

**EUROPE DURING THE THIRD
MILLENNIUM BC AND BELL BEAKER
CULTURE PHENOMENON :
PEOPLING HISTORY THROUGH DENTAL
NON-METRIC TRAITS STUDY**



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The Bell Beaker complex is defined, above all, by a ceramic style widespread across Europe during the third millennium BC. Its particularly vast geographic distribution has provoked different interpretations : 1) a unique population invading Europe, 2) the long-distance exchange of prestige goods, and 3) the absence of a Bell Beaker population with only the diffusion of its cultural components.

To understand the mechanisms leading to the origins of the Bell Beaker culture, it is necessary to work in a vast territory since this is a phenomenon extending across all of Europe. And it is in this perspective of a broad view of the Bell Beaker culture that an interdisciplinary research program directed by prof. Marie Besse, entitled *Europe during the third millennium BC : from archaeological fact to peopling history*, was developed. This program aims at better understanding of the modes of appearance of the Bell Beaker through evaluation of the importance of the Neolithic ground in its establishment. There are four complementary axes of research : typology and chronology of the common ware pottery, territory occupation, metallurgy and biological anthropology.

Biological anthropology makes it possible to test the first of these hypotheses, which proposes the diffusion of a culture by population displacement. Pertinent elements on the human skeleton must thus be identified for analysis. Here, the choice was made to analyze nonmetric dental traits, anatomic variations observed on permanent and deciduous dentition. Based on results obtained from studies of archaeological material, the regions selected to test this hypothesis are Spain, France, Switzerland, the Czech Republic and Hungary.

The Bell Beaker culture

The Bell Beaker culture initially refers to a pottery style largely widespread in Europe and North Africa during the third millennium BC, a period that corresponds to the end of the Neolithic. It was first defined at the end of the 19th and beginning of the 20th century, in Spain, to describe S-profiled vases, in the form of an inverted bell. The Bell Beaker culture covers a vast territory from the British Isles to the North African coast – for its north-south extension – and from Portugal

to Hungary – for its east-west extension. The Bell Beaker complex was established on a Europe-wide scale, with quite different preceding local substrates. Between the uniform eastern pre-Bell Beaker ground (the Corded Ware culture) and the western heterogeneity, data are difficult to compare.

The Bell Beaker complex is characterized by material including decorated pottery – the common denominator of this culture –, common ware ceramics varying by region, diverse artifacts including wristguards, tanged daggers, Palmela points and buttons with V perforation (Fig. 1). While these artifacts unite the Bell Beaker complex, the incontestable diversity of its funerary and domestic structures blurs the overall uniformity. From the individual grave, re-use, collective tombs and incineration, the funeral practices of the Bell Beaker reveal its complexity (Besse and Desideri, 2004). Similarly, variability in domestic structures, whether with respect to construction – on posts or dry-

