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RADIOCARBON DATING OF ST. GEORGE'S ROTUNDA IN NITRIANSKA BLATNICA (SLOVAKIA): AN ARCHAEOLOGICAL COMMENT

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ABSTRACT. In 2021, a series of radiocarbon dates for St. George's Rotunda in Nitrianska Blatnica (Slovakia) was published. The samples were acquired during restoration work. Based on the analysis, the authors dated the rotunda to the period of around AD 820–887, with 86% of the probability distribution lying in the period before AD 863. The chronology is based on the combined radiocarbon date 1191 ± 10 BP, which was obtained from four samples of wood fragments found in the oldest mortar layer. However, the date proposed by the authors raises concerns. The conclusions were based on a selection of samples and modeling of radiocarbon dates but put less emphasis on the results of many years of broad archaeological research on the local settlement agglomeration as well as extant historical and archaeological knowledge. The present re-analysis of the early medieval mortar and plaster samples and simple modeling corroborates the alternative hypothesis, providing us with the date 1115 ± 13 BP (cal AD 892–988 2σ). The resulting probability range is consistent with current archaeological and historical knowledge. Consequently, contrary to former conclusions, the construction of the rotunda should be dated to the period between the end of the 9th century and the end of the 10th century.

KEYWORDS: architecture, Christianity, chronology, excavation method, radiocarbon dating.

INTRODUCTION

The pre-Romanesque rotunda of St. George in Nitrianska Blatnica is one of the most interesting and most precious early medieval sacral buildings in Central Europe. Its value stems partly from the fact that it is so well preserved. The publication in Radiocarbon (Povinec et al. 2021) made the results of radiocarbon dating of samples obtained during the excellent restoration work available to researchers and will facilitate debates surrounding the chronology of the rotunda. Nevertheless, the conclusions drawn in the original paper are puzzling. In this paper, I do not question the correctness of the sample analysis. On the contrary, I believe that the results are reliable and that the possibilities associated with mortar dating are remarkable. However, the interpretation of the results presented in the original paper is controversial at best—particularly the conclusion that the rotunda might have been built in the first half of the 9th century. The most problematic aspect of the analysis is the fact that the authors' reasoning was based on a radiocarbon date (1191 ± 10 BP) obtained by combining the dating of four wood fragments found in the oldest layer of mortar. It is puzzling because the authors obtained 20 radiocarbon dates in total from the site (Povinec et al. 2021:Table 1): six from wood samples (W), three from charcoal (C), seven from mortar (M) and four from plaster (P). Five of these dates refer to periods younger than the Early Middle Ages and the time of the rotunda's construction, but the remaining 15 dates allow performing a more thorough interpretation of the results, e.g. through combining samples, modeling the results, and their interpretation in the context of historical and archaeological research. The main aim of the original paper was to publish results of the dating—not a thorough critical discussion on the results—the entire original paper and its analysis puts less emphasis historical and archaeological view of the rotunda and the entire site. Therefore, the interpretation presented in the original paper is only one option among possible explanations.

The aim of the present paper is threefold. Firstly, it critically discusses the methods used to obtain the final combined dates and their interpretation presented in the original paper.

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Specifically, the present paper highlights different approaches used by the authors of the original study to the analysis of outliers in wood/charcoal samples and mortar/plaster samples. Secondly, the paper explains that, notwithstanding the benefits of the plaster and mortar analyses, the dating of an archaeological feature should not rely solely on the radiocarbon dating of mortar and plaster samples. Furthermore, it argues that the interpretation of the radiocarbon dates obtained from historical monuments or archaeological sites should take into account the extant literature. Finally, the paper seeks an alternative interpretation of the dating that is driven by historical and archaeological knowledge. By confronting the results of the radiocarbon analysis with historical and archaeological contexts, the present paper shows a fuller view of the chronology of St. George's Rotunda in Nitrianska Blatnica.

DOUBTS CONCERNING WOOD AND CHARCOAL SAMPLES

First of all, my doubts are raised by the fact that the entire analysis in the original paper in question relies on a combined radiocarbon date coming from wood samples (Povinec et al. 2021:974), even though the authors had other dates with which to inform their conclusions. Nevertheless, the original paper presents the date 1191 ± 10 BP as a final answer to the question of the rotunda's chronology. However, as the authors stressed, the date 1191 ± 10 BP combines and averages the dating results of four wood samples, namely W3, W4, W5, and W6 (of which W3 and W6 combined two further samples each). The resulting date 1191 ± 10 BP was obtained by dating small fragments of wood of unknown origin found in mortar in various spots of the feature. Yet, the authors treat the date as a benchmark against which they evaluate all other samples. Then, they used the date—or rather the 2σ section of the calibration range (cal AD 820–887 79.9%)—as a reference for further models (combinations of charcoal and mortar samples) that have been adjusted to the date in question. Finally, the authors attempted to corroborate their dating of the combined wood samples as well as charcoal samples (with a failed χ^2 test) by means of one of the samples used in this combination (W3 1212 ± 15 BP—incorrect labeling in the original paper).

