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# CHRONOMETRY OF LATE ENEOLITHIC AND 'EARLY BRONZE' CULTURES IN THE MIDDLE DNIESTER AREA: INVESTIGATIONS OF THE YAMPIL BARROW COMPLEX

## ABSTRACT

The paper discusses the 2010-2015 studies of the radiocarbon chronology of Podolia 'barrow cultures' on the left bank of the middle Dniester. The studies have relied on series of $^{14}C$ dates for the Klembivka 1, Pidlisivka 1, Porohy 3A and Prydnistryanske 1 sites determined in Kyiv and Poznań laboratories. They are the first attempt to construct a regional ('Yampil') radiocarbon scale for 'Early Bronze' funerary rites (4th/3rd-2nd millennium BC) as practised by barrow builders – the communities of the Tripolye and Yamnaya cultures – and the secondary barrow users – the designers of necropolises located on barrows – belonging to the Catacomb, Babyno and Noua cultures.

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The study of the radiocarbon chronometry of Late Eneolithic and 'Early Bronze' cultures within the *Yampil Barrow Complex* (located between where the Murafa and Markivka rivers empty into the Dniester, Yampil district, Vinnitsa *Oblast*) is an integral part of the international research programme devoted to the study of the north-western frontier of settlement by the nomadic communities of the Black Sea Coast, associated with the prologue of the Bronze Age. The programme commenced in 2010 with the exploration of the Pidlisivka 1 funeral site[1]. The series of radiocarbon measurements discussed in this paper was obtained for seven barrows excavated in 2010-2014 by the Polish-Ukrainian *Yampil Expedition* launched by the Institute of Prehistory, Adam Mickiewicz University in Poznań and the Institute of Archaeology, Ukrainian National Academy of Sciences (UNAS) in Kyiv, in association with the Institute of Archaeology and Ethnology of Polish Academy of Sciences, Centre for Mountains and Uplands Archaeology in Kraków.

## 1. PIDLISIVKA 1: STAGE OF METHODOLOGICAL DISCUSSIONS AND PRELIMINARY STUDY

These issues were tackled for the first time in respect of both (a) the correspondence of radiocarbon dating methods and (b) the analyses of specific measurements referring to graves investigated in 2010 and linked to the cultures – Yamnaya (YC) and Babyno (BC) – covered by the research programme and others staying beyond its scope – originating from the Early Middle Ages – in the paper by T. Goslar, A. Kośko and S. Razumov published in 2014 [Goslar *et al*. 2014].

Available then, 14 measurements made from samples of human bones and wooden structures of grave pits taken from eight Pidlisivka features/burials (1A, 1Aa, 1B, 4, 5, 7, 11 and 12)[2] were performed at the Kyiv Radiocarbon Laboratory, Institute of Environmental Geochemistry, UNAS (Ki) and the Poznań Radiocarbon Laboratory, Foundation of the Adam Mickiewicz University (Poz) (Tab. 1). The latter laboratory (Poz), besides presenting absolute chronological findings, determined also the content and composition of the stable isotopes of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) [Goslar *et al*. 2014: Tab. 4.1: 2].

Both the need to discuss 'the methodological correspondence of all analyses', felt by the major Polish and Ukrainian project team members [Klochko *et al*.

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[1] For a broader description of the programme objectives *see* Kośko *et al*. 2014: 11-13.

[2] For a broader discussion *see* Kośko *et al*. 2014a.

Table 1

Results of $^{14}C$ dating of features from the barrow 1 at Pidlisivka. Results sets of double dating of the same samples are separated by dotted lines. Dates considered unrepresentative [Goslar *et. al* 2014] are printed in italics.

| FEATURE | Lab no. | $^{14}C$ Age BP | Calendar Age BC (68.2%) |
|---|---|---|---|
| | | **Eneolithic (?)** | |
| *1/1B* | *Ki-16674* | *3680±90* | *2199-1944* |
| *1/11* | *Ki-16676* | *3690±80* | *2198-1964* |
| 1/11 | Poz-81824[1] | 4085±30 | 2836-2575 |
| | | **YC** | |
| *1/1Aa floor* | *Ki-16673* | *3720±60* | *2201-2032* |
| *1/1Aa floor* | *Ki-16892* | *3895±70* | *2473-2287* |
| 1/1Aa floor (wood) | Poz-52423 | 4190±35 | 2884-2700 |
| 1/1A ceiling | Poz-38529 | 4195±35 | 2886-2701 |
| 1/1A ceiling | Poz-39214 | 4080±40 | 2840-2500 |
| 1/1A ceiling (wood) | Poz-52424 | 4085±35 | 2838-2506 |
| | | **CC (?)** | |
| 1/7 | Poz-38531 | 4120±35 | 2858-2621 |
| 1/4 | Ki-16675 | 3810±80 | 2436-2139 |
| | | **BC** | |
| *1/5* | *Ki-16677* | *4170±90* | *2884-2632* |
| *1/5* | *Ki-16893* | *4130±50* | *2864-2622* |
| 1/5 | Poz-38530 | 3430±35 | 1862-1685 |
| | | **Early Middle Ages** | |
| 1/12 | Ki-16678 | 1050±80 | 887-1146 AD |

[1] – a new determination, not published in Goslar *et al*. [2014]

2015a], and the differences between archaeological and radiocarbon age determinations made their re-analysis necessary. Initially, it focused on the possibility of the reservoir effect (Poz) eventually affecting the $^{14}C$ ages of human bones, dominating by far in the Pidlisivka samples, owing to their 'chronometric advantage of short-livedness' (12 out of 14 analyzed samples). It was found out that 'the $\delta^{15}N$ value, measured for the collagen of dated Pidlisivka bones (10-11.6‰), could not be considered the sign of making $^{14}C$ ages older by the reservoir effect'. Nevertheless, the possibility of making age measurements older, as a consequence of the reservoir effect, made us attempt to corroborate the finding by 'dating samples of other materials than human bones. As no bones of herbivorous animals were available, oak wood was used for this purpose, taken from the ceiling at the level of the pit cover of grave 1A, as well as charcoals (oak) from the floor of this feature' [Goslar *et al*. 2014: 306, 307]. This attempt proved positive as well: the chronometric credibility of local ('middle Dniester') human bone samples was retained. Consequently, it was necessary to concentrate on the possible methodological-procedural differences between the two radiocarbon laboratories (Ki and Poz) [Goslar, Kośko 2011], leading to a discussion between them (*see* Ch. 2.2).

Relying on spatial stratigraphy and the typo-chronology of funerary practices, four grave subsets were distinguished: Eneolithic (graves 1B, 10 and probably also 11), YC (central feature for the younger mound: 1A + 1Aa), Catacomb culture (CC) (graves 4 and 7) and BC (diagnostic feature 5).

Continuing the inter-laboratory discussion after 2014, in this case devoted to 'Yampil taxonomic nomenclature' as regards 'barrow cultures', researchers subjected the cultural attributions made earlier [Kośko *et al*. 2014a] to verification, pointing to the need of considering the presence of Eneolithic and CC graves (features 4 and 7) on the Pidlisivka 1 site.

The dating of the oldest phase, associated with the Late Eneolithic, was unsuccessful: the result obtained for central grave 1B was not credible as it referred to the late 3rd and early 2nd millennia BC. Associated with the Eneolithic or the YC, feature 11 has also yielded a result, based on Ki-16676, which was not credible. An additional, recent dating of bones from this feature (Poz-81824) is, however, consistent with the age of Eneolithic feature 7 from the Porohy 3A site discussed below (Ch. 2.2, Tab. 3).

In order to date the YC phase, a series of measurements (Poz) was procured, dating wood and human bones from features 1A + 1Aa. They point to the interval of 2865-2665 BC (68.2%), which is representative of the building of the younger barrow mound.

The date obtained for grave 7 (2858-2621 BC) can be treated as a 'non-typological-ritual' argument in favour of linking it to the CC circle [Kośko *et al*. 2014a: Fig. 3.1: 6; Razumow 2014; due to its rather indistinctive character, the feature was earlier considered to have been related to the BC]. This measurement clearly differs from the result obtained for grave 4 (2436-2139 BC) – also hypothetically associated with the CC, but in an earlier publication associated with the YC.

To assess the chronometry of the youngest of the 'Early Bronze' grave subsets identified with the BC a single date is available, which is 'credible from an archaeological point of view' and was obtained for human bones from feature 5 (Poz-38530): 1862-1685 BC (68.2%).

## 2. THE 2011-2014 INVESTIGATIONS: PERIODIZATION AND CHRONOMETRY OF 'YAMPIL BARROW' USE IN THE 4TH/3RD-2ND MILLENNIUM BC

In 2011, 2012 and 2014 another three *Yampil barrow* cemeteries located on the following sites: Porohy 3A, Klembivka 1 and Prydnistryanske 1 were excavated. Corollaries of the excavations, next 57 age determinations of funeral features were made either by both laboratories mentioned earlier (Porohy 3A) or the Poznań laboratory (Klembivka 1, Prydnistryanske 1). The determinations concern a broader range of 'barrow cultures': the Late Tripolye culture – Gordineşti group (TC-G), other groups of the forest-steppe Eneolithic, YC, CC, BB and the Noua culture (NC), documenting the interval from ca. 3350 BC to 1400 BC. The sequences of the newly obtained series of $^{14}$C dates shall be discussed in the subsections that follow, giving prominence – by discussing it first – to the diagnostically superior series of radiocarbon measurements obtained on the Prydnistryanske 1 site.

### 2.1. PRYDNISTRYANSKE 1

Located 1.0 km north of the Dniester, the site comprised four excavated barrows. Within them, the series of the oldest barrow features to be recorded in the Podolia Middle Dniester Area was exposed and shown to represent TC-G burials under mounds (barrows I-III and the oldest mound of barrow no. IV). The formal-metric characteristics of these funeral structures are discussed in Klochko *et al*. [2015]. So far, this 'pre-Yamnaya barrow horizon' [Ivanova, Toschev 2015a; 2015b] has been identified in typo-chronological classifications made in Moldavia, including nearby Oknişa, Kamenka district, situated 17 km east of the site under discussion [Manzura *et al*. 1992], and in the middle Dniester-Prut interfluve [Larina 2003; Yarovoy *et al*. 2012: 299, Fig. 10]. It must be stressed that the chronology of TC-G barrow cemeteries presented here is the first attempt to determine the time frame of the phenomenon in question which until now has been presented taking advantage of the effect of general chronology.