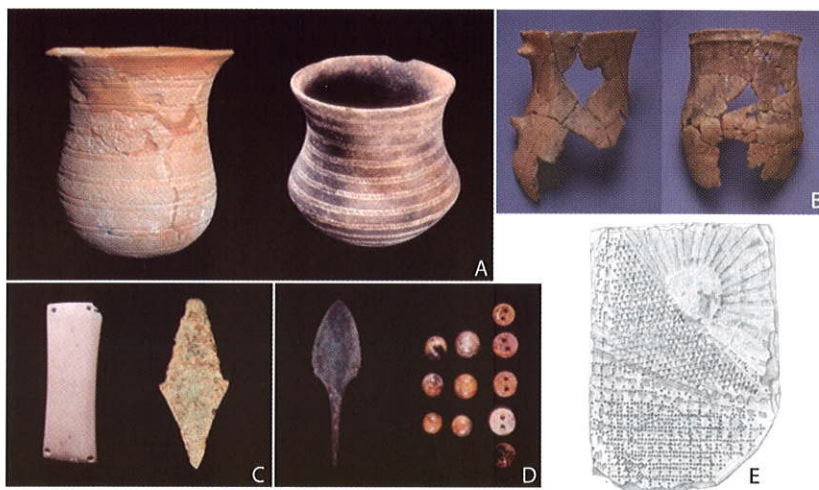


Figure 1. Bell Beaker material : (A) Decorated pottery (left, Engelhardt 1999, p. 38 ; right, Contu, 1998, p. 286) / (B) Common ware pottery (Photo : OPH Jura) / (C) Left, a wristguard (Nicolis and Mottes 1998, p. 199), right dagger blade (Guilaine 1998, p. 107) / (D) Left, Palmela point (Guilaine 1998, p. 104), right, V-perforated bone buttons (Nicolis and Mottes 1998, p. 323) / (E) Anthropomorphic stela (Favre et al. 1986, plate 21).

stone –, form – circular, oval, rectangular –, or location – near or far from their substrate –, is clear (Besse and Desideri, 2005).

The Bell Beaker complex developed during the third millennium BC, between 2900 and 1800 BC, and it is possible to demonstrate a south-west-northeast gradient for its emergence (Guilaine, 1998). Initial explanations concerning the emergence of the Bell Beaker were primarily based on the pan-European character of certain types of artifacts and varied between population movements, exchange of goods and exchange of ideas (Del Castillo, 1928 ; Sangmeister, 1963 ; Lanting and Van der Waals, 1976...). Today, research focuses on divergences, analyzing vast territories using specific instruments. The least exceptional elements of the material culture, such as common ware ceramics and lithics, demonstrate a clear dichotomy in the Bell Beaker complex that opposes the eastern and western regions of this phenomenon (Bailly, 2002 ; Besse, 2003 ; Lemerrier, 2004 ; Furestier, 2007).

Five Bell Beaker portraits

Five regions representing five different portraits of the Bell Beaker occupation during the third millennium BC have been chosen. While far from representing the entire range of variability in the Bell Beaker complex, an attempt has been made to cover a large portion of this variability.

Northern Spain : The Iberian Peninsula is a significant region for understanding the Bell Beaker phenomenon. The Bell Beaker developed during the first half of the third millennium BC, during the recent phase of the Chalcolithic and coexisted with it until the emergence of the Early Bronze Age. Archaeological data suggest that the emergence of the Bell Beaker was associated with societal transformations at the end of the Neolithic by the exchange of socially valuable goods. From an anthropological point of view, no element suggests a renewal or displacement of populations at the origins of the Bell Beaker ; however, studies have not specifically addressed this issue and concern primarily the effects of environment on individuals. The sample here consists

of around 180 individuals and 14 sites from northern Spain. The samples are attributed to the Final Neolithic, Chalcolithic and Bell Beaker.

Southern France : The end of the Neolithic, marked by the emergence of a multitude of distinct and geographically limited cultural groups, is divided into two phases : the Final Neolithic and the Chalcolithic. The Bell Beaker was established in irregular manner across the region considered and, in some cases, coexisted with local cultures. It developed during the first half of the third millennium BC. Archaeological data generally reveal two phases of Bell Beaker occupation. The first marks a clear rupture with local traditions, the second a period of integration and cohabitation. The complicated funerary contexts in this region have probably not led to many anthropological studies. The sparse data do not permit interpretation in terms of population history. The sample consists of around 700 individuals and five sites from southern France. The samples are chronologically situated between the Final Neolithic/Chalcolithic and the Early Bronze Age.

Switzerland : The Swiss territory is located in an intermediary position between the western and eastern domains. Archaeological material, unequally distributed across Switzerland, demonstrates an east-west duality of traditions in different cultural areas. The Bell Beaker appeared during the second half of the third millennium BC, at the end of the Neolithic, and was succeeded by the emergence of the Early Bronze Age. Based on the archaeological data, the origin of the Bell Beaker in Switzerland could have been the result of more or less marked influences from both the western domain (ideological influences) and the eastern domain (population migration). Different anthropological studies note a high degree of homogeneity in pre-Bell Beaker populations. By contrast, results for successive populations are more uncertain, sometimes suggesting population continuity, sometimes invoking population renewal. The sample consists here of more than 520 individuals and eight sites that are chronologically situated between the Middle Neolithic and the Early Bronze Age.

