Galicia. In Iberian Peninsula, 2T and 2W bracers rarely share the same areas. On the one hand, 2W bracers are in majority in the Spanish Meseta. On the other, every 2W bracer from Portugal and Galicia is distributed along the Atlantic coast, whilst 2T bracers from the same area are mostly in the hinterland. It should also be noted that the 2W bracers mapped in Brittany are all distributed along the southern coast of this peninsula, facing the Iberian Peninsula. Similarly, the only 2W bracers recorded in southern France are not distributed in the hinterland but along the Gulf of Lion.

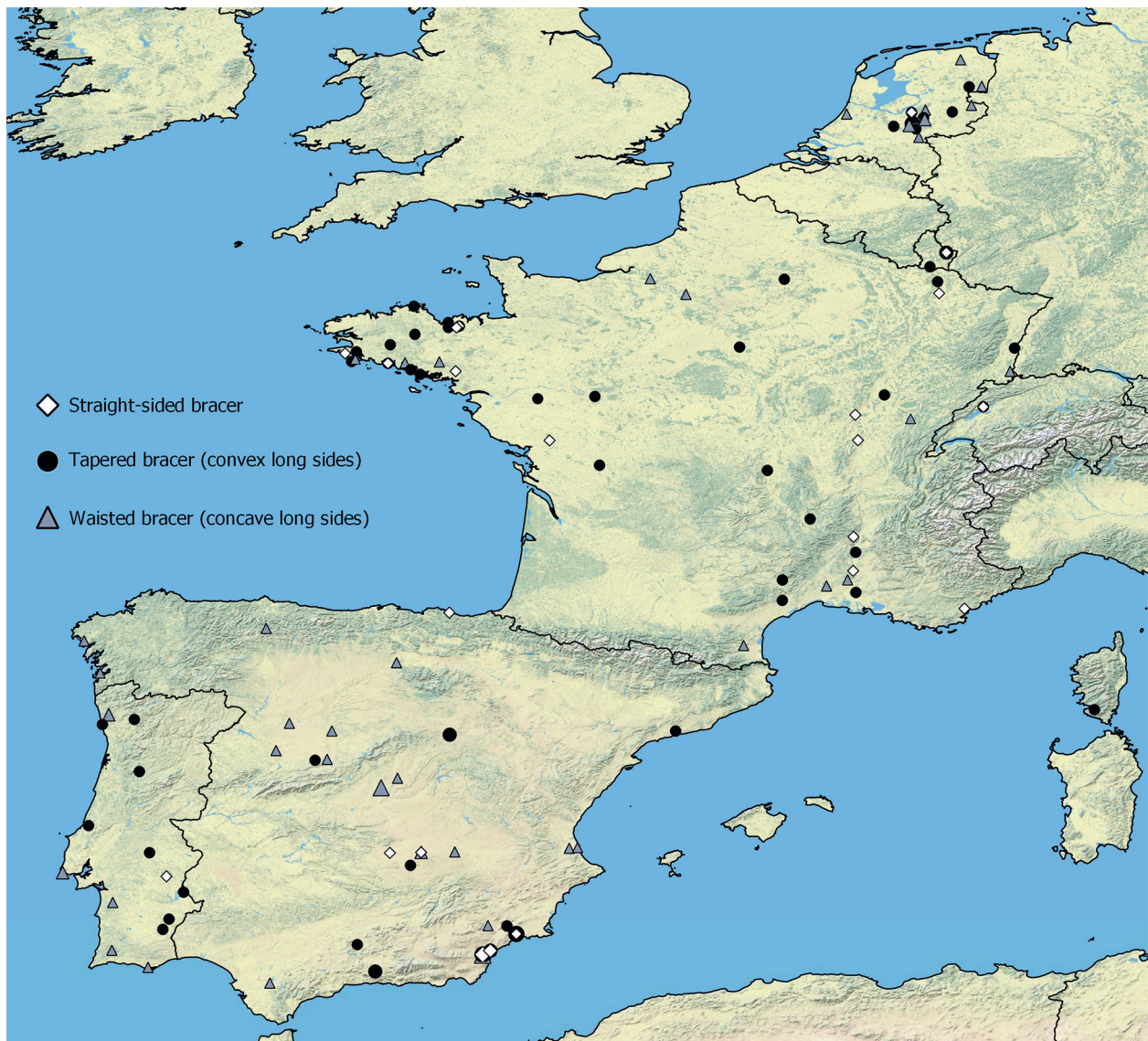


Figure 3: Geographical distribution of the two-holed stone bracers inventoried in Western Europe, distinguished following the long sides morphology (see section II, Fig. 2 and Supplementary Information). Map © Julien Vitani (Paris I – Trajectoires) & Guy André (CNRS – LAMPEA)