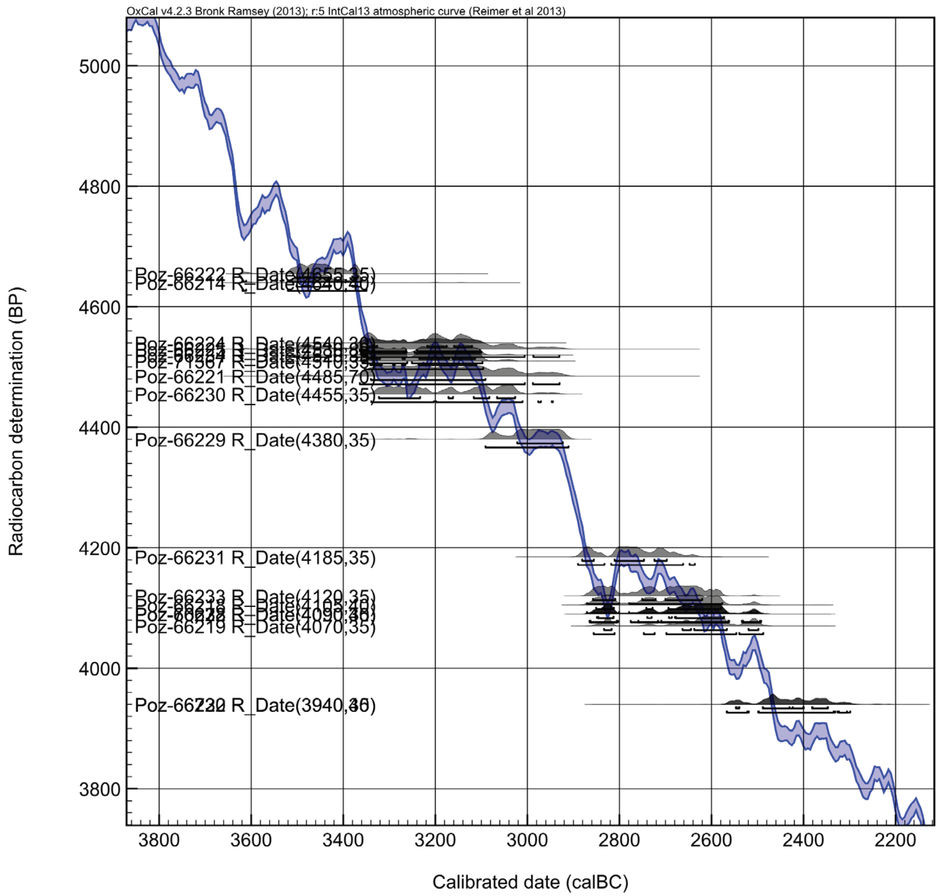
The second group of barrow features within the Prydnistryanske 1 site consists of YC features: ones under barrows and others sunk into mounds (younger mounds nos. 2 and 3 of barrow IV). The third group comprises a double CC burial sunk into the mound of barrow I (feature I/4) [Klochko *et al*. 2015]. The recorded feature indicates connections to the Donets group/culture [*see* the concept of Ingul-Donets Early Bronze Civilization in Klochko, Kośko 2013].

Table 2

Results of $^{14}C$ dating of features from Prydnistryanske 1. Sample material other than human bones is indicated with feature designations

| FEATURE | Lab No. | 14C Age BP | Calendar Age BC (68.2%) | Calendar Age in model[1] BC (68.2%) | Collagen Extraction Efficiency (%) | Collagen C/N (at) |
|---|---|---|---|---|---|---|
| | | | **TC-G** | | | |
| I/1 (wood) | Poz-66214 | 4640±40 | 3464-3341 | 3380-3274 | | |
| II/2 (wood) | Poz-66222 | 4655±35 | 3506-3369 | 3381-3281 | | |
| II/1 (charcoal) | Poz-66221 | 4485±30 | 3331-3099 | 3291-3151 | | |
| III/1 | Poz-66224 | 4540±35 | 3362-3119 | 3360-3131 | 11.8 | n.m. |
| III/2 | Poz-66225 | 4530±35 | 3356-3116 | 3356-3183 | 14.0 | n.m. |
| III/3 (wood) | Poz-71367 | 4510±40 | 3343-3109 | 3289-3138 | | |
| IV/10 mound 1 | Poz-66234 | 4520±40 | 3350-3113 | 3351-3177 | 7.4 | n.m. |
| | | | **YC early rite** | | | |
| IV/4 mound 2 | Poz-66230 | 4455±35 | 3323-3027 | 3063-2933 | 1.5 | n.m |
| IV/4 mound 2 (wood) | Poz-66229 | 4380±35 | 3023-2911 | 3063-2933 | | |
| IV/6 mound 2/3 | Poz-70673 | 4090±40 | 2850-2573 | 2861-2682 | 7.0 | 3.07 |
| IV/6 mound 2 (wood) | Poz-66231 | 4185±35 | 2882-2698 | 2861-2682 | | |
| | | | **YC late rite** | | | |
| IV/9 mound 3 | Poz-66233 | 4120±35 | 2858-2621 | 2680-2586 | 8.0 | n.m. |
| IV/8 mound 3 | Poz-66232 | 4090±35 | 2847-2574 | 2671-2586 | 9.0 | n.m. |
| IV/3 mound 3 | Poz-66228 | 4090±35 | 2847-2574 | 2671-2586 | 4.6 | n.m. |
| | | | **CC** | | | |
| I/4 (wood) | Poz-66218 | 4105±40 | 2851-2580 | 2621-2489 | | |
| I/4 (M) | Poz-66219 | 4070±35 | 2834-2499 | 2564-2467 | 13.6 | n.m. |
| I/4 (F?) | Poz-66220 | 3940±40 | 2548-2348 | 2564-2467 | 11.0 | n.m. |
| I/4 (F?) BIS | Poz-66732 | 3940±35 | 2548-2348 | 2564-2467 | as above | as above |
| | | | **Other** | | | |
| I/1 (wood) | Poz-66235 | 13390±70 | 14281-14056 | --- | | |
| III/3 (wood) | Poz-66226 | 9090±50 | 8447-8233 | --- | | |
| I/2 | Poz-66216 | 1930±30 | 29 AD-123 AD | --- | 3.7 | n.m. |
| III/4 | Poz-74405 | 1160±30 | 778 AD-944 AD | --- | 13.0 | 3.20 |
| I/2 (wood) | Poz-66215 | 235±30 | 1680 AD-1939 AD | --- | | |
| II/3 | Poz-66223 | 155±30 | 1669 AD-194 5AD | --- | 15.5 | n.m. |

[1] – allowing for the time lag between the tree-ring growth and tree cutting, and carbon accumulation effect in respect of bone sample I/4 (male (M) skeleton).




F i g . 1 . Calibration results of $^{14}$C ages of samples from Prydnistryanske 1 shown against the Intcal13 calibration curve [Reimer *et al.* 2013]. The position of probability distributions of calibrated dates in respect of the vertical axis corresponds to the $^{14}$C ages of samples. For the calibration, the Oxcal v 4.2.3 software [Bronk Ramsey, Lee 2013] was used

Among the sample materials from Prydnistryanske 1, human bones are the hardest to date, because their dating results may be distorted due to collagen contamination (collagen undergoes degradation in bones buried in sediments) or the reservoir effect. The experience of radiocarbon laboratories shows that a good indicator of the state of preservation of collagen is extraction efficiency (expressed as the ratio of the mass of obtained collagen to initial bone mass), with the efficiency threshold recommended by the Oxford $^{14}$C Laboratory being 1% [Brock *et al*. 2012]. The experience of the Poznań laboratory shows that very good dating results can be also obtained at lower extraction efficiencies (between 0.5-1.0%).

Another and a more direct indicator of collagen quality is the atomic ratio of C/N, which in the extracted collagen should stay in the interval of 2.9-3.5 [van Klinken *et al*. 1999; Brock *et al*. 2010]. In this context, it can be said that the very high extraction efficiency values (Tab. 2) leave no doubt as to the quality of collagen in the dated bones from Prydnistryanske 1.

Below, radiocarbon determinations attributed to Eneolithic and Early Bronze cultures (TC-G, YC, CC; Tab. 1) have been taken into account, leaving out Neolithic, Mesolithic, Iron Age and common era dates. Importantly, the measured $^{14}C$ ages of samples linked to the above-named cultures cluster around values corresponding to the plateaus of the radiocarbon calibration curve (Fig. 1), while there are no results, corresponding to the steep sections of the curve. With a more or less random distribution of the calendar ages of measured samples, this distribution of $^{14}C$ ages is the most probable, because the plateaus correspond to periods on the scale of calendar years which are many times longer than the steep sections of the curve. Such a 'usual' distribution of $^{14}C$ ages would be distorted no doubt by the reservoir effect (it would come into play if the dated samples came from the individuals who subsisted on an aquatic diet), which makes the $^{14}C$ ages of single samples older by any, randomly distributed values.

The issue of the distortion of $^{14}C$ dating results by the reservoir effect was raised in the above-mentioned discussion of the chronometric investigations of Pidlisivka 1 barrows [Goslar *et al*. 2014], where the measured values of $\delta^{13}C$ and $\delta^{15}N$ in the collagen of the examined bones did not suggest that it played a significant role. A similar conclusion can be drawn from the measurements of $\delta^{13}C$ and $\delta^{15}N$ in the bones from Prydnistryanske 1; these results stayed in the range of -18.8 – -17.9‰ and 8.2-10.9‰, respectively. The position of the $^{14}C$ ages from Prydnistryanske 1 with respect to the calibration curve clearly supports this conclusion.

