PODOLIA ‘BARROW CULTURE’ COMMUNITIES: 4TH/3RD-2ND MILL. BC
THE YAMPIL BARROW COMPLEX: INTERDISCIPLINARY STUDIES

Maciej Chyleński
Michał Dąbrowski
Tomasz Goslar
Kacper Jachimowicz
Michał Jankowski
Justyna Jasińska
Anna Juras
Joanna Kałużna-Czaplińska
Viktor I. Kloczko
Aleksander Kośko
Jerzy J. Langer
Maria Lityńska-Zając
Dorota Lorkiewicz-Muszyńska
Arkadiusz Marciniak
Adam Michalski
Michał Podsiadło
Mykhailo V. Potupchyk
Marcin M. Przybyła
Angelina Rosiak
Andrzej Sikorski
Julia Sobol
Tomasz Stępnik
Marzena Szmyt
Piotr Włodarczak
Yevheniya Y. Yanish
Oleh Zhuravlov
Danuta Żurkiewicz

BALTIC-PONTIC STUDIES

V O L U M E 22 • 2017

BALTIC-PONTIC STUDIES
61-614 Poznań (Poland)
Umultowska 89D
Tel. 618291418
E-mail: antokol@amu.edu.pl

ADAM MICKIEWICZ UNIVERSITY, POZNAŃ
INSTITUTE OF EASTERN STUDIES
INSTITUTE OF ARCHAEOLOGY
Poznań 2017
ISSN 1231-0344

PODOLIA 'BARROW CULTURE' COMMUNITIES: 4TH/3RD-2ND MILL. BC
THE YAMPIL BARROW COMPLEX: INTERDISCIPLINARY STUDIES

Maciej Chyleński
Michał Dąbrowski
Tomasz Goslar
Kacper Jachimowicz
Michał Jankowski
Justyna Jasińska
Anna Juras
Joanna Kałużna-Czaplińska
Viktor I. Kloczko
Aleksander Kośko
Jerzy J. Langer
Maria Lityńska-Zając
Dorota Lorkiewicz-Muszyńska
Arkadiusz Marciniak
Adam Michalski
Michał Podsiadło
Mykhailo V. Potupchyk
Marcin M. Przybyła
Angelina Rosiak
Andrzej Sikorski
Julia Sobol
Tomasz Stępnik
Marzena Szmyt
Piotr Włodarczak
Yevheniya Y. Yanish
Oleh Zhuravlov
Danuta Żurkiewicz

BALTIC-PONTIC STUDIES

V O L U M E 22 • 2017

Reviewers: Lucyna Domańska
Przemysław Makarowicz

Cover Design: Eugeniusz Skorwider

Linguistic consultation: Ryszard J. Reisner
Piotr T. Żebrowski

Editorial consultation: Karolina Harat
Marcin Ławniczak
Jakub Niebieszczański
Rafał Skrzyniecki

Printed in Poland

Computer typeset by PSO Sp. z o.o. w Poznaniu

Printing: TOTEM.COM.PL sp. z o.o. spółka komandytowa

CONTENTS

Editor's Foreword

The present volume of *Baltic-Pontic Studies* continues the program of presentation of the results of studies on the Middle Dniester cultural contact area of communities originating from the Pontic and Baltic drainage basins in the 4th/3rd – 2nd millennium BC. It is focused mainly on the issues of the Polish – Ukrainian research project whose aim was to explore the *Yampil Barrow Cemetery Complex* located in the southern portion of the Middle Dniester Area (Vinnitsa *Oblast*)*.

A common feature of the vast majority of the presented articles is their interdisciplinary character. They can be included in three thematic blocks of analysis: environmental and spatial aspect of ceremonial practices; the image of builders and users of barrows, described from the position of natural science research methods and the view of the "Podolia" ritual and funeral activities.

The twenty-second volume of the BPS contains another part of the achievements of the project "Podolia as a Cultural Contact Area in the 4th/3rd-2nd Millennium BC", implemented as part of the National Program for the Development of Humanities (No. 108 / NPH3 / H12 / 82 / 2014), documenting a new stage in the process of expanding – including and internationalization – the area of his cognitive inspiration.

The papers in this volume were peer reviewed by Professors Lucyna Domańska and Przemysław Makarowicz.

---

* For a broader discussion *see*: A. Kośko, M. Potupczyk, S. Razumow (Eds) „*3rd Mil. and first half of 2nd Mil. BC Dniester Tumuli Cemetery Complexes tied to Yampil Region Commmunities, Winnica Province: Research on North-West Border 'Early Bronze Age Pontic' culture Settlements*". *Archaeologia Bimaris – Monografie* 6, Poznań 2014 and A. Kośko (Ed.) *Podolia as a Cultural Contact Area in the 4th/3rd-2nd Millenium BC, Baltic-Pontic Studies* Vol. 20, 2015.

Editorial comment

1. All dates in the BPS are calibrated [BC; see: Radiocarbon vol. 28, 1986, and the next volumes]. Deviations from this rule will be point out in notes [bc].
2. The names of the archaelogical cultures and sites are standarized to the English literature on the subject (e.g. M. Gimbutas, J.P. Mallory). In the case of a new term, the author's original name has been retained.
3. The spelling of names of localities having the rank of administrative centres follows official, state, English language cartographic publications (e.g. *Ukraine, scale 1 : 2 000 000*, Kyiv: Mapa LTD, edition of 1996; *Rèspublika BELARUS', REVIEW-TOPOGRAPHIC MAP*, scale 1:1 000 000, Minsk: *BYELORUSSIAN CARTOGRAPHIC AND GEODETIC ENTERPRISE*, edition 1993).

Baltic-Pontic Studies
vol. 22: 2017, 7-29
ISSN 1231-0344
DOI 10.1515/bps-2017-0018

Kacper Jachimowicz*, **Danuta Żurkiewicz****

SPATIAL ANALYSIS OF YAMPIL BARROW COMPLEX

ABSTRACT

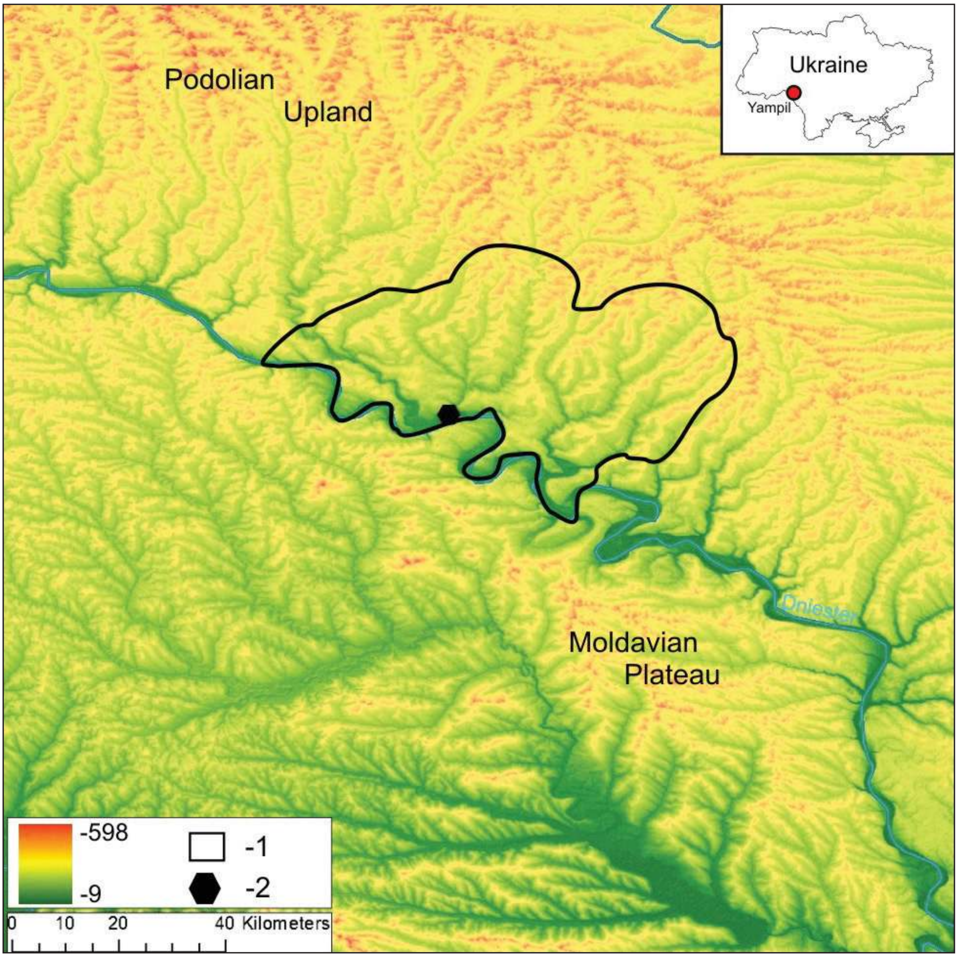
The Yampil Region represents a concentration of densely populated barrow cemeteries. Some 156 mounds figure in the available cartographic studies, which are the basis of spatial analysis presented below. The aforementioned therefore shall involve an examination of parameters for the localisation of tumuli in respect to altitude, terrain surface incline, direction of exposition and distance from waterways and watershed ridges as well as an analysis of visibility for selected sites, which shall describe preferences in respect to the chosen place of construction.

Key words: spatial analysis, Dniester, Eneolithic, Bronze Age

INTRODUCTION

The Yampil Region lies on the southern edge of the Podolia Upland, in the drainage basin of the Middle Dniester (Fig. 1). The loess substrata here represents

* k.jachimowicz89@gmail.com
** Department of Prehistory of Central and Eastern Europe, Institute of Archaeology, Adam Mickiewicz University, Umultowska 89D, 61-614 Poznań, Poland; danuta@amu.edu.pl



F i g . 1 . Location of research area: 1 – Yampil Region border; 2 – Yampil

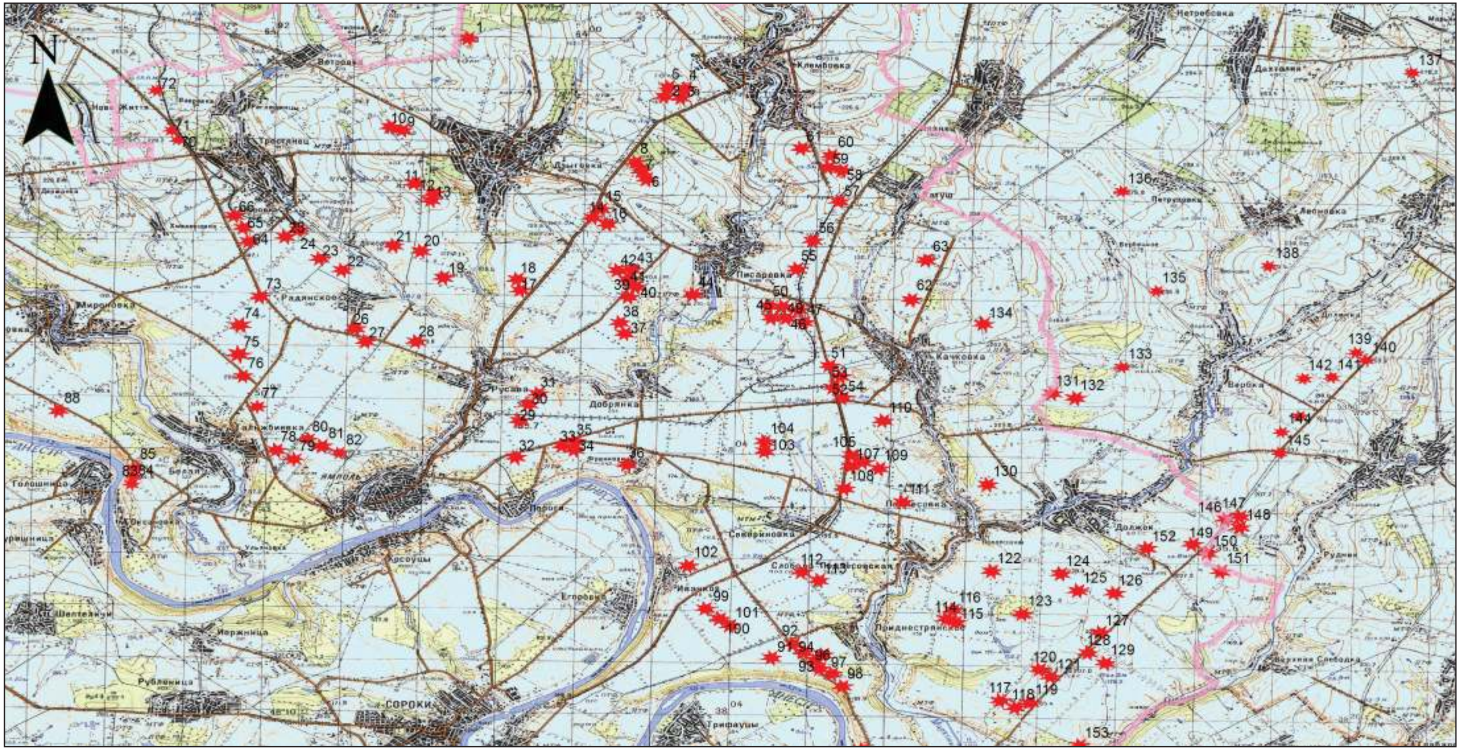
the major scale of studies in this area, which to a significant degree impact on the landscape profile. In the general geomorphological context, the Yampil Region can be said to be in the category of flat and undulating planes of an alluvial and delluvial origin. In respect to climate and flora the subject of study lies in the forest steppe belt – a transitory area between the forest zone and the steppe. The native flora that is characteristic for this terrain is one of oak forests, meadow and stipa grass steppes [Makohonienko, Hildebrandt-Radke 2014; Kusiński, Zastawnyj 2003].

The modern-day landscape of the area under study, combining the traits forming the terrain and its flora, allows for the reading of its particular properties. From the moderate rises of the region vast areas are visible towards a horizon many tens of kilometres away in the distance.

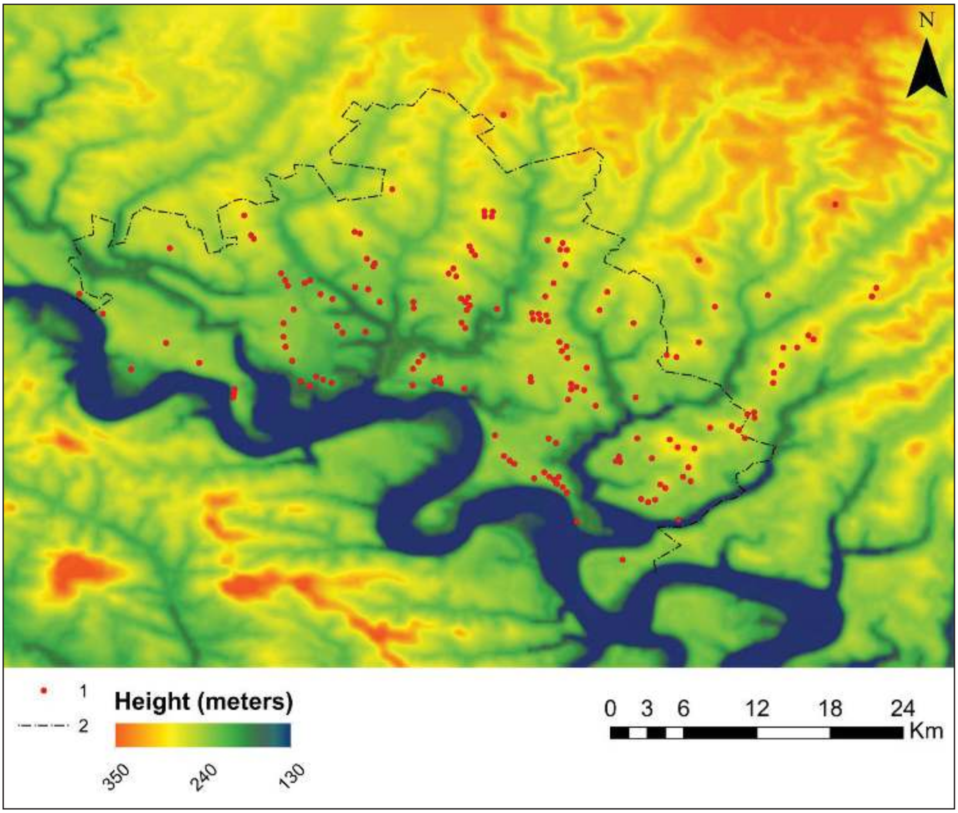
T a b l e   1

Yampil Barrow Cemetery Complex: excavation in 2010-2012 and 2014 research results marked in gray.

Item	Site	Barrow number	Eneolithic	Yamnaya culture	Catacomb culture	Babyno culture	Noua culture	Iron Age	Unidentified	Number of inhumations
1	Dobrianka	1		5		6				11
2	Porohy	1		2						2
3	Porohy	2		4				2		6
4	Porohy	3		2		5		1	1	9
5	Porohy	3A	7	10			4	1		22
6	Porohy	4		1		4		3	1	9
7	Pysarivka	1		2						2
8	Pysarivka	2		1				2		3
9	Pysarivka	3		3				1	1	5
10	Pysarivka	4		2						2
11	Pysarivka	5		1		1		1		3
12	Pysarivka	6		3				1		4
13	Pysarivka	7		1				2	2	5
14	Pysarivka	8		1		1			2	4
15	Pysarivka	9		2		1			1	4
16	Severynivka	1		1		1		2	2	6
17	Severynivka	2		11		1		1		13
18	Pidlisivka	1	3	4	2	2		1	1	13
19	Klembivka	1	3			6	4		2	15
20	Prydnistryanske	I	1		1			2		4
21	Prydnistryanske	II	2						1	3
22	Prydnistryanske	III	2					1		3
23	Prydnistryanske	IV	2	5				2	1	10
			20	61	3	28	8	23	15	158



M a p 1. Base map of the spatial analysis of the Yampil Barrow Cemetery Complex (*see* Annex 1)



F i g . 2 . Yampil barrow cemetery complex: digital elevation model for studied area. 1 – barrows, 2 – borders of the Yampil Region

The hydrographical network of the Yampil Region is made up by the left bank tributaries of the Dniester, which in part demarcates the southern administrative border of the Yampil Region and the territory of Ukraine.

1. MATERIALS

A conservation study of the Yampil Region has produced a topographical map in the scale of 1:100,000 featuring identified barrows in the area [Potupczyk, Razumow 2014], which constitutes the basis of spatial analysis that was conducted. Its publication in 2010 did not entail any new discoveries [Przybyła *et al.* 2017]. In the area under study within the administrative borders of the Yampil Region, measur-

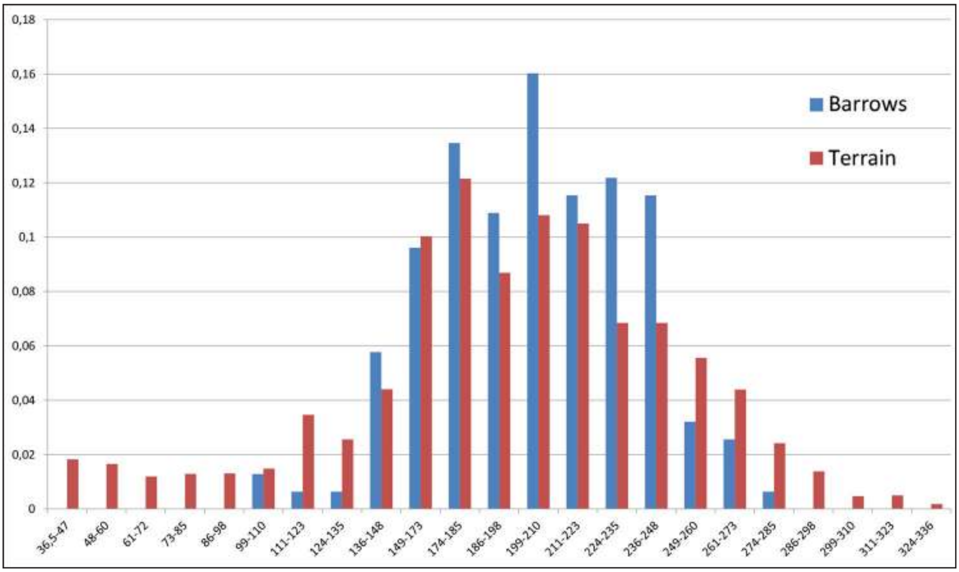
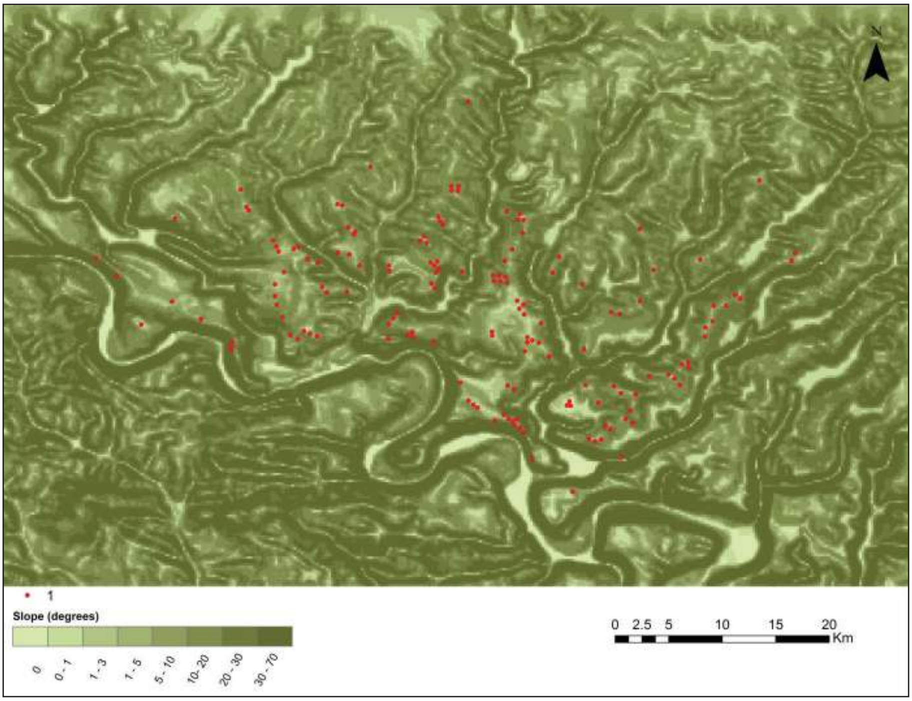


Fig. 3. Yampil barrow cemetery complex: percentage distribution of barrows and surface area in the altitude categories established above sea level.