Secondly, in the conclusions the authors presented yet another value, namely AD 783–880 (94.2%), obtained from this arbitrarily selected wood sample (W3). Putting aside all other samples and dates, the authors claimed that this date is decisive, because of low uncertainty. Instead, maybe it would be much better and in line with practices for dating archaeological features to focus on the W5 sample which is consistent with series of mortar samples? In general, however, radiocarbon dates obtained from scraps of charcoal and wood in this particular case should not be decisive at all and treated with highest carefulness (Bronk Ramsey 2009; Daugbjerg et al. 2020). Regrettably, the authors' choice has far-reaching consequences—the date AD 783–880 has been appearing in scientific and popular literature as well as in information for tourists and widely available magazines as the ultimate solution to the question of the history and chronology of the St. George's rotunda.

Why then do I find the date combining wood samples misleading despite the fact that the dating uncertainty of wood samples is lower than mortar samples? Applying standard methods, the rotunda should be treated as an archaeological feature and the mortar (stonework) and plaster as archaeological layers created during the short period in which the rotunda was built. This assumption is very important for the reliability of the chronology. If we treated wood and charcoal in the same way, they would have to be construction elements (of course only assuming that no older beams were used), not fragments that could get into the mortar and plaster from unknown sources (as contaminations). Wood and charcoal scraps could have

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come from the time during which the rotunda was built; equally likely, however, the fragments could have been slightly or even much older. But this we do not (and cannot) know. Given the uncertainty surrounding their origins, the dates—particularly those averaged or combined—obtained from wood and charcoal samples may inform the general chronology of archaeological sites such as the Nitrianska Blatnica-Jurko (the settlement on the hill) but should not be used as a decisive argument in the dating of the building.

In this case, however, rejecting older samples of charcoal or wood (e.g. W2 1140 ± 30 BP) has no justification. It is possible that each of the samples was dated correctly—of course with an error characteristic for radiocarbon analysis. When analysing samples from archaeological sites, we may not know when and from where fragments have originated or how they have entered a layer of mortar or plaster. We need to remember that mortar was not prepared in sterile conditions, but rather in pits near the construction site. The pit could have been contaminated with the remains of previous activities. Finally, we do not know from which part of a tree the fragments came, which may affect the analysis as well. Situations in which charcoal fragments in the backfill (e.g. soil filling a pit) are older than the chronology of an entire site are not rare, and archaeologists, when finding charcoal in such contexts, usually assume that it would be the case (Bronk Ramsey 2009). Consequently, averaging the dates of wood and charcoal shreds—as potentially random contaminants—raises methodological doubts and burdens the analysis with the risk of misinterpretation. The same applies to the dating of mortar samples (Daugbjerg et al. 2020). On the contrary, the analyses of samples taken from mortar and plaster—which are understood to be archaeological layers created at a specific point in time—if obtained correctly—would provide more reliable and more trustworthy information. Of course, we need to be aware that the presence of geological carbonates and other contaminations in the mortar could affect final results but in the absence of petrographic analyses we cannot know whether such contaminations were present in the samples. That fact forces us to treat the results with due caution. This is not a major hindrance, though. As Daugbjerg et al. (2022) pointed out results that do not take into account the presence of geological contaminants or secondary carbonates can be accepted without harming the model, provided the sample series passed statistical tests. The methodology for taking mortar samples used during the restoration seems to meet the highest scientific standards (Povinec et al. 2021:960–961). Therefore, we can assume that the series of mortar samples (cleaned of charcoal and wood fragments) was obtained and treated with a view to minimise the risk of contamination and bias during establishing the chronology (Daugbjerg et al. 2020; Hajdas et al. 2020b). Of course, future additional ^{14}C analyses can change the interpretation of the mortar samples.