Among the radiocarbon dated materials from Prydnistryanske 1 are samples of human bones and wood (including charred wood). Interestingly enough, within the taxonomically distinguished cultural phases, calendar ages of wood samples are on the average older than bone sample ages (Fig. 2). This may reflect the actual relationship between the calendar ages of examined features, which just happens to be so, but may also result from the fact that the age of wood determined using the $^{14}C$ method corresponds to the time when the examined tree rings grew, hence it is necessarily older than the moment the tree in question was cut down and its wood was used. If the dated wood comes from larger structural elements (e.g. grave), the resulting ageing of the dating result by several decades may be considered highly probable. Keeping this effect in mind, we can admit that the oldest dated wood samples from phase TC-G come from the graves that are indeed of the same age as the burials dated by measuring bone samples. For let it be noticed that the $^{14}C$ ages of samples Poz-66214 and Poz-66222 are, admittedly, older than the ages of bones by 150-200 radiocarbon years, but the ranges of calendar ages of these samples are not more than 50 years apart. Obviously, the question whether the graves

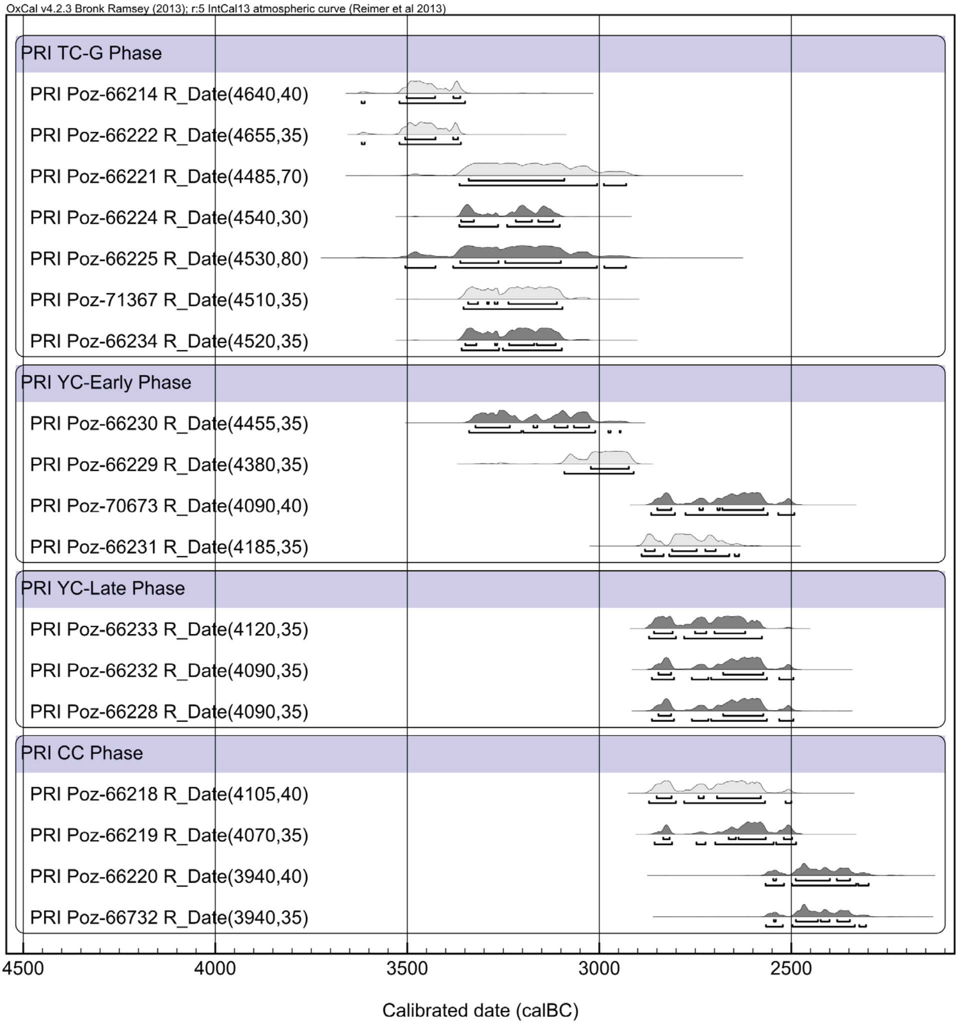



Fig. 2. Calibration results of $^{14}C$ ages of samples from Prydnistryanske 1. Light-grey silhouettes correspond to wood and charcoal samples

dated with the two wood samples mentioned above are older than the others or not, cannot be settled here.

When calibrating a $^{14}C$ age, the effect of the difference between the date when a tree grew a given piece of wood and the date when the tree was cut down can be accounted for by allowing for the time lag between these two events. In the case of the investigated site, we do not know anything about the amount of this allowance but the fact that the trees used for building the grave structures are not likely to have had more than 100 annual growth rings. Thus, we can only assume that the

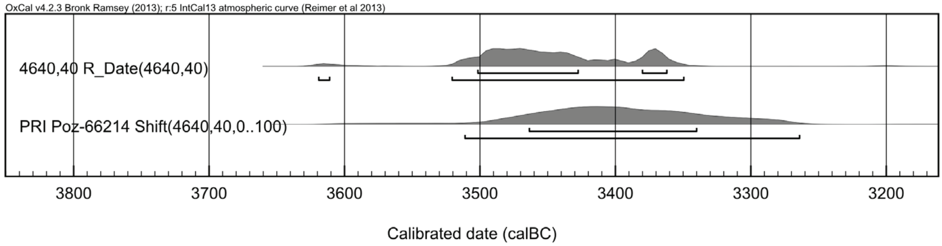


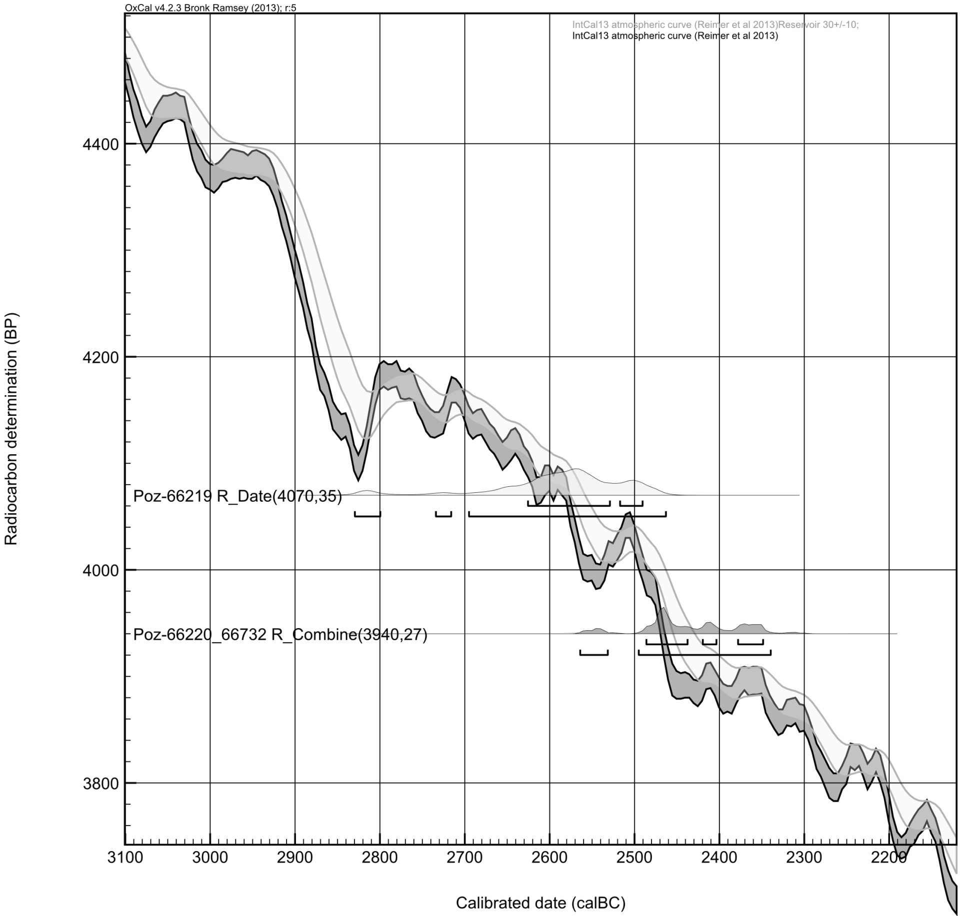

Fig. 3. Prydnistryanske 1: Correction to the probability distribution of a calibrated date allowing for the time lag between the growing of the dated piece of wood and the cutting down of the tree. Above: probability distribution of the calibrated age of the dated sample. Below: probability distribution of the tree-cutting date calculated on the assumption that the correction may take any value in the 0-100 range

allowance amount has a uniform probability distribution in the interval of 0-100 years. The impact of such an allowance, on the example of one $^{14}$C date, is shown in Fig. 3.

Another interesting effect is revealed by the relationship between the $^{14}$C ages of bones from feature I/4. In this case, $^{14}$C dates for the bones of a male (Poz-66219) and a female (Poz-66220 and Poz-66732) differed despite the fact that the remains were identified as a single coherent instance of funeral behaviour. The reason for the difference (besides the inevitable statistical scatter of measurement results) is the suggested considerable age difference between the two individuals at the moment of death (the woman being much younger than the man). The age of an individual at death has a certain impact on the result of $^{14}$C dating of bones, because the carbon in bones is quickly replaced (with carbon supplied with food) only in young individuals (below 20-30 years of age), while in the bones of older individuals atoms can be encountered that have been accumulated over a long time. For example, in a 50-year-old man, the average 'age' of an atom of carbon in bone is 30 ± 10 years [Geyh 2001]. Therefore, when calibrating the $^{14}$C age of bones of an individual who died at an advanced age, one should use in principle a calibration curve corrected to account for the 'accumulation effect' (Fig. 4).

Strictly speaking, the effect of carbon accumulation in bones should be accounted for when calibrating the $^{14}$C age of all human bones. However, this effect, even in the case of dating bones belonging to individuals who died at an advanced age, is not very serious and it is surely for this reason that it is very rarely taken into account when processing $^{14}$C dates apart from cases when altering the result of calendar dating by 10-30 years makes a significant difference.

Allowing for the accumulation effect when calibrating the dating results of the bones of the male and female, grave I/4 shows the simultaneity of both burials to be quite probable (Fig. 5: A). This can be seen in the values of the matching




F i g . 4 . Prydnistryanske 1: Calibration results of $^{14}$C ages of the bones of a female (averaged Poz-66220 and Poz-66732 results) and a male (Poz-66219) from feature I/4. The darker band represents the Intcal13 calibration curve, while the lighter one represents the same curve allowing for the carbon accumulation effect over a period of 30±10 years

index ‘A’ of both distributions to the model being higher than 60 – considered to be a threshold value. It is harder, however, to accept the simultaneity of both burials and the moment of tree cutting, the wood of which (fragment of the handle of a stone mace) is dated by the result Poz-66218 (Fig. 5: B). For this model matches rather poorly (A=44) with the date for the bones of the woman obtained as the result of two $^{14}$C measurements (Poz-66220 and Poz-66732). Therefore, it has to be admitted that either the tree trunk (the wood of which was extracted from grave I/4) had more than 100 annual growth rings or the moment of cutting down this very tree preceded the burial.

