Vinča-Belo Brdo, Serbia: The times of a tell

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Introduction: the developing Neolithic

This paper, focused on the great tell of Vinča-Belo Brdo near Belgrade, Serbia, *(figs 1–2)* is ultimately a contribution to understanding the development of the Neolithic way of life in the southern part of the Carpathian basin, in the northern Balkans of south-east Europe. It confronts some of the key questions about the trajectory of change in the Neolithic period, through the study of a single site, which can now be dated – as presented in this paper – from the first decades of the 53rd century cal BC to the later part of the 46th century cal BC. Much attention has been directed, across Neolithic studies as a whole, to the processes of transition and transformation involved at the start of the period, but comparatively less sustained effort has been given to examining in detail how subsequent change unfolded; basically evolutionary or gradualist models have frequently been applied, in which Neolithic communities are seen to have become progressively more settled, more numerous and ultimately more socially differentiated, leading on to even more complex society in the Copper and Bronze Ages. As John Robb has put it (2014, 28): "In the social evolutionary tradition which remains implicit in much of the discipline, the big story lines are technology / economy and inequality. This leaves much of the Neolithic as a null category: early agricultural tribes are a baseline about which there is very little to say other than that they farmed and were egalitarian. Once you get past the Origins of Agriculture, you can safely fast-forward a couple of millennia until you get to Metals and Hierarchy."

Vinča-Belo Brdo, however, is part of a much more complicated story, all the more so as its chronology becomes more precise.

Neolithic people, things and practices had reached the northern Balkans around 6000 cal BC, in the form of the Starčevo culture (Tasić 2009; Whittle et al. 2002). Recent aDNA research revives the older hypothesis that this transformation involved the arrival of new people from the south (Szécsényi-Nagy et al. 2015), and the density of Mesolithic occupation had anyway been patchy at best, though we know of established Mesolithic communities in the Danube Gorges, which were themselves involved in complex processes of change at the turn of the seventh and sixth millennia cal BC (Borić 2011). Across northern Serbia and Croatia, Starčevo sites can be locally quite numerous, especially in the river valleys. A comparable situation was found in the Körös culture on the Great Plain in eastern Hungary; Starčevo sites are also found in western Hungary or Transdanubia, up to around Lake Balaton, but so far in lower numbers (Bánffy et al. 2010). Occupations can be extensive, witnessed by the recently discovered site at Alsónyék-Bátaszék in south-eastern Transdanubia just west of the Danube (ibid.). Many may have

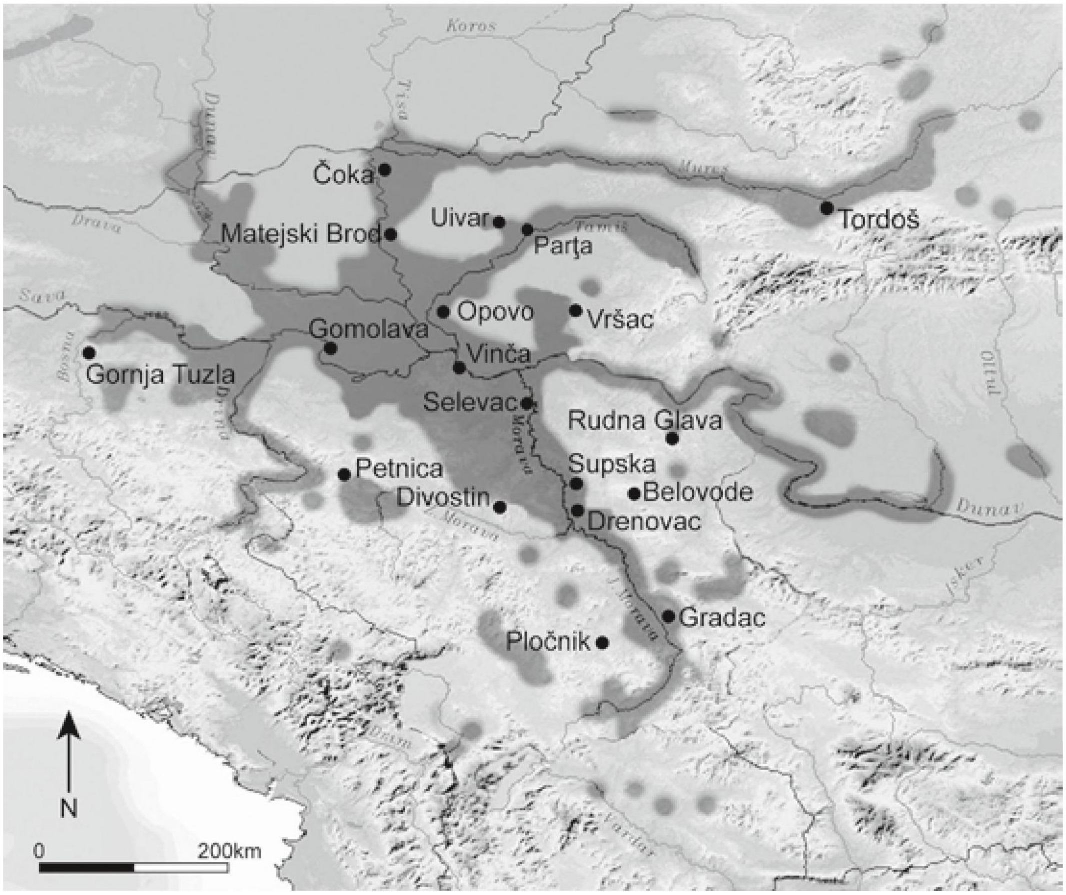


Fig. 1. The location of Vinča-Belo Brdo and other significant Vinča culture sites mentioned in the text. The maximum extent of the Vinča culture is shaded in grey.

been quite short-lived, and overall, while houses are known in both the Starčevo and Körös cultures, few if any stratigraphies of any significant depth have been found. Vinča-Belo Brdo has Starčevo occupation, detailed below.

We do not yet know the precise date at which the Starčevo culture ended and its successor, the Vinča culture, began, though the latter was certainly in existence at Vinča-Belo Brdo itself by the last three centuries of the sixth millennium cal BC, as detailed below. In the Vinča culture as a whole, from the later sixth millennium into the middle of the fifth millennium cal BC, considerable changes in settlement and the nature of community can be seen. Broadly comparable developments have also been found in some parts of the Great Hungarian Plain. More sites are found, and a wider range of the landscape was exploited. The sense of consolidation and expansion is also seen further north, with the emergence and dispersal of the Linear Pottery culture from western Hungary into central Europe and beyond, in the second half of the sixth millennium cal BC. That the process was driven in substantial measure by new people is again supported by new aDNA research (Brandt et al. 2013), but whether the long-mooted idea of new people arriving from somewhere in the south of the Balkans to form the Vinča culture can be sustained as well is open to question, and requires further research (cf. Hervella et al. 2015). The out-

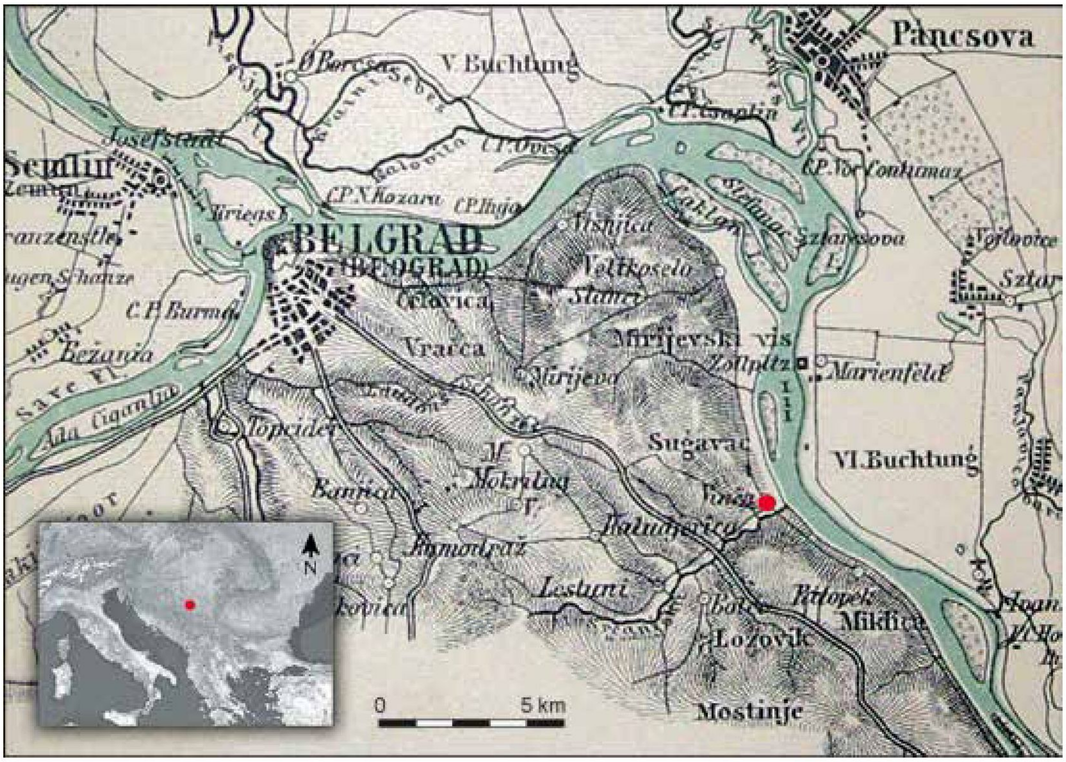


Fig. 2. The local setting of Vinča-Belo Brdo, on the background of an early twentieth-century map (held in the archive of the Arheološka Zbirka of the University of Belgrade).

comes of change, however, were extensive, in the form of more sites, often bigger sites, and differentiation between so-called flat sites, often of extensive size but without significantly deep stratigraphies, and tell sites, where layer upon layer of house remains and other occupation deposits accumulated, forming mounds in many cases several metres high. Vinča-Belo Brdo is the classic and largest example of a tell in the northern Balkans *(figs 3–5)*. It and other sites like it in the Vinča culture have rich material assemblages, and the traditional archaeological 'culture' is probably better thought of as a complex network or interaction sphere.

The emergence of tells poses many questions. How did their deposits accumulate, and how quickly? What sort of role did they play in local and wider settlement networks? Were they somehow more important than flat sites, and if so, what were the social differences between the respective communities of users? What were the conditions in which tell accumulation was maintained, to emerge as 'timemarks', with 'vertical dominance' as John Chapman (1997, 145–6) has put it? These are all in different ways chronological questions, and Vinča-Belo Brdo offers the opportunity to examine many of them in considerable detail.

The ending of tells also sets difficult questions. If they appear to represent a much greater stability of settlement than in the first centuries of the Neolithic, why was that not maintained for longer than – in the northern Balkans and on the Great Hungarian Plain at least – the middle of the fifth millennium cal BC? In many ways, this is an unexpected history (Whittle 2015). What caused tells to be abandoned and new forms of settlement

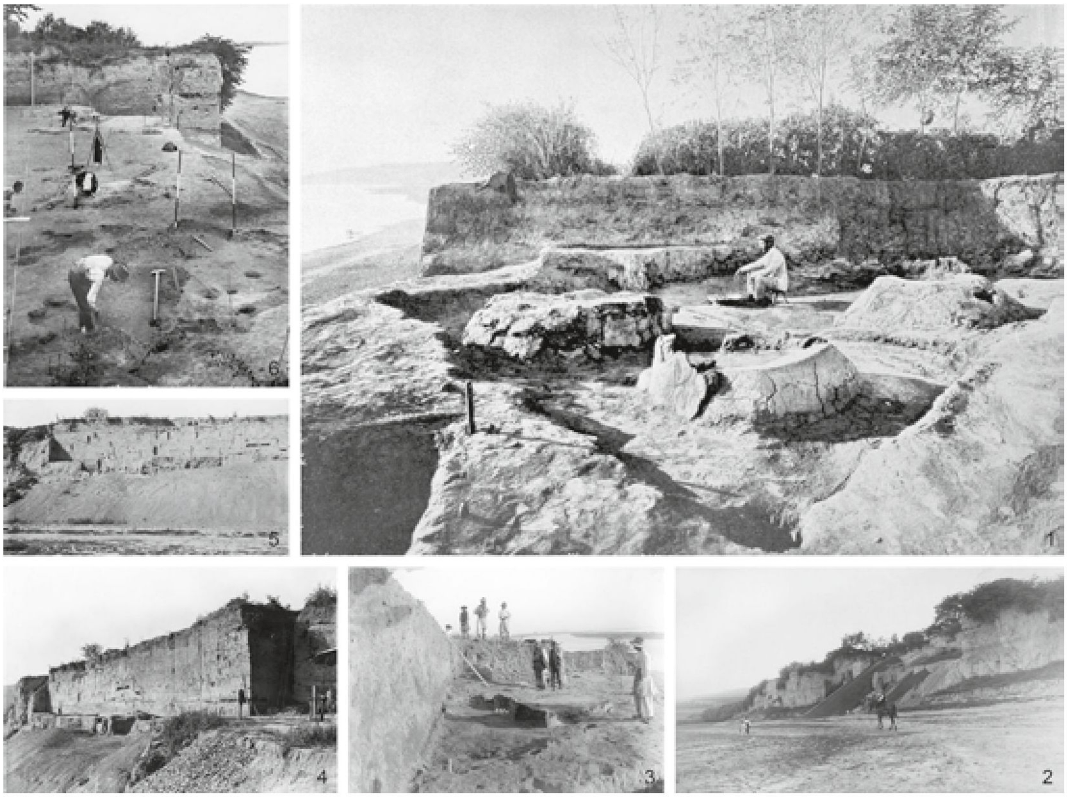


Fig. 3. Scenes from the Vasić excavations. Clockwise from top right: Vasić himself sitting in the 'house of kilns', 1911; view from the north-east in the 1920s; excavation in 1911 or 1912; view from the north-east of the section in 1934; view from the east of the section in 1934; excavations in 1924 or 1929.

Fig. 4. The section in 1924, from the east.

to be adopted involves a complex set of problems, but one way to begin to unravel these is to examine the chronology of the ending of tells in more detail. Initial review indicates tell endings across the Vinča culture perhaps through the 47th and 46th centuries cal BC (Borić 2015a), but much greater precision is required. Vinča-Belo Brdo is again an obvious place to start.

This paper is one outcome of a major project, *The Times of Their Lives* (ToTL: see Acknowledgements), which is seeking to show that chronologies across the European Neolithic can radically be refined. It is doing so by the application of Bayesian statistics for the interpretation of radiocarbon dates. This allows chronologies that are precise within a scale of human lifetimes and generations to be constructed routinely (Bayliss 2009), opening up new avenues of interpretation for archaeologists (Bayliss / Whittle 2007; Whittle et al. 2011, Chapter 14; Bayliss et al. in press). Currently the best available approach, the Bayesian framework, enables us to go far beyond the conventional combinations of stratigraphy, typology, seriation and the visual inspection of radiocarbon dates, which are the basis for most chronologies at present, including (as detailed below) for Vinča-Belo Brdo. Not that stratigraphy, typology or seriation should be set aside, since they can be powerful components of Bayesian models, but without formal constraint against the 'scatter' of radiocarbon dates around a given event, visual inspection regularly produces estimates that phenomena started earlier, went on for longer and ended later than was the case in reality (Bayliss et al. 2007). It is no wonder then that slow change over the long term has been the dominant, if not the unthinking default, chronological perspective; and a further, perhaps unavoidable, consequence of the dating methods which are usually available, and the imprecise chronologies which result, has been that many prehistorians have been content to write accounts of the past which have been very generalised. This paper is part of a sustained effort to do better.

The basic idea behind the Bayesian approach to the interpretation of data is encapsulated by Bayes' theorem (Bayes 1763). This simply means that we analyse the new data we have collected about a problem ('the standardised likelihoods') in the context of our existing experience and knowledge about that problem (our 'prior beliefs'). This enables us to arrive at a new understanding of the problem which incorporates both our previously existing knowledge and our new data (our 'posterior belief'). We do this by the use of formal probability theory, where all three elements of our model (that is existing beliefs, new information and revised interpretations) are expressed as probability density functions. These give us a quantitative measure of our state of knowledge of each component of the model. Bayesian models are thus interpretative constructions which rely on multiple lines of evidence (Buck et al. 1996). An accessible general introduction to the principles of Bayesian statistics is provided by Lindley (1985), and to its history by Bertsch McGrayne (2011). The worked example of Vinča-Belo Brdo is presented in detail below.

Aims of this paper

This paper presents formally modelled date estimates for the stratigraphic and material sequence established at the great Neolithic tell of Vinča-Belo Brdo near Belgrade, Serbia (*figs 1–2*), on the basis of the first excavations, led by Miloje Vasić (*figs 3–5, 7*). This is part of a three-strand approach to dating the occupation and finds from the tell that is being undertaken as part of the project *The Times of Their Lives* (ToTL). The project has already dated the last two certain Vinča culture building horizons towards the top of the tell, excavated from 1978–2009, which has enabled close examination of successive levels and

Fig. 5. View of the excavations and the section in 1931. The pits in the foreground are at a depth of c. 9.2–9.3 m.

the question of the extent and character of burning (Tasić et al. 2015). The project is also in the process of dating finds from right through the new deep sounding *(fig. 6)*, which was bottomed in 2014. This provides a single-context record of the stratigraphy right through the tell, enables the choice of short-life, single-entity samples of known provenance and interpretable taphonomy for radiocarbon dating, and offers the chance to estimate house durations formally (Tasić et al. 2016).

Although those two other strands offer much more secure dating of the structural sequence of Vinča-Belo Brdo, the Vasić sequence remains key to our understanding of the tell because of the quantities of material recovered by the earlier excavations, and the volume and impact of the research which this material, especially but not only the pottery, has generated *(figs 10–13, 24)* (cf. Schier 1996, fig. 9; Link 2006, Abb. 10). Vinča-Belo Brdo is important in its own right within the Vinča culture or interaction sphere, not just for giving it its name, and has been the principal yardstick against which other sites in this network have been measured. It has also served as a key link between other Neolithic worlds to its south and north (among many others, see Childe 1929; Milojčić 1949a; Garašanin 1979; Chapman 1981; Parzinger 1993).

Despite the limited stratigraphic information available for the Vasić archive, the use of depth as a proxy for chronological succession appears to be broadly valid. This has been demonstrated by the innovative application of correspondence analysis by Wolfram Schier (2000, fig. 4), detailed below. The coherent sequence produced by this analysis demonstrates that the 10-cm levels in question can broadly be considered as 'closed contexts', with relatively limited mixing either from the excavation methodology employed by Vasić or from site formation processes. The depth of dated finds becomes powerful prior information in the Bayesian model which we present below.

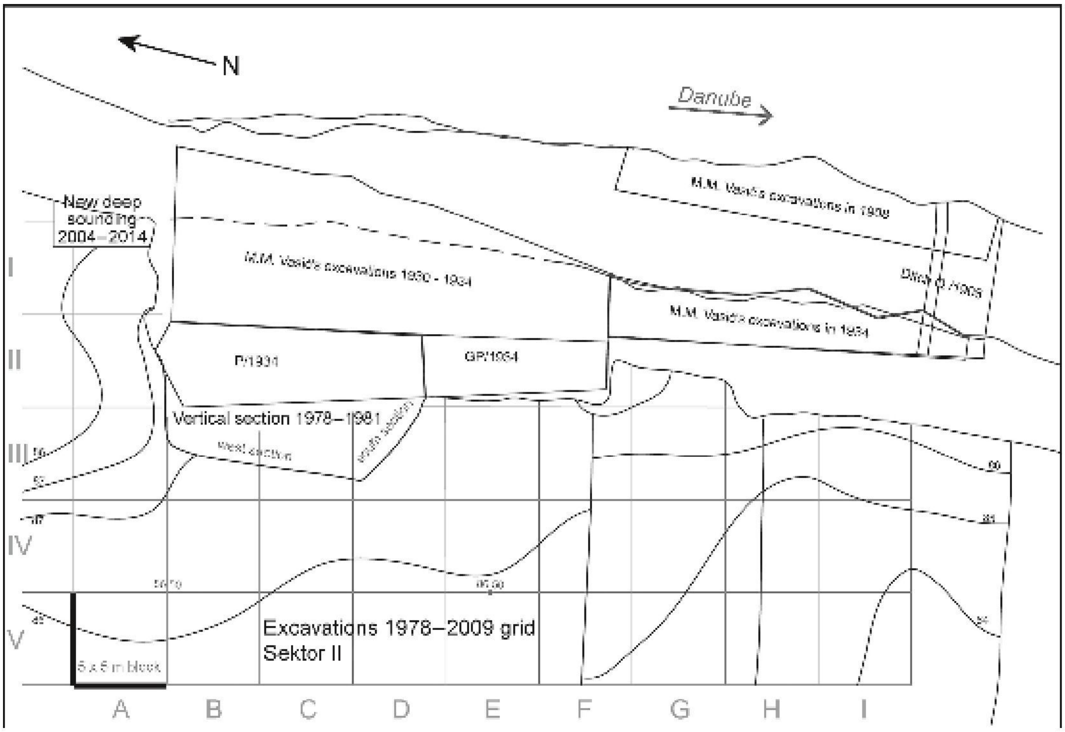


Fig. 6. Outline plan of the main areas of excavation at Vinča-Belo Brdo. The new samples reported here are from the areas marked 'M. M. Vasić's excavations 1930–1934', 'P/1934' and 'GP/1934'.

Our key aim therefore has been to date the Vasić sequence at Vinča-Belo Brdo with as much precision as possible, in order to, first, achieve better understanding of the timing, duration and tempo of the formation of the tell itself and, secondly, obtain more precise understanding of the timing, duration and tempo of the succession of changes in its material. That will enable, in due course, more precise comparison with other sites and their finds in the core area where they occur and beyond, but that belongs to other papers and to future research.

Future research will surely exploit modern excavation methods and recording, but a secondary aim of this paper is to demonstrate the usefulness and relevance of older archives, and to underline the importance of their continued curation; the Vasić archive was digitised in 2001. If significant results can be generated from the earlier work at Vinča-Belo Brdo, there is every chance that these can be emulated from older investigations at similar sites.

The Vinča culture

For convenience and continuity, we retain the term 'Vinča culture', though better alternatives such as network or interaction sphere spring readily to mind. Many past notions derived from the use of the culture concept, including those of origins, identity and change, appear to have been based, in the end, on the character and distributions of pottery styles. The adoption of alternative terminology would probably help to resolve, or at the very least recast, many traditional debates (cf. Porčić 2012, 171).

The Vinča culture belongs to the latter part of the sixth millennium cal BC and the first half of the fifth millennium cal BC (Borić 2009; Orton 2012; Porčić 2011;Tripković 2011). Its network extends through the river valleys – the Danube, its tributaries and their catchments – of the northern and central Balkans, from southernmost Hungary and easternmost Croatia through Serbia down to Kosovo and parts of Macedonia and Bulgaria, and from Croatia and Bosnia-Herzegovina eastwards as far as parts of Transylvania in Romania *(fig. 1)*. It shows significant changes in the character of Neolithic settlement and social relations (Chapman 1981; Kaiser / Voytek 1983; Tringham / Krstić 1990), following the initial establishment of Neolithic existence in the area of its distribution from the late seventh and early sixth millennium cal BC onwards (Whittle et al. 2002). Questions of settlement expansion, population increase, a greater variety of sites including tells themselves, more permanence of occupation, the role of households and changes of production are all actively debated (see also Borić 2009; Borojević 2006; Chapman 1990; Crnobrnja et al. 2009; Link 2006, 93–96; Orton 2010; id. 2012; Porčić 2012; Tasić 2011; Tringham et al. 1992; Tripković 2011; Whittle 1996, 105).

Distinctive material culture, comprising modelled face-like lids, figurines and copper artefacts as well as ubiquitous and abundant pottery of exceptional quality, has been the basis for not only classic periodisations (outlined below), of which variants of the A–D ceramic schemes have been the most familiar, but also prolonged debate about the nature and source of origins and subsequent changes. One widely shared view, within a culture-historical framework, has been of southern origins for both initiation of the Vinča culture and subsequent changes during its development (such as the claimed 'shock of Vinča C' (e. g. Garašanin 1951; id. 1979; Lazarovici et al. 2009; Suciu 2009). Within the material repertoire, there is a notable increase in the quantity and variety of ritual paraphernalia (such as figurines, altars and bucrania); at a general level, this may reflect increasingly pressing issues of identity at both household and community level (Chapman 2000, 203–20; Bailey 2005).

The Vinča culture is central to our understanding of social and cultural change in Neolithic south-east Europe and also in surrounding areas. Its issues of development, aggregation, identity, ritualisation and differentiation prompt comparison with many situations elsewhere (e. g. Birch 2013). There continue to be frequent studies of its many dimensions. Despite the host of interpretations and chronological schemes produced, however, it remains the case that the calendar dating of Vinča culture changes has not so far been rigorously or widely established, though some important steps in that direction are to be noted (Borić 2009; Id. 2015a; Orton 2012; Schier 1995; Id. 1996; Id. 2000; Id. 2014). Now the challenge is to time Vinča culture developments more precisely. This paper addresses that task, focusing specifically on Vinča-Belo Brdo.

The Vinča-Belo Brdo tell within the Vinča culture

From the early days, the tell of Vinča-Belo Brdo has been at the forefront of research *(figs 2–3)*. Finds from it were brought into the National Museum from 1904 onwards, and Vasić began his excavations in 1908. The term 'Vinča culture' was probably first formalised soon after the second world war, for example by Vladimir Milojčić (1949a; Id. 1949b). In *The Danube in Prehistory*, Gordon Childe (1929; cf. Fewkes 1935; Id. 1936) had simply referred to 'the first Neolithic civilization on the Middle Danube' and 'the civilizations of period II', and defined both Vinča I and Vinča II phases by the material from Vinča-Belo Brdo itself, with some cross-reference to further sites such as Supska, Čóka, Tordoš, Vršac and others; Milutin Garašanin consistently referred to the 'Vinča group' or 'Vinča

Fig. 7. Recording in action, probably in 1912, showing depths added by Vasić to the glass slide.

cultural group' (Garašanin 1951; Id. 1954). Although Vinča-Belo Brdo cannot stand for the whole of the Vinča culture or network, nonetheless it illustrates many of its features.

The Vinča-Belo Brdo tell has been central to the construction of many Vinča culture chronologies, which we outline below, and it has often been implied that it was also central to both the genesis and subsequent life of the Vinča culture. It may have been among the very first Vinča sites to develop tell-like form (possible rivals for this status include Gornja Tuzla and Matejski Brod, and perhaps Drenovac, some 150 km to the south [Perić 2009]), but in its more immediate region, it certainly seems, on the basis of existing knowledge of pottery development, to have emerged as a visible tell before Gomolava and Parţa (Brukner 1986; Lazarovici et al. 2001). It also went on to accumulate c. 8 m or more of Vinča culture deposit in its central part, incorporating several discernible building horizons, discussed below (Korošec 1953; Chapman 1981; Stalio 1984; Jovanović 1984; Stevanović / Jovanović 1996; Borić 2009), to end as the highest tell by far not only in the area of the Vinča culture but also compared to the Hungarian Plain to the north (Rosenstock 2009; Raczky et al. 2011).

