Although more than 50 years have passed since the discovery of Lepenski Vir (Fig. 1), the controversy as to how one should best interpret its stratigraphy and accurately date various discovered features has not ceased. Over the past 20 years, several versions of a revised view of the stratigraphy and chronology of this site have been offered. These reinterpretations have predominantly relied on a new understanding of the most dominant phase with trapezoidal buildings and associated material culture, with an important grounding in the extant conventional radiocarbon dates and more recently obtained Accelerator Mass Spectrometry (henceforth AMS) measurements. The offered revised understanding of the site's stratigraphy and chronology significantly changed initial interpretations that had been offered by the excavator of the site, Dragoslav Srejović. Most recently, these revised understandings of the site have further been supported and nuanced by a series of new and more precise AMS measurements on human and animal bones and archive charcoal samples from various contexts, Bayesian statistical probabilistic modelling of radiocarbon dates as well as new analysis of the associated material culture and human remains found at the site.

With smaller or greater differences among the authors who have studied this cultural phenomenon over the last two decades, a minimal consensus has been reached about the stratigraphy and chronology of Lepenski Vir.

Key words – Mesolithic, Neolithic, foragers, farmers, AMS dating, aDNA, Lepenski Vir, Danube Gorges

Abstract – This article offers a new look at the stratigraphy and chronology of Mesolithic and Neolithic deposits at Lepenski Vir, particularly based on newly available Accelerator Mass Spectrometry (AMS) dating and aDNA genomic evidence. It focuses on a detailed analysis of several key contexts for which new radiocarbon dates are available while at the same time reviewing taphonomic and age-offset problems when dating human remains and other materials affected by the aquatic reservoir effect in the Danube Gorges area. The robust chronological evidence as well as available stratigraphic data overwhelmingly show that the start of the main and iconic phase of the occupation of this site, represented by the architecture of trapezoidal buildings and sculpted sandstone boulders, should unequivocally be dated to the period of the Mesolithic-Neolithic transition in the last two centuries of the seventh millennium cal BC. At this time, local forager populations of distinct hunter-gatherer genetic ancestry came into contact and mixed with incoming Neolithic, farming populations of north-western Anatolian genetic ancestry, based on the available genomic data but also supported by studies of material culture traditions. The article deals directly with the recent criticism of this chrono-stratigraphic model for Lepenski Vir.
that sees the best represented phase with trapezoidal buildings (Fig. 2) attributed to the period of the Mesolithic-Neolithic transition, also referred to as the “Final Mesolithic”, absolutely dated to the last two centuries of the seventh millennium cal BC, representing a continuous process of transformation caused by cultural contacts between Mesolithic indigenous foragers and newly emerging Neolithic agro-pastoralist groups.

However, recently, Perić and Nikolić offered their own reinterpretation of the stratigraphy and chronology of Lepenski Vir with a different understanding of stratigraphic relationships at the site and absolute chronological attributions of the main architectural units when compared to the views held by other authors who have written about this phenomenon in more recent years. According to Perić and Nikolić, buildings with trapezoidal floor bases were constructed prior to 7,500 years cal BC, based on their reading of associated radiocarbon dates, and there was a pronounced discontinuity between the Mesolithic and Neolithic settling of Lepenski Vir. The view of these authors represents a significant deviation from the recently established consensus among researchers studying Lepenski Vir and, thus, requires a new consideration of the questions of chronology and stratigraphy of this site, due to the discrepancy of more than a millennium in the suggested dating of the site’s most notable features.

In this article, the stratigraphy and chronology of Lepenski Vir are reconsidered once more through a focused analysis of several contexts with newly available AMS dates and with a detailed discussion of taphonomic and other issues surrounding the dating of samples from this site and the Danube Gorges area more generally. An attempt is made to clarify ways of using radiocarbon

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5 Perić, Nikolić 2016.
Fig. 2. Site plan of Lepenski Vir with features from different phases shown. Key: 1 – primary burial, flexed lower limbs (‘seated’); 2 – primary burial, extended supine; 3 – neonate; 4 – primary burial on its lateral sides and flexed lower limbs; 5 – secondary burial, disarticulated mandible; 6 – disarticulated cranial remains; 7 – disarticulated postcranial remains. Blue: Proto-LV; yellow: LV I–II; red: LV III; green: Copper Age; orange: Roman; purple: medieval; black: unclear dating (figure prepared by Dušan Borić)

measurements with the highest level of scrutiny following modern scientific standards and best practice – from the selection of samples to the modelling and interpretation of the obtained data. This is followed by an analysis of stratigraphic issues and the nature of depositional processes at the site. Finally, the chronological picture of Lepenski Vir that emerges from this review is compared to recently obtained ancient DNA (henceforth aDNA) genomic data on human remains from Lepenski Vir and several other Mesolithic-Neolithic sites in the Danube Gorges area.

A brief overview of the research and debate

In the following section, a brief overview will be offered regarding different views about the stratigraphy and chronology of Lepenski Vir held by various authors who have written about these questions, presented in chronological order.

Even before the final, 1970 campaign of excavations at Lepenski Vir, in 1969, in a monograph published in Serbian and several years later translated, with minor modifications to the original text, and published in English and German, the principal excavator of the site, Dragoslav Srejović, offered the first authoritative view of the stratigraphy and chronology of Lepenski Vir. According to Srejović, there are four main stratigraphic phases at the site. The earliest Mesolithic phase is labelled Proto-Lepenski Vir and is represented by rectangular stone-lined hearths without limestone floors, with the occupation restricted to a narrow belt along the Danube’s bank. In continuity with this phase, follows Mesolithic phase I with trapezoid-shaped limestone building floors and centrally located rectangular stone-lined hearths, which in their dimensions and style of construction differ from the hearths attributed to the Proto-Lepenski Vir phase (Fig. 2). Phase I was subdivided into phases Ia to If, representing different building horizons within phase I, primarily based on evidence of complete superposition of some building floors, partial overlapping and horizontal displacement of building floors and hearths, or intercutting of older floors by new ones. Buildings of this phase are marked by Arabic numerals (1, 2, etc.). Furthermore, this continuous Mesolithic development, according to Srejović, is followed by the final Mesolithic phase II, consisting of stone walls creating trapezoidal outlines, sometimes with rectangular stone-lined hearths, lacking limestone floor packings, and generally found at a higher level than the trapezoidal building floors of phase I. The assumed buildings of this phase are marked by Roman numerals (I, II, etc.). Srejović argued that this continuous Mesolithic development was interrupted by the abandonment of the site, during which period a thin sterile layer covered the site and its Mesolithic features. According to his view, the site was resettled again at the start of the Early Neolithic, which, in the stratigraphy, is marked as phase III, subdivided into phases IIIa and IIIb. While occasional finds dated to the Copper Age, Bronze Age, Iron Age, Roman, and Medieval periods were also found at the site, these were not marked as separate phases and no distinct “layers” in the site’s stratigraphy can be associated with these later periods of the site’s use.

Already at the time of the writing of Srejović’s first book on Lepenski Vir, there appeared a series of 19 radiocarbon dates dating 14 charcoal samples associated with the occupation of 12 trapezoidal buildings of phase I and two dates dating charcoal samples from the contexts attributed to two structures of phase II. It was obvious to H. Quitta, who reported the results of radiocarbon dating in one of the appendices of Srejović’s book, that these dates suggest the contemporaneity of phases I and II with various Early Neolithic sites in south-eastern Europe for which radiocarbon dates started to become available at the time. However, for Srejović, the dating evidence did not play an important part in his narrative regarding the chronological and cultural attribution of the main features found at Lepenski Vir. At that time, he had already obtained confirmation through radiocarbon dating of an earlier, Mesolithic occupation of the neighbouring site of Vlasac (Fig. 1), the excavations of which he also oversaw, together with Zagorka Letica, which preserved the roots of the cultural tradition seen at Lepenski Vir during phases I and II based on the similarities in the shape of rectangular stone-lined hearths and trapezoid-shaped dwelling floors. Such a dating of Vlasac might have strengthened his conviction that Lepenski Vir phases I and II should be dated to the Mesolithic too, separate from the subsequent Early Neolithic occupation of the site.

Challenges to this view came soon after the publication of Srejović’s book in English. One of the first

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6 Srejović 1969.
7 Srejović 1972.
8 Srejović 1975.
9 Quitta 1975.
10 Srejović, Letica 1978.
reviews of the book was published in the *Proceedings of the Prehistoric Society* by John Nandriš who argued that “Lepenski Vir I and II, deriving from those predecessors, were nevertheless largely contemporary with the beginnings of the First Temperate Neolithic, and not, as Srejović claims, rigidly antecedent stages”11. Nandriš rather critically ends his review by stating: “With regard to the age of Lepenski Vir, surely the attempt to make it older than it is, is an indication that the site is being used to answer the wrong sorts of questions”12. In the following years, several internationally recognised authors working on various aspects of south-eastern European prehistory had similarly critical views of Srejović’s dating of Lepenski Vir13.

Locally, the challenge to Srejović’s dating of the site came early, while the excavations were still ongoing, through the work of one of his peers, Borislav Jovanović, who excavated the contemporaneous Mesolithic-Neolithic site of Padina-Gospodin Vir (Fig. 1), located five kilometres upstream of Lepenski Vir. Among other features, Jovanović discovered the architecture of trapezoidal buildings similar to those from Lepenski Vir and documented abundant associations of several discovered features with Early Neolithic, Starčevo type ceramics14. Subsequently, he suggested that Lepenski Vir phases I–II, similar to his Padina B settlement phase, should be dated to the Early Neolithic. These two different views remained entrenched throughout the 1970s and 1980s with no resolution of the debate.

After Michael Tellenbach15 dealt a blow by challenging the stratigraphy and dating of Padina, Jovanović felt compelled to reinstate his conviction regarding the material associations of trapezoidal buildings at Padina with Early Neolithic Starčevo ceramics by publishing a piece on his findings in *Germania*16. As it was probably difficult to ignore such compelling evidence of Early Neolithic associations with trapezoidal structures at Padina, Srejović17 conceded to Jovanović’s views and accepted that Jovanović’s Padina phase B-2, which related to the middle row of trapezoidal buildings at sector III of Padina–Gospodin Vir, could be attributed to the Mesolithic-Neolithic transition phase, while the uppermost row of buildings attributed to Phase B-3, with the clearest examples of the association of Early Neolithic ceramics with trapezoidal building floors and hearths, was assigned to the Early Neolithic. In the same comparative chronological table provided by Srejović in 1988, Lepenski Vir I and II remained firmly linked to the Late Mesolithic. A similar regional synchronisation of the site’s phasing, with minor differences to the one offered by Srejović, can also be found in a synthesis of the Danube Gorges evidence provided by Voytek and Tringham18.

In 1996, Ivana Radovanović’s synthesis entitled *The Iron Gates Mesolithic* for the first time in a detailed way systematised the available evidence regarding the Mesolithic of the region. Trapezoidal buildings from Lepenski Vir remained fixed to six Mesolithic developmental stages proposed by Radovanović, while this author only briefly acknowledged the problems surrounding the chronological synchronisation of Padina and Lepenski Vir with Early Neolithic sites elsewhere in the Balkans, and provided only a very limited discussion of the then available radiocarbon evidence. Radovanović spread the timing of the Lepenski Vir phase I from the second half of the eighth and throughout the seventh millennia cal BC, despite the existing evidence of charcoal dates from the site. Radovanović also suggested a new division of Srejović’s phase I derived from her architectural rephrasing of building horizons based on the presence and absence of ‘V’-shaped “supports” in association with buildings’ hearths and other “stylistic” differences19.

A major step forward in the understanding of this cultural taxonomic unit came with new AMS dating of human bones from Lepenski Vir, Vlasac, and Schela Cladovei20. These new measurements from Lepenski Vir provided the first dates for five burials attributed to phase III, while suggesting a significant time depth for some of the dated human remains from neighbouring Vlasac. Bonsall et al.21 also published the first stable isotope study from the same three sites that not only provided indications of dietary practices but also suggested that the dating of human remains from this region raises the problem of the aquatic reservoir effect due to the significant consumption of fish resources that introduce concentrations of carbon into the human body.

11 Nandriš 1972, 427.
12 Nandriš 1972, 429.
14 Jovanović 1969.
15 Tellenbach 1983.
17 Srejović 1988, 10.
19 For a critique of this rephrasing of Lepenski Vir building horizons see Borić, Dimitrijević 2007/2009.
20 Bonsall et al. 1996.
from an ecosystem different than the atmosphere. The introduction of “old carbon” made the obtained dates older than reality and required a correction of the age-offset. The correction factor was derived from the comparative dating of the so-called “perfect pairs”, i.e. both human remains and associated contemporaneous herbivorous remains in the form of bone tools, sometime found embedded in the skeletal remains as projectile points in Late Mesolithic burials at Schela Cladovei22.

In 1999, I published a critique of the hitherto widely held views on the stratigraphy and chronology of Lepenski Vir by stressing the Early Neolithic historical context already suggested by the conventional radiocarbon dates and by arguing for the contemporaneity of the trapezoidal building phases from Lepenski Vir and Padina-Gospodin Vir in the context of absolute dating of Early Neolithic sites elsewhere in the Central Balkans23.

This critique was then followed by the publication of previously unpublished photographs showing Early Neolithic ceramics on the floors of two buildings (4 and 54) from Lepenski Vir24. It should be noted that the publication of such evidence, previously kept secret, became possible only after the death of Srejović in 1996. While accepting the chronological contemporaneity of Lepenski Vir phases I and II with Early Neolithic settlements elsewhere in the Balkans, Garašanin and Radovanović retained the label “Iron Gates Mesolithic” for the nature of occupation of the two settlements during these phases.

In 2002, I expanded my revision of the stratigraphy of Lepenski Vir by suggesting that phases I and II are part of the same building horizon, with the stone walls of phase II seen as retaining walls of dug-in features of phase I buildings with trapezoid-shaped limestone floors25. Also, a new reconstruction of the upper construction of the semi-subterranean trapezoidal buildings was suggested, envisaged with upright wooden pillars holding a flat roof. The early series of conventional radiocarbon dates from Lepenski Vir and Padina was further supported by the first, newly obtained and more accurate AMS measurements on animal bones associated with the occupation of trapezoidal buildings from Lepenski Vir and Padina26. Some of these dates made on fish and dog bones showed the same reservoir effect problems as with the dating of human remains, demanding the age-offset correction. In addition, as part of my doctoral research, I obtained the first direct AMS dates on human remains from the sites of Padina and Hajdučka Vodenica (Fig. 1), and further dates on animal bones from Padina. These new measurements suggested a significant depth in the occupation of these sites and, importantly for the understanding of the chronological position of phase I at Lepenski Vir, confirmed the assumed dating of trapezoidal structures from Padina in the last centuries of the seventh and the first century of the sixth millennia cal BC27.

In the 2000s, 34 further AMS dates were obtained from 32 different contexts of Lepenski Vir, dating three human bones and 29 animal bones28. This dating programme provided a more robust series of measurements for the overall stratigraphy of the site. We dubbed the main phase with trapezoidal buildings as phase I–II and provided the first realistic indication of the time depth at Lepenski Vir with some contexts dating back to the second half of the tenth millennium cal BC. This already representative series of dates further supported the earlier suspicion that Lepenski Vir might not have been settled during the Late Mesolithic, dated in this regional context to the last centuries of the eighth and the largest part of the seventh millennia cal BC. Also, the first direct AMS dates were obtained on five bones of domesticated animals (goat, cattle, and pig) found in contexts attributed to phase III, providing the first indication of the timing of the introduction of domestic stock to this site, starting from the first century of the sixth millennium cal BC29.

Around the same time, Bonsall et al.30 published 26 AMS dates on 25 human burials from Lepenski Vir that, apart from dating 19 Mesolithic-Neolithic contexts, also provided 4 measurements dating medieval burials, 1 dating Roman age skeletal remains, and 1 dating a Copper Age burial. The remainder of the obtained dates provided earlier Mesolithic, ninth-millennium cal BC dates or late-seventh and early-sixth millennia cal BC dates, after their correction for the reservoir effect. Unfortunately, this series of measurements was affected by a technical problem caused by the application of

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23 Borić 1999.
26 Borić 2002; Whittle et al. 2002.
30 Bonsall et al. 2008.
the ultrafiltration protocol in the Oxford laboratory from 2000 to 2002, resulting in artificially older values\textsuperscript{31}, and all had to be remeasured. They were replaced by new measurements reported by Bonsall et al.\textsuperscript{32}, and now mostly fall in line with the rest of the available radiometric evidence from the site, including the dating results obtained separately on four of the same dated individuals in another lab – the NSF Arizona AMS Laboratory\textsuperscript{33} (see below).