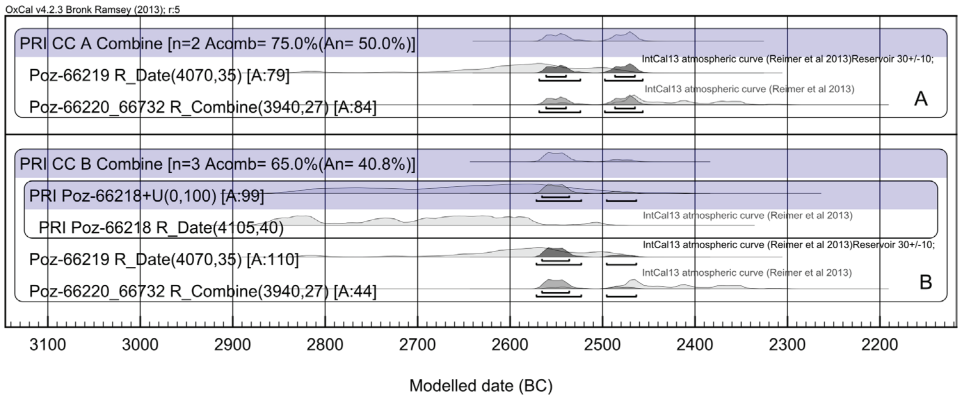
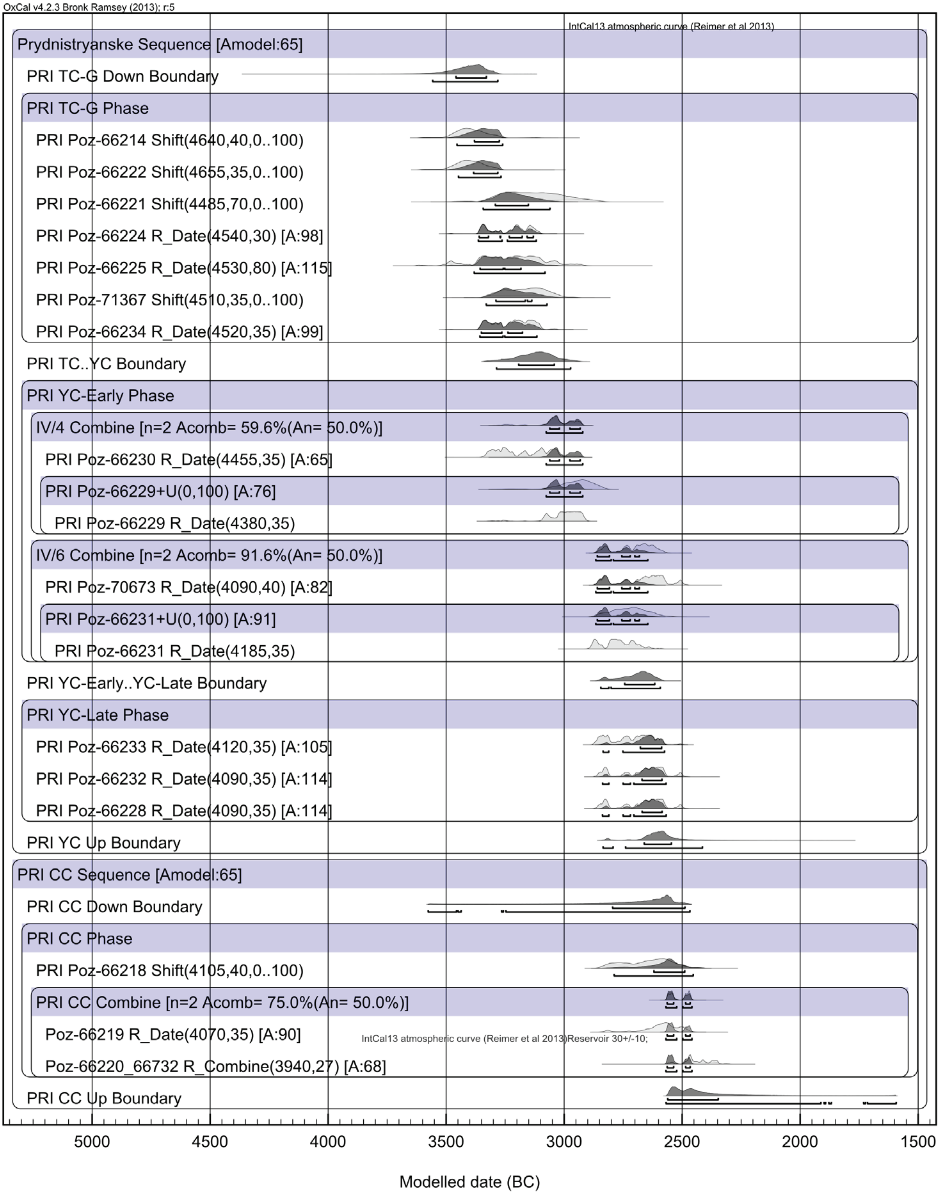



Fig. 5. Prydnistryanske 1: A – Results of calibration of $^{14}$C ages of bones from feature I/4, assuming the simultaneity of both burials. Date Poz-66219 was calibrated allowing for the carbon accumulation effect. B – Results of the combined calibration of the $^{14}$C ages of bones and wood from feature I/4. The age of wood was calibrated allowing for the time lag between the growing of the dated piece of wood and the cutting down of the tree. The simultaneity of both burials and the cutting down of the tree was assumed

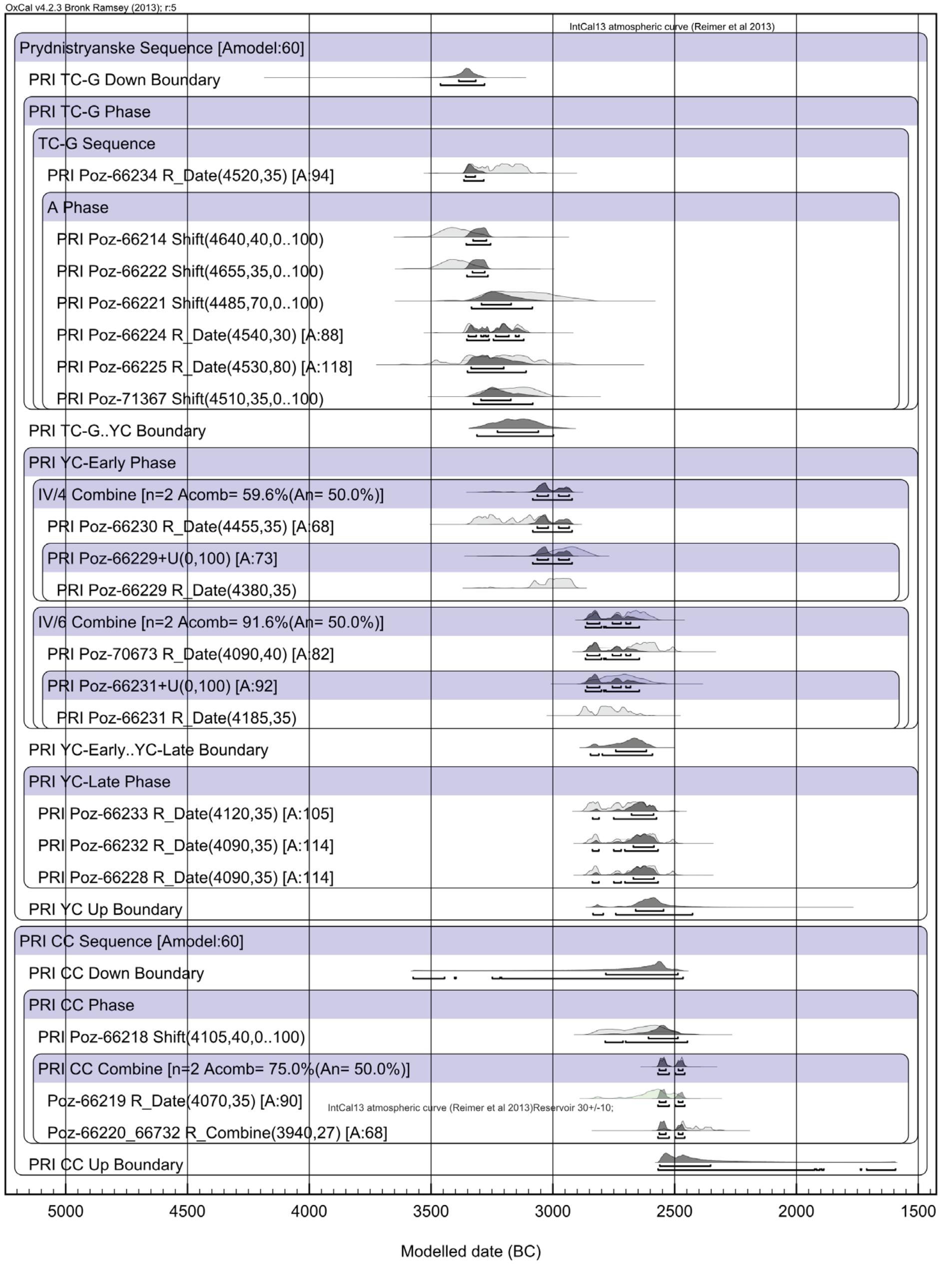
The set of $^{14}$C dating results was processed using a Bayesian approach [Bronk Ramsey 2009] by grouping samples into phases according to their taxonomic attribution to particular cultures (Fig. 6). The grouping into a phase reflects the assumption that in the time interval (corresponding to the period when a given culture functioned) the calendar dates of examined samples are randomly distributed. Since a connection can be presumed to exist between the dates for wood/bone sample pairs coming from the same grave (Poz-66230/Poz-66229 and Poz-70673/Poz-66231), within a single phase, dates for such pairs were combined, assuming the simultaneity of the tree felling and burial. The dates for all bones from grave I/4 were treated jointly as well.

The model assumed that YC features were younger than ‘Late Tripolye’ features (TC-G). It was further assumed that two YC phases succeeded one another in agreement with the typological division into YC-early ritual (YC-ER) and YC-late ritual (YC-LR). No exact time sequence was imposed, however, on the relation of YC features to the CC feature on the assumption that the features of these two cultures could come into existence in parallel in a certain period.

The results of modelling place the dates for TC-G features in the interval of 3364-3165 BC (68.2%), YC features, divided into the YC-ER and YC-LR, in the brackets of 3056-2767 BC and 2690-2577 BC (68.2%), respectively, and the CC feature in the bracket of 2669-2419 BC (68.2%). Interestingly, the chronometric verification does not undermine the correctness of matching YC features to the phases of the early and late ritual while suggesting that the former prevailed much




F i g . 6 . The Bayesian model of the ages of samples from Prydnistryanske 1, representing the Eneolithic cultures discussed in the text. The model assumptions are presented in full in the figure. In the case of wood (or charcoal) samples, the probability distributions of tree-cutting dates, calculated applying the correction illustrated in Fig. 3, are marked with the word Shift. Results Poz-66220 and Poz-66732 date the same sample, hence, in the Bayesian model, their weighted mean was used




F i g . 7. The Bayesian model of the ages of samples from Prydnistryanske 1, representing the Eneolithic and 'Early Bronze' cultures discussed in the text. In the model, besides the assumptions as in Fig. 6, it was assumed that grave IV/10 (Poz-66234) was the oldest of all the graves of the TC-G phase longer. It must be added, however, that this suggestion follows from the dating of a single feature (IV/4).