The Czech Republic : This region, often considered as one of the major actors in Bell Beaker peopling history, represents the eastern-

type occupation. The Bell Beaker developed during the second half of the third millennium BC, in an intermediate position between the Corded Ware and the Unetice cultures. Archaeological data demonstrate the great affinities of the Bell Beaker with the two cultures preceding and succeeding it, as much with respect to funerary practices as artefacts themselves. Analysis of human remains, in contrast, suggests a certain degree of mobility of individuals that differs depending on the approach employed. A sample of more than 500 individuals and 64 sites has been selected. They belong to the Corded Ware, Bell Beaker and Unetice (Early Bronze Age) cultures.

Hungary : The Hungarian Bell Beaker occupation – the Csepel-Bell-Beaker – is the only one in the eastern domain outside the zone of the Corded Ware substrate. It is integrated within the middle phase of the Early Bronze Age, during the second half of the third millennium BC, and is limited to the region around Budapest. Different interpretations have been advanced to explain the limited intrusion of the Bell Beaker complex in Hungary. For some, the origin of this complex would have resulted from the migration of small groups from the Czech Republic ; for others, it would have been due to an internal development of Early Bronze Age society. The rare anthropological data plead in favour of a population renewal without excluding the possibility of contacts with contemporaneous populations. Here, a corpus has been composed of around a hundred individuals and 15 sites. These samples are attributed to the Csepel-Bell Beaker and to contemporaneous (Obedà-Pitvaros) or succeeding (Nagyrev, Perjamos) cultures.

As can be seen, the data are not comparable from one region to the other. The multiple facets of the Bell Beaker phenomenon prevent a single interpretation for its origin.

A tooth as a tool

Non-metric dental traits are anatomical variations observed on the permanent and deciduous dentition. They refer, in general, to traits that are present or absent, or that reflect different degree of development (Fig. 2). Dental traits are a valuable tool for understanding relation-

ships between populations (Scott and Turner, 1997 ; Desideri, 2003). On the one hand, dentition is one of the most resistant elements of the skeleton, and thus often the best preserved. On the other hand, non-metric dental traits can be observed on living people, and research on genetic determinism is facilitated by direct analysis of similar subjects or twins. The reference to modern populations finds its significance here. Scientific progress has also contributed to improving understanding of the mechanisms and processes involved in odontogeny.