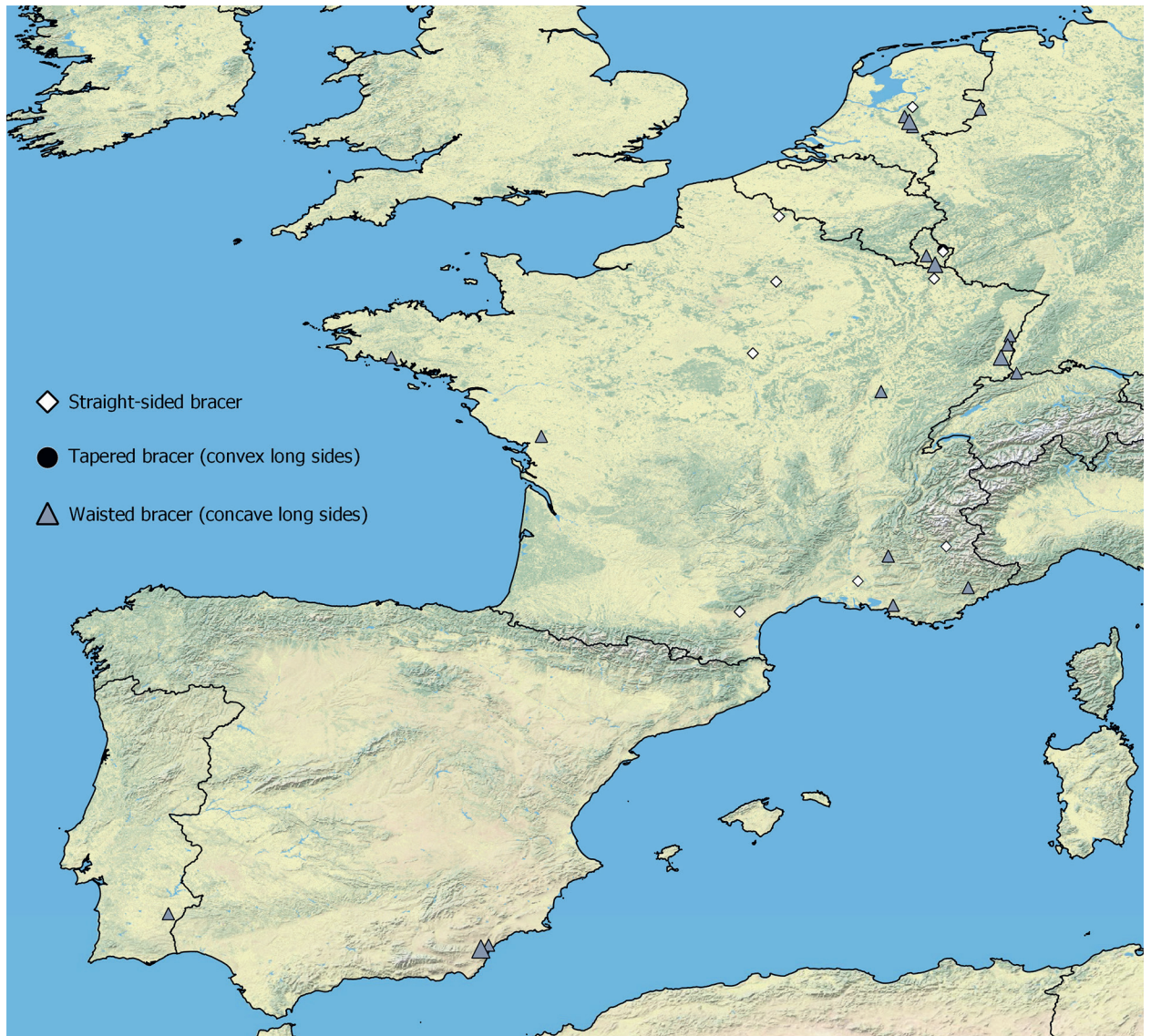


Figure 4: Geographical distribution of the stone bracers with more than two holes inventoried in Western Europe, distinguished following the long sides morphology (see section II, Fig. 2 and Supplementary Information). Map © Julien Vitani (Paris I – Trajectoires) & Guy André (CNRS – LAMPEA)

The geographical pattern is very different for bracers with more than 2 holes: they concentrate in the eastern half of the map, especially in the upper Rhine Valley, French Moselle/Luxemburg and the Netherlands, while they are very rare in the western area (Figure 4). Most of the eastern >2W bracers concentrate in these three Rhine regions, especially in the upper Rhine valley where they are the only known >2 holes bracers. The other eastern >2W bracers are quite scattered in central- and south-eastern France. The six last >2W bracers are the only >2 holes bracers known in the western area; moreover, they occur in regions where the 2W bracers are quite well represented (Figure 3: north-western France, southern Portugal, south-eastern Spain) and belong with them to a wide Iberian and Atlantic area. On the contrary, >2S bracers, less numerous, are very scattered and do not seem to contribute to any

geographical logic, except that they all belong to a large eastern, non-Iberian and non-Atlantic half of the map, like most of the >2 holes bracers. A unique 3T bracer occurs in Luxembourg.