Arguments for the likely importance of Vinča-Belo Brdo (Chapman 2000, 203–20) start with the fact that it was built up as a tell above an old place, already occupied in the Starčevo period (and the relationship, or interval, between the two becomes an important question). From an early stage of its formation, it had a significant concentration of ritual paraphernalia, ornaments and exotic lithics (cf. Chapman 1981; Dimitrijević / Tripković 2006, 244; 249; Tripković 2003). The people concerned were able to sustain the continued vertical growth of the tell, which Chapman (2000, 212–14) sees in terms of the ability of 'limited interest groups' to control ancestral memories and the emergent 'timemark' (see also Id. 1997). The tell remained part of diverse ritual and exchange practices in its developed phases, but was claimed to have declined in importance relative to other sites and regions in the latter phases of its Vinča culture occupation (Id. 2000, 216–18). Other papers continue to examine specific features and finds from the tell itself (among others: Antonović 2002; Perić / Nikolić 2008; V. Dimitrijević 2008; Tasić 2011).

But if the importance of Vinča-Belo Brdo within the Vinča culture is clear, how well has its chronological development been understood up till now and what can be done to achieve a more precise and reliable chronology?

Constructing chronologies for Vinča-Belo Brdo and the Vinča culture

The Vasić excavations and the archive

The excavations begun in 1908 by Miloje Vasić (the first professional archaeologist of Serbia, born in Gradište and educated in Berlin and Munich), continued, with several interruptions, over the next 26 years. Reports soon followed (e. g. Vasić 1910), placing the name of Belo Brdo on the European archaeological map *(figs 3–6).*

The surviving area of the tell is estimated to cover at least 10 ha. We do not know how much may have been lost to the Danube before excavations began. Vasić excavated a small portion, of less than 2000 m^2. He based his early excavation methodology (Vasić 1910, Taf. 7; Id. 1911; Id. 1912; Id. 1913) on a row of uniform parallel transects perpendicular to Danube, covering an area 80 by 20 m on the south-east portion of the tell. Like his contemporaries, he used arbitrary 10-cm spits to excavate to a total depth of c. 11 m, labeling the recovered finds using relative depths. Above the Vinča culture deposits there are Copper Age, Bronze Age and early medieval deposits (Tasić et al. 2015). In the later campaigns, having bought additional property with the funds given by the Russian Imperial Archaeological Institute in Istanbul and Sir Charles Hyde[1], Vasić opened a larger area and changed the methodology of spatial recording to metric measurements from a roughly speaking NW-SE oriented metric axis parallel to the tell profile and the Danube. This rudimentary coordinate system was employed in the 1930–1934 period and several photographs of this axis exist in the surviving records. From the outset, Vasić employed glass plate photography, then a relatively rare commodity in Serbia, resulting in over 900 preserved negatives now in the National Museum in Belgrade and the Archaeological collection of the Faculty of Philosophy in Belgrade University. Some are labelled by Vasić himself, recording the relative depths at which a given structure or pit was found. These, accompanied by illustrations published in his four-volume *Preistoriska Vinča* (Vasić 1932; Id. 1936a; Id. 1936b; Id. 1936c), present unique evidence of his research *(fig. 7).* Day-to-day descriptions of the finds and important situations in the field are preserved in six volumes of field logs which give a clear insight into his work[2]. War damage to both the National Museum in Belgrade and the Archaeological collection in the Faculty of Philosophy in Belgrade University accounts for the poor state of preservation of the technical drawings and field sketches. In one of the volumes of *Preistoriska Vinča,* Vasić (1936a, figs 213–214) published two hand-drawn, vertical sections in colour.

[1] Sir Charles Hyde was then editor of the Birmingham Evening Post, millionaire and flamboyant social figure, who supported the Belo Brdo excavations in 1930–1934; his help was reported in the Illustrated London News for October 18 and November 1, 1930.

[2] It was not only his archaeological research that was documented in the field logs. Vasić (1911) mentions a steamboat race occurring on the Danube, and also the conscription of his workers during the second Balkan war (Vasić 1913), which forced him to suspend his excavations. In his 1934 excavation logbook, he notes the death of his wife, which occurred whilst he was hospitalised due to kidney problems. Only a week later, Vasić was back in the field excavating.

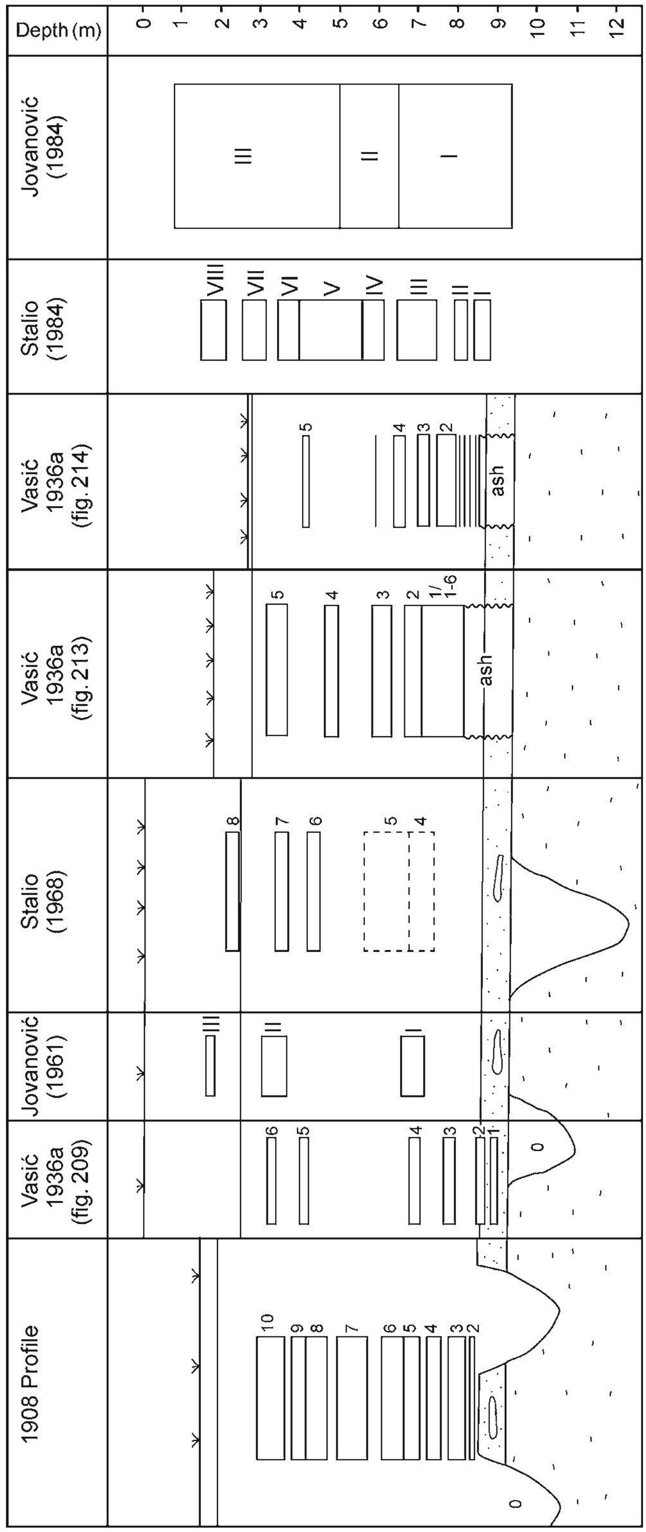


Fig. 8. Reconstructions of the depths of possible building horizons, drawing on Vasić's *Preistoriska Vinča*, Stalio, Jovanović and Chapman. Redrawn from Chapman (1981, fig. 2).

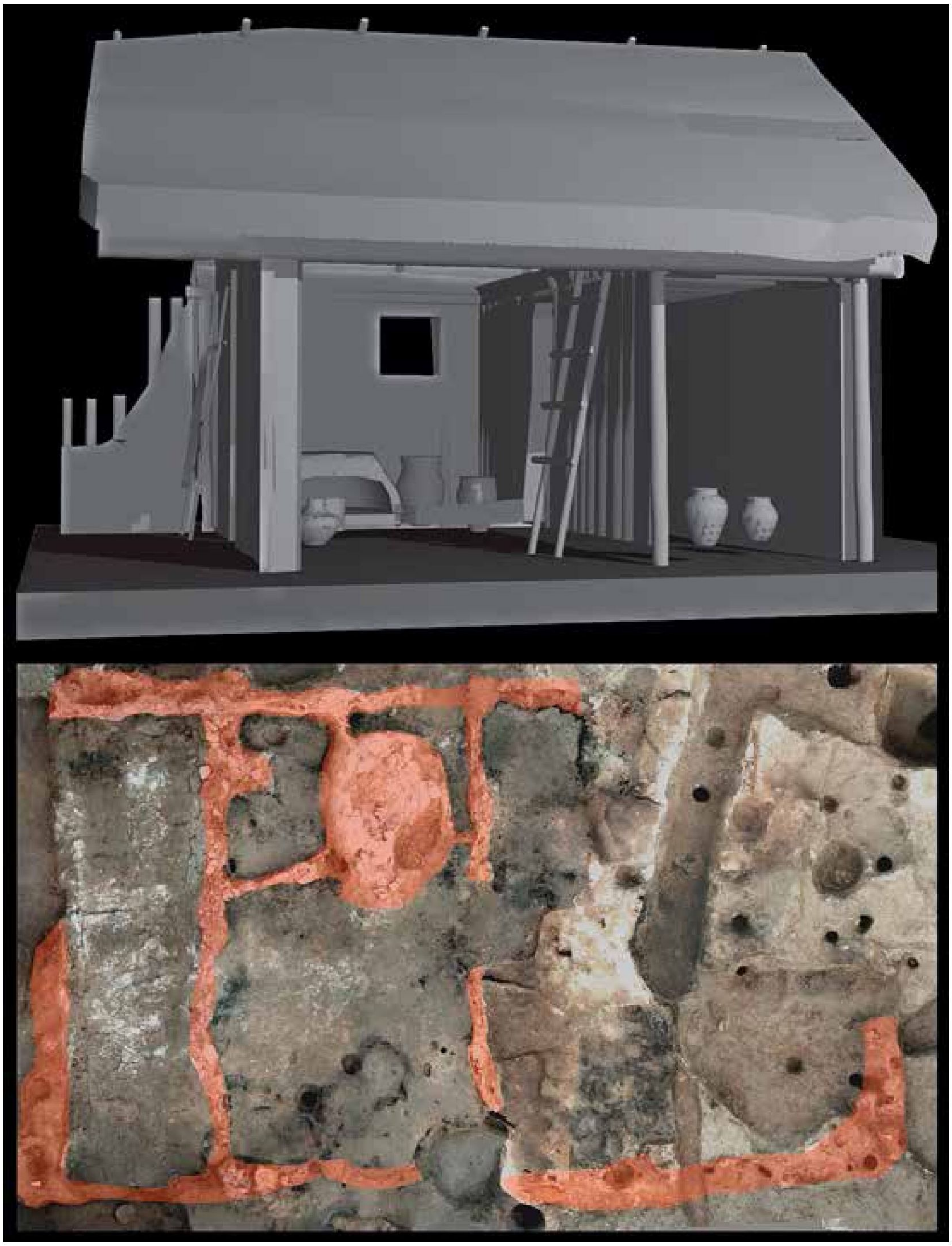


Fig. 9. Plan and reconstruction of House 01 / 06 at 3.0–3.2 m.

Settlement phase	Horizon	Depth in m	Number of houses	Specific examples and comments
Starčevo pits				
1 (early Vinča)	I	8.8–8.5	2, and kilns	
	II	8.3–7.9	6	Best described structure is house 5 or the 'Brown structure' as it is named in the field log
	III	7.5–6.5	13	Best known structure is 'Grundriss 1913': floor level was found between 7.19–7.16 m
2	IV	6.2–5.6	7	Best known structure is House 1 or the *megaron*, around 6.2–6.1 m
	V	5.6–4	4	?Disturbed
3 (late Vinča)	VI	4–3.5	3	
	VII	3.2–2.6	4	Best known structures are 'Grundriss 2 1912' or the 'bucrania house' (Vasić's 1912 field log) and the 1911 'house with kilns'
	VIII	2.2–1.5	3	N-S orientation, differing from the usual NW-SE one

Tab. 1. The scheme of Stalio (1968; Id. 1984) for settlement phases and building horizons at Vinča-Belo Brdo.

The Vasić stratigraphy and the character of the tell deposits and 'building horizons'

Although he wrote on several occasions about the settlements and structures on the site in his four-volume monograph, Vasić never tried to interpret their number. It was only in the work of Borislav Jovanović (1961; Id. 1984; Stefanović / Jovanović 1996) and Blaženka Stalio (1968; Id. 1984) that this issue came into full focus, although there had been some earlier attempts, albeit with less success (e. g. Korošec 1953; cf. Chapman 1981) *(fig. 8)*. For purposes of general illustration, a photo and reconstruction of a typical, substantial Belo Brdo house are given in *fig. 9*, though this does not come from the Vasić excavations.

These authors sought to identify major settlement phases or building horizons. This was on the basis of the main concentrations of houses and other structures at common, identifiable levels, as seen both in plan and in section. The authors in question disagree in detail, but at a broader scale they can be seen to be constructing a rather similar narrative for the succession of buildings through the history of the accumulation of the tell. Although Jovanović was able to use a new section, dug in the 1980s *(fig. 6)*, which was not available to Stalio, both were strongly influenced by what had been observed and recorded by the first excavator. Vasić only described burnt structures in his field logs and publications and there is no mention of unburnt structures, although new research on the site has shown that these appear regularly; with the benefit of hindsight recorded deposits of yellow clay often signify the presence of unburnt houses. It therefore seems to us very probable that the discussion about major building phases and horizons should in fact be seen in terms of major identifiable episodes of burning. These could have been in some cases single events, but in others cases may perhaps evidence wider-scale episodes *(fig. 8)*. The rest of the tell deposit can be thought of as a steadily accumulating formation, derived from the varied use, decay or destruction and levelling of houses and associated spaces around them.

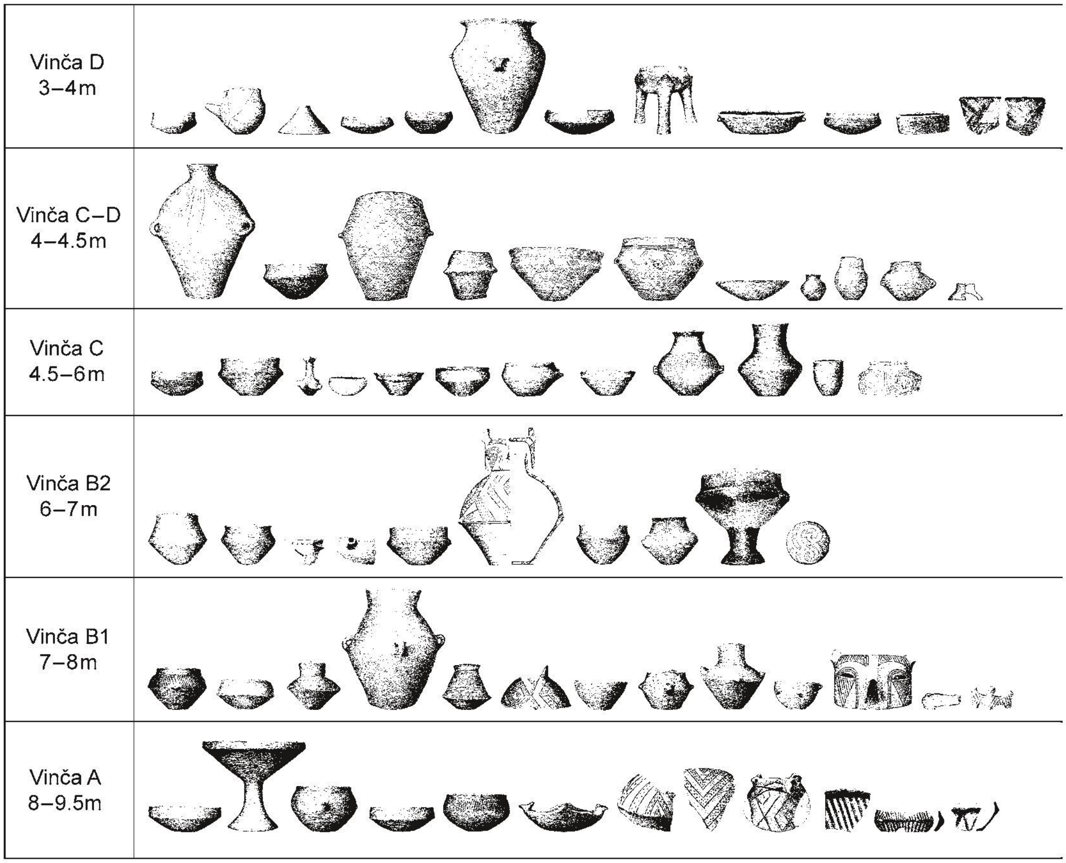


Fig. 10. Selected pot forms by depth at Vinča-Belo Brdo (after Milojčić 1949a; 1949b).

Stalio (1968; Id. 1984) used the Vasić monograph and log books, and it is important to stress that her stratigraphic scheme is closely based on the Vasić record, as is the new chronology presented in this paper. She argued for nine settlement or building horizons, the first being the Starčevo occupation with pits, and the rest being settlements of surface rectangular structures made of wattle and daub; these were divided into three phases. It is important to underline that these horizons are defined on the basis of burnt remains and the vertical gaps between these remains may have comprised unburnt occupation levels.

Details of the Stalio scheme are set out in *table 1* and indicate the scope for re-interpretation. The depth span for settlement III is rather large for a single settlement horizon. It is possibly better to divide this settlement horizon (not least in the light of the recent experience of fresh excavations in 2012–2014) into at least two or three more, one at 7.5–7.3 m (houses 1 and 2), the second at 7.2–7 m (houses 3, 4 and 5) and the third associated with structures between 6.8–6.5 m (houses 6–13)[3]. Settlement IV also spans a significantly thicker horizon. There may again be more than one horizon in this span.

[3] Depths hereafter are given from the top of the tell. The Brown house was named for Mrs Helen Brown, wife of the cultural attaché in the British embassy in Belgrade, who was also the link to Sir Charles Hyde.

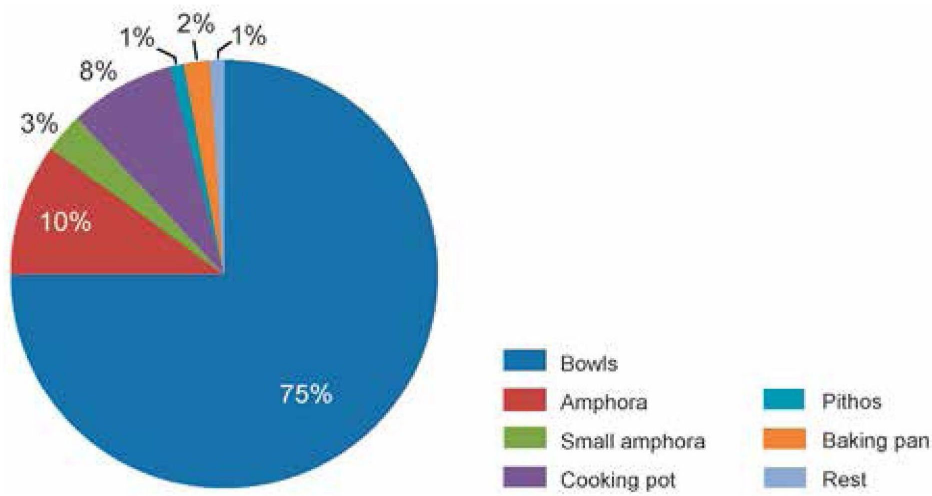


Fig. 11. Pie-chart of the frequency of major ceramic forms at Vinča-Belo Brdo, showing the dominance of bowls.

Houses 1–3 are all grouped around 6.2–6.1 m, but Houses 4–6, on the other hand, are all grouped around 5.95–5.9 m, some 20 cm higher. Stalio (1984, 39) noted that remains from settlement V were disturbed, to the extent that "no clear image of the fifth settlement can be reconstructed". Settlement VI also covers a considerable depth. Houses 1 and 2 were found between 3.6 and 3.49 m (ibid.) and were parallel to each other. House 3, on the other hand, was found between 3.6 and 3.54 m.

Other divisions of the tell have also been developed by Jovanović (Stefanović / Jovanović 1996) and Chapman (1981) *(fig. 8)* but our current focus is on the division offered by Stalio.

A concise guide to Vinča pottery

Abundant pottery was found in all the levels of Vinča-Belo Brdo. This has been the material principally used as the basis for phasing of the Vinča culture, supplemented by figurines, altars and bone tools, and in combination with the stratigraphy of Belo Brdo. This section provides a brief overview of this material *(figs 10–13)*.

While perhaps best known for its black-burnished wares, there was in fact a range of surface treatments of Vinča pottery; Childe (1929, 27–8), for example, already made a fourfold division for earlier pottery fabrics and noted the use of red slip. Overall, there were various kinds of bowl, bowls with tripod feet, pedestalled vessels, bowls and dishes with protomes, amphorae of various kinds and sizes, some with accompanying lids (some of distinctive prosopomorphic form), handled jugs, miniature vessels and plates with thickened rims. There were also fired clay 'altars' (footed dishes) and strainers. Bowls seem to be the most chronologically sensitive form – not for nothing were they the focus of correspondence analysis by Schier, who defined 180 types organised into 23 type groups (2000, 189; and see below) – and have been classed, broadly speaking, into conical, biconical, globular, carinated and tripartite types, with variation also in their rims. Some broad chronological trends among these forms should be noted. Simple conical and globular bowls occur early accompanied by carinated bowls whilst more everted as well as inturned

Fig. 12. A selection of pots from Vinča-Belo Brdo, showing some of the principal forms, the range of colours and the quality of production. Various scales.

rims are late, as are tripod bowls. Pedestalled vessels do not occur above 4 m relative depth, their bases becoming progressively more solid. Lids, altars and miniature vessels are also mainly early, while plates with thickened rims, S-shaped profiles and handled jugs are late.

All forms of the Vinča-Belo Brdo pottery have been found with decoration, though perhaps a maximum of 10 % of vessels are decorated. Incised linear or zigzag bands with infilling punctuations are one typical form of decoration, found especially on bowls and lids in earlier levels. Grooving and channeling were also used, in linear arrangements in earlier levels, and curvilinear ones later, and then in linear fashion again towards the end of the sequence. Some early painted wares are known, principally bowls with red on black linear decoration, seemingly replaced by burnished treatments in later levels; there are also late red-painted or 'crusted' wares.

Referring to the major chronological schemes for pottery development, both forms and decoration could be said for the most part to evolve steadily *(fig. 10)*. From a depth of 6 m, however, there are a series of much more abrupt changes, which Romanian colleagues have referred to as the 'Vinča C shock' (Lazarovici et al. 2009). At this point, changes in pot manufacture can be seen, such as in the choice of fabric and inclusions (Vuković 2011), perhaps in parallel with the appearance of copper metallurgy (Borić 2009). As already noted, various forms disappear, including pedestalled vessels, lids and miniature vessels, and plates, and channeling, grooving and pattern burnishing appear as almost the only decorative techniques.

Fig. 13. A selection of figurines, altars and prosopomorphic lids, with their recorded depths. Various scales.

Other material culture also shows trends through time. Early figurines have simple 'pillar' forms, but become progressively more elaborate; after 6 m, this profusion of form and decoration ends; incised decoration is found throughout, meanders coming in later, following linear arrangements earlier. Bi-coloured figurines are found in earlier levels, up to 6 m. Altars also become more elaborate in middle levels of the tell and are scarce in later levels; the abundance of bone tools including spatulae appears to follow a similar trend (Srejović / Jovanović 1959).

Ceramic typologies and ceramic phasings, from Childe to Schier

Vasić himself had difficulties in making up his mind on the character of this material from Vinča. Initially (Vasić 1906; cf. Id. 1930, 200) he assumed that the Vinča deposit formed between the Neolithic and Hallstatt periods. Later, he paralleled the Vinča material with the horizons of Troy (Vasić 1932, 87), and soon after he placed Vinča in the second half of the 7^{th} century BC (Vasić 1936b, V; VI; 153). Fewkes (1935; see also Palavestra 2013) was later to critique these misconceptions.

Childe (1929) correctly saw Vinča as a Neolithic site and as one of the key points for confirmation of his idea of a gradual spread of the Neolithic from the Aegean. His internal division of the archaeological material from Belo Brdo was one of the first of many periodisations to come. Childe saw the material for himself and discussed it with Vasić, who had also proposed a similar division in one of his early papers (1908, 319). Childe (1929, 27–32) had enough data to distinguish only two phases (Vinča I and II).

After a little refinement provided by the Austrian scholar Oswald Menghin (1931), the first more developed periodisation of Vinča-Belo Brdo came from the German prehistorian Friedrich Holste (1939) (elected to the Marburg chair just before his death in 1942, and best known for Bronze Age research in Germany). This was based on the typology of pottery excavated and published by Vasić. It divides the material into five phases labelled A–E, with phases A–D covering the Neolithic development of the site. Although redefined and remodelled by later authors, this structure continues to be the most widespread periodisation of the Vinča culture as a whole.

In 1949 Vladimir Milojčić, in his day the outstanding advocate of the cultural-historical approach, proposed a further refinement (Milojčić 1949a; cf. *fig. 24*). For this, he used exclusively the published material from Vasić's *Preistoriska Vinča*. He basically reproduced Holste's scheme but added sub-phases B1 and B2. His phase B1 denotes a time when meanders still appear as a decorative motif and his phase B2 is the time of appearance of curvilinear motifs which were more visible in the following phase Vinča C. Milojčić also identified a transitional C–D phase between 4.5–4 m, marking the transition to the last Neolithic phase at Vinča (Milojčić 1949a, 266; 267). He was also the first fully to incorporate other Late Neolithic sites from the central Balkans into his chronological system. However, being an antagonist of radiocarbon dating which had appeared soon after the publication of his own great chronological study, Milojčić agreed with Vasić's first dating of Vinča (1906; Id. 1908; Id. 1932) and put the beginning of the Vinča culture at the time of Troy I.