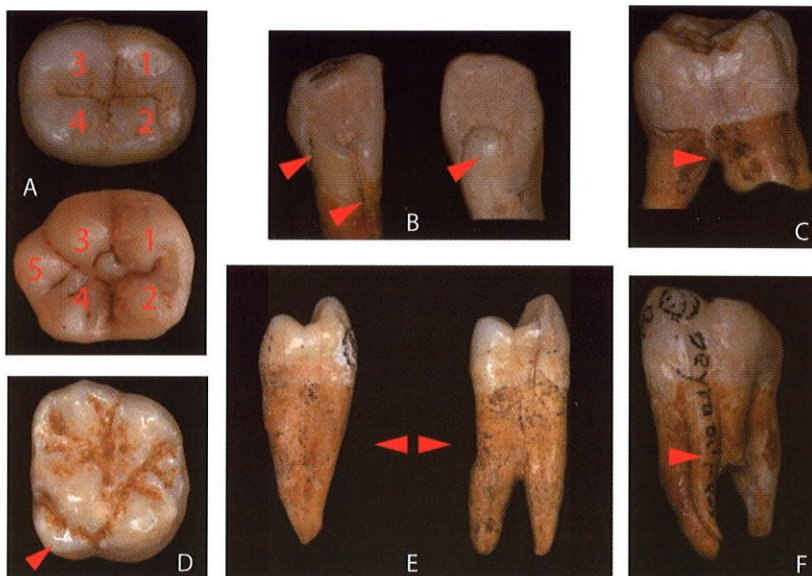


Figure 2. Non-metric dental traits : (A) number of cusps on lower molars, top, 4 cusps, bottom, 5 cusps / (B) on right, lateral incisor with two interruption grooves, one medial and the other distal ; on left, lateral incisor with a tuberculum dentale on the lingual surface / (C) enamel extension is present on the upper molar / (D) occlusal view of upper molar with Carabelli's trait / (E) number of roots on upper premolar, monoradicular on left and biradicular on right / (F) presence of surnumerary root on a first upper molar, radix paramolaris.

First, research has established that dental development is highly subject to genetic control (Thesleff and Nieminen, 1996 ; Cobourne and Sharpe, 2003). Several studies have demonstrated that the development of the dentition is controlled by a certain number of genes that act in different

places and intervene at distinct moments of its formation (Thesleff, 2003). While no trait follows a simple mode of inheritance, they are not as complex as those of models of polygenic inheritance in which many genes are involved. In addition, although we cannot deny a probable influence of environmental factors, we also cannot contest the fact that their effects are minor (Tyrell, 2000). Finally, studies based on genetic determinism have demonstrated that most of these traits seem to possess a large hereditary component (Scott and Potter 1984, Townsend and Martin, 1992). Next, the viability of the system of observation is an essential element in the validation of data. In effect, the lack of standardization of data can sometimes lead to entirely different results. The subjectivity of the observation has often been a determining element in the criticism of the study of dental traits. But at present, it is possible to move past this obstacle, by using dental casts and precise definitions of the different variables, and by eliminating traits that could pose possible problems of standardization by testing not only their own accordance, but also that between different observers. Finally, studies on the value of non-metric dental traits when applied to modern populations are clearly reassuring (Brewer-Carias et al., 1976 ; Kiverskari, 1978 ; Scott and Dahlberg, 1982 ; Higa et al., 2003...). Comparison of results of dental morphology with different estimators, such as geographic proximity, linguistics and genetic data, has reinforced the idea that these variables are good indicators of biological distance between populations.

Today, research on non-metric dental traits continues and leads to a better understanding of these variables. Even if some aspects should be better mastered, notably the genes responsible for the development of these variables, to cite only a single example, the genetic determinism underlying the expression of dental traits allows them to be used for comparative studies between populations.

The data and their treatment

111 dichotomous or graduated traits were selected, representing 530 possible observations. For permanent dentition, we have retained the traits proposed by the ASU-DAS system Arizona State University Dental Anthropology System (Turner et al. 1991) and the FU-DTS system –

Freiburg University Dental Trait System (Alt 1997). For deciduous dentition, we have selected the traits defined by K. Hanihara (1963), P.W. Scullli (1977) and K.D. Jørgensen (1956). In most cases, we have retained the expressions proposed by the different authors and recording systems.

We recorded data totalling more than 2'000 individuals and 255'000 observations. During analysis, several different aspects were addressed. First, we measured the accordance in determination of teeth and non-metric dental traits. Disagreements were not numerous, thus negligible. Then, a preliminary treatment of data was done : bilateral expression was treated by applying the *individual count method* developed by Scott (1977), one tooth (key tooth) by morphological class was retained, relationship between variables (intertrait, intra- and interdistrict correlations) were measured and sexual dimorphism was tested. Next, frequencies were calculated by applying *expression count method* developed by Turner (1985), which obtained an adjusted frequency taking into account all of the information provided by the gradations. It was carried out in two steps : obtainment of a unique frequency followed by the introduction of a correction factor taking into account the sample size. Finally, several types of multivariate analyses were selected : ascendant hierarchical classification (using Ward's algorithm) completed by bootstrap analysis, multidimensional scaling completed by minimal spanning tree and principal components analysis. We present here results from multidimensional scaling completed by minimal spanning tree (PAST – PAlaeontological STatistics, version 1.67, Hammer and Harper, 2005).