II. 2. 3. Cross-section morphology

II. 2. 3. 1. Geographical pattern

All of the bracers with a concavo-convex cross-section belong to the most north-easterly regions of the corpus, i.e., the Netherlands (ID 80, 84), Luxembourg (ID 70, 72-74), Burgundy (ID 6) and especially the upper Rhine valley (ID 34-37, 39, 186). Most of the cross-sections from the upper Rhine valley are concave. Then, the further west you go, the more the concavo-convex morphology coexists with the other shapes

(Netherlands, Luxembourg, Burgundy), or even disappears in their favour west and south of the Rhine basin and Burgundy.

In southern France (ID 2-4, 50-56, 61-66) and the Netherlands (ID 76-104), a plano-convex cross-section is in the majority while a biconvex cross-section is in the minority. Then, the further west you go, the more the biconvex section seems to dominate, especially in Brittany (ID 11-31) and Iberian Peninsula (ID 105-183). However, while cross-section is well documented in the eastern regions, this is unfortunately less known in the latter two western areas.

II. 2. 3. 2. Typological correlations

In our corpus, a concavo-convex cross-section is an almost exclusive attribute of >2W bracers, which concentrate 11 of the 13 recorded concavo-convex cross-sections (Figure 2: D). The last two are a 2T and a >2T bracer. Concavo-convex cross-section thus tends to combine with both concave long sides and >2 holes devices.

Waisted bracers concentrate 21 plano-convex cross-sections (Wpc), i.e., 41.18% of the plano-convex cross-sections. This rate is equivalent to the rate of waisted bracers in the corpus (41.40%). By contrast, the 14 Tpc bracers represent only 27.45% of the plano-convex cross-sections, considering that tapered bracers constitute 38.17% of the corpus. On the other hand, the 15 Spc bracers form 29.41% of the plano-convex cross-sections, while straight-sided bracers constitute 18.82% of the corpus. It therefore seems that a plano-convex cross-section and straight long sides are preferably combined. However, there are more than a third of undefined cross-sections among tapered bracers in balance (24 Tx). About opposite holes, Spc morphologies have proportionally far more >2 holes bracers than the Wpc morphologies.

Waisted bracers concentrate 20 biconvex cross-sections (Wbc), i.e., 42.55% of the biconvex cross-sections (Figure 2: D). This rate too is equivalent to the rate of waisted bracers in the corpus. We then note that Sbc bracers are only 2, whilst Tbc bracers are 25 (53.19% of biconvex cross-sections). Thus, we can assume that a biconvex cross-section and convex long sides are preferably combined. There are more than a third of the undefined cross-sections among straight-sided bracers, though (13 Sx). About opposite holes, only the waisted bracers have specimens with both a biconvex cross-section and >2 holes.

Straight-sided bracers concentrate 5 plano-plano cross-sections (Spp), i.e., 27.78% of the plano-plano cross-sections. This rate is higher than the rate of straight-sided bracers in the corpus (18.82%). Consequently,

rates of Tpp and Wpp bracers among plano-plano-cross-sections are respectively a little lower than those of tapered and waisted bracers in the corpus. However, plano-plano cross-sections are too rare and undefined cross-sections too frequent to draw preferential combinations with any certainty. We can just note that again, only the waisted bracers have specimens with both a plano-plano cross-section and >2 holes.

III. Contextual overview

III. 1. Methodology for evaluating the archaeological interest of contextual information

In order to study the contextual relationships of the 186 recorded stone bracers on a reliable scientific basis, we have graded their archaeological contexts into five unequal interest levels reflecting the whole range of stratigraphic and documentary situations that can be confronted: 3, 2, 1, X, 0 (Figure 5).

Level 3 rounds up closed homogeneous assemblages confirmed by a superior archaeological operation. That is, each of them is guaranteed to be a complete assemblage of items deposited at the same time. Level 2 collects homogeneous assemblages which, according to a superior or average operation, may have been truncated (re-used or amputated site), and also all homogeneous assemblages delimited by an average operation. In both cases, although a homogeneous stratigraphical core is identified, the known assemblage may be partial.