In 2016, I published the first dedicated study focusing on the contextual analysis of all human remains from Lepenski Vir, based on archival documentation and new analysis, firmly grounded in a stratigraphic analysis of different contexts in which human remains are found throughout the main phases of occupation of the site and supplemented by a robust series of available radiocarbon measurements\textsuperscript{34}.

In the same year, there came a challenge to the previously described years of painstaking build-up of chronological revisions and refinements of the stratigraphy and chronology of Lepenski Vir. In the book entitled *Lepenski Vir: Stratigraphy, Chronology and Periodization. Excavations 1966*, Slaviša Perić and Dubravka Nikolić\textsuperscript{35} undertook a detailed analysis of a portion of the archival documents from Lepenski Vir, providing a critique of the hitherto held views, and suggested a periodisation of the site and its chronology dramatically different in the cultural and chronological attribution of different features found at the site. As suggested by the subtitle of their book, the provided detailed analysis of archives, for unknown reasons, did not encompass all excavation campaigns but only 1966, even though in certain parts of the book contexts and features excavated in 1965\textsuperscript{36} and later campaigns are also discussed. In short, these authors suggested a rephasing of the site into two main phases: Lepenski Vir I, which represents a Mesolithic development of the Lepenski Vir culture, from around 9500 to around 7500 cal BC associated with trapezoidal buildings, while a hiatus in the occupation of the site from 7500 cal BC to 6300 cal BC is subsequently followed by their phase Lepenski Vir II, which represents the occupation of the site in the Early Neolithic by the Starčevo culture taxonomic unit. Perić and Nikolić reject the contextual and active association of trapezoidal buildings with charcoal samples and material culture found on their floors, suggesting that almost all materials found on the floors and in the fills of trapezoidal buildings, except for sculpted boulders, come from Early Neolithic intrusions into these features.

There are a number of problematic aspects in the book published by Perić and Nikolić that require close scrutiny—from their understanding of the depositional processes at the site and its stratigraphy to their selective and arbitrary use of available radiocarbon evidence. After the publication of their volume, several new radiocarbon measurements also became available from secure contexts of the site that fundamentally challenge the main postulates of their stratigraphic and chronological reckoning of the evidence from Lepenski Vir. While the treatment of various chronological and stratigraphic issues of Lepenski Vir with the application of Bayesian probabilistic modelling of all the then available radiocarbon dates has recently been provided elsewhere\textsuperscript{37}, in the following I would like to offer a more focused discussion, on the one hand, about the nature of the radiocarbon dataset from this site, zooming in on a few key contexts that have recently been AMS-dated, and, on the other hand, returning to the issue of depositional processes and site build-up as seen in its stratigraphic sequence.

**Radiocarbon chronology of Lepenski Vir**

*The current dataset and charcoal dates*

Currently, Lepenski Vir is one of the sites with the largest number of available radiocarbon dates in southeastern Europe. There are in total 114 radiocarbon measurements (including several duplicates and triplicates of the same samples), while 108 measurements date Mesolithic and Neolithic contexts (Table 1)\textsuperscript{38}. The dates are made on charcoal (26), animal bones (47), and human bones (41)\textsuperscript{39}.

Apart from the previously mentioned first series of 21 charcoal dates obtained in the late 1960s, there are now five new AMS dates on four charcoal samples that were selected from the preserved archive with charcoal samples collected at the time of excavations.

\textsuperscript{31} Bronk Ramsey et al. 2004.
\textsuperscript{32} Bonsall et al. 2015.
\textsuperscript{33} Borić et al. 2018; cf. Bonsall et al. 2015.
\textsuperscript{34} Borić 2016.
\textsuperscript{35} Perić, Price 2013; Borić et al. 2018; cf. Bonsall et al. 2015.
\textsuperscript{36} Perić, Nikolić 2016.
\textsuperscript{37} Borić et al. 2018.
\textsuperscript{38} Borić et al. 2018.
\textsuperscript{39} I become aware of two additional AMS dates on human remains (burials 68 and 91, see Table 1) from Lepenski Vir after the publication in 2018, and these are here added to the constructed chronological model for the first time.
at Lepenski Vir. Prior to their dating, these samples were analysed in order to identify wood species and four samples were selected, of which two were associated with trapezoidal buildings: an oak (*Quercus* sp.) beam found during excavations in building 37 in 1967 (OxA-32866 and OxA-32887—duplicate measurements on the same sample) and dogwood (*Cornus* sp.) charcoal remains found during excavations in building 62 in 1968 (OxA-32865). These new dates on charcoal from Lepenski Vir have much smaller error terms than early charcoal dates, reflecting significant improvements in measuring precision, and are consistent with the series of AMS dates on animal bones and human remains associated with trapezoidal buildings. Even before being modelled with other dates within the Bayesian statistical framework, using prior stratigraphic information (see below), these dates, when individually calibrated at 95% confidence (Table 1), fall into a relatively short period of the last century of the seventh millennium cal BC, and correspond with the assumption of a short duration of the phase with trapezoidal building structures.

In their book, Perić and Nikolić40 rightly comment on the problematic nature of the first series of charcoal dates, especially regarding the large error terms, which extended the duration of the phase of trapezoidal buildings to almost a millennium (ca. 6500 to 5500 cal BC). Especially problematic seem to be the dates produced in the Berlin (Bln-) and Zagreb (Z-) labs which appear consistently younger than other measurements (Table 1). However, Perić and Nikolić’s uncertainty over the reconciliation of the long duration indicated by the old series of conventional dates and new AMS dates for the occupation of trapezoidal buildings is unjustified—while these two different series overlap, more recent and more precise dates have shortened the duration of the dated phase significantly, and we can now provide even more precision using the Bayesian statistical modelling of the dates (see below).

**Dating human remains and age-offset**

In Chapter 3 of their book, Perić and Nikolić41 spend a lot of time discussing the absolute chronology of Lepenski Vir by casting doubt on various aspects of the dating evidence. However, there are significant problems with the evidence they chose to use, the way they understand various issues surrounding radiocarbon dating, and the way they discuss the existing dating evidence. For instance, regarding human bone samples they say “that the span of time assumed for individual buildings is very long due to reservoir-corrected human bone ages”42. This is a misunderstanding. As previously explained, since the late 1990s, it has been known that the majority of human bones from the Danube Gorges area as well as the dated bones of dogs or fish and other organisms linked to the riverine ecosystem require an age-offset correction. In other words, the obtained dates are “too old” and need to be corrected similar to various regional examples where a food-chain dependence on marine/freshwater ecosystems has been documented.

In the early 2000s, for the Danube Gorges region, three methods were suggested for the correction of the dates on humans based on the dating of the so-called “perfect pairs” of terrestrial animal and human remains from the same contexts, thus assumed to be contemporaneous (e.g. grave offerings and similar, see above). The estimated percentage of aquatic diet was calculated on the basis of the δ15N isotope values, which reflect protein intake, the majority of which in the Danube Gorges was derived from the consumption of fish43. While error terms of dates corrected for the aquatic reservoir effect are slightly larger, these do not affect our estimates for the duration of particular buildings and other contexts in which burials are found. In the future, it is hoped that the precision of the correction factor will increase by obtaining multi-isotope signatures, including 34S isotope values as accurate indications of fish intake rather than just measuring protein intake through δ15N44, and by Bayesian FRUITS modelling of multi-isotope values45 in order to estimate the most likely contribution of aquatic foods in the diet of an individual and, thus, enable more precise corrections of the reservoir ages. Another alternative is dating compound-specific single amino acids46. For the moment, there are independent indicators through dating animal bones sometimes associated with human remains indicating that the correction factor we continue to use across the Danube Gorges area to arrive at the real ages for the dated materials affected by the age-offset is adequate for the purpose.

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40 Perić, Nikolić 2016, 95–100.
41 Perić, Nikolić 2016.
42 Perić, Nikolić 2016, 100.
44 Nehlich et al. 2010.
46 Honch et al. 2012.
Perić and Nikolić also single out discrepancies in the obtained AMS measurements on several burials of the same individuals obtained in two different laboratories, saying that these “in some cases do not overlap at all” 47. As this statement is erroneous, let us have a detailed look at these instances. For burials 7/1, 26, 54d, and 8 (the last being omitted from the mention by Perić and Nikolić), measurements were obtained, on the one hand, by Clive Bonsall in the Oxford Radiocarbon Accelerator Unit (ORAU) 48, and, on the other hand, by T. D. Price and myself in the NSF Arizona AMS Laboratory 49. One of the reasons for the discrepancies between the initial series of dates obtained on human remains from Lepenski Vir in Oxford and those obtained in Arizona relates to the previously mentioned problem of the ultrafiltration protocol in the Oxford laboratory 50. In the article that was, judging by their list of references, available to Perić and Nikolić, Bonsall et al. 51 reported newly measured AMS dates that replaced the dates on the same burials initially published in 2008, with all of the remeasured bones, apart from two samples, producing, as expected, younger dates than the samples measured using the ultrafiltration protocol. This reduced some of the discrepancies between the Arizona and Oxford dates on the same four individuals.

However, it is true that the two different dates from two different labs on burial 8, even after remeasuring the sample in Oxford, still remain statistically distinct despite similar reported δ15N and δ13C values (Table 1). The Oxford measurement on this burial is surprisingly older than younger than the initial ultrafiltrated date 52, which may raise doubts as to some of the possible problems associated even with this new measurement. Only a new date on another bone sample of this individual could resolve the problem. Yet, both of the obtained dates on burial 8 fall into the assumed duration of phase III after 5900 cal BC, in accordance with the assumed stratigraphic position of this crouched inhumation (see below). A similar situation exists with burial 54d (Table 1), where again the Arizona date is somewhat younger than the Oxford date with the two being statistically distinct. Again, in this case the differences do not change the fact that both dates fall into the assumed duration of the phase with trapezoidal buildings to which the burial stratigraphically belongs (see below). On the other hand, both of the dates obtained in different labs on burial 26 are statistically consistent (Table 1). Finally, there exists a significant discrepancy in the radiocarbon ages obtained in the two different labs on burial 7/1, with a significant difference of ~4.6% between the obtained δ15N values (Table 1). However, once the correction factor is applied to each date based on their respective δ15N values, the two corrected dates become statistically consistent. Bonsall et al. 53 put forward an interesting possibility that the observed discrepancies between these radiocarbon ages and δ15N values in the case of burial 7/1 may stem from the fact that two different skeletal elements were analysed respectively—a femur sample in the Oxford lab and a rib sample in the Arizona lab. Due to the fast collagen turnover in ribs and a much slower turnover in other bones of the skeleton, the δ15N signal from the rib could be an indication of a significant dietary change in this individual prior to his death while the value obtained on the femur would be an indication of earlier life diet heavily based on fish.

These instances go to show the necessity of engaging closely with this complex set of data when trying to use them in wider interpretations as well as the fact that with new data and analyses, previous conclusions can be refined, adjusted, or entirely modified. This sense of constant influx of new data that could modify previous conclusions is surprisingly absent from the way Perić and Nikolić treat earlier studies and their conclusions rather than acknowledging the process of the adjustment and nuancing of previous conclusions on the basis of newly available evidence.

However, some of the mentioned “problems” with the dating evidence singled out by Perić and Nikolić are of minor importance compared to the main issue they take with those authors who have previously used radiocarbon dates to clarify stratigraphic and chronological problems of Lepenski Vir. In fact, Perić and Nikolić do not reject the reality of the dating evidence but rather the argued association of the dated material with the features these measurements are supposed to date. This is linked to the main claim they make that trapezoidal buildings are much older than the datable material culture associated with them. Hence, according to these authors, most of the existing dates are linked to intrusions made by Early Neolithic Starčevo
occupants of the site who brought various datable materials—charcoal and animal and human bones—in association with the floors of trapezoidal buildings which, as they argue, predate 7500 cal BC.

According to Perić and Nikolić, none of the articulated AMS-dated inhumations that cut through the floors of trapezoidal buildings or are placed over these floors should be linked to these buildings. It would take a separate article (or a book) to enlist all of the instances and provide a thorough refutation of this claim. For the moment, it suffices to say that such a blanket approach is unhelpful. The deposition of crouched inhumations in burials 8 and 9 in building 24, burial 4 in building 25/XIX, burials 5 and 6 in building 26, and 19 in building 57/XLIV are all instances of Neolithic phase III disposals of skeletal remains in the spaces of trapezoidal structures that were out of use and probably backfilled at the time when these interments took place, after ca. 5900 cal BC\textsuperscript{54}. On the other hand, the deposition of extended inhumations in burials 7/I in building 21\textsuperscript{55}, individuals 54a-d in building 65/XXXV, burial 26 in building 34, burial 47 in building 62, and burial 61 in building 40 can undoubtedly be linked to

\textsuperscript{54} Borić 2016, chapter 5.

\textsuperscript{55} If burial 7/I were indeed a Neolithic intrusion, how could one possibly explain the presence of an ornamented stone boulder, typical of the forager tradition that was undeniably linked to the architecture of trapezoidal buildings, on the forehead of this individual at the floor level (Borić 2016, Fig. 4.3A)? One of the explanations, if only slightly eccentric, could be that it was a reuse of a much older sculpted/ornamented boulder accidentally found at the site by Early Neolithic settlers and subsequently placed here at the time of the burial. A more parsimonious explanation, however, is that the burial context and the context of the architecture of trapezoidal buildings and associated material culture, such as sandstone boulders, are directly linked. The same logic applies to the sculpted boulder found on the floor of building 40, directly above the head of the individual in burial 61 (see below on this context and the genomic ancestry of this individual).
the duration or the end of the phase with trapezoidal buildings. One of the ways Perić and Nikolić explain that their Early Neolithic phase of occupation exhibits both crouched and extended inhumations is by arguing that both burial positions were used by Early Neolithic Starčevo groups. Needless to say, this does not square with the existing evidence from this and wider regional contexts, and I will come back to the question of burial positions and expression of identity through mortuary rites in the final section of this article.

One particular group of articulated burials, which show a distinct pattern of deposition in relation to trapezoidal buildings, are almost entirely omitted from Perić and Nikolić’s account. This is the group of 39 neonate burials found in association with 18 trapezoidal buildings at the site. It has been shown that neonate burials were almost always placed in the back of trapezoidal structures at the edge of the floor area, under rocks surrounding the floor and also by cutting through the floor. In one instance, a small burial pit cut through the floor of building 63’, which was covered by the limestone floor of the younger structure 63, contained articulated neonate skeletal remains covered by a stone slab at the level of the floor. It would be hard to argue that these are accidental intrusions as Perić and Nikolić suggest for other burials associated with the floors of trapezoidal structures where, according to these authors, no “respect” was shown to the integrity of these structures by interring burials. Surely, neonate burials represent a coherent phenomenon with these burial events taking place broadly contemporaneously with the occupation/ recognition of the trapezoidal buildings. Conveniently for their argument, Perić and Nikolić omit the mention of the AMS date on one of these neonates, burial 94, found in the back area of building 24 along with three other neonates found in the same area (see below). This neonate individual exhibits a nursing signal on the basis of its very high δ¹⁵N value (19.5‰). After correction for the reservoir effect, OxA-16010 dates this individual to the very end of the seventh and the first century of the sixth millennium cal BC, which falls into the expected short span of phase I–II related to the use of trapezoidal buildings (Table 1).

**Best practice, taphonomic issues, and AMS-dated animal bones**

Currently, the best practice when selecting samples for radiocarbon dating prescribes choosing samples from articulated skeletal remains, human or animal alike, as these are the best indications of freshly deposited corpses/carcasses that have not been moved from the original place of their deposition. By dating such articulated remains we can be reassured that the obtained date on such remains will have a close association with the layer in which the remains were found. For this reason, dates on articulated inhumation burials are the best type of dating evidence from Lepenski Vir. In a

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60. Differently, when trying to date human activity in a cave environment, which might have been intermittently shared between humans and (predatory) animals in the accumulation of bone remains, especially in the case of early (Palaeolithic) periods and due to a lower chronological resolution associated with such periods, cutmarked or anthropically modified bones are often the material of choice. Obtaining direct dates on particular species of plants and animals that might have been introduced to an environment or region by humans, as in the case of domesticates, can also be useful for estimating the timing of their arrival to a particular site. Depending on research questions and interests, typologically sensitive artefacts can also be good material for dating.
limited sample of animal bones associated with various features of the site, there are only few positively identified articulated remains. One such example comes from AMS-dated articulated remains of a brown bear dated by OxA-24812. The remains were found beneath building 31 and have given the Middle Mesolithic, mid-eighth-millennium cal BC date for the occupation linked to the Proto-Lepenski Vir phase (see below, Table 1). Only by dating articulates is one able to avoid problems that arise from using single elements of unmodified animal bones that can potentially be residual or intrusive and, thus, have no active association with the contexts they are supposed to date.