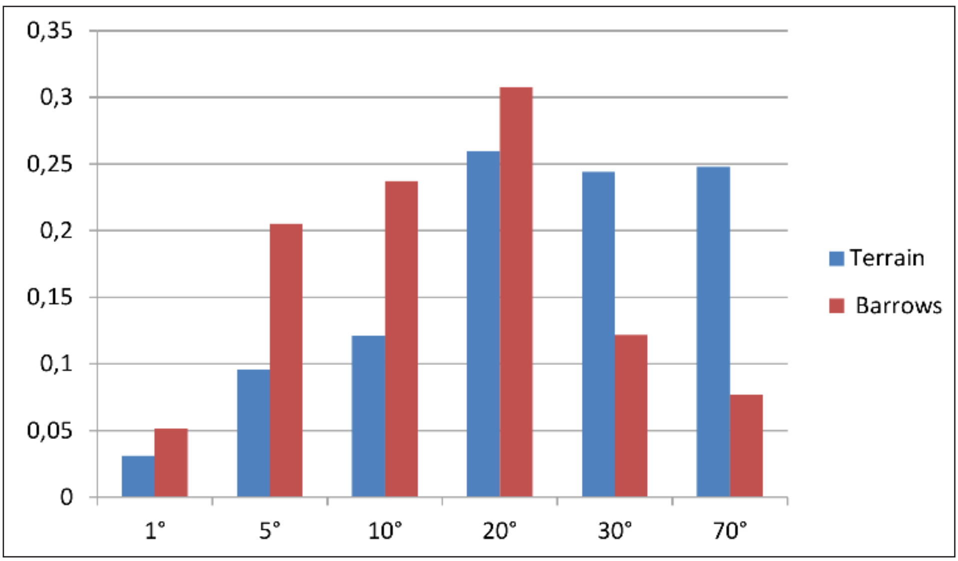
ing some 790 km^2, there have been recorded thus far 156 tumuli (approximately 0.2 per km^2). Only 23 so far (approximately 15%) have been verified in the context of excavation research. Their characteristics are presented in Tab. 1. Four of the sites studied by the Polish-Ukrainian expedition in the period 2010 to 2014 have been subjected to more detailed analysis of their location in the context of data gained for the entire barrow cemetery complex [Kośko 2015].

2. METHODS

Spatial analysis was conducted on the basis of the Digital Elevation Model (DEM) created using a topographical map in the scale of 1: 100,000 (Map 1 and Fig. 2) [Placek 2008; Jaskulski, Szmidt 2013]. This map also served to create a vector layer that defined the location of barrows. The following were taken into consideration or parameters describing the locus of sites studied: terrain incline, slope exposition as well as distance from river valleys and watershed ridges. The ArcMap 10.2 application, part of the ArcGis software, created by ESRI (Environmental Systems Research Institute) [Litwin, Myrda 2005] was used to record the analysis below. All analysed parameters are given in Annex 1.



F i g . 4 . Yampil barrow cemetery complex: map of slope incline of the terrain under study. 1 – barrows



F i g . 5 . Yampil barrow cemetery complex: percentage distribution of barrow number and terrain surface for established categories

3. ALTITUDE ABOVE SEA LEVEL

The terrain under study is characterised by marked differences in relative altitude. The lowest placed areas are those in the Dniester Valley (to 36 m a.s.l.). The highest measurements reaching 349 m are recorded on the upland in the northern part of the area under study. As far as the topography is concerned, there is a domination of terrain situated at an altitude between hundred and 49 to 248 m. In this category some 66% of the surface area studied is found and 86% of barrows (Fig. 3).

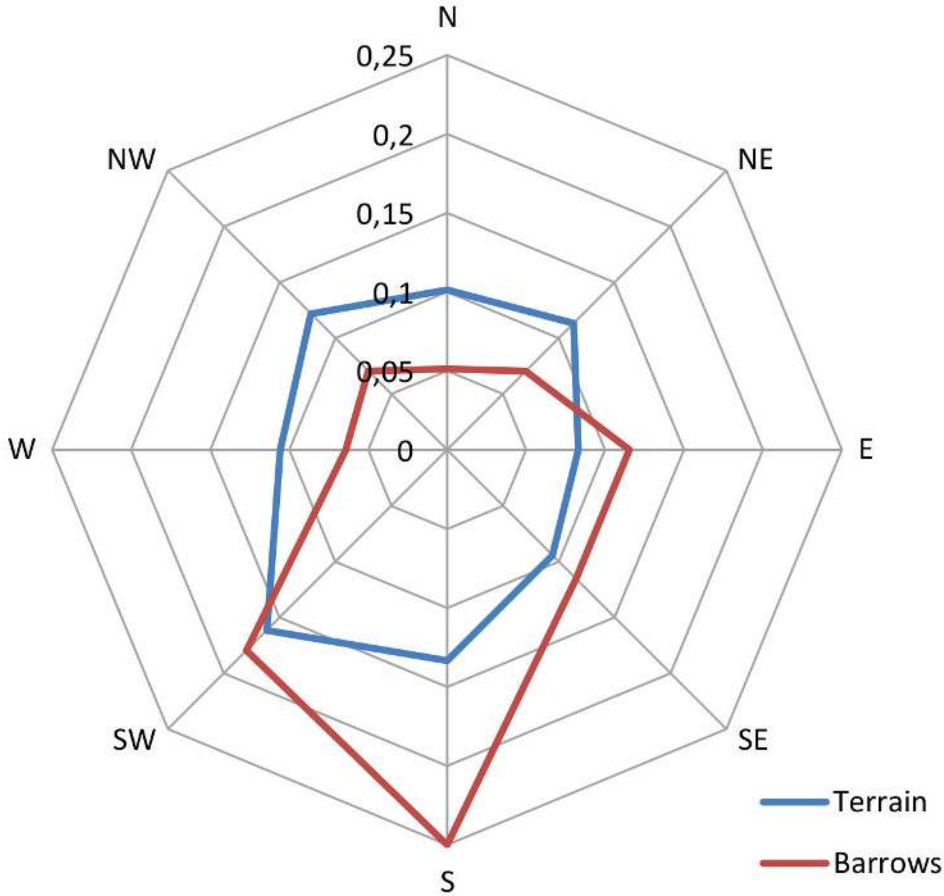
The location of particular mounds in terms of altitude above sea level in general represents the nature of the terrain as such. The highest placed mound – 283 m a.s.l. – is found in the north-east end of the area under study, near the town of Horodkiv. The lowest placed on the other hand, is the mound near Velyka Kisnytsya, almost 100 m a.s.l. The majority of barrows under study – 86% – are situated in the category of 149-248 m a.s.l.

The excavated sites relate to the category that groups the greatest number of mounds located at a altitude between 140 and 244 m. Amongst this group the lowest situated are the sites in Porohy and Prydnistryanske (163 and 193 m a.s.l.), Whilst the highest located features are found in Pidlisivka and Klembivka (201 and 242 m a.s.l.).

4. TERRAIN SURFACE INCLINE

An analysis of the terrain surface incline map shows that the greatest degree of incline relates to the slope of the Dniester Gorge (up to 68°, Fig. 4). Such a high degree of incline can be also observed on the valley slopes of this river's tributaries. One half (50.8%) of the terrain under study shows a small incline between 0 to 20 degrees, where over 80% of tumuli are found (Fig. 5).

The topography of barrows in the context of landscape incline suggests quite clearly that these tumuli were located on a terrain with a low incline. There are however, a small number of sites that appear to be situated in areas of high parameters in this context (above 20° – Fig. 5). Moreover, the presence of barrows in the last two categories gives one cause for further reflection. This is a result of the fact that inasmuch as a terrain with a 30 to 40° incline physically is suitable for the filling of a mound, areas of a higher parameter in this context would appear to be exceptionally difficult ones in which to undertake such work. First and foremost, the rather large scale of the source map has had an influence in this regard on the



F i g . 6 . Yampil barrow cemetery complex: distribution of terrain surface and tumuli for geographical direction

research results. In order to improve these it would be necessary to create a digital altitude model for the use of maps with a decidedly lower scale, which would reduce the risk of error.

The sites subjected to excavation research show small amounts of the parameter in question. In this regard the terrain incline read from the base map does not exceed 13° in any of the cases (Porohy – *see* Annex 1).

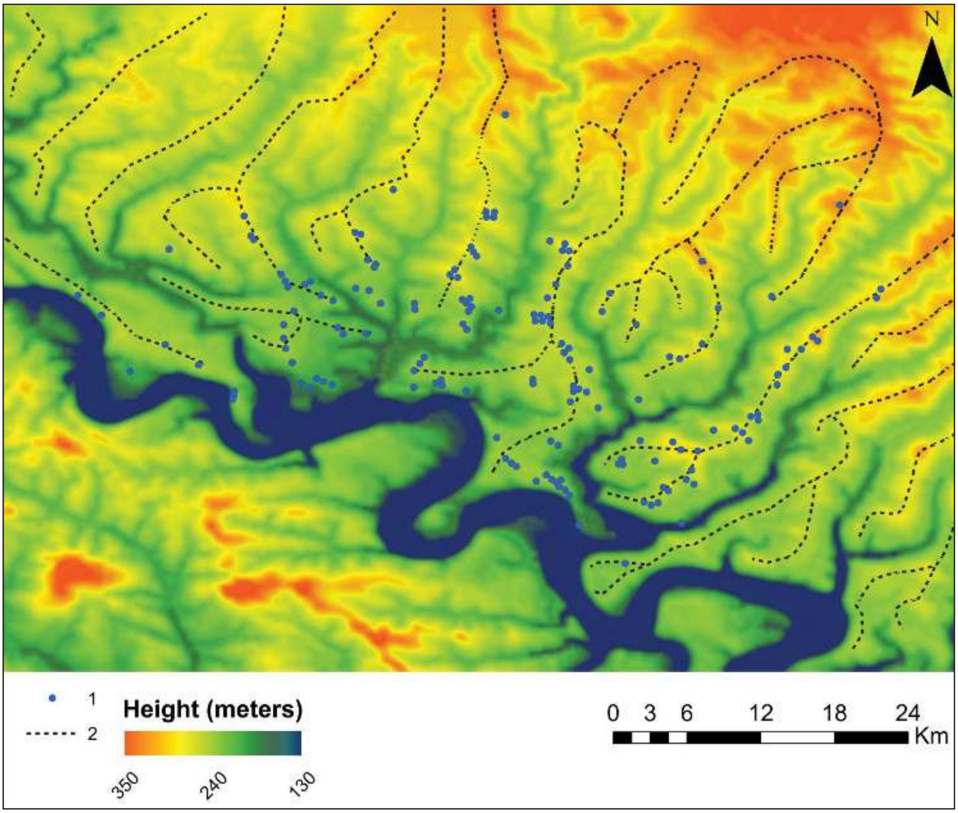


Fig. 7. Yampil barrow cemetery complex: marked watershed ridges of the terrain under study in terms of the altitude model. 1 – barrows, 2 – watershed ridges

5. EXPOSITION DIRECTION

An analysis of topography relating to the sites mentioned in the context of this research aspect is difficult on account of its low readability. This is caused by the differentiated nature of terrain profile in the area studied. Steep river valleys – both the Dniester and its tributaries as well as the numerous hills on watersheds result in a large differentiation of the parameter mentioned. Thus, a description of the usefulness in respect to the exposition parameter in the present discussion needs to take place on the basis of a graph that shows what number of tumuli are situated on inclined slopes in a specific direction (Fig. 6).

The area described as flat combines a mere 8.5% of the terrain surface under study, where 12 barrows are found (8%). The remaining directions of slope incline in the area under study are broken down rather equally, accepting values oscillating between 10 and 15 % of terrain surface.

In terms of mound topography therefore, there is a tendency for the avoidance of prominent slopes in a northerly direction and preferences for a southern and southern-western direction.

6. DISTANCE FROM WATERWAYS AND WATERSHED RIDGES

The creation of river layers took place through the vectorisation of waterways lines, based on the map in the scale of 1:100,000. So as to mark the line of watershed ridges on the basis of a digital altitude model a layer of surface flow directions was created, using the Flow Direction module, ArcMap application. Subsequently, the halftone that arose as a result of this process was transformed by the Flow Accumulation module. As a result, a map was created, which showed the accumulation of surface flow for every one of the units. On this basis watershed ridges were marked, creating a line in places where the relevant units took on the value 0 (Fig. 7). Naturally, the remaining lines were drawn far more simply so that the network of ridges was not overly dense.

The decided majority of the barrows found is placed at a distance from rivers in the range of 1001 two 4000 m (89% sites, Figs. 8, 9). In this context, the most predominant range of distance is from 2001 to 3000 m, covering as much as 39% of sites. This particular state of affairs allows one to propose that the location of barrows in respect to the *Yampil Complex* was not related to the immediate proximity of rivers.

The chart of distribution for percentage distance from watershed ridges shows that over 77% of barrows (121 mounds) are found at a distance up to 1000 m from the watershed ridge.

In respect to the entire above group there can be seen a clear preference for the location of barrows within watershed ridges and at the same time, an avoidance of locating tumuli in the immediate neighbourhood of waterways.

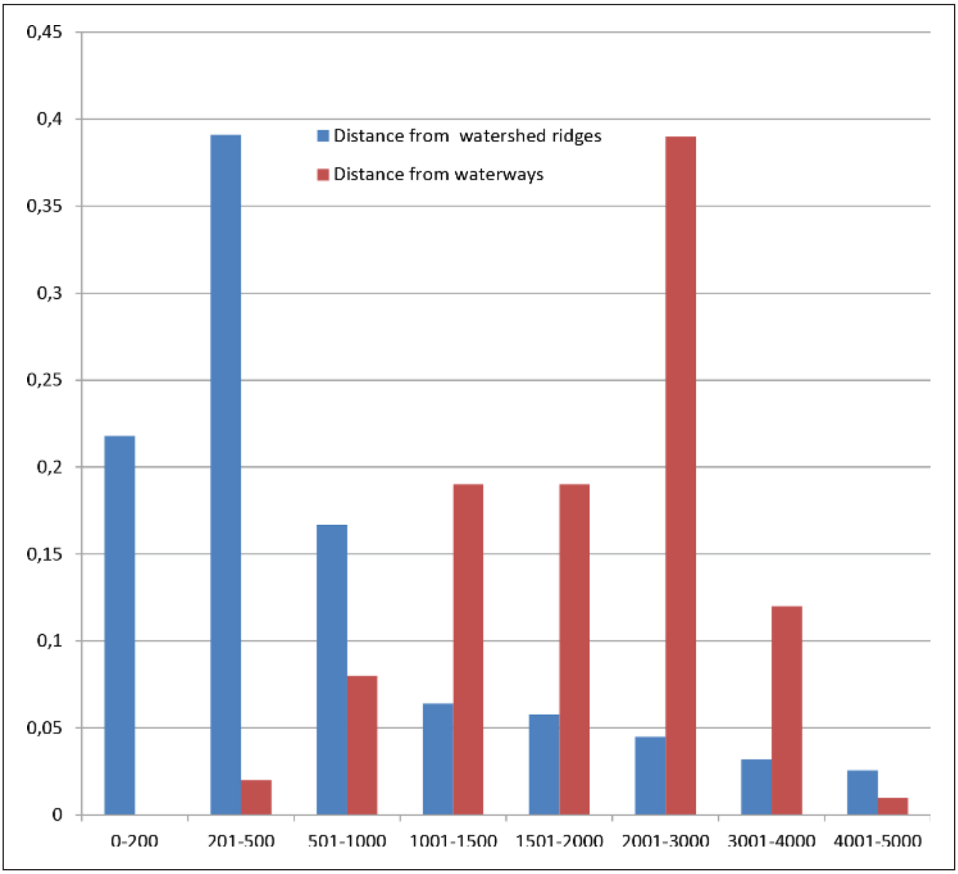
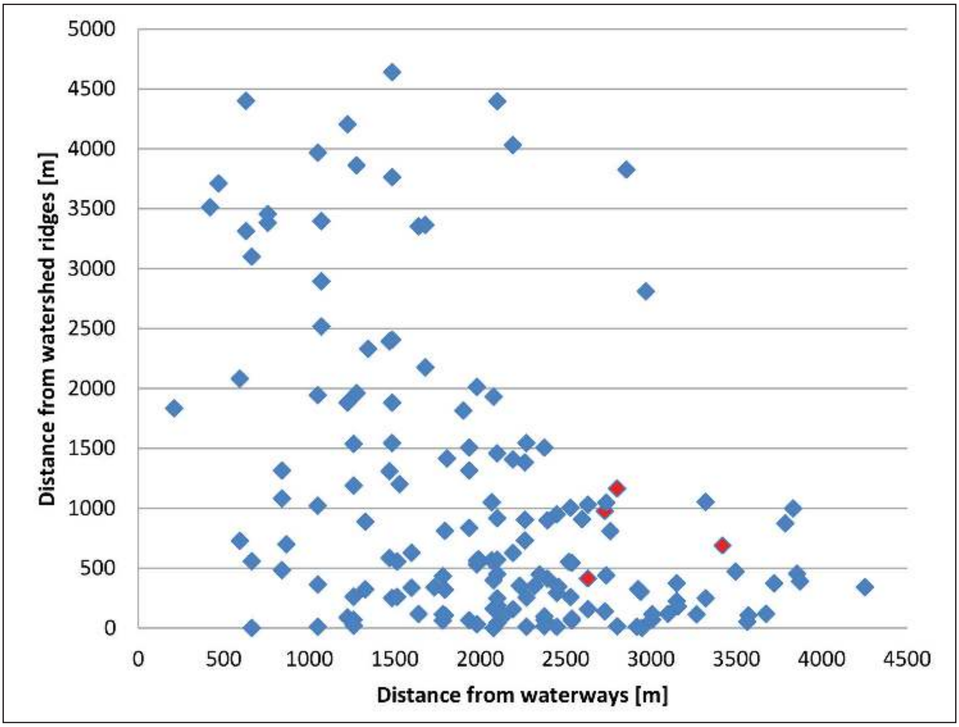


Fig. 8. Yampil barrow cemetery complex: distribution of tumuli number and terrain surface for accepted categories of distance from watershed ridges and waterways

7. ANALYSIS OF VISIBILITY

The visibility of barrows is considered to be one of the significant aspects for the choice of a place for their location [Ślusarska 2011]. In a subsequent analysis a simulation was conducted for the visibility of excavated barrows. For these purposes a buffer with a diameter of 2200 m for each of the tumuli was marked in which a zone was delineated, where a given mound was visible for an observer of 1.7 m [Weathley 1995].

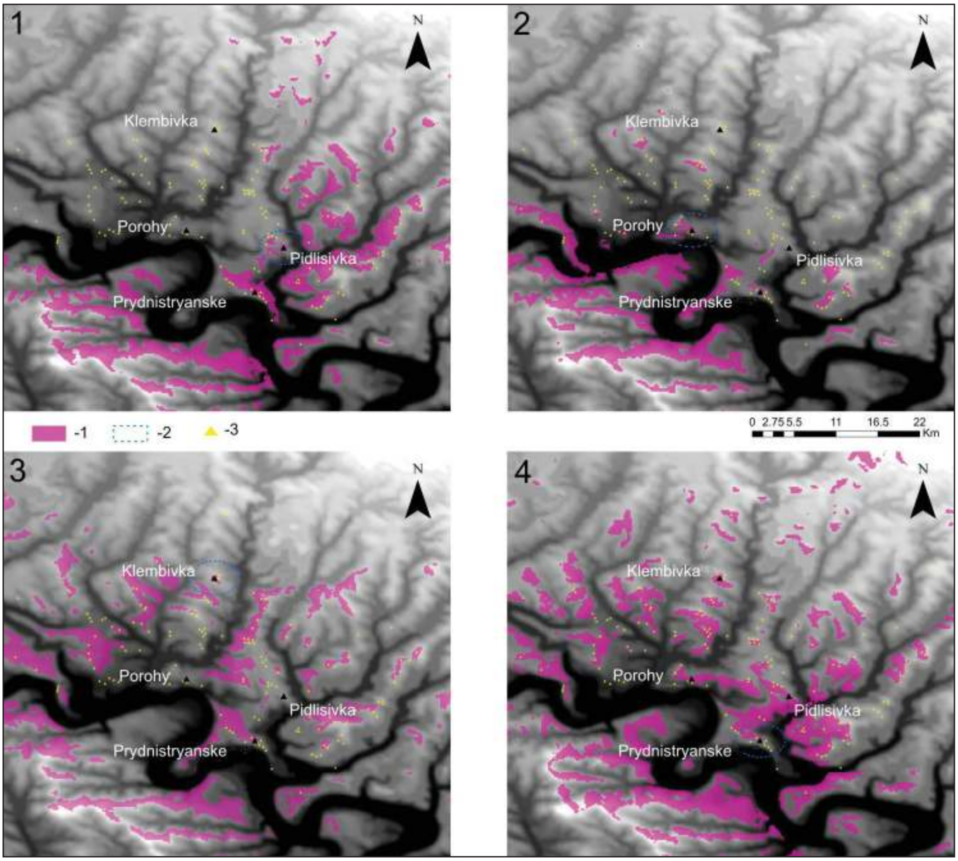
The mound at the site in Pidlisivka, within the buffer measuring 2200 m in diameter, would only be visible from 15% of this surface area, concentrated mainly in a western and north-western direction (Fig. 10: 1). With a broadening of the



F i g . 9. Yampil barrow cemetery complex: the location of particular barrows for distance from waterways and watershed ridges. Sites excavated are mark in red

zone, from which the tumulus in Pidlisivka would be visible, it is possible to note that these areas combine in a decidedly eastern and southern direction from the site in question. Within their area some 35 barrows were found from this region, which may be interpreted as an indicator of the potential visibility from 35 other barrow mounds in Pidlisivka. This provides a picture of the spatial grouping of these mounds – generation of concentrations that based on the parameter of visibility can create a genus of mutually related local units (chronological?; regional?).