For his PhD thesis, Milutin Garašanin (1951) was the first to make an inventory of the entire pottery collection from Vasić's excavations at Vinča. He systematised the material from Belo Brdo and divided it into two major phases, Vinča-Tordoš and Vinča-Pločnik, drawing also on material from other sites in the wider Vinča culture distribution. Hence, he used the labels Tordoš and Pločnik to link his early and late phases of the Vinča culture (as a whole) with the northernmost and southernmost sites known at the time. At first he sub-divided both his Vinča-Tordoš and Vinča-Pločnik phases, and later elaborated this division even further (Garašanin 1979; Id. 1993). He also incorporated the views of Jovanović on the Gradac phase, which stands for a sudden and significant change in the pottery forms first attested at the south Serbian site of Gradac.

Overlapping with and following the work of Garašanin, other periodisations essentially also based on the typology of pottery, such as those by Berciu (1961), S. Dimitrijević (1974) and Lazarovici (1981), treated the Vinča culture as a whole, but since they concentrated on its periphery they will not be considered here.

The A–D division was endorsed by John Chapman (1981) for pragmatic reasons, to enable comparison within the wider Vinča culture. In his work, phases A–C denote early Vinča and phase D late Vinča.

Hermann Parzinger (1993) presented quantified estimates of the varying occurrence of selective decorative motifs and forms by depth through the Belo Brdo tell, which he incorporated in a comparative scheme of successive cultural horizons, which covers the wider west Balkan region and indeed far beyond. At Belo Brdo itself he distinguished the 'Gruben' or pit horizon with the Starčevo culture material and starts the Late Neolithic sequence with Vinča II (Parzinger 1993, 60). That equates to Holste's and Milojčić's phase A and Garašanin's Vinča-Tordoš I, and his Vinča III with Milojčić's phase B. Phase Vinča IV is marked by the pottery discovered between 6 and 4.1 m, corresponding to Milojčić's phases C and C–D. The house at 4.1 m in Parzinger's scheme represents the typical material for his phase V. The youngest sealed unit in trench G 33, at 3.48 m, marks the end of the Vinča sequence at Belo Brdo and was labelled Vinča VI. Parzinger saw the first task of prehistorians as working with the material; engagement with radiocarbon dating should only follow when that has been completed (ibid. 273).

Last but not least is the scheme developed by Wolfram Schier. It consists of eight main phases and several sub-phases and covers the sequence from the beginning of the Vinča occupation on the tell to 4 m from the top (Schier 1995; Id. 1996; Id. 2000). The phasing is based on detailed analyses of changes in the form and decoration of bowls, and its chronological credibility was tested by correspondence analysis. Instead of using the existing and rather intuitive relative chronology based on selected ceramic types, he introduced a more formal statistical approach. The correspondence analyses of 204 pottery types and decorative elements from 39 stratigraphic units (10-cm levels and pits from the lowest horizon) produced three very important results. First, the 10-cm excavation spits proved to provide pottery assemblages that are coherent from a chronological perspective; secondly, Vasić's excavation methodology or site-formation processes do not seem to have masked the overall depositional sequence of the tell; and thirdly, it was possible to identify phase boundaries in the seriation empirically (Schier 1996, 145–150, fig. 9). Schier also compared the newly defined phases with data from several other sites and concluded that the proposed division is valid at least for the 'core' area of the Vinča culture, within a radius of some 100 km of Vinča-Belo Brdo itself (Schier 1995; Id. 1996, 147). His radiocarbon dating is discussed below.

Finally, since the appearance of Schier's chronology, Garašanin (2000) has refined his chronological system even further, consistent with Schier's results. Additional subdivisions have been added, including Vinča-Tordoš IIb 1–3.

Existing radiocarbon dates from Vinča-Belo Brdo and the Vinča culture

The first radiocarbon dates for the Vinča culture were very much in the tradition of their time – one or two samples of charred material from a given site. Only a handful of sites had three to six dates. Vinča-Belo Brdo itself was fortunate to obtain two measurements on charred grain samples from a house at 3.48 m and from 8.0 m (GrN-1537 and GrN-1546; Vogel / Waterbolk 1963, 183–184). A third sample measured at this time was of unidentified charcoal from 7.5–6.5 m (GrN-1535; Todorović / Cermanović 1961, 71).

At the beginning of the 1980s, Chapman (1981, 17–31) was able to gather details of 36 radiocarbon dates from 16 sites for the Vinča culture – the first such chronological framework – and used these uncalibrated radiocarbon dates in comparison with local stratigraphic sequences. He reached three major conclusions: that the duration of phases A–C was comparable to the duration of the entire D phase; that the final centuries of the Vinča culture were not represented at the type-site; and that the different rates of development in the various regions prevent Vinča-Belo Brdo from being used as a 'type-site' for the development of the Vinča culture as a whole.

Three more conventional radiocarbon dates were obtained in 1985 by Nikola Tasić, during the course of cleaning the upstanding section through the tell left by the earlier excavations (GrN-13155–7; Tasić 1988, 46). These are all on unidentified charcoal and from known depths in the sequence.

In the 1990s, Schier (1996, tab. 1) obtained a series of 14 conventional radiocarbon dates on worked antlers and large animal bones that had been recovered by Vasić and recorded by depth. These derive from the middle and lower part of the tell (4.1–9.3 m) covered by his seriation of a sample of the surviving pottery assemblage. Using these results and the first series of dates produced in Groningen, Schier (1996, figs 11–12) produced the first Bayesian chronological model for Vinča-Belo Brdo, combining the radiocarbon dates with the sequence by depth in the tell recorded on the samples. His model suggested that the tell between 9.3 m and 4.1 m accumulated between c. 5200 cal BC and c. 4750 cal BC.

At the same time Roland Gläser presented a review of 76 radiocarbon dates from 14 Vinča culture sites. He provided a Bayesian chronological model combining the site stratigraphy with the corpus of radiocarbon dates for Selevac (Gläser 1996, fig. 5), but otherwise his analysis is based on simple calibrated radiocarbon dates and summed probability distributions of calibrated dates for selected sites, and site and ceramic phases. He suggested that the Vinča culture spanned the period from c. 5200 cal BC to c. 4500 cal BC.

The next synthesis of the chronology of the Vinča culture, by Dušan Borić (2009) mustered a total of 155 radiocarbon dates from 27 sites, including 40 new AMS measurements on short-life, single-entity samples from seven sites. Bayesian models were presented for six sites: Belo Brdo, Rudna Glava, Belovode, Pločnik, Gomolava and Divostin II. This analysis suggested that the culture dated from 5400–5300 cal BC to 4650–4600 cal BC. Contrary to Chapman, Borić argued (2009, 234) for an approximately similar duration of each phase (A to D) of 200 ± 50 years. More recently, a set of 26 new AMS dates on animal bone from Gomolava, Opovo and Petnica have been published and Bayesian models constructed (Orton 2012). These new dates generally fit the chronological framework suggested by Borić.

Radiocarbon dating

From the outset the new radiocarbon dating programme for the Vasić sequence at Vinča-Belo Brdo was conceived within the framework of Bayesian chronological modelling (Buck et al.1996). We aimed to date the succession of Neolithic finds from the complete sequence of the tell, using the depths recorded on those finds by Vasić and a new series of radiocarbon dates on samples of bone and antler artefacts from his archive.

Our sampling strategy aimed to obtain one or two measurements on finds at 20-cm vertical spacings through the Vasić sequence (i. e. sampling alternate 10-cm spits). In almost all cases, broken bone or antler tools were selected for sampling and a small (1–2 g) fragment removed from the broken end using a circular dental saw. Sometimes it was necessary to obtain single samples at a closer spacing, since two samples were not available for a particular depth (although a total of over 1000 bone artefacts survive in the Vasić archive: Srejović / Jovanović 1959). Towards the top of the sequence, above 4 m, fewer bone tools were available and so our dated sample is smaller and more widely spaced (ibid. fig. 18). From pit Z, at the base of the mound, we sampled all nine distinct individuals that could be identified in the human bone assemblage[4].

A total of 85 radiocarbon measurements are now available from the Vasić sequence at Vinča, including 61 commissioned by the ToTL project *(tab. 2)*. These come from 82 samples (as replicate results have been obtained on three of them). All the measurements are conventional radiocarbon ages, corrected for fractionation (Stuiver / Polach 1977).

The six samples of bulk charred plant material dated at Rijksuniversiteit Groningen were dated by gas proportional counting using methods described in Mook / Streurman (1983). Sixteen samples of bone and antler were dated by gas proportional counting at Universität Heidelberg, using methods outlined by Münnich (1957), Dörr et al. (1989), and Schoch et al. (1980). Fourteen of these measurements were originally published by Schier (1996, tab. 1), although the measured $\delta^{13}C$ values for these samples and two additional results from the samples he submitted are published here for the first time[5].

[4] Although there may have been up to 11 individuals from this context in total, perhaps predominantly male (Chapman 2000, 206).

[5] We thank Wolfram Schier for permission to publish these data.

Laboratory number	Find number	Material and stratigraphic details	Radiocarbon age (BP)	AMS $\delta^{13}C$ (‰)	IRMS $\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)	C:N	Notes
UBA-22044	1.0 m I.3209	*Cervus elaphus* antler from a depth of 1 m			−21.6±0.22	+5.9±0.16	3.2	
OxA-27746	1.3 m I.3210	Fallow deer / red deer (ZooMS BioArCh-11401) long bone from a depth of 1.3 m	5744±31		−20.3±0.2	+5.0±0.3	3.2	
UBA-22045	1.6 m I.3728	*Cervus elaphus* antler from a depth of 1.6 m			−20.5±0.22	+6.8±0.16	3.2	
MAMS-19495	1.7 m I.3657	*Capreolus capreolus* antler (V. Koldžić) (ZooMS BioArCh-11402) from a depth of 1.7 m	6176±29	−25.6	−23.1±0.2	+7.5±0.25	3.3	
OxA-16597		R3, right metatarsal of domestic cattle from House 6: sector II, segment III, bag 56, field inv. 42 from a depth of 1.8 m	5728±34		−19.0±0.2	+6.9±0.3		Borić 2009, tab. 7
OxA-27645	2.2 m I.3225	Fallow deer / red deer (ZooMS BioArCh-11403) long bone from a depth of 2.2 m	5730± 32		−20.1±0.2	+5.7±0.3	3.2	
MAMS-19496	2.2 m I.3727	*Cervus elaphus* (V. Koldžić) (ZooMS BioArCh-11404) antler from a depth of 2.2 m	5699± 28	−26.5	−19.6±0.2	+6.2±0.25	3.3	
OxA-28625	2.6 m I.3726-1	*Cervus elaphus* antler from a depth of 2.6 m	5746±31		−21.4±0.2	+6.0±0.3	3.2	
UBA-22046	2.8 m I.3725	*Cervus elaphus* antler from a depth of 2.8 m			−21.5±0.22	+6.3±0.16	3.2	
MAMS-19497	2.9 m I.3233	*Capreolus capreolus* (ZooMS BioArCh-11406) long bone from a depth of 2.9 m	5805±29	−26.9	−20.3±0.2	+4.3±0.25	3.3	
OxA-27610	3.0 m I.3241	Fallow deer / red deer (ZooMS BioArCh-11407) metapodial from a depth of 3.0 m	5802±32		−20.5±0.2	+5.7±0.3	3.3	
OxA-28626	3.2 m small box in box 33	*Capreolus capreolus* antler from a depth of 3.2 m	5822±32		−20.3±0.2	+5.2±0.3	3.1	$\delta^{13}C$ (IRMS), −20.35±0.15 ‰, T'=0.1; $\delta^{15}N$, +4.89±0.14 ‰, T'=1.4
UBA-22036	3.2 m small box in box 33	Replicate of OxA-28626			−20.4±0.22	+4.8±0.16	3.2	
OxA-28627	3.3 m I.3260	*Capreolus capreolus* (ZooMS BioArCh-11408) bone from a depth of 3.3 m	6004±33		−20.92±0.2	+4.6±0.3	3.1	
UBA-22037	3.4 m I.3722	*Cervus elaphus* antler from a depth of 3.4 m			−19.9±0.22	+5.8±0.16	3.2	
GrN-1537		Grain from a house at 3.48 m (Vinča D2)	5845±160					Vogel / Waterbolk 1963, 183–184
OxA-28628	3.5 m box 32	*Bos taurus* cranium from a depth of 3.5 m	6035±33		−21.0±0.2	+8.0±0.3	3.1	
MAMS-19517	3.5 m box 33	*Capreolus capreolus* (ZooMS BioArCh-11409) antler from a depth of 3.5 m	5825 ±23	−19.4	−20.7±0.2	+6.4 ±0.25	3.2	$\delta^{13}C$ (IRMS), −20.97±0.15 ‰, T'=4.1; $\delta^{15}N$, +6.26±0.13 ‰, T'=0.5
UBA-22462	3.5 m box 33	Replicate of MAMS-19517			−21.3±0.22	+6.2±0.16	3.2	

Laboratory number	Find number	Material and stratigraphic details	Radiocarbon age (BP)	AMS $\delta^{13}C$ (‰)	IRMS $\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)	C:N	Notes
OxA-27652	3.6 m I.3243	*Capreolus capreolus* (ZooMS BioArCh-11410) metapodial from a depth of 3.6 m	5986±37		–22.2±0.2	+8.0 ±0.3	3.2	
UBA-22038	3.9 m I.3238	*Cervus elaphus* antler from a depth of 3.9 m			–20.0±0.22	+5.3±0.16	3.2	
MAMS-19498	4.1 m I.3286-1	Fallow deer / red deer (ZooMS BioArCh-11411) metapodial from a depth of 4.1 m	5779±29	–23.9	–19.5±0.2	+5.5±0.25	3.3	
OxA-27609	4.1 m I.3286-8	*Capreolus capreolus* (ZooMS BioArCh-11412) metapodial bone from a depth of 4.1 m	5976±32		–21.3±0.2	+3.8 ±0.3	3.2	
Hd-17374		Mammal bone at 4.1 m (Vinča D1)	5855±27		–20.7			Schier 1996, tab. 1
OxA-27651	4.3 m I.3302-9	Cattle / bison (ZooMS BioArCh-11413) rib from a depth of 4.3 m	5911±35		–20.2±0.2	+6.9 ±0.3	3.1	
MAMS-19499	4.4 m I.3306	*Capreolus capreolus* antler (V. Koldžić) (ZooMS BioArCh-11414) from a depth of 4.4 m	5848±29	–31.3	–25.0±0.2	+7.7±0.25	3.3	
UBA-22039	4.5 m I.3311-10	Large mammal rib from a depth of 4.5 m			–20.8±0.22	+7.5±0.16	3.2	
MAMS-19500	4.6 m I.3324-3	Cattle / bison (ZooMS BioArCh-11415) rib from a depth of 4.6 m	6241±29	–25.9	–20.8±0.2	+6.5±0.25	3.3	
OxA-27608	4.7 m I.3327-7	*Capreolus capreolus* (ZooMS BioArCh-11416) long bone from a depth of 4.7 m	5972 ±35		–20.7±0.2	+4.4±0.3	3.2	
OxA-27650	4.9 m I.3338-10	Cattle / bison (ZooMS BioArCh-11417) rib from a depth of 4.9 m	5936±36		–20.8±0.2	+7.9±0.3	3.2	
MAMS-19501	4.9 m I.3338-6	Cattle / bison (ZooMS BioArCh-11418) rib from a depth of 4.9 m	5881±28	–20.5	–21.0±0.2	+6.6±0.25	3.3	
UBA-22040	5.1 m I.3351	*Cervus elaphus* antler from a depth of 5.1 m			–20.6±0.22	+5.7±0.16	3.2	
MAMS-19502	5.3 m I.3360-5	Cattle / bison (ZooMS BioArCh-11419) rib from a depth of 5.3 m	5927±28	–30.3	–21.1±0.2	+6.6±0.25	3.2	
UBA-22041	5.3 m I.3364	*Cervus elaphus* antler from a depth of 5.3 m			–22.4±0.22	+8.6±0.16	3.2	
MAMS-19503	5.5 m I.3371-1	*Capreolus capreolus* (ZooMS BioArCh-11420) long bone from a depth of 5.5 m	5893±30	–27.8	–21.8±0.2	+4.0±0.25	3.2	
OxA-27644	5.5 m I.3371-4	Cattle / bison (ZooMS BioArCh-11421) rib from a depth of 5.5 m	6007±34		–20.1±0.2	+7.0±0.3	3.2	
OxA-27649	5.7 m I.3659	Fallow deer / red deer (ZooMS BioArCh-11422) long bone from a depth of 5.7 m	5972 ±37		–22.4±0.2	+8.2±0.3	3.2	

Laboratory number	Find number	Material and stratigraphic details	Radiocarbon age (BP)	AMS $\delta^{13}C$ (‰)	IRMS $\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)	C:N	Notes
UBA-22042	5.9 m I.3387	*Cervus elaphus* antler from a depth of 5.9 m			–21.4±0.22	+5.8±0.16	3.2	
OxA-27643	6.1 m I.3396-5	*Capreolus capreolus* (ZooMS BioArCh-11423) long bone from a depth of 6.1 m	5990±32		–21.8±0.2	+5.3±0.3	3.2	
MAMS-19504	6.2 m I.3398	*Capreolus capreolus* (ZooMS BioArCh-11424) long bone from a depth of 6.2 m	5967±27	–23.7	–21.6±0.2	+3.7±0.25	3.3	
UBA-22043	6.3 m I.3413-2	Large or medium-sized mammal long bone from a depth of 6.3 m			–22.1±0.22	+7.9±0.16	3.2	
Hd-16639		*Cervus elaphus* antler at 6.4 m (Vinča C)	6081±68		–21.3			Schier 1996, tab. 1
OxA-27648	6.5 m I.3429-3	Cattle / bison (ZooMS BioArCh-11425) rib from a depth of 6.5 m	6104±36		–21.5±0.2	+7.5±0.3	3.2	
MAMS-19505	6.5 m I.3429-5	Cattle / bison (ZooMS BioArCh-11426) rib from a depth of 6.5 m	6159±35	–16.9	–21.1±0.2	+8.2±0.25	3.3	
GrN-1535		Unidentified charcoal from the third burnt layer from the bottom – Vinča Tordoš (found between 6.5 m and 7.5 m)	6170±85					Todorović / Cermanović 1961, 71
MAMS-19506	6.7 m I.3708	*Cervus elaphus* (V. Koldžić) (ZooMS BioArCh-11427) antler from a depth of 6.7 m	6141±28	–27.4	–20.1±0.2	+6.0±0.25	3.2	
OxA-27607	6.7 m I.3709	*Cervus elaphus* antler from a depth of 6.7 m	6010±30		–19.5±0.2	+5.0±0.3	3.3	
MAMS-19516	6.9 m box 33	Fallow deer / red deer (V. Koldžić) (ZooMS BioArCh-11428) antler from a depth of 6.9 m	6154±25	–18.0	–21.0±0.2	+3.2±0.25	3.3	$\delta^{13}C$ (IRMS), –21.18±0.15 ‰, T’=1.8; $\delta^{15}N$, +3.2±0.13 ‰, T’=0.0
UBA-22048	6.9 m box 33	Replicate of MAMS-19516			–21.4±0.22	+3.2±0.16	3.2	
Hd-17525		Mammal bone at 6.9 m (Vinča B)	6051±34		–21.8			Schier 1996, tab. 1
Hd-17776		*Cervus elaphus* antler at 6.9 m (Vinča B)	6259±47		–22.2			Schier 1996, tab. 1
GrN-13155		Unidentified charcoal from 6.97 m in Sector I, House 3, layer 9	6470±170		–25.0 (assumed)			Tasić 1989
Hd-16733		*Cervus elaphus* antler at 7 m (Vinča B)	6293±79		–20.7			Schier 1996, tab. 1
MAMS-19515	7.1 m box 33	*Cervus elaphus* (V. Koldžić) (ZooMS BioArCh-11429) antler from a depth of 7.1 m	6201±25	–20.6	–20.4±0.2	+5.9±0.25	3.2	$\delta^{13}C$ (IRMS), –20.54±0.15 ‰, T’=1.0; $\delta^{15}N$, +5.9±0.14 ‰, T’=0.0
UBA-22028	7.1 m box 33	Replicate of MAMS-19515			–20.7± 0.22	+5.9±0.16	3.2	
Hd-16864		*Cervus elaphus* antler at 7.1 m (Vinča B)	6145±34		–21.8			Schier1996, tab. 1
Hd-17674		*Cervus elaphus* antler at 7.1 m (Vinča B)	6198±51		–21.0			Schier 1996, tab. 1

Laboratory number	Find number	Material and stratigraphic details	Radiocarbon age (BP)	AMS $\delta^{13}C$ (‰)	IRMS $\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)	C:N	Notes
OxA-27611	7.3 m small box in box 33, sample 1	*Capreolus capreolus* antler from a depth of 7.3 m	6185±32		−23.3±0.2	+8.2±0.3	3.2	
MAMS-19507	7.3 m small box in box 33, sample 2	*Capreolus capreolus* antler from a depth of 7.3 m	6141±38	−15.1	−22.6±0.2	+8.1±0.25	3.2	
Hd-17401		*Cervus elaphus* antler at 7.3 m (Vinča B)	5673±34		−20.3			Schier 1996, tab. 1
MAMS-19508	7.5 m I.3480	*Cervus elaphus* (V. Koldžić) (ZooMS BioArCh-11431) antler from a depth of 7.5 m	6110±29	−19.9	−20.7±0.2	+4.6±0.25	3.2	
MAMS-19514	7.5 m I.3742	*Cervus elaphus* (V. Koldžić) (ZooMS BioArCh-11432) antler from a depth of 7.5 m	6247±25	−19.2	−20.5±0.2	+7.3±0.25	3.4	$\delta^{13}C$ (IRMS), −20.77±0.15 ‰, T'=4.1; $\delta^{15}N$, +7.02±0.14 ‰, T'=1.8
UBA-22029	7.5 m I.3742	Replicate of MAMS-19514			−21.1± 0.22	+6.9±0.16	3.3	
MAMS-19509	7.7 m box 33	*Cervus elaphus* (V. Koldžić) (ZooMS BioArCh-11433) antler from a depth of 7.7 m	6075±29	−16.3	−20.3±0.2	+4.4±0.25	3.2	
OxA-27605	7.7 m I.3743	*Cervus elaphus* antler from a depth of 7.7 m	6231±37		−20.0±0.2	+6.7±0.3	3.2	6233±24BP, T'=0.0; $\delta^{13}C$ (IRMS), −20.05±0.14 ‰, T'=0.1; $\delta^{15}N$, +6.55±0.21 ‰, T'=0.5
OxA-27606	7.7 m I.3743	Replicate of OxA-27605	6235±30		−20.1±0.2	+6.4±0.3	3.3	
GrN-13156		Unidentified charcoal from a depth of 7.79 m	6010±150		−25.0 (assumed)			Tasić 1989
MAMS-19513	7.8 m small box in box 33	*Capreolus capreolus* (V. Koldžić) (ZooMS BioArCh-11434) antler from a depth of 7.8 m	6170 ±30	−19.4	−22.2±0.2	+8.4±0.25	3.3	$\delta^{13}C$ (IRMS), −22.38±0.15 ‰, T'=1.8; $\delta^{15}N$, +8.26±0.13 ‰, T'=0.5
UBA-22030	7.8 m small box in box 33	Replicate of MAMS-19513			−22.6± 0.22	+8.2±0.16	3.3	
Hd-14110		*Cervus elaphus* antler at 7.8 m (Vinča B)	6149±63		−22.7			Schier 1996, tab. 1
Hd-16636		*Cervus elaphus* antler at 7.8 m (Vinča B)	6180±40		−22.2			Schier 1996, tab. 1
Hd-17147		*Cervus elaphus* antler at 7.8 m (Vinča B)	6117±32		−20.8			
OxA-28629	8.0 m I.3518-10	Cattle / bison (ZooMS BioArCh-11435) from a depth of 8.0 m	6124±32		−20.9±0.2	+8.0±0.3	3.3	6136±23BP, T'=0.3; $\delta^{13}C$ (IRMS), −20.9±0.2 ‰, T'=0.0; $\delta^{15}N$, +7.5±0.21 ‰, T'=7.5
OxA-28630	8.0 m I.3518-10	Replicate of OxA-28629	6147±31		−20.9±0.2	+7.0±0.3	3.1	
OxA-27647	8.0 m I.3518-8	Cattle / bison (ZooMS BioArCh-11436) rib from a depth of 8.0 m	6349±36		−21.9±0.2	+7.8 ±0.3	3.2	

Laboratory number	Find number	Material and stratigraphic details	Radiocarbon age (BP)	AMS $\delta^{13}C$ (‰)	IRMS $\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)	C:N	Notes
GrN-1546		Grain at 8.0 m (Vinča A) quoted as GrN-1542 by Chapman (1981)	6190±60					Vogel / Waterbolk 1963, 183–184
MAMS-19512	8.1 m I.3538-1	Cattle / bison (ZooMS BioArCh-11437) rib from a depth of 8.1 m	6214 ±40	–13.2	–20.9±0.2	+7.7±0.25	3.2	$\delta^{13}C$ (IRMS), –21.13±0.15 ‰, T'=2.8; $\delta^{15}N$, +7.49±0.13 ‰, T'=1.0
UBA-22031	8.1 m I.3538-1	Replicate of MAMS-19512			–21.4±0.22	+7.4±0.16	3.2	
GrN-13157		Unidentified charcoal from 8.22 m	6240±45		–25.6			Tasić 1989
OxA-27604	8.3 m I.3545-2	Cattle / bison (ZooMS BioArCh-11438) rib from a depth of 8.3 m	6173±38		–22.8±0.2	+7.5±0.3	3.3	
Hd-17665		*Cervus elaphus* antler at 8.4 m (Vinča A)	6273±49		–24.3			Schier 1996, tab. 1
OxA-27745	8.5 m I.3572-5	Cattle / bison (ZooMS BioArCh-11439) rib from a depth of 8.5 m	6143±32		–21.2±0.2	+7 ±0.3	3.2	
Hd-14235		*Cervus elaphus* antler at 8.5 m (Vinča A)	6264±22		–22.0			Schier 1996, tab. 1
OxA-28631	8.7 m box 33	*Cervus elaphus* antler from a depth of 8.7 m	6261±32		–22.2±0.2	+6.4±0.3	3.2	
UBA-22032	8.7 m I.3581-4	Large mammal long bone from a depth of 8.7 m			–21.3±0.22	+4.7±0.16	3.2	
Hd-16661		*Cervus elaphus* antler at 8.7 m (Vinča A)	6353±66		–20.3			Schier 1996, tab. 1
OxA-27642	8.9 m I.3589-4	Cattle / bison (ZooMS BioArCh-11440) rib from a depth of 8.9 m	6267±33		–21.6±0.2	+7.2±0.3	3.2	
MAMS-19510	9.1 m I.3600.1	Cattle / bison (ZooMS BioArCh-11441) rib from a depth of 9.1 m	6204 ±29	–20.7	–23.1±0.2	+7.0±0.25	3.2	
Hd-17120		*Cervus elaphus* antler at 9.1 m (Vinča A)	6223±89		–21.9			
OxA-27646	9.2 m I.3608-2	Cattle / bison (ZooMS BioArCh-11443) rib from a pit at a depth of 9.2 m	6196±34		–20.0±0.2	+7.2±0.3	3.2	
MAMS-19511	9.2 m I.3611-1	Cattle / bison (ZooMS BioArCh-11442) rib from a pit at 9.2 m depth	6168 ±30	–23.1	–21.5±0.2	+7.1±0.25	3.3	$\delta^{13}C$ (IRMS), –21.68±0.15 ‰, T'=1.8; $\delta^{15}N$, +6.89±0.13 ‰, T'=1.0
UBA-22034	9.2 m I.3611-1	Replicate of MAMS-19511			–21.9±0.22	+6.8±0.16	3.2	
UBA-22035	9.3 m I.3620	Large mammal long bone from a depth of 9.3 m			–21.7±0.22	+7.4±0.16	3.3	
OxA-27826	9.3 m I.3635	Large or medium-sized mammal rib from pit at 9.3 m	5834±30		–20.7±0.2	+6.4±0.3	3.1	
Hd-14184		*Cervus elaphus* antler from a pit at 9.3 m (Vinča A)	6249±31		–22.5			Schier 1996, tab. 1