Out of 47 AMS-dated animal remains, there are only three dates that do not correspond to the stratigraphic dating of the contexts in which they were found, representing much older, Early Mesolithic residual material from the disturbed remains of the Proto-Lepenski Vir phase that ended up in stratigraphically later contexts. In two instances, the residual dated materials come from the layer between two overlapping floors: OxA-16004 found between the floors of superposed buildings 47 and 47' and OxA-16071 found between the floors of superposed buildings 26 and 26'. In the third case, the dated material (OxA-16076) reportedly comes from the floor of building 54. The most parsimonious explanation for the instances of dates relating to the overlapping floors could be that the area on top of the floor of an earlier building was levelled before the new structure was constructed and that the sediments used for such levelling contained materials from an earlier occupation of the site. The Field Journal from the lifting of the floors of different trapezoidal buildings in 1970 mentions cultural deposits between 20 and 50 cm in thickness between such superposed building floors (see below). On the other hand, in the

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case of the dated antler fragment reportedly found on the floor of building 54, one explanation could be that it might have come from the area just outside of the building space and floor, i.e. it might have been included with the building floor contents due to overcutting during the excavation of this structure that reached into deposits containing materials from an earlier Mesolithic occupation of the site. Moreover, one dated wild boar tool (OxA-26547) was found beneath the floor of building 54 and falls in the expected date range 6393–6116 cal BC (95% confidence). As building 54 is one of the largest and best preserved structures at Lepenski Vir, and had no visible intrusions on its limestone floor (Fig. 3, 4), the obtained measurement on this artefact found beneath its floor should be taken as an acceptable and reliable terminus post quem for the construction of this building.

No matter how inconvenient the three previously mentioned outliers might be for the overall chronological picture of Lepenski Vir, statistically they are insignificant in the larger pattern achieved by dating different materials that represent the deposition of food and material culture residues on the floors of trapezoidal structures. Perić and Nikolić63, in their criticism of the relevance of AMS dates made on animal bones from Lepenski Vir, echo the criticism raised by Bonsall et al.64 who rightly pointed out various taphonomic issues when dating disarticulated animal bones, even when these come from the contexts beneath trapezoidal building floors and, thus, could serve as termini post quos for these building structures. Bonsall et al.65 argue that in cases where documentary evidence cannot show the exact position of dated animal bone finds beneath limestone floors, we cannot be sure that various intrusions and damaged areas of building floors did not introduce through bioturbation younger materials to these subfloor contexts. In theory this is all true. However, I find such criticism in this research context completely decontextualized. At Lepenski Vir, we felt lucky when we discovered in the late 1990s that a rather small portion of the original animal bone assemblage and other organic materials had survived and had been available for dating. We also could not expect from the rescue nature of excavations carried out here in the late 1960s to have provided the type of detailed contextual information that would be required by modern standards of excavation and recording. Hence, the obtained AMS dates on animal bones, now including typologically sensitive artefacts66, while not carrying the same weight in building an accurate chronological framework as the remains of articulates, still represent an important and, by their sheer number, robust indication of the stratigraphic integrity of the dated contexts. Even more importantly, they are entirely comparable to the dates on articulated inhumations.

In what follows, my intention will be to show that even leaving aside AMS-dated animal bones, it is possible to refute Perić and Nikolić’s views on the chronology and stratigraphy of Lepenski Vir by providing contextual details of only three key AMS-dated contexts associated with trapezoidal buildings that furnish irrefutable evidence that the construction and abandonment of all of these structures can be dated to the period ca. 6150 to 5950 cal BC, i.e. at the time of the Mesolithic-Neolithic transition in this area67. I am aware that only incontrovertible dating evidence that completely excludes even a remote chance of dating intrusive or residual samples will be able to clear any remaining doubts, if these still exist, as to the chronological position of trapezoidal buildings.

The date for one of the contexts to be discussed was already available at the time when Perić and Nikolić68 wrote their book, and it was discussed by these authors in a problematic and factually erroneous way. Two other AMS measurements and the contexts they are dating have recently been obtained, in 2017. One should mention that since the publication of Perić and Nikolić’s volume, there have appeared an additional 23 measurements from Lepenski Vir in total (including new charcoal dates and new dates on osseous artefacts and human remains), with all of the measurements only further strengthening the pattern already reported more than ten years ago by Borić and Dimitrijević69.

Articulated inhumation burial 100 (OxA-34519)

According to Field Journal entries from the 1970 season of excavations at Lepenski Vir, human remains marked as burial 100 were found on September 15th, 1970, beneath the floor of building 24 in the course of the lifting of trapezoidal building floors. The articulated burial remains were found under the back part of the

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63 Perić, Nikolić 2016, 103.
64 Bonsall et al. 2008, 191.
66 Borić et al. 2018.
67 Borić et al. 2018 and references therein.
68 Perić, Nikolić 2016, 102.
building floor, in the natural (i.e. archaeologically sterile deposits) next to two stone slabs inserted into the natural. These stone slabs were assumed to have belonged to building 24. Two neonate burials, marked as 101 and 102, were found nearby, towards the back of the building. Burial 100 is a partially preserved inhumation with in situ articulated lower limbs placed parallel to each other as clearly visible both on the detail plan of this context and on the existing photograph (Fig. 5). To the excavators this suggested that the burial was laying in an extended supine position, so that it must have been oriented with the head to the south. This burial orientation would correspond with the Late Mesolithic burial norm of placing bodies of the deceased parallel with the Danube, head pointing downstream⁷⁰.

The skeletal remains comprised fragmented femurs, tibiae, patellae, several foot bones, metacarpal bones, and a phalanx. The preserved epiphyses of the tibiae are unfused, and the estimated age is around eight years. The presence of labile articulations, such as patellae and metacarpals and unfused epiphyses, are strong indications of a primary burial, i.e. remains that were deposited in this place without subsequent disturbances or movements of the preserved part of the skeleton⁷¹.

Before obtaining a direct AMS date on the remains of this individual in 2017, in my analysis of the patterns of burial evidence from Lepenski Vir, I have tentatively dated these skeletal remains to the Proto-Lepenski Vir phase, i.e. to the occupation of the site in the course of the Early/Middle Mesolithic⁷². The reason

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⁷⁰ E.g. Bonsall 2008; Borić 2016; Radovanović 1996.
⁷² Borić 2016, 86, 523.
⁷⁴ Borić 2016, Fig. 3.1.
⁷⁵ Borić 2016, 103.
for such a relative dating stemmed from following the general stratigraphic assumption proposed for Lepenski Vir, and aided by a number of AMS-dated contexts, that features found beneath many of the trapezoidal building floors likely represent the remnants of an earlier Mesolithic occupation of the site. Yet, in the discussion of the orientation of this burial, as well as another partially articulated primary burial, 104, found beneath the floor of building 43, which also had the same orientation as burial 100, I raised the doubt that "the difference between the orientation of these and other individuals more securely dated to the Proto-Lepenski Vir phase partly challenges the chronological attribution of burials 100 and 104". In addition, δ13S values for these two burials, different from other burials analysed for δ13S attributed to the Proto-Lepenski Vir phase, suggested a high intake of aquatic foods, which was yet another signal that the two burials are

Fig. 7. A) Building 40 with mandible burial 21 (OxA-34968) next to the hearth and subfloor primary inhumation burial 61 (OxA-25211). Adapted from detail plans 49 (07/08/1967) and 164 (12/08/1968); B) Building 40 with boulder sculpted with a human face (inv. no. 21) placed above the head of burial 61 at the floor level, facing west; C) Close-up of mandible burial 21 in its in situ position next to the hearth of building 40. (after Borić 2016: Fig. 4.22)
outliers to the Proto-Lepenski Vir phase, “leaving the possibility open that these disturbed remains of primary burials should be assigned to phase I–II. This dilemma can only be resolved by direct AMS dating of the skeletal remains”\(^{76}\).

Direct AMS dating of the remains of the individual in burial 100 confirmed this suspicion, with OxA-34519 dating these remains after the applied correction for the aquatic reservoir effect to the range 6362–6052 cal BC at 95% confidence (Table 1; see later about the Bayesian modelling of the radiocarbon dates from Lepenski Vir and the further restriction of the probability estimates of this time range). Fig. 6 provides a good close-up of the floor of building 24 taken by Alan McPherron during his visit to the site in 1968. The circled area on the floor shows the zone under which the remains of burial 100 were found, suggesting an intact floor area covering these burial remains. This evidence should by all means be acceptable for ruling out any possibility for the insertion of chronologically younger burial remains into older trapezoidal building structures, as argued by Perić and Nikolić. Thus, the obtained AMS date on burial 100, in unison with the AMS date obtained on the remains of the articulated primary neonate inhumation burial 94 found in the same building, can serve as a secure terminus post quem for the construction of the floor of building 24, sometime in the last two centuries of the seventh millennium cal BC.

**Mandible burial 21 (OxA-34968)**

One of the unique burials at Lepenski Vir, singled out by Srejović\(^ {77}\) in his chapter with the evocative title “Hearth Guardians”, is a disarticulated mandible marked as burial 21. This mandible was inserted with the occlusal surface of the teeth facing down into the floor of building 40 at the back, on the narrow side of the central hearth of this building (Fig. 7). Between the mandibular rami, a small, regular stone plaque was vertically inserted so that the mandible and the plaque resemble the typical ∀-shaped “supports” encircling rectangular stone hearths, characteristic of the majority of building structures at Lepenski Vir\(^ {78}\). On the inferior side of the mandibular rami, the one that was facing up in the context in which it was found, there is a small trace of scorching by fire, presumably derived from the fire of the hearth during the time it was in use, i.e. during the use of the building structure. The mandible belonged to a possible male individual, around 30–35 years old (Fig. 8)\(^ {79}\).

The sample selected for dating comes from the right condylar process. OxA-34968 dates this individual, after age-offset correction, to the range 6050–5880 cal BC, with 95% confidence (Table 1). This is a unique context and sample for dating the actual architectural elements of trapezoidal buildings due to the fact that the datable material was very literally used in the construction of the hearth, as its integral constructive element, forming a recognisable form also found in other trapezoidal buildings at Lepenski Vir. This date alone should be able to remove any doubts as to the actual chronological place of trapezoidal buildings at Lepenski Vir.

In this context, one should also mention the AMS-dated remains of a 2-6-year-old child in burial 61 found beneath the floor of this same building, towards its back part. This primary extended inhumation was directly AMS-dated by OxA-25211 with the obtained range of 6223–5916 cal BC (95% confidence) (Table 1). While Perić and Nikolić\(^ {80}\) suggest that those who buried this individual did not have any knowledge of

\(^{76}\) Borić 2016, 113.

\(^{77}\) Srejović 1972.

\(^{78}\) E.g. Radovanović 1996; Srejović 1972.

\(^{79}\) Borić 2016, 206, Fig. 4.45.

\(^{80}\) Perić, Nikolić 2016, 102.

\(^{81}\) Srejović 1972, 117.

\(^{82}\) Borić 2016, 159, Fig. 4.22.
the existence of trapezoidal building structures, the excavator of the site, Srejović, suggests that this burial was interred before the construction of the floor of the building. Existing field notes, detail plans and photographs of this context do not mention or show any burial cut visible at the floor level (Fig. 7B). Moreover, a sculpted boulder with the depiction of a human face was found immediately above the head of the deceased at the floor level. It seems unlikely that a burial cut through the building floor was not recognised in this case and it is more likely that the burial was placed here before the floor was constructed or, alternatively, a burial pit cut through the floor might have been re-plastered. The presence of the sculpted boulder here can hardly be coincidental and shows that there is a meaningful link between the burial and the boulder, suggesting that the deceased was within living memory of those who constructed and utilised this building structure, and carved sandstone boulders. Thus, the obtained date on this burial can be used as a *terminus post quem* for the construction of the floor of building 40. Moreover, the obtained ages for this burial and the dated mandible marked as burial 21 are consistent with their respective stratigraphic position within this building context.

**Skull burial 122 (OxA-16005, OxA-16006)**

Skull burial 122 was found between two overlapping limestone floors, i.e. beneath the floor of the later building 47 and 20 cm above the hearth of an older building in this location — marked as 47'. Building 47’ was smaller than the later building 47, and there is a slight displacement of the location of the hearth of the two buildings, which nevertheless had the same orientations.

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Fig. 9. A) Buildings 47 and 47’ and subfloor burials 122 (OxA-16005, OxA-16006), 123, and 124. Adapted from detail plan 271 (27/10/1970).
B) Floor of building 47’ with burials 122–123, facing southeast; C) Close-up of burial 122 (after Borić 2016: Fig. 4.35)

Сл. 9. A) грађевине 47 и 47’ – остаци индивида у гробовима 122 (OxA-16005, OxA-16006), 123 и 124 јеронађени их од јела јерђевине – прилагођен је детаљ 271 (27. 10. 1970); B) јела јерђевине 47’ са остацима индивида у гробовима 122–123, гледајући ка југоистоку; C) детаљ гроба 122 (према: Borić 2016, Fig. 4.35)
(Fig. 9). The Field Journal entry for October 27th, 1970, when this context was excavated, notes that the cultural layer between the two structures was 40 cm thick. In the back area of building 47', which also corresponds to the back area of building 47, two neonate burials, marked as burials 123 and 124, were found. Similar to the skull marked as burial 122, burial 123 was found on a layer around 20 cm thick above the level of the floor of building 47'. Hence, it is likely that these two neonates were deposited here from the level of the floor of building 47. On the other hand, considering the fact that no burial pit was visible on the floor level of building 47 for the interment of the disarticulated skull (Fig. 3), burial 122, one could assume that it was deposited before the floor of building 47 was constructed. One of the possible ways to explain this situation is to argue that the space of building 47' might have been abandoned and partially backfilled in the course of the use of the site during phase I–II. This then might have been followed by the deposition of the skull into the backfilled area, followed immediately, or with some delay, by the construction of a new structure, i.e. the floor of building 47. Alternatively, the skull was deliberately placed into the layer that was deposited here immediately prior to the plastering of the new building floor. Yet another possibility is that a cut through the floor to deposit this skull might have been replastered, leaving it imperceptible to the excavators. One should also note that, based on the field photographs (Fig. 3) and detail plan of the floor of building 47 (Fig. 9), it was one of the best preserved structures with no observable intrusions from above. The skull belonged to a subadult (15–18-year-old), possibly a female individual (Fig. 10). There are visible traces of slicing and scraping from the likely secondary mortuary treatment of this skull. It might have been kept for an unknown period of time before being placed in its secondary burial location.

Consistent duplicate AMS measurements, OxA-16005 and OxA-16006, date this individual in the range 6102–5996 cal BC, at 95% confidence (Table 1). Based on the previously described stratigraphic information and contextual data, it is highly likely that this date can be used as a terminus post quem for the construction of the floor of building 47, which is consistent with the time span for all other discussed building structures. Perić and Nikolić, who discussed this dated context, claim that the skull must have been buried through the floor of building 47, mentioning a damaged part of the floor covered by a stone slab, thus hinting at a later intrusion. The documentary evidence from Lepenski Vir does not show any such stone slab above this skull in burial 122 (Fig. 9A). Perić and Nikolić also comment that it is “totally unlikely” that the skull would have remained preserved upon the construction of the floor of building 47. However, if the skull was already firmly encased within the layer covering the floor of building 47' at the time the floor of building 47 was constructed, there is no reason that it would have had suffered any particular damage.

In the context of building 47, there is also a conventional charcoal date measured in the Institute of Geophysics and Planetary Physics University of California (UCLA-) radiocarbon lab on the material collected from a well-preserved burnt rafter. According to the Field Journal of October 14th, 1967, along the longer, right-hand (north-western) side of the building floor, a metre long rafter was found, 10 cm wide and 6–8 cm thick, which might have been made from oak. The excavators assumed that the position the rafter was found...
in indicates its original horizontal placement. We could speculate that these remains represented one of the horizontal beams holding the upper building construction of this trapezoidal structure that fell to the floor upon the destruction of the building by fire. During Marija Gimbutas’s visit to the site, on October 20th, 1967, the remains of this rafter were lifted and a sample for dating was given to Gimbutas. This sample provided the UCLA date. Relative to the date obtained on the skull of the individual in burial 122, this charcoal date (UCLA-1407, Table 1) is somewhat younger, calibrated in the range 5983–5736 cal BC, at 95% confidence, which corresponds to its stratigraphic position, and can tentatively be seen as an acceptable date for the use/destruction of building structure 47 (see Table 1).