The site in Porohy in direct proximity of the barrow (buffer measuring a diameter of 2220 m) would be visible from a small fragment of area located west of the barrow, taking up 12% of the surface (Fig. 10: 2). The factor analysed, however, begins to increase in respect to distance from the site, where areas with a view of the mound group in particular on the opposite line of the Dniester. Within the bounds of areas from which it is possible to notice the mound in Porohy, merely 15 other tumuli were found, which to a large extent is related to the significant occurrence of areas from which it is possible to see the mound in Porohy on the other side of the Dniester and therefore in areas for which we do not have barrows located.



F i g . 1 0 . Yampil barrow cemetery complex: analysis of visibility at the site in Pidlisivka (1), Porohy (2), Klembivka (3) and Prydnistryanske (4). 1 – areas from which the analyzed barrow was visible, 2 – buffer measuring a diameter of 220 m, 3 – remaining barrows

The barrow in Klembivka, in the outline of its buffer, is merely visible from 10% of the area (Fig. 10: 3). From a greater distance, analysis shows its visibility to be concentrated mainly along the tributaries of the Dniester, where 52 other barrows were found.

Within the immediate surrounds of the tumulus in Prydnistryanske only 15% of the terrain demonstrates the possibility of seeing its placement (Fig. 10: 4). By increasing the distance of these areas, from which it is potentially possible to see the tumulus, there are compact areas placed here and there on the opposite side of the Dniester and its tributaries that are visible.

In summarising the results of this analysis is possible to suggest that if the criterion of barrow visibility was in fact important for the creators of these assumptions it was related to significant distances.

SUMMARY

Taking into account the limitations of data used in presenting the above analysis, it is possible to cautiously draw several general conclusions in respect to the preferences of Yampil barrow constructors as to the choice of location. Here, areas placed at a high altitude with the lowest possible terrain incline were chosen, whereby the exposition direction was focused towards the south and south-west. One significant parameter over and above these criteria is the distance of mounds from waterways and watershed ridges, where the latter would appear to be extremely relevant. As far as the visibility of the tumulus in the surrounding landscape is concerned, it would appear that for its constructors the visibility of the barrow was important from a greater distance, which could serve the network of 'connection' in the context of the entire studied region.

For the purposes of this research project a spatial analysis of barrow culture would also be of particular interest, where a particular group rather clearly is differentiated in respect to the average values of parameters analysed.

ANNEX 1. VALUES OF ANALYSED PARAMETERS FOR THE YAMPIL BARROW CEMETERY COMPLEX

ID (Map 1)	M A.S.L	Incline [°]	Exposition direction	Distance from waterways [m]	Distance from watershed ridges [m]	Visible from Prydnistryanske	Visible from Pidlisivka	Visible from Porohy	Visible from Klembivka
0	269,1	18,7	SW	2802	1164	1	0	0	0
1	241,1	4,4	S	3418	689	0	0	0	1
2	243,7	8,7	E	2631	412	1	0	0	1
3	238,9	10,3	Flat	2730	976	0	0	0	0
4	237,0	15,2	S	2597	908	0	0	0	0
5	252,5	10,4	SW	2271	255	1	0	0	1
6	229,2	26,9	NE	3786	873	1	0	0	0
7	242,3	14,7	S	3495	471	1	0	0	0
8	244,3	4,9	SW	3100	118	0	0	0	1
9	231,7	2,5	S	3855	453	0	0	0	1
10	231,7	1,2	SW	3673	118	0	0	0	1
11	205,9	13,4	SW	2730	138	1	0	0	1
12	200,9	3,1	S	2100	189	1	0	0	1
13	195,8	15,8	E	2100	41	1	0	0	0
14	237,9	15,9	SW	3320	248	1	0	1	0
15	241,4	19,2	NE	3267	114	0	0	0	0
16	241,8	5,0	W	3872	389	1	0	1	0
17	181,3	6,1	Flat	1224	1881	0	0	0	0
18	182,2	5,3	Flat	1277	1961	0	0	0	0
19	180,3	7,4	S	1071	2517	1	0	0	0
20	177,0	9,1	Flat	1485	1881	0	0	0	0
21	175,2	27,4	SW	594	2081	0	0	0	0
22	180,2	20,0	S	664	0	0	0	0	1
23	167,6	18,7	SW	1050	10	0	0	0	0
24	156,3	22,1	NE	594	728	0	0	0	0
25	164,3	1,1	SW	1050	363	0	0	0	0
26	167,2	6,9	S	2271	10	1	0	0	1
27	161,5	16,6	Flat	2100	450	0	0	0	0

ID (Map 1)	M A.S.L	Incline [°]	Exposition direction	Distance from waterways [m]	Distance from watershed ridges [m]	Visible from Prydnistryanske	Visible from Pidlisivka	Visible from Porohy	Visible from Klembivka
28	150,7	7,8	NW	1224	88	0	0	0	0
29	187,1	16,4	SW	1936	65	0	0	0	0
30	193,3	5,1	SW	1514	554	1	0	0	0
31	174,9	41,8	W	840	1081	0	0	0	0
32	146,6	27,2	N	1806	1415	0	0	1	0
33	163,1	33,0	NW	1328	887	0	0	1	0
34	168,0	33,3	SE	1050	1021	0	0	0	0
35	180,0	13,5	Flat	1470	584	1	0	1	0
36	142,8	32,5	N	840	1314	0	0	0	0
37	189,7	18,7	SE	1071	2895	1	0	0	0
38	191,9	8,2	SE	1470	2393	0	0	0	0
39	185,0	17,8	NW	1345	2330	1	0	0	0
40	195,3	23,2	NW	1485	2407	1	0	0	0
41	203,3	7,9	NE	2079	1931	1	0	0	0
42	204,1	5,8	NW	2376	1506	1	0	0	0
43	206,2	6,7	S	1981	2013	1	0	0	0
44	159,6	21,7	N	630	4401	0	0	0	0
45	218,6	23,4	E	2262	1382	1	0	0	1
46	229,1	21,5	Flat	2762	808	1	0	0	0
47	218,8	20,7	W	2192	156	1	0	0	0
48	231,6	19,3	SE	2319	350	0	0	0	1
49	228,3	15,7	S	2449	949	0	0	0	1
50	213,9	13,0	SW	1936	1506	0	0	0	1
51	211,0	0,6	SW	2079	399	0	0	0	0
52	208,7	11,9	N	1981	530	0	0	0	0
53	211,6	0,5	SW	2449	10	1	0	0	0
54	210,9	1,3	NW	2376	65	0	0	0	0
55	216,2	8,5	S	1992	555	0	0	0	1
56	220,0	5,6	S	2141	105	0	0	0	1
57	236,7	18,2	SE	2079	162	1	1	0	1
58	241,7	6,3	NE	2738	440	1	0	0	0

ID (Map 1)	M A.S.L	Incline [°]	Exposition direction	Distance from waterways [m]	Distance from watershed ridges [m]	Visible from Prydnistryanske	Visible from Pidlisivka	Visible from Porohy	Visible from Klembivka
59	236,4	23,8	SE	2262	903	1	0	0	1
60	242,2	11,0	S	2738	1045	0	0	0	1
61	211,8	13,4	S	1680	2176	0	0	0	1
62	224,6	6,6	E	1782	432	0	1	0	1
63	229,2	9,7	SE	1640	117	0	0	0	0
64	166,8	2,2	E	2232	353	0	0	0	0
65	171,0	8,8	E	2079	0	0	0	0	0
66	180,6	13,7	Flat	1782	62	1	0	0	0
67	210,6	12,7	SW	1485	1544	1	0	0	0
68	178,1	54,7	Flat	866	699	0	0	0	0
69	173,6	54,5	SW	664	557	0	0	0	0
70	231,9	4,3	SE	2449	292	1	0	0	1
71	231,8	3,6	S	2458	344	0	0	0	0
72	241,2	8,0	N	2947	0	1	0	0	1
73	186,5	4,7	S	3150	224	0	0	0	1
74	184,3	2,6	N	3832	998	0	0	0	1
75	190,4	8,2	NW	3721	372	0	0	0	1
76	200,0	2,7	S	2925	324	1	0	0	1
77	173,5	15,2	NE	2271	1544	0	0	0	0
78	123,2	16,6	NE	1640	3353	0	0	0	0
79	120,9	13,9	S	2192	4031	0	0	0	0
80	140,5	1,4	NW	2856	3827	0	0	0	0
81	141,4	4,3	SE	2100	4398	0	0	0	0
82	143,4	6,9	Flat	1485	4641	0	0	0	0
83	146,0	63,0	Flat	470	3712	0	0	0	0
84	146,0	52,2	W	420	3513	0	0	0	0
85	147,9	41,5	N	630	3314	0	0	0	0
86	141,0	2,1	S	2970	2810	0	0	0	0
87	200,5	3,7	S	2631	157	1	0	1	1
88	200,9	2,5	S	1260	261	1	0	1	1
89	171,1	9,3	S	1260	68	0	0	0	0

ID (Map 1)	M A.S.L	Incline [°]	Exposition direction	Distance from waterways [m]	Distance from watershed ridges [m]	Visible from Prydnistryanske	Visible from Pidlisivka	Visible from Porohy	Visible from Klembivka
90	107,8	47,9	E	757	3383	0	0	0	0
91	186,7	24,5	Flat	1071	3398	0	0	0	0
92	188,5	8,2	S	1680	3365	1	1	1	1
93	193,1	6,4	S	1277	3864	1	1	1	1
94	188,4	10,9	SE	1224	4206	0	1	0	1
95	179,5	23,4	E	1485	3764	0	1	0	0
96	181,3	20,9	W	1050	3968	0	0	0	0
97	179,8	16,2	SW	757	3456	0	1	0	0
98	163,7	37,0	NE	664	3100	0	0	0	0
99	191,9	1,6	S	2394	411	1	1	1	1
100	191,0	4,2	S	2529	1003	1	1	0	1
101	190,3	3,4	SW	2100	1458	1	1	0	1
102	181,6	15,5	W	1470	1309	0	0	1	1
103	206,4	1,9	SW	1260	1537	1	0	0	1
104	206,6	0,9	W	1260	1189	0	0	0	1
105	211,2	2,6	S	1599	336	0	0	0	0
106	211,5	1,2	E	1794	105	1	0	0	0
107	210,2	3,8	E	1328	323	1	0	0	0
108	203,4	6,8	NE	840	483	1	0	0	0
109	207,4	7,4	W	2262	730	0	0	0	0
110	208,8	6,1	SW	1529	1201	0	0	0	0
111	201,5	7,5	NW	1902	1816	1	1	0	0
112	177,0	6,6	SW	2100	916	1	0	0	0
113	168,1	19,4	SW	2192	1407	1	0	0	0
114	179,7	0,7	NW	1936	836	1	1	0	0
115	179,7	0,5	Flat	2068	1049	1	1	0	0
116	179,3	0,3	NW	1599	627	1	1	0	0
117	199,7	11,0	S	2100	248	1	1	1	0
118	199,4	24,1	W	2192	626	0	0	0	0
119	200,0	6,8	SE	1992	574	0	0	0	0
120	218,7	28,7	S	3157	179	1	1	1	1

ID (Map 1)	M A.S.L	Incline [°]	Exposition direction	Distance from waterways [m]	Distance from watershed ridges [m]	Visible from Prydnistryanske	Visible from Pidlisivka	Visible from Porohy	Visible from Klembivka
121	217,4	15,3	E	2940	303	0	0	0	0
122	200,9	2,7	S	1514	555	1	1	0	1
123	202,4	4,7	SW	3320	1052	1	1	0	1
124	248,6	12,3	SW	2068	565	1	1	1	1
125	253,2	6,3	S	2917	10	0	0	0	0
126	250,3	12,5	S	3570	105	0	0	0	0
127	231,6	15,2	SE	3564	52	1	0	1	0
128	199,2	15,7	S	3150	373	0	0	0	0
129	197,6	29,2	W	2631	1029	0	0	0	0
130	188,8	8,3	SE	1050	1944	1	1	0	1
131	223,3	16,1	E	1981	562	1	1	0	1
132	234,5	24,5	SE	2537	62	1	1	0	0
133	238,7	15,7	E	1732	340	0	0	0	0
134	223,8	7,5	E	1485	250	1	1	0	1
135	226,5	1,8	S	1260	19	0	0	0	0
136	272,3	8,8	SW	1782	114	1	1	0	0
137	282,7	0,9	S	4252	341	0	1	0	1
138	222,6	4,5	SE	1514	259	0	0	0	0
139	261,6	15,7	SE	1981	31	1	1	0	1
140	263,9	7,5	E	2100	570	1	1	0	1
141	233,4	9,0	S	2376	14	0	0	0	0
142	239,7	13,8	S	1794	810	0	0	0	1
143	237,1	4,1	E	3007	69	1	1	0	1
144	234,3	0,9	S	2802	14	1	1	0	1
145	230,9	11,9	NE	2348	446	1	1	0	0
146	222,3	18,8	E	2376	96	0	1	0	0
147	225,4	13,6	SE	2529	259	0	0	0	0
148	218,6	28,9	SW	2520	551	0	0	0	0
149	231,0	11,3	S	2537	543	0	1	0	1
150	232,5	4,4	SW	3007	114	0	0	0	0
151	218,3	14,3	NE	2394	899	0	0	0	0

ID (Map 1)	M A.S.L	Incline [°]	Exposition direction	Distance from waterways [m]	Distance from watershed ridges [m]	Visible from Prydnistryanske	Visible from Pidlisivka	Visible from Porohy	Visible from Klembivka
152	216,8	23,1	E	1936	1314	0	1	0	0
153	99,5	57,1	N	210	1834	0	0	0	0
154	254,6	8,3	SE	1794	319	0	1	0	0
155	254,8	13,6	SW	2537	78	0	1	0	0

Translated by Piotr T. Żebrowski

REFERENCES

Jaskulski M., Szmidt A.
2013 Ocena przydatności automatycznego wyznaczania linii szkieletowych terenu do analiz geomorfometrycznych. *Folia Geographica Socioeconomica* 13: 145-156.

Kośko A. (Ed.)
2015 Podolia as a Cultural Contact Area in the 4th/3rd-2nd Millennium BC, *Baltic Pontic Studies* 20.

Kusiński W., Zastawnyj F.
2003 *Ukraina: przyroda – ludność – gospodarka.* Warszawa.

Litwin L., Myrda G.
2005 *Systemy informacji geograficznej. Zarządzanie danymi przestrzennymi w GIS, SIP, SIT, LIS*. Gliwice.

Makohonienko M., Hildebrandt-Radke I.
2014 Kontekst przyrodniczy i perspektywy studiów paleośrodowiskowych stanowiska kultury jamowej w Pidlisiwce nad Dniestrem, zachodnia Ukraina. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 247-274. Poznań.

Placek A.
2008 Zastosowanie numerycznego modelu terenu w geomorfologii strukturalnej na przykładach z obszaru Sudetów. *Landform Analysis* 9: 364-368.

Potupczyk M., Razumow S.
2014 Zgrupowanie cmentarzysk kurhanowych w rejonie jampolskim. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 35-40. Poznań.

Przybyła M.M., Podsiadło M., Potupchyk M., Włodarczak P., Żurkiewicz D.
2017 The Eneolithic ritual barrow complex, Prydnistryanske, Vinnytsia Oblast: magnetometric surveys. *Baltic-Pontic Studies* 22: 30-40.

Ślusarska K.
2011 Uwagi o uniwersalnym znaczeniu kurhanów w tradycji grzebalnej społeczności wspólnoty katakumbowej wczesnego okresu epoki brązu Nadczarnomorza. In: H. Kowalewska-Marszałek, P. Włodarczak (Eds) *Kurhany i obrządek pogrzebowy w IV-II tysiącleciu p.n.e,* 131-138. Kraków.

Weathley D.
1995 Cumulative Viewshed Analysis: a GIS-based method for investigating intervisibility, and its archaeological application. In: G. Lock, G. Stan (Eds) *Archaeology and GIS: a European perspective,* 5-13. London.

Baltic-Pontic Studies
vol. 22: 2017, 30-40
ISSN 1231-0344
DOI 10.1515/bps-2017-0019

Marcin M. Przybyła[*], Michał Podsiadło[*], Mykhailo V. Potupchyk[**], Piotr Włodarczak[***], Danuta Żurkiewicz[****]

THE ENEOLITHIC RITUAL BARROW COMPLEX IN PRYDNISTRYANSKE, VINNYTSIA OBLAST: MAGNETOMETRIC SURVEYS

ABSTRACT

The article presents the results of magnetometric surveys carried out in the village of Pridnistryanske on two barrow sites. In the site 1, the principal objectives were to capture the course of barrow ditches – not covered by the excavations – and investigate the space between the mounds. On site 2 relying on photographs was a group of nearby barrows selected for geophysical investigations.

Key words: barrows, spatial analysis, magnetometric method

INTRODUCTION

The investigations of barrow cemeteries always run up against the problem of delineating the limits of the space used for ritual purposes. Usually, excavations centre first on the visible elements of funeral architecture and sometimes on their

[*] "Dolmen" S.C. Marcin Przybyła, Michał Podsiadło, pl. Emila Serkowskiego 8/3, 30-512 Kraków, Poland; megzyk@poczta.onet.pl, thergo@o2.pl
[**] Department of Culture and Arts, Khmelnytske St. 7, 21036 Vinnitsa, Ukraine; m_potupchik@ukr.net
[***] Institute of Archaeology and Ethnology of Polish Academy of Sciences, Centre for Mountains and Uplands Archaeology, Sławkowska 17, 31-016 Kraków, Poland; wlodarczak.piotr@gmail.com
[****] Department of Prehistory of Central and Eastern Europe, Institute of Archaeology, Adam Mickiewicz University, Umultowska 89D, 61-614 Poznań, Poland; danuta@amu.edu.pl

immediate surroundings. In practice, however, usually only a barrow mound is explored. The large dimensions of barrows located in the steppe and forest-steppe zones often make them isolated targets of investigations, while their surroundings are left unexplored. Moreover, as in present Central Europe, intensive agriculture has completely levelled off the mounds of many barrows and considerably changed the original relief. Particularly susceptible to such destruction, Eneolithic barrows are typically distinctly smaller than barrows built or heightened in the Early Bronze Age (associated with the Yamnaya culture). Now, only vestiges of such features are perceptible as is the case with barrows I-III, site 1, Prydnistryanske, Yampil Region, Vinnitsta *Oblast*, explored as part of the Polish-Ukrainian project to study the Yampil Barrow-Ritual Complex in 2014 [Klochko *et al.* 2015].

The future-oriented methods of non-invasive prospection can considerably expand our knowledge and help us in planning excavations. First, however, it is necessary to analyse aerial and satellite photographs to identify levelled-off barrows that are hardly perceptible from the ground. After a review of such photographs, areas to be surveyed using geophysical methods were selected. A decision was made to begin with the zone excavated earlier: a group of barrows on site 1, Pridnistryanske. The principal objectives were to capture the course of barrow ditches – not covered by the excavations – and investigate the space between the mounds. Only then, relying on photographs was a group of nearby barrows selected for geophysical investigations. These barrows were of a similar size and degree of destruction to those on site 1 and formed an analogous linear arrangement (site 2, Pridnistryanske). This was done for comparing the structures of unexplored barrows with the results of excavations on site 1. A secondary objective was to check the readability of results in the environment of Podolia *chernozem* soils that had not been investigated until then.

1. METHODOLOGY

To carry out the survey, a magnetic method was chosen, allowing large areas to be sampled relatively quickly. A magnetometer records the presence of anomalies of higher or lower values of the earth's magnetic field caused by diverse human activity. Recognisable anomalies (usually point or linear anomalies with higher magnetic field values) result in particular from the presence of dug-in features (pits, ditches, sunken buildings, etc.). Special anomalies, showing large amplitude of changes, are associated with the presence of furnaces, hearths and other features exposed to high temperatures in the past, for instance, the relics of burnt buildings. Dipolar anomalies, in turn, are caused by the presence of ferrous objects. Under favourable conditions, recognizable anomalies may be also caused by the relics of

F i g . 1 . Prydnistryanske, Yampil Region. Location of geophysically surveyed barrow clusters: sites 1 and 2

masonry, in particular bricks. Zone anomalies may also mark human activity sites. Inhumation graves, however, may pose a problem in this respect as their fills do not differ much, in terms of physicochemical properties, from their background and, thus, do not give any magnetic anomalies [David *et al.* 2008: 20-21; Misiewicz 2006: 78]. The magnetic method allows the position of archaeological sites to be recognized quickly and comprehensively. It has a shortcoming, though: a relatively small penetration depth only slightly exceeding 1.0 m [David *et al.* 2008: 16].

Magnetic measurements in Prydnistryanske were made with a fluxgate magnetometer [Misiewicz 2006: 74-98] 4.032 DLG manufactured by the Foerster Ferrex company, measuring the gradient of the vertical component of the magnetic field and fitted with one probe of a resolution of 0.2 nT. Sampling lines were 1.0 m apart. Ten measurements per 1.0 sq. m were made. The data were collected bidirectionally.

The survey resulted in the recording of very many anomalies of a various nature. They are shown on magnetic charts plotted using the Terra Surveyor 3.0.29.3 software.