From tooth to peopling history

During analysis, several different aspects were addressed. We present here individual analysis for each region, an analyse including only Bell Beaker samples for the five regions treated and an unmixed gender analysis of the Czech corpus.

Regional analysis : The involvement of local populations in the emergence of the Bell Beaker varies according to region (Fig. 3). It is only in northern Spain and Bohemia that strict links between the Bell Beaker occupation and local occupations exist (Fig. 4 and 5).

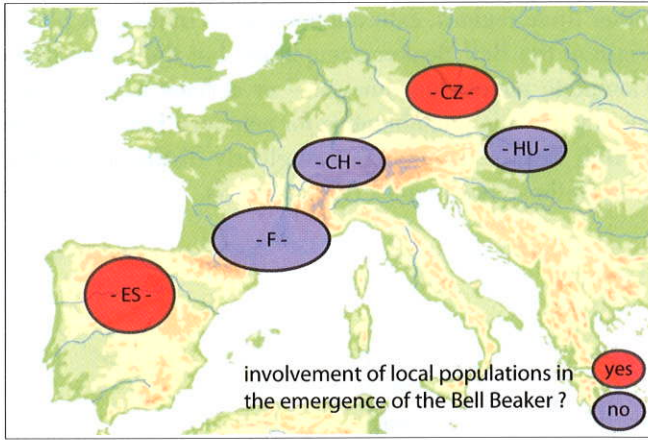


Figure 3. Regional analysis : Summary of dental data results for individual analysis of each region treated.

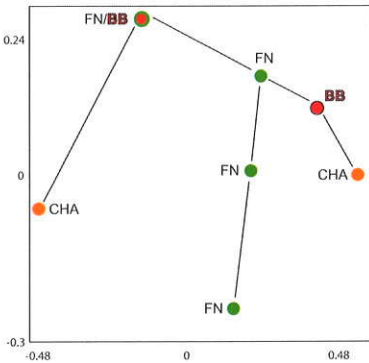


Figure 4. Northern Spain relationship between the different populations analyzed using a multidimensional scaling completed by a bootstrap giving the direction of the relations (MDS_stress : 0.00). 7 groups formed by 183 individuals belonging to Final Neolithic in green, Chalcolithic in orange and Bell Beaker in red.

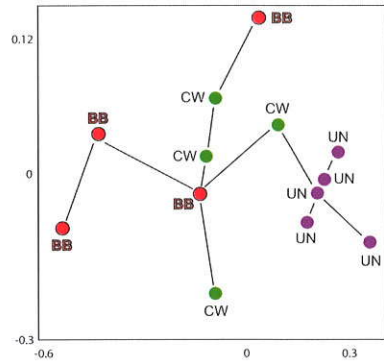


Figure 5. The Czech Republic relationship between the different populations analyzed using a multidimensional scaling completed by a bootstrap giving the direction of the relations (MDS_stress : 0.05). 13 groups formed by 506 individuals belonging to Corded Ware (Final Neolithic) in green, Bell Beaker in red and Unetice cultures (Early Bronze Age) in purple.

For the other three regions, external population influences played a role in the origin of the Bell Beaker occupation, but their contribution also varies. Complete population renewal – or at least a highly significant exogenous impact – is unambiguous for southern France and Hungary. In effect, Bell Beaker populations are clearly distinguished from local populations in these two regions (Fig. 6 and 7).