In this context, it must be observed that the older limit of the Eneolithic phase (TC-G), set by the dating results of two wood samples (Poz-66214 and Poz-66222) may be inadvertently made older. For the dated wood samples are certainly older than the dates of burials in respective graves (no bone remains were recovered from these graves, which prevented us from making any comparative date determinations), while the shape of the calibration curve in the relevant time interval makes a minor ageing on the scale of calendar years correspond to a large difference in the radiocarbon age (Fig. 1) and a major shift of the older limit of the calibrated age range.

To study this effect, the Bayesian model was slightly modified by assuming that the oldest of dated TC-G features was grave IV/10 (Poz-66234). It must be observed that the consistency of $^{14}C$ dates with this model (Fig. 7) continues to be good and the effect of the assumption is only a slight shift in the range of TC-G phase from 3364-3165 BC (68.2%) to 3348-3199 BC (68.2%). However, the oldest age of grave IV/10, although suggested by the horizontal distribution pattern, is not a hundred-percent certain.

### 2.2. POROHY 3A

The site is located 1.4 km north of the Dniester and comprises the cluster of a minimum of five barrows known as the *Tsari* group [Potupczyk, Razumov 2014: 37, Fig. 1.2: 2], of which three 'Early Bronze' ones have been investigated to date[3].

The typo-chronological analysis of ritual activities within funerary features recorded on the Porohy 3A site helped distinguish three cultural categories divergent in terms of time: Eneolithic, YC and NC. YC graves correspond to the younger mound (this applies to a part of, stratigraphically diagnostic, features), while NC graves were found around the barrow edge. An attempt to date the older – Eneolithic – barrow phase and a related central feature (3A/14) failed (from a human bone coming from a secondarily disturbed fill, a result was obtained indicating the Late Bronze Age). Uncertain, in turn, is the association with the older – Eneolithic – phase of grave 3A/7 (sunk into the older mound?) for which a similar determination was obtained as for YC features (Poz-70667: 4115 ± 35 BP) [Klochko *et al*. 2015b: Fig. 2].

All radiocarbon dated samples from this site were human bones. A major portion of the samples was dated by the Kyiv laboratory. Since the interpretation of

[3] For the state of investigations from 1984-1993 *see* Harat *et al*. 2014: 70-104 – sites 1, 2, 3 and 4.

Table 3

Results of $^{14}C$ dating of Eneolithic, YC and NC features on the Porohy 3A site. Results sets of multiple dating of the same samples are separated by dotted lines. Dates left out from the Bayesian model are given italics.

| FEATURE | Lab No. | $^{14}C$ Age BP | Calendar Age BC (68.2%) | Calendar Age in model BC (68.2%) | Collagen Extraction Efficiency (%) | Collagen C/N (at) |
|---|---|---|---|---|---|---|
| | | | **Eneolithic** | | | |
| 3A/7 | Poz-70667 | 4115±35 | 2856-2601 | 2864-2731 | 2.1 | 3.20 |
| | | | **YC** | | | |
| *3A/1* | *Ki-17384* | *3770±170* | *2460-2010* | | | |
| *3A/1* | *Ki-17437* | *4430±70* | *3310-2920* | | | |
| *3A/1* | *Poz-70668* | *3760±35* | *2275-2064* | --- | *8.2* | *3.05* |
| *3A/10* | *Ki-17383* | *3860±160* | *2600-2000* | | | |
| *3A/10* | *Ki-17438* | *4370±70* | *3100-2900* | | | |
| *3A/10* | *Ki-18928* | *4070±50* | *2860-2490* | | | |
| 3A/10 | Poz-74393 | 4105±35 | 2850-2687 | 2632-2572 | 4.8 | 3.19 |
| 3A/10 | Poz-81824 | 4040±35 | 2619-2490 | 2632-2572 | 4.0 | 3.12 |
| *3A/15* | *Ki-17386* | *4010±220* | *2900-2200* | | | |
| *3A/15* | *Ki-17439* | *3580±90* | *2120-1770* | | | |
| 3A/2 | Poz-74392 | 4140±35 | 2864-2632 | 2736-2626 | 0.3 | n.m. |
| *3A/2* | *Ki-18927* | *2980±90* | *1370-1050* | --- | | |
| 3A/11 | Poz-47741 | 4075±35 | 2836-2500 | 2665-2571 | 1.1 | n.m. |
| 3A/19 | Poz-70665 | 4185±35 | 2882-2698 | 2781-2638 | 2.5 | 3.16 |
| 3A/17 | Poz-47743 | 4050±35 | 2828-2492 | 2632-2506 | 1.0 | n.m. |
| *3A/17* | *Poz-74394* | *3930±35* | *2477-2346* | | *0.1* | *n.m.* |
| 3A/12 | Poz-47742 | 3985±35 | 2566-2471 | 2577-2521 | 0.9 | n.m |
| *3A/20* | *Ki-17385* | *3820±80* | *2360-2140* | --- | | |
| 3A/20 | Poz-47744 | 4190±35 | 2884-2700 | 2785-2676 | 1.4 | n.m. |
| 3A/20 | Poz-74397 | 4175±35 | 2879-2695 | 2785-2676 | 2.5 | 3.58 |
| | | | **NC** | | | |
| 3A/22 | Poz-70666 | 3380±35 | 1734-1630 | 1694-1615 | 1.3 | 3.58 |
| 3A/22 | Ki-17478 | 3260±50 | 1612-1497 | 1619-1511 | | |
| 3A/5 | Ki-17440 | 3200±90 | 1611-1396 | 1636-1471 | | |
| | | | **Other** | | | |
| *3A/14* | *Poz-74396* | *3675±35* | *2134-1982* | --- | *1.5* | *3.17* |

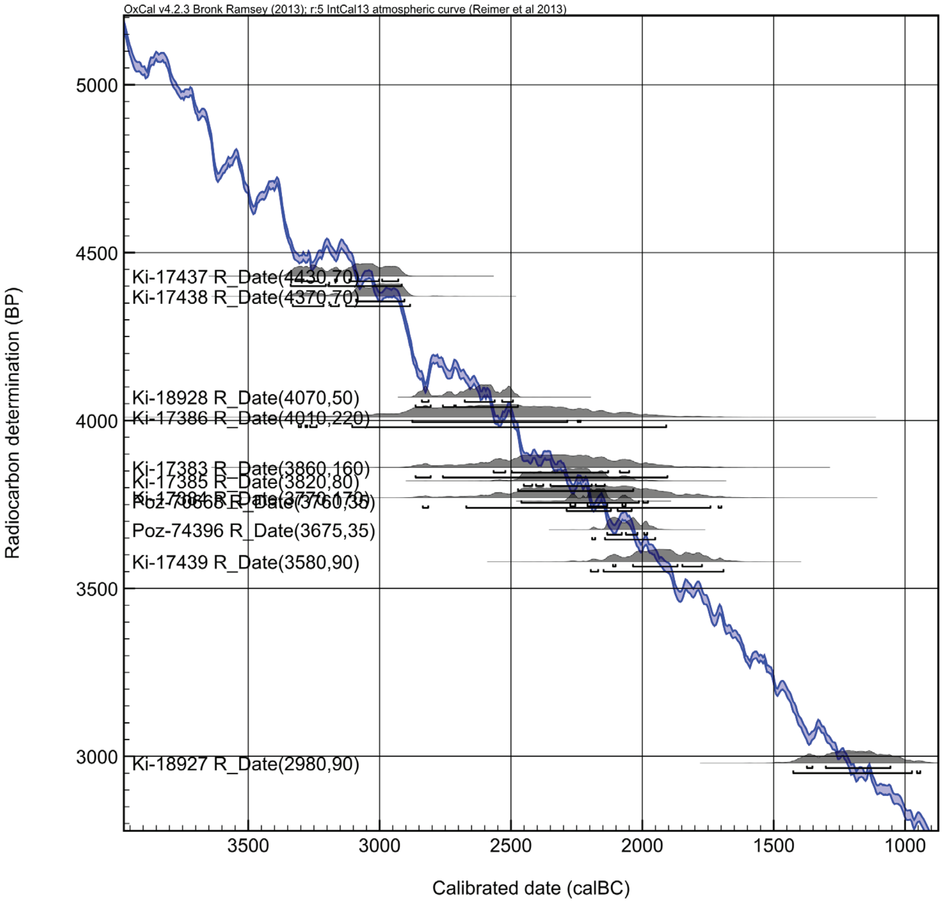



Fig. 8. Calibration results of $^{14}C$ ages inconsistent with the chronometric model of the Porohy 3A site, shown against the Intcal13 calibration curve. The position of probability distributions of calibrated dates in respect of the vertical axis corresponds to the $^{14}C$ ages of samples

dating results of some samples raised doubts, the Kyiv laboratory repeated the dating of three samples (sample from feature 10 was re-dated twice) and two of these samples were dated also in Poznań (Tab. 3). In the case of all re-dated samples, successive dating attempts undertaken in Kyiv yielded divergent results and only one (for sample from feature 1: Ki-17384 and for sample from feature 10: Ki-18928) was consistent with the result obtained in Poznań. For this reason, the Kyiv dates for these three samples were left out from the Bayesian approach. Moreover, the model ignored Kyiv dating results for feature 20 (Ki-17385), clearly different from the two – consistent with each other – $^{14}C$ dates obtained in the Poznań laboratory, and feature 2 (Ki-18927).