Fig. 2. Prydnistryanske, Yampil Region. Site 1. Magnetic map superimposed on satellite photograph

2. RESULTS

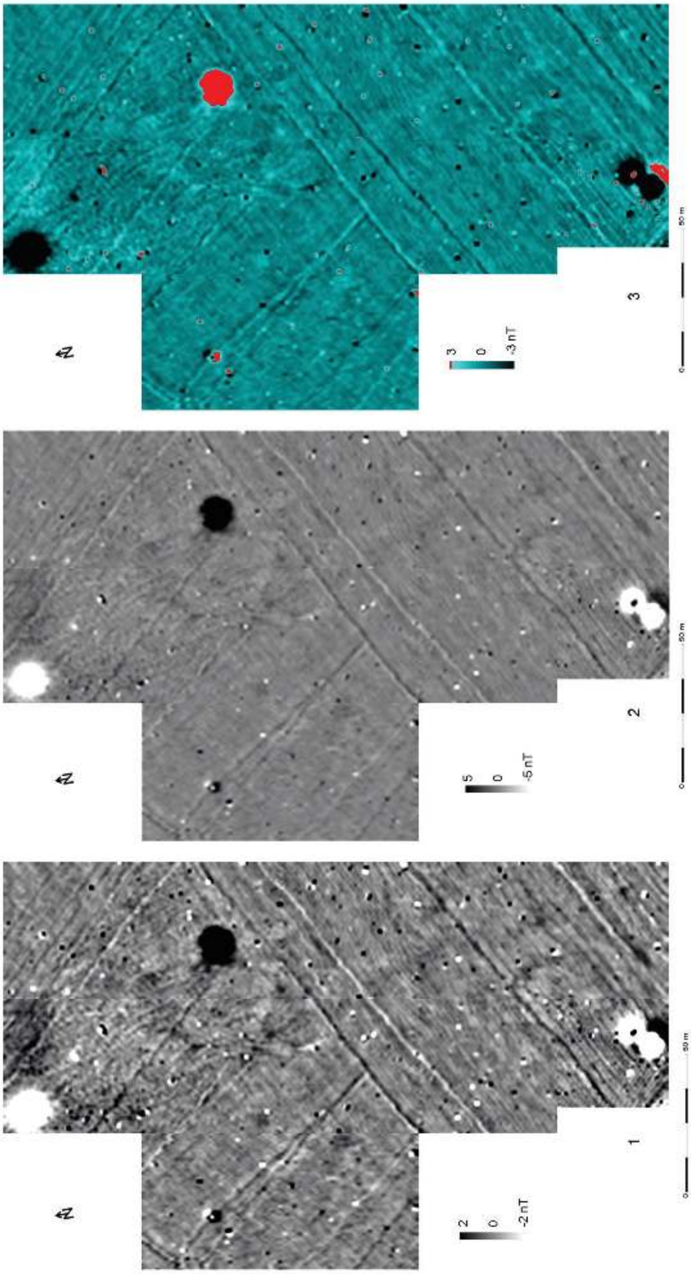
For the survey, Prydnistryanske, site 1 and 2, being barrow clusters, were selected (Fig. 1). On site 1, measurements covered 2.95 ha (Fig. 2), on site 2 – 0.75 ha (Fig. 3).

On site 1, satellite photographs helped identify four barrows: one large and three smaller ones arranged in a line. All were excavated in 2014 [Klochko *et al.* 2015]. The magnetic survey covered the large barrow and two of the three smaller ones (Figs. 2, 5). In the surveyed area, very many distinct linear anomalies related to land cultivation were identified and found to be related to baulks dividing fields in various times and traces of deep ploughing. Furthermore, numerous small dipolar anomalies were recorded related, no doubt, to ferruginous objects located in the humus layer. Relatively numerous positive and negative point anomalies seem to be related rather to natural, geological and zoogenic formations than potential archaeological features. Situated in the surveyed area, high-voltage electricity pylons were sources of strong dipolar anomalies (Fig. 5).

F i g . 3 . Prydnistryanske, Yampil Region. Site 2. Magnetic map superimposed on satellite photograph

The Eneolithic barrows may be associated only with positive anomalies caused by ditches or rather borrow pits surrounding the barrows (Fig. 5: 1, 2, 3). In the case of the large barrow, the recorded anomaly was a zone one and was irregularly shaped (Fig. 5: 1). It was best recognizable in the northern part of the barrow perimeter. Similar anomalies, connected to other smaller barrows, may be called linear. They formed ring-like patterns, marking barrow edges (Fig. 5: 2, 3). Their values varied and their recognisability was limited. No anomalies were recorded that could be unequivocally connected with other barrow elements, as for instance grave pits.

In the case of Prydnistryanske, site 2, the survey covered all the three hypothetical barrows (Figs. 3-6). In this case, too, numerous linear anomalies were observed, related to land cultivation (ploughing), and exceptionally numerous minor dipolar anomalies, attesting to the area being littered with ferromagnetic objects. Out of three discernable supposed barrows (soil indicators visible on satellite photographs), only the south-easternmost barrow was the source of recognisable anomalies. One of them was a zone positive anomaly (Fig. 7: 1), forming a ring around the supposed barrow. The anomaly is no doubt related to the place from which earth was taken to build the barrow. The very mound of the barrow is seen as an oval area of lowered magnetic susceptibility (Fig. 7: 2). The nature of the anomaly (lowered value of magnetic field) may be related to the barrow structure, namely, the removal of the layer of a high value of the magnetic field from its site.



F i g . 4 . Prydnistryanske, Yampil Region. Magnetic maps of site 1. 1 – greyscale magnetic map in the range -2/2 nT; 2 – greyscale magnetic map in the range -5/5 nT; 3 – colour-scale magnetic map in the range -2/2 nT with the highest values highlighted

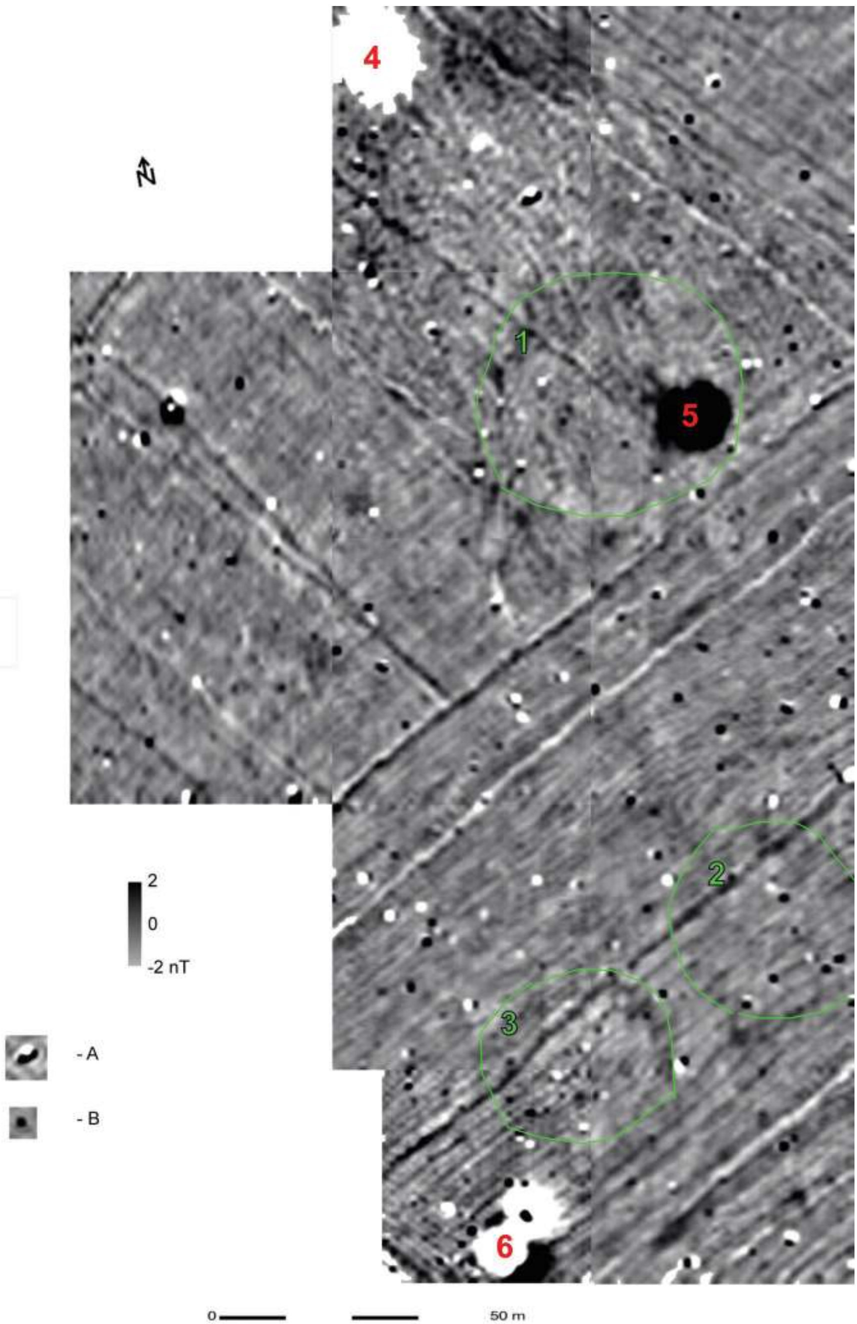
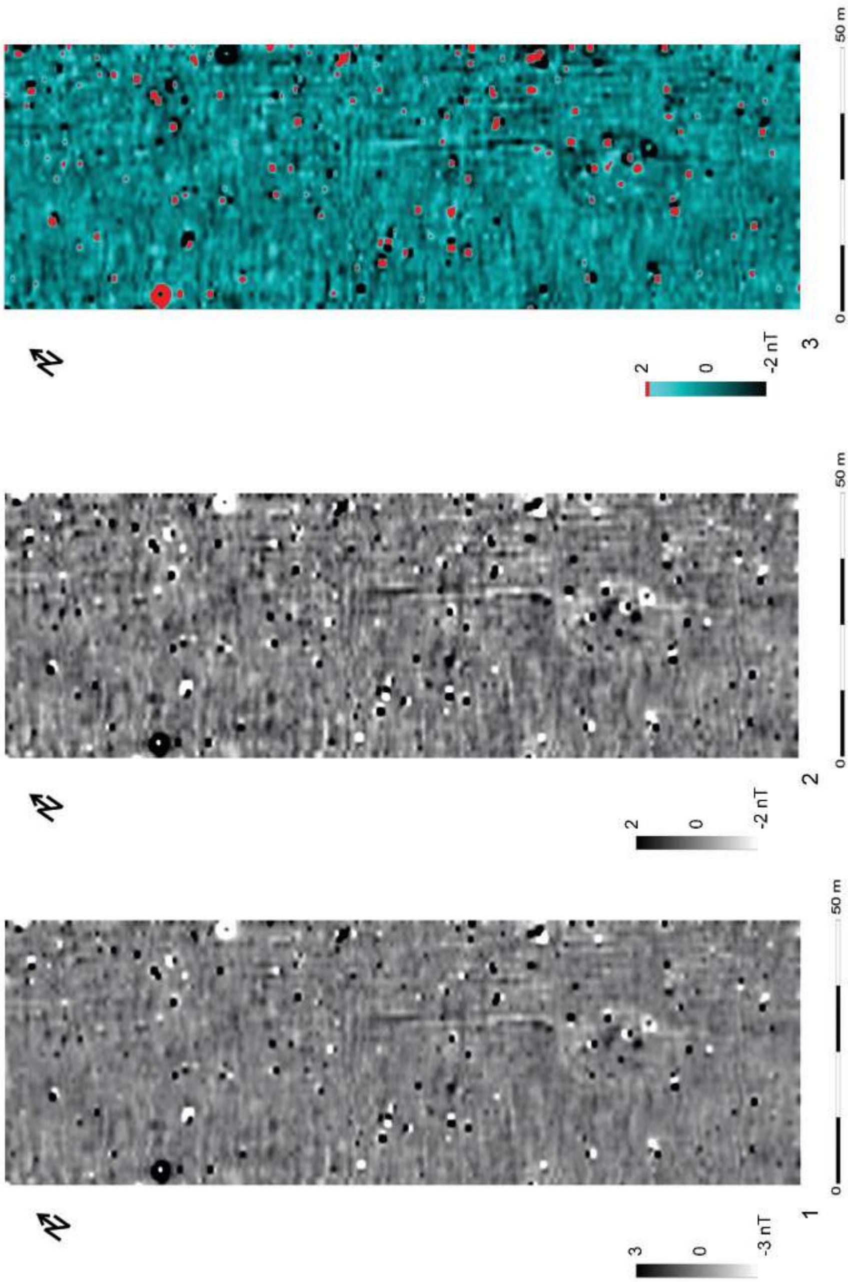
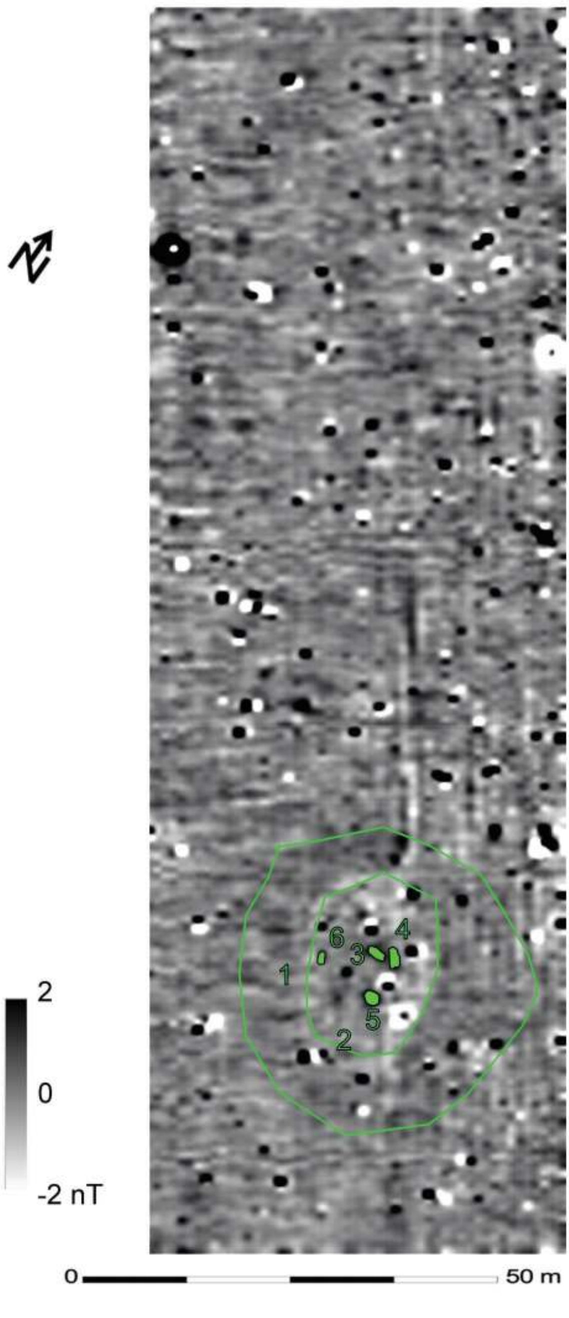


Fig. 5. Prydnistryanske, Yampil Region. Magnetic map of site 1 with selected anomalies marked. 1-3: positive anomalies related to barrow structure; 4-6: anomalies related to high-voltage electricity pylons. A – example of dipolar anomaly; B – example of spot positive anomaly



F i g . 6 . Prydnistryanske, Yampil Region. Magnetic maps of site 2. 1 – greyscale magnetic map in the range -3/3 nT; 2 – greyscale magnetic map in the range -2/2 nT; 3 – colour-scale magnetic map in the range -2/2 nT with the highest values highlighted



F i g . 7 . Prydnistryanske, Yampil Region. Magnetic map of site 2 with selected anomalies marked. 1-2: positive anomalies related to barrow structure; 3-6: spot positive anomalies suggesting possible archaeological features

This may be a sign that the site was dehumified prior to the building of the barrow or that material of low magnetic field values, as pure loess, accumulated within the barrow mound perimeter. In addition, within the barrow mound perimeter, a few positive point anomalies can be identified (Fig. 7: 3-6). Not especially high values, the elongated shape and dimensions, especially of anomalies 3, 4 and 6, may permit to associate them with archaeological features, possibly grave pits.

The poor recognisability of anomalies connected with the ditches surrounding the Eneolithic barrows is no doubt a result of a layer of humus over 1.0 m thick extending over the site. It muffles the anomalies of not especially high values related to archaeological features. On the other hand, the poor recognisability of anomalies is a consequence of the nature of features being their sources. These are relatively shallow, irregular ditches of a basin-like cross-section. Their fills have a magnetic susceptibility value close to that of humus. Relatively small barrow mound dimensions show that the barrows were built above all of the material of surface *chernozem* layers without reaching as far as the bedrock.

3. CONCLUSIONS

Despite visualization shortcomings, magnetic surveys have proven to be an effective non-invasive method of prospection for barrow sites in the area of Podolia *chernozem* soils. Their information has improved site plans by adding elements located outside the excavated areas (such as borrow pits). Furthermore, magnetic surveys have helped distinguish a complex of barrow cemeteries in the Dniester Area dated to the Late Eneolithic (second half of the 4th millennium BC). The object of the surveys was a cluster of three small barrow features, the structure of which turned out to be analogous to that of the barrows investigated on site 1 in Prydnistryanske. Presumably, in the vicinity of Prydnistryanske, a large ritual-funerary complex used to function in connection with Late Tripolye/Pre-Yamnaya population groups. So as to advance our knowledge in this field it is beholden to investigate it further, taking advantage of aerial photography and geophysical surveys.

Translated by Piotr T. Żebrowski

REFERENCES

David A., Linford N., Linford P
2008 *Geophysical survey in archaeological field evaluation*. Swindon.

Klochko V.I. Kośko A., Razumow S.M., Potupczyk M.V., Włodarczak P., Żurkiewicz D., Ivanova S.V.
2015 Tripolye (Gordinesti group), Yamnaya and Catacomb culture cemeteries, Prydnistryanske, site 1, Yampil Region, Vinnitsa *Oblast*: An archaeometric and chronometric description and a taxonomic and topogenetic discussion. *Baltic-Pontic Studies* 20: 183-255.

Misiewicz K.
2006 *Geofizyka archeologiczna*. Warszawa.

Baltic-Pontic Studies
vol. 22: 2017, 41-53
ISSN 1231-0344
DOI 10.1515/bps-2017-0020

Michał Jankowski[*], **Michał Dąbrowski**[*], **Justyna Jasińska**[*], **Adam Michalski**[*]

YAMPIL BARROW COMPLEX: PRYDNISTRYANSKE 1 AND KLEMBIVKA 1. PEDOLOGICAL-ENVIRONMENTAL ASPECTS OF LOCATION

ABSTRACT

The paper presents results of pedological studies of Klembivka site 1 and Prydnistryanske site 1 barrow IV and the reference soil profile Prydnistryanske site 1 in the context of pedostratigraphy, basic soil properties, construction material origin and palaeoenvironmental implications.

Key words: *Chernozems*, forest-steppe zone, calcic horizon, kurgans (barrows), pedoarchaeology

Soil conditions have always been a major environmental factor in locating human activity. Apart from their fundamental role in natural ecosystems, soils have provided a base for the planned cultivation of chosen crops and determined if it was successful and what direction it took. On the other hand, soil morphological structure and properties reflect the special character of the soil-forming environment, that is, the natural geographical environment and the human activity interfering in the soil [Karpachevski 1983; Bednarek 2007]. Apart from being used for crop cultivation, soils were a basic, universally available and easily procured building material of anthropogenic structures. Such earthen structures include barrows. The study of the material they are built of and soil properties around them may, in

* Department of Soil Science and Landscape Management, Faculty of Earth Sciences, Nicolaus Copernicus University, ul. Lwowska 1, 87-100 Toruń, Poland; mijank@umk.pl, michal.dabrowski@op.pl, justynaj1804@wp.pl, adamich@o2.pl

F i g . 1 . Location of the study sites

favourable conditions, be helpful in reconstructing the environmental conditions that prevailed when they were being built and also later environment changes. It may even shed some light on the preferences and customs of their builders.

The study of soils within the *Yampil Barrow Complex* (YBC) was undertaken on the invitation from Prof. Aleksander Kośko. The first barrow mound to be studied was Pidlisivka 1 explored in 2010 [Bednarek, Jankowski 2014]. This article presents the results of the next stage of investigations centred on the structure of other two barrows, designated as Prydnistryanske 1-IV [Klochko *et al.* 2015b] and Klembivka 1 [Klochko *et al.* 2015a]. Characteristics of barrow building materials in comparison with natural soil and also an attempt of their pedological-environmental interpretation are the aim of this work.

The study involved the analysis of a set of soil samples and vertical cores collected in the course of archaeological excavations. The samples and cores represented barrow mound strata and their contact with the underlying remains of original soils. The samples were analyzed for basic physical and chemical properties, determining the genetic characteristics and origin of barrow building materials, using standard methods employed in soil science: *hydrometric (Bouyoucos-Casagrande) and sieve* for particle size distribution, *Tiurin wet-burning* for organic carbon (OC) content, *Kjeldahl* for total nitrogen content (Nt), potentiometric for pH measured in ultrapure H_2O and 1 mol/dm^3 KCl, *Scheibler* for $CaCO_3$ content and *Bleck as modified by Gebhardt* for phosphorus content (Pt). To interpret correctly the barrow-building materials, the investigations were extended to cover the analysis of the reference soil profile Prydnistryanske 1, located at the site of the same name in the immediate vicinity of the complex of four barrows.

1. ENVIRONMENTAL-PEDOLOGICAL CONDITIONS AROUND YAMPIL

The YBC is situated in the northern left-bank part of the Dniester drainage basin (Fig. 1). The barrows rise from a loess plateau, gently descending north-south, in the direction of the river ravine edge. Around Klembivka, the plateau surface stretches at about 250-270 m a.s.l., while around Prydnistryanske 1 it rises to about 180-200 m. a.s.l. A special relief feature is the domination of vast undulating or flat surfaces cut by many ravines and gorges, belonging to the Dniester fluvial system, having impressive depths exceeding 100 m or locally even 160 m. According to a topographic map, the water level of the Dniester, at the shortest distance from Prydnistryanske 1, extends at about 41 m a.s.l.

The plateau surface is built of Pleistocene loess formations, being the parent rock of contemporary soils. The loess cover lies over older rocks the outcrops of which can be seen on Dniester valley slopes and in quarries worked on the Ukrainian and Moldavian sides of the river alike. The Pleistocene formations are underlain by the plates of Tertiary, Mesozoic and Palaeozoic sedimentary rocks. Underneath, the granites of the Precambrian Ukrainian Shield are exposed in several locations [Siemiradzki 1922; Boguckyj *et al.* 2007]. The bottoms of ravines and side valleys are filled with colluvial and alluvial materials, coming chiefly from loess re-deposition already in the Holocene. The Dniester valley bottom is built of Holocene alluvial deposits.

In bioclimatic terms, the south-eastern part of western Ukraine is considered a part of a forest-steppe zone [Zastawnyj, Kusiński 2003]. It is characterized by a mosaic of potential steppe vegetation and deciduous forests. On Ukraine's map of vegetation, the area in question has been marked for the most part as 'arable land in place of oak forests'. However, the immediate vicinity of Yampil is marked on maps as a wedge of meadow steppe stretching along the Dniester and interspersed with small enclaves of oak and oak-hornbeam forests. This fact alone attests to special geo-ecological conditions, including soil-forming ones, present in the area under investigation when compared to the surrounding area. Boguckyj *et al.* [2007] use the designation 'Ukrainian subtropics' with regard to the Dniester valley, which reflects the differences between this area and the rest of this part of the country in terms of landscape and climate.