DATING OF MORTAR AND PLASTER SAMPLES

The authors are clearly aware that mortar and plaster samples are younger than wood samples. Yet, they have refrained from a more detailed analysis of results for the oldest mortar and plaster. Instead, they have attempted to adjust the combined mortar date to the 2σ range that they obtained for combined wood samples. The authors argue that the χ^2 test fails for mortar samples. Such is true but only due to one sample (M6 1260 ± 23 BP) which is clearly an outlier and could have been eliminated from the combined sample. After all, in the case of wood samples the authors did not hesitate to eliminate the oldest sample as an outlier. Moreover, they accepted the results for charcoal samples, even with the failed χ^2 test, as they were similar to the results for wood samples. This lack of a consistent approach raises considerable doubts about the modeling process and results obtained by the authors.

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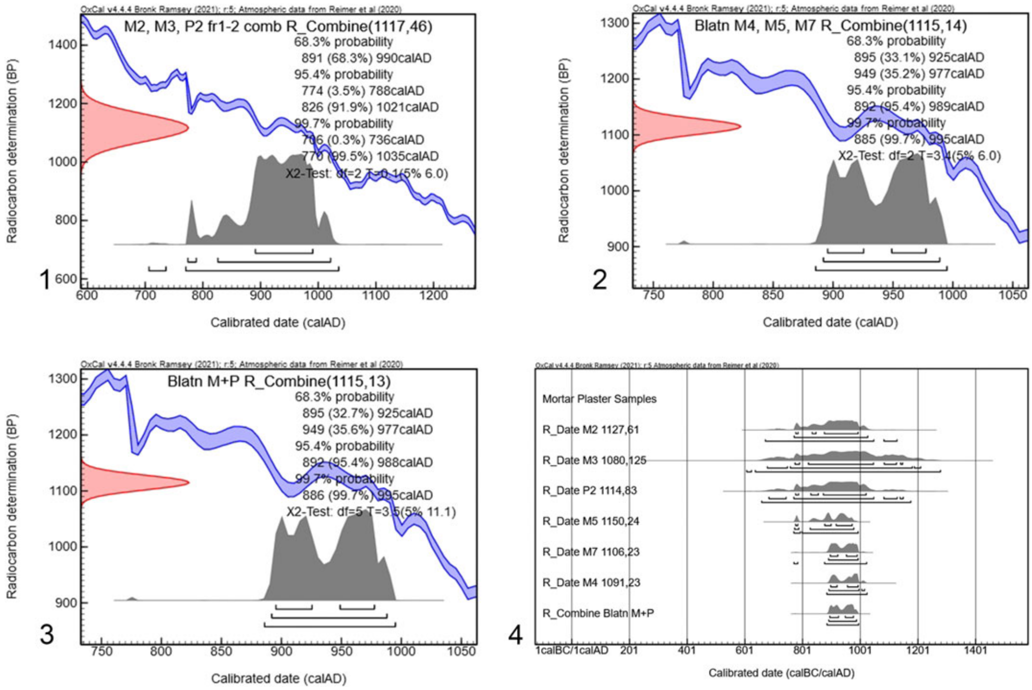

Figure 1 1: Calibrated combined date of the oldest mortar (M) and plaster (P) samples provided by ETH Zurich. 2: Calibrated combined date of the oldest mortar samples provided by Comenius University Laboratory (Bratislava)/University of Georgia (Athens). 3: Calibrated samples and combined date of the oldest mortar and plaster from the rotunda in Nitrianska Blatnica (OxCal 4.4.4). 4: Single raw data and combined calibrated samples (OxCal 4.4.4, Bronk Ramsey, 2021); atmospheric data from Reimer et al. (2020); raw data from Povinec et al. (2021: Table 1). Model by Z. Robak.

Let us then test the combined dates for the oldest mortar and plaster samples (excluding the M6 sample, which is clearly too old). There may be various causes of this inconsistent result for M6: measurement error or historical or modern contamination. The exclusion would be consistent with the methodology (Bronk Ramsey 2009). All other results—both separately for the two laboratories (ETH Zurich and Bratislava/Athens Laboratory) using different methods of analysis (Figure 1:1 and Figure 1:2) and combined (Figure 1:3)—are strikingly consistent. Importantly, there are twice as many mortar samples as wood samples; thus, the trial is more reliable. In the case of the dates provided by the ETH Zurich laboratory, I used the results for the first and second fractions presented in the original paper (Povinec et al. 2021:Table 2) as the best approximations of the age of the samples (Ringbom et al. 2014; Hajdas et al. 2020a; 2020b; Daugbjerg et al. 2022). The combined dates of the oldest mortar and plaster pass the χ^2 test, and the 1σ (cal AD 895–925 32.7% and cal AD 949–977 35.6%), 2σ (cal AD 892–988) and even 3σ (cal AD 886–995) ranges obtained by calibrating the 1115 ± 13 BP date differ only minimally (Figure 1:3). As an archaeologist-medievalist, I could only wish that all radiocarbon results were so clear.