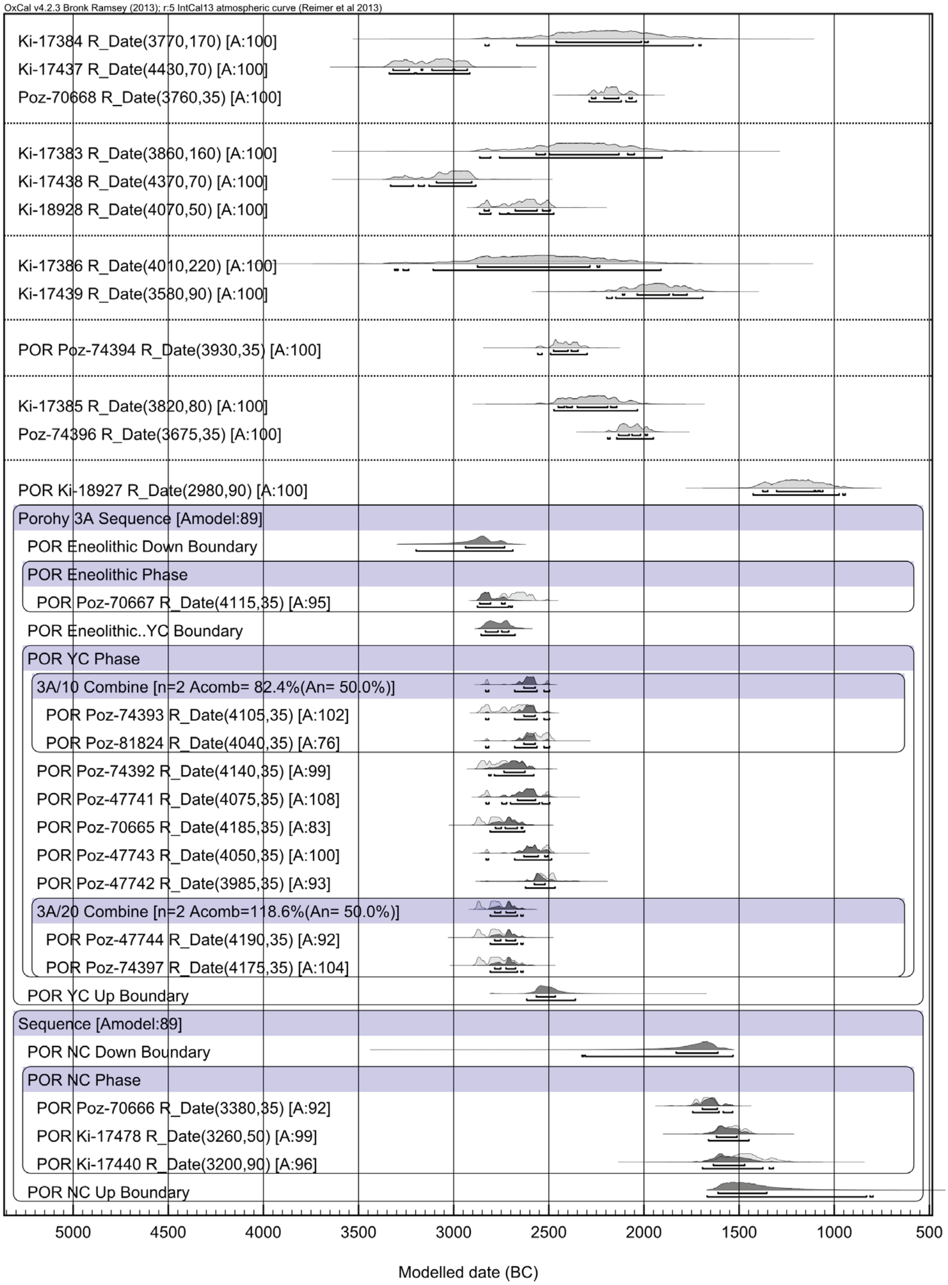



Fig. 9. Calibration results of $^{14}C$ dates of samples from Porohy 3A. The dates of samples not included in the chronometric model are represented as light-grey silhouettes in the upper section of the diagram

From among the Poznań dating results, in the chronometric model, the following exclusions were made: $^{14}C$ age of a sample from feature 3A/14, because the feature could not be assigned to a specific phase, the result Poz-70668 of the dating of a sample from feature 3A/1, because it was far too young to be assigned to a YC feature, and the result Poz-74394, because of too low collagen extraction efficiency. It must be admitted that the number of dates excluded from the chronometric model of the Porohy 3A site is quite large. The reasons for this may be a few:

(a) The first Kyiv $^{14}C$ analyses of samples from features 3A/1, 3A/10 and 3A/15 (Ki-17384, Ki-17383, Ki-17386) were performed on very small amounts of collagen, which was reflected in the reported, high uncertainty of dates (Tab. 3; *see* Figs. 8, 9), but could also contribute to the contamination of the dated fraction and distort the dating further. Due to the low collagen extraction efficiency too, uncertainty affects the first Poznań date for feature 3A/17 (Poz-74394),

(b) The result of $^{14}C$ dating is wrong due to the insufficient collagen purity (for instance when no ultrafiltration was used to lower the content of degraded collagen fragments in the extract) or accidental mistakes made in the laboratory dating process,

(c) Dated features are not homogeneous and bones found in them come from various periods. A special case of non-homogeneity is feature 3A/2, which was dated in Kyiv at the last stage of investigations (already after agreeing the details of practical chemistry with the Poznań laboratory in May 2015), using bones from a badly damaged grave pit – feature 3A/2.

Besides the obvious reason (a), when discussing the accuracy of dating results (b), it must be admitted that among the $^{14}C$ dates – which do not match the chronometric model – there is result Poz-70668 which was obtained following all the rules of the art of dating and using collagen of very high purity. Furthermore, if one does not count the results mentioned in (a), none of $^{14}C$ ages excluded from the model has fallen on the steep sections of the calibration curve (Fig. 8), which in the light of an earlier discussion concerning Figure 1 seems to testify to the accuracy of dating results. The question of the interpretation of the dates excluded from the model presented today certainly calls for further study.

The Bayesian model of the chronology of the Porohy 3A site (Fig. 9) places the age of the Eneolithic sample in the interval of 2864-2731 BC (68.2%), while the ages of YC and NC samples are placed in the 2723-2543 and 1710-1470 BC (68.2%) ranges, respectively. Hence, the range of the YC phase corresponds rather well to the 68% range of the YC late ritual phase dated in Prydnistryanske 1.

Table 4

Results of $^{14}C$ dating of Eneolithic, 'Early Bronze' and 'Late Bronze' features from the Klembivka Site. Dates left out from the Bayesian modelling are given in italics.

| FEATURE | Lab No. | $^{14}C$ Age BP | Calendar Age BC (68.2%) | Calendar Age in model BC (68.2%) | Collagen Extraction Efficiency (%) | Collagen C/N (at) |
|---|---|---|---|---|---|---|
| | | | **Eneolithic** | | | |
| 1/15 | Poz-77470 | 4290±35 | 2920-2885 | 2912-2885 | 0.6 | 3.26 |
| *1/15* | *Poz-70669* | *3505±35* | *1886-1772* | --- | *5.8* | *2.93* |
| 1/14 (wood) | Poz-52422 | 4260±40 | 3012-2898 | 2876-2812 | | |
| 1/14 mound 2 | Poz-52605 | 4135±35 | 2863-2630 | 2876-2812 | 1.9 | 2.94 |
| 1/5 | Poz-70670 | 4225±35 | 2898-2761 | 2901-2792 | 7.6 | 2.64 |
| | | | **BC** | | | |
| 1/12 | Poz-74400 | 3645±35 | 2117-1952 | 2117-1952 | 5.0 | 3.21 |
| 1/3 | Poz-74398 | 3495±35 | 1880-1771 | 1880-1771 | 3.3 | 3.22 |
| | | | **NC** | | | |
| 1/7 | Poz-74399 | 3130±35 | 1443-1311 | 1443-1311 | 1.3 | 2.92 |
| | | | **?** | | | |
| *1/11* | *Poz-70672* | *4370±40* | *3022-2918* | --- | *0.6* | *3.07* |
| *1/11* | *Poz-72043* | *4345±35* | *3011-2908* | --- | *as above* | *as above* |

## 2.3. KLEMBIVKA 1

The site is located 15.0 km north of the Dniester and comprises a cluster of five barrows. In 2012, one mound was excavated, revealing a series of 13 graves (and two ritual features) which, on the strength of typo-chronology, the funerary rite and grave goods, were linked to the Eneolithic, BC and NC [Klochko *et al*. 2015c]. The Eneolithic graves – of the founders of the necropolis – correspond to two mounds (1 = a small mound over grave 1/15; 2 = mound over grave 1/14) and one of them (1/5) was sunk into the central portion of the barrow. BC graves were sunk into mounds, while NC graves were located outside mounds – at their edges.

Almost all (but one) dated samples from this site were taken from human bones (Tab. 4) and the $^{14}C$ age of the only wood sample fits into the range covered by the dates of bones attributed to the same culture. The content of stable carbon and

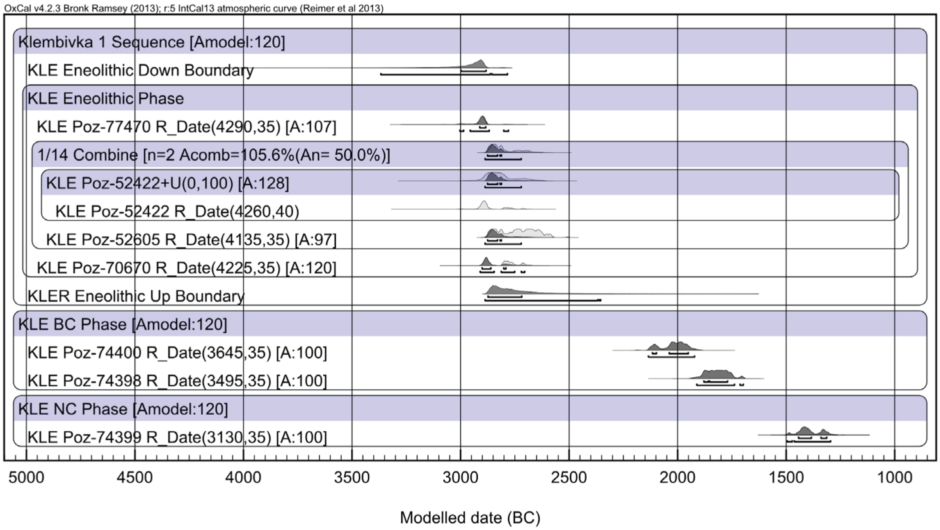



Fig. 10. The Bayesian chronometric model of the Klembivka 1 site. In the case of grave 14, the simultaneity of tree-cutting (dated by sample Poz-52422) and burial (Poz-52605) was assumed

nitrogen isotopes ($\delta^{13}C$, $\delta^{15}N$), determined for only one bone sample, again does not indicate age distortion by the reservoir effect. Unfortunately, the number of $^{14}C$ dates from this site is small, and to build the presented model, determinations were used which were obtained for six features associated with three cultural-chronological blocks (Fig. 10).