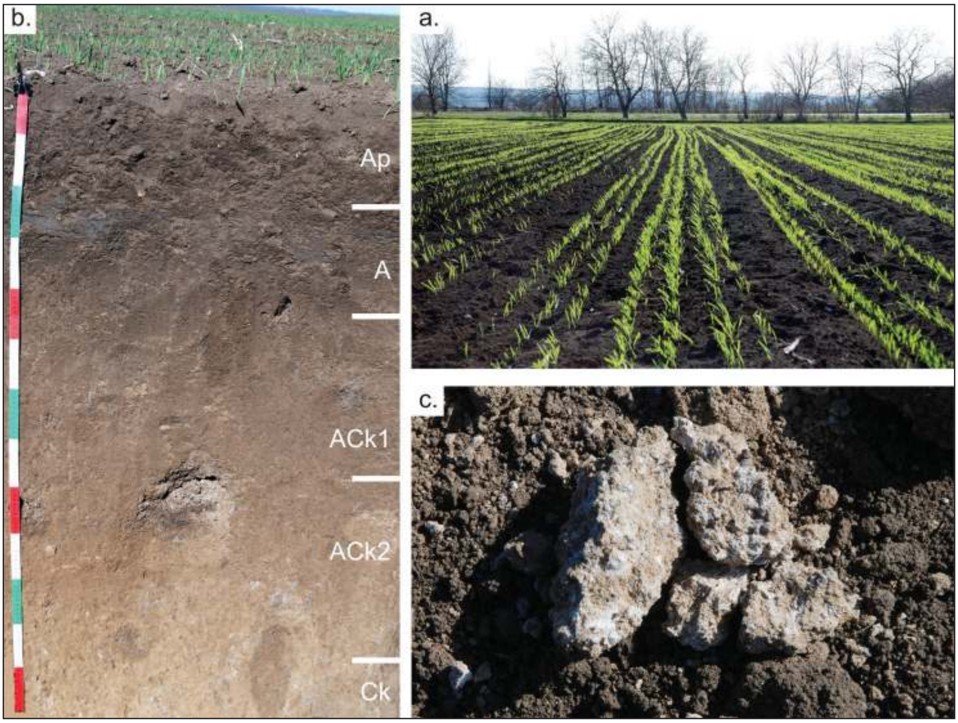


Fig. 2. Morphology of the reference soil profile Prydnistryanske site 1: a. soil surface, b. soil profile (horizons marked with standard symbols used in soil science), c. $CaCO_3$ concentration in the Ck *calcic* horizon

Typical soils in the forest-steppe zone include above all degraded and 'podzolized' *chernozems* and (dark-) grey forest soils [Bednarek, Prusinkiewicz 1980; Baliuk *et al.* 2017], occurring also as a mosaic. A comparison of the bioclimatic conditions with peculiar geomorphological features reveals, however, a certain special characteristic of the mosaic landscape around Yampil. The wide distribution of potential steppe or meadow-steppe vegetation may be associated with the elevated, sun- and wind-exposed, relatively dry hilltops of the loess plateau. In its soil cover, *chernozems* with steppe rather than forest-steppe characteristics may be expected to dominate. Deciduous forests, in turn, should be mainly connected with more humid conditions prevailing in valleys and on their slopes, potentially covered by grey forest soils as well as colluvial and alluvial soils.

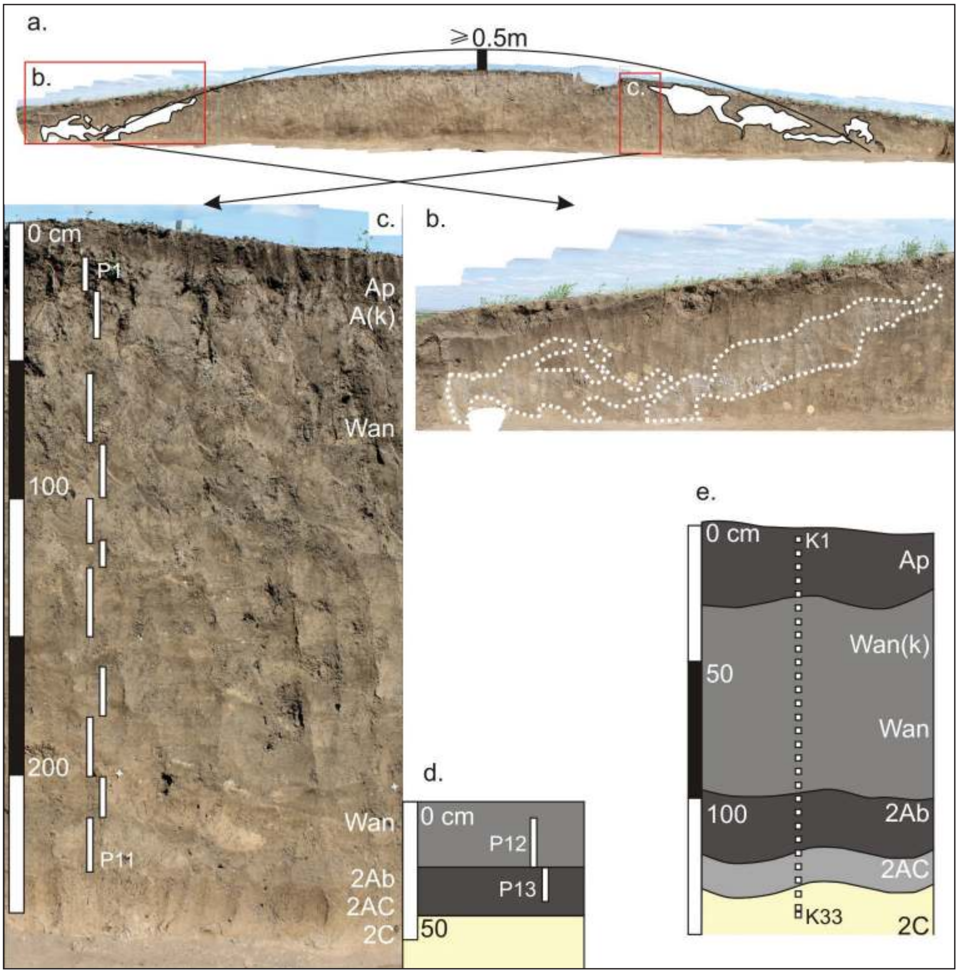


Fig. 3. Morphology of barrows: Prydnistryanske, Yampil Region, site 1, barrow IV: a. cross-section N-SO, with secondary calcic horizon and probable former barrow height marked, b. closer view of secondary calcic horizon, c. scheme of core 1 sampling (section N-SO), d. scheme of core 2 sampling (section S-NO); and Klembivka 1: e. scheme of barrow sampling (Photo: D. Żurkiewicz)

2. SOIL MORPHOLOGY IN THE REFERENCE PROFILE AND BARROWS MOUNDS

The reference soil profile is located at Prydnistryanske 1 site, about 75 m south of barrow IV and west of barrow II [Klochko *et al.* 2015b] on the flat, slightly tilted towards the south-west surface of the loess plateau. The area is used to grow crops,

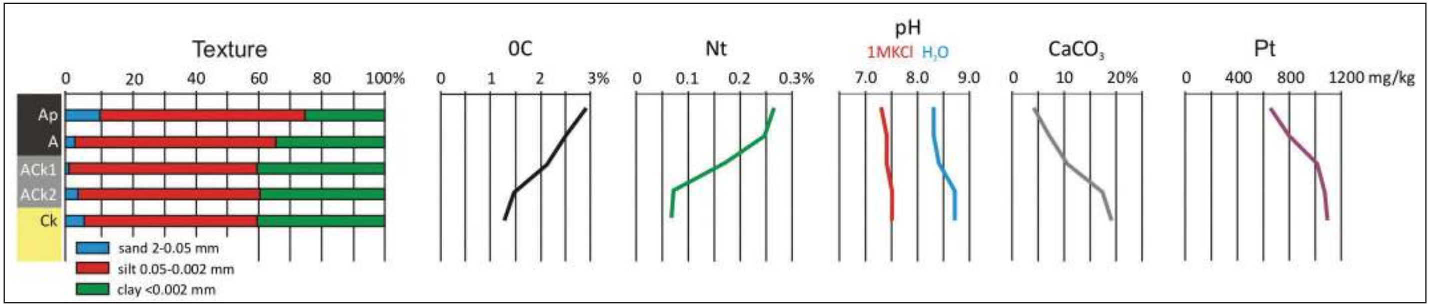


Fig. 4. Basic properties of the soil in the reference profile Prydnistryanske 1

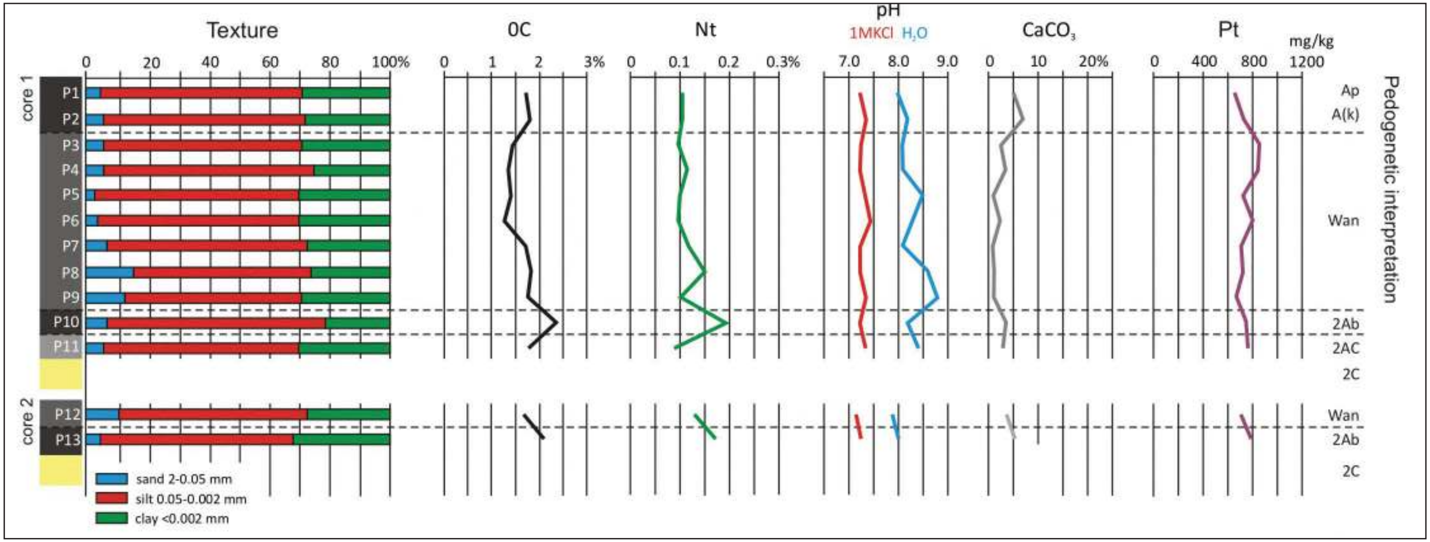


Fig. 5. Basic properties of soil material building barrow IV in Prydnistryanske site 1

where during field work in early April 2016 sprouting wheat could be seen in the field (Fig. 2a).

The reference profile Prydnistryanske 1 exposes soil the morphological structure of which is characteristic of typical *chernozem* (Fig. 2b). In its top part, up to a depth of about 45 cm, a humic horizon A is present. It is dark-grey coloured (10YR 2/2 when wet and 2.5Y 3/3 when dry) and granular structured. The top layer of this horizon, down to a depth of about 25 cm, is contemporary ploughing horizon Ap. The floor, natural part of humic horizon A, gradually turns into carbonate accumulation horizon Ck. White $CaCO_3$ precipitations, distinct against a dark-yellow colour typical of loess, can be seen already in transitional horizon ACk, from a depth of 45 cm (Fig. 2c). The entire solum (sequence of genetic horizons above the parent rock) shows traces of great biological activity such as numerous krotovinas (zooturbations), resulting from soil fauna activity and typical of steppe soils.

The original barrow stratigraphy is barely noticeable due to the considerable homogeneity of building materials and the original soil, and the high concentration of krotovinas (post-deposition zoogenic bioturbations; Fig. 3). The mounds of Prydnistryanske 1-IV and Klembivka 1 barrows are built of soil material whose principal properties resemble those of the *chernozem* humic horizon A in the reference profile Prydnistryanske 1. All studied samples, collected from the mound layers of both barrows, represent loess material of a dark-grey colour, resulting from a high organic matter content. The top layer of the mounds, 20-25 cm thick, is additionally homogenized by contemporary ploughing. In turn, under the mounds, the remains of original natural soils, on which the barrows were founded, can be seen in places. In terms of morphology, these soils are analogous to contemporary *chernozem* but differ from it in the lower thickness of the humic horizon A, being only 15-20 cm thick. It cannot be ruled out that the top part of the natural soils could have been removed in the course of barrow construction.

3. SOIL PROPERTIES IN THE REFERENCE PROFILE AND BARROW MOUNDS

In the Prydnistryanske 1 profile, *chernozem* is built of silty-clayey loess in which the silty fraction (0.05-0.002 mm) clearly dominates, making up 55-65 per cent of the granulometric composition. The share of clayey fraction (<0.002 mm) is considerable, amounting to 24-40 per cent (Fig. 4). Interestingly, the contemporary surface ploughing horizon is characterized by a higher content, exceeding 10 per cent, of the sandy fraction (0.05-2.0 mm).

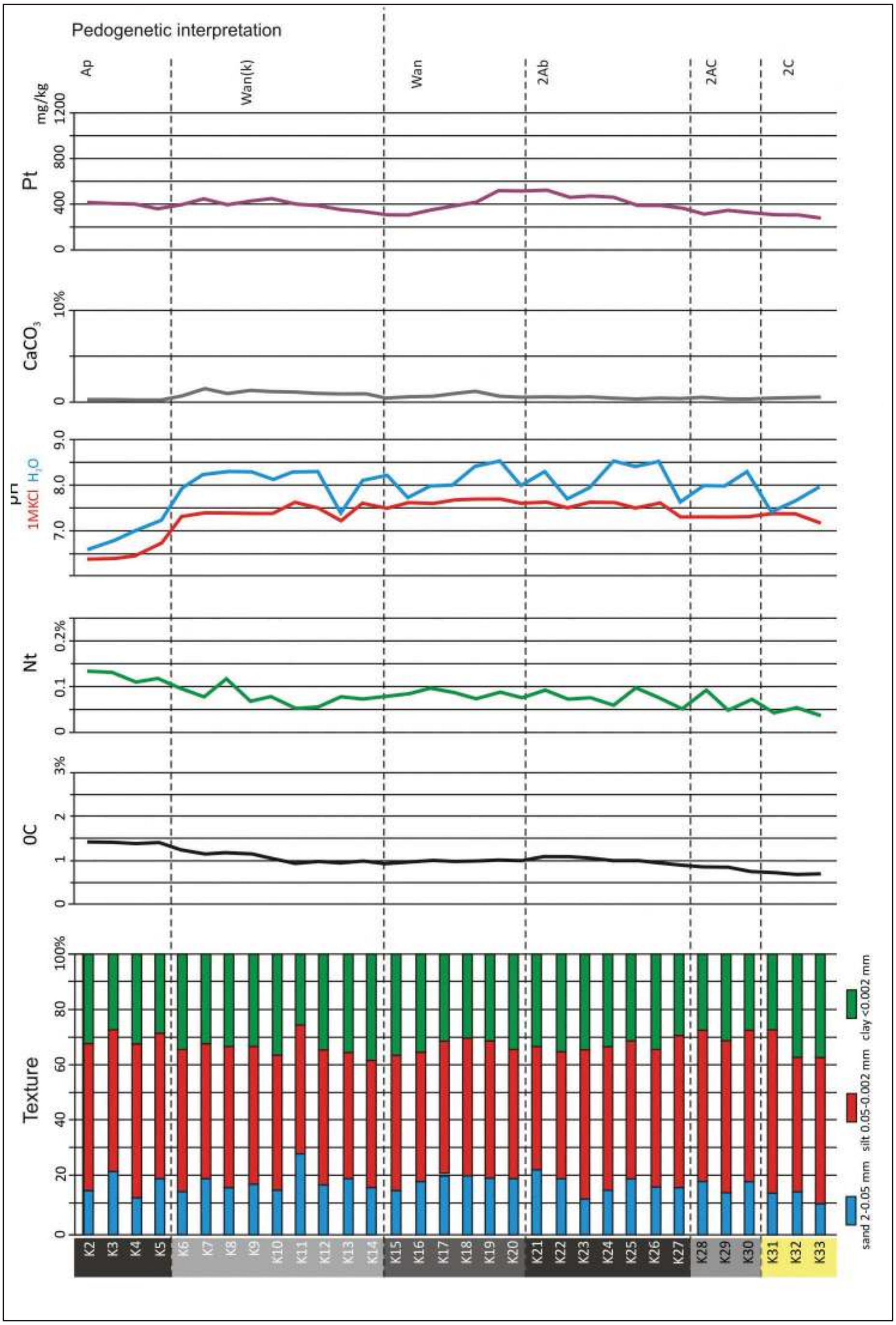


Fig. 6. Basic properties of soil material building barrow Klembivka 1

The humic horizon of the soil contains 2.5-3.0 per cent of organic carbon (Fig. 4), that is, approx. 4.0-5.0 per cent of organic matter. Nitrogen content is approx. 0.25 per cent, while the C/N ratio is about 10-12. The reaction of the entire profile is alkaline. The pH values measured in ultrapure water are 8.3-8.7, while in 1 mol/dm^3 KCl – 7.3-7.5. So high a pH value is connected with the high content of $CaCO_3$ that grows from 4 to 20 per cent when going deeper into the profile. With depth, phosphorus (Pt) content grows as well. In the plough horizon, the content of this element is about 650 mg.kg^{-1}, while in the parent rock, it exceeds 1,000 mg.kg^{-1}. So high a content and its inverse distribution must be considered a geochemical anomaly. According to oral communication from M.V. Potupczyk, phosphorite deposits are found in the vicinity of the site, potentially causing the anomaly.

According to the criteria of the international soil classification, WRB [IUSS Working Group WRB 2015], the above soil properties in the representative profile are diagnostic for the Soil Reference Group *Chernozems*. The biologically active, deep, humic, alkaline horizon, over 0.5 m thick, 10YR 2/2 black and cloddy, containing over 2.5 per cent (over 1 per cent and 1 per cent more than in Ck) of organic carbon fully meets the criteria of the *chernic* horizon in its deep variety (pachic). Carbonate accumulation horizon Ck (and ACk2), containing over 15 per cent (<25%) of $CaCO_3$, at a depth of up to 50 cm below the floor of the *chernic* horizon, chiefly in the form of secondary precipitations, meets the criteria of a *calcic* (*hypocalcic*) horizon. The particle size of silt-clay and the very large number of zoogenic bioturbations (krotovinas) permit the use of the respective qualifiers *loamic* and *vermic*.

Consequently, according to the WRB 2015 classification, the analyzed soil has been defined as Vermic Hypocalcic Chernozem (Loamic, Pachic). Such a soil must be considered typical of the environmental conditions prevailing in the transition zone of the subboreal belt [Bednarek, Prusinkiewicz 1980], characterized by a temperate climate with clearly marked continental traits and lush steppe vegetation.

The material of which barrow mound layers are built has a granulometric composition analogous to that of the soil in the reference profile (Fig. 4, 5, 6). It is solely anthropogenically redeposited silty and silty-clayey loess, with the silty fraction dominating. Samples from Klembivka 1 barrow show a slightly higher content of the sandy fraction (15-23%) than samples from barrow 1-IV and the soil at Prydnistryanske 1 (3-16%). This may be a result of natural sedimentological differentiation of loess sediments.

Both barrows under investigation are characterized by a slightly higher content of the sandy fraction in the floor layers of the mounds, analogously to the top part of the humic horizon of the natural soil in the reference profile Prydnistryanske 1 and in fossil soil remains underneath the barrows. This shows that earth material scooped directly from the surface of the ground was used to build the bottom layers of the barrows.

All studied samples from barrow mound layers contain a considerable amount of organic matter. Carbon content in Klembivka 1 is approx. 1-1.2 per cent, while in Prydnistryanske 1-IV, it is from 1.2 to 2.3 per cent. It is worth noting that slightly higher values are found in the bottom layers of the mounds, attesting that the building material came from the surface layers of soils. Nitrogen content is about 10-18 times smaller than organic carbon content. The C/N ratio values in the mounds are slightly broader than in the reference *chernozem*. Such a broadening of the C/N ratio value is related to diagenetic changes, resulting from the burying of soil material under an overlying mound and cutting it off from the impact of an active soil-forming environment [Bednarek 2002].

Barrow building materials are alkaline and show no difference in this regard when compared to the reference profile. High pH values (7.3-8.8 in H_2O and 7.2--7.6 in KCl) are connected with the ubiquity of calcium carbonate. Its content, however, differs between the barrows. In the mound of Klembivka 1, it stays in principle between 0.2 and about 1.0 per cent. In Prydnistryanske 1-IV, the building material as a rule contains from about 1.0 to 3.5 per cent of $CaCO_3$.

The content of phosphorus, an element that is often treated as an indicator of organic remains accumulation as a result of human activity [Markiewicz 2008], has no diagnostic significance in the case of the studied barrows. In Klembivka 1 mound, Pt content is 300-450 mg kg^{-1}. In Prydnistryanske 1-IV, it is considerably higher: 650-850 mg kg^{-1}, but still stays below the high values found for the geochemical background in the Prydnistryanske 1 reference profile (up to 1100 mg kg^{-1}) and the remains of the top parts of fossil soils preserved underneath the barrows. As already mentioned, such an anomaly is probably geogenic in nature.

A comparison of all the above characteristics of the mounds of barrows Klembivka 1 and Prydnistryanske 1-IV with the properties of the *chernozem* in the reference profile Prydnistryanske 1 permits the conclusion that they were built of the material coming from the humic horizon A, that is, the surface mineral horizon of soil, from a depth not exceeding 0.5 m.