Only level 3 and 2 assemblages are constituted of strict associations. Level 3 assemblages, definitively closed, do not admit probable or uncertain associations. On the contrary, level 2 assemblages, maybe partial, can admit probable or uncertain associations which could complement them. Furthermore, level 3 and 2 assemblages can be linked by peripheric associations to other assemblages which suggest a site logic (e. g., a pottery deposit above a grave).

Level 1 gathers hypothetically homogeneous assemblages. These may have been affected by stratigraphic or methodological defects which question the deposit homogeneity (disturbed context, unskilled excavation, etc). Hypothetical assemblages can at most admit probable and uncertain associations. While some may see them as strict associations, other (including us) may still have doubts: no archaeological consensus seems possible.

The terms 'probable' and 'uncertain' reflect our own opinion: rather positive with the first term, rather negative with the second one; both terms give room for doubt in either direction. We will only comment on strict and probable associations, while listing the associations we consider uncertain.

Methodological factor		Stratigraphical factor (after documentation)				Operations methodological limitations
		heterogeneous or undefined assemblage or isolated find	hypothetically homogeneous assemblage	homogeneous assemblage, but possibly partial	closed and homogeneous assemblage	
Operation quality	High	0	1	2	3	"Superior operations: optimal field view"
	Average	0	1	2	2	"Average operations: partial field view"
	Low	0	1	1	1	"Inferior operations: minimal or no field view"

Archaeological interest level	3	closed homogeneous assemblage
	2	possibly partial homogeneous assemblage
	1	hypothetically homogeneous assemblage
	X	hypothetical assemblage awaiting further information
	0	definitively no substantial contextual data

Figure 5: Proposed methodology for evaluating the archaeological interest of contextual information © Julien Vitani (Paris I – Trajectoires) & Agnès Caraglio (Éveha – LAMPEA). A: Combination of methodological and stratigraphic factors involved in the assessment of contextual data. B: Scale of archaeological interest of contextual information (see section III. 1).

Level X collects hypothetical assemblages which are still awaiting further information. Like level 1 assemblages, they can at most admit probable and uncertain associations.

Level 0 puts together heterogeneous (i.e., mixed) or undefined assemblages as well as isolated finds: no substantial contextual data.

III. 2. Archaeological interest of the recorded contextual data

11 stone bracers (5.91% of the corpus) belonged to a closed homogeneous assemblage confirmed by a superior archaeological operation (level 3). 15 further bracers (8.06%) come from a level 2 homogeneous assemblage (possibly partial). This makes a total of 26 stone bracers, out of 186 (13.98%), that belonged to a confirmed homogeneous assemblage (see Supplementary Information, ‘LVL’ column).

36 stone bracers (19.35%) come from a hypothetically homogeneous assemblage (level 1) and 9 others (4.84%) are still awaiting further contextual information (level X). These 42 stone bracers can at most admit probable and uncertain associations (24.19%).

The last 115 stone bracers (61.83%) are separated from any reliable contextual relationship, either as isolated finds or from mixed or undefined assemblages (level 0).

III. 3. Kinds of contexts

Out of the 186 stone bracers recorded in Western Europe, 109 belonged to a funerary context (58,60%). 23 further stone bracers come from a domestic context (12,37%). The last 54 bracers (29,03%) are isolated finds or come from an undefined kind of context (see Supplementary Information, ‘CTXT’ column).

Among the recorded domestic contexts, 1 is level 2 (ID 105), 2 are level 1 (ID 6, 54), 20 are level 0. We will therefore focus on the most reliable among the numerous recorded funerary contexts, which have yielded 25 homogeneous assemblages (levels 3 and 2) and 38 hypothetical assemblages (levels 1 and X).

III. 4. Association patterns in Western European funerary contexts

III. 4. 1. Strict associations

Copper-based weapons (metal arrowheads, Palmela points, copper daggers, other copper weapons) constitute the most significant set of stone bracers’ contextual relationships with a total of 17 strict associations (Figure 6). The second set is formed by Bell Beaker ware with 11 strict associations. A third set can be delimited by archery-related items with 9 strict associations (arrowheads and 1 grooved-stone interpreted as a shaft polisher).

However, the latter set would be more important if it included the 5 associations of Palmela points, whose functionality remains unsure: these items may equally have been mounted on either an arrow or a javelin (Gutiérrez Sáez *et al.* 2010, 2014).

III. 4. 2. Probable associations

Here too, copper-based weapons are the largest set with 14 probable associations. Archery-related items are the second set with 9 probable associations (arrowheads and one bow-shaped pendant), 10 if one includes Palmela points. Bell Beaker ware is the third set with seven probable associations (Figure 6).

However, six probable associations of undefined ware might be attributed to the Bell Beaker phenomenon as well as to an Early Bronze Age culture.