Laboratory number	Find number	Material and stratigraphic details	Radiocarbon age (BP)	AMS $\delta^{13}C$ (‰)	IRMS $\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)	C:N	Notes
OxA-15996		R1, adult human skull from Pit Z–burial 'chamber'	6620±45		–19.7±0.2	+13.6±0.3		Borić 2009, tab. 7
MAMS-19518	Starčevo II	Human skull from a pit with at least eight more articulated skeletons at the base of the tell at a depth of 11 m	6499±24	–15.3	–19.6±0.2	+12.8±0.25	3.3	$\delta^{13}C$ (IRMS), –20.0±0.15 ‰, T'=7.2; $\delta^{15}N$, +12.5±0.13 ‰, T'=2.8
UBA-22464	Starčevo II	Replicate of MAMS-19518			–20.4±0.22	+12.3±0.16	3.2	
OxA-28632	Starčevo III	Human skull from a pit with at least eight more articulated skeletons at the base of the tell at a depth of 11 m	6596±34		–20.7±0.2	+10.2 ±0.3	3.2	Collagen yield 4.8 mg from 610 mg starting weight; just below the 1 % wt. collagen cutoff
OxA-28633	Starčevo IV	Human skull from a pit with at least eight more articulated skeletons at the base of the tell at a depth of 11 m	6626±33		–19.8±0.2	+13.2±0.3	3.2	
OxA-28634	Starčevo V	Human skull from a pit with at least eight more articulated skeletons at the base of the tell at a depth of 11 m	6581±34		–20.6±0.2	+11.2±0.3	3.2	OxA-28634 had a low collagen yield (0.8 %) $\delta^{13}C$ (IRMS), –20.6±0.15 ‰, T'=0.0; $\delta^{15}N$, +11.4±0.14 ‰, T'=0.3
UBA-22463	Starčevo V	Replicate of OxA-28634			–20.6±0.22	+11.4±0.16	3.2	
OxA-28635	Starčevo VII	Human skull from a pit with at least eight more articulated skeletons at the base of the tell at a depth of 11 m	6582±33		–20.2±0.2	+11.6±0.3	3.2	
OxA-28636	Starčevo IX	Human skull from a pit with at least eight more articulated skeletons at the base of the tell at a depth of 11 m	6665±33		–20.4±0.2	+11.6±0.3	3.1	6717±20BP, T'=3.8; $\delta^{13}C$ (IRMS), –20.2±0.14 ‰, T'=2.0; $\delta^{15}N$, +11.8±0.21 ‰, T'=0.5
MAMS-19519	Starčevo IX	Replicate of OxA-28636	6746±25	–18.0	–20.0±0.2	+11.9±0.25	3.4	
OxA-28637	Starčevo X	Human skull from a pit with at least eight more articulated skeletons at the base of the tell at a depth of 11 m	6514±34		–20.0±0.2	+10.7±0.3	3.2	
OxA-28638	Starčevo unmarked	Human skull from a pit with at least eight more articulated skeletons at the base of the tell at a depth of 11 m	6757±34		–20.4±0.2	+12.4±0.3	3.3	$\delta^{13}C$ (IRMS), –20.4±0.15 ‰, T'=0.0; $\delta^{15}N$, +12.2±0.14 ‰, T'=0.8
UBA-22465	Starčevo unmarked	Replicate of OxA-28638			–20.4±0.22	+12.1±0.16	3.3	

Tab. 2. Radiocarbon ages and stable isotopic measurements from Vinča-Belo Brdo; the statistical consistency of replicate measurements has been assessed using the method of Ward / Wilson (1978) (T' (5 %) = 3.8; T' (1 %) = 6.0; ν = 1 for all).

The 25 bone and antler samples dated at the Curt-Engelhorn-Zentrum Archäometrie, Mannheim, were prepared by gelatinisation and ultra-filtration (Brown et al. 1988), combusted in an elemental analyser, graphitised and dated by Accelerator Mass Spectrometry (AMS) (Kromer et al. 2013). Sub-samples of the prepared collagen were sent to the University of Otago for stable isotope measurement by Isotope Ratio Mass Spectrometry (IRMS), using methods outlined in Beavan Athfield et al. (2008, 3). All 38 samples dated at the Oxford Radiocarbon Accelerator Unit were similarly prepared by gelatinisation and ultra-filtration (Brock et al. 2010), combusted and graphitised (Dee / Bronk Ramsey 2000), and dated by AMS (Bronk Ramsey et al. 2004). Stable isotopic measurements were also produced by IRMS on a further 23 samples at the Queen's University, Belfast, using methods outlined in Reimer et al. (2015).

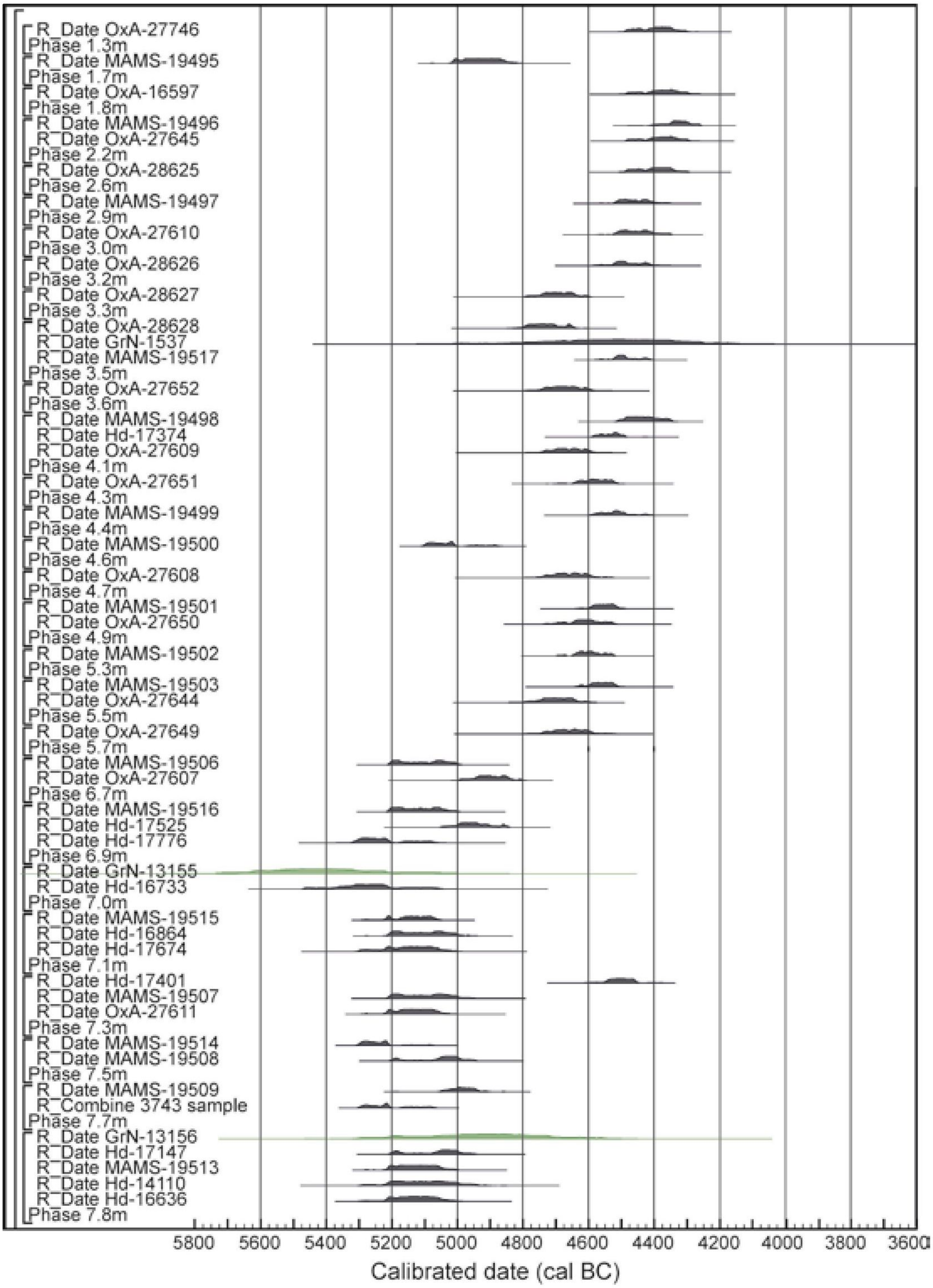
Three pairs of replicate radiocarbon measurements are available, all of which are statistically consistent at 95 % confidence *(tab. 2)*. Weighted means of these results have been taken before calibration and inclusion in the chronological models (Ward / Wilson 1978). Fourteen replicate pairs of $\delta^{13}C$ values measured by IRMS are available, of which eleven are statistically consistent at 95 % confidence. Two further pairs are statistically consistent at 99 % confidence. Of the fourteen replicate pairs of $\delta^{15}N$ values, thirteen are statistically consistent at 95 % confidence, with the final pair consistent at 99 % confidence. Weighted means have also been taken of these isotopic ratios before their inclusion in the dietary analysis presented below *(tab. 2)*.

In order to amplify the existing taxonomic identifications 45 samples of bone powder from a selection of tools were submitted for zooarchaeology by mass spectrometry (ZooMS) analysis at BioArCh (University of York) (Buckley et al. 2009; Hounslow et al. 2013), following the preparation and processing methods described in Collins / Rowsell (2014, 5). Using matrix-assisted laser desorption / ionisation time-of-flight mass spectrometry (MALDI-TOF-MS) to analyse the collagen sequence, all samples were identified to species level: 18 are cattle / bison, 13 are fallow / red deer and 14 are roe deer. These identifications by ZooMS are listed in *tab. 2* in the description of the radiocarbon samples.

Chronological modelling

The Bayesian chronological modelling, which combines these radiocarbon data with the excavated sequence, has been undertaken using the programme OxCal v4.2 (Bronk Ramsey 2009a; Bronk Ramsey / Lee 2013) and the atmospheric calibration curve for the northern hemisphere published by Reimer et al. (2013). The algorithm used is defined exactly by the OxCal CQL2 programme code provided as supplementary information (Vinca_Vasic_age_depth_final.oxcal, doi:10.11588/data/10081). The brackets and keywords on the left-hand side of *fig. 16*, however, show the overall form of the model (http://c14.arch.ox.ac.uk/). The posterior density estimates output by the model are shown in black, with the unconstrained calibrated radiocarbon dates shown in outline. The other distributions correspond to aspects of the model. For example, the distribution '9.3m' *(fig. 16)* is the posterior density estimate for the time when the deposition of diagnostic Vinča-type material culture began at Belo Brdo. In the text and tables, the Highest Posterior Density intervals of the posterior density estimates are given *in italics*.

The calibrated radiocarbon dates from Belo Brdo are shown in order of their vertical depth through the tell in *fig. 14*. Although a clear chronological progression is apparent, there are clearly dates which are misplaced in this sequence. We must be clear about the


R_Date OxA-27746
Phase 1.3m
R_Date MAMS-19495
Phase 1.7m
R_Date OxA-16597
Phase 1.8m
R_Date MAMS-19496
R_Date OxA-27645
Phase 2.2m
R_Date OxA-28625
Phase 2.6m
R_Date MAMS-19497
Phase 2.9m
R_Date OxA-27610
Phase 3.0m
R_Date OxA-28626
Phase 3.2m
R_Date OxA-28627
Phase 3.3m
R_Date OxA-28628
R_Date GrN-1537
R_Date MAMS-19517
Phase 3.5m
R_Date OxA-27652
Phase 3.6m
R_Date MAMS-19498
R_Date Hd-17374
R_Date OxA-27609
Phase 4.1m
R_Date OxA-27651
Phase 4.3m
R_Date MAMS-19499
Phase 4.4m
R_Date MAMS-19500
Phase 4.6m
R_Date OxA-27608
Phase 4.7m
R_Date MAMS-19501
R_Date OxA-27650
Phase 4.9m
R_Date MAMS-19502
Phase 5.3m
R_Date MAMS-19503
R_Date OxA-27644
Phase 5.5m
R_Date OxA-27649
Phase 5.7m
R_Date MAMS-19506
R_Date OxA-27607
Phase 6.7m
R_Date MAMS-19516
R_Date Hd-17525
R_Date Hd-17776
Phase 6.9m
R_Date GrN-13155
R_Date Hd-16733
Phase 7.0m
R_Date MAMS-19515
R_Date Hd-16864
R_Date Hd-17674
Phase 7.1m
R_Date Hd-17401
R_Date MAMS-19507
R_Date OxA-27611
Phase 7.3m
R_Date MAMS-19514
R_Date MAMS-19508
Phase 7.5m
R_Date MAMS-19509
R_Combine 3743 sample
Phase 7.7m
R_Date GrN-13156
R_Date Hd-17147
R_Date MAMS-19513
R_Date Hd-14110
R_Date Hd-16636
Phase 7.8m
5800 5600 5400 5200 5000 4800 4600 4400 4200 4000 3800 3600
Calibrated date (cal BC)

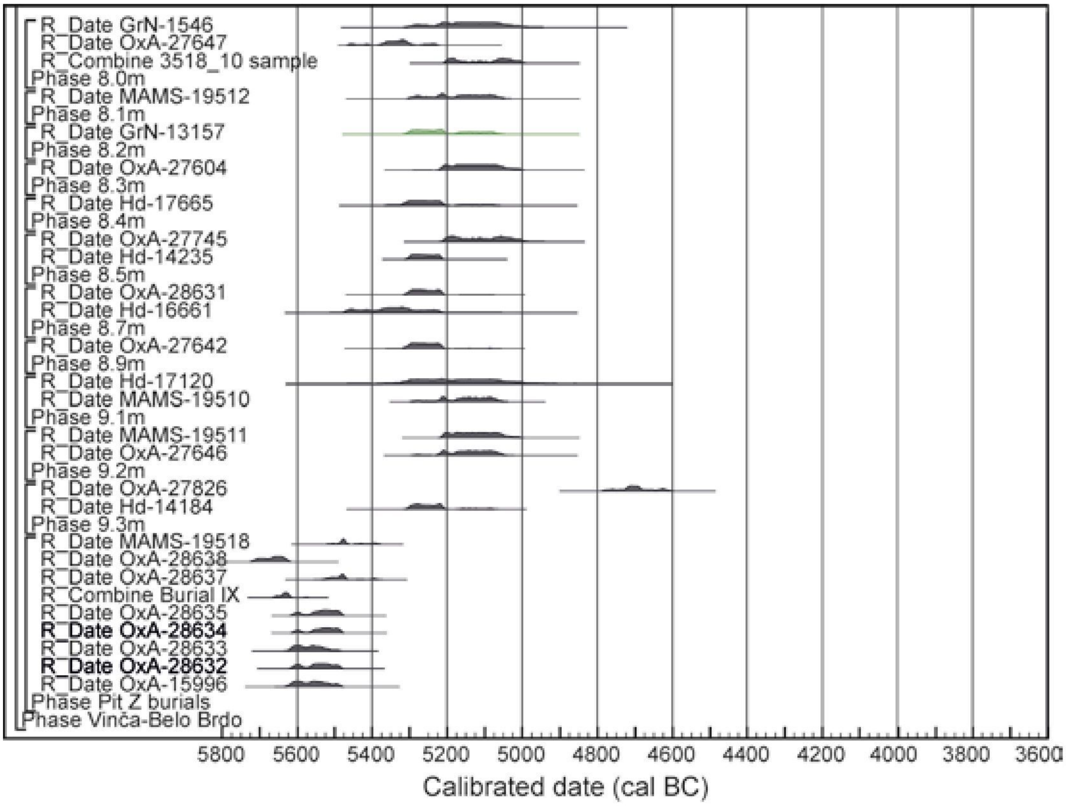


Fig. 14. Calibrated radiocarbon dates from Vinča-Belo Brdo, calibrated using the probability method (Stuiver / Reimer 1993) and IntCal13 (Reimer et al. 2013), and plotted by depth; samples of unidentified charcoal, which may incorporate an old-wood offset and so be older than the depth at which they were deposited, are shown in green.

reasons why this might occur, so that we can take measures to incorporate each radiocarbon date appropriately in the model. There are three main categories of such measurements:

1) Statistical outliers – the 1 in 20 radiocarbon results whose true age lies outside the 95 % range. These must be retained in the model as their exclusion would statistically bias the model outputs.
2) Misfits – dates which do not fit in the expected stratigraphic position, or which are inaccurate for some technical reason. Generally, samples which prove to be residual can be used as *termini post quos* for their contexts, but intrusive samples or inaccurate dates need to be excluded from the analysis. Sometimes it may be possible to reinterpret the stratigraphy.
3) Offsets – measurements that are systematically offset from the calibration data by a knowable amount (most commonly, reservoir effects that can be accounted for in the calibration process). Confusingly, both categories 2) and 3) are both known in the statistical literature as 'systematic offsets' although, archaeologically, they are very different.

We clearly have the potential for all three categories of measurement in our assemblage of radiocarbon dates from the Vasić sequence. In a series of 85 measurements, there should be four or five statistical outliers. Given the very limited contextual information available for almost all the dated samples, there is the potential both for residual samples to have been dated and for samples which were in features cut into the depth from which the sample was recovered from higher in the tell. In this instance, given the good reproducibility of both the replicate radiocarbon ages and replicate stable isotopic measurements from this site, we consider it unlikely that any of the reported results are inaccurate. We must also consider the potential for a dietary offset in the radiocarbon ages produced from the human bone samples from pit Z caused by the consumption of freshwater fish (Borić 2009, 202; Cook et al. 2002).

Our first step in constructing a chronological model for the Vasić sequence is to account for any possible dietary effect in the radiocarbon ages of the human burials from pit Z.

Diet reconstruction for each of the nine humans was determined by the Bayesian mixing model FRUITS v.2.0β (Food Reconstruction Using Isotopic Transferred Signals; Fernandes et al. 2014). FRUITS utilises the isotopic averages of possible food sources (in this case terrestrial herbivores, cereals, fish and legumes) and allows the user to include uncertainties and prior information in the stable isotope mixing model, including the uncertainty in isotopic signals of potential food groups and diet-to-tissue isotopic offsets. FRUITS produces solutions which estimate the proportion of each possible food source in the diet of each consumer.

The FRUITS modelling on two diet proxies ($\delta^{13}C$ and $\delta^{15}N$) for the Vinča humans employed the following data and assumptions:

1. Stable isotope values of potential diet sources

Stable isotope averages from four possible food groups were used in the FRUITS modelling for Vinča. The terrestrial herbivore values used are from bones from Vinča itself (*tab. 2*; n = 72; only values measured by the Oxford Radiocarbon Accelerator Unit [OxA-] or the University of Otago were used). Freshwater fish values are from the late Mesolithic site of Vlasac (n = 3; Nehlich et al. 2010). Values for cereals included archaeobotanical samples of wheat (n = 12) and barley (n = 6) (Ogrinc / Budja 2005) and modern einkorn (n = 4) from Fraser et al. (2013), which were adjusted by 1.5 ‰ for the Suess effect on $\delta^{13}C$ (Suess 1958).

Values for legumes were archaeobotanical specimens of peas (n = 4; Ogrinc / Budja 2005) and an unspecified number of archaeobotanical samples of bitter vetch (Fraser et al. 2013).

2. Diet-to-tissue offset arising from isotopic fractionation during tissue building

A review of published enrichment values under experimental conditions yields a range of 3.7–6.0 ‰ for $\delta^{13}C$ values between diet and collagen, and a range of 1.7–6.9 ‰ for $\delta^{15}N$ values (Fernandes et al. 2014; O'Connell et al. 2012; Bocherens / Drucker 2003; Bocherens / Mariotti 2002; Bocherens et al. 1994). FRUITS allows the user to test different assumptions for the diet-to-tissue offset. We gradually adjusted starting values of 1 ‰ for carbon and 3 ‰ for nitrogen based on diet-to-consumer offset values in 0.5 ‰ increments until the FRUITS programme could resolve the baseline diet with consumer values. Our working diet to tissue offsets for the FRUITS modelling were 4 ‰ diet-to-consumer for $\delta^{13}C$ and 4.5 ‰ diet-to-consumer for $\delta^{15}N$. We also chose a conservative 0.5 ‰ uncertainty for both carbon and nitrogen in these diet-to-consumer offset values.

3. Prior information

FRUITS allows other information on the relationships between the different food groups and / or food fractions to be incorporated in the model. On the basis of the preva-

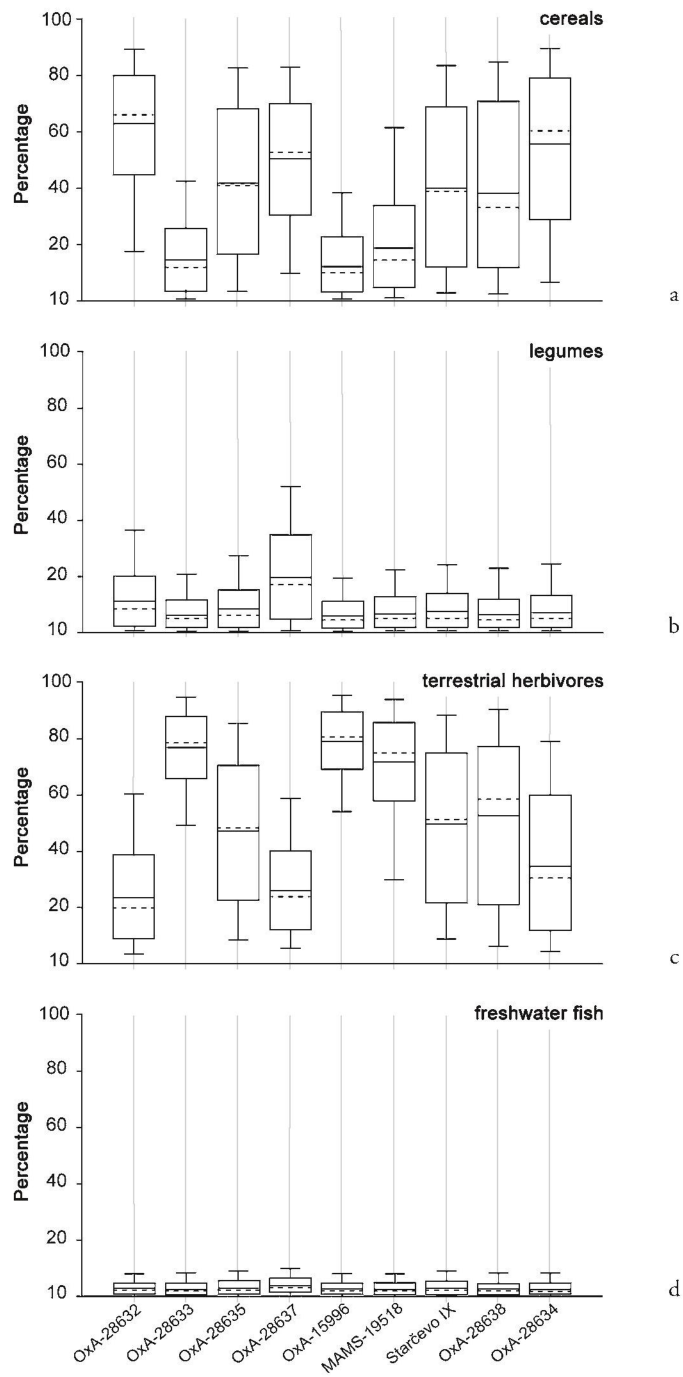


Fig. 15. Box plots of the FRUITS estimations for each of the four diet sources, a) cereals, b) legumes, c) terrestrial herbivores, and d) freshwater fish, for each of the human skeletons from pit Z. The boxes provide a 68 % confidence interval while the whiskers provide a 95 % confidence interval. The horizontal continuous line indicates the average while the horizontal discontinuous line indicates the median (50th percentile). These box plots illustrate that terrestrial herbivores and cereals are estimated to be the largest components of human diets at Vinča-Belo Brdo.