Contemporary ploughing horizons on barrows differ from the principal parts of mounds in a slightly higher carbon and nitrogen content, and slightly lower pH values and phosphorus content. Immediately below the ploughing horizons, in both barrows, there is a zone of poor $CaCO_3$ accumulation, which can be seen to be a poorly developed analogue of the calcic horizon found in the profile of natural *chernozem*. The content of $CaCO_3$ grows in this zone up to about 1.3 per cent in Klembivka 1 and 5-7 per cent in Prydnistryanske 1-IV. Both the distinctive character of the ploughing horizon and the accumulation of carbonates immediately underneath it are the effects of the ongoing soil-forming process characteristic of the steppe environment. This process results in the development of a successive generation of *chernozems* in the roofs of anthropogenic barrow mounds. This fact suggests a conclusion that the direction of pedogenesis is continued and, thus, that the environmental conditions have remained relatively stable in the vicinity of Yampil since the time the barrows were built up to this very day.

Initial *calcic* horizons, found in upper parts of barrows extend at various depths. In Klembivka, it is 45 cm below the contemporary land surface analogously to the Prydnistryanske 1 reference soil profile. In barrow Prydnistryanske 1-IV, the carbonate accumulation zone begins already at the ground level. In the same barrow, slightly better marked, morphologically observable fragments of the calcic horizon (Fig. 3a, b) are found on the barrow mound sides, although they are inclined at a more acute angle than the mound slopes. This arrangement of the carbonate accumulation horizons suggests that barrow Prydnistryanske 1-IV was a subject of denudation and an agro-erosive removal of the top portion of its mound at least approx. 0.5 m thick and its re-deposition in the lower portions of the slopes.

4. CONSLUSIONS

The *Yampil Barrow Complex* located in south-eastern part of western Ukraine, lies in the steppe zone, where typical *chernozems* dominate in the soil cover. In this work these soils are represented by the Prydnistryanske 1 soil profile – acc. to WRB 2015: Vermic Hypocalcic *Chernozem* (Loamic, Pachic).

Anthropogenic sediments building the Prydnistryanske 1-IV and Klembivka 1 barrows were collected from the top humic horizons A of surrounding *Chernozems*, from maximum 0.5 m deep layer of soil.

Effects of secondary, post-depositional soil forming processes are seen in the morphology and chemical properties of materials building burial mounds: humus accumulation, initial calcic horizon formation and phosphorus redeposition. As the effect of agro-denudation the burial mound Prydnistryanske 1-IV has been lowered about 0.5 m.

Translated by Piotr T. Żebrowski

REFERENCES

Baliuk S., Medvedev V., Kucher A., Solovey V., Levin A., Kolmaz Y.

2017 Ukrainian chernozems as a factor in global food security and resilience of agriculture to climate change. In: *Global Symposium on Soil Organic Carbon*, 1-6. Rome.

Bednarek R.

2002 Diagenetic changes in sandy buried soils. In: B. Manikowska, K. Konecka--Betley, R. Bednarek (Eds) *Paleopedology problems in Poland,* 47-57. Łódź.

2007 Znaczenie studiów paleopedologicznych w archeologii środowiskowej. In: M. Makohonienko, D. Makowiecki, Z. Kurnatowska (Eds) *Studia interdyscyplinarne nad środowiskiem i kulturą w Polsce. Środowisko-Człowiek--Cywilizacja* 1: 71-91. Poznań.

Bednarek R., Jankowski M.

2014 Charakterystyka gleboznawcza materiału budującego nasyp kurhanu 1 w Pidlisivce. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 275-279. Poznań.

Bednarek R., Prusinkiewicz Z.

1980 *Geografia gleb.* Warszawa.

Boguckyj A., Dmytruk R., Łanczont M., Madeyska T., Jacyšyn A.

2007 Paleogeograficzne uwarunkowania współczesnych krajobrazów w dolinie środkowego Dniestru. In: U. Myga-Piątek (Ed.) *Doliny rzeczne – Przyroda-krajobraz-człowiek. Prace Komisji Krajobrazu Kulturowego PTG* 7, 191-201. Sosnowiec.

IUSS Working Group WRB

2015 World Reference Base for Soil Resources 2014, update 2015. International soil classification system for naming soils and creating legends for soil maps. *World Soil Resources Reports* No. 106. FAO. Rome.

Jankowski M., Dąbrowski M., Jasińska J., Michalski A.

2017 Yampil Barrow Complex: Prydnistryanske 1 and Klembivka 1. Pedological-environmental aspects of location. *Baltic-Pontic Studies* 22: 41-53.

Karpachevski L. O.
1983 *Zierkalo landshafta.* Moskva.

Klochko V.I., Kośko A., Razumov S.M., Włodarczak P., Żurkiewicz D.
2015a Eneolithic, Babyno and Noua culture cemeteries, Klembivka, site 1, Yampil Region, Vinnitsa Oblast: archaeometry, taxonomy and topogenetics. *Baltic-Pontic Studies* 20: 142-182.

Klochko V.I., Kośko A., Potupchyk M., Włodarczak P., Żurkiewicz D., Ivanova S.V.
2015b Tripolye (Gordineşti group), Yamnaya and catacomb culture cemeteries Prydnistryanske, site 1, Yampil Region, Vinnitsa Oblast: an archaeometric and chronometric description and a taxonomic and topogenetic discussion. *Baltic-Pontic Studies* 20: 83-255.

Markiewicz M.
2008 *Diagnoza zasięgu oraz intensywności dawnej działalności człowieka na podstawie badań gleb na wybranych stanowiskach archeologicznych ziemi chełmińskiej.* Toruń.

Siemiradzki J.
1922 *Geologja ziem polskich. 1. Formacje starsze do jurajskiej włącznie.* Lwów.

Zastawnyj F., Kusiński W.
2003 *Ukraina: przyroda – ludność – gospodarka.* Warszawa.

Baltic-Pontic Studies
vol. 22: 2017, 54-63
ISSN 1231-0344
DOI 10.1515/bps-2017-0021

Maciej Chyleński*, Anna Juras, Danuta Żurkiewicz***, Michał Jankowski****, Piotr Włodarczak*****

PRESERVATION OF ANCIENT DNA IN HUMAN BONES FROM THE ENEOLITHIC AND BRONZE AGE KURGAN CEMETERES IN YAMPIL REGION, UKRAINE

ABSTRACT

Ancient DNA was analyzed in altogether 28 Late Eneolithic and Bronze Age human skeletons form 4 sites in southern Ukraine. More than 0,3% of human DNA was preserved only in 13 skeletons. The results of our analyses provide evidence that recovery of DNA molecules suitable for genetic analyses is more dependent on the specificity of the archaeological site and is not strongly correlated with particular environmental factors.

Key words: ancient DNA, Middle Dniester Area, barrows

* Department of History and Methodology of Prehistory, Institute of Archaeology, Adam Mickiewicz University, Umultowska 89D, 61-614 Poznań, Poland; maciejchylenski@gmail.com

** Department of Human Evolutionary Biology, Institute of Anthropology, Faculty of Biology, Adam Mickiewicz University, Umultowska 89d, 61-614 Poznań, Poland; ajuras.anthropology@gmail.com

*** Department of Prehistory of Central and Eastern Europe, Institute of Archaeology, Adam Mickiewicz University, Umultowska 89D, 61-614 Poznań, Poland; danuta@amu.edu.pl

**** Department of Soil Science and Landscape Management, Faculty of Earth Sciences, Nicolaus Copernicus University, Lwowska 1, 87-100 Toruń, Poland; mijank@umk.pl

***** Institute of Archaeology and Ethnology of Polish Academy of Sciences, Centre for Mountains and Uplands Archaeology, Sławkowska 17, 31-016 Kraków, Poland; wlodarczak.piotr@gmail.com

INTRODUCTION

In recent years ancient DNA (aDNA) has become a powerful tool for bioarchaeological research. It is being used to tackle variety of research questions concerning past migrations, kinship structure of prehistoric societies and human microevolution. Since the first attempts to extract DNA from archaeological samples were published, its diagenesis and the role of environmental factors in its preservation were widely discussed [Allentoft *et al.* 2012]. Determining which factors and in what way affects the DNA degradation would be crucial for estimating the DNA preservation in potential samples and therefore form most cost-effective sampling strategies for ongoing and future research projects.

Despite the fact that the field is now more than 30 years old no consensus on what factor or set of factors is the most crucial for the aDNA preservation. Numerous aspects were discussed: burial and exposure temperature, rapid or slow sedimentation, chemical properties of the soil, pH value, the presence or absence of oxygen, water, ionic radiation and microorganisms. The deposition temperature and its fluctuations seem to have mostly pronounced effect on DNA preservation. This factor seems to be coupled not only with the climatic zone but also the type of the archaeological site and deposition depth both of which can have a buffering effect on the temperature itself [Smith *et al.* 2001]. Nevertheless, the temperature doesn't explain all the variation in aDNA preservation between samples coming from similar contexts. Other factors such as the amount of liquid water and hydrolytic factors are thought to play major role in DNA degradation [Schwarz *et al.* 2009]. And those can be closely connected with the sediment properties such us its permeability and pH [Geigl 2002]. Some researchers believe that those factors might vary within the burials, and more attention should be paid to microenvironments surrounding particular bone parts targeted for sampling [Hagelberg *et al.* 1991]. Other studies show that not the post-excavation factors such as bone treatment and storage could be responsible for rapid DNA degradation in some samples [Pruvost *et al.* 2007].

Here we aimed to compare how various environmental factors connected with soil properties and deposition depth of skeleton remains influenced preservation of DNA in Bronze Age human bones coming from archaeological excavations conducted in the Yampil Region, in western Ukraine.

1. MATERIALS AND METHODS

Materials. All ancient human skeletons were excavated during the *Yampil Expedition* conducted in 2010-2015, in Ukraine and came from archaeological sites in Pidlisivka (*n*=3), Porohy (*n*=12), Prydnistryanske (*n*=7) and Klembivka (*n*=5) (Tab. 1). All of the burials were interred between 4000 BC and 1000 BC in barrows made of loess soil on various depths (Tab. 1). Excavated human skeletons were treated and stored in similar way. Morphological preservation of each individual was described in detail by Litvinova *et al.* [2015].

The features of the soil environment, including pH, soil type and content of calcium carbonates, for the mounds from Pidlisivka, Klembivka and Prydnistryanske, from which the studied skeletons originate, were reconstructed on the basis of the methods described in chapter Jankowski *et al.* [2017] of this study. Collagen extraction efficiency in analyzed human bones was obtained through ^{14}C analyses which were previously conducted and described by Goslar *et al.* [2015].

Ancient DNA analyses. Ancient DNA was analyzed in altogether 27 Eneolithic Bronze Age human skeletons. From all individuals teeth and/or petrous bones were collected. DNA studies were performed in sterile ancient DNA laboratory at the Faculty of Biology, Adam Mickiewicz University in Poznań (UAM), Poland. Cleaning of the samples, drilling the roots of teeth and/or inner parts of petrous bones (regions of semicircular canals), as well as DNA extraction were conducted following the methods previously described in Litvinova *et al.* [2015] and Juras *et al.* [2017]. For each individual one blunt-end genomic library was build according to Mayer and Kircher [2010], omitting the first nebulization step due to degraded character of aDNA. Amplification of the genomic libraries and their purification was performed following Günther *et al.* [2015], with slight modifications. Concentration measurements and DNA fragment length distribution were estimated with the use of 2200 Tape Station System (Agilent). Shotgun sequencing of DNA libraries on Illumina HiSeq followed by bioinformatic and statistical analyses were carried out as previously described in Litvinova *et al.* [2015].

2. RESULTS

The proportion of human DNA generated through shotgun sequencing of one particular DNA library for each individual, ranged from 0.02% to 13% (Tab. 1). The highest proportion of human DNA (>5%) was found in two individuals from Pidlisivka 1/13, 1/1B site and one individual from Prydnistryanske I/4 (ind. 1).

Table 1

Description of analyzed individuals

Individual	DNA	Archaeological Culture	Dating	Bone material	Proportion of human DNA* (%)	No. of mtDNA fragments	Deposition depth [m]	Collagen Extraction Efficiency (%)	Type of soil	pH (in H_2O)	Ground water depth	Permeability of water (calcium deposits)
Pidlisivka 1 site												
1B	90	Eneolithic	n.a.	teeth	5	1059	1,4	n.a.				
11	91	Yamnaya	2836-2575 BC	teeth	0.1	7	2,4	7,3				
13	94	Babino	n.a.	teeth	10	9063	0,35	n.a.	*Chernozem*	8.4-8.6	n.d. (>2 m)	medium ($CaCO_3$ 5.7-10.3‰)
				petrous bone	13	1742		n.a.				
1A	95	Yamnaya	2886-2701 BC	teeth	0.02	37	1	n.a.				
Klembivka 1 site												
5	211	Eneolithic?	2898-2761 BC	teeth	2	162	1,45	7,6				
				petrous bone	3	397		n.a.				
11	212	Noua	3022-2918 BC	teeth	2	299	1,1	0,6	*Chernozem*	7.0*-8.5	n.d. (>2 m)	medium ($CaCO_3$ 0.2-1.3‰)
3	356	Babino	1880-1771 BC	petrous bone	0.3	45	1,3	3,3				
12	213	Babino	2117-1950 BC	teeth	2	1942	1,2	5,0				
14	214	Eneolithic	2863-2630 BC	teeth	0.8	81	3	1,9				
Prydnistryanske 1 site												
IV/ 3	219	Yamnaya	2847-2574 BC	teeth	0.08	0	0,3	4,6				
I/4, ind. 1	220	Catacomb	2834-2499 BC	teeth	5	793	1,3	13,6				

I/4, ind. 2	221	Catacomb	2548-2348 BC	teeth	1.1	806	1,3	11,0	*Chernozem*	7.9-8.8	n.d. (>2 m)	medium ($CaCO_3$ 0.8-6.8%)
IV/4	222	Yamnaya	3023-2911 BC	teeth	2.2	737	3,1	1,5				
IV/6	223	Yamnaya	2850-2573 BC	teeth	0.09	28	1,5	7,0				
IV/8	224	Yamnaya	2847-2574 BC	teeth	0.05	675	2,2	9,0				
IV/9	225	Yamnaya	2858-2621 BC	teeth	10	1050	2,25	8,0				
Porohy 3A site												
1	199	Yamnaya	2275-2064 BC	teeth	0.02	0	2,15	8,2	n.a.	n.a.	n.a.	n.a.
3	200	Noua	n.a.	teeth	0.04	1	0,6	n.a.				
5	201	Noua	n.a.	teeth	0.02	1	0,85	n.a.				
7	202	Eneolithic/ Yamnaya	2856-2601 BC	teeth	0.03	2	0,65	2,1				
10	203	Yamnaya	2619-2490 BC	teeth	0.05	13	1,3	4,8; 4,0				
11	204	Yamnaya	2836-2500 BC	teeth	0.1	1	1,45	1,1				
12, ind. I	205	Yamnaya	2566-2471 BC	teeth	0.1	44	1,15	0,9				
15	206	Yamnaya	n.a.	teeth	0.04	16	1,35	n.a.				
19	208	Yamnaya	2882-2698 BC	teeth	0.1	55	1,35	2,5				
20	209	Yamnaya	2884-2700 BC	teeth	0.1	17	2,6	2,5; 1,4				
22	210	Noua	1734-1630 BC	teeth	0.02	1	1,05	1,3				
14	355	Eneolithic	2134-1982 BC	petrous bone	0.05	5	2,2	1,5				

*data from the screening of one genomic library on Illumina HiSeq
n.a. – not analyzed

The lowest levels of human DNA content (< 0.05%) were identified in individuals from Porohy archaeological site and one individual from Pidlisivka (sample from grave no. 1A) (Tab. 1). The number of mitochondrial DNA (mtDNA) fragments which are present in living human cells in a high number of copies, varied between ancient individuals and was the highest (>1000 mtDNA fragments) in Pidlisivka 1/13, 1/1B, Klembivka 1/12 and Prydnistryanske IV/9 (Tab. 1). The lowest amount of mtDNA fragments (<100) were found in all individuals from Porohy archaeological site, two individuals from Pidlisivka (samples 11 and 1A), two individuals from Klembivka 1/3, 1/14 and two individuals from Prydnistryanske IV/3, IV/6. The success rate of recovering DNA was the highest in Klembivka site where statistically 66% of individuals possessed well preserved DNA. Prydnistryanske and Pidlisivka archaeological sites had 57% and 50% of individuals with well recovered DNA, respectively. We did not find any individual with the amount of DNA suitable for genetic analyses (>1%) from Porohy archaeological site.

The deposition depth of human skeletons varied from min. 0.3 to max. 2.6 m. (Tab. 1). Collagen extraction efficiency (%) differed between samples and archaeological sites. The lowest levels were observed in Porohy archaeological site, with the exception of individual from grave 3A/1 (Tab. 1). Higher levels of collagen extraction efficiencies were found in samples from Pidlisivka, Klembivka and Prydnistryanske, with the highest identified in five individuals from Prydnistryanske (>7%) (Tab. 1).

The soil environment of the studied barrows at Pidlisivka, Klembivka and Prydnistryanske described in greater detail in Jankowski *et al.* [2017] had an alkaline reaction with slight differences between particular archaeological sites (Tab. 1). In some cases, only surface layers had a neutral reaction. All studied samples contained calcium carbonates: in barrow material, it was up to about 10 per cent (Tab. 1) but in the reference soil profile it was even 19 per cent, which did not form an impregnated and impermeable layer. The loess of which the soils (and barrow mounds) were built had the character of silty formations with a substantial share of a clayey fraction. They were characterized by high porosity and an ability to hold moisture in capillaries. Their considerable thickness and the deep downcutting of the valleys surrounding the region suggest that the water table was very low (at least several metres under the ground level). No impact of it could be seen in barrow samples or in the soil profile down to a depth of 1.5 m. On account of the climate, it can be presumed that the soils could have been moist for a greater part of the year, but rather not wet. On the other hand, during a hot dry summer, they could have dried. For more information on the soil environment of the studied barrows [*see* Jankowski *et al.* 2017].

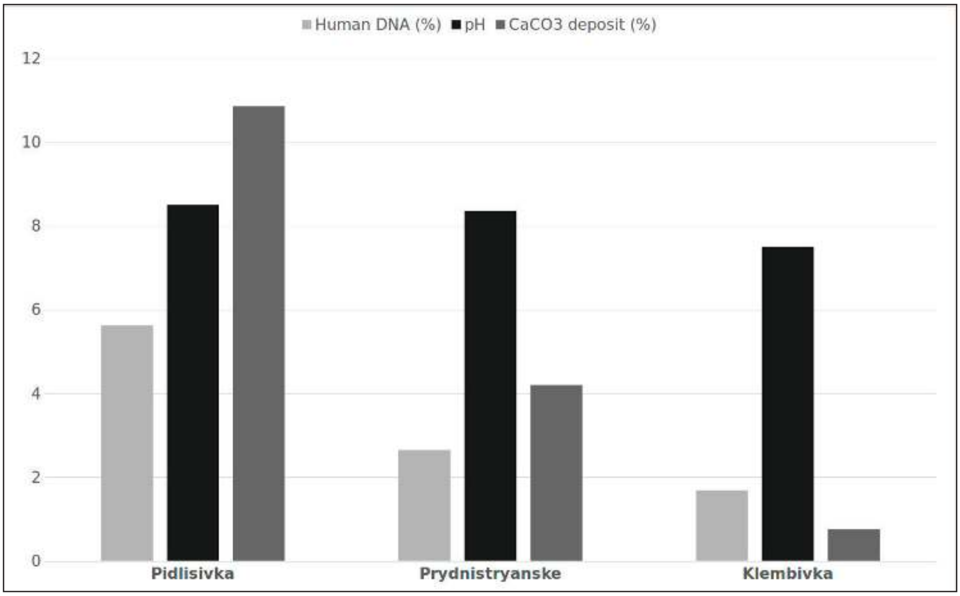


Fig. 1. The correlations between the average proportion of human DNA and soil properties (pH and $CaCO_3$ concentration) for three out of four analyzed archaeological sites

3. DISCUSSION

The results of our analyses provide evidence that recovery of DNA molecules suitable for genetic analyses is more dependent on the specificity of the archaeological site and is not strongly correlated with particular environmental factors. In all analyzed archaeological sites we didn't find correlation between proportion of human DNA in teeth or petrous bones and the depth of deposition of the skeletons. Due to high temperatures on the steppes during the summer one could assume that the deeper the human remains were deposited, the better DNA would have been preserved. Unfortunately, even a deeper deposition, protecting DNA against the effects of high temperatures, did not increase the proportion of genetic material, especially in individuals from Porohy archaeological site. The human remains were deposited there at a depth of 0.6 – 2.6 meters and a small number of mtDNA fragments were obtained only from individuals deposited at a depth of around 1.15 – 1.3 m. The best preserved samples from our sample set including individual 1/3 from Pidlisivka and individual IV/9 from Prydnistryanske were deposited at a depth of 0.35 and 2.25 metres, respectively. Results obtained for these samples confirmed no significant correlation between deposition depth and preservation of human DNA in analyzed archaeological sites in Yampil Region.

Rough correlation can be seen between the average DNA preservation (seen as an average proportion of human DNA in all of the samples from each site) and the pH of the layer the individuals were deposited in (Fig. 1). Interestingly similar concentration can be seen between the amount of $CaCO_3$ (indicative of permeability of water). That last result could suggest that the presence of water has negative effect on DNA preservation only when coupled with other factors. However, in both cases only the average data for each site was available. In order to more definitively discuss the idea, the information from the burial infills should be acquired and the samples should be compared individually.

We did not find direct correlation between collagen extraction efficiency and preservation of DNA. However, individuals with the best preserved DNA from Klembivka archaeological site retained the highest percentages of collagen extraction efficiency (1.5 to 13.6) among all analyzed individuals. In the same time, samples from Porohy were characterized by the lowest percentages of collagen extraction efficiency (0.9-4.8), with the exception of individual from grave 3A/1. Result obtained for sample from grave 3A/1 in Porohy is in accordance with the statement that the presence of collagen not necessarily confirms adequate DNA preservation [Schotsmans *et al.* (Eds) 2017].