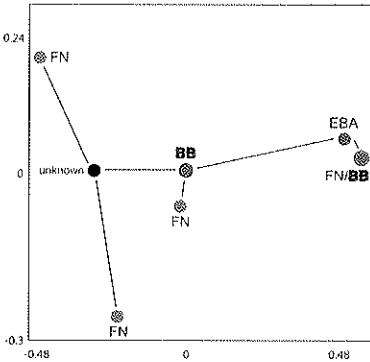


Figure 6. Southern France relationship between the different populations analyzed using a multidimensional scaling completed by a bootstrap giving the direction of the relations (MDS_stress : 0.09). 7 groups formed by 630 individuals belonging to Final Neolithic in green, Bell Beakers in red and Early Bronze Age in purple.

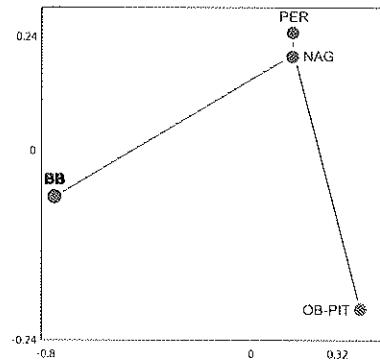


Figure 7. Hungary relationship between the different populations analyzed using a multidimensional scaling completed by a bootstrap giving the direction of the relations (MDS_stress : 0.00). 4 groups corresponding to Bell Beaker and contemporaneous south culture – Obeda-Pitvaros – in red and succeeding cultures – Nagyrev and Perjamos – in purple.

As for Switzerland, however, shows a local regional population disturbed by partial population renewal or the integration of exogenous individuals (Fig. 8). Such a situation in the Swiss region seems to have already been present, although less intensively, during the Late Neolithic.

Czech unmixed gender study : We tested behaviour of men and women of Corded Ware, Bell Beaker and Unetice cultures (Fig. 9). Men are close and women have a tendency to be more variable. The inter-

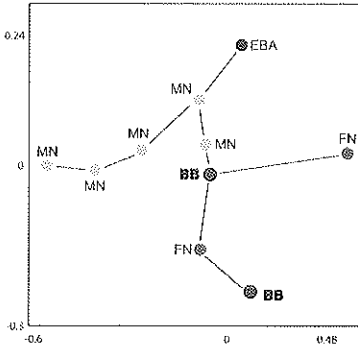


Figure 8. Switzerland relationship between the different populations analyzed using a multidimensional scaling completed by a bootstrap giving the direction of the relations (MDS_stress : 0.08). 10 groups formed by 520 individuals belonging to Middle Neolithic in yellow, Final Neolithic in green, Bell Beaker in red and Early Bronze Age in purple.

mediary position of Corded Ware men as a common denominator uniting the group of populations is without doubt more than interesting.

Bell Beaker through Europe : Dental morphology has demonstrated two populational spheres present in the territory studied (Fig. 10). The

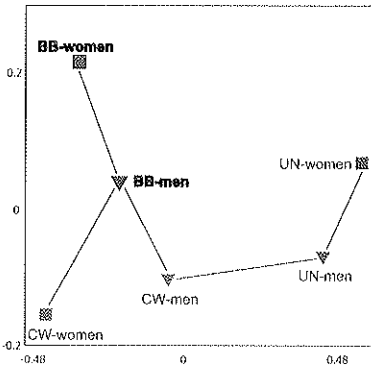


Figure 9. Czech unmixed gender study relationship between women (square) and men (triangle) analyzed using a multidimensional scaling completed by a bootstrap (MDS_stress : 0.03). 6 groups formed by 240 individuals belonging to Corded Ware (Final Neolithic) in green, Bell Beaker in red and Unetice cultures (Early Bronze Age) in purple.