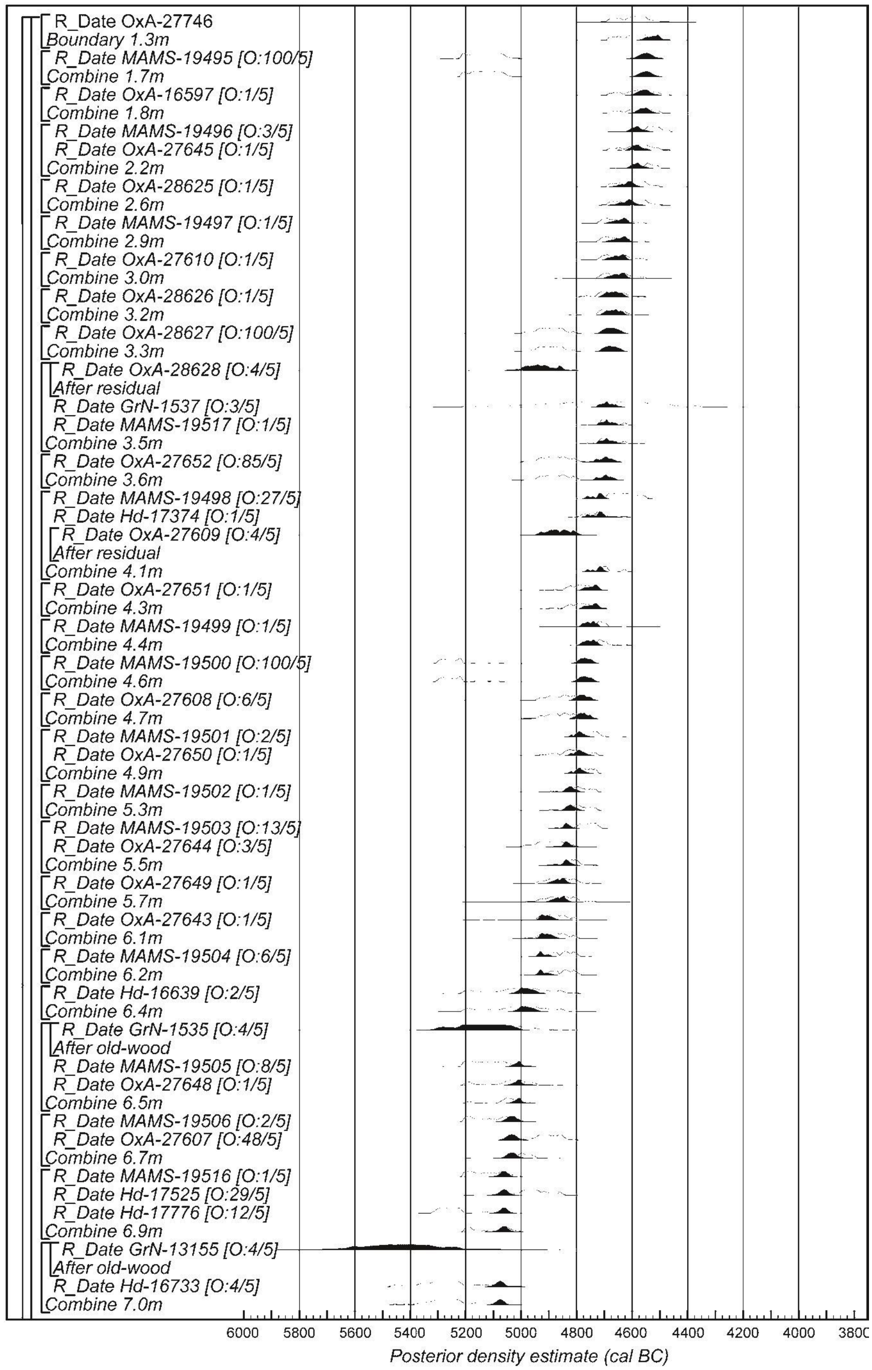
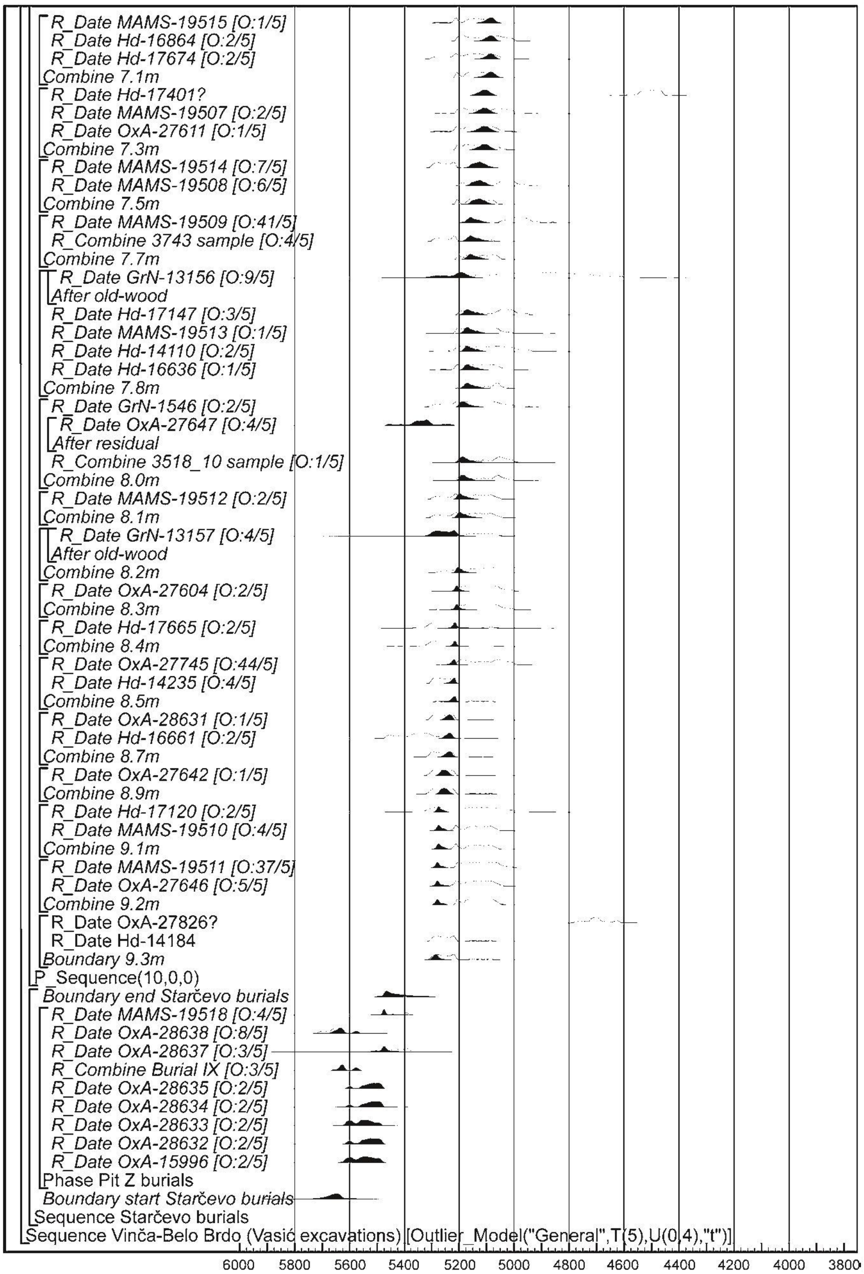


Fig. 16. Probability distributions of radiocarbon dates from a poisson-process age-depth model of the Vasić sequence through the tell at Vinča-Belo Brdo, incorporating the general outlier model and mixed-sourced calibrations for the human burials from pit Z. Each distribution represents the relative probability that an event occurs at a particular time. For each of the dates two distributions have been plotted: one in outline, which is the result of simple radiocarbon calibration, and a solid one, based on the chronological model used. Distributions other than those relating to particular samples correspond to aspects of the model. For example,



the distribution '*9.3 m*' is the estimated date when Vinča activity on the site began. Measurements followed by a question mark and shown in outline have been excluded from the model for reasons explained in the text, and are simple calibrated dates (Stuiver / Reimer 1993). Posterior and prior outlier probabilities are shown after each measurement. The model is defined exactly by the OxCal code provided as supplementary information (Vinca_Vasic_age_depth_final.oxcal: doi:10.11588/data/10081).

lence of faunal remains on the site, we assumed that terrestrial herbivores would have contributed to more consumer stable isotope values than freshwater fish.

The FRUITS estimates for the proportion of the diet of each dated individual provided by the four food groups are shown in *tab. 3*. Some variation between the diets of different individuals is apparent, but all the estimates agree in suggesting that the majority of the diet of humans at Vinča-Belo Brdo consisted of protein derived from terrestrial herbivores and cereals *(fig. 15)*.

The human $\delta^{15}N$ value range of 10.2 ‰ to 13.6 ‰ indicates diets that are fairly high in animal protein. Of the two possible sources of animal protein available to the inhabitants of Belo Brdo, terrestrial herbivores and freshwater fish, FRUITS estimates suggest that fish may contribute between 2 ± 2 % and 4 ± 3 % to consumer stable isotope signatures. The comparatively large error terms associated with these estimates, however, also suggest that fish could have made up a very small proportion of the diet (2 % or less).

Terrestrial herbivores are clearly the significant contributors to the most enriched $\delta^{15}N$ values among the humans considered here (Starčevo IV = ?R1, Starčevo VII and Starčevo II), with cereals making up the next largest dietary proportion. Dietary variation in the population is also evidenced in people with higher estimated legume consumption (Starčevo III and Starčevo X).

Broadly speaking, these diet estimates, though the range of nitrogen values should be noted, conform with archaeological evaluation of the principal means of subsistence across the Starčevo and Körös cultures (Tringham 2000; Colledge / Conolly 2007; Colledge 2013). Caution on every aspect is appropriate, however, since so few sites have been investigated with sieving, dry or wet, which radically affects recovery rates, including of both cereals and small bones. In the Körös culture context of Ecsegfalva 23, for example, sieving helped to establish the presence of a range of fish species, but these were thought to be just a small component of a subsistence strategy dominated by garden cultivation of cereals and the husbandry of domesticated animals, especially sheep and goats; fishing may have there, in the context of the Kiri-tó oxbow in the Berettyó river valley, have been seasonal and opportunistic, following episodes of flooding (Bartosiewicz 2007a; Id. 2007b; Bogaard et al. 2007).

In this paper, however, our principal interest in the amount of fish that may have been consumed by the inhabitants of Vinča lies in the potential for a dietary offset in the radiocarbon age of those individuals. Cook et al. (2002) have calculated a freshwater reservoir effect of 540 ± 70 BP for the Danube at the Iron Gates Gorge. So here we use this reservoir, offset from the atmospheric calibration dataset (Reimer et al. 2013), and the Mix_Curves function of OxCal v4.2 (Bronk Ramsey 2001, amended following Jones / Nicholls 2001). For each dated individual, we have constructed a personal calibration curve, which incorporates the freshwater reservoir in the proportion suggested by the dietary estimate for freshwater fish provided by the FRUITS model in that particular individual *(tab. 3)*. So, for example, OxA-28632 (Starčevo III) has been calibrated using a calibration curve including a component of 3 ± 2 % freshwater fish (note that the proportion of any curve is constrained to be 0–100 %). The remainder of diet sources will be in equilibrium with the contemporary atmosphere and have been calibrated using IntCal13 (Reimer et al. 2013). In this analysis, we have included OxA-15996 as a separate individual. This must be incorrect, as this sample came from one of the skulls recorded from pit Z and we have otherwise sampled all the individuals from this deposit. Unfortunately, we were unable to determine which of the Starčevo skulls was sampled for OxA-15996, although on the basis of the stable isotope results it may have been Starčevo IV.

The second step in constructing our model for the chronology of the Vasić sequence is to identify misfits. This is a challenge, since almost all the samples are disarticulated bones and thus could be residual or intrusive. This means that we have no fixed points that are certainly correct against which we can judge the potential reliability of these disarticulated samples. We do, however, have radiocarbon measurements on more than one sample from pit Z and from a number of 10-cm spits. Initially, therefore, we consider the statistical consistency of these groups of results. Unsurprisingly, the nine individuals buried in pit Z do not provide a statistically consistent set of radiocarbon measurements (T' = 78.1; T' (5 %) = 15.5; ν = 8; Ward / Wilson 1978), which suggests that people may have been buried in this pit over a period of time.

Thirteen depths have radiocarbon measurements on two samples *(tab. 2)*. In seven cases, these results are statistically consistent, as might be expected if the material was freshly discarded as the tell accumulated (OxA-27646 and MAMS-19511 at 9.2 m [T' = 0.4], MAMS-19510 and Hd-17120 at 9.1 m [T' = 0.0], OxA-28631 and Hd-16661 at 8.7 m [T' = 1.6], Hd-16733 and GrN-13155 at 7.0 m [T' = 0.9], OxA-27648 and MAMS-19505 at 6.5 m [T' = 1.2], OxA-27650 and MAMS-19501 at 4.9 m [T' = 1.5], and OxA-27645 and MAMS-19496 at 2.2 m [T' = 0.5] [T' (5 %) = 3.8, ν = 1 for all]). In six cases they are not. Of the two samples from pits at 9.3 m, OxA-27826 is clearly from a much later pit than that which contained Hd-14184 (T' = 92.6; T' (5 %) = 3.8; ν = 1), although it is not clear which of the statistically inconsistent pairs at 8.5 m (OxA-27745 and Hd-14235; T' = 9.7; T' (5 %) = 3.8; ν = 1), 7.7 m (MAMS-19509 and OxA-27605–6; T' = 17.6; T' (5 %) = 3.8; ν = 1), 7.5 m (MAMS-19514 and MAMS-19508; T' = 12.8; T' (5 %) = 3.8; ν = 1), 6.7 m (OxA-27607 and MAMS-19506; T' = 10.2; T' (5 %) = 3.8; ν = 1), and 5.5 m (MAMS-19503 and OxA-27644; T' = 10.2; T' (5 %) = 3.8; ν = 1) might be misplaced in their position in the sequence.

At six depths, measurements on three bone tools are available. Only those at 7.1 m are statistically consistent (MAMS-19515, Hd-16864, and Hd-17674; T' = 1.8; T' (5 %) = 6.0; ν = 2). At 7.3 m, Hd-17401 is clearly from a feature which cut down to this depth from much higher up, as the other two results from this level are statistically consistent (MAMS-19507 and OxA-27611; T' = 0.8; T' (5 %) = 3.8; ν = 1). At 8.0 m, OxA-27647 also seems to be residual as it is earlier than the other measurements from this level (OxA-28629–30, OxA-27647 and GrN-1546; T' = 25.2; T' (5 %) = 6.0; ν = 2). OxA-27609, from 4.1 m, also appears to be residual since it is significantly earlier than the other two samples from this height (MAMS-19498, OxA-27609, and Hd-17374; T' = 21.0; T' (5 %) = 6.0; ν = 2), and at 3.5 m OxA-28628 similarly appears to be residual (GrN-1537, OxA-28628, MAMS-19517; T' = 27.6; T' (5 %) = 6.0; ν = 2). At 6.9 m the three results are widely scattered and so the taphonomy of the dated samples is unclear (Hd-17525, Hd-17776 and MAMS-19516; T' = 13.6; T' (5 %) = 3.8; ν = 1).

Five results are available from 7.8 m, all of which are statistically consistent (GrN-13156, MAMS-19513, Hd-14110, Hd-16636 and Hd-17147; T' = 2.9; T' (5 %) = 9.5; ν = 4).

On the basis of this replicate analysis, we can identify five samples as archaeological misfits: OxA-27826 at 9.3 m and Hd-17401 at 7.3 m appear to be from later features that were cut down to the depths from which the samples were recovered, and OxA-27647 from 8.0 m, OxA-27609 from 4.1 m and OxA-28628 at 3.5 m appear to be residual. There are clearly further misfits in the dataset, at 8.5 m, 7.7 m, 7.5 m, 6.9 m, 6.7 m and 5.5 m, but we cannot be certain which sample from these depths is problematic.

There are two possible approaches to identifying and dealing with further misfits. The first approach is to identify them manually using our archaeological judgment about the

Laboratory number	Section	$\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)	Terrestrial herbivores (%)	Freshwater fish (%)	Emmer, einkorn, barley (%)	Legumes (%)
OxA-28632	Starčevo III	−20.7±0.2	10.2±0.3	23±15	3±2	63±18	11±10
OxA-28633	Starčevo IV	−19.8±0.2	13.2±0.3	77±12	3±2	14±12	6±5
OxA-28635	Starčevo VII	−20.2±0.2	11.6±0.3	47±22	3±2	42±23	8±7
OxA-28637	Starčevo X	−20.0±0.2	10.7±0.3	26±14	4±3	51±19	20±14
OxA-15996	R1	−19.7±0.2	13.6±0.3	79±11	3±2	12±10	6±5
MAMS-19518/ UBA-22464	Starčevo II	−20.0±0.15*	12.5±0.13*	72±16	3±2	19±16	7±6
MAMS-19519/ OxA-28636	Starčevo IX	−20.2±0.14*	11.8±0.21*	50±23	3±2	40±24	7±7
OxA-28638/ UBA-22465	Starčevo unmarked	−20.4±0.15*	12.3±0.25*	53±24	2±2	38±26	7±6
OxA-28634/ UBA-22463	Starčevo V	−20.6±0.15*	11.4±0.14*	35±22	3±2	55±23	7±7

Tab. 3. FRUITS (Fernandes et al. 2014) estimates of diet proportions from the four food groups for the nine human skeleton in pit Z (* weighted averages of IRMS $\delta^{13}C$ and $\delta^{15}N$ analyses on duplicate samples; see *tab. 2*).

character of particular samples and deposits and the individual agreement indices provided by OxCal (Bronk Ramsey 1995, 429), and then to decide how to include each date in the model depending on its specific characteristics. The major advantage of this approach is that it allows us to account for all the information we have about the character of particular samples or deposits; the disadvantage is that the indices of agreement provided by OxCal are not derived from a formal statistical approach (although they have proven robust in a wide range of applications). Given the limited archaeological information available about the dated samples from this sequence, manual outlier detection using agreement indices has not been used here since its disadvantages are not, in this case, outweighed by its advantages.

The second approach is formal, statistical outlier detection. This assumes that we can never really be sure whether any particular measurement is an outlier, and so weights each sample according to how likely it is be correct using a model averaging approach. The advantage of this method is that it is an explicit statistical process; the disadvantage is that it may not take account of the archaeological information we may have about the relative strengths and weaknesses of particular samples or deposits. Since we are hoping to identify misfits that are outliers on the calendar scale (samples are residual or intrusive at the depth at which they were found), we use the general outlier model proposed by Bronk Ramsey (2009b, 1028).

The final step in constructing a model for the chronology of the Vasić sequence is to incorporate the depths from which samples were recovered. For this, we need to implement an age-depth model. We do this using the poisson process depositional model described by Bronk Ramsey (2008) with a rigidity parameter (k-value) of 10. This means that the granularity of tell accumulation is in the 10-cm spits that were excavated by Vasić. Of course, the tell will actually have accumulated at a granularity both much less than this (for example, where sediment was accumulated through trampling) and much more than this (for example, where material was brought in to provide a level platform for the construction of a new building). But the record that we are dating is the settlement sequence and material culture assemblages that are recorded to 10-cm depths, so the granularity of record that we are modelling is at this resolution.

The form of the chronological model for the Vasić sequence is illustrated in *fig. 16* (it is exactly defined by the OxCal code provided in supplementary information [Vinca_Vasic_age_depth_final.oxcal]).

The Starčevo burials in pit Z are considered as a discrete period of activity, which is followed by the start of the accumulation of Vinča material culture at Belo Brdo. Each human burial has been calibrated using a personal calibration curve, which incorporates the freshwater reservoir (540 ± 70 BP) in the proportion suggested by the dietary estimate for freshwater fish provided by the FRUITS model in that particular individual *(tab. 3)* using the Mix_Curves function of OxCal v4.2 (Bronk Ramsey 2001, amended following Jones / Nicholls 2001). The remainder of diet sources will be in equilibrium with the contemporary atmosphere and have been calibrated using IntCal13 (Reimer et al. 2013).

Vinča cultural material then accumulates in a poisson-process, continuously in successive 10-cm spits until Vinča occupation at Belo Brdo ends. Dates at each depth are combined after calibration, proportionately as determined by the general outlier model employed, to obtain a single date estimate for the time when material at each dated 10-cm spit was deposited. OxA-27826 and Hd-17401 have been excluded from the model on the basis that they are clearly later samples deriving from unrecorded cut features, and OxA-27609, OxA-27647 and OxA-28628 have been modelled as *termini post quos* since they appear to have been residual at the depths from which they were recovered. The four samples of unidentified charcoal, GrN-1535 and GrN-13155–7, are also modelled as *termini post quos* because of the possibility that these samples incorporate an old-wood offset. Each measurement in this model has been given a prior outlier probability of 5 %.

The age-depth modelling enables us to calculate the dates of deposition for other depths in the tell from which we were unable to find datable material. So, for example, we have no datable samples from a depth of 6.0 m, although this is a key depth as Garašanin (1998) identifies this as his boundary between the Gradac and Pločnik I ceramic phases. The age-depth model suggests that this boundary dates to *4935–4850 cal BC* (*95 % probability*; 6.0 m; see Vinca_Vasic_age_depth_final.oxcal), probably to *4920–4875 cal BC* (*68 % probability*). For ease of interpretation the interpolated dates for different heights in the tell have been re-labelled according to their archaeological significance in the discussion below. For example, this parameter is re-labelled as '*Gradac / Pločnik I*' in *fig. 22* below. Some depths have been identified as significant by numerous scholars. For example, the parameter at 4.0 m is the transition between Pločnik I and Pločnik IIa (Garašanin 1998), the end of Schier's (1996) phase 8b, the transition between ceramic phases C–D and D (Milojčić 1949a) and the end of Stalio's (1984) Horizon V. This parameter is therefore variously labelled '*Pločnik I / IIa, end Schier 8b, C–D / D*' and '*end Horizon V*' in what follows. The depth for each key parameter is shown in *tables 5–9*.

By comparing the probability distributions for the start and end of an activity, a new probability distribution is calculated which expresses the number of years between the parameter. So, for example, by comparing the probability distribution for the end of pit Z ('*end Starčevo burials*'; *fig. 17*) with the probability distribution for the start of the accumulation of Vinča cultural material on the tell ('*9.3 m*'; *fig. 17*), we can determine that the gap between them was *45–220 years* (*95 % probability*; *gap*; *fig. 18*), probably *120–200 years* (*68 % probability*).

Parameter	Depth	*Highest Posterior Density interval (95 % probability)*	*Highest Posterior Density interval (68 % probability)*
Calendar date estimates			
start Starčevo burials		*5770–5565 cal BC*	*5705–5620 cal BC*
end Starčevo burials		*5490–5330 cal BC*	*5480–5405 cal BC*
start Vinča-Belo Brdo	9.3 m	*5305–5255 cal BC*	*5300–5270 cal BC*
end Vinča-Belo Brdo	1.3 m	*4570–4460 cal BC*	*4550–4495 cal BC*
Durations and intervals			
duration pit Z		*95–395 years*	*155–290 years*
gap		*45–220 years*	*120–200 years*
use Vinča-Belo Brdo	9.3 m–1.3 m	*705–825 years*	*735–795 years*

Tab. 4. Key parameters for pit Z and the Vinča occupation of the tell (derived from the model illustrated in *fig. 17*).

At this point in model construction, we can check whether the approach adopted is reasonable. The age-depth model for the Vasić sequence provides an estimate for the end of deposition of Vinča cultural material on the site of *4570–4460 cal BC* (*95 % probability*; *1.3 m*; *fig. 17*), probably of *4550–4495 cal BC* (*68 % probability*). This is compatible with, an entirely separate, estimate for the end of the Vinča tell recently derived by modelling the latest building horizons excavated in Sector II: *4550–4485 cal BC* (*95 % probability*; *Fire 2*; Tasić et al. 2015, fig. 14), probably *4545–4505 cal BC* (*68 % probability*). The medians of these probability distributions vary by just three years.

The posterior outlier probabilities for each radiocarbon date are shown on *fig. 16*. Twelve have posterior outlier probabilities of more than 10 %. Six of these come from depths identified as problematic from the analysis of the replicate measurements described above. OxA-27745 at 8.5 m, MAMS-19509 at 7.7 m, Hd-17525 and Hd-17776 at 6.9 m and MAMS-19503 at 5.5 m appear to be residual, and OxA-27607 at 6.7 m appears to be from a later feature that cut down to this depth. Of the inconsistent replicate groups from a single depth, only the samples at 7.5 m appear to be from bone tools that were freshly deposited at this depth (MAMS-19514 and MAMS-19508, with posterior outlier probabilities of 7 % and 6 % respectively). The outlier model identified further misfits at depths with only a single sample: MAMS-19500 at 4.6 m, OxA-27652 at 3.6 m, OxA-28627 at 3.3 m and MAMS-19495 at 1.7 m all appear to be residual. At 9.2 m (MAMS-19511) and 4.1 m (MAMS-19498) the outlier model has also identified samples that may be slightly too recent for the depths from which they were recovered, and thus were probably from cut features. The results of the outlier model and the replicate analysis are entirely compatible.

The analysis presented here identifies 14 samples as intrusive or residual out of a total of 82 that have been dated. This suggests that c. 17 % of the artefacts recorded at a particular depth may not have been newly deposited at that depth (but, conversely, that 83 % of the material will have been freshly deposited there). This strongly supports Schier's (2000, 192) conclusions, based on his correspondence analysis, that the chronological resolution of Vasić's 10-cm spits is far clearer than previously thought, and that the contamination effects caused by unrecognised pits and reworked material are not serious enough to discredit the entire stratigraphic sequence and the analysis of cultural finds based upon it. Schier's study only covered the lower part of the tell, up to 5.0 m in detail, and more tentatively up to 4.0 m. The age-depth modelling suggests that a coherent chronological sequence of material is present in the Vasić archive up to 1.3 m. Although we have dated a lower number of samples in the upper parts of the tell, they are no more likely to be misfits than samples from a greater depth.

Results and discussion

The history of the Vinča-Belo Brdo tell as seen from the Vasić archive

Our work on the Vasić archive, together with other strands in progress, will lead in due course to further assessment of the Belo Brdo tell within the context of the Vinča culture, and to comparison with other tells in the Vinča culture and beyond. Here, however, our focus is principally on the detail of Vinča-Belo Brdo itself, as available from the Vasić archive. We note that few other tells in south-east Europe and beyond have been subject to chronological analysis in comparable detail, as opposed to broad generalisation and informal date estimates (Rosenstock 2009), and we believe that there is now no substitute for the hard work and time (cf. Manning et al. 2014, 1065) required to build robust formal models site by site.

On that basis, we present an age-depth model for the chronology of the Vasić sequence at Vinča-Belo Brdo, incorporating the general outlier model and the mixed-source calibration for the burials from pit Z. This model is explicitly defined by the CQL2 code provided as supplementary information (Vinca_Vasic_age_depth_final.oxcal) and is illustrated in *figs 16* and *17*.

The model places the Starčevo burials in pit Z between the mid-57th and mid-55th centuries cal BC *(tab. 4; fig. 17)*. These estimates place this activity in what is probably the latter part of the span of the Starčevo culture (Whittle et al. 2002; Tasić 2009), though formal modelling in the future is required to establish more robust estimates for the Starčevo culture as a whole. Burial in pit Z probably persisted for a couple of centuries *(tab. 4; fig. 18)*. It is perhaps easy to overlook the significance of this context, given the sheer volume of deposits and material that was to accumulate in succeeding centuries above it. It stands out in the wider setting of the Starčevo and Körös cultures, which had a range of mainly individual burials in and around settlements, usually in quite modest numbers (Whittle et al. 2002; Borić 2015b). Recent discoveries through large-scale rescue excavation at the site of Alsónyék-Bátaszék in south-west Hungary have revealed some 30 Starčevo burials, but deposited mainly in ones and twos, with at most three individuals in some single contexts (Bánffy et al. 2010; Osztás et al. 2012, 378; Anett Osztás, pers. comm.). The persistence of pit Z as a place for what became an unusually concentrated form of mortuary deposition may have helped to mark out the location of Vinča-Belo Brdo as special (Tuan 1977; Chapman 2000, 206–207).

There was a gap, probably of just over a century, between the end of burial in pit Z and the start of the accumulation of Vinča material culture on the site *(tab. 4; fig. 18)*. It should be noted, however, that we have dated only one of the range of Starčevo features at the base of the tell, so it is certainly possible that Starčevo activity continued on the site after the collective burial deposit in pit Z had been closed. Nonetheless, though the span of the gap as modelled is comfortably within the probable range of social memory (Bradley 2002; Chadwick / Gibson 2013), the interval could also have helped, speculatively, to foster a sense of powerful mythic past rooted in the site (Gosden / Lock 1998).