Field Journal notes from the excavation of this building structure also mention that on October 14th, 1967, ceramic fragments were found on a slightly depressed area of the floor between the hearth of this building and a stone slab towards the narrower side, while on October 20th, 1967, in the narrow, back part of the building floor, fragments of a fine oval bowl fired in red were uncovered.

In summary, it is very unlikely that the construction of trapezoidal buildings as an intense period of activity at the site would not be associated with the majority of the obtained radiocarbon dates found in various associations with these architectural units.

*Bayesian probabilistic modelling*

In the preceding discussion, when presenting dating evidence from Lepenski Vir, I used only individually calibrated dates expressed as ranges at 95% confidence that were calibrated using OxCal v. 4.3.285. The purpose of this was to show that even when using such "raw" dating information it is clear to what broadly defined periods of the occupation of this site should we attribute certain AMS-dated features, and particularly building structures with trapezoidal floors. Yet, over the past decade or so, archaeologists have increasingly started using formal modelling of raw radiocarbon data within the Bayesian statistical framework86. The modern standard and best practice when using radiocarbon evidence today is not to use the so-called “eyeballing” of the ranges of individually calibrated dates, which leaves us with relatively imprecise dating or even significantly wrong estimates of events about which we are keen to have precise information. It is, thus, unwise to underutilise the potential of the radiocarbon probability ranges.

Bayesian methods rely on the incorporation of prior information or “beliefs” for obtaining the highest statistical probability and can be described as qualitative statistics that are heavily dependent on what prior information/beliefs are. Any change in the prior beliefs of a model can change the obtained posterior density estimates. While, theoretically, probabilities could also be calculated with pen and paper, computing capacities of modern-day computers have facilitated the widespread application of this method. Markov Chain Monte Carlo methods—a simulation-based approach to deriving the solution to Bayesian problems—have been behind the recent boom in applications through their incorporation into programs such as OxCal and WinBUGS.

When it comes to the archaeological applications of Bayesian modelling for building reliable chronological frameworks from radiocarbon dates, information incorporated into our models primarily rely on the existing stratigraphic evidence of relationships between dated contexts recovered at a site. Such prior beliefs about what sample predates another based on reasonably secure stratigraphic inferences and information about the phasing of archaeological features within a stratigraphic Harris matrix are incorporated into chronological models and, when computed, significantly reduce the spread of probabilities, shortening the obtained radiocarbon ranges, i.e. providing more accurate estimates of the probability densities. This approach has allowed us to start constructing high-resolution chronologies that reduce estimates for events/durations-periods to less than a century for remote prehistoric periods, going as close as possible to the generational time scales of half a century, and even aiming at subgenerational precision87.

Recently, we have used the large dataset of Mesolithic-Neolithic radiocarbon dates from Lepenski Vir along with the existing prior stratigraphic information to provide more accurate estimates for the construction and abandonment of certain architectural features,

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86 E.g. Buck et al. 1996; Bayliss 2009; Bayliss et al. 2007; Bronk Ramsey 1998, 2009; Hamilton, Krus 2018; Whittle 2018; see also Weninger et al. 2015.
87 For a series of recent dedicated applications of Bayesian modelling of radiocarbon dates to European Neolithic case studies see Whittle 2018 and references therein. For a criticism of the claims that the Bayesian radiocarbon dates modelling can provide subgenerational precision see Weninger et al. 2015.
Fig. 11. Bayesian modelling of all available dates from Lepenski Vir based on Model 1 (n=108) plotted against the North Greenland (NGRIP) δ^{18}O_{ice} record and event stratigraphy. For the radiocarbon measurements, distributions in outline are the results of simple radiocarbon calibrations, solid distributions are the output from the chronological model. The large square brackets and OxCal v. 4.3.2 CQL2 keywords define the overall model exactly. Blue: human bone; magenta: animal bone; green: charcoal (figure prepared by Dušan Borić)
deposition of datable materials and duration of certain phases. The proposed stratigraphic model suggested three main phases in the Mesolithic-Neolithic occupation of the site, slightly modified from the original Šre­jović’s labels for the phases: Proto-Lepenski Vir (Early and Middle Mesolithic), Lepenski Vir I–II (Mesolithic-Neolithic transition period primarily associated with trapezoidal buildings), and Lepenski Vir III (Early Neolithic). As previously mentioned, curiously, none of the existing radiocarbon measurements suggests occupation of the site in the course of the Late Mesolithic, which is found at all other sites with overlapping stratigraphic sequences to the one found at Lepenski Vir. Various discussions of this stratigraphic model and features linked to various phases of occupation have already been provided elsewhere.

In order to check whether the obtained modelling results are dependent on the type of material that was being dated, we have provided Bayesian models that utilise all available dates (model 1, Fig. 11), only AMS dates on human and animal bones (model 2), and only dates on articulated remains of humans and animals (model 3). As expected, model 1 provides the poorest fit due to the inclusion of relatively imprecise and possibly problematic conventional early charcoal dates while model 3 provides the best fit once all possibly problematic and residual/intrusive samples are excluded. However, there is a remarkable similarity between the models in the obtained estimates of each of the main phases.

The most interesting finding of the application of the Bayesian modelling on radiocarbon evidence from Lepenski Vir relates to the obtained formal estimates for phase I–II, which was surprisingly short, starting, according to model 1, in 5610–6080 cal BC (95% probability), probably in 6140–6100 cal BC (68% probability) and ending in 5980–5940 cal BC (95% probability), probably in 5980–5930 cal BC (68% probability). The duration of the phase is estimated between 120 and 210 years (95% probability), probably between 140 and 190 years (95% probability). The modelling also shows that there was no break in the occupation of the site between phases I–II and III, with the start of the latter estimated in 5970–5910 cal BC (95% probability), probably in 5960–5930 cal BC (68% probability). When these precise chronological estimates are compared to the climatic data from the North Greenland (NGRIP) δ18O ice record and event stratigraphy (Fig. 11), there is a significant correspondence between the estimated start date of phase I–II, i.e. resettling of Lepenski Vir after more than a millennium, and the end of the so-called 8.2 ka cal BP cooling event of climatic deterioration that lasted from around 6300 to 6100 cal BC.

After having reviewed the latest results on the absolute dating of Lepenski Vir—its occupation phases and individual features—I now turn to several aspects of the revised understanding of the stratigraphy of Lepenski Vir that underline the stratigraphic scheme used in modelling radiocarbon data. This will also serve to answer various issues raised in the recent criticism of this revised stratigraphic model.

**Stratigraphy of Lepenski Vir**

**Formation processes and topographic gradient**

Lepenski Vir was formed on a terrace remnant of the meandering Danube River, at its floodplain edge. These “promontories on the valley floor, composed of riverine sand, wind-blown loessic silt and/or scree off the adjacent steep slopes, [were] often re-cut and re-carved by channel avulsion processes. It was on [one of] these ‘tongues’ of land projecting at near right angles to the adjacent valley slopes” that Lepenski Vir was established on finely laminated riverine sands. These “terrace remnants” were likely above the immediate influence of the river and also might not have been covered by woodland that developed across the Danube.

88 Borić et al. 2018.
89 While the underlying scheme remains the same, some of the labels for periods in question are slightly altered from the article in which this chrono-stratigraphic model was introduced for the first time (Borić, Dimitrijević 2007/2009). In that article, phase I–II was labelled “Transformational/Early Neolithic”, in order to underline the Early Neolithic historical context for this phase during which the earliest Neolithic settlements were established across the Balkans at the end of the seventh millennium cal BC. Subsequently, phase III was labelled “Middle Neolithic” in order to emphasise the presence of well-established early Neolithic groups in the Balkans, making this period also comparable to the contemporaneous duration of the Middle Neolithic in the southern Balkans/Greece. While this logic still makes some sense to me, for practical reasons, more recently, I came to think that the labels used herein for these two phases at Lepenski Vir are more adequate as their usage is more widespread and this makes them self-explanatory.
91 For more details on the Outlier detection methods used in our Bayesian modelling, see Borić et al. 2018.
92 For a further discussion of this correlation see Borić et al. 2018 and references therein.
93 Borić et al. 2008, 262.
94 See also Banu 1972; Grubić 1972; Marković-Marjanović 1978; Rabrenović, Vasić 1997; Stevanović 1997.
Gorge’s hills from the onset of the Holocene. The sequence at Lepenski Vir was developed on vertically faulted to blocky dark red limestones. Above the bedrock, the profile was, in places, over 4 m thick (based on the thickness shown on some of the sections from the excavations of the site) and is composed of a pale whitish/yellowish brown calcitic silt and very fine sand, probably a loessic-like deposit. Micromorphological analyses of the section preserved today at the river’s edge at the place where the Lepenski Vir settlement once stood, suggest that this is a colluvial sequence, where multiple episodes of hillwash were intermittent with anthropogenic activities.

These general remarks about the nature of this colluvial sequence must be a starting point for a reevaluation of the stratigraphy of Lepenski Vir, along with an acknowledgement of the fact that the site is situated on a sloping topographic gradient, which is affected by processes of downslope erosion that directly impacted on the accumulation of material culture across this river terrace at different times. Yet, despite this situation, the way Lepenski Vir was excavated and the way the stratigraphy of the site was understood depended heavily on envisaging uniform depositions of “cultural horizons” across the whole area of the site rather than trying to document discrete episodes of cuttings and re-cuttings, depositions, and removals, as in the modern-day excavation of single contextual/stratigraphic units. This, by now, outdated type of excavation practice relied on representative stratigraphic sections as the key to understanding the successive change of one culture by another over time. This stands in contrast to the widespread and dominant modern-day methodologies of single-context recording that reflect our primary interests in action and behaviour.

The logic of excavating by supposed culture horizons and cuttings, i.e. spits, across the sloping topographic gradient of Lepenski Vir missed the opportunity for the stratigraphic excavation of various pits and semi-subterranean structures, including trapezoidal buildings. Here, I could wholeheartedly agree with Perić and Nikolić that “[t]he excavation by arbitrary horizontal excavation layers in the terrain where the difference in height between the surface points may have exceeded 1 metre, had an especially negative impact on the possibility of recognizing and differentiating the cultural contents of the horizontal excavation layers and their beddings, which led to obvious mixing up of materials from different stratigraphic units.” Yet, I would add that not all is lost, and I have shown that there is no need for despair in attempting to productively use the Lepenski Vir archive.

Since 1999, I have argued that the fact that trapezoidal building structures were dugouts, i.e. semi-subterranean structures dug into the sloping terrace with their back parts inserted into the slope up to 1.5 m in certain places, must be taken into account when re-

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96 French forthcoming.
97 Lucas 2001, 18–63.
98 Perić, Nikolić 2016, 131.
99 Borić 2016.
100 Cf. Srejović 1972, 36.
interpreting the stratigraphic understanding of this site and the nature of depositional processes\textsuperscript{101}. My other reason for insisting on this aspect of semi-souterranean building structures was to show that the layout of the settlement as visible on numerous photos from excavations of Lepenski Vir is misleading in showing these structures placed on flat terraces.

The best evidence we currently have for a topographically based three-dimensional post-excavation reconstruction of the site layout is in the recorded stratigraphic sections running along different lines of the $x$ and $y$ axes of the excavation grid (Fig. 2) that cross-section cuts of several trapezoidal building structures closer to the narrow, more deeply dug-in parts of buildings. Particularly useful and representative in this respect has been the section along line $b$ through the cut for building 27 in its back part (Fig. 13). It is also the only section that Srejović\textsuperscript{102} published in his main publication on Lepenski Vir. Borić and Dimitrijević\textsuperscript{103} have compared Srejović’s published section above building 27 to a sketch of the same section found in the Lepenski Vir archive in order to confirm the following: (a) the semi-souterranean space of trapezoidal buildings was cut into the natural/paleosol\textsuperscript{104} and the layer that fills these cuts belongs to the phase we defined as phase I–II, combining phases that Srejović associated with trapezoidal building structures; (b) neither of the two sections has Lepenski Vir phase II shown, suggesting that its separation is problematic; and (c) that ceramic layers marked either as ceramic layers 1 and 2 (on the field sketch of the section) or IIIa (younger and older) and IIIb (younger and older) (in the final publication) are distinct from the layer that can be associated with the occupation, abandonment, and back-filling of trapezoidal structure dugouts.\textsuperscript{105} All this went to show that the main postulates of our revised stratigraphic model for Lepenski Vir were further supported by radiocarbon dates.

Perić and Nikolić\textsuperscript{106} have offered their view of the stratigraphy of Lepenski Vir by providing a detailed analysis of the available documentation for the 1965–1966 excavation seasons only, while sporadically also using the Lepenski Vir archive for the excavations that took place during later excavation seasons. For obvious limitations of space, a detailed discussion of various aspects of the stratigraphic data presented by Perić and Nikolić will not be attempted here. It suffices to say that Perić and Nikolić take great pains in discussing various existing section drawings and photographs in order to argue the main tenet of their stratigraphic

\begin{thebibliography}{99}
\bibitem{srejovic1972} Srejović 1972.
\bibitem{peric-nikolic2016} Perić and Nikolić (2016, 41–42, 122–123) spend a lot of time in their discussion trying to disentangle what the excavators of Lepenski Vir meant by the Serbian term “prahumus”, marked on some of the sections. “Prahumus” can roughly be translated as “primary humus” rather than “pre-humus” as suggested by Perić and Nikolić. It suffices here to say that the designation when used in the documentation of Lepenski Vir was not based on any good understanding of pedological processes but was, in the course of the 1960s, 1970s, and 1980s, among some Yugoslav archaeologists, rather heuristically and indistinguishably used in order to indicate a vaguely defined palaeosurface. In the book that sums up methodological approaches of the time, Tasić and Jovanović (1979, 53) use a related or even equivalent term “prvobitni humus”, which is literally translated as “primary humus”). In certain sections from Lepenski Vir, a “prahumus” designation is shown above the natural (in Serbian “zdravica”) although in some photographs it seems indistinguishable from the natural. It is sometimes also shown as covering anthropogenic levels, so it is not always clear what the excavators meant by its use. The use of the term “prahumus” in the documentation of Lepenski Vir does not necessarily equal the well-established and widely used term palaeosol, or buried soil, as used in geology and pedology, meaning a formation of a soil horizon in the past that got buried beneath later deposits, thus preserving chemical and physical characteristics different from the present-day climate and vegetation.
\bibitem{peric-nikolic2016b} In their book, Perić and Nikolić (2016, 122–123, Fig. 218) criticise the fact that the archive section we published was adapted rather than identical to the drawing from the archive. The differences they stress in our adaptation of the section from the original are minor and banal. For instance, we changed what was labelled as “prah.”, shortened for “prahumus” (“primary humus”), as shown on the original, since it was obvious from other documentary sources this was part of the infill of the same layer that filled building structures so could not be palaeosol. We also lumped the label of a layer marked as “ker.”, shortened from “keramicki” (ceramic) on a part of the section with the horizon that is on the other part of the section labelled as ceramic layers 1 and 2. As the archive sketch we used was not entirely coherent or completed in the way various shown layers along the section are marked (e.g. certain lines showing layers are not completed at all and run only up to a middle point of a quadrant), a fact also recognised by Perić and Nikolić (2016, 122), we adapted this drawing as closely as possible following the original and modified some of the labels by making a comparison with the section published by Srejović and other sources, such as colour photographs of this section (Fig. 13). Regardless of its incompleteness, this drawing remains an informative indication of the process of thinking on the part of the excavators in defining and recording stratigraphic units of Lepenski Vir. Differently from Perić and Nikolić, in using an excavation archive, I do not believe that the main task is criticising excavators by pointing out various technical errors and inconsistencies in field records, as Perić and Nikolić do throughout their book. I rather believe that we can use these records constructively and contextually. Surely, any archive should also be available to others to cross-check the conclusions reached by a researcher.
\end{thebibliography}
and chronological understanding of Lepenski Vir—that Neolithic pits and intrusions repeatedly brought later Neolithic materials into close association with much (>1000 years) older architectural units.

It should be emphasised that different from the expectations of culture-historical approaches, to which Perić and Nikolić’s book can also be attributed, individual profiles, i.e. section drawings at any site, regardless of how possibly representative they might be of the overall underlying stratigraphy, could never encompass the complete complexity of both geological and anthropogenic formation processes that can best be expressed through a Harris-matrix of contexts recorded during excavations, with the nature of each context/layer checked by micromorphological analyses. Hence, any attempt to arrive at a consistent understanding of different sections from Lepenski Vir by comparing rather amateurish (in geoarchaeological terms) descriptions of layers by various diggers who worked at the site over several years while it was excavated is doomed to fail. They recorded the site’s features based on arbitrarily assigned attributes, such as soil colour/hue and/or consistency, or, worse, based attributions of the stratigraphic units on presumptions about an established cultural stratigraphy of the site. Instead, we could try to reconstruct to the best of our abilities that which is shown in documentary evidence and what makes logical sense.