Testing and Modeling of the Samples

We can now try to test the result 1115 ± 13 BP by modeling the radiocarbon dates and using knowledge from other sources. We have six dates for mortar (M2–M7) and one for plaster (P2). We already know that the mortar sample M6 (1260 ± 23 BP) is an outlier and not consistent

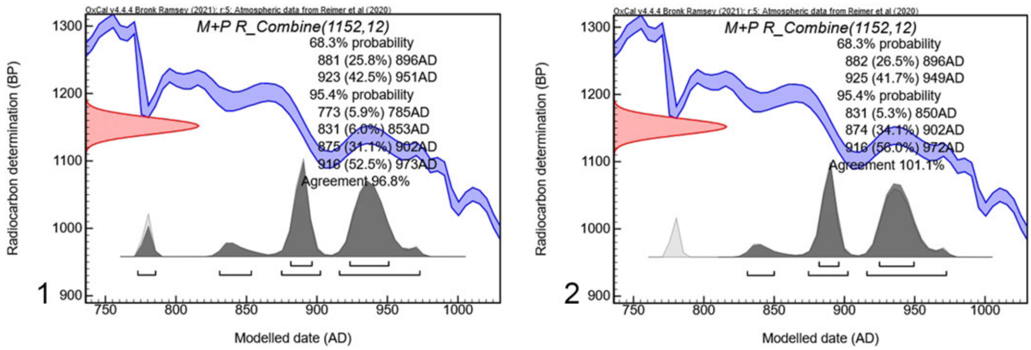

Figure 2 1: Combination of all the oldest mortar and plaster samples from Nitrianska Blatnica using the outlier analysis (N(0,2),0,s). 2: Model with TPQ AD 820 (OxCal 4.4.4). Raw data: Povinec et al. (2021:Table 1). Model by Z. Robak.

with other samples. Yet, it comes from the same "archaeological layer" as that of other mortar and plaster samples. It probably was created at the same time as that of the other samples; thus, its context hardly raises any doubts. However, because the χ^2 test for the entire set of mortar and plaster fails, we could use the modeling method with outliers that allows ignoring the failed χ^2 test and using all six early medieval mortar samples and one plaster sample. The advantage of this kind of analysis is that in a controversial case like this, we do not need to perform a qualitative assessment of which dates are most likely to be wrong (Bronk Ramsey 2009:8).

The modeling result 1152 ± 12 BP (Figure 2:1) is consistent with earlier calibrations (Figure 1:3), aging the combined date 1115 ± 13 BP only slightly, whereby indicating that the contaminated sample M6 has little effect on the entire set. We clearly see two density areas of the probability 1σ clustering around two ranges: cal AD 881–896 and cal AD 923–951. The dates are even clearer in the range of 2σ. However, if a low but noticeable probability of dating mortar and plaster samples to the second half of the 8th century looks troubling for someone, dating modeling allows eliminating such inconvenience. Generally, historical sources inform that Moravians were Christianised in AD 831 (Kalhous 2019:117). An enigmatic church of the as-yet-pagan Pribina was mentioned in the year AD 828/9. Consequently, the oldest churches in Moravia and Slovakia (and thus also their walls and mortar) cannot be much older. Let us then assume that the *ante quem non* date for the mortar is AD 820. This assumption allows us to eliminate any early results of calibration (Figure 2:2). As we can see, this assumption does not significantly change the chronology of the model presented in Figure 2:1. In both cases the hypothesis that the time of the construction activities should be dated to the first half of the 9th century is only minimally probable (5–6%). On the contrary, it should be rather linked with the turn of the 9th and 10th centuries or mid-10th century. Now, the only chronological dilemma that remains could be solved based on historical knowledge of the feature and its context.

ARCHAEOLOGICAL DISCUSSION

As we have seen, the combined date for loose wood fragments of unknown origin should be treated with the highest caution. The date 1191 ± 10 BP (or rather its components) should refer to a range in the chronology of the entire archaeological site (not only the rotunda). The church most likely was not built on a deserted spot, but inside the settled area. Based on the date, thus, we can say that the archaeological site should be dated to the Early Middle Ages, a range between the 9th and 10th centuries. This result points to any possible human activities on the site during that

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period. This is consistent with archaeological knowledge linking the site generally with the time between the 9th and 11th centuries (Ruttkay 2016; 2017). On the other hand, the date for the mortar and plaster samples (1115 ± 13 BP; Figure 1:3) provides a more direct approximation of the construction time of the rotunda. Unfortunately, this more reliable chronology has been dismissed by Povinec et al. (2021), who proposed a much older chronology instead.