The model suggests that Vinča material culture was deposited at Belo Brdo from the first quarter of the 53rd century cal BC *(tab. 4; fig. 17)*. It will be for other papers within

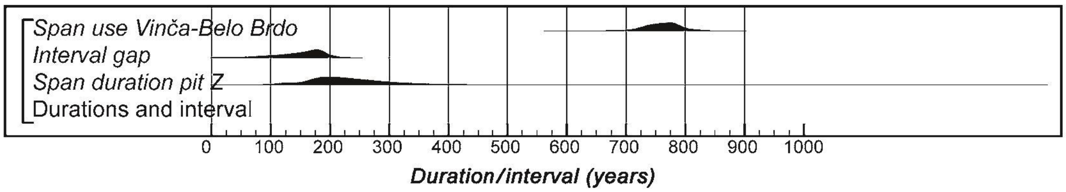


Fig. 18. Posterior density estimates for key parameters for the durations of pit Z and the accumulation of Vinča material culture at Belo Brdo and the interval between them (derived from the model illustrated in *fig. 17*).

the ToTL project to relate this to formal estimates for the start of the wider Vinča culture, with the key question of whether or not the earliest activity at Vinča-Belo Brdo represents the earliest manifestation of the Vinča culture. The estimated date for when this phase of deposition ended, in the second half of the 46th century cal BC *(tab. 4; fig. 17)*, is almost identical to our estimate for the end of Vinča culture activity on the site in Sector II (see above). Overall, Vinča-type material was deposited on the site for between 700 and 800 years *(tab. 4; fig. 18)*. The tell formed at a rate of approximately one metre per century, and accumulation appears to have been more or less even, and without significant hiatus, despite the recognised episodes of house burning *(fig. 17)*. This underlines the commitment to continuity which has been so often discussed in relation to tells (Chapman 1997). Many generations would have experienced episodes of building, levelling and rebuilding (and see further below), and at a lifetime scale and within social memory, the steady rise of the tell would surely have been notable. As noted above, it has been claimed that for various reasons, mainly based on the character of the material and its wider connections, the tell declined in relative social importance in the later phases of the Vinča occupation (Chapman 2000, 218–220), but in the light of our models, this seems implausible; a by then venerably old site was maintained and it continued to rise vertically at a seemingly inexorable, steady rate. It is even possible, though much further research is required, that the tell continued to expand outwards in its later stages, as suggested by recent surface collection and geophysical surveys in 2009 and 2010 in the fields to the south and west of the main site (though without excavations in this area it cannot be said with certainty to which phase these finds belong).

Again it will be for other papers to begin to compare the formally modelled biography of Vinča-Belo Brdo with the lives of other tells, such as 4 m-high Gomolava and Uivar and 6 m-high Drenovac, within the Vinča culture (Orton 2012; Schier 2008; Schier et al. forthcoming; Perić 2009, 31), or 4 m-high Okolište (Hofmann 2013), Csőszhalom (Raczky et al. 2011) and Pietrele (Reingruber 2011), further afield. As often noted, however, the pre-eminence of Vinča-Belo Brdo already stands out, underpinned by its seemingly unstoppable growth.

Posterior density estimates for the construction and destruction of the building horizons identified by Stalio (1968; Id. 1984) are shown in *fig. 19*. Highest Posterior Density intervals for these estimates are provided in *tab. 5*. By comparing the start and end of each building horizon, we can estimate the duration of its use *(tab. 6; fig. 20)*. Most appear to have been in use for one or two generations, although Horizon IVB was extremely short and Horizon V seems to have endured for over a century.

The building horizons whose dates are shown in *fig. 19* were burnt. The periods between these horizons should therefore indicate periods when burning was not practised on the

Parameter	Depth	*Highest Posterior Density interval (95 % probability)*	*Highest Posterior Density interval (68 % probability)*
start Horizon I	8.8 m	*5270 – 5220 cal BC*	*5260–5230 cal BC*
end Horizon I	8.5 m	*5250–5205 cal BC*	*5230–5210 cal BC*
start Horizon II	8.3 m	*5230–5170 cal BC*	*5220–5195 cal BC*
end Horizon II	7.9 m	*5200–5125 cal BC*	*5195–5155 cal BC*
start Horizon III	7.5 m	*5165–5085 cal BC*	*5155–5105 cal BC*
end Horizon III	6.5 m	*5045–4955 cal BC*	*5030–4990 cal BC*
start Horizon IIIA	7.5 m	*5165–5085 cal BC*	*5155–5105 cal BC*
end Horizon IIIA	7.3 m	*5150–5070 cal BC*	*5130–5085 cal BC*
start Horizon IIIB	7.2 m	*5135–5060 cal BC*	*5115–5075 cal BC*
end Horizon IIIB	7.0 m	*5115–5040 cal BC*	*5090–5055 cal BC*
start Horizon IIIC	6.8 m	*5085–5005 cal BC*	*5065–5025 cal BC*
end Horizon IIIC	6.5 m	*5045–4955 cal BC*	*5030–4990 cal BC*
start Horizon IV	6.2 m	*4965–4870 cal BC*	*4945–4895 cal BC*
end Horizon IV	5.6 m	*4895–4810 cal BC*	*4865–4825 cal BC*
start Horizon IVA	6.2 m	*4965–4870 cal BC*	*4945–4895 cal BC*
end Horizon IVA	6.1 m	*4945–4860 cal BC*	*4935–4885 cal BC*
start Horizon IVB	5.95 m	*4930–4845 cal BC*	*4915–4865 cal BC*
end Horizon IVB	5.9 m	*4925–4840 cal BC*	*4910–4860 cal BC*
start Horizon V	5.6 m	*4895–4810 cal BC*	*4865–4825 cal BC*
end Horizon V	4.0 m	*4765–4680 cal BC*	*4760–4735 cal BC (12 %)* or *4725–4690 cal BC (56 %)*
start Horizon VI	4.0 m	*4765–4680 cal BC*	*4760–4735 cal BC (12 %)* or *4725–4690 cal BC (56 %)*
end Horizon VI	3.5 m	*4730–4640 cal BC*	*4720–4665 cal BC*
start Horizon VII	3.2 m	*4710–4620 cal BC*	*4695–4635 cal BC*
end Horizon VII	2.6 m	*4665–4570 cal BC*	*4645–4630 cal BC (7 %)* or *4625–4585 cal BC (61 %)*
start Horizon VIII	2.2 m	*4620–4535 cal BC*	*4605–4560 cal BC*

Tab. 5. Key parameters for building construction horizons (derived from the model illustrated in *fig. 17*).

site (especially given the large scale of the Vasić excavations at Vinča). Examples were noted above of deposits of yellow clay which could be one good indication of unburnt houses. *Fig. 21* shows the intervals between building horizons and *tab. 7* provides the Highest Posterior Density intervals for these estimates. It is clear that burning was an endemic ending to house lives at Vinča. There is at most one unburnt building horizon (lasting a generation or so) between almost all the burnt building horizons. In some cases, it is practically certain that one burnt building horizon was immediately succeeded by a second burnt building horizon (e. g. IV/V and V/VI). The exception to this pattern is between building horizons III and IV, where, even if these are sub-divided as suggested by Stalio (1968; 1984), there is still a gap of perhaps three or four generations between the latest episode of burning in horizon III and the earliest in horizon IV. This potential break in practice occurs at the end of the 51st century cal BC and into the first half of the 50th century cal BC.

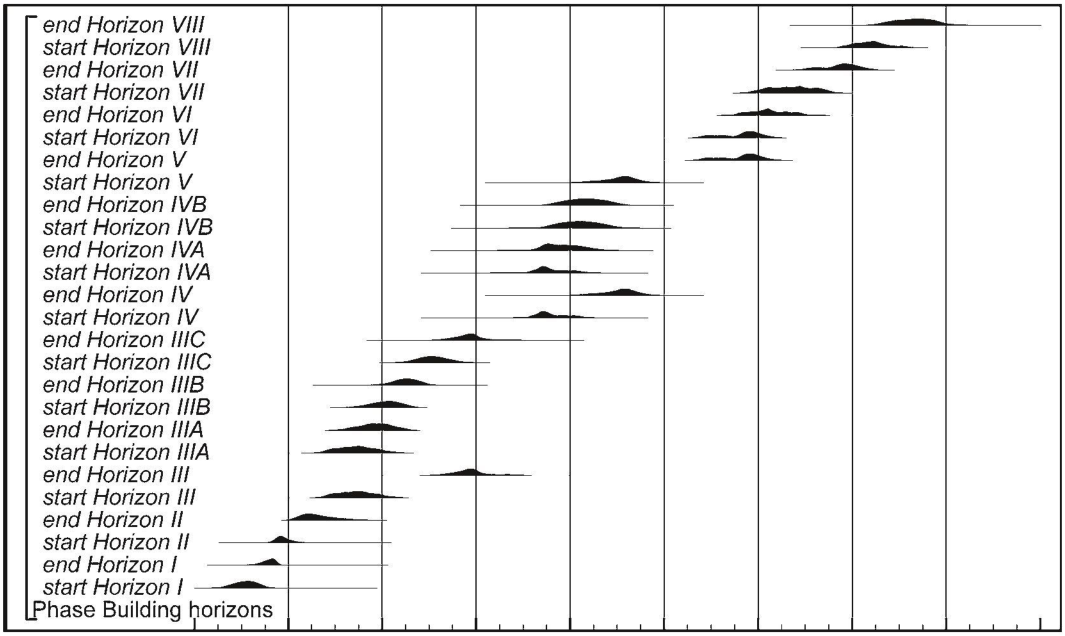
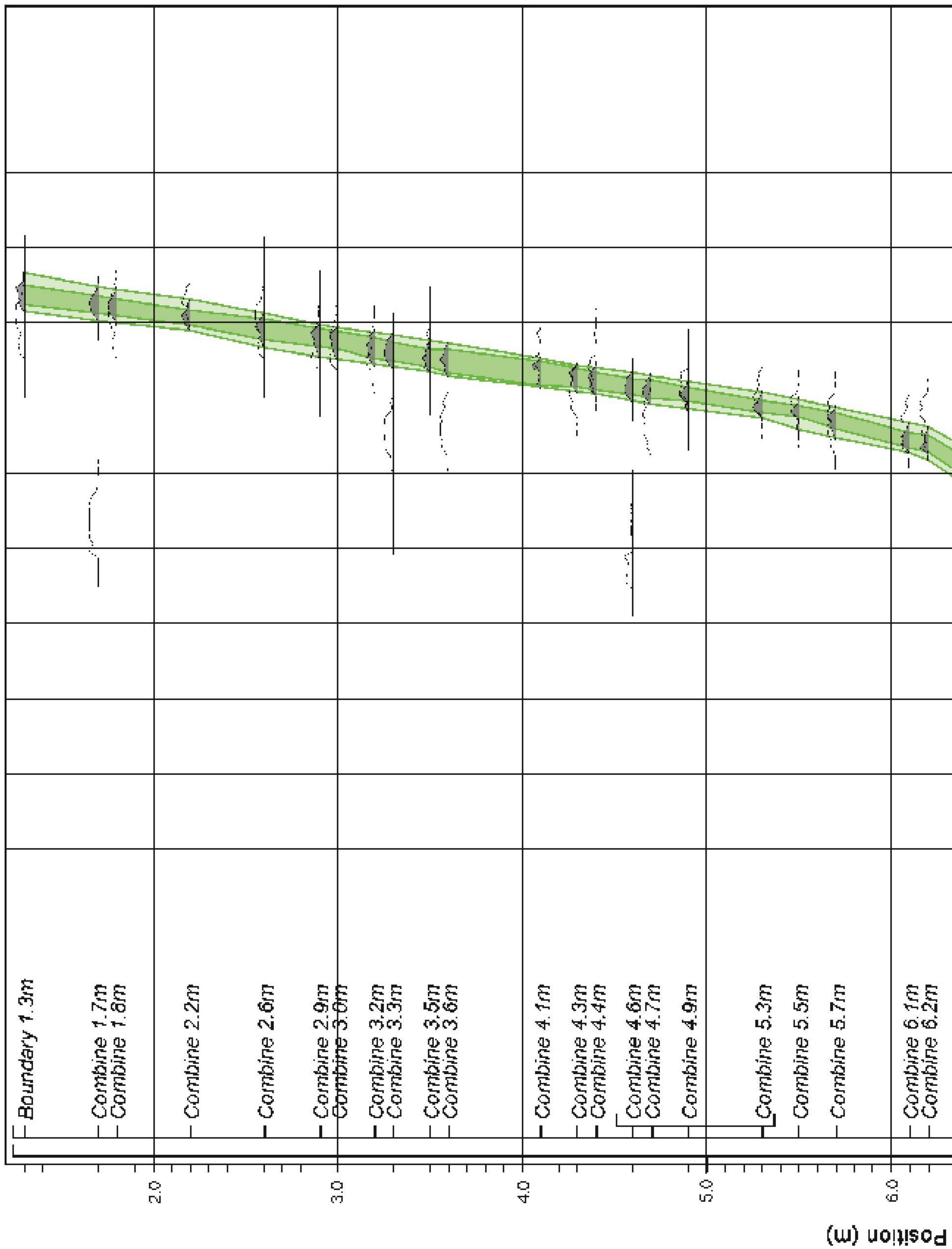


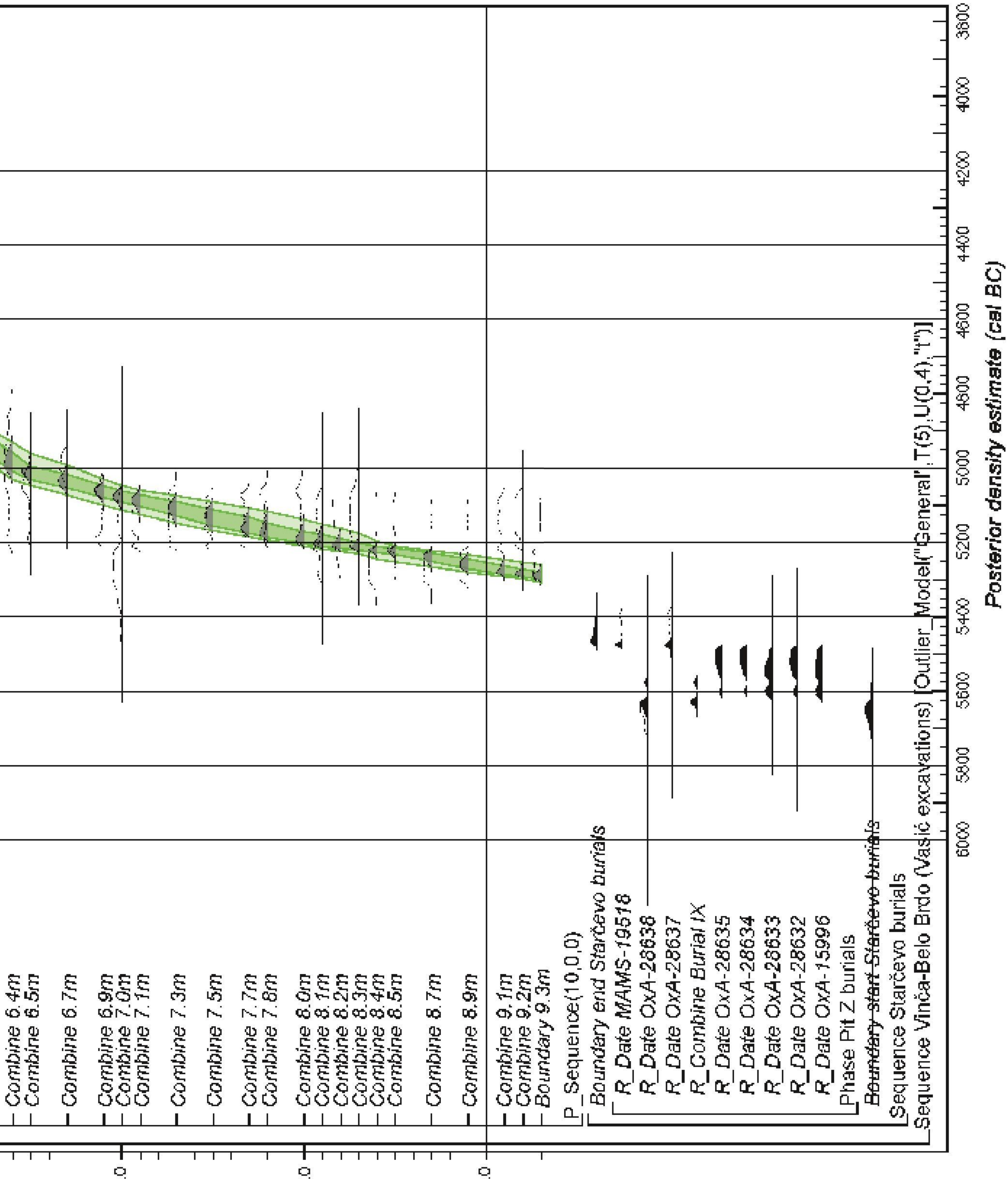
Fig. 19. Posterior density estimates for key parameters for the start and end of the building construction horizons (derived from the model illustrated in *fig. 17*).

The detailed record of the succession of buildings in the Vasić excavations at Vinča-Belo Brdo is obviously far from perfect, but the estimates from our models serve powerfully to add considerably more detail, which can be compared in due course both with other modelled results from Belo Brdo and from other sites such as Uivar, western Romania, where the ToTL project is collaborating on another formal dating programme through the deposits of that tell (Schier et al. forthcoming; Draşovean et al. forthcoming). The models here raise the perennially important issues of house duration and the nature of endings, and especially the issue of burning.

It can be noted first that the continuity and steady growth of the tell, emphasised above, are constituted by the rebuilding, over perhaps nearly 30 human generations (using a working figure of 25 years per generation), with little evident hiatus. Each building horizon lasted from one to two generations, though identification of further unburnt horizons might serve to reduce such spans a little. That is the general picture, but the estimates of duration (*figs 20–21*) show more variation. Through that sharper lens, the bulk of the building horizons do indeed appear to last for one to two generations, but not completely uniformly so. Horizon V obviously stands out as much longer, but probably not too much can be read into that, since there are uncertainties about disturbance, which could be masking the more normal succession of building activity. The next striking difference are the short durations of subdivisions of building horizon IV, which serve to maintain the continuity of the tell but straddle the important material changes around 6 m. Is this just coincidence, or do significant changes in both the tempo of occupation and the character of material culture give credence to the notion, derived from culture-historical approaches, of a 'shock' outside the core Vinča area, associated with Vinča C? There might also be a subtler rhythm in the succession of building horizons. We will explore this in more detail with the Uivar sequence (Draşovean et al. forthcoming), but here we can note how there

Fig. 17. Probability distributions from the age-depth model defined by the OxCal code provided as supplementary information (Vinca_Vasic_age_depth_final.oxcal: doi:10.11588/data/10081); the combined posterior distribution for each dated depth is shown along with the interpolated age-depth model (dark green, 68 % probability; light green 95 % probability). The Starčevo burials from pit Z are not included in the age-depth model, but are a period of activity that is constrained to be earlier than the start of accumulation of Vinča cultural material on the tell.


Boundary 1.3m
Combine 1.7m
Combine 1.8m
Combine 2.2m
Combine 2.6m
Combine 2.9m
Combine 3.0m
Combine 3.2m
Combine 3.3m
Combine 3.5m
Combine 3.6m
Combine 4.1m
Combine 4.3m
Combine 4.4m
Combine 4.6m
Combine 4.7m
Combine 4.9m
Combine 5.3m
Combine 5.5m
Combine 5.7m
Combine 6.1m
Combine 6.2m
2.0
3.0
4.0
5.0
6.0
Position (m)



Combine 6.4m
Combine 6.5m
Combine 6.7m
Combine 6.9m
Combine 7.0m
Combine 7.1m
Combine 7.3m
Combine 7.5m
Combine 7.7m
Combine 7.8m
Combine 8.0m
Combine 8.1m
Combine 8.2m
Combine 8.3m
Combine 8.4m
Combine 8.5m
Combine 8.7m
Combine 8.9m
Combine 9.1m
Combine 9.2m
Boundary 9.3m
P_Sequence(1,0,0,0)
Boundary end Starčevo burials
R_Date MAMS-19518
R_Date OxA-28638
R_Date OxA-28637
R_Combine Burial IX
R_Date OxA-28635
R_Date OxA-28634
R_Date OxA-28633
R_Date OxA-28632
R_Date OxA-15996
Phase Pit Z burials
Boundary start Starčevo burials
Sequence Starčevo burials
Sequence Vinča-Belo Brdo (Vasić excavations) [Outlier_Model("General",T(5),U(0,4),"t")]
7.0
8.0
9.0
3800
4000
4200
4400
4600
4800
5000
5200
5400
5600
5800
6000
Posterior density estimate (cal BC)

Parameter	Depth	*Highest Posterior Density interval (95 % probability)*	*Highest Posterior Density interval (68 % probability)*
Horizon I	8.8–8.5 m	*1–50 years*	*5–35 years*
Horizon II	8.3–7.9 m	*5–75 years*	*15–50 years*
Horizon III	7.5–6.5 m	*65–180 years*	*90–150 years*
Horizon IIIA	7.5–7.3 m	*1–50 years*	*1–30 years*
Horizon IIIB	7.2–7.0 m	*1–50 years*	*1–30 years*
Horizon IIIC	6.8–6.5 m	*5–80years*	*15–55 years*
Horizon IV	6.2–5.6 m	*25–120 years*	*45–95 years*
Horizon IVA	6.2–6.1 m	*1–40 years*	*1–20 years*
Horizon IVB	5.95–5.9 m	*1–25 years*	*1–10 years*
Horizon V	5.6–4.0 m	*75–185 years*	*100–160 years*
Horizon VI	4.0–3.5 m	*5–60 years*	*10–45 years*
Horizon VII	3.2–2.6 m	*15–90 years*	*25–70 years*
Horizon VIII	2.2–1.5 m	*15–85 years*	*25–60 years*

Tab. 6. Key parameters for the duration of building horizons (derived from the model illustrated in *fig. 17*).

is a possible pattern of a cycle of slightly lengthening horizons. That is to say, horizon II could be slightly longer than I, then IIIC longer than IIIA and IIIB, V (with reservations as noted above) longer than IVA and IVB, and finally VII and VIII slightly longer than VI. If this is not reading too much into the modelled estimates of duration, how might it be interpreted?

Much depends on how long we think buildings of this kind might have lasted. Did they come to the end of a natural use-life somewhere between 25 and 50 years after construction? Or with suitable repair and maintenance, given the evident commitment to place evident in the emergence and growth of the tell in the first place, could they not have gone on for longer? We will explore this in further detail elsewhere (Draşovean et al. forthcoming), but suffice it to say here that the latter possibility seems plausible. House duration was not therefore some abstract, given constant, but contingent on circumstances and human intentions. There could have been a desire throughout the sequence to hasten the end of the 'natural' use-lives of buildings, to contribute deliberately to the initial formation and then the ongoing maintenance of the tell. It is interesting in that regard that horizon I appears to be of slightly shorter duration than horizon II. That would certainly fit with what we know from the ethnographic record about buildings being deliberately destroyed in order to construct a past and a history full of renown (Waterson 1990, 389–390; Draşovean et al. forthcoming). On this view, following generations could have perceived things on a slightly longer timescale, but then the urge to pay homage to the past and to achieve renown may have been renewed with the passage of time, and this cycle repeated over the centuries during which Belo Brdo continued to form. There is again no particular reason to think that in these terms the tell declined towards the end of its life.

As noted above, the practice of house burning appears to have been recurrent through the long history of Vinča-Belo Brdo. We have also discussed elsewhere the many issues which house burning raises (Tasić et al. 2015; Draşovean et al. forthcoming), but some repetition is in order here. Belo Brdo is of course far from unique in having burnt houses, and an

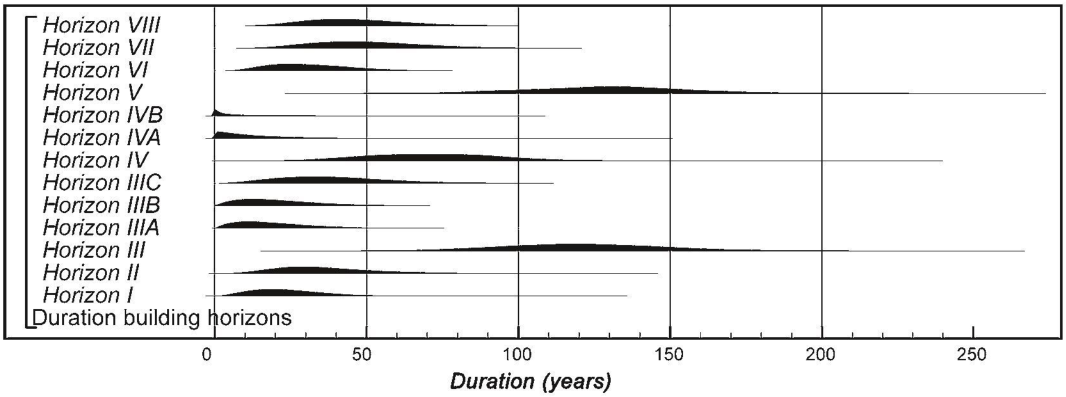


Fig. 20. Posterior density estimates for key parameters for the durations of the building construction horizons (derived from the model illustrated in *fig. 17*).

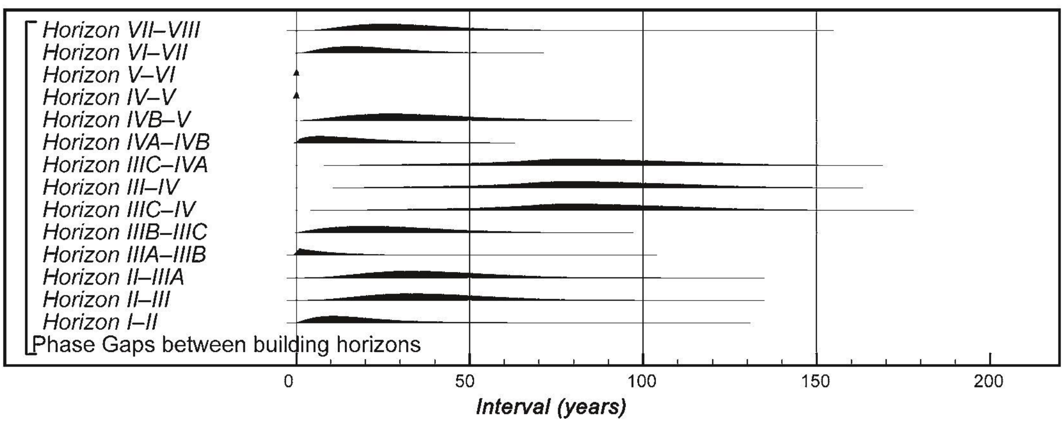


Fig. 21. Posterior density estimates for key parameters for intervals between building construction horizons (derived from the model illustrated in *fig. 17*).