American archaeologist Alan McPherron, during his visit to Lepenski Vir in the late 1960s, took an excellent colour photograph of the section above building 27 that better than other photographs of the same section from the Lepenski Vir archive shows different layers formed in this particular location that could

Fig. 13. Section drawing 2 (1967): NE–SW along axis y through quad. a, b/I, 0–8 (7.7 m); section drawing 2’: SE–NW parallel with axis x through quad. b/I, 1–4 m (photo: Alan McPherron)

Сл. 13. Цртеж профила 2 (1967): СИ–ЈЗ уз осу у квадрате a, b/I, 0–8 (7.7 m); цртеж профила 2’: ЈИ–СЗ паралелан са осом x кроз квадрате b/I, 1–4 m (фото: Ален Мекферон)
be taken as representative of the site’s stratigraphy but cannot be taken as necessarily equal to all other locations at the site (Fig. 13). The interpretation of this section is further aided by the existence of a detailed section drawing from 1967 (sections 2 and 2') of the right-hand part of the profile above building 27 through quadrant b/l along line b of the x axis of the grid (section 2’). This section is here shown in conjunction with the section that ran along the y axis of the grid, i.e. through quadrants a/l and b/i, cross-sectioning the deposits above the floor of building 27 along its longer axis (section 2), approximately through the middle of the structure (Fig. 13). Here, we can clearly see that the cut was made into the natural deposits of the site consisting of pale whitish/yellowish brown calcitic silt and very fine sand. This natural deposit can similarly be observed on the section remnant of the river terrace at the location of Lepenski Vir today (Fig. 12)\(^\text{110}\). The cut is filled by a rather homogenous deposit of darker buff colour that extends above and outside the zone of the cut and runs horizontally away from both of the cut’s vertical sides as an occupation layer. The deposit shows a sharp boundary to the underlying natural. The drawing indicates that this fill/layer consisted of ashy deposits mixed with charcoal and several zones of red burnt soil as well as concentrations of charcoal, which, based on the shapes they make, might have related to the burning of various elements of the building’s wooden upper construction, which likely burnt in a fire upon the building’s abandonment. I suggest this deposit should be linked to the occupation, abandonment, and backfilling (both anthropogenic and colluvial) of the phase I–II trapezoidal buildings that took place in the course of the two centuries or less as estimated on the basis of the current radiocarbon dataset (see above).

There is a slightly diffuse, undulating boundary between this first anthropogenic fill/layer, as visible on this section, and the layer above it that is of a darker hue (perhaps a deposit richer in organic and/or burnt remains) for which the drawing indicates a significant presence of ceramics, animal bones, and charcoal as visible in the section. This deposit is linked to the fully Neolithic occupation of the site associated with phase III, which might have lasted several centuries. On the basis of the radiocarbon chronology, there is no gap between the end of phase I–II and the start of phase III. There is a diffuse, strongly undulating boundary between this layer and the layer of yellow clayey soil found above it. The latter layer seems to be less rich in cultural material than the preceding deposits, with only occasional fragments of ceramics and charcoal shown on the section drawing. A hypothesis can be put forward that this layer represents a hillwash deposit whose accumulation was caused by erosion of devegetated slopes above Lepenski Vir that, for a period of time during and after the abandonment of the Neolithic occupation, had accumulated these colluvial deposits, until the regenerated vegetational/woodland cover on the hillside above the site, presumably unaffected by human action in the post-Neolithic period, stabilised the downslope erosion. We should probably expect traces of differential colluvial deposition events across the site due to intermittent episodes of overland hillwash processes. Finally, the sequence is capped by the modern-day humus and subhumus layers of brown colour.

A more detailed presentation of further evidence for the proposed scheme regarding formation processes and stratigraphic cultural attribution of particular contexts at Lepenski Vir must be provided elsewhere. In what follows, I will focus on furnishing further evidence for my earlier claim about the existence of retaining walls surrounding the cuts of trapezoidal buildings of phase I–II triggered by Perić and Nikolić’s\(^\text{111}\) rejection of this interpretation.

**Retaining walls and evidence for the upper construction of trapezoidal buildings**

I have previously shown that by overlapping the phase I trapezoidal limestone floors and trapezoid-shaped stone structures that Srejović assigned to phase II, one gets a remarkable correspondence between the two types of features, showing that many trapezoid-shaped stone constructions surrounded the limestone floor outlines, or are closely linked to limestone floors as integral parts of these architectural features\(^\text{112}\). For this reason, this occupation period is renamed as phase I–II, with labels for limestone floors attributed to phase I (Arabic numerals) and labels for stone constructions

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107 French 2015.
108 Cf. Borić 2016, Fig. 1.14.
109 A separation of a "prahumus", i.e. palaeosol layer (see footnote 104) above the natural as shown on the section published by Srejović (1972, Fig. 6) is not justified here and neither is such a layer shown on this detailed drawing of this section from 1967 (section 2’, plan no. 277).
110 Borić 2016, Fig. 1.5.
111 Perić, Nikolić 2016, 135.
Fig. 14. A) Outlines of the fills of buildings 32 and 24 (phase I–II) above the floor level dug into the natural of the Lepenski Vir terrace at the level of spit 7 in quad. b/IV–V and at the level of spit 8 in quad. b/II–III with the position of burials 8 (AA-58319, OxA-25207), 9 (OxA-25280), and 10 (all phase III) in the fill or over the floor of building 24 (phase I–II) at the level of spit 7 (adapted from detail plans 21–22 [25/07/1967] and 29 [29/07/1967]); B) Section along line b with exposed floors of buildings 27, 20, and 32; C) section along line b above building 32 (after Borić 2016: Fig. 5.5, 1.13)
attributed to phase II (Roman numerals) joined into a single architectural unit designation (e.g. building 65/XXXV)\textsuperscript{113}. It is suggested that these stone constructions were retaining walls around the cuts of trapezoidal buildings, which, similar to the so-called wind breaks, are a common occurrence in archaeological and ethnographic cases, in particular related to forager dwelling structures worldwide\textsuperscript{114}. As Perić and Nikolić have called this revision of the stratigraphy of Lepenski Vir into question, I would like to provide several examples of existing evidence for the reality of stone retaining walls around the cuts of trapezoidal structures. This is particularly true of the upslope area of the site where the terrain is steeper, but there is some evidence that such retaining walls can also be found in the lower parts of the site, closer to the Danube, on presumably flatter terrain\textsuperscript{115}.

In their critique of the existence of retaining stone walls in association with the cuts of trapezoidal buildings at Lepenski Vir, Perić and Nikolić\textsuperscript{116} use the previously discussed section above building 27 and the continuation of the section along the same axis of the grid onto adjacent building 32 (Fig. 14B-C) to claim that such walls would have been visible here had they existed. Yet, the Field Journal of July 27\textsuperscript{th}, 1967, describing the excavation of building 27, states that while the floor of this structure was found in spit 8, rocks indicating the outline of the structure were visible since spit 5.\textsuperscript{117} These rocks were drawn (detail plan 30) and subsequently lifted. The excavators also note that “along the edge of the house stone constructions were preserved, possibly for holding the upper construction”.\textsuperscript{118}

Similarly, for the adjacent structure, building 32, the Field Journal states that six vertically inserted slabs were found along the edge of the floor. In addition, in connection to building 32 and the adjacent trapezoidal structure, building 24, a detail plan of the two buildings at the level of spits 7 and 8, represents a rare case in the field records of Lepenski Vir of clearly visible building cuts shown in plane, before the floors of these buildings were exposed (Fig. 14A). Moreover, the pattern in the distribution of charcoal on the left-hand side of building 32, at its front corner, and further along the same side towards the back seem to furnish evidence for the existence of vertical posts that supported the upper construction of this structure. Perić and Nikolić\textsuperscript{119} suggest the existence of an unrecognised Neolithic pit intrusion into the front part of building 32 due to the presence of red burnt soil, ceramics, and a polished stone axe\textsuperscript{120} just above the floor of building 32. The existing detail plan, however, indicates that these burning zones were spread around the middle part of this backfilled space, especially in the area just above the building’s central hearth\textsuperscript{121}. As previously discussed in the case of building 27, red burnt soil and the remains of charcoal likely represent the burning of the upper construction of this building structure upon its abandonment.

Another example comes from the cross-section along the x axis of the excavation grid, in the back, narrow area of building 37 (Fig. 2). Here, similar to the previously discussed section above building 27, there is a visible cut on both sides of the building floor (Fig. 15). The photographs clearly show the vertical stacking of rocks along the edge of the trapezoidal floor closer to the sections. Presumably, some of the similar constructive rocks along the side of the floor closer to the front part of the building might already have been removed at the time these photographs were taken. The

\textsuperscript{113} Borić, Dimitrijević 2007/2009.
\textsuperscript{114} E. g. for the Natufian culture see Valla 1988; cf. Haklay, Gopher 2015.
\textsuperscript{115} For instance, see the photograph taken in August 1967, with visible rocks from a retaining wall on each side of the floors of buildings 21 and 22 (Borić 2016, Fig. 1.10). All subsequent photographs of this building location do not show any such rocks, which were removed soon after the discovery.
\textsuperscript{116} Perić, Nikolić 2016, 126.
\textsuperscript{117} Similar kinds of statements are found throughout the Field Journals in relation to various buildings at Lepenski Vir and confirm that the excavators of the site clearly observed a direct link between the existence of such stone constructions, which are here interpreted as retaining walls, and the dugout spaces for trapezoidal buildings.
\textsuperscript{118} A direct citation from the Field Journal of the July–August excavation season in 1967 in Serbian states the following: “Ivićom kuće očuvane su kamene konstrukcije verovatno za držanje gornje konstrukcije” (page 65).
\textsuperscript{119} Perić, Nikolić 2016, 124.
\textsuperscript{120} Cf. Antonović 2006.
\textsuperscript{121} In the description of original detail plan 29, it is stated that a circular zone in the middle part of building 32 was a “ceramic nest” (in Serbian “keramičko gnezdo”). It is not clear what is meant by this designation. In the adapted version of this detail plan, I have tentatively referred to it as “compact daub” (Borić 2016, Fig. 5.5), since the depiction on the detail plan more resembles a concentration of daub than ceramics. However, the situation remains unclear as there is no mention of this feature in the Field Journal for the excavation of building 32. It is curious that such a feature is found, presumably in situ, directly above the area of the rectangular hearth of the building. It is worth noting here a possibly comparable instance at the site of Padina, where Jovanović reports the existence of a concentration of “burnt earth” resembling daub above the rectangular hearth of trapezoidal building 18 (Jovanović 1969, 30, Table XI.2), which also furnished abundant evidence of in situ ceramics in direct association with the building floor and inside its hearth (Jovanović 1987).
Field Journal of the excavation (page 69) of this building in 1967 mentions that stone constructions were found along the edge of the trapezoid sides. One should note that there was around 40 cm of distance between the visible edges of the cuts on the section and the line of rocks that were placed closer to the floor edge of the building on both sides. The Field Journal of July 10th, 1967 mentions that, running along the left side of the building from its deeper corner D, the remains of two burnt rafters were found, presumably from the upper construction of this building.

Building 39 is yet another building structure with construction rocks along the sides of the floor, also seen vertically stuck on the edge of the floor on both sides of the profile that cross-sections the narrow back part of this building along the x axis of the excavation grid (Fig. 16). While the front part of the building was excavated and exposed during the field season in the summer of 1967, the back, narrow part of this building was excavated during the autumn field season, on October 26th, 1967. At that time, a concentration of rocks were exposed and recorded in relation to this building structure. These rocks can be interpreted as elements of the possibly collapsed retaining wall in the back of the building (Fig. 17) that might also have served to reinforce its upper construction.

Finally, in the way the architectural unit marked building 65/XXXV was excavated and recorded, it probably represents the clearest example for the practice of using retaining walls at Lepenski Vir (Fig. 18). Here, five individuals, burials 54a-e (see Table 1), were found placed over the floor area of the building as extended supine inhumations, heads pointing down-

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122 It is very likely that several existing charcoal dates from this building (Table 1) directly date these burnt beams as the 1967 Field Journal mentions that samples were taken for ¹⁴C analysis.

123 Borić 2016; Borić et al. 2014; Radovanović 1996.

124 Perić, Nikolić 2016, 102.

125 The absence of a cross-section through the building along line b is due to an extension of a 1 m cut into the profile of the initial excavation area. It is reported that there were no finds in this extension (Field Journal, August 5th, 1968), which probably suggests that it was made into sterile layers on the outer side of the retaining wall.
stream, i.e. according to the burial norm of the Late Mesolithic period in the Danube Gorges area\(^\text{123}\). The central hearth of the building was removed, with some of the individuals placed directly on the floor (burial 54d-e), while others were interred in the already partly backfilled space of this building (burials 54a-c). Perić and Nikolić\(^\text{124}\) suggest that these burials were Neolithic intrusions. Leaving aside for the moment the question of the Mesolithic burial tradition evident here, it is not clear how these authors explain the presence of rocks along the trapezoidal sides, which clearly follow the outline of the building floor, if the people making these Neolithic burial intrusions, to which these rocks are also attributed, were unaware of the existence of the trapezoidal building in this location. Unfortunately, in the way this area was excavated, and in the absence of a cross-section\(^\text{125}\) in the back part of the building space, there is no evidence here of cuts that must have been located on the outer sides of the stone rows along the longer sides of the floor. There is also a well-built apsidal

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Fig. 16. Section above building 39, with adhering rocks on both sides of the floor edge from a likely retaining wall, facing west (photo: Faculty of Philosophy, Belgrade)

Сл. 16. Профил изнад грађевине 39, са камењем које излази из профила са обе стране ивице Јога, а које Њошаче од вероватно Јошаче лица, излазајући ка југу (фото: Филозофски факултет, Београд)
retaining wall on the narrow side of this building at a somewhat higher level than the building floor (the bottom of the stone wall is found about half a metre above the level of the floor\textsuperscript{126}), with several massive rocks inserted vertically along with smaller rocks as the sub-

construction\textsuperscript{127}. Perić and Nikolić\textsuperscript{128} argue that this difference in height between the apsidal wall and the building floor excludes a connection between the two. Contrary to this view, while we do not have enough detailed contextual information from the excavation archive on

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**Fig. 17. Construction rocks from a likely retaining wall found collapsed in the back of building 39:**
- A) facing northwest; B) facing north; C) facing northwest; D) facing south

(photo: Faculty of Philosophy, Belgrade)

**Сл. 17. Конструктивно камене од вероватно срушеног потпорног зида, пронађено у позадинском делу грађевине 39:
- A) гледајући ка северозападу; B) гледајући ка северу; C) гледајући ка северозападу; D) гледајући ка југу

(фото: Филозофски факултет, Београд)
whether the back retaining wall was built during the life of the domestic structure or during the time when this building space was partly backfilled and used as a tomb, it does not change the fact that in the way this feature was used, there must have been, within living memory, awareness and recognition of this structure. I continue to argue that this particular case shows a transformation of a presumably domestic building structure during the early days of phase I–II into a tomb that was utilised in the course of the same phase.

In summary, one possible explanation for the occasional absence of more abundant evidence for retaining walls in relation to some building structures at Lepenski Vir has to do with the fact that the excavators of the site more often than not quickly removed rocks found in the zones above certain trapezoidal buildings in the course of their excavations, with the floors of the buildings exposed and only with the lowermost parts of the retaining wall surrounding the trapezoidal outlines left in situ (Fig. 4). Some of the removed rocks (presumably larger rocks) were recorded but it is likely that many remained unrecorded. There is also a possibility that these rocks were sometimes reused, in the case of abandoned buildings. Yet, the underlying principle of using rocks as retaining walls along the floors and cuts of trapezoidal buildings and also in fixing the construction elements of the buildings’ upper constructions, evident in numerous buildings, should by now be uncontroversial.

Early Mesolithic features and contexts
Perić and Nikolić\textsuperscript{129} make another surprising claim that the Proto-Lepenski Vir phase cannot be separated from the phase of occupation related to trapezoidal building structures. It is, however, only a logical consequence of their thinking by which trapezoidal building structures are placed in the duration of the Early/Middle Mesolithic. Let me show why this is erroneous.