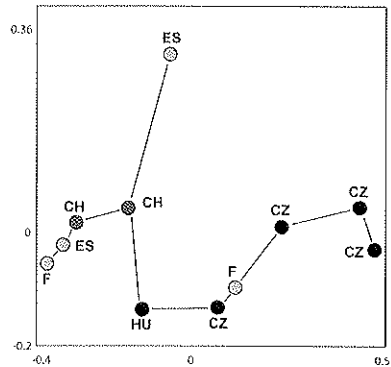


Figure 10. Bell Beaker through Europe relationship between the different Bell Beaker populations analyzed using a multidimensional scaling completed by a bootstrap giving the direction of the relations (MDS_stress : 0.04). 11 groups formed by 474 individuals.

entities are clearly distinct ; we thus have the western Bell Beakers and the eastern Bell Beakers, which we respectively term Bell Beakers and Beakers. The western Bell Beakers are quite similar and the Swiss populations can be strongly linked to their morphology. They form a highly uniform group. The eastern Bell Beakers show a certain cohesion that seems, however, to have been less isolated.

A discussion on population dynamics

Based on these results, it is possible to propose a diffusion model for the Bell Beaker phenomenon. The emergence of the Bell Beaker culture in the western sphere resulted from the displacement of individuals from the Iberian Peninsula into Europe. The biological impact was recorded to at least Switzerland, and possibly also to Hungary. Thus, the Bell Beakers small groups of individuals equipped with their material culture and know-how – formed the basis for Bell Beaker diffusion in this region of the phenomenon. The situation in the eastern sphere is more complex. Dental data suggest evolution within a single society. Nevertheless, women – Corded Ware and Bell Beaker – were differentiated from the local populations, probably resulting from societies practicing exogamy. Thus, to understand the modalities for the establishment of the Bell Beaker phenomenon, we must dissociate the diffusion of western elements from the exogamic diffusion of women in the eastern domain into two distinct points in times (Fig. 11 et 12). On the basis of currently available radiocarbon dates suggesting a southwest-northeast gradient for the expansion of the Bell Beaker, we propose the following :

Phase 1 : Migration of groups of Bell Beaker individuals from the Iberian Peninsula toward the east, while the eastern domain is still occupied by the Corded Ware culture.

Phase 2 : Part of the Corded Ware on the edge of the phenomenon was individualized and adopted, by borrowing, some of the western Bell Beaker traditions. Diffusion of this new society – the Beakers – continued toward the east. At the same time, certain eastern elements were diffused toward the west.

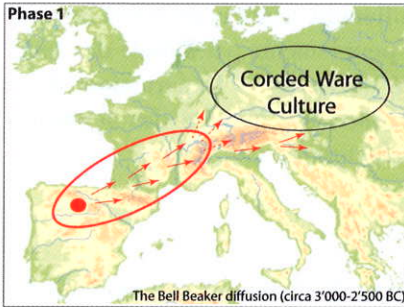


Figure 11. Bell Beaker diffusion : population dynamics during the third millennium BC.

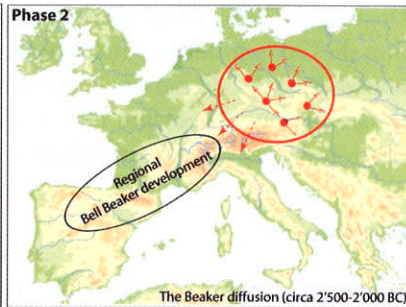


Figure 12. Beaker diffusion : population dynamics during the third millennium BC.

Conclusion

The five occupations analyzed offer a rich and complex portrait of society during the third millennium BC. A single explanation does not account for the entire range of variability in the Bell Beaker phenomenon. The study of the Bell Beaker individuals – who are privileged witnesses of a culture that we still have difficulty in defining in its entirety – provided here crucial keys to understanding. A new interpretation of the Bell Beaker emergence and diffusion is proposed involving on the one hand displacement of populations in the western sphere, and on the other hand adoption of Bell Beaker tradition by borrowing from the exogamic diffusion of women in the eastern sphere.

Acknowledgments

I would like to sincerely thank the International Latsis Foundation for this prestigious recognition of my work and the Swiss National Science Foundation (FNS) for providing crucial funding during my research (Project FNS 101412-100599 *Europe during the third millennium BC : archaeological facts lead to an interpretation of peopling* under the direction of prof. Marie Besse and grant FNS GE-112885).

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