The original article focused on the radiocarbon dating of the rotunda and derived the outcomes from the excellent restoration research carried out by J. Dorica. It seems however, that authors of the analysis overly trusted one specific historical source (Conversio Bagoariorum). The discussion, however, puts less emphasis on the detailed results of archaeological research on the site and its broader environment. I understand that this was not the main purpose of the article, but this context could change the perception of the chronology of the church.

The series of independent radiocarbon dates obtained by the two laboratories excellently reflect extant historical and archaeological knowledge of the Nitrianska Blatnica-Jurko site and other neighbouring sites. However, when in archaeology we use radiocarbon analyses that provide more than one possible dating after calibration and modeling, the interpretation of the results cannot be undertaken by neglecting the historical context. And the context is now relatively well known. The Nitrianska Blatnica-Jurko site—which between the 9th and 11th centuries was a light-strengthened mansion—belongs to the agglomeration of settlements, cemeteries, and smaller defensive structures surrounding the mighty early medieval stronghold Bojná-Valy. The authors, however, seem to overlook this fact. The entire agglomeration has currently been studied constantly through excavations and non-invasive methods for the past 17 years by a team of archaeologists from the Institute of Archaeology (SAS) (Pieta and Robak 2017; Robak 2021a; 2021b). The hillfort Bojná-Valy is located only 4 km from the rotunda, on the eastern slope of the same hill on which the rotunda stands and where the mansion had been located. Undoubtedly, these sites must have been related—particularly since neither the church nor the mansion was found inside of the stronghold. The fortifications of Bojná-Valy were dendrochronologically dated to the end of the 9th century (the construction was built around AD 890–895). The ramparts were used (reconstructed) for at least 20–30 years. Interestingly, Bojná-Valy and many other Slovak hillforts had been traditionally believed to be funded by Pribina in the first third of the 9th century, at least until dendrochronological analyses of wood samples taken from the fortifications refuted those hypotheses (Henning and Ruttkay 2011). Furthermore, dendrochronology shed new light on the older radiocarbon results and allowed their re-evaluation (Henning et al. 2017; Robak 2018:162).

What is more, we need to take into account the so-called *Eigenkirche*—private churches owned by the nobility in the eastern peripheries of the Carolingian Empire (currently Bohemia, Moravia, and Slovakia). Such churches are directly linked with the formation of early feudalism in this region and the emergence of the first local nobility (who could pay to build churches on their estates). Not only was owning a church a manifestation of prestige, social standing, and aspirations, it could also protect at least part of the property ceded for the church's needs from being seized by the ruler (Lukačka 2011; Macháček et al. 2018; 2021; Robak 2018). Chronologically, the processes started during the decline of Great Moravia and the reign of Svatopluk (871–894) and his descendants and in the post-Great Moravian period dated to the first half of the 10th century. That is why small pre-Romanesque aisleless churches and rotundas, also mentioned by the authors of the original paper, are generally dated to the 10th century. Moreover, remains of a recently found rotunda and mansion in Břeclav-Pohansko (Moravia) are also linked with the turn of the 9th and 10th centuries (Macháček et al. 2018). Therefore, the chronological model presented in Figure 2:2 is consistent with current historical knowledge, unlike the conclusions of the original paper.

CONCLUSION

Extant historical and archaeological knowledge corroborates the view that the rotunda in Nitrianska Blatnica was built at the turn of the 9th and 10th centuries or in the first decades of the 10th century. The combined radiocarbon date (1115 ± 13 BP) for mortar samples is consistent with archaeological and historical knowledge. It seems to be likely that the rotunda was a private church belonging to some local but reputable nobleman linked to the area protected and controlled by the Bojná-Valy stronghold at the turn of the 9th and 10th centuries. But even if the rotunda had been built in the second half of the 10th century, which is also allowed by the interpretation of the model, it would still be chronologically consistent with the time during which noblemen's small churches were constructed in this region. Even if dated to the second half of the 10th century, it would still remain one of the oldest churches still existing in Central Europe. To recognise the historical value and meaning of the site, we need neither "duke" Pribina (whose position and power tend to be exaggerated in Slovak literature) nor Saints Cyril and Methodius. If, however, the rotunda in Nitrianska Blatnica turned out to be the first of Pribina's churches—not a private church of an anonymous local nobleman—it would bring nothing but joy for many archaeologists, including myself. But it takes much more than a few scraps of wood and charcoal to unambiguously prove the origins of the rotunda.

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