Absolute dating of certain burials and contexts was instrumental in our recognition of the Proto-Lepenski Vir phase as a phase that is sporadically preserved and relates to the earliest documented periods in the occupation of the site (Table 1). There are now five directly AMS-dated burials (22, 50, 60, 68, and 69) associated with this phase that spans a long period of time from the mid-tenth to the mid-to-late-eighth millennia BC (Fig. 11). None of these burials were associated with trapezoidal building structures. In three cases—burials 22, 68, and 69 (Fig. 2)—these human remains were found in association, i.e. close vicinity, of four

\textsuperscript{126} Borić 2016, Fig. 4.16, 4.21.
\textsuperscript{127} Several ceramic fragments were found while cleaning this construction (Field Journal, August 10\textsuperscript{th}, 1967). The first burial remains within the stone construction were found here already at the level of spit 7.
\textsuperscript{128} Perić, Nikolić 2016.
\textsuperscript{129} Perić, Nikolić 2016, 138–139.
rectangular stone-lined hearths that, by all the elements of their construction and their proportions, are entirely different from the hearths of Lepenski Vir trapezoidal buildings (Fig. 19). The disarticulated mandible of the individual in burial 22 was in the immediate vicinity of hearth a, and is directly AMS-dated to the second half of the eighth millennium cal BC. Articulated primary inhumation burial 69 with flexed limbs (“seated”), directly AMS-dated to the first half of the eighth millennium cal BC, was found in the vicinity of Proto-Lepenski Vir hearth b, while slightly farther to the south in the adjacent quadrant a/14, a similar hearth marked as c was found. Finally, primary articulated burial 68, directly AMS-dated to the first half of the eighth millennium cal BC, was found in the vicinity of a Proto-Lepenski Vir hearth at the far north-western part of the site (Fig. 2)130.

Similar to typical Mesolithic hearths found at other contemporaneous sites in the Danube Gorges131, these Middle Mesolithic Proto-Lepenski Vir hearths are all significantly narrower than Lepenski Vir I–II hearths and were also made from different grey limestone slabs compared to larger/massive stone blocks characterising the hearths of much later Lepenski Vir buildings132. In addition, in connection to these Proto-Lepenski Vir hearths, there were never associated additional elements characterising the hearths of trapezoidal buildings, such as \( \forall \)-shaped hearth “supports”, approach platforms, and ash-places, or flat stone slabs (so-called “tables”) inserted into limestone floors.

Fig. 19. Comparison of rectangular stone-lined hearths attributed to the Proto-Lepenski Vir phase (A–C) and those found in I–II phase trapezoidal buildings (D–F): A) hearth a; B) hearth beneath the floor of building 13; C) hearth 68; D) building 24; E) building 54; F) building 19

Сл. 19. Поређење правоугаоних камених огњишта приписаних фази прото-Лепенски Вир (A–C) и оних приписаних фази I–II у оквиру трапезоидних грађевина (D–F): A) огњиште а; B) огњиште испод пода грађевине 13; C) огњиште 68; D) грађевина 24; E) грађевина 54; F) грађевина 19
Another type of context in which we find preserved remains of this phase, as shown by AMS dating of animal remains, are occupation zones with anthropogenic remains beneath trapezoidal building floors. To date, such occupation residues have been confirmed for layers beneath the floors of buildings 19, 23, 26’, 31, 34, 38, and 47’ as well as in several locations outside the area with trapezoidal buildings (Table 1) (Fig. 2). Another Proto-Lepenski Vir hearth was found beneath the floor of building 13 (Fig. 19). The oldest occupation residues are found beneath buildings 38 and 47’ and are dated to the second part of the tenth millennium cal BC, corresponding broadly to the direct AMS date on burial 60 (Table 1). Such evidence shows that somewhat different from Srejović’s remark that Proto-Lepenski Vir features should be confined to the strip along the riverbank, not more than 15 m away from it, this occupation phase might have used most of the river terrace on which the site is located. The remains of these early occupation episodes at Lepenski Vir must have been damaged by much later construction activities, primarily linked to the occupation of the site during phase I–II.

Forager-farmer admixtures at Lepenski Vir and other sites in the Danube Gorges

In the final section of this paper, I turn to the results of recent aDNA research and other scientific approaches as complementary evidence that support the view of the stratigraphy and absolute dating of Lepenski Vir espoused in the foregoing discussion.

Genome-wide aDNA evidence has become recently available for over 50 individuals from the Mesolithic-Neolithic sites in the Danube Gorges134. This evidence shows that most of the analysed individuals dated to the Mesolithic occupation of the region had a specific Eurasian hunter-gatherer ancestry, leaning closer to the so-called Western hunter-gatherers. However, at two sites—Lepenski Vir and Padina—there is now evidence of six individuals consistent with either entirely north-western-Anatolian-Neolithic-related ancestry, or admixtures between these two distinct genomic signatures.

Of 11 newly analysed individuals from Lepenski Vir with genomic data, five exhibit entirely hunter-gatherer ancestry, with two burials assigned to the Proto-Lepenski Vir phase (burials 68 and 126, with a direct AMS date on burial 68, see Table 1) and three burials attributed to phase I–II (burials 27, 27d, and 91, with a direct AMS date on burial 91, see Table 1). Four individuals have entirely north-western-Anatolian-Neolithic-related ancestry, with burials 54e and 82 attributed to phase I–II and burials 17 and 73 attributed to phase III135, confirmed by direct AMS dates on burials 17 and 54e (Table 1). As expected for individuals with entirely north-western-Anatolian-Neolithic-related ancestry, burials 17 and 73 (Fig. 20) were placed in crouched positions. On the other hand, it was not expected that burial 54e, found in the multiple burial over the floor of building 65/XXXV (Fig. 18A) placed in a typical Mesolithic extended supine burial position parallel to the Danube, head pointing downstream (see above), would also show entirely north-western-Anatolian-Neolithic-related ancestry. However, the non-local origin of individuals in burials 17 and 54e has been corroborated independently based on strontium isotope data136.

The most intriguing genomic evidence yet comes from two individuals found in burials 61 (Fig. 7A) and 93 (Fig. 21) that exhibit approximately equal proportions of both ancestries and represent direct evidence of admixtures between local foragers and incoming farmers. Both burials 61 (beneath building 40, see above) and 93 (placed over building 72) are directly AMS-dated, confirming their Lepenski Vir I–II phase attribution, and were placed as extended supine inhumations parallel with the Danube, their heads pointing in a downstream direction. These individuals are likely the first generation that resulted from mixing between the two distinct populations. In addition, an individual marked as burial 4, found in a multiple burial location at the site of Padina (Fig. 1), and dated to the same Mesolithic-Neolithic transition phase at the end of the seventh and the beginning of the sixth millennia cal BC137, also had

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130 Borić 2016.
132 The dimensions of Proto-Lepenski Vir hearths were 0.8–1.0 m by 0.20–0.25 m with slabs of around 10 cm in thickness. In contrast, hearths of trapezoidal buildings were built from “large and heavy stone blocks with dimensions most often 100 x 50 x 40 cm or 60 x 40 x 35 cm” (Srejović 1972, 53). This is the reason why such hearths were attributed to the Proto-Lepenski Vir phase separated by the excavators in the first place, and were consequently marked by small letters (a, b, c).
133 Srejović 1969, 43; 1972.
134 González-Fortes et al. 2017; Hofmanová 2017; Mathieson et al. 2018.
135 Borić 2016.
roughly 50 percent of hunter-gatherer-related ancestry and 50 percent of the north-western-Anatolian-Neolithic-related ancestry, as yet another instance of admixtures between these two populations.

This evidence is in strong agreement with the suggested chrono-stratigraphic model for Lepenski Vir that assumes forager-farmer contacts starting during the Mesolithic-Neolithic transition period represented at Lepenski Vir by phase I–II\(^{138}\), and also observed at other neighbouring sites, such as Vlasac and Padina\(^{139}\). Recent evidence for the mixing of forager and farmer lifeways in the Danube Gorges area also comes from the analysis of lipid residues on Early Neolithic ceramics from five sites found in this region that show a very extensive use of ceramics for the preparation and consumption of fish-related foods, a pattern that is dramatically different from broadly contemporaneous sites in the surrounding areas of south-eastern Europe as well as in the rest of Europe, with the exception of certain areas of southern Scandinavia\(^{140}\). In the context of all other evidence, this strongly suggests that in the Danube Gorges area, Late Mesolithic forager subsistence practices linked to fishing activities continued to play an important part during the Early Neolithic period\(^{141}\), with an adaptation of the newly available technology of ceramic production and food preparation to the tradition of fish consumption. New genomic data suggest that this specific use of ceramics, unique to the region, must have stemmed from the merging of the two cultural traditions.

All these strands of data stand in stark contrast to the stratigraphic and chronological understanding of

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\(^{138}\) Borić 2016; Borić, Price 2013.

\(^{139}\) Borić 2011; Borić et al. 2014.

\(^{140}\) Cramp et al. 2019.

the sequence at Lepenski Vir by Perić and Nikolić who maintain that the Mesolithic occupation of the site is entirely separated from the Neolithic occupation, stating that “[t]he only logical answer would be that such cohabitation between ideologically completely different inhabitants at the same settlement is unimaginable and unlikely.”\textsuperscript{142} The best evidence against this view comes from burial 61, which according to Perić and Nikolić was placed beneath the floor of building 40 by a Neolithic intrusion. Yet, aDNA evidence now indicates that it shares two distinct genomic ancestral lines, of which one is linked to the local hunter-gatherers. New genomic data, more than other strands of evidence, most clearly show that foragers and farmers met and interbred at Lepenski Vir and other sites. In the course of this process, it is more than likely that they exchanged cultural traditions, as clearly observable from the mixture of material culture traditions during phase I–II\textsuperscript{143}. It is worth noting here that during the Lepenski Vir I–II phase, the Late Mesolithic norm of extended supine burial positions was maintained for all those buried, regardless of their place of origin. This may significantly suggest that the forager culture was dominant during this phase, as underlined by architectural and symbolic expression too. The transformation into a predominantly Neolithic culture tradition took place only with the onset of phase III, when crouched inhumations appear for the first time, and with an abandonment of various aspects of forager cultural tradition, save for the continuing importance of fishing along with the consumption of aquatic resources.

**Conclusions**

In this article, I have presented extant and new evidence for the previously suggested chrono-stratigraphic model for Lepenski Vir. Some of the presented evidence only recently became available and it now further strengthens the chronological and stratigraphic picture of the site already put forward some ten years ago\textsuperscript{144}. These views continue to be refined with further research and the constant influx of new data, but the main outlines of the model remain well established and are supported by the new data. Here, every attempt has also been made to place the chronology and stratigraphy of Lepenski Vir with all its specificities into a regionally contextualised reading by keeping an eye on contemporaneous sequences in the Danube Gorges area and beyond.

In short, the evidence shows that the terrace remnant on which Lepenski Vir was situated became inhabited from the beginning of the Holocene in the second half of the tenth millennium cal BC, based on AMS-dated animal remains, including osseous artefacts, found in a couple of contexts beneath later trapezoidal building floors. Based on one AMS-dated burial (no. 60), the site was also used for the interment of the dead at the end of the tenth/beginning of the ninth millennium cal BC. These Early Mesolithic occupation episodes are followed by what could now be defined as the Middle Mesolithic occupation of the site from the second half of the ninth millennium cal BC. On the face of the current evidence, this period is better represented and dated than the Early Mesolithic. The AMS-dated contexts attributed to the Middle Mesolithic phase are often sealed by later trapezoidal buildings, but the novelty seems to be rectangular stone-lined hearths with common elements in the constructive style, in three instances linked to the nearby presence of burials, all of which are now securely AMS-dated. Both Early and Middle Mesolithic occupations of the site, which might have been intermittent throughout these periods, could be linked with the Proto-Lepenski Vir phase as originally defined by Srejović but with various modifications based on new evidence. The likely end of this phase is in the second half of the eighth millennium cal BC. No AMS dates can be linked with the ensuing period throughout most of the seventh millennium cal BC, i.e. the duration of the regional Late Mesolithic. It remains unclear why there are no traces of human presence at the site during this long period, when most of the other known sites in the Danube Gorges area were intensely inhabited. A complete removal of hypothetical Late Mesolithic occupation deposits by later inhabitants of Lepenski Vir or by erosional events seems unlikely\textsuperscript{145}.

Thanks to a large pool of AMS dates, burial events and constructional activities for trapezoidal building structures associated with the start of phase I–II can now be dated precisely in the range 6160–6080 cal BC (95% probability, model 1). Trapezoidal building structures were constructed by the cutting of their back, narrow ends into the slope of the site at different heights of the sloping terrace. Rectangular stone-lined hearths, which in their style, dimensions, and proportions differ

\textsuperscript{142} Perić, Nikolić 2016, 104.
\textsuperscript{143} Borić et al. 2018.
\textsuperscript{144} Borić et al. 2018.
\textsuperscript{145} Borić et al. 2018.
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significantly from earlier Mesolithic hearths, were placed in the central location of trapezoid-shaped dug-outs and were often elaborated by stone entrance platforms at the front, wide sides of the buildings where one also finds the location of the so-called ash-places. Hearths were also surrounded by \( \forall \)-shaped “supports” made of thin limestone plaques and in one case in combination with a human mandible. A reddish-pinkish limestone compound was then plastered across the levelled surface, forming a trapezoidal shape. In many buildings, we find evidence of retaining walls used to retain the surrounding soil deposits into which the buildings were cut, with additional evidence for a patterned placement of postholes, reinforced by rocks, at the corners and along the longer sides of the trapezoidal bases. This is an intense period of occupation of the site that lasted between 120 and 210 years (95% probability, model 1). During this period, some of the trapezoidal building structures must have been abandoned for domestic use and backfilled, and sometimes transformed into a tomb for multiple burials. A small sample of individuals analysed for aDNA shows that the inhabitants of the site during this phase comprised people who had both the distinct local, hunter-gatherer-related ancestry and those with entirely Neolithic-north-western-Anatolian-related ancestry, as well as a couple of individuals with evidence of admixtures between these genetically different populations, which corresponds very well with the evidence for the increase in non-local individuals during this phase, based on strontium isotope data. Yet, during this phase, all of the non-local individuals were buried as extended supine burials, i.e. according to the typical Late Mesolithic burial norms. Since there is evidence for the presence of Neolithic people and practices, including technological know-how, at Lepenski Vir during this period, it is very likely that ceramics were available at the site at this time. It remains unclear to what extent ceramics were part of the life of the I–II phase settlement at Lepenski Vir and, apart from occasional comments about the presence of ceramics in association with trapezoidal buildings based on Field Journals, I have left this question open until such time that the complete ceramic assemblage from the site is adequately published with all of the relevant contextual details.

How the transition from using the site during phase I–II to its use in phase III took place is not entirely clear. On the face of the current radiocarbon chronology, there does not seem to be any significant break in the occupation of the site between these two periods. It seems that by the start of phase III, estimated to have begun in 5970–5910 cal BC (95% probability, model 1), most if not all trapezoidal buildings were abandoned and backfilled. There is clear evidence that the phase III occupants of the site sometimes interred their pits, including burials, into the backfilled areas of trapezoidal building structures. Yet, a number of such intrusions remained rather limited and these in no way compromise the integrity of phase I–II. Available stratigraphic sections show that the use of ceramics must have been widespread during phase III, with all other typical elements of Early Neolithic Starčevo material culture present. Crouched or flexed inhumations represented an exclusive burial norm while there seems to have been a continuing influx of new, non-local people of entirely north-western-Anatolian ancestry. At the same time, some aspects of a forager way of life, such as the staple use of river fish, continued during this phase, despite the introduction of domestic animals. This is especially clear based on recent evidence that ceramic vessels were predominantly used for processing aquatic resources, different from most of the other areas in Europe where ceramic lipid analyses have been applied. The reason for the end of this phase and abandonment of the site in 5870–5480 cal BC (95% probability, model 1), probably in 5720–5540 cal BC (68% probability, model 1), remains unclear. Evidence from stratigraphic sections showing the presence of a massive deposit described as “yellow clayey soil” covering the remains of the phase III settlement could tentatively suggest that these is a colluvial deposit that might have been triggered by the devegeted nature of the slopes above Lepenski Vir, possibly caused by human activities in the course of phase III.