One particularly beguiling matter of research investigation is the intriguing set of Klembivka 1 sample $^{14}C$ dates for bones from feature 1/11 (Tab. 3) – a grave which by reason of being located outside the mound and furnished with a stylistically diagnostic vessel can be assigned to the NC. Both $^{14}C$ dates – much older than could be expected – agree with each other very well and fall on a plateau before the steep section of the radiocarbon calibration curve, beginning at ca. 2900 BC (Fig. 1). These circumstances appear to indicate that the $^{14}C$ dating results of these samples were not distorted by the reservoir effect or an accidental laboratory mistake. Nevertheless, the mystery of the divergence between the actual dating and expected result remains unexplained. In the light of the above, $^{14}C$ dates for feature 1/11, were excluded from the chronometric model.

Another exclusion concerns the dating result of one of the two bone samples from feature 1/15 (Poz-70669), which – archaeometrically speaking – ought to be linked to the Eneolithic but indicated the first half of the 2nd millennium BC.

The results of Bayesian modelling (Fig. 10) place the dates for Eneolithic features between 2936 and 2782 BC (68.2%). This range appears to be synchronous with the dating of the YC early ritual (YC-ER) from Prydnistryanske 1. This syn-

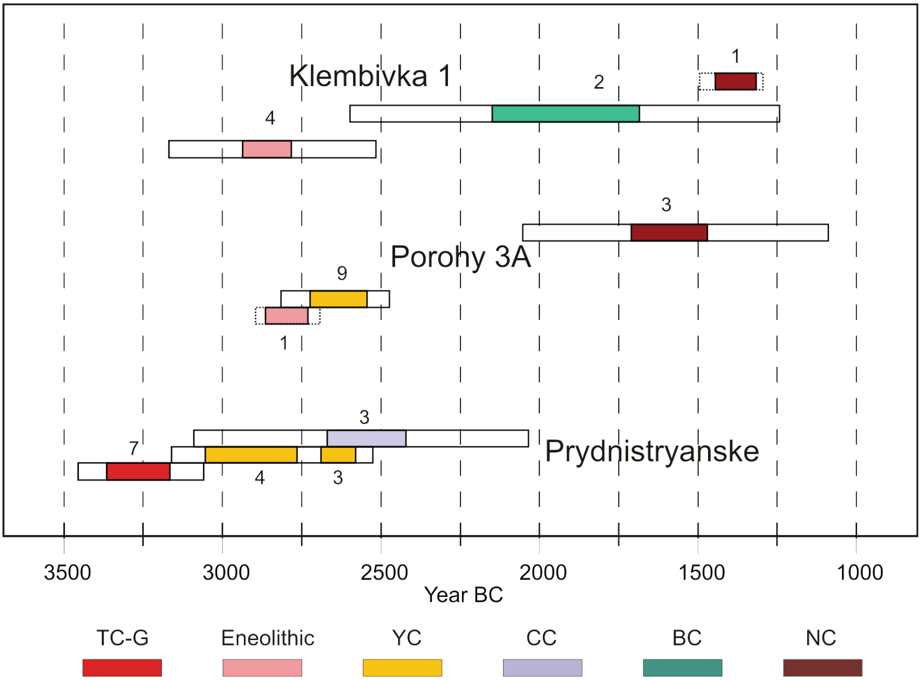



Fig. 11. The 68%-ranges (marked in colour) and 95%-ranges (without colour) of phases corresponding to particular cultures found on the Prydnistryanske 1, Porohy 3A and Klembivka 1 sites. The numbers of dated samples corresponding to particular cultures are given. On Prydnistryanske 1, two phases (early and late) of the Yamnaya culture were distinguished

chronicity, however, ought to be approached with caution due to the small number of dated samples.

The cultural attribution of feature 1/5 from Klembivka 1 is debatable. By reason of the arrangement of the deceased and the shape of the grave pit, it was linked to the Eneolithic rite. The $^{14}$C determination for this grave would suggest that it be linked to the decline stage of the Eneolithic or the beginnings of the Early Bronze Age. Less probable as it seems, the linking of this feature to the early CC [Otroshchenko 2013: 25-27] would assign to it an exceptionally early date (2898-2761 BC) within this cultural complex. However, this result should be treated with caution, because the C/N ratio in the dated collagen (2.65, *see* Tab. 3) considerably differs from the range accepted as normal.

## 2.4. CONCLUSIONS

The results of chronometric modelling of the Prydnistryanske 1, Porohy 3A and Klembivka 1 sites are synthetically illustrated in Fig. 11. The diagram shows 68% and 95% time intervals respectively, corresponding to cultures the graves of which were dated using the radiocarbon method.

It must be noted that the phase limits presented here result from model calculations in which the grouping of $^{14}C$ dates into a phase reflects the approximation that the dated samples represent events uniformly spread within the phase. The quality of such an approximation is poor if the number of samples from a given phase is small. It is for this very reason that phases represented by no more than four samples each (Klembivka 1 – Eneolithic and the BC, Porohy 3A – NC, Prydnistryanske – CC) have 95% time frames, which are several times broader than the 68% time frames. It can be expected that the 95% intervals of these phases would be considerably narrowed down if a larger number of representative samples were available. An exception in this respect is the phase of the YC late ritual (YC-LR) in Prydnistryanske the 95% interval of which is narrow despite the small number of samples. This is so thanks to a chronological connection to the early ritual phase (YC-ER) on the same site. A different quality is shared by intervals corresponding to cultures represented by single samples (Porohy 3A – Eneolithic, Klembivka 1 – NC). These intervals may be treated only as a 'spot signal' by no means reflecting the time a given culture functioned.

In the light of the above, as best substantiated, one should consider the respective time frames of TC-G on Prydnistryanske 1 and YC ones on Prydnistryanske 1 and Porohy 3A. It must be added that the YC phase from Porohy 3A appears to correspond to the YC-LR on Prydnistryanske 1 (ca. 2700-2550 BC), while the Eneolithic graves from Klembivka 1 seem to be of the same age as the YC-ER on Prydnistryanske 1 (ca. 3000-2750 BC).

The dating results for the Prydnistryanske 1 and Porohy 3A sites justify a claim that the chronometry (Poz) of wood and bones from features 1A +1Aa on Pidlisivka 1 [Ch. 1 and Goslar *et al*. 2014] fits into the well-defined interval of YC functioning in the region. Whereas the dating of features 4 and 11 on Pidlisivka 1 (Ch. 1) do not find any time equivalents on the other three sites. The question of relationships between periods when particular barrows functioned after ca. 2500--2400 BC calls therefore for further study.

## 3. THE CONTEXT OF YAMPIL CEMETERY CHRONOMETRY ON THE SCALE OF THE NORTHERN PONTIC AREA: SECOND HALF OF THE 4TH – FIRST HALF OF THE 3RD MILLENNIUM BC.

We shall focus below on the time frames the communities belonging to the older stages of 'barrow cultures' developed in. The *Yampil research project* has contributed a lot of new and inspiring information to make these time frames more accurate.

### 3.1. GENERAL REMARKS

The sequence of radiocarbon determinations obtained for materials from a barrow cluster in the vicinity of Yampil makes a significant contribution to the discussion of the chronology of cultural phenomena in the Eneolithic and the prologue of the Bronze Age in the Northern Pontic Area. Published in the early 20th century, the works by V.A. Gorodtsov [1905, 1907] laid the foundations for the scheme of the general succession of three great cultural blocks of the Pontic steppe: Yamnaya, Catacomb and Timber-Grave (Srubna) cultures. However, the time frames of these cultures and the question whether they overlapped have been discussed ever since. Gradually, an ever greater role in the relevant research has been played by $^{14}C$ dating results. Despite a large number of determinations [e.g. Telegin *et al*. 2003: 142--148, Tab. 1; Chernykh, Orlovskaya 2004: 86-92, Tab. 1-2; Rassamakin, Nikolova 2008: 81-87, Tab. 1], the discussed questions have not been made any clearer. On the contrary, new and barely surmountable controversies have arisen, caused by the significant expansion of the time frames of particular cultural phenomena [Rassamakin, Nikolova 2008: 65]. Alas, the situation has not been helped either by the fact that arguments used in the discussion are often weakened by the unclear context of sample procurement and the fact that a large number of dated graves have not been published in full. To make matters worse, the recent results of radiocarbon dating in some cases are inconsistent with earlier determinations [Bratchenko 2003; Rassamakin, Nikolova 2008: 62], while in others a hardly explainable difference is noticeable between measurement results and the stratigraphic position of a grave in the barrow [Rassamakin, Nikolova 2008: 62, 63]. Such inconsistencies may result from both different kinds of dated materials and various imperfections of laboratory methodology.

Attempts to verify and make date determinations more specific are currently made, using results obtained for various materials (wood and bone) and allowing for the reservoir effect, affecting $^{14}C$ measurements. Such comprehensive research has been carried out in respect of Caspian finds [Shishlina *et al*. 2000; 2007; 2009]. For the Northern Pontic Area, major significance is attached to a series of results obtained for the barrow Sugokleyska Mogila in Kirowograd [Nikolova, Kaiser 2009; Nikolova 2012] supported by dendrochronological dating results [Heußner 2009]. This research indicates that radiocarbon dating results can be fine-tuned by focusing on materials from specific settlement micro-regions and treating them comprehensively. The effects of such research are far better than adding up even a large number of single results obtained for barrows from an entire macro-region. This opinion is borne out by date series from *Yampil barrows* as well.

### 3.2. ENEOLITHIC

The results for Prydnistryanske 1 barrows put the age of the Eneolithic materials of the Gordineşti/Kasperovtsy type at ca. 3350-3200 BC. These are the first determinations for the cemeteries of this group and also the only ones for Eneolithic barrows from the Podolia Upland [Ivanova *et al*. 2015]. The time gap separating the rise of the Gordineşti-type barrows and the oldest YC graves is not large. The age of grave IV/4 from Prydnistryanske 1 is estimated at the late 4th/early 3rd millennium BC. These results of course do not illustrate all important processes related to the decline of the Eneolithic and the beginnings of the Early Bronze Age in Podolia. There are still few determinations for the assemblages of other Eneolithic traditions, including extended burials (Okniţsa, graves 6/24 and 7/14, Timkovo, grave 1/5) [Manzura *et al*. 1992; Manzura 2010; Ivanova, Toschev 2015; Ivanova *et al*. 2015]. It would be crucial, too, to be able to date culturally ambiguous phenomena: some central burials and barrow structures as well (Mocra, barrow 1, or Porohy barrow 3A) [Kashuba *et al*. 2001-2002; Klochko *et al*. 2015b]. Supported by vertical and horizontal stratigraphy, the chronological model for the Prydnistryanske site is naturally sequential in character. A still unsolved problem remains the time overlapping of the discussed cultural phenomena: the possibility that Eneolithic traditions had survived in the YC barrow rites.