III. 4. 3. Geographical distribution

13 out of the 17 strict associations of stone bracers with copper-based weapons come from the Iberian Peninsula (Figure 6: lower part); the last four are spread across the lower Loire (ID 60), Burgundy (7), Moselle (41) and the Netherlands (86). This country (ID 84, 87), southern Brittany (22-24), northern and southern France (46, 52, 55), Corsica (33) and the Iberian Peninsula have provided the 14 probable associations of stone bracers with copper-based weapons. These are unknown within both strict and probable associations from the upper Rhine valley.

The latter region and the Netherlands have each yielded two strict and three probable associations of stone bracers with archery-related items (ID 35-36, 38, 81, 85-87, 100). Between these two regions, Moselle has

Figure 6: Presence-absence table of the contextual relationships of the 63 stone bracers from the most reliable funerary assemblages recorded in Western Europe. Strict, probable and uncertain associations. P: peripheric associations (see section III. 1).

				●	0	2	5	8	2	0	6	1	8	4	3	11	4	2	2
Strict associations				●	0	2	5	8	2	0	6	1	8	4	3	11	4	2	2
Probable associations				◇	4	0	1	12	1	3	8	1	5	0	4	7	1	6	0
Uncertain associations				○	6	0	3	5	2	2	7	1	8	1	6	14	3	6	0
“Stone bracers from the most reliable funerary assemblages”				metal ornament	metal arrowhead	Palmela point	copper dagger	other copper weapon	other metal industry	lithic arrowhead	other archery item	other lithic industry	other bone industry	other ornament	Bell Beaker ware	EBA ware	undefined ware	single gravegood	
ID	CTRY	SITE	LVL																
1	FRA	La Gravière Peer II	3							●									
2	FRA	Sabatas	1									○		○			○		
7	FRA	Le Nicolot	2				●					●			●				
11	FRA	Men-ar-Rompét	1												◇				
22	FRA	Coatjou-Glas	1				◇		◇	◇				◇			○		
23	FRA	Penker	1				◇			○		◇		◇	○		◇		
24	FRA	Lothéa	1	◇			◇		◇	◇		○		◇					
31	FRA	Kerallant: dolmen 2	1	○								○			○				
33	FRA	Palaghju	1	◇			◇		◇			◇					◇		
35	FRA	Reguisheim: g. 221	X							◇	◇			◇	◇				
36	FRA	Reguisheim: g. 8182	X	◇						◇					◇				
37	FRA	Gravière Hohwald	1												◇				
38	FRA	Les Villas d’Aurèle	3							●	●	●			●				
40	FRA	La Sente: g. 515	3							●						●			
41	FRA	La Sente: g. 722	3		●											●			
42	FRA	ZAC Chèvre Haie	3									●	●		●				
43	FRA	Usine Solblank	3							●		●	●		●				
46	FRA	Arenberg	1				◇			◇					◇				

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"Stone bracers from the most reliable funerary assemblages"				metal ornament	metal arrowhead	Palmela point	copper dagger	other copper weapon	other metal industry	lithic arrowhead	other archery item	other lithic industry	other bone industry	other ornament	Bell Beaker ware	EBA ware	undefined ware	single gravegood	
ID	CTRY	SITE	LVL																
47	FRA	Les Bretelles	3																●
52	FRA	Colombel	1				◇												
55	FRA	Grotte 4 du Rhinocéros	1					◇							○				
60	FRA	Les Bouloires	3				●									P			
61	FRA	Le Villard	1				○				○	○		○	○				
66	FRA	L'Agriotier	1							○		○		○			○		
80	NET	Ginkelse Heide: Girhen	1				○		○	○		○			○		○		
81	NET	Harskamp 1: Hondslög	1							◇		◇			○				
84	NET	Korte Struiken	1				◇								○				
85	NET	Lunteren 1: De Valk	1							◇		◇							
86	NET	Lunteren 2: Vlooiënpol	2				●			●		●			●				
87	NET	Lunterse Heide: g. 1.50	1				◇			◇					○				
91	NET	Hunderberg	2												●				
94	NET	Oostereng	1							○		◇			○				
96	NET	Holten: Tum. IV	1							○		○				○			
98	NET	Dalen	2									●			P				
100	NET	Harenermolen	2							●		●		●	P				
102	NET	Maarsbergen	1												◇		◇		
106	POR	Godinho	1	○													◇		
112	POR	Ferradeira	1				◇										◇		
114	POR	Seixas	X			○		○							○				
120	POR	Regedoura 2	1			○						○					○		
121	POR	Chã de Arefe: g. 1	2			●											●		
122	POR	Chã de Arefe: g. 2	2																●
133	SPA	El Argar: g. 154	1										○	○					
134	SPA	El Argar: g. 425	1	○															
135	SPA	El Argar: g. 530	1				○												
136	SPA	El Argar: g. 692	1				○										○		
137	SPA	El Argar: g. 767	1	○															
148	SPA	Cu. de los Granadillos	1															◇	
150	SPA	Los Bermejales: g. 8.5	1				◇										◇		
153	SPA	Morra del Quintanar	2												●				
161	SPA	El Alto del Reinoso	2		●										●	●			
163	SPA	La Sima: UE 18	2				●								●				
164	SPA	La Sima: UE 6	1		○	○	○	○	○					○	○				
165	SPA	Perro Alto	1	◇	◇	◇				○					◇				
169	SPA	Humanejos: UE 455.7	2	○	●										●				
170	SPA	Humanejos: UE 455.8	2	○	●	●									●				
171	SPA	Humanejos: UE 680	3												●				
172	SPA	Humanejos: UE 1853	2		●	●	●	○					●	○	●				
175	SPA	Agra da Ínsua	2				●												
176	SPA	Gandón	2		●												●		