'age of fire' has been proposed for the Neolithic and Early Copper Age Europe as a whole (Stevanović 2002; Tringham 2005). Major issues have been, first, the scale of burnings, whether house by individual house or across swathes of settlements, and secondly, whether these were accidental or deliberate, and if the latter, whether buildings were burnt by occupants or local descendants for ritual purposes, or by outsiders with hostile intent.

It is of course possible that all the potential scenarios could be seen in the archaeological record for Neolithic and Early Copper Age in the region, and it is important to try to find specific evidence for individual cases, rather than to construct a uniform, generalising model. There may even be variation within the history of individual sites. For the uppermost two definite occupations at Belo Brdo, seen in more recent excavations in Sector II, which would fit broadly within horizon VIII as described here, we have argued that the scale of burning, which definitely encompasses a series of buildings, and signs of conflict in the form of a body between two burnt houses, strongly suggest attack by outsiders (Tasić et al. 2015); that is circumstantially supported by an interval of up to *25 years*

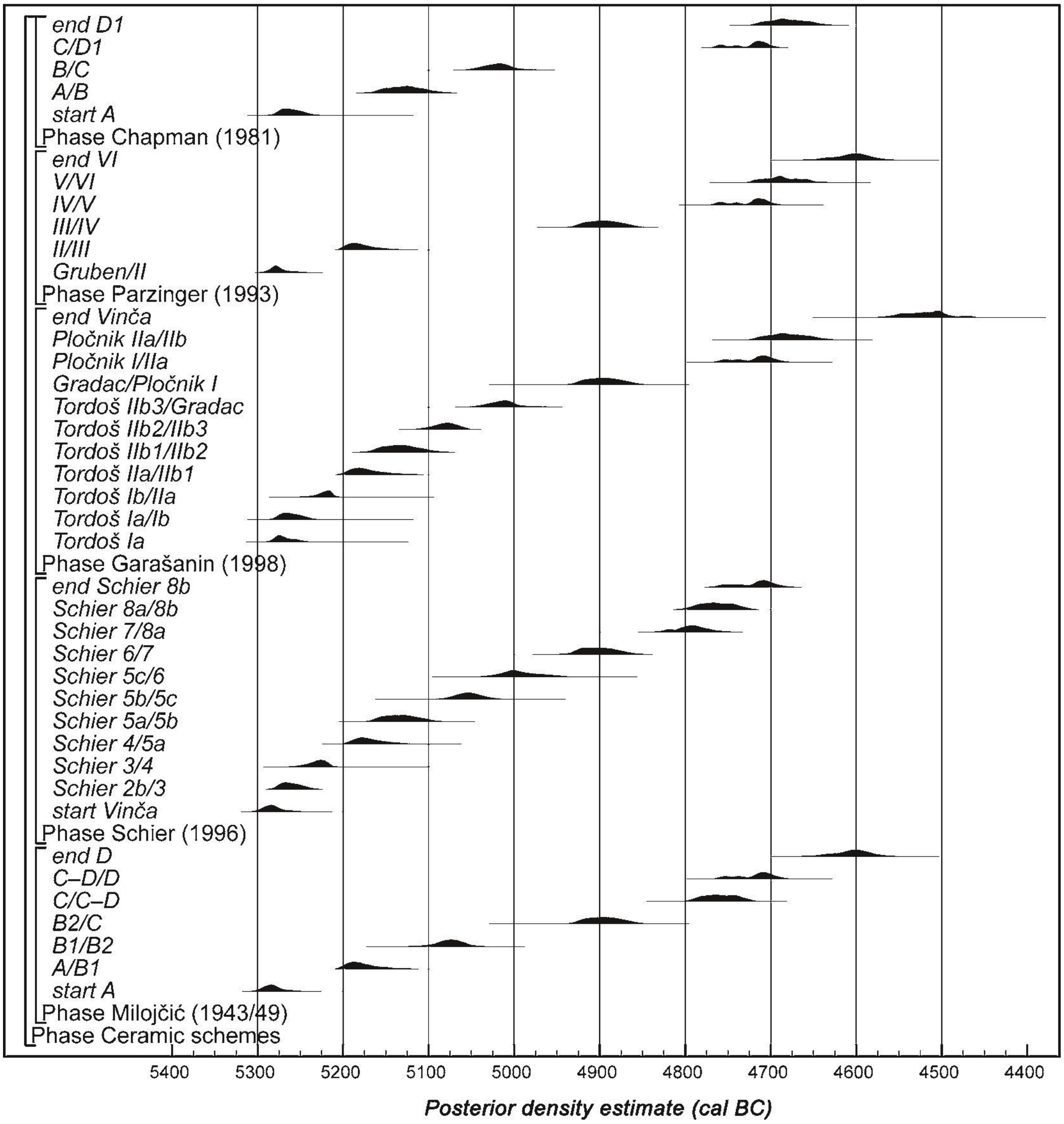


Fig. 22. Posterior density estimates for key parameters for the phase boundaries of selected chronological schemes of Vinča pottery (derived from the model illustrated in *fig. 17*).

(*68 % probability*; *fire frequency*; ibid. fig. 9) between the two uppermost construction horizons, and a duration for the latest horizon of probably not more than *15 years* (*68 % probability*; *use House 8*; ibid.), after which the tell as a whole appears to have been abandoned. Would that kind of explanation apply also to lower levels of the Belo Brdo tell?

Here we are hampered by the recording of the earlier excavations. The uppermost levels in Sector II were recorded over an area of at least 50 by 30 m; coring has suggested, however, that burning did not extend for ever, not being visible some 60 m distant from Sector II (Tasić et al. 2015), but at least groups of houses and perhaps whole neighbourhoods were involved in the late burnings. Lower down, it is hard to know what the situation or situations might have been. The surviving great section facing the Danube certainly still

Parameter	Depth	*Highest Posterior Density interval (95 % probability)*	*Highest Posterior Density interval (68 % probability)*
Horizon I–II	8.5–8.3 m	*1–45 years*	*1–25 years*
Horizon II–III	7.9–7.5 m	*5–75 years*	*15–55 years*
Horizon II–IIIA	7.9–7.5 m	*5–75 years*	*15–55 years*
Horizon IIIA–IIIB	7.3–7.2 m	*1–35 years*	*1–15 years*
Horizon IIIB–IIIC	7.0–6.8 m	*1–65 years*	*5–40 years*
Horizon IIIC–IV	6.5–6.2 m	*25–140 years*	*60–115 years*
Horizon III–IV	6.5–6.2 m	*25–140 years*	*60–115 years*
Horizon IIIC–IVA	6.5–6.2 m	*25–140 years*	*60–115 years*
Horizon IVA–IVB	6.1–5.95 m	*1–45 years*	*1–25 years*
Horizon IVB–V	5.9–5.6 m	*5–75 years*	*10–50 years*
Horizon IV–V	5.6 m	Abutting	Abutting
Horizon V–VI	4.0 m	Abutting	Abutting
Horizon VI–VII	3.5–3.2 m	*1–50 years*	*5–30 years*
Horizon VII–VIII	2.6–2.2 m	*5–65 years*	*10–45 years*

Tab. 7. Key parameters for the intervals between building horizons (derived from the model illustrated in *fig. 17*).

shows many obvious burnt buildings along its 300 m length, but whether these constitute uniform events of the kind suggested for the uppermost two levels in Sector II has yet to be determined. A clearer answer may have to wait for future cleaning and recording of that enormous section, but it is nonetheless already valuable to think about the implications of possible outcomes and different scenarios.

One possibility is that aggression by outsiders was present through much of the history of the tell. The successful establishment of a major settlement, with the connections and flows of material already described by John Chapman (2000), could have attracted jealousy from others, or even by factions within the 'coalescent community' that such a site may have represented (Kowalewski 2006; Birch 2013). Even if so, however, the record shows that the Belo Brdo community always bounced back. On the other hand, it may be pertinent that the burnings largely came at more or less – as discussed above – regular intervals, after periods of occupation, perhaps with the exceptions of horizons IVA and IVB. If attacks were involved, it might be expected that they should have come at more irregular intervals, including immediately after rebuildings, and it has to be questioned whether any community could have sustained such a rain of blows and the accumulation of so many bad memories, for so long. So another scenario is that burnings took place on a smaller scale, for a variety of ritual and social reasons, as discussed extensively in the literature – including to mark particular deaths or the end of a household, to create individual renown, or in some cases perhaps more mundanely for cleansing purposes (Whittle 1997). Debate has tended to focus on individual houses in this regard, but if the household were spread over more than one building (Souvatzi 2008), there would be no reason not to expect small groups of burnt buildings. If that were the normal background, there is in turn no need to exclude the possibility of episodes when burning took place in the context of attack from the outside. The substantial Q-ditch has been argued to be both defensive and early in the sequence (Nikolić 2006). Horizon IV and the uppermost two levels in Sector II also again spring to mind. But it is also worth reflecting on whether we have over-interpreted the evidence from the top of the tell (Tasić et al. 2015), even though further evidence for conflict has emerged at a comparable level in the new deep sounding.

The history of Vinča culture material as seen from the Vasić archive for Belo Brdo

Posterior density estimates for the phase boundaries of selected chronological schemes for Vinča pottery are shown in *fig. 22*, with the Highest Posterior Density intervals for these estimates provided in *tab. 8*. By comparing the start and end of each ceramic phase, we can estimate its duration *(tab. 9; fig. 23)*. These are now the most detailed estimates available for the Belo Brdo material sequence. Overall, a strong continuity can be argued, paralleling the steady growth of the tell itself and the more or less stable character of the buildings it contained. *Fig. 22* shows a more or less even, step-by-step development through the principal phases of the main ceramic schemes. The pottery so far studied in the most detail – the various bowls analysed so thoroughly by Wolfram Schier, up to 5 m – shows a fairly constant tempo of relatively small changes at a timescale of every one–two to two–three human generations. Schier's phase 7 stands out for its longer duration. Though we do not know much in specific detail about the locations of ceramic production within Belo Brdo, it is tempting of course to link traditions of making pots with the other obvious fact of the tell – its houses, many of which contained ovens. Ceramic production could thus have been closely tied to house or household (see, for example, the range of forms from burnt houses 13 and 14 at Divostin: McPherron / Srejović 1988; Borić 2009, figs 29–30). Continuity appears strongly to have characterised much of the histories of both.

It should be underlined that the duration of the ceramic phases illustrated in *fig. 23* may derive as much from the detail with which material has been studied as from the actual pace of change of ceramic forms. Schier's correspondence analysis identified change in ceramic forms at the scale of human generations (phases 2, 3, 5a, 8a and 8b) and lifetimes (phases 4, 5b, 5c and 6). Only his phase 7 seems to have endured for more than a century. This contrasts with earlier studies of the same material which partitions it mostly into phases lasting well over a century *(fig. 23)*. In the circumstances, is the apparent longer duration of the later ceramic phases at Vinča not an indication of a more conservative tradition, but just a consequence of the fact that this material has yet to be studied in equivalent detail? The comparatively short durations of Pločnik IIa, Parzinger's phases V and VI, and Chapman's phase D1 may indicate that the material change in the later period was just as dynamic as earlier, but this remains to be revealed by further research. The radiocarbon dates obtained by this project appear to indicate the chronological coherence of these upper deposits, perhaps even up as far as 1.3 m (see above).

Of course, as already described in the early part of this paper, there were changes through time beyond variation in bowl forms, rim shapes and decoration, seen in the waxing and waning of other pot forms, and in the presence, absence or relative abundance of lids, altars, figurines and copper *(figs 10–13)*. Some of these changes were probably gradual, in line with the overall continuity argued here, but others were probably much more rapid.

Three clear changes in material culture are visible in at least four of the main chronological schemes discussed in this paper. The first occurs between a depth of 7.9 m and 8.0 m (depending on the chronological scheme used) in the first half of the 52nd century cal BC. It marks the boundary between Milojčić phases A and B1, between Schier

Parameter	Depth	*Highest Posterior Density interval (95 % probability)*	*Highest Posterior Density interval (68 % probability)*
Milojčić (1943/1949)			
Milojčić start A	9.3 m	*5305–5255 cal BC*	*5300–5270 cal BC*
Milojčić A/B1	8.0 m	*5210–5135 cal BC*	*5200–5165 cal BC*
Milojčić B1/B2	7.0 m	*5115–5040 cal BC*	*5090–5055 cal BC*
Milojčić B2/C	6.0 m	*4935–4850 cal B*	*4920–4875 cal BC*
Milojčić C/C–D	4.5 m	*4795–4720 cal BC*	*4785–4735 cal BC*
Milojčić C–D/D	4.0 m	*4765–4680 cal BC*	*4760–4735 cal BC (12 %)* or *4725–4690 cal BC (56 %)*
Milojčić end D	2.5 m	*4655–4560 cal BC*	*4625–4575 cal BC*
Schier (1996)			
start Vinča-Belo Brdo	9.3 m	*5305–5255 cal BC*	*5300–5270 cal BC*
Schier 2b/3	9.0 m	*5285–5235 cal BC*	*5280–5250 cal BC*
Schier 3/4	8.6 m	*5260–5210 cal BC*	*5240–5215 cal BC*
Schier 4/5a	7.9 m	*5200–5125 cal BC*	*5195–5155 cal BC*
Schier 5a/5b	7.55 m	*5170–5090 cal BC*	*5160–5110 cal BC*
Schier 5b/5c	6.85 m	*5095–5015 cal BC*	*5075–5035 cal BC*
Schier 5c/6	6.45 m	*5040–4940 cal BC*	*5020–4970 cal BC*
Schier 6/7	6.05 m	*4940–4855 cal BC*	*4930–4880 cal BC*
Schier 7/8a	4.95 m	*4830–4755 cal BC*	*4810–4770 cal BC*
Schier 8a/8b	4.55 m	*4800–4725 cal BC*	*4785–4740 cal BC*
Schier end 8b	4.0 m	*4765–4680 cal BC*	*4760–4735 cal BC (12 %)* or *4725–4690 cal BC (56 %)*
Garašanin (1998)			
start Tordoš Ia	9.1 m	*5290–5240 cal BC*	*5285–5255 cal BC*
Tordoš Ia/Ib	9.0 m	*5285–5235 cal BC*	*5280–5250 cal BC*
Tordoš Ib/IIa	8.5 m	*5250–5205 cal BC*	*5230–5210 cal BC*
Tordoš IIa/IIb1	7.95 m	*5205–5130 cal BC*	*5200–5160 cal BC*
Tordoš IIb1/IIb2	7.55 m	*5170–5090 cal BC*	*5160–5110 cal BC*
Tordoš IIb2/IIb3	7.05 m	*5120–5050 cal BC*	*5095–5060 cal BC*
Tordoš IIb3/Gradac	6.55 m	*5055–4960 cal BC*	*5035–4995 cal BC*
Gradac/Pločnik I	6.0 m	*4935–4850 cal BC*	*4920–4875 cal BC*
Pločnik I/IIa	4.0 m	*4765–4680 cal BC*	*4760–4735 cal BC (12 %)* or *4725–4690 cal BC (56 %)*
PločnikIIa/IIb	3.4 m	*4725–4635 cal BC*	*4710–4655 cal BC*
end Vinča-Belo Brdo	1.3 m	*4570–4460 cal BC*	*4550–4495 cal BC*
Parzinger (1993)			
Gruben/II	9.2 m	*5295–5245 cal BC*	*5290–5265 cal BC*
II/III	8.0 m	*5210–5135 cal BC*	*5200–5165 cal BC*
III/IV	6.0 m	*4935–4850 cal BC*	*4920–4875 cal BC*
IV/V	4.1 m	*4770–4690 cal BC*	*4765–4750 cal BC (10 %)* or *4745–4735 cal BC (4 %)* or *4725–4695 cal BC (54 %)*

Parameter	Depth	*Highest Posterior Density interval (95 % probability)*	*Highest Posterior Density interval (68 % probability)*
V/VI	3.48 m	*4730–4640 cal BC*	*4715–4665 cal BC*
end VI	2.5 m	*4655–4560 cal BC*	*4625–4575 cal BC*
Chapman (1981)			
Chapman start A	9.0 m	*5285–5235 cal BC*	*5280–5250 cal BC*
Chapman A/B	7.5 m	*5165–5085 cal BC*	*5155–5105 cal BC*
Chapman B/C	6.6 m	*5060–4970 cal BC*	*5040–5000 cal BC*
Chapman C/D1	4.1 m	*4770–4690 cal BC*	*4765–4750 cal BC (10 %)* or *4745–4735 cal BC (4 %)* or *4725–4695 cal BC (54 %)*
end D1	3.4 m	*4725–4635 cal BC*	*4710–4655 cal BC*

Tab. 8. Key parameters for phase boundaries of selected chronological schemes of Vinča pottery (derived from the model illustrated in *fig. 17*).

phases 4 and 5a, in late Tordoš IIa, and between Parzinger's phases II and III *(fig. 24)*. This shift serves to underline changes not only in bowls but also in other pot forms, surface treatment and decoration, and in the details like a striking new symmetry in the modelled face-lids (Milojčić 1949b, 274 fig. 5). Overall, Milojčić for example (1949b, 273) declared that "settlement at Vinča carried on without interruption [...] The kinds of pottery in use [in B1] continue to be the same and show no momentous difference in the technique of manufacture." Even within a classic culture-historical approach, changes were not seen as being on such a scale as to warrant any inference of major disruption. On the other hand, based on the "exceptional dissimilarity in the type composition" of the levels in question, Schier (2000, 196 and fig. 8) proposed this as an "innovation horizon", though it should be noted that he envisaged, with the dating evidence then available to him, a much more uneven rate of tell accumulation than modelled here.

A second clear change in material culture occurs at a depth of 6 m, in the decades around 4900 cal BC. This marks the boundary between Milojčić phases B2 and C, between Schier phases 6 and 7, between Gradac and Pločnik I, and between Parzinger's phases III and IV. Here there is the potential for much more significant change, and the short durations of building horizons within IV were stressed above. Above 6 m, there are changes in other material culture than ceramic vessels alone, face-lids for example becoming very rare (Milojčić 1949b, 279). Some of those working more towards the perceived periphery of the culture have stressed the 'shock' of Vinča C (Lazarovici 1987; Id. 2000; Lazarovici et al. 2001), drawing attention to black-burnished carinated vessels and arguing for population arrivals and replacements.

In more detail, the idea of a 'Vinča C shock' was coined by Lazarovici (1987) and borrows Schachermeyer's (1955) idea of a 'metallic shock'. Both of them refer to the spread of black-burnished carinated vessels, which Schachermeyer saw as imitations of metallic vessels by the Middle Neolithic Balkan potters. Lazarovici limits his observations primarily to western and central Romania, positing subsequent waves of migration (Lazarovici et al. 2001, 370). He sees these processes as taking place over a vast territory and having significant effects on the local population (ibid.; Lazarovici 2000, 7). The 'Vinča C shock' has been widely supported by Romanian archaeologists (for example

Parameter	Depth	*Highest Posterior Density interval (95 % probability)*	*Highest Posterior Density interval (68 % probability)*
Milojčić (1943/1949)			
Milojčić A	9.3–8.0 m	*65–155 years*	*80–125 years*
Milojčić B1	8.0–7.0 m	*55–145 years*	*80–125 years*
Milojčić B2	7.0–6.0 m	*125–235 years*	*150–210 years*
Milojčić C	6.0–4.5 m	*80–190 years*	*105–165 years*
Milojčić C–D	4.5–4.0 m	*10–75 years*	*15–55 years*
Milojčić D	4.0–2.5 m	*65–165 years*	*85–135 years*
Schier (1996)			
Schier 2a–b	9.3–9.0 m	*1–45 years*	*5–30 years*
Schier 3	9.0–8.6 m	*5–55 years*	*15–45 years*
Schier 4	8.6–7.9 m	*25–110 years*	*35–80 years*
Schier 5a	7.9–7.55 m	*5–70 years*	*10–50 years*
Schier 5b	7.55–6.85 m	*30–130 years*	*50–105 years*
Schier 5c	6.85–6.45 m	*15–115 years*	*30–80 years*
Schier 6	6.45–6.05 m	*30–150 years*	*60–125 years*
Schier 7	6.05–4.95 m	*60–160 years*	*80–135 years*
Schier 8a	4.95–4.55 m	*5–60 years*	*10–40 years*
Schier 8b	4.55–4.0 m	*10–85 years*	*20–60 years*
Garašanin (1998)			
Tordoš Ia	9.1–9.0 m	*1–25 years*	*1–10 years*
Tordoš Ib	9.0–8.5 m	*10–65 years*	*20–55 years*
Tordoš IIa	8.5–7.95 m	*15–90 years*	*25–65 years*
Tordoš IIb1	7.95–7.55 m	*5–75 years*	*15–55 years*
Tordoš IIb2	7.55–7.05 m	*15–90 years*	*25–70 years*
Tordoš IIb3	7.05–6.55 m	*25–120 years*	*40–90 years*
Gradac	6.55–6.0 m	*60–175 years*	*85–145 years*
Pločnik I	6.0–4.0 m	*115–235 years*	*145–210 years*
Pločnik IIa	4.0–3.4 m	*10–70 years*	*20–55 years*
Pločnik IIb	3.4–1.3 m	*100–220 years*	*130–190 years*
Parzinger (1993)			
II	9.2–8.0 m	*55–145 years*	*70–115 years*
III	8.0–6.0 m	*220–340 years*	*255–315 years*
IV	6.0–4.1 m	*110–225 years*	*140–205 years*
V	4.1–3.48 m	*10–70 years*	*20–55 years*
VI	3.48–2.5 m	*35–125 years*	*55–100 years*
Chapman (1981)			
Chapman A	9.0–7.5 m	*85–180 years*	*105–160 years*
Chapman B	7.5–6.6 m	*55–165 years*	*80–135 years*
Chapman C	6.6–4.1 m	*230–350 years*	*265–330 years*
Chapman D1	4.1–3.4 m	*15–80 years*	*25–60 years*

Tab. 9. Key parameters for the duration of ceramic phases in selected chronological schemes for Vinča pottery (derived from the model illustrated in *fig. 17*).

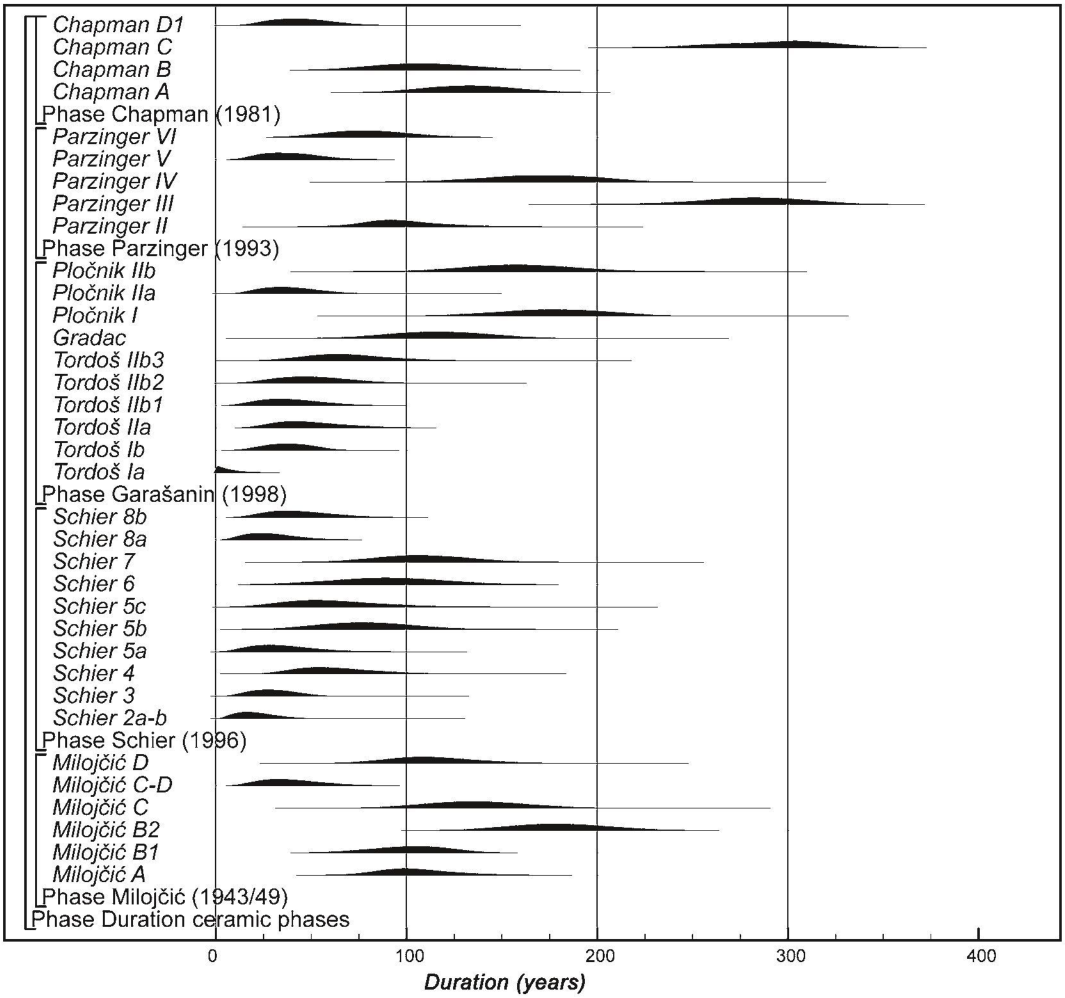


Fig. 23. Posterior density estimates for key parameters for the duration of ceramic phases from selected chronological schemes of Vinča pottery (derived from the model illustrated in *fig. 17*).

Suciu 2009), with claims for "social shock and cultural collision" (Merlini / Lazarovici 2008, 157). However, this claim is based only on the abrupt appearance of black-burnished carinated vessels in a series of sites in the Banat and Transylvania. This diffusionist view is adopted to explain the very complex picture of the Middle Neolithic of Transylvania. The mosaic of decorated fine-ware pottery styles has been interpreted as twelve regional Neolithic 'cultures' (Maxim 1999), which are underpinned, however, by the use of the same coarse wares.