Eneolithic graves have been also identified on the other recently investigated *Yampil sites* (Pidlisivka 1, Klembivka 1 and Porohy 3A). A short series of radiocarbon determinations was obtained only for barrow 1 in Klembivka. Exposed there, the graves, on account of burial arrangement traits, represent the Lower Mikhailovka/Cernavoda I type tradition (graves I/5 and I/15) [Ivanova 2015: 280] as well as Late-Tripolye or Zhivotilovka ones (grave I/14). Their dates point to the first centuries of the 3rd millennium BC, that is to the period which is clearly younger than the TC-G phase Prydnistryanske. At the same time, this age is similar to that of the older YC phase in the region in question.

The radiocarbon determinations allow us to distinguish the Eneolithic horizons of barrow cemeteries in the Yampil district. An older horizon (ca. 3350-3150 BC) is represented by the Prydnistryanske graves, having clear affinities with the Gordinești type. A younger horizon (ca. 3000-2800 BC), in turn, is represented on the Klembivka site and possibly on the Pidlisivka one as well. The younger horizon in all likelihood overlaps with the beginnings of the Bronze Age and the emergence of graves displaying YC traits.

### 3.3. YAMNAYA CULTURE

The import of the determinations for YC graves on three *Yampil barrow* sites is interesting: they indicate an interval between the decline of the 4th millennium BC and the middle of the 3rd millennium BC. This time frame is narrower than determined earlier for this culture, including finds from the North-Western Black Sea Region [Ivanova 2013a; Ivanova *et al*. 2015]. Especially meaningful is the final date – older than the age determined for Budzhak phase graves as defined by V.A. Dergachev [1986] or the late phase of the Budzhak culture according to the proposition of S.V. Ivanova [2013a]. This may be explained by the absence of any burials corresponding to this period from *Yampil sites*. The investigated barrows yielded no materials that would suggest so late a chronological position. Similar characteristics are shared by finds from the nearby region of Kamenka [Yarovoy 1981; Manzura *et al*. 1992; Bubulich, Khakheu 2002]. The abandoning of the entire *Yampil cemetery complex* ca. 2500 BC is seen also in the presence of only single CC graves. Furthermore, for feature I/4 from Prydnistryanske 1, representing this tradition, dates were obtained pointing to the middle of the 3rd millennium BC or the time corresponding to the youngest YC burials in the area in question.

In the interval of about 500 years, in which *Yampil YC graves* were built, no clear internal periodization can be made using radiocarbon dates. This is so in part because of the 'outstanding' plateau of the calibration curve, covering almost 300 calendar years of the 1st half of the 3rd millennium BC. In the group of obtained results, those concerning grave IV/4 from Prydnistryanske 1 stand out, owing to its older age; it is probably connected with the add-on phase of the Eneolithic barrow mound. Its dating refers to the late 4th and early 3rd millennia BC. Determinations obtained for graves occupying similar stratigraphic positions on other sites (feature 3A/2, Porohy, and feature 1/1A, Pidlisivka 1, i.e. central graves for younger mounds) are slightly younger and because of their falling on the above-mentioned calibration curve plateau indicate a broad interval of ca. 2900-2600 BC. If referred to the older portion of this interval, they even make it possible to create an older horizon together with the features from Klembivka 1 and Prydnistryanske 1 mentioned earlier.

Cemeteries comprising YC graves sunk into mounds were discovered in Prydnistryanske 1 and Porohy 3A. The date series obtained for them can be subjected to comprehensive analyses. In general, these results resemble one another and are in the range of ca. 2900-2500 BC. This is almost the same interval as in the case of younger graves from the older horizon mentioned earlier. So broad an interval (about 400 years) means also that actual time differences between the date determinations of particular graves in this interval may be considerable and reach several hundred years. This is borne out by the situation encountered in the barrow Sugokleyska Mogila in Kirowograd, in which for two secondarily sunk graves nos. 5 and 20, markedly different dendrochronological determinations were obtained (2548 BC and 2845 ± 5 BC, respectively) [Heußner 2009: 237].

In our case, too, differences between both sites and particular graves found on them can be considerable. With strong stratigraphic arguments lacking (due to advanced mound levelling off), the existence of such differences may be presumed only from the differences in funerary rite traits. In this regard, there are a few differences between graves from Prydnistryanske 1 and Porohy 3A. On the former site, one can see clearer differences in grave structures and burial arrangements. The classical supine position of the deceased with extended upper limbs and bent, originally pointing upwards lower limbs is encountered in three features: IV/4, IV/6 and IV/3. Other arrangements can be observed in two other graves (IV/8 and IV/9), with the differences being underscored by a different structure of the two latter graves (with a wooden boarding of side walls). In Porohy 3A, in contrast, the dominant position of the deceased is crouched on the side. Keeping in mind the consistency in the use of this position, it is understandable that Porohy 3A graves are younger than the 'older portion' of Prydnistryanske 1 features. The radiocarbon dates permit such a reconstruction and some of the younger results obtained for Porohy 3A graves (features 3A/12 and 3A/17) seem to bear out this hypothesis. Taking into account the older position of feature 3A/2 (central for the second mound) and accepting rather early determinations for feature 3A/20 (which is connected with the late mound add-on), the age of graves sunk into the barrow may be linked to the younger portion of the above-mentioned broad interval (2900-2500 BC), thus generally to ca. 2650-2500 BC. In the model suggested here, it has been assumed that the youngest phase of the graves dated using the radiocarbon method is formed by a group of features sunk into the younger mound (3A/7, 3A/10, 3A/11, 3A/12, 3A/15 and 3A/17). These graves form a characteristic arch, suggesting that whole lay-out had been planned [Klochko *et al*. 2015b].

The overall time interval determined for the three YC cemeteries in the 'Yampil Complex' is ca. 3050-2500 BC. This result corresponds to ranges determined for other regions in recent years, including in particular the western zone. Similar conclusions can be drawn from date series for materials from Bulgaria [Kaiser, Winger 2015: 127, Tab. 1], Romania [Frînculeasa *et al*. 2015: 58, 59, Tab. 2] and Hungary [Horvath *et al*. 2013: 165, Table 3]. Most of the series were obtained for bones from human burials using the AMS $^{14}$C method. In all these cases, there are also determinations indicating an earlier, Eneolithic beginning of the rise of barrow cemeteries. In the context of these new series, it is necessary to verify earlier models assuming a much broader time frame, including a clearly later final date [Rassamakin 1999; Telegin *et al*. 2003; Rassamakin, Nikolova 2008; Ivanova 2013a]. These are based on $^{14}$C results obtained in the Kyiv Radiocarbon Laboratory for quite many sites. They lack, however, longer series referring to selected complexes – micro-regions. An open question remains the dating of graves displaying the late, Budzhak YC variety. The new series of dates did not concern such features.

### 3.4. CATACOMB CULTURE

A date fitting into the range of 2669-2419 BC was obtained for CC grave I/4 in Prydnistryanske 1. The arrangement of burials (with only slightly bent lower limbs) and the type of grave goods suggest its connection with the territories on and beyond the Dnieper, specifically the CC Donetsk group. A thought should be also given, however, to its link to the Ingul CC, appearing more frequently on the Dniester and Danube, in particular on the Budzhak steppe. The date fits into a small set of older determinations for this group, generally referred to the range of ca. 2600-2000 BC, with a vast majority of the determinations being made for 'classic' Ingul burials indicating the period of 2400-2000 BC [Kaiser 2009: 65, 66].

The early dating of burial I/4, Prydnistryanske 1, suggests also its contemporaneity with, or possibly a temporal proximity to, the age of the late YC phase in the Yampil district (especially in respect of the grave dating results for barrow 3A, Porohy). An analogous meaning is carried by determinations for sites located on the Dnieper: Tarasova Mogila in Orikhiv [Govedarica *et al*. 2006] and barrow 24 in Vinogradnoye [Görsdorf *et al*. 2004], although in these cases $^{14}$C determinations refer to features associated with the early CC.

On account of corpse arrangement traits and grave pit shape, the CC rite is also believed to have been followed in the case of grave 1/7, Pidlisivka, in earlier publications linked to the BC [Harat *et al*. 2014; Razumov 2014]. What is more, the $^{14}$C determination obtained (Poz-38531: 4120 ± 35 BP, or 2858-2621 BC) makes researchers refer it to the early CC [Otroshchenko 2013: 25-27]. From the Middle Dniester Area, we know only of single features of this type (e.g. Kuzmin, grave 2/5) [Bubulych, Khakheu 2002: 132]. They are clearly different from the only fully distinctive Early Catacomb feature from barrow 3 in Okniţsa [Klochko 1990] to be found in the area in question. In terms of corpse arrangement, however, they point to connections with the type dominating on northern Moldavian cemeteries [Kaiser 2003: 40, 42]. Burials and grave structures on these sites share traits with the 'Donets Catacomb culture' [Ivanova 2013b]. The dating of early assemblages of this type to ca. 2800-2500 BC on the Dnieper and further east has already been documented well [Kaiser 2009: 63-65]. Whereas, on the North-Western Black Sea Region, the radiocarbon dating results have until now indicated a clearly later range: from ca. 2600 BC to the end of the 3rd millennium BC [Kaiser 2009; Ivanova 2013b; Ivanova *et al*. 2015]. The adoption of the early dating of some CC materials in the Dniester-Prut interfluve significantly alters several crucial cultural issues related to both the situation on the Black Sea Coast and its repercussions for central Europe [Bratchenko 2001: 53, 54]. Due to the very small number of samples, the results cited here must, however, be approached with great caution.

The research into the *Yampil chronometry* of the oldest builders and users of barrows could be said to introduce us to the temporal position of barrow architecture and associated issues in the Podolia cultural interchange across the second half of the 4th and first half of the 3rd millennia BC. The subsequent research conclusions and further questions these may elicit in relation to the above shall no doubt provide a particular fulcrum of interest. Specifically, research inspirations concern the development coincidences of the TC-G and the eastern group of the Globular Amphora culture, as well as the YC and the so-called Sub-Carpathian culture/group and, as a continuation, also the Małopolska group(s) of the Corded Ware culture. Attempts to read the indicated research problems anew and from a fresh perspective in terms of the current literature were taken up in separate papers published in this volume of *Baltic-Pontic Studies* [Ivanova *et al*. 2015].

*Translated by Piotr T. Żebrowski*

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