“Stone bracers from the most reliable funerary assemblages”				metal ornament	metal arrowhead	Palmela point	copper dagger	other copper weapon	other metal industry	lithic arrowhead	other archery item	other lithic industry	other bone industry	other ornament	Bell Beaker ware	EBA ware	undefined ware	single gravegood
ID	CTRY	SITE	LVL															
177	SPA	Los Cipreses	3				●	●				●	●					
181	SPA	Zapata: g. 15	1				◇										○	
186	SWI	Hörnlfriedhof	X												○			

provided three strict associations with arrowheads (40-41, 43). Most of both strict and probable associations of stone bracers with archery-related items thus belonged to the Rhine basin. The last two archery-related strict associations come from central France and the Spanish Meseta (ID 1, 161). Brittany and northern France have yielded the last three archery-related probable associations (22, 24, 46).

Every Palmela points association occurs in the Iberian Peninsula.

IV. Discussion

IV. 1. Geochronology

A typological dichotomy between Western and Central European stone bracers has long been recognised by past leading works (Sangmeister 1964; Treinen 1970; Harrison 1980). Indeed, whilst the latter bracers show a greater typological diversity, the former are simpler from this point of view. With two-holed types, Central European bracers admit various >2 holes types, including >2T types, and numerous concavo-convex cross-section morphologies (Nicolas 2020a). As an interface between Western and Central Europe, the most western areas where such a typological variety is known are Great Britain (Woodward and Hunter 2011), the Rhine basin, eastern France (see section II) and Italy (Aspes and Fasani 1976; Delpino and Pellegrini 1999; Ferrarese Ceruti 1997). Then, the further west you go, the simpler the holes device and cross-section morphology (section II).

The above-mentioned reference studies proposed a typo-geochronology of stone bracers which consisted in their *simplification* from East to West, from Central Europe to the Iberian Peninsula. Since then, this idea has been discussed and replaced by its logical reverse: a *complexification* gradient of stone bracers from the Iberian Peninsula to Central Europe (Nicolas *et al.* 2013; Nicolas 2020a). This gradient may be more coherent with the Maritime Model which supports a growth of the Bell

Beaker phenomenon from simple Iberian beaker types to more complex sets of ceramic wares and from West to East (Guilaine 2004; Salanova 2011). Nevertheless, this model can be challenged (Beckerman 2012; Vander Linden 2012; Jeunesse 2014; Bailly 2020).

The earliest radiocarbon-dated stone bracer contexts recorded in Western Europe do not seem to be older than the earliest radiocarbon-dated Central European stone bracer contexts we are aware of (Figures 7 and 8). Those from the Rhine basin (ID 38, 98) and the Iberian Peninsula (ID 105, 169-172) might be contemporary to those in Central Europe; some of the latter might even be a little bit older (U Isidorka, Záhlinice, Sutny). All other radiocarbon-dated Western bracers, from France, may belong to the beginning of Early Bronze Age (Figure 7). These data might corroborate the old stone bracer typo-geochronology and disprove the recent one, while suggesting a very fast phenomenon on a continental scale by 2450 cal. BC. However, reliably radiocarbon-dated bracer contexts remain scarce in continental Western Europe and even absent from certain bridge regions (e.g., Brittany, southern France); thus, new or unknown data could affect our assumptions.