In the case of three individuals DNA was extracted from petrous part of temporal bones (Tab. 1). Dense bone parts of the petrous bone were proved to provide high endogenous aDNA yields from most of ancient individuals [Pinhasi 2015; Hansen *et al.* 2017]. However, petrous bones from individual 1/3 from Klembivka and individual 3A/14 from Porohy used for DNA extractions did not produce sufficient amount of DNA. This stays in agreement with Hansen *et al.* [2017] who pointed that using petrous bone not always lead to better results as whole array of factors plays role in DNA preservation. On the other hand, we extracted DNA from both teeth and petrous bone belonging to the individual 1/13 from Pidlisivka and retrieved slightly higher amount of human DNA from petrous bone than from the teeth.

A comprehensive treatment of *Yampil population* fossil DNA analyses from the transitions periods between the Eneolithic and the Early and Late Bronze Age, and their relation to the Corded Ware culture in the Polish lands is to be found in a separate publication [Juras *et al.*, forthcoming].

Translated by Anna Juras, Maciej Chyleński
Piotr T. Żebrowski

REFERENCES

Allentoft M.E., Collins M., Harker D., Haile J., Oskam C.L., Hale M.L.
2012 The half-life of DNA in bone: measuring decay kinetics in 158 dated fossils. *Proceedings of the Royal Society B: Biological Sciences B* 279 (1748): 4724-4733.

Geigl E.M.
2002 On the circumstances surrounding the preservation and analysis of very old DNA. *Archaeometry* 44 (3): 337-342.

Goslar T., Klochko V.I., Kośko A., Włodarczak P., Żurkiewicz D.
2015 Chronometry of Late Eneolithic and 'Early Bronze' Cultures in the Middle Dniester Area: Investigations of the Yampil Barrow Complex. *Baltic-Pontic Studies* 20: 257-292.

Günther T., Valdiosera C., Malmström H., Ureña I., Rodriguez-Varela R., Sverrisdóttir Ó.O.
2015 Ancient genomes link early farmers from Atapuerca in Spain to modern-day Basques. *Proceeding of the National Academy of Sciences of the United States of America* 112 (38): 11917-11922.

Hagelberg E., Bell L.S. Allen T., Boyde A., Jones S.J., Clegg J.B.
1991 Analysis of ancient bone DNA: techniques and applications. 3 *Philosophical Transactions: Biological Sciences* 33 (1268): 399-407.

Hansen H.B., Damgaard P.B., Margaryan A., Stenderup J., Lynnerup N., Willerslev E.
2017 Comparing Ancient DNA Preservation in petrous bone and tooth cementum. *PLOS ONE* 12 (1): e0170940.

Jankowski M., Dąbrowski M., Jasińska J., Michalski A.
2017 Yampil Barrow Complex: Prydnistryanske 1 and Klembivka 1. Pedological-environmental aspects of location. *Baltic-Pontic Studies* 22: 41-53.

Juras A., Chyleński M., Krenz-Niedbała M., Malmström H., Ehler E., Pospieszny Ł.
2017 Investigating kinship of Neolithic post-LBK human remains from Krusza Zamkowa, Poland using ancient DNA. *Forensic Science International: Genetics* 26: 30-39.

Juras A., Chyleński M., Ehler E., Malmström H., Żurkiewicz D., Włodarczak P., Wilk S., Peška J.,, Fojtík P., Králík M., Libera J., Bagińska J., Tunia K., Klochko V., Dabert M., Jakobsson M., Kośko A.
forthcoming Ancient mitochondrial genome data support the participation of females in the Yamnaya migration into Central Europe.

Litvinova L.V., Łukasik S., Żurkiewicz D., Gwizdała M., Chyleński M., Malmström H,
2015 Anthropological Description of Skeletal Material from the Dniester Barrow-Cemetery Complex, Yampil Region, Vinnitsa *Oblast* (Ukraine). *Baltic-Pontic Studies* 20: 293-336.

Meyer M., Kircher M.
2010 Illumina sequencing library preparation for highly multiplexed target capture and sequencing. *Cold Spring Harbor Protocols* 6: pdb.prot5448.

Pinhasi R., Fernandes D., Sirak K., Novak M,. Connell S., Alpaslan-Roodenberg S.
2015 Optimal ancient DNA Yields from the inner ear part of the human petrous bone. *PLOS ONE.* 10 (6): e0129102.

Pruvost M., Schwarz R., Correia V.B., Champlot S., Braguier S., Morel N.
2007 Freshly excavated fossil bones are best for amplification of ancient DNA. *Proceeding of the National Academy of Sciences of the United States of America* 104 (3): 739.

Schotsmans E.M.J., Májrquez-Grant N., Forbes S.L. (Eds)
2017 *Taphonomy of human remains: forensic analysis of the dead and the depositional environment.* West Sussex.

Schwarz C., Debruyne R., Kuch M., McNally E., Schwarcz H., Aubrey A.D.
2009 New insights from old bones: DNA preservation and degradation in permafrost preserved mammoth remains. *Nucleic Acids Research* 37 (10): 3215--3229.

Smith C.I., Chamberlain A.T., Riley M.S., Cooper A., Stringer C.B., Collins M.J.
2001 Neanderthal DNA: Not just old but old and cold? *Nature* 410 (6830): 771-772.

Baltic-Pontic Studies
vol. 22: 2017, 64-90
ISSN 1231-0344
DOI 10.1515/bps-2017-0022

Dorota Lorkiewicz-Muszyńska*, Julia Sobol, Jerzy J. Langer***, Aleksander Kośko****, Piotr Włodarczak*****, Danuta Żurkiewicz****, Mykhailo Potupchyk ******

RITUAL POSITION AND "TATTOOING" TECHNIQUES IN THE FUNERAL PRACTICES OF THE "BARROW CULTURES" OF THE PONTIC-CASPIAN STEPPE/ FOREST STEPPE AREA. POROHY 3A, YAMPIL REGION, VINNYTSIA OBLAST: SPECIALIST ANALYSIS RESEARCH PERSPECTIVES

ABSTRACT

The present paper discusses the results of an interdisciplinary study of human remains in the form of two ulnae from a female skeleton found in grave 10, Porohy 3A site (Middle Dniester Area), dated to Early Bronze Age: 2650-2500 BC. The paper describes the technical aspects of applying the decorations revealed in the examination of the aforementioned bones.

Key words: Yamnaya culture, funeral rites, tattoo, postmortem changes

* Departament of Forensic Antropology and Odontology, Poznań University of Medical Sciences, Święcickiego 6, 60-781 Poznań, Poland; dlorkiew@gmail.com

** Department of Pathology and Clinical Genetics, Faculty of Medicine and Health Science; University of Zielona Gora; Zyty 28, 65-046 Zielona Góra, Poland; soboljul@gmail.com

*** Laboratory for Materials Physicochemistry and Nanotechnology, Faculty of Chemistry, Adam Mickiewicz University, Umultowska 89b, 61-614 Poznań, Poland; langer@amu.edu.pl

**** Department of Prehistory of Central and Eastern Europe, Institute of Archaeology, Adam Mickiewicz University, Umultowska 89D, 61-614 Poznań, Poland; antokol@amu.edu.pl, danuta@amu.edu.pl

***** Institute of Archaeology and Ethnology of Polish Academy of Sciences, Centre for Mountains and Uplands Archaeology, Sławkowska 17, 31-016 Kraków, Poland; wlodarczak.piotr@gmail.com

****** Department of Culture and Arts, Khmelnytske St. 7, 21036 Vinnitsa, Ukraine; m_potupchik@ukr.net

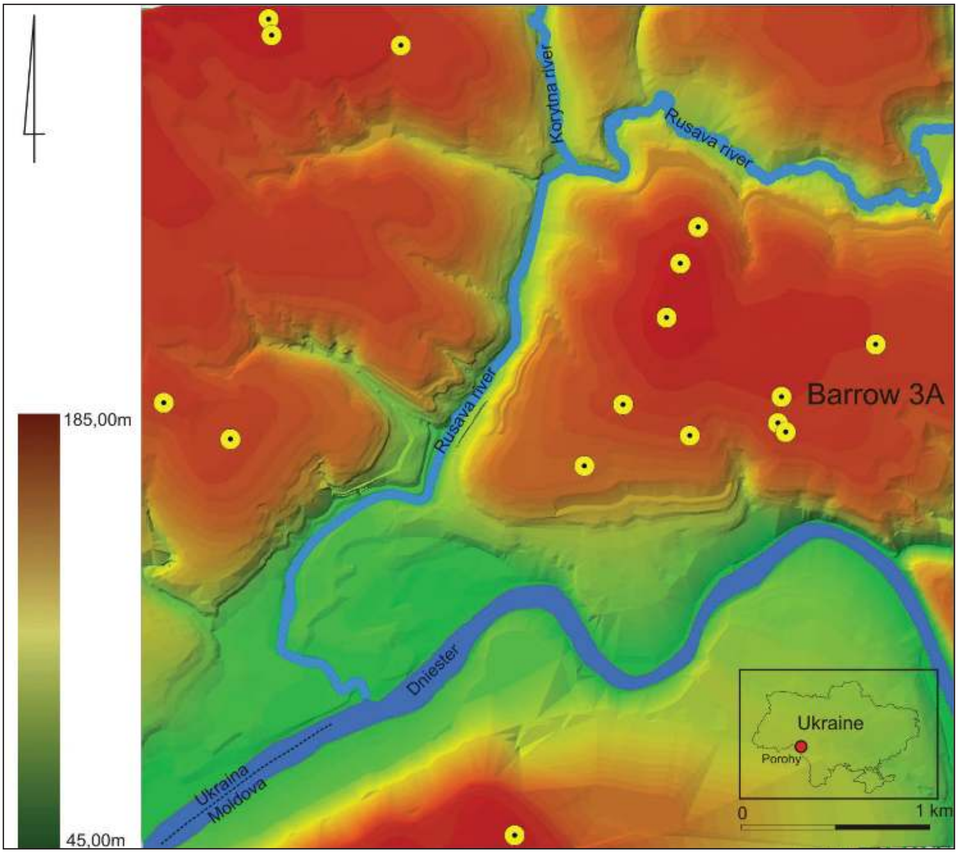


Fig. 1. Porohy, Yampil Region, barrow 3A. Barrow location in the elevation model of the immediate surroundings of the site

An important regional diagnostic feature of the Pontic-Caspian steppe/forest steppe cultural area of the IIIrd millenium BC are "tattoos", recognized in a particularly informative version in the funereal context: on the bones in the burials related to Early Bronze Age barrow cultures: Yamnaya (YC) and Catacomb (CC). Uncommon as such phenomena are within aforementioned taxons, they inspire numerous culture-related discussions in the *barrow archaeology* research circles. The latest studies conducted by the team led by Natalia I. Shishlina focused on the objects from the Caspian steppe area CC, unambiguously indicating the connection between its prominent ritual observances and symbolic body decorations [*see* more: Shishlina *et al*. 2013].

In tomb 10, barrow 3A in Porohy, Yampil Region, Vinnytsia *Oblast* (Middle Dniester Area), the most outlying – furthest to the west – indications of the use of "tattoos" among the barrow cultures in the Pontic-Caspian area.

The above mentioned burial can be tied to the beginning of the late YC phase, with this particular site dated to around 2650-2500 BC, i.e. the prologue to the Budzhak stage [*see* Goslar *et al*. 2015 and Klochko *et al*. 2015 for the results of archaeological, anthropological and archaeometrical studies].

The subject of the interdisciplinary research were two ulnae from a female skeleton aged approximately 25-30 years old, subject to FT-IR spectrophotometric analysis, optical microscopic analysis, as well as SEM analysis with energy-dispersive X-ray spectroscopy (EDS). The study is complemented by medical and forensic anthropology expertise.

The article is structured around featuring three scopes of analytical view: archaeological (Chapter 1), physicochemical (Chapter 2) and anthropological, taphonomical and tanathological (Chapter 3).

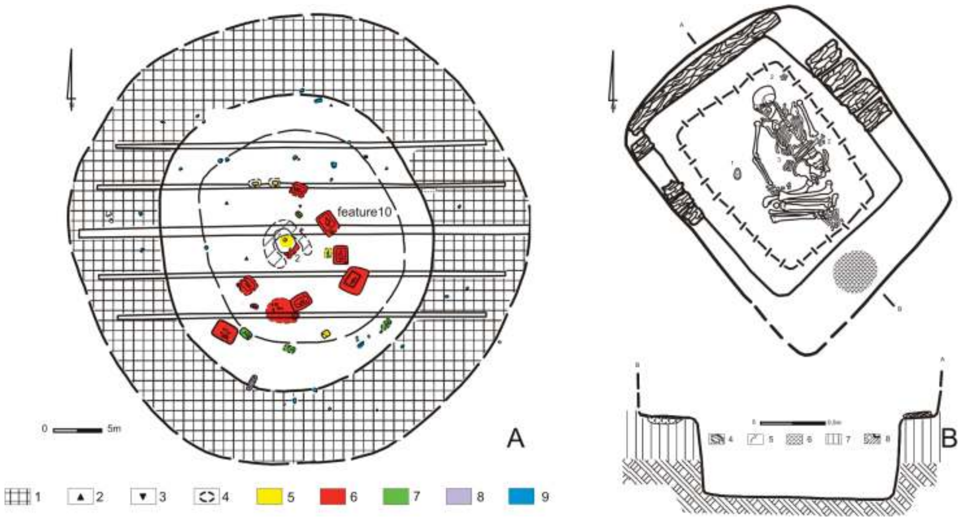
1. YAMPIL BARROW COMPLEX – ARCHAEOLOGICAL ASSESSMENT

The structure of the chapter is based upon the findings presented in previous papers concerning the outcomes of the *Yampil Barrow Complex* research [Kośko *et al*. (Eds) 2014; Klochko *et al*. 2015].

a. Porohy, barrow 3A

The barrows located in Porohy (to date, five surface evident barrows: 1, 2, 3, 3A, 4 have been examined [*see* Potupczyk, Razumow 2014:Fig. 1.2: 2] are part of a particularly prominent ceremonial and funereal centres within the *Yampil Barrow Complex* [Potupczyk, Razumow 2014: Fig. 1.2: 1]. This may be due to their positioning in the landscape zone situated directly above the Dniester River Valley, which may explain the intensity of their ritual application, both in the Late Eneolithic as well as Early and Late Bronze Ages [*see* Harat *et al*. 2014: 70n.; Klochko *et al*. 2015] (Fig. 1). They were, however, recorded in the state of widespread devastation, which hindered the inventory of archaeometric observations and implementation of interpretative efforts. The range of local "incidental ritualistic behaviours", including the hereby analysed procedure of "tattooing" the bones in the limbs of buried individuals, highly unusual, as far as the Northern Pontic scale is concerned, as well as unique amphora depositories (barrows 2, 3 and 4) [*see* Iwanowa *et al*. 2014], warrants the undertaking of further archaeometric and interpretative research initiatives.

Barrow 3A in Porohy is situated 4 km to the east of Yampil, Vinnytsia *Oblast*, where a group of minimum five barrows, locally known as *Tsari* (= royal burials), was found in the fields of the Porohy farmstead (Fig. 1). The group is located in the vicinity of the road from Yampil to Kryzhopil, in the southern part of the culmina-



F i g . 2 . Porohy, Yampil Region, barrow 3A: A – barrow plan: 1 – surrounding ditch; 2 – animal bones; 3 – pottery shards; 4 – vessel fragments; 5 – features associated with the Eneolithic; 6 – features associated with the Yamnaya culture; 7 – features linked with Noua culture; 8 – features linked with Iron Age; 9 – elements of barrow kromlech; B – plan and profile of feature 3 A/10: 1 – lump of ochre; 2 – phalanges and hoofs of small horned cattle; 3 – cattle bone tool; 4 – wood remains; 5 – outline of mat; 6 – hearth; 7 – layer under the barrow mound; 8 – sterile soil

tion of the watershed between the valleys of Dniester and its left bank tributary, Rusava. Apart from barrow 3A, two other barrows were examined as well.

The examination of barrow 3A revealed 20 features: 4 Eneolithic/from the beginning of Early Bronze Age (?), 10 YC, 5 Noua culture and 1 from the Middle Sarmatian period (Fig. 2: A). Due to considerable damage to the mound resulting from farming activities in the area, determining the relation of particular graves to the stages of raising the barrow is problematic. Two main phases have been determined, as well as local mound’s enlarging. During the oldest (Eneolithic?) phase, the barrow was encircled with a stone cromlech, though the construction was significantly damaged in the process of expanding the mound in later phases. In part N, on the border of the older mound, an overturned *stele* was uncovered.

b. Porohy, barrow 3A: stage II (Early Bronze Age)

The planigraphic and stratigraphic analysis of kurgan 3A in Porohy justifies the distinction of the sequence of two barrow cemetery complexes and that of level ones dug within the rim and culmination, tied in cultural terms to the communities of the Eneolithic /?/ (stage 1) and Early – (stage 2) as well as the Late Bronze Age (stage 3).

The oldest one in stage 2 necropolis, grave 2, located in the central part of the barrow, was damaged by the other object. For this reason, it is difficult to establish the details of its construction and the position of the burial. The graves dug into the mentioned "younger mound" of barrow 3A in Porohy constitute the biggest complex of YC burials in the mound – so called "users" (9 graves) – in the scale of the *Yampil Barrow Complex*. Instead of being oriented according to the cardinal points, the graves were aligned with their longer axis towards the centre of the barrow, creating arcs around the centre of the mound, which is characteristic of the Dniester-Danube YC. At the same time, the sometime-characteristic rule of orienting the dead along or against the arrow of time, depending on their position in the kurgan [Dergachev 1986: 40], was not applied. The concentration of the Porohy graves in the eastern part of the mound is not frequently noted in the region in question.

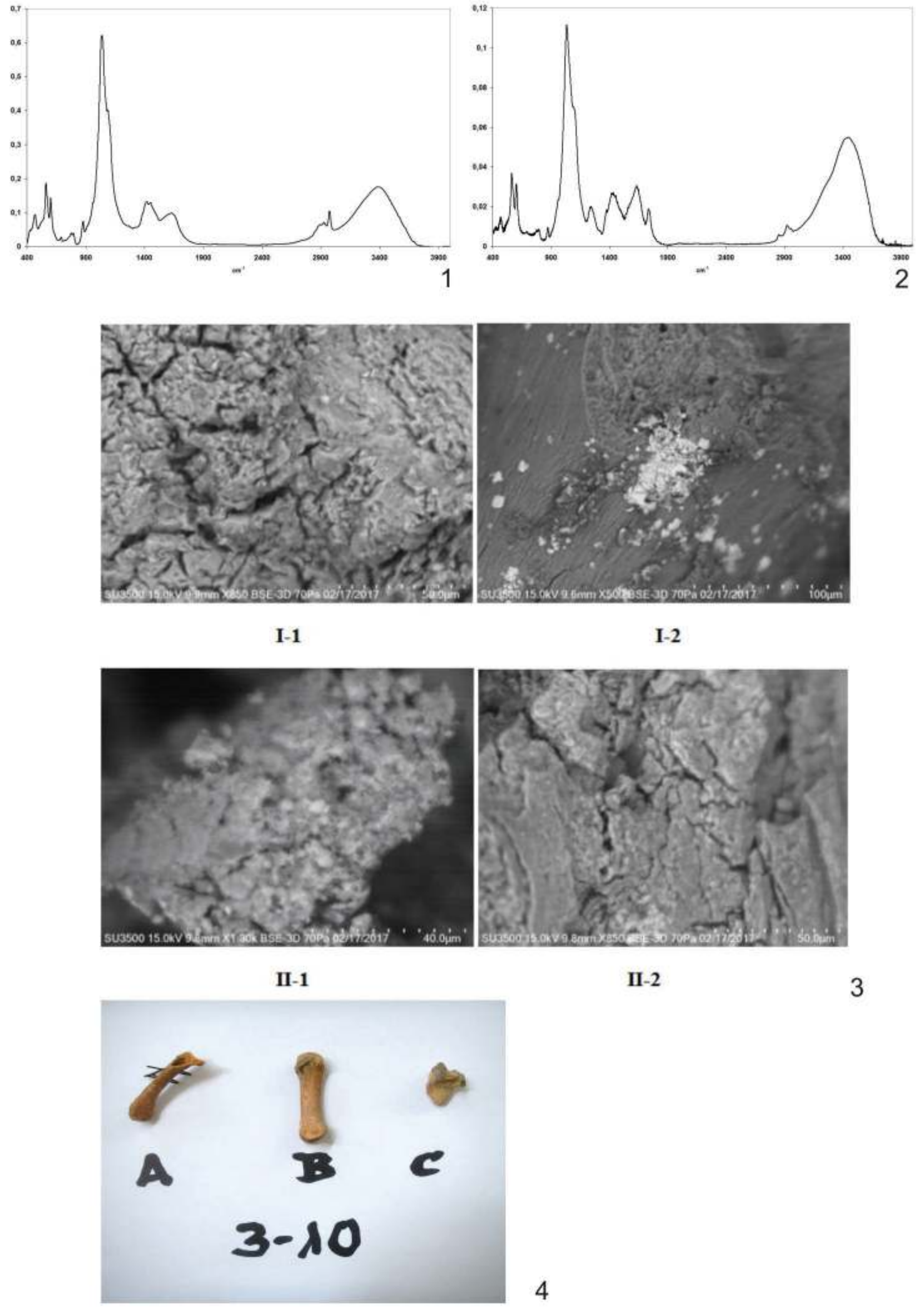
c. Porohy, barrow 3A, grave 10: archeometric and taphonomical specification

Grave 10 was dug into the north-eastern part of the mound. The rectangular outline of the grave pit was caught at the depth of 45 cm, with the step leading to the burial chamber located at the depth of 75 cm. Traces of a circular hearth were recorded in its south-eastern part, 30 cm in diameter with the fill of approximately 10 cm in depth, consisted of burnt soil, ash and charcoal. Traces of wooden elements of a transverse roofing, up to 20 cm wide and 5 cm thick, were found on the step. At the discovery level, the pit was 2.35 x 1.9 m and oriented along the NW-SE axis (Fig. 2: B).