The outlined view of the stratigraphy and chronology of Lepenski Vir stands in stark contrast to that recently presented by Perić and Nikolić. In this paper, I examined various flawed aspects of their stratigraphic and chronological model for Lepenski Vir that must be refuted based on the presented evidence. What remains initially problematic about their publication is that after almost half a century since the excavations of the site, they present detailed evidence for only two initial excavation seasons, as if this were an interim report. They further selectively used data from later excavation seasons by choosing and picking what fits their argument. This is hardly a way to present evidence from an archaeological site. One of the most problematic aspects of their view of Lepenski Vir is that the interpretation offered completely decontextualises evidence from the
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site when compared to the evidence from other sites in the region and beyond. This is particularly clear in their claims that extended supine inhumation burials should not be seen as a typical Mesolithic burial norm or that Proto-Lepenski Vir hearths do not differ from the hearths of the Lepenski Vir I–II phase. Immersed in the outdated frameworks of the culture-historical paradigm, their account of the evidence from Lepenski Vir can hardly do justice to an extraordinary sequence and the wealth of recorded data that can be retrieved from the site’s surviving archive.

In the near future, we will continue to receive results of new analysis from the old excavations of Lepenski Vir and other sites in the Danube Gorges. This may change some of the conclusions expressed herein. In order to elucidate further questions of the chronology and stratigraphy of this site we need thorough publications of all currently unpublished elements of the Lepenski Vir archive. In an ideal world and from the perspective of open-access policies, this and other “seasoned” excavation archives should become open and available to all interested researchers, who can then draw conclusions based on the first-hand analysis of recorded data and collected materials.

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Иако је прошло више од 50 година од открића Лепенског Вира, не престаје контроверза у вези с тумачењем стратиграфије и са апсолутно-хронолошким датовањем овог, у светским оквирима важног, праисторијског налазишта. Током последњих 20 година понуђено је неколико верзија ревидираних слика стратиграфије и хронологије овог налазишта, утемељених у новом, контекстуалном тумачењу стратиграфских односа најзаступљеније фазе са трапезоидним грађевинама и проћена материјалне културе, с важним ослоњем на постојеће и новодобијене радиокарбонске датуме. Те ревизије су током последње две деценије додатно поткрепљиване новим датумима и новим анализама материјала. Уз мања или већа одступања у тумачењу постојећих података од стране различитих аутора који су се бавили овим проблемом, успостављен је минимални консенсус да фазу са трапезоидним грађевинама треба везати за период прелаза из мезолита у неолит у последњим вековима седмог миленијума пре н. е., будући да представља део континуираног процеса трансформације прореконструисаног културним контактом мезолитских домородца и придошлих земљорадничких група. Понуђено ревидирано гледиште значајно мења иницијално тумачење које је дао први истраживач овог налазишта. Међутим, у светском време, Перић и Николић понудили су своје тумачење које другачије поставља хронолошке односе на Лепенском Виру, уз ново читање постојећих 14С датума. Ти аутори сматрају да грађевине са трапезоидним подовима нису настале касније од 7500. године пре н. е. и да је постојао наглашен дисконтинуитет између мезолитског и неолитског населивања Лепенског Вира. Њихово гледиште представља значајно одступање од консенсуса који је међу истраживачима успостављен током последњих година и захтева ново разматрање питања хронологије и стратиграфије Лепенског Вира.

У овом раду пружа се нови осврт на стратиграфију и хронологију Лепенског Вира кроз усредсређену анализу неколико кључних контекста с новим 14С AMС (акцелераторна масена спектрометрија) датумима и уз детаљну расправу о тафономским и другим проблемима датовања и њиховом исправном тумачењу по модерним научним стандардима. Козначно, ова хронолошка слика упоређена је с недавно добијеним геномским анализама древне ДНК на људским остацима са Лепенског Вира и с неколико других мезолитско-неолитских налазишта у Ђердапу.
### Table 1. Radiocarbon measurements on charcoal, animal and human bones from Lepenski Vir. Ages are corrected for those dates that have $\delta^{15}N$ values $> +9.5\%$ (affected by the aquatic reservoir effect) as suggested by Cook et al.\(^1\). The $\delta^{15}N$ values used to estimate percentage of aquatic diet.

**Method 1:** A weighted mean age offset for a 100% fish-based diet estimated as 540±70 radiocarbon years.

**Method 2:** $\delta^{15}N$ values $> 13.0 = 100\%$ reservoir correction applied (440±45 years); $\delta^{15}N$ values $< 13.0 = 50\%$ reservoir correction applied (220±23 years). Dates are calibrated with OxCal v. 4.3.2.\(^2\)

<table>
<thead>
<tr>
<th>Laboratory code</th>
<th>Sample material and reference</th>
<th>Sample association</th>
<th>Radiocarbon age (BP)</th>
<th>$\delta^{13}C$ (%)</th>
<th>$\delta^{15}N$ (%)</th>
<th>$\delta^{18}S$ (%)</th>
<th>C:N</th>
<th>% protein (fish?)</th>
<th>signal</th>
<th>Raw carbon measurement corrected for average freshwater fish offset (Cook et al. 2011) BP</th>
<th>Calibrated date (95% confidence) cal BC or cal AD</th>
<th>Posterior density estimate for Model 1 (95% probability unless otherwise stated) cal BC</th>
<th>Source</th>
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<tbody>
<tr>
<td>OxA-32864</td>
<td>Pinus sylvestris (S. no. 7)</td>
<td>Quad. c/f-ll (hearth) (22/08/1968)</td>
<td>12,335±50</td>
<td>–24.2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>12,730–12,140</td>
<td>10,020–7440 (poor agreement 7.1%)</td>
<td>Borić et al. 2018</td>
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<tr>
<td>OxA-32863</td>
<td>Pinus sylvestris (S. no. 6)</td>
<td>Quad. A/3, LV horizon II, beneath rock (18/10/1967)</td>
<td>10,075±45</td>
<td>–24.3</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>10,000–9400</td>
<td>9870–9320</td>
<td>Borić et al. 2018</td>
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<tr>
<td>OxA-26552</td>
<td>Red deer antler</td>
<td>building 38, underneath the building’s floor</td>
<td>10,035±50</td>
<td>–19.3</td>
<td>6.3</td>
<td>3.2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>9852–9338</td>
<td>9780–9320</td>
<td>Borić et al. 2018</td>
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<tr>
<td>OxA-25092</td>
<td>Human right or left femur</td>
<td>Burial 60, primary, adult male (?), extended perpendicular to the Danube</td>
<td>9970±45</td>
<td>–19.1</td>
<td>15.0</td>
<td>5.9</td>
<td>3.2</td>
<td>78%</td>
<td>9540±71 (method 1)</td>
<td>9530±64 (method 2)</td>
<td>9230–8700 (94.7%) or 8680–8650 (0.7%)</td>
<td>Bonsall et al. 2015</td>
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<tr>
<td>OxA-16004</td>
<td>LV10, red deer metatarsus</td>
<td>Between the floors of building 47 and 47’, on the floor of Building 47 (1314a) (09/10/1970)</td>
<td>9730±50</td>
<td>–20.3</td>
<td>6.0</td>
<td>3.4</td>
<td>–</td>
<td>–</td>
<td>9294–8928</td>
<td>9310–9120 (87.0%) or 9010–8910 (8.0%) or 8890–8870 (0.8%)</td>
<td>Borić, Dimitrijević 2007/2009</td>
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<tr>
<td>OxA-16076</td>
<td>LV30, red deer antler</td>
<td>Building 54, floor (October 1967)</td>
<td>9750±45</td>
<td>–19.6</td>
<td>6.1</td>
<td>3.2</td>
<td>–</td>
<td>–</td>
<td>9297–9152</td>
<td>9310–9140 (94.1%) or 8989–8940 (1.3%)</td>
<td>Borić, Dimitrijević 2007/2009</td>
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<tr>
<td>BA-10651</td>
<td>Human rib</td>
<td>Burial 50, primary, adult male, extended supine with flexed lower limbs at the knees (raised), perpendicular to the Danube</td>
<td>9455±38</td>
<td>–19.5</td>
<td>14.2</td>
<td>4.8</td>
<td>69%</td>
<td>9082±62 (method 1)</td>
<td>9015±59 (method 2)</td>
<td>8532–8208 (1)</td>
<td>8340–7961 (2)</td>
<td>8550–8190 (93.8%) or 8110–8090 (0.4%) or 8080–8060 (0.1%) or 8040–7990 (1.0%)</td>
<td>Borić, Price 2013</td>
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<tr>
<td>OxA-25215</td>
<td>Human left femur</td>
<td>Burial 69, adult male, sitting w/crossed legs</td>
<td>9089±38</td>
<td>–19.3</td>
<td>14.6</td>
<td>3.2</td>
<td>73%</td>
<td>8695±64 (method 1)</td>
<td>8649±59 (method 2)</td>
<td>7940–7591 (1)</td>
<td>7933–7573 (2)</td>
<td>7970–7580</td>
<td>Bonsall et al. 2015</td>
</tr>
</tbody>
</table>

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3. Low pretreatment yield of collagen: 590 mg was treated and 4.14 mg recovered, a yield of 0.7% wt. collagen, and below the Oxford Laboratory’s minimum threshold.
<table>
<thead>
<tr>
<th>Laboratory code</th>
<th>Sample material and reference</th>
<th>Sample association</th>
<th>Radiocarbon age (BP)</th>
<th>$\delta^{13}$C (‰)</th>
<th>$\delta^{15}$N (‰)</th>
<th>$\delta^{34}$S (‰)</th>
<th>C:N</th>
<th>% protein (fish? signal average freshwater fish offset)</th>
<th>Radiocarbon measurement corrected for</th>
<th>Calibrated date (95% confidence) cal BC or cal AD</th>
<th>Posterior density estimate for Model 1 (95% probability unless otherwise stated) cal BC</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>UBA-29842</td>
<td>Human petrous bone</td>
<td>Burial 68, possible adult female, supine, flexed limbs, next to hearth 68</td>
<td>9092±59</td>
<td>-19.7</td>
<td>14.6</td>
<td>6.8</td>
<td>?</td>
<td>73%</td>
<td>8698±78 (method 1) 8652±74 (method 2)</td>
<td>8167–7580 (1) 7940–7571 (2)</td>
<td>8180–8110 (2.6%) or 8090–8070 (0.1%) or 8060–8040 (0.5%) or 8000–7570 (92.2%)</td>
<td>Dušan Borić</td>
</tr>
<tr>
<td>OxA-26551</td>
<td>Red deer antler intermediate piece/tool (BB-23) (S. no. 20)</td>
<td>Quad. A/11, spit 6 (801)</td>
<td>8910±45</td>
<td>-21.2</td>
<td>9.7</td>
<td>-</td>
<td>3.1</td>
<td>-</td>
<td>8251–7941</td>
<td>8270–7910 (93.3%) or 7900–7830 (2.1%)</td>
<td>Borić et al. 2018</td>
<td></td>
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<tr>
<td>OxA-24771</td>
<td>Red deer antler diffused-end tool (punch) (S. no. 32)</td>
<td>Building 19, beneath the building’s floor</td>
<td>8871±38</td>
<td>-21.1</td>
<td>5.5</td>
<td>-</td>
<td>3.1</td>
<td>-</td>
<td>8224–7837</td>
<td>8230–7820</td>
<td>Borić et al. 2018</td>
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<tr>
<td>OxA-8610</td>
<td>Long bone of a large-size ungulate</td>
<td>Building 23, beneath the floor (1299c)</td>
<td>8770±60</td>
<td>-21.6</td>
<td>4.7</td>
<td>-</td>
<td>3.3</td>
<td>-</td>
<td>8200–7600</td>
<td>8200–8110 (7.2%) or 8100–8030 (2.6%) or 8010–7600 (95.6%)</td>
<td>Whittle et al. 2002</td>
<td></td>
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<tr>
<td>AA-57781</td>
<td>Human mandible</td>
<td>Burial 22, old adult, in association with hearth “a”</td>
<td>8814±60</td>
<td>-20.6</td>
<td>14.4</td>
<td>-</td>
<td>71%</td>
<td></td>
<td>8431±78 (method 1) 8374±75 (method 2)</td>
<td>7596–7317 (1) 7580–7191 (2)</td>
<td>7600–7320</td>
<td>Borić, Price 2013</td>
</tr>
<tr>
<td>OxA-16074</td>
<td>LV22, shed red deer antler</td>
<td>Occupation zone around hearth “a” (268/1) (02/10/1967)</td>
<td>8645±40</td>
<td>-20.3</td>
<td>5.9</td>
<td>-</td>
<td>3.2</td>
<td>-</td>
<td>7740–7587</td>
<td>7760–7580</td>
<td>Borić, Dimitrijević 2007/2009</td>
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<tr>
<td>OxA-26549</td>
<td>Wild boar tusk pointed-edged tool/burin (BB-187)</td>
<td>Space between buildings 40 and 41 [zone around hearth “a”] (02/10/1967)</td>
<td>8659±45</td>
<td>-22.0</td>
<td>7.7</td>
<td>-</td>
<td>3.2</td>
<td>-</td>
<td>7754–7596</td>
<td>7754–7596</td>
<td>Borić et al. 2018</td>
<td></td>
</tr>
<tr>
<td>OxA-24813</td>
<td>LV34, red deer bone</td>
<td>Beneath building 34 (1307/5)</td>
<td>8640±40</td>
<td>-22.1</td>
<td>5.2</td>
<td>-</td>
<td>3.1</td>
<td>-</td>
<td>7740–7580</td>
<td>7840–7540 (94.7%) or 7420–7290 (0.7%)</td>
<td>Borić et al. 2018</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>Artifactual Material</td>
<td>Location</td>
<td>Age (1σ)</td>
<td>Probability</td>
<td>Associated Events</td>
<td></td>
<td></td>
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<tr>
<td>OxA-24812</td>
<td>Brown bear, humerus, from a</td>
<td>Building 31, beneath the floor</td>
<td>8410±39</td>
<td>19.7</td>
<td>6.8, 3.1, 7574–7359, 7580–7360</td>
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</table>

### Lepenski Vir I-II contexts (Mesolithic-Neolithic Transition Phase)

#### Building 37

<table>
<thead>
<tr>
<th>Number</th>
<th>Artifactual Material</th>
<th>Location</th>
<th>Age (1σ)</th>
<th>Probability</th>
<th>Associated Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bln-649</td>
<td>LV5/67, charcoal (Quercus sp.)</td>
<td>Building 37, floor</td>
<td>6800±100</td>
<td></td>
<td>6510–5940 (poor agreement 6.3%)</td>
</tr>
<tr>
<td>Bln-678</td>
<td>charcoal, large timber beam</td>
<td></td>
<td>6900±100</td>
<td></td>
<td>6070–5980</td>
</tr>
<tr>
<td>BM-379</td>
<td>Charcoal, Quercus sp. (S. no. 9)</td>
<td>Wooden beam from building 37 (June 1967)</td>
<td>7156±36</td>
<td>25.3</td>
<td>6074–6000</td>
</tr>
<tr>
<td>OxA-32886</td>
<td>Charcoal, Quercus sp.</td>
<td>Building 37, floor</td>
<td>7191±35</td>
<td>24.3</td>
<td>6080–6000</td>
</tr>
<tr>
<td>OxA-32887</td>
<td>Charcoal, Quercus sp. (S. no. 9)</td>
<td>Wooden beam from building 37 (June 1967)</td>
<td>7191±35</td>
<td>24.3</td>
<td>6080–6000</td>
</tr>
<tr>
<td>OxA-16082</td>
<td>LV20, bone tool (inv. 673)</td>
<td>Building 37, floor</td>
<td>7138±37</td>
<td>20.6</td>
<td>6070–5980</td>
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#### Building 62

<table>
<thead>
<tr>
<th>Number</th>
<th>Artifactual Material</th>
<th>Location</th>
<th>Age (1σ)</th>
<th>Probability</th>
<th>Associated Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>KN-405</td>
<td>Charcoal (possibly Quercus sp.)</td>
<td>Building 62, from a timber beam over the hearth of building 62</td>
<td>7430±160</td>
<td></td>
<td>6595–6006</td>
</tr>
<tr>
<td>OxA-32865</td>
<td>Charcoal, Cornus sp.</td>
<td>Building 62, in front of the hearth, toward side C-D (charcoal 5) (29/07/1966)</td>
<td>7176±36</td>
<td>25.4</td>
<td>6110–5980</td>
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#### Buildings 20, 33 and 32

<table>
<thead>
<tr>
<th>Number</th>
<th>Artifactual Material</th>
<th>Location</th>
<th>Age (1σ)</th>
<th>Probability</th>
<th>Associated Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-1598</td>
<td>Charcoal</td>
<td>Building 32, hearth of the building</td>
<td>6814±69</td>
<td></td>
<td>6510–5940 (poor agreement 3.9%)</td>
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<tr>
<td>OxA-15998</td>
<td>LV1, roe deer metacarpus</td>
<td>Between the floors of buildings 20 and 33, on the floor of building 20 in corner D (1082) (30/08/1968)</td>
<td>7280±45</td>
<td>22.1</td>
<td>6231–6056</td>
</tr>
<tr>
<td>OxA-8725</td>
<td>Fish vertebra</td>
<td>Between the floors of buildings 20 and 33, on the floor of building 20 in corner D</td>
<td>7600±90</td>
<td>16.9</td>
<td>6420–6060 (2)</td>
</tr>
<tr>
<td>OxA-15999</td>
<td>LV2, red deer right proximal</td>
<td>Building 32, from the floor (1090/4) (1968)</td>
<td>7111±40</td>
<td>20.8</td>
<td>6061–5902</td>
</tr>
</tbody>
</table>