IV. 2. Functionality

Out of 186 stone bracers, only 25 come from homogeneous funerary assemblages (section III). Among these, 18 bracers share strict associations with either copper-based weapons (13 bracers) and/or archery-related items (8, 13 bracers if Palmela points were arrowheads), while seven bracers share no strict association with either copper-based weapons or archery-related items (Figure 6). Among 38 hypothetical funerary assemblages, 17 stone bracers share probable associations with either copper-based weapons (13 bracers) and/or archery-related items (8, 9 bracers if Palmela points were arrowheads), while 21 bracers share no probable association with either set. Of these 63 bracers coming from the most reliable funerary contexts, 28 share no strict or probable association with either set.

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Figure 7: Radiocarbon-dated stone bracers contexts in continental Western Europe (INTCAL2020). Three stone bracers from Dutch graves are not listed here as their direct link with radiocarbon-dated material cannot be ensured (ID 80, 84, 86).

ID	CTRY	Municipality	Site	CTXT	Locus	Material	Carbon-14 BP dates	Cal. dates (INTCAL2020)	Type	References
1	FRA	Riom	La Gravière Peer II	FNR	SP 2	human bone	3830 ± 55 [Ly-7681]	2463-2140 cal BC (95.4%)	2Tpc	Loison 2003
7	FRA	Genlis	Le Nicolot	FNR	UF 24	cremated deposit	3805 ± 30 [Poz-64785]	"2396-2388 cal BC (0.8%) 2344-2140 cal BC (94.7%)"	2Tbc	Christin <i>et al.</i> 2016
38	FRA	Sierentz	Les Villas d'Aurèle	FNR	SP 68	human bone	"3875 ± 35 [Poz-41226] 3910 ± 35 [Poz-41227]"	"2552-2238 cal BC (95.4%) 2465-2209 cal BC (95.4%) "	2Wpc	Vergnaud 2013
40	FRA	Mondelange	La Sente	FNR	SP 515	?	"3805 ± 35 [GrA-44685]"	"2446-2424 cal BC (1.3%) 2405-2378 cal BC (2.8%) 2350-2136 cal BC (91.3%)"	2Tx	Lefebvre 2010
47	FRA	Saint-Martin-la-Garenne	Les Bretelles	FNR	F.54	dental collagene	"3800 ± 30 [Beta-467207]"	2343-2138 cal BC (95.4%)	2Wbc	Domenech & Corona 2018
60	FRA	Saint-Martin-de-Fraigneau	Les Bouilloires	FNR		human bone	3700 ± 50 [Ly-7487]	"2276-2255 cal BC (2.1%) 2206-1946 cal BC (93.3%)"	2Spc	André 1998
98	NET	Coevorden	Dalen	FNR		burnt human bone	"3910 ± 50 [GrA-13617]"	"2566-2531 cal BC (4.3%) 2496-2277 cal BC (85.3%) 2254-2206 cal BC (5.8%) "	2Tpc	Lanting & Plicht 2000
105	POR	Mourão	Porto das Carretas	DOM	"M13 C.2B2 Hearth A"	wood charcoal	"3920 ± 40 [Beta-196681] "	"2566-2531 cal BC (4.5%) 2495-2286 cal BC (90.4%) 2246-2239 cal BC (0.5%)"	2Tpc	Soares & Tavares da Silva 2010b
					"ibid. Hearth B"	wood charcoal	"3860 ± 40 [Beta-204062]"	"2462-2470 cal BC (77.8%) 2260-2204 cal BC (17.6%) "		
					"ibid. Hearth C"	wood charcoal	"3840 ± 60 [Beta-193743]"	2470-2136 cal BC (95.4%)		
163	SPA	Miño de Medinaceli	La Sima	FNR	"SIMA III UE 18"	human bone	"3860 ± 30 [KIA-17999]"	"2460-2276 cal BC (80.5%) 2256-2206 cal BC (15.0%)"	2Tpp	Rojo Guerra <i>et al.</i> 2005
						human bone	"3862 ± 28 [KIA-18000]"	"2459-2280 cal BC (82.9%) 2253-2208 cal BC (12.6%)"		

ID	CTRY	Municipality	Site	CTXT	Locus	Material	Carbon-14 BP dates	Cal. dates (INTCAL2020)	Type	References	
169	SPA	Parla	Humanejos	FNR	UE 455	human bone	"3825 ± 37 [Ua40218]"	"2454-2418 cal BC (5.5%)	2Wbc	Garrido Pena <i>et al.</i> 2019	
170								2409-2194 cal BC (83.4%)			2176-2144 cal BC (6.5%)"
171					UEx 680	?	"3920 ± 20 [GrM-15289]"	"2470-2341 cal BC (93.1%)	2318-2306 cal BC (2.3%)"		2Wpp
172					UEx 1853	human bone	"3917 ± 33 [Ua43524]"	"2555-2544 cal BC (0.9%)	2488-2483 cal BC (0.4%)		2476-2290 cal BC (94.1%)"

As the other 49 bracers from funerary contexts have a mixed or undefined assemblage and 54 further stone bracers come from an undefined context (see Supplementary Information), it is difficult to estimate the representativeness of those associations in continental Western Europe. Only regional trends may be suggested (section III. 4). Archers' sets from the Rhine basin graves can be compared to those from Central Europe (Nicolas 2020b), while Palmela points from Iberian graves are very specific to this Peninsula (Gutiérrez Sáez *et al.* 2010).