Yet there is a tension between this view and evaluations of changes at Belo Brdo itself. Chapman (1981) does not identify significant change at this level, and shifts in Schier's bowl forms and rims at this point appear to form part of the ongoing pattern of steady, generational change. Milojčić too, while conscious of what was happening in the building horizon at this level, was inclined to follow Holste in again seeing continuity alongside change, claiming that "on the whole the development carries on continuously" (Milojčić 1949b, 279); he notes of course a series of changes, including more curvilinear decoration,

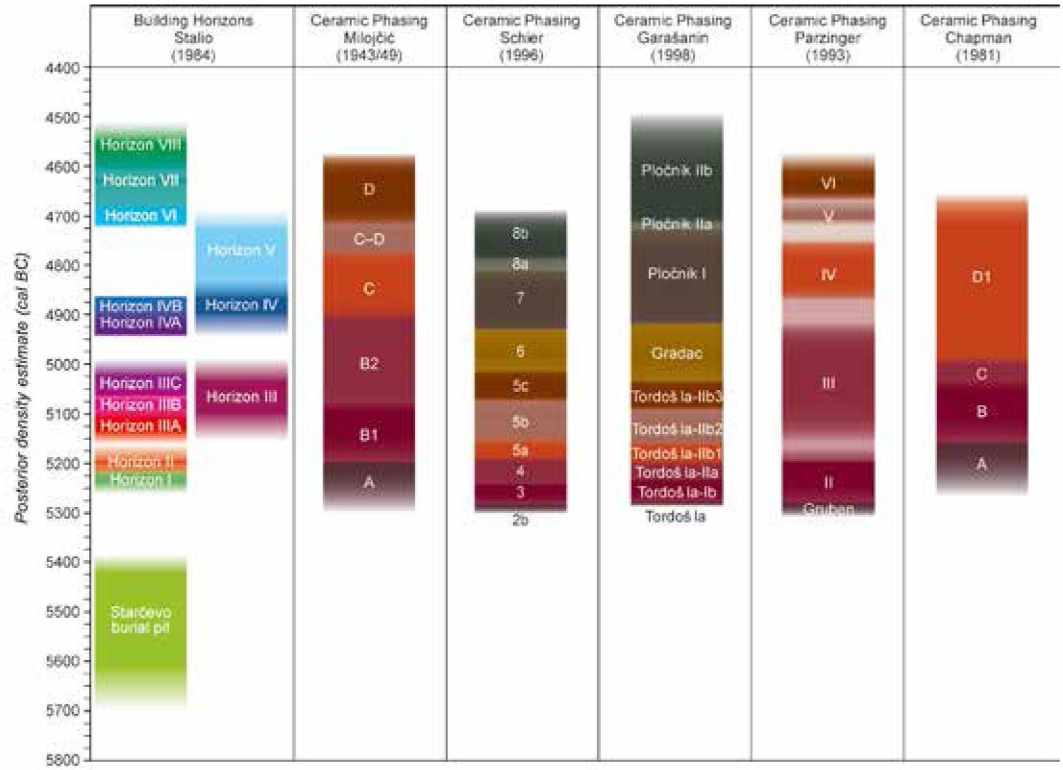


Fig. 24. The main chronological schemes for the Vinča culture based on Vinča-Belo Brdo, with date estimates derived from the age-depth model presented in this paper (*fig. 17*; based on Schier [1996, fig. 9]).

and the beginning of the disappearance of incised amphorae and face-lids, alongside the continued dominance of pottery with "blackish-grey fabrics with rippled and polished decoration" (ibid. 279–280, fig. 7; cf. Schier 2000, 196).

Another clear change in material culture is identified by all the chronological schemes considered in this paper. This occurs between a depth of 4.1 m and 4.0 m (depending on the chronological scheme used) in the second half of the 48th century cal BC. It marks the boundary between Milojčić phases C–D and D, the end of Schier's phase 8b, the boundary between Pločnik phase I and Pločnik phase IIa, and between Parzinger's phases IV and V, and between Chapman's phases C and D1. There are certainly changes in form and decoration, seen for example in the disappearance of "slipped stemmed bowls and cherry-red ware" and amphorae with face lids and a rarity of "stamped ware with repetition motives" or in the new abundance of red and white "crusted ware", the appearance of big, three-handled amphorae and four-handled "crater-like pots", among others (Milojčić 1949b, 281–282, fig. 8). But it is interesting to note that the first feature stressed by Milojčić (1949b, 281) is that "black polished ware with polished and fluted decoration continues to be the most frequent ware." So again there is a balance between continuity and change, and even within the culture-historical approach the former has been seen as at least as significant as the latter.

It is important to underline that the suggested timing and tempo of continuity and change in pottery shapes and decoration are pertinent primarily to Belo Brdo and these may differ from the times of change in other Vinča sites with similar material sequences. A similar approach to that undertaken by the ToTL project is needed to date the material sequences from other sites to enable wider comparison.

Conclusions and future research

The timing, duration and tempo of tell formation and material changes

Unsurprisingly perhaps for an archive of this antiquity, there are many issues which we do not fully understand from the Vasić excavations at Vinča-Belo Brdo. We would, for example, like to know more about the qualities and characteristics of the tell deposit itself, as those are clearly a key variable (cf. Rosenstock 2009, 116–123). More detail on the nature and layout of the buildings and any possible changes through time would be highly desirable. More precise subphasing within the upper deposit identified as Vinča D remains to be done, and for all the work carried out over the years on the pottery, we are missing the kind of contextual understanding of its production and use in houses and households that a modern excavation would hope to bring. Many of these lacunae may be made good by further analytical and archival research. Beyond these uncertainties, however, we would like to end this paper on a positive and optimistic note. We were unsure at the start of this strand of our cooperation on Vinča-Belo Brdo how much we could achieve from the Vasić archive. In the event, it has proved possible not only to obtain a substantial body of new radiocarbon dates, but to demonstrate that these, as formally modelled, form a coherent and meaningful sequence for both the formation of the tell and the material it contains. We have provided formally modelled estimates for the timing and duration of the successive episodes of tell formation and material deposition. From that, we can derive many insights about the tempo of development and change. In particular, we would like to emphasise three main features.

First, we have argued that the Vinča-Belo Brdo tell formed at an even rate, of roughly a metre per century, and this more or less steady growth continued in seemingly unstoppable fashion over several centuries up the abandonment of the site in the second half of the 46th century cal BC. There were subtle variations in the rate of accumulation, which could have a cyclical pattern, speculatively related to household histories and perceptions of the past.

Secondly, we have identified the probable presence of more unburnt houses than previously recognised, but nonetheless burning of houses appears to have been endemic virtually throughout the long sequence. Understanding this fully is hampered by the lack of information about the horizontal layout of buildings within the area opened by Vasić, but the detailed timings now established do contribute, we have argued, to the perennially important question of how to interpret house burning. At the top of the tell, we have seen the two successive last, burnt horizons as probably indicating aggression from the outside (Tasić et al. 2015), but the sheer repetition of burning through the long and seemingly little interrupted sequence of the tell as a whole gives us pause for thought as to whether that kind of explanation can apply to the whole history of Belo Brdo. It may be that there were both ritualised and localised burnings, and episodes of hostile attack, presumably from outside (though factional strife is not to be excluded).

Thirdly, our models provide a now much firmer basis for arguing that there was considerable continuity in the use of material culture at the tell. Of course there were long-term changes, captured not only in the many schemes for the development of the pottery, but also in the alterations in the form and relative abundance of other things, such as lids, altars and figurines. Our models have served to show mostly gradual and subtle changes every one–two or two–three generations, and we have speculated that this may relate to household-based production. Even with the appearance of what are known as Vinča C assemblages, there may be more continuity at Belo Brdo itself than elsewhere in the orbit of the Vinča world. We would still like to know more, however, about the detail of changes in the generations running up to the abandonment of the tell.

The wider geographical scale

This does not exhaust the questions raised by our modelling of samples from the Vasić archive, but we will deal with these in other papers. Within the ToTL project, we will in due course be able to offer formally modelled comparisons with early Vinča material at the sites of Szederkény and Versend in south-west Hungary (Jakucs / Voicsek 2015), and with later Vinča material from the Uivar tell in western Romania. We also hope to extend modelling of the available dates for the Vinča culture as a whole (cf. Borić 2009; Id. 2015a; Orton 2012). The dates of the beginning and end of the Belo Brdo tell relative to the start and finish of the Vinča culture remain important, open questions. Our work seems to us to have underlined the pre-eminence of the Vinča tell within its world, and its significance for the major themes we noted at the start of this paper of development, aggregation, identity, ritualisation and differentiation, but we need to establish, by comparison with other sites, how much of the span of Vinča culture process is found at Belo Brdo itself.

Working with archives

Many tells have been excavated across south-east Europe as a whole, and many, sadly, and for all sorts of reasons, remain unpublished in full detail or are covered so far only by interim reports. We can think of at least several such sites in eastern Hungary, Romania and Serbia, within a 150 km radius of Vinča-Belo Brdo. On an optimistic note, our work at Vinča-Belo Brdo has shown how much can still be recovered from the archives, which continue to deserve dedicated care and attention, and it is partly on the basis of further research in those invaluable sources that the discipline could now achieve the wider detailed histories which this period deserves.

Summary · Zusammenfassung · Résumé

Summary

This paper presents formally modelled date estimates for the sequence of deposits and material at the great Neolithic tell of Vinča-Belo Brdo near Belgrade, Serbia, on the basis of the first excavations led by Miloje Vasić (1908–1934). This is part of a three-strand approach to dating the occupation and finds from the tell that is being undertaken as part of *The Times of Their Lives* project.

Key aspects of the Vinča culture and of the Belo Brdo tell are discussed, and the nature of the Vasić excavations and archive presented. Particular attention is given to the stratigraphy of the tell and the sequence of building horizons which have been inferred. Vinča culture pottery is summarised, along with the ceramic typologies and phasing produced by nearly a century of research. Existing radiocarbon dates are noted.

The new radiocarbon dating programme for the Vasić sequence at Vinča-Belo Brdo was designed within the framework of Bayesian chronological modelling. We aimed to date the succession of Neolithic finds from the complete sequence of the tell, using the depths recorded on those finds by Vasić and a new series of radiocarbon dates on samples of bone and antler artefacts from his archive. A total of 85 radiocarbon measurements are now available from 82 samples from known depths through the Vasić sequence at Vinča, including 61 commissioned by the ToTL project. Details of the dated samples and the radiocarbon results and associated measurements are given, including procedures to estimate potential dietary offsets (using FRUITS). The steps in constructing the chronological model are presented, including protocols for identifying and handling outliers, misfits and offsets. Misfits are identified by careful comparison of samples from the same contexts and by formal outlier analysis. An age-depth model is constructed, using a poisson-process depositional model. Fourteen samples are identified as intrusive or residual out of a total of 82 that have been dated. This suggests that c. 83 % of the material will have been freshly deposited at the depth from which it was recovered, strongly supporting Schier's (2000) conclusions, based on correspondence analysis, that the chronological resolution of Vasić's 10-cm spits is far clearer than previously thought. On this basis, we present a poisson-process age-depth model for the chronology of the Vasić sequence at Vinča-Belo Brdo, incorporating a general outlier model and mixed-source calibration for the Starčevo burials from pit Z.

The model places the Starčevo burials in pit Z between the mid-57th and mid-55th centuries cal BC. There was a gap, probably of just over a century, between the end of burial in pit Z and the start of the accumulation of Vinča material culture on the site, probably from the first quarter of the 53rd century cal BC. The estimated date for the end of Vinča culture deposition is in the second half of the 46th century cal BC. Overall, Vinča-type material was deposited on the site for between 700 and 800 years. The tell formed at a rate of approximately one metre per century, and accumulation appears to have been more or less even and without significant hiatus, despite the recognised episodes of house burning. This underlines the commitment to continuity which has been so often discussed in relation to tells. Many generations would have experienced episodes of building, levelling and rebuilding, and at a lifetime scale and within social memory, the steady rise of the tell would have been notable. Detailed estimates are given for the inferred building horizons; questions of variation in duration and of the role of burning are raised. Attention is drawn to unburnt houses, which the Vasić excavations largely failed to recognise.

Detailed estimates are also presented for a selection of the ceramic phases proposed. Much continuity is proposed, but significant change is noted between a depth of 7.9 m and 8.0 m (depending on the chronological scheme used) in the first half of the 52nd century cal BC (the boundary between Milojčić phases A and B1, between Schier phases 4 and 5a, in late Tordoš IIa, and between Parzinger's phases II and III); at a depth of 6 m, in the decades around 4900 cal BC (the boundary between Milojčić phases B2 and C, between Schier phases 6 and 7, between Gradac and Pločnik I, and between Parzinger's phases III and IV); and between a depth of 4.1 m and 4.0 m in the second half of the 48th century cal BC (the boundary between Milojčić phases C–D and D, the end of Schier's phase 8b, the boundary between Pločnik phase I and Pločnik phase IIa, and between Parzinger's phases IV and V, and between Chapman's phases C and D1).

The paper ends by noting the many questions remaining for future research and by stressing the fundamental importance of archives.

Zusammenfassung

Dieser Beitrag legt formal modellierte Datierungen vor für die Schichtenabfolge und das Fundmaterial des großen neolithischen Siedlungshügels von Vinča-Belo Brdo nahe Belgrad, Serbien, auf der Grundlage der ersten, von Miloje Vasić (1908–34) geleiteten Ausgrabungen. Dies ist Teil eines dreisträngigen Ansatzes zur Datierung der Besiedlung und der Funde des Tells, die im Rahmen des Projektes The Times of Their Lives (ToTL) durchgeführt wird.

Schlüsselaspekte der Vinča-Kultur und von Belo Brdo werden diskutiert und die Grabungen Vasićs sowie das Grabungsarchiv vorgestellt. Besondere Aufmerksamkeit gilt der Stratigraphie des Tells und der Abfolge der Bauhorizonte, die erschlossen worden sind. Die Vinča-Keramik wird summarisch vorgestellt, zusammen mit den Keramiktypologien und den Stufengliederungen, die in nahezu einem Jahrhundert intensiver Forschung erstellt wurden. Ebenso werden bereits existierende ^{14}C-Daten genannt.

Das neue ^{14}C-Datierungsprogramm für die Abfolge in Vinča-Belo Brdo nach Vasić wurde innerhalb eines Bayesischen chronologischen Rahmens entwickelt. Unser Ziel war es, die Abfolge neolithischen Fundmaterials über die komplette Sequenz des Tells zu datieren, und zwar anhand der Tiefen, die Vasić für bestimmte Funde dokumentiert hatte, sowie einer neuen Serie an Radiokarbondaten von Knochen- und Geweihartefakten aus seinem Archiv. Insgesamt stehen nun 85 Radiokarbonmessungen von 82 Proben aus bekannten Tiefen der Schichtenabfolge Vasićs in Vinča zur Verfügung, einschließlich von 61 Messungen, die vom ToTL-Projekt in Auftrag gegeben wurden. Die Details zu den datierten Proben und die Ergebnisse und zugehörigen Messungen werden in diesem Beitrag gemeinsam mit Maßnahmen zur Feststellung von möglichen ernährungsbedingten Verschiebungen (unter Anwendung von FRUITS) vorgelegt. Die Schritte zur Konstruktion des Chronologiemodells werden dargelegt, einschließlich der Identifikation von und des Umgangs mit Ausreißern, Unstimmigkeiten und Versatz. Unstimmigkeiten werden durch sorgfältigen Vergleich von Proben aus dem gleichen Kontext identifiziert sowie durch formale Ausreißer-Analyse. Ein Zeittiefenmodell wird konstruiert mithilfe eines Poisson-Prozess-Schichtenmodells. Hierdurch werden von den 82 datierten Proben 14 als intrusiv oder residual identifiziert. Dies legt nahe, dass ca. 83 % des Materials frisch in der Tiefe deponiert worden waren, aus der sie geborgen wurden, was deutlich die Schlussfolgerungen von Schier (2000) unterstützt, die dieser anhand einer Korrespondenzanalyse gezogen hatte, dass nämlich die chronologische Auflösung von Vasićs 10-cm starken Abhüben weit genauer ist als bisher gedacht. Auf dieser Basis präsentieren wir ein Poisson-Prozess-Zeittiefenmodell für die Chronologie der Vasić-Abfolge von Vinča-Belo Brdo, unter Einbeziehung eines Ausreißer-Modells und einer Mixed-Source-Kalibration für die Bestattungen der Starčevo-Zeit in Grube Z.

Das Modell datiert die Starčevo-Bestattungen in Grube Z in den Zeitraum zwischen der Mitte des 57. und der Mitte des 55. Jahrhunderts cal BC. Es folgte eine Lücke von wahrscheinlich kaum mehr als einem Jahrhundert zwischen dem Ende der Beisetzungen in Grube Z und dem Beginn der Akkumulation von Vinča-zeitlichem Material an diesem Platz, vermutlich ab dem ersten Viertel des 53. Jahrhunderts cal BC. Das errechnete Datum für das Ende der Aufschichtung von Vinča-Material liegt in der zweiten Hälfte des 46. Jahrhunderts cal BC. Insgesamt wurde für einen Zeitraum von 700 bis 800 Jahren Material der Vinča-Kultur hier deponiert. Der Tell wuchs mit einer Geschwindigkeit von ungefähr einem Meter pro Jahrhundert, wobei die Akkumulation mehr oder weniger gleichmäßig und ohne auffälligen Hiatus geschehen zu sein scheint, trotz der festgestellten Phasen von Hausbränden. Dies unterstreicht die Bindung an die Kontinuität des Ortes, die so oft in Bezug auf Tellsiedlungen diskutiert wurde. Viele Generationen dürften Phasen des Bauens, des Planierens und Neubauens erlebt haben, und das stetige Wachstum des Siedlungshügels wird innerhalb eines Menschenalters und innerhalb des sozialen Gedächtnisses bemerkbar gewesen sein. Detaillierte Berechnungen für die erschlossenen Bauhorizonte werden angegeben und Fragen nach der Dauer und der Bedeutung der Brandphasen werden aufgeworfen. Die Aufmerksamkeit wird zudem auf die unverbrannten Häuser gelenkt, die während der Grabungen Vasićs weitgehend unerkannt blieben.

Detaillierte Berechnungen werden auch für eine Reihe von vorliegenden Keramikchronologien präsentiert. Es kann eine weitgehende Kontinuität festgestellt werden, aber auch jeweils auffälliger Wandel zwischen einer Tiefe von 7,9 m und 8,0 m (je nach benutztem Chronologieschema) in der ersten Hälfte des 52. Jahrhunderts cal BC (der Grenze zwischen Milojčićs Phasen A und B1, zwischen Schiers Phasen 4 und 5a, im späten Tordoš IIa, und zwischen Parzingers Phasen II und III); in einer Tiefe von 6 m, während der Jahrzehnte um 4900 cal BC (der Grenze zwischen Milojčićs Phasen B2 und C, zwischen Schiers Phasen 6 und 7, zwischen Gradac und Pločnik I, und zwischen Parzingers Phasen III und IV); sowie bei einer Tiefe von 4,1 m und 4,0 m in der zweiten Hälfte des 48. Jahrhunderts cal BC (der Grenze zwischen Milojčićs Phasen C–D und D, dem Ende von Schiers Phase 8b, der Grenze zwischen Pločnik I und Pločnik IIa, und zwischen Parzingers Phasen IV und V sowie zwischen Chapmans Phasen C und D1).

Der Beitrag endet mit der Feststellung der vielen für die künftige Forschung noch offenen Fragen und mit der Betonung der fundamentalen Bedeutung von Archiven.

Résumé

Cet article présente des datations modélisées pour la séquence stratigraphique et les artefacts du grand tell néolithique de Vinča-Belo Brdo près de Belgrade en Serbie. Les premières fouilles menées par Miloje Vasić (1908-1934) ont servi de base à cette étude intégrée à une approche sur trois axes en vue de dater l'occupation et les artefacts du tell dans le cadre du projet *The Times of Their Lives* (ToTL).

Cet article discute les aspects clés de la culture de Vinča et de Belo Brdo, et présente les fouilles de Vasić ainsi que l'archive des fouilles. On porte une attention toute particulière à la stratigraphie du tell et à la succession des horizons de construction qui furent identifiés. La céramique de Vinča est présentée brièvement avec les typologies et les chronologies mises au point au cours d'un siècle de recherches intensives. Les datations au radiocarbone déjà existantes sont également mentionnées.

Le nouveau programme de datation au radiocarbone pour la stratigraphie de Vinča-Belo Brdo selon Vasić fut développé dans un cadre chronologique bayésien. Notre but était de dater l'évolution du matériel néolithique sur toute la séquence du tell en se référant aux niveaux identifiés par Vasić pour certains objets et au moyen d'une nouvelle série de datations au radiocarbone obtenues sur des artefacts en os et bois de cerf de son archive. On dispose à présent de 85 datations au radiocarbone, dont 61 commandées par le projet ToTL, faites sur 82 échantillons provenant de niveaux connus des couches identifiées à Vinča par Vasić. Les détails concernant les échantillons datés, les résultats et les mesures qui s'y réfèrent figurent ici avec les dispositions prises en vue d'identifier des décalages éventuels dus à l'alimentation (en utilisant FRUITS). On décrit les étapes de la construction du modèle chronologique, y compris l'identification et le traitement de biais, d'incohérences et de décalages. Une comparaison attentive des échantillons issus du même contexte, ainsi qu'une analyse formelle des biais, permet d'identifier les incohérences. Un modèle âge-profondeur a pu être réalisé en utilisant un modèle de dépôt selon le processus

de Poisson. Il en ressort que 14 des 82 échantillons datés sont considérés comme intrusifs ou résiduels. Ceci suggère, que 83 % du matériel avait été déposé directement au niveau où il fut trouvé, et appuie clairement les conclusions qu'avait tirées par Schier (2000) d'une analyse des correspondances : Le découpage chronologique de Vasić obtenu par des décapages de 10-cm est bien plus précis qu'on ne le pensait jusqu'ici. C'est sur cette base que nous présentons un modèle de dépôt selon le processus de Poisson pour la chronologie de la stratigraphie de Vasić à Vinča-Belo Brdo, en incluant un modèle de biais et une calibration de source mixte pour les sépultures de la fosse Z attribuée à l'époque de Starčevo.

Le modèle situe les sépultures Starčevo de la fosse Z entre le milieu du 57^{e} et le milieu du 55^{e} siècle cal BC. Suit un hiatus de probablement cent ans à peine entre les dernières sépultures de la fosse Z et le début de l'accumulation de matériel Vinča à cet endroit, probablement dès le premier quart du 53^{e} siècle cal BC. La datation obtenue pour la fin de la stratification du matériel Vinča se situe dans la deuxième moitié du 46^{e} siècle cal BC. Le dépôt de matériel Vinča s'étend donc ici sur 700 à 800 ans. La croissance du tell atteignait ainsi une vitesse d'un mètre par siècle avec une accumulation relativement constante et sans hiatus spécial, malgré les phases d'incendies constatées. Ceci souligne l'attachement au même endroit tant discuté dans le cas des tells. Beaucoup de générations ont dû vivre des phases de construction, de nivellement et de reconstruction, et la croissance constante du tell aura marqué l'existence des individus et la mémoire sociale. Les horizons de construction identifiés font l'objet de calculs détaillés et on s'interroge aussi sur la durée et le rôle des incendies. L'attention se porte également sur les maisons qui n'ont pas brûlé et qui ont échappé aux observations durant les fouilles de Vasić. On présente des calculs détaillés pour une série de chronologies existantes, basées sur la céramique. On constate une grande continuité, mais également un changement entre 7,90 et 8,00 m de profondeur (suivant le schéma chronologique utilisé) à la première moitié du 52^{e} siècle cal BC (la limite entre les phases A et B1 de Milojčić, entre les phases 4 et 5a de Schier, le Tordoš IIa tardif, et les phases II et III de Parzinger). Un autre changement se dessine à une profondeur de 6 m durant les décennies autour de 4900 cal BC (la limite entre les phases B2 et C de Milojčić, les phases 6 et 7 de Schier, entre Gradac et Pločnik I, et entre les phases III et IV de Parzinger) ; et encore à une profondeur de 4,10 m et 4,0 m à la deuxième moitié du 48^{e} siècle cal BC (la limite entre les phases C/D et D de Milojčić, la fin de la phase 8b de Schier, la limite entre Pločnik I et Pločnik IIa, entre les phases IV et V de Parzinger, ainsi qu'entre les phases C et D1 de Chapman.

Cette contribution s'achève par le constat que la recherche aura encore beaucoup de questions à résoudre, et en insistant sur le rôle fondamental des archives.

Y. G.

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Supplementary Material

The OxCal CQL2 programme code (Vinca_Vasic_age_depth_final.oxcal): doi:10.11588/data/10081 http://dx.doi.org/10.11588/data/10081

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Zusammenfassung: Vinča-Belo Brdo, Serbien: Die Zeiten eines Tells

Dieser Beitrag legt für die Schichtenabfolge und Funde des großen neolithischen Siedlungshügels von Vinča-Belo Brdo nahe Belgrad in Serbien innerhalb eines Bayesischen chronologischen Rahmens formal modellierte Datierungen vor; Grundlage hierfür sind die ersten Ausgrabungen unter der Leitung von Miloje Vasić (1908–1934). Dies ist Teil eines dreisträngigen Ansatzes zur Datierung der Besiedlung und der Funde des Tells, die im Rahmen des Projektes *The Times of Their Lives* durchgeführt wird. Eine Gesamtzahl von 85 Radiokarbondaten steht nun aus bekannten Tiefen der von Vasić in Vinča erfassten Schichtenfolge zur Verfügung. Ein Bayes'sches Chronologiemodell wird unter Verwendung eines Poisson-Prozess-Schichtenmodells konstruiert.

Abstract:Vinča-Belo Brdo, Serbia: The times of a tell

This paper presents formally modelled date estimates,within a Bayesian chronological framework, for the sequence of deposits and material at the great Neolithic tell of Vinča-Belo Brdo near Belgrade, Serbia, on the basis of the first excavations, led by Miloje Vasić (1908–1934). This is part of a three-strand approach to dating the occupation and finds from the tell that is being undertaken as part of *The Times of Their Lives* project. A total of 85 radiocarbon measurements are now available from known depths through the Vasić sequence at Vinča. A Bayesian chronological model is constructed, using a poisson-process depositional model.

Résumé: Vinča-Belo Brdo, Serbie: Le temps d'un tell

Cet article présente des datations, modélisées dans un cadre chronologique bayésien, pour la séquence stratigraphique et les artefacts du grand tell néolithique de Vinča-Belo Brdo près de Belgrade en Serbie. Les premières fouilles menées par Miloje Vasić (1908–1934) ont servi de base à cette étude intégrée à une approche sur trois axes en vue de dater l'occupation et les artefacts du tell dans le cadre du projet *The Times of Their Lives*. On dispose à présent de 85 datations au radiocarbone provenant de niveaux connus des couches identifiées par Vasić à Vinča. Un modèle chronologique bayésiena pu être réalisé en utilisant un modèle de dépôt selon le processus de Poisson.

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Figs 1, 6, 9, 11–13: N. Tasić. – *Figs 2–5, 7*: Arheološka Zbirka, Faculty of Philosophy, University of Belgrade. – *Figs 8, 10*: ToTL project, redrawn by K. Harding. – *Figs 14, 16–24*: A. Bayliss. – *Fig. 15*: N. Beavan and A. Bayliss. – *Tab. 1-9* all authors, K. Ruppel, RGK.