References:
- Borić et al. 2018
- Borić, Dimitrijević 2007/2009
<table>
<thead>
<tr>
<th>Sample code</th>
<th>Material and reference</th>
<th>Sample association</th>
<th>Radiocarbon measurement</th>
<th>Calibration (95% confidence) BP</th>
<th>Posterior probability estimate (95% probability interval) cal AD</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>OAA-16000</td>
<td>LV 3, red deer skull</td>
<td>Building 26, floor, quad, AV 1 (01/01/1977)</td>
<td>70.70±40</td>
<td>–21.5 6.7 – 3.4 – –</td>
<td>6023–5849</td>
<td>Borić, Dimitrijević 2007/2009</td>
</tr>
<tr>
<td>OAA-16002</td>
<td>Charcoal from a timber beam lying along the left side</td>
<td>69.93±60</td>
<td>–19.4 7.2 9.9 3.3 15%</td>
<td>7109±41 (method 1) Borić, Dimitrijević 2007/2009</td>
<td></td>
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</tr>
<tr>
<td>OAA-16004</td>
<td>Charcoal from a timber beam 6</td>
<td>67.9±40</td>
<td>–18.1 10.2 9.9 3.3 21%</td>
<td>6609–5982 (1) Borić, Dimitrijević 2007/2009</td>
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</tr>
<tr>
<td>OAA-16005</td>
<td>LV 3, human skull fragment</td>
<td>Burial 122, disarticulated 15-18 year-old male</td>
<td>71.0±40</td>
<td>–19.5 9.5 – 3.3 17%</td>
<td>7098±47 (method 1) Borić, Dimitrijević 2007/2009</td>
<td></td>
</tr>
<tr>
<td>OAA-16006</td>
<td>LV 3, human skull fragment</td>
<td>Burial 122, disarticulated 15-18 year-old male</td>
<td>71.0±40</td>
<td>–19.3 9.3 – 3.3 17%</td>
<td>7098±47 (method 1) Borić, Dimitrijević 2007/2009</td>
<td></td>
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</tbody>
</table>

### Measurements

- **δ¹³C** (‰)
- **δ¹⁵N** (‰)
- **δ³⁴S** (‰)
- **% C:N**
- **C/N**
- **% protein**
- **signal**
- **radioactive measurement corrected for average freshwater fish offset (Cook et al. 2011)**
- **Bp**
- **Calibrated date (95% confidence) cal BC or cal AD**
- **Posterior density estimate for Model 1 (95% probability unless otherwise stated) cal BC**
- **source**
- **Buildings 26 and 26’**
- **16000 LV4, red deer skull**
- **Building 26, floor, quad, AV 1 (01/01/1977)**
- **70.70±40**
- **–21.5 6.7 – 3.4 – –**
- **6023–5849**
- **Borić, Dimitrijević 2007/2009**

---

### References

- Quitta 1975
- Borić, Dimitrijević 2007/2009
- Whittle et al. 2002
- Černá, Košťák, 2001
- Borić et al. 2007

---

### Note

- **Lab code**
- **Sample material and reference**
- **Sample association**
- **Radiocarbon measurement**
- **Calibrated date (95% confidence) cal BC or cal AD**
- **Posterior density estimate for Model 1 (95% probability unless otherwise stated) cal BC**
- **Source**
- **Buildings 47 and 47’ and Burial 122**
- **1407 CL**
- **Charcoal from a timber beam**
- **Building 47, timber beam found lying along the left side**
- **69.93±60**
- **–18.1 10.2 9.9 3.3 21%**
- **7109±41 (method 1) Borić, Dimitrijević 2007/2009**
<table>
<thead>
<tr>
<th>Code</th>
<th>Type</th>
<th>Description</th>
<th>Radiocarbon Dates</th>
<th>References</th>
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</thead>
<tbody>
<tr>
<td>AA-57782</td>
<td>Human mandible</td>
<td>Burial 26, adult male, extended inhumation, parallel to the Danube, head downstream direction</td>
<td>7332±50, 7122±55</td>
<td>Borić, Price 2013</td>
</tr>
<tr>
<td>OxA-25206</td>
<td>Human right tibia</td>
<td>Burial 10, primary disturbed, c. 8 years old, extended supine, articulated beneath the floor of building 24 (26/08/1970)</td>
<td>7161±34, 7058±37</td>
<td>Bonsall et al. 2015</td>
</tr>
<tr>
<td>OxA-16009</td>
<td>LV19, red deer mandible</td>
<td>Area around the hearth of building 24 (1300a) (02/09/1970)</td>
<td>7285±45</td>
<td>Borić, Dimitrijević 2007/2009</td>
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<tr>
<td>OxA-34519</td>
<td>Human unfused long bone</td>
<td>Burial 100, primary disturbed, c. 8 years old, extended supine, articulated beneath the floor of building 24 (26/08/1970)</td>
<td>7695±40, 7520±40</td>
<td>Borić et al. 2013</td>
</tr>
<tr>
<td>AA-57783</td>
<td>Human skull fragment</td>
<td>Burial 54a, of old adult female placed over the floor of building 65, partly disturbed</td>
<td>7494±51</td>
<td>Borić, Dimitrijević 2007/2009</td>
</tr>
<tr>
<td>OxA-25213</td>
<td>Human left femur</td>
<td>Burial 54c, adult female (?), extended parallel to the Danube, head downstream direction</td>
<td>7474±35, 7461±35</td>
<td>Borić et al. 2013</td>
</tr>
<tr>
<td>OxA-25209</td>
<td>Human left femur</td>
<td>Burial 54c, adult female (?), extended parallel to the Danube, head downstream direction</td>
<td>7474±35, 7461±35</td>
<td>Borić et al. 2013</td>
</tr>
<tr>
<td>AA-57783</td>
<td>Human skull fragment</td>
<td>Burial 54a, of old adult female placed over the floor of building 65, partly disturbed</td>
<td>7494±51</td>
<td>Borić, Dimitrijević 2007/2009</td>
</tr>
<tr>
<td>OxA-25213</td>
<td>Human left femur</td>
<td>Burial 54c, adult female (?), extended parallel to the Danube, head downstream direction</td>
<td>7474±35, 7461±35</td>
<td>Borić et al. 2013</td>
</tr>
<tr>
<td>AA-57783</td>
<td>Human skull fragment</td>
<td>Burial 54a, of old adult female placed over the floor of building 65, partly disturbed</td>
<td>7494±51</td>
<td>Borić, Dimitrijević 2007/2009</td>
</tr>
<tr>
<td>OxA-16537</td>
<td>LV9, red deer skull</td>
<td>Structured deposition of red deer skull with antlers in burial 7, interred through the floor of building 21 (524) (20/10/1967)</td>
<td>6924±37, 7133±37</td>
<td>Borić, Dimitrijević 2007/2009</td>
</tr>
<tr>
<td>OxA-32933</td>
<td>Aurochs skull</td>
<td>Structured deposition of aurochs skull in burial 7, interred through the floor of Building 21 (20/10/1967)</td>
<td>6924±37, 7133±37</td>
<td>Borić et al. 2018</td>
</tr>
<tr>
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<td>Sample association</td>
<td>Radiocarbon age (BP)</td>
<td>δ¹³C (%)</td>
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<tr>
<td>AA-57779</td>
<td>Human rib</td>
<td>Burial 7/I-a, articulated male adult burial interred through the floor of building 21</td>
<td>7368±74</td>
<td>–18.9</td>
</tr>
<tr>
<td>OxA-25204</td>
<td>Human right femur</td>
<td></td>
<td>7710±35</td>
<td>–18.3</td>
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<tr>
<td>OxA-25205</td>
<td></td>
<td></td>
<td>7689±37</td>
<td>–18.1</td>
</tr>
<tr>
<td>AA-57780</td>
<td>Human skull fragment</td>
<td>Burial 7/I1-b, disarticulated adult human skull placed on the left shoulder of burial 7/I-a</td>
<td>7512±71</td>
<td>–20.0</td>
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**Building 54**

<table>
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<tr>
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<td>Z-115</td>
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<td>Bln-653</td>
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<tr>
<td>Bln-738</td>
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<td>KN-407</td>
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<td>OxA-26547</td>
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**Building 27**

<table>
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<td>KN-406</td>
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**Buildings 35 and 36 – between two floors**

<table>
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<th>Buildings 35 and 36</th>
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### Building 4

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Location</th>
<th>Description</th>
<th>Date Range</th>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bln-740a</td>
<td>LV13/68, charcoal (Quercus sp.)</td>
<td>From timber beam lying on the floor of building 36 beneath the floor of building 35</td>
<td>7310±100</td>
<td>6376–6060 Weighted mean: 7335±71 X^2-Test: df=1 T=0.1 (5% 3.8)</td>
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### Building 40

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Location</th>
<th>Description</th>
<th>Date Range</th>
<th>Additional Notes</th>
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</thead>
<tbody>
<tr>
<td>OxA-25211</td>
<td>Human right femur</td>
<td>Burial 61, beneath the floor of building 40, child 2-6 years old, primary extended parallel with the Danube, head downstream</td>
<td>7670±35</td>
<td>6120–5980 Bonsall et al. 2015</td>
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</tbody>
</table>

### Only one measurement per building

<table>
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<tr>
<th>Sample Code</th>
<th>Location</th>
<th>Description</th>
<th>Date Range</th>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bln-576</td>
<td>LV2/66, charcoal (Quercus sp.)</td>
<td>Building 16, A thin layer of charcoal on the floor</td>
<td>6820±100</td>
<td>5972–5556 6090–5940 (poor agreement 14.1%) Quita 1975</td>
</tr>
<tr>
<td>Bln-575</td>
<td>LV1/66, charcoal (Quercus sp.)</td>
<td>Building 1, floor, SE area of the building, between two stone slabs</td>
<td>6860±100</td>
<td>5982–5574 6070–5930 (poor agreement 27.5%) Quita 1975</td>
</tr>
<tr>
<td>Bln-647</td>
<td>LV3/67, charcoal (Quercus sp.)</td>
<td>Building 9, Timber beam in the area covered by the floor of building 8</td>
<td>6845±100</td>
<td>5979–5566 6070–5930 (poor agreement 22.8%) Quita 1975</td>
</tr>
<tr>
<td>Sample association</td>
<td>Sample material and reference</td>
<td>Laboratory code</td>
<td>Radionuclide</td>
<td>Radiocarbon age (BP)</td>
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</tr>
<tr>
<td>Human left femur</td>
<td>OA-25214</td>
<td>77,593±33</td>
<td>–18.9</td>
<td>15.8</td>
</tr>
<tr>
<td>Human right femur</td>
<td>OA-25090</td>
<td>77,601±37</td>
<td>–18.9</td>
<td>15.9</td>
</tr>
<tr>
<td>Human skull fragment</td>
<td>BA-10653</td>
<td>75,500±70</td>
<td>–18.5</td>
<td>15.1</td>
</tr>
<tr>
<td>Human rib bone</td>
<td>OxA-25089</td>
<td>75,21±36</td>
<td>–18.4</td>
<td>15.9</td>
</tr>
<tr>
<td>Human tibia</td>
<td>UBA-25084</td>
<td>76,01±49</td>
<td>–20.4</td>
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<tr>
<td>Human petrous bone</td>
<td>OxA-5839</td>
<td>76,05±38</td>
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<tr>
<td>Human left humerus</td>
<td>OxA-5827</td>
<td>77,70±30</td>
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<td>Human right humerus</td>
<td>OxA-58261</td>
<td>76,01±38</td>
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<tr>
<td>Human scapula</td>
<td>OxA-58262</td>
<td>77,70±30</td>
<td>–18.7</td>
<td>15.7</td>
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**Phase III (Early Neolithic)**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Building</th>
<th>Charcoal</th>
<th>AMS date</th>
<th>Source</th>
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<tr>
<td>Ia-654</td>
<td>LV/1067</td>
<td>Quarta 1975</td>
<td>5724–5739</td>
<td>5920–5530</td>
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<td>Ia-655</td>
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**Phase III (Late Neolithic)**

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**Phase III (Early Bronze Age)**

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<tr>
<td>Ia-654</td>
<td>LV/1067</td>
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<td>Quarta 1975</td>
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<tr>
<td>Sample ID</td>
<td>Site &amp; Feature</td>
<td>Find Description</td>
<td>Date</td>
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<tr>
<td>OxA-16007</td>
<td>LV13, bone tool</td>
<td>Stone construction above the level of building 8 (spit 7) (08/07/1966)</td>
<td>7030±40</td>
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<tr>
<td>OxA-16212</td>
<td>LV37, domestic goat proximal metacarpus</td>
<td>Domed oven in quad. d/3, spit 6 (831a) (26/07/1968)</td>
<td>7041±35</td>
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<tr>
<td>OxA-16253</td>
<td>LV38, Domestic goat mandible</td>
<td>Quad. CXVI, spit 3 (16/08/1968)</td>
<td>7008±38</td>
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<tr>
<td>OxA-16213</td>
<td>LV39, Domestic cattle proximal metatarsus</td>
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<td>7043±37</td>
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<tr>
<td>OxA-16079</td>
<td>LV35, domestic pig scapula</td>
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<tr>
<td>OxA-16211</td>
<td>LV36, Domestic cattle horncore</td>
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<tr>
<td>OxA-16538</td>
<td>LV14, unfused epiphysis of a medium-sized mammal (inv. 552)</td>
<td>Placed with crouched primary adult burial 5 (11/07/1966)</td>
<td>7136±37</td>
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<tr>
<td>AA-58319</td>
<td>Human skull fragment</td>
<td>Burial 8, primary, old adult female, crouched position, right side, over the floor of building 24 (bag 263)</td>
<td>6825±51</td>
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<tr>
<td>OxA-25207</td>
<td>Human left femur</td>
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<td>7097±36</td>
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<td>OxA-25208</td>
<td>Human left femur</td>
<td>Burial 9, primary, old adult female, crouched position, right side, over the floor of building 24</td>
<td>7120±34</td>
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<tr>
<td>OxA-5828</td>
<td>Human left femur</td>
<td>Burial 32, primary, adult female (?) in crouched position, right side</td>
<td>7270±90</td>
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<tr>
<td>OxA-5831</td>
<td>Human femur or left tibia (?)</td>
<td>Burial 88, primary, adult female (?) in crouched position, right side, stone construction</td>
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<tr>
<td>OxA-5829</td>
<td>Human long bone (?)</td>
<td>Burial 35, adult female (?), disarticulated bones</td>
<td>6910±90</td>
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<tr>
<td>BA-10652</td>
<td>Human skull fragment</td>
<td>Burial 73, primary, adult male (?), right crouched</td>
<td>7265±30</td>
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<tr>
<td>AA-58320</td>
<td>Human skull fragment</td>
<td>Burial 17, primary, cranial fragment of possible young adult female, partly disturbed crouched inhumation</td>
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<td>Laboratory code</td>
<td>Sample material and reference</td>
<td>Sample association</td>
<td>Radiocarbon age (BP)</td>
<td>$\delta^{13}$C (%)</td>
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<tr>
<td>OxA-25093</td>
<td>Human right femur</td>
<td>Burial 2, primary, adult female (?), flexed</td>
<td>5337±32</td>
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<tr>
<td>OxA-25217</td>
<td>Human left ulna</td>
<td>Burial 18, adult, disarticulated remains</td>
<td>1825±25</td>
<td>−18.6</td>
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<tr>
<td>OxA-25212</td>
<td>Human left fibula</td>
<td>Burial “4”, adult, mixed bones?</td>
<td>421±23</td>
<td>−18.5</td>
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<tr>
<td>OxA-25216</td>
<td>Human left femur</td>
<td>Burial 29, primary, adult male, extended supine</td>
<td>426±23</td>
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<tr>
<td>OxA-25218</td>
<td>Human right humerus</td>
<td>Burial 30, primary, adult male, extended supine</td>
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<td>−18.7</td>
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<tr>
<td>OxA-25219</td>
<td>Human right femur or right tibia</td>
<td>Burial 62, primary, adult male, extended supine</td>
<td>389±23</td>
<td>−18.8</td>
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