If the recorded funerary associations were given some importance in the functional debate, it could be assumed that both hypotheses of archery-related bracers and sharpening-polishing tools for copper-based weapons would be equally plausible. This equality of chances may also be reflected in the funerary contexts of stone bracers from both Britain and Central Europe, where, again, copper-based weapons and archery-related items are equally represented (Woodward and Hunter 2011; Nicolas 2020b).

However, only further use-wear analyses will be able to identify the actual functionality of these obscure plates. Stone bracers' functionality probably has more to teach us about their contexts than the other way around. Contexts 'suggest' avenues, but these must be rectified by functional studies taking into account a wide and varied range of possibilities, otherwise they could lead to the circular reasoning of imaginary prehistory (Stoczkowski 2002). At present, there is no consensus on the interpretation of stone bracers' marks. Into the same kinds of marks have been read either the sharpening-polishing of copper weapons (Delgado Raack and Risch 2006; Muñoz Moro 2017) or technological stigmata; the latter identification,

combined with the perceived absence of use marks other than wearing the bracer, has recently been linked to a mainly ornamental function (Woodward and Hunter 2011; Nicolas 2020a).

Conclusion and perspectives of research

Our survey has been able to gather, comment on and compare most of the up-to-date typological and contextual stone bracer information from the investigated Western European areas. We hope the proposed methodologies and collected data may have laid the foundation for future works and debates. We think that both chrono-cultural and functional issues need further in-depth studies. We must try to reason without any confirmation bias and remain open to every possibility. With this in mind, the first author is preparing a PhD thesis including the functional analysis of these curious stone plates.

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Figure 8: Radiocarbon-dated stone bracers contexts in Central Europe (INTCAL2020).

Country	Municipality	Site	CTXT	Locus	Material	Carbon-14 BP dates	Cal. dates (INTCAL2020)	Type	References
Czechia	Hrobčice	Radovesice-Bílina III	FNR	"grave 53/80-II"	?	3860 ± 40 [Kl-4449]	"2462-2270 cal BC (77.8%) 2260-2204 cal BC (17.6%)"	4Wcc	Nicolas 2020a
Czechia	Hulín	U Isidorka	FNR	grave 63	human bone	"3950 ± 30 [KIA-34665]"	"2570-2519 cal BC (20.8%) 2500-2342 cal BC (74.6%)"	4Scc	Peška 2013
Czechia	Hulín	Záhlinice	FNR	grave 48/89	human bone	"3935 ± 40 [VERA-5230]"	"2568-2528 cal BC (10.1%) 2496-2296 cal BC (85.4%)"	4#Xpc	Nicolas 2020a
Czechia	Kyjovice / Těšetice	Sutny	FNR	grave 27	dagger wooden sheath	"3940 ± 40 [Poz-44322]"	"2570-2521 cal BC (13.6%) 2499-2296 cal BC (81.8%)"	4Scc	Nicolas 2020a
Czechia	Tvořihráz	Tvořihráz	FNR	grave 2/91	wood charcoal	"3869 ± 40 [Bln-4497] 3746 ± 52 [Bln-4498] 3771 ± 44 [Bln-4499] 4011 ± 52 [Bln-4500] 3838 ± 42 [Bln-4501]"	"2464-2206 cal BC [95.4%] 2340-1978 cal BC [95.4%] 2341-2035 cal BC [95.4%] 2846-2348 cal BC [95.4%] 2458-2150 cal BC [95.4%]"	6Tbc	Nicolas 2020a
Hungary	Szigetszentmiklós	Felső Űrgehegyi dűlő	FNR	grave 49	human bone	"3830 ± 40 [VERA-4749]"	"2456-2196 cal BC (90.3%) 2172-2146 cal BC (5.1%)"	4Wcc	Nicolas 2020a
Hungary	Szigetszentmiklós	Felső Űrgehegyi dűlő	FNR	grave 626	human bone	"3845 ± 35 [VERA-4757]"	2456-2202 cal BC (95.4%)	4Scc	Nicolas 2020a

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Supplementary information

Our critical inventory of Western Europe stone bracers (SB) and rejected items (RI) is hosted online by the University of Geneva's publications server. It can be accessed via the following link:
<https://archive-ouverte.unige.ch/unige:156838>

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