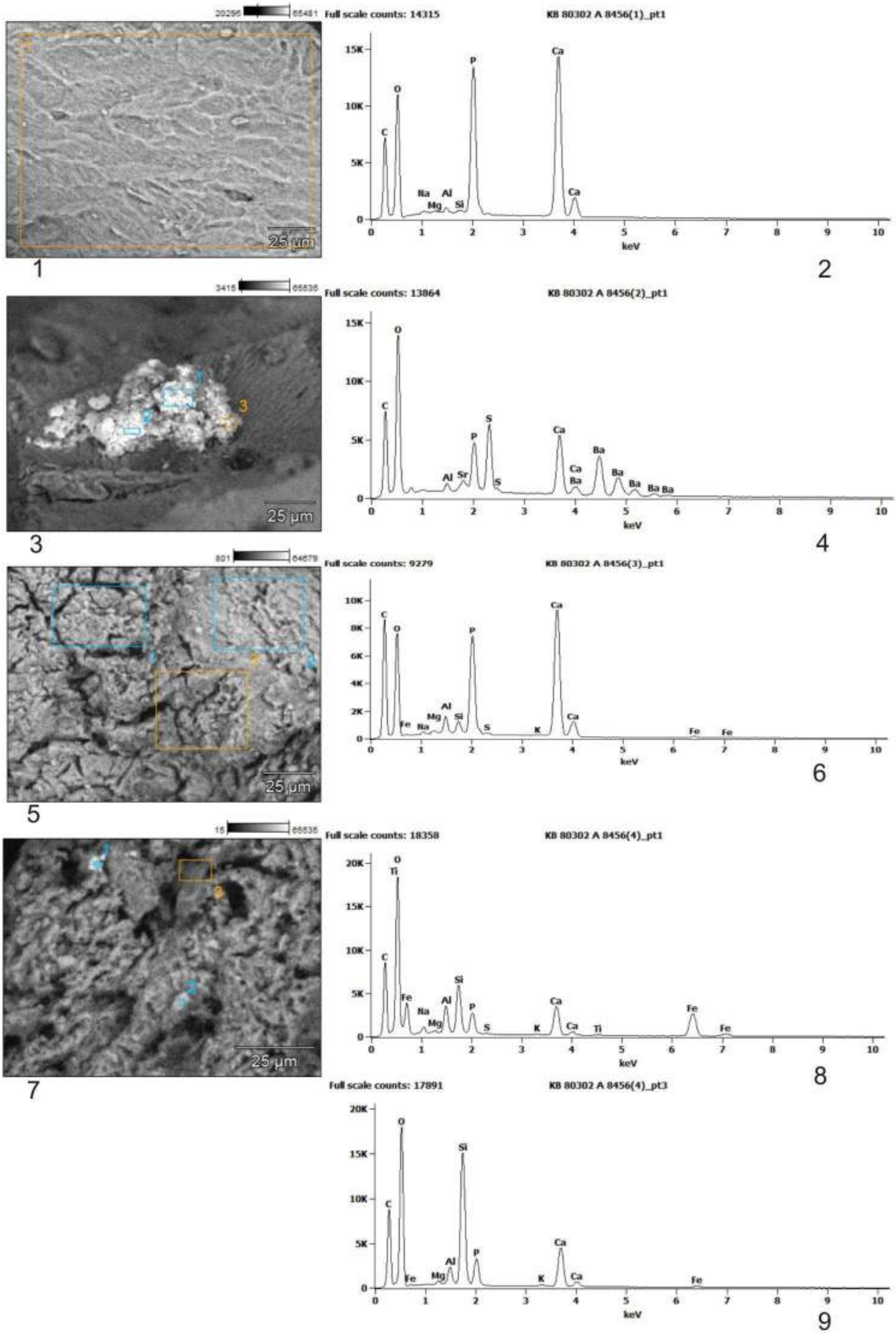
The burial chamber was of rectangular shape (1.7 x 1.4 m at the level of its bottom), 60 cm deep. Lying at the bottom of the chamber there was a skeleton of a female *Adultus* (25-30 years), preserved in the anatomical order. The body was placed in a crouched position on the back, with the lower limbs bent at the hip and knee joints. Originally placed with the knees pointing upwards, which later fell to the right side. The bones bore traces of ochre pigmentation. The upper limbs were arranged in a way characteristic of Porohy burials, with one of the limbs bent and turned towards the pelvis. The upper right limb was abducted and bent slightly at the elbow. The upper left limb was bent at the elbow at a slightly obtuse angle. Its humerus was placed parallel to the long axis of the body, and the distal ends of the forearm bone rested on the right wing of ilium. On both ulnae, regular patterns in the shape of arches and chainlets were recorded.

The deceased was placed on a mat lining the bottom of the pit, presumably made of a type of aquatic grass (reed or acorus?). Moreover, chemical compounds characteristic of the propolis lipid profile were found in the examination of the lining of the grave. Imprints of plain-weaved fabric were preserved within the precinct of the bottom of the pit – possibly remnants of a shroud [*see* Kałużna *et al*. 2017].

Metacarpal bones and finger bone segments of a goat/sheep were found under the left elbow and next to the scull of the buried individual. 20 cm to the east of the lower left limb there was a lump of ochre. A "bone awl" was found under the bones of the rib cage. When categorizing YC grave site inventories, artifacts such as these are qualified as "everyday objects", identified functionally as perforators



F i g . 3 . Porohy, Yampil Region, barrow 3A, feature 10. Chemical analysis: 1 – FT-IR absorption spectra of black dye samples (I) 80302 A-8456; 2 – FT-IR absorption spectra of black dye samples (II) 80303 A-8457; 3 – results of SEM observation of dye materials I and II; 4 – samples without a dye: 3-10A, 3-10B and 3-10C



F i g . 4 . Porohy, Yampil Region, barrow 3A, feature 10. Chemical analysis: 1-9 EDS analysis of samples of dye material I

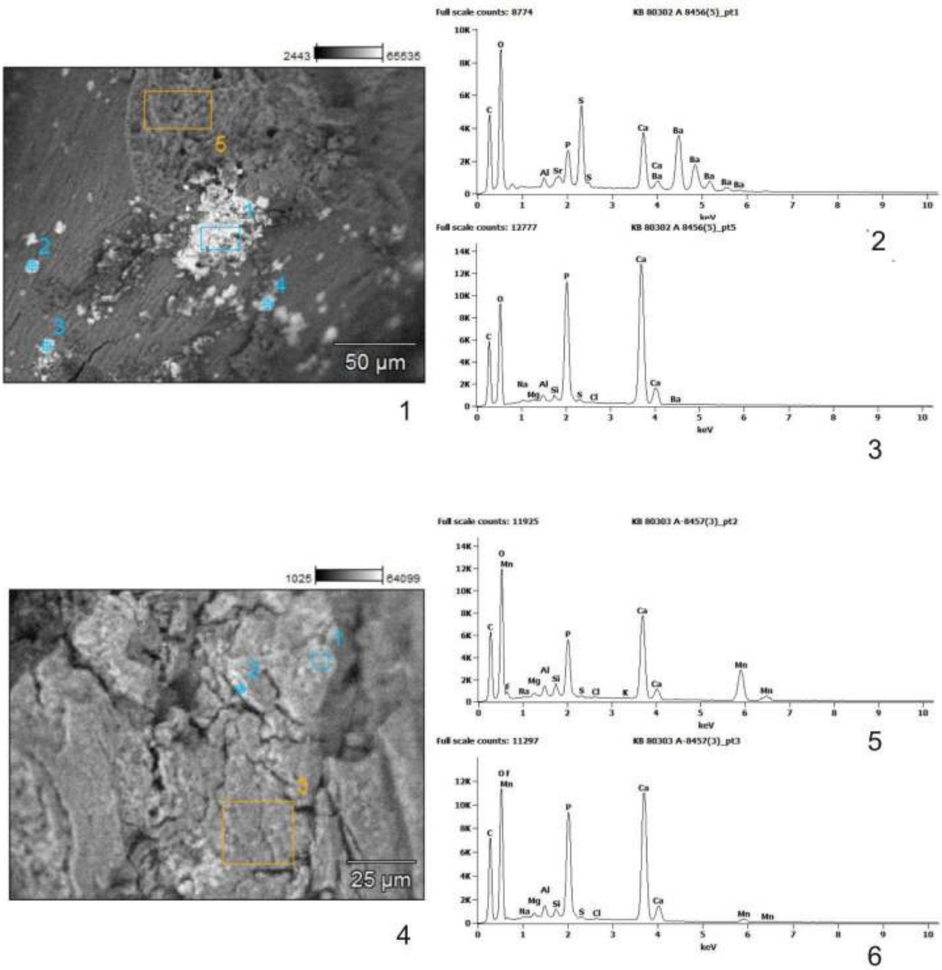


Fig. 5. Porohy, Yampil Region, barrow 3A, feature 10. Chemical analysis: 1 – EDS analysis of samples of dye material I; 2 – EDS analysis of samples of dye material II

or pins [*see* Melnik, Steblina 2013: 47-48; Subbotin 2003: 98-100]. In this case, however, the possibility that we are dealing with a “ritual object”: a fragment of a unilateral point – with reference to the ritual recorded in several graves of the eastern Globular Amphora culture (GAC) group [Wiślański 1966: 42; Szmyt 1999: 48, Fig. 10: 10].

Five ^{14}C markings were made on human bones (rib fragments): Ki-17383: 3860 ± 160 BP; Ki-17438: 4370 ± 70 BP; Ki-18928: 4070 ± 50 BP; Poz-74393: 4105 ± 35 BP; Poz-81824: 4040 ± 35 BP, situating the burial in the time 2572-2532 BC [*see* Goslar *et al*. 2015: 271].

Inventory

1. An oval lump of ochre, dimensions: 8 x 5 cm.

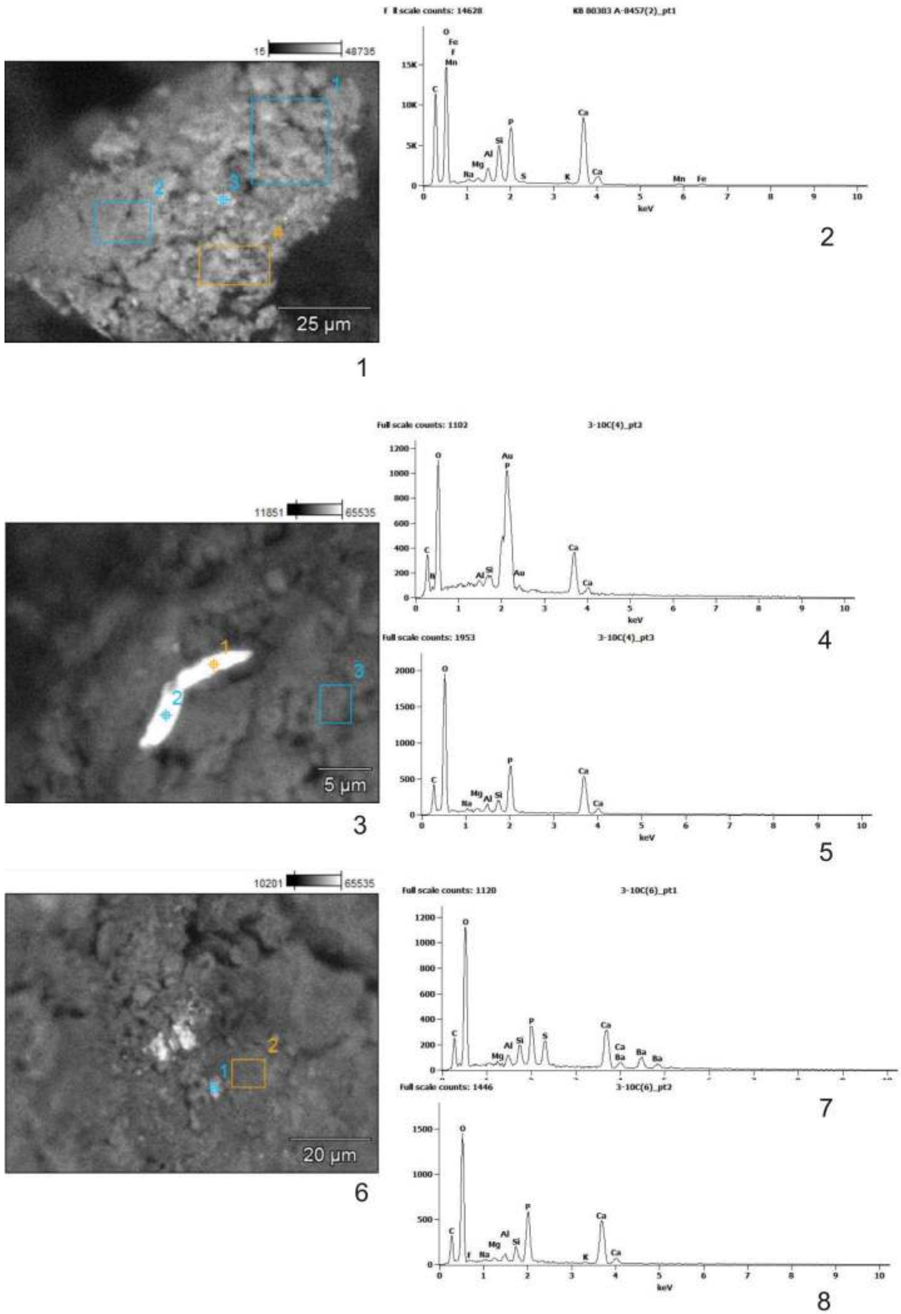
2. A „awl"/pin/damaged blade, C-shaped in cross-section, made from a fragment of a sheep's (goat's) shinbone. Dimensions: 7 x 1,5 x 0,5 cm.

d. Porohy 3A cemeteries: grave 10; ritual context: interdependent feature context

The majority of YC graves dug in the layers of the younger mound created an arc, starting at post-holes 6 and 13 on the northern side, dug before the construction of the second mound. It consists of graves nos. 12 (female, 22-25 years old), 10 (*see* pp. c), 11 (male, 25-30 years old), 1 (male, 30-35 years old), 19 (?, under 18 months old) and 17 (male, 30-35 years old). Grave 20 was found outside of this sequence – placed separately at the fringe of the kurgan. The possibility cannot be excluded that the formation of this grave site was accompanied by the extension of the kurgan, this, however, could not be confirmed due to the fact that the mound had been ravaged. The layout of secondary burial graves on an arc is a feature characteristic to the entire Dniester-Danube area [Shmagliy, Chernyakov 1970: 96; Yarovoy 1985: 57-61; Dergachev 1986: 32]. Burials in such an establishment display common features. It is noteworthy that in most cases, the documented positioning of the deceased person's body was: crouched position, with noticeable turn to the side and one of the upper limbs bent and turned towards the pelvis. This arrangement is typical for late phases of the YC. The repetitive character of ritualistic features indicates cultural proximity of the hereby specified YC burials. Therefore, burials found in the system of objects located on the *circumferencial arc* around the centre of the "younger mound" share a presumed ritual bond with grave 10, which inspired the present chapter.

2. THE "TATTOO" BURIAL: AN INTERDISCIPLINARY ANALYSIS OF THE INVESTIGATED RITUAL

Feature 10 of barrow 3A in Porohy documents the furthermost western – "frontier" – confirmation of "tattoo" application in the Pontic-Caspian area of use of this ritual procedure. Taking into account the previously motivated interpretative experiences from within local *barrow culture* rituals [Shishlina *et al*. 2013], specialist analyses were undertaken in order to – according to the baseline research plan – gain more specific expertise, the results of which deserve to be considered highly innovative (!), and thus deserve to be more broadly discussed. To substantiate, the analysed ulnae reveal decorations being applied directly to the bone of the deceased and as such, the ritual diverges from the defining framework of a tat-



F i g . 6 . Porohy, Yampil Region, barrow 3A, feature 10. Chemical analysis: 1, 2 – EDS analysis of samples of dye material II; 3, 4, 5 – EDS analysis of samples 10; 6, 7, 8 – EDS analysis of the surrounding soil too as *a permanent decoration of the body surface (in said case one can speak of a quasitattoo – a "tattoo")*. The undertaken research concerned (2.1) the analysis of the chemical composition and application of the pigment, and (2.2) the analysis of observing said ritual cycle in terms of forensic medicine.

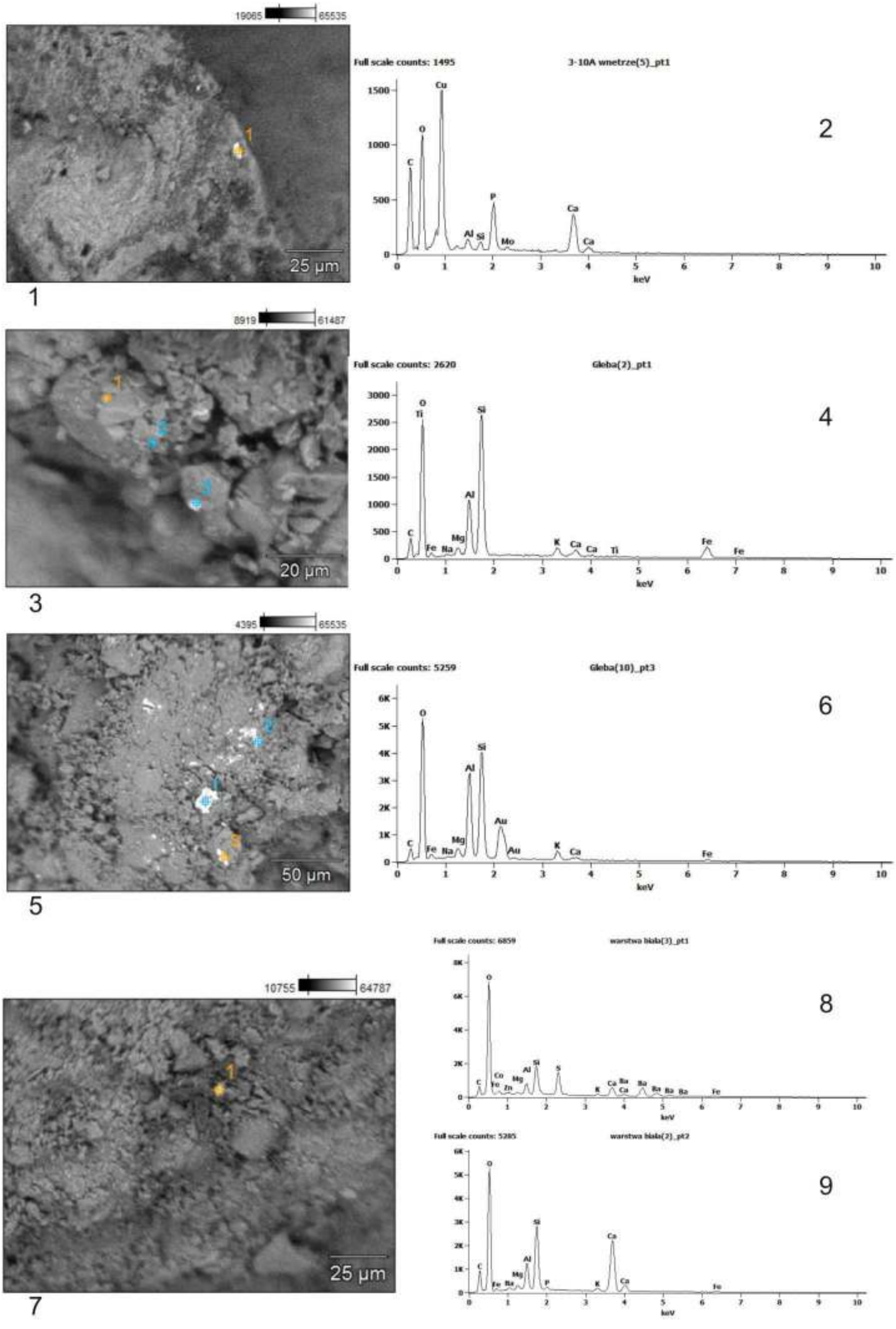
2.1. CHEMICAL ANALYSIS OF THE DYE IDENTIFIED ON THE BONES

A chemical analysis of the dye was performed by means of the electron scanning microscope Hitachi SEM equiped with the EDS facility and the infrared FTIR spectrometry (KBr) using Bruker spectrometer FT-IR IFS 66/s. Two samples of dried materials were analysed: (I) taken from bone 80302 A-8456 and (II) taken from bone 80303 A-8457. FT-IR spectra samples I and II demonstrated a significant similarity (Fig. 3: 1, 2), especially with regard to organic components. The differences that are visible are products of secondary chemical processes (transformations of organic acids salt) and the presence of various mineral admixtures, which are present in bones, soils and random contaminations. An important observation is a well-defined spectrum, clearly differing from that of a charcoal with a thermally destroyed molecular structure. This demonstrates that the black dye used was not charcoal and was not exposed to such high temperatures (i.e. 900 ^{o}C), as applied in the production of charcoal. At the same time, it should be noted that there is a high probability of the wood tar having been used.

FT-IR spectra analysis suggests that the base for the production of material I and II was the bark and the wood of birch (absorption approx. 884 cm^{-1} and 730 cm^{-1}). In the case of material II the results demonstrates it was a bark covered wood (we found the absorption of esters at approx. 1730 cm^{-1}). The spectrum of material I is testifying to the lack of esters and the predominance of organic acids (the absorption at approx. 1650 cm^{-1}), which clearly leads to the conclusion that the basic raw material was bark and not wood.

The specific environment, however, could have led to the hydrolysis of esters and therefore one should take into consideration that in both cases the same material as material type II was used (if other circumstances do not indicate otherwise), while material I arose through hydrolysis and neutralisation of acids under the influence of environmental components, which is manifested in occurrence the strong broad absorption line, typical for carboxylic acids salt (1640-1650 cm^{-1}) and lack of absorption of free acids (1700-1720 cm^{-1}) as well as esters (1730 cm^{-1}). This may be related to the dye position, enabling the environment to chemically impact in the case of material I and creating difficulties in the case of material II.

Analysis of inorganic components with the use of SEM and EDS excludes the use of iron and manganese oxides as fundamental components of the dye in materi-



F i g . 7. Porohy, Yampil Region, barrow 3A, feature 10. Chemical analysis: 1, 2 – EDS analysis of samples 3-10; 3, 4, 5, 6 – EDS analysis of the surrounding soil; 7, 8, 9 – EDS analysis of “white layer” under burial – sample from around the head

Fig. 8. Porohy, Yampil Region, barrow 3A, feature 10: 1 – plan of feature; 2 – reconstruction of the burial by Michał Podsiadło; 3 – bones contain regular black patterns in situ; 4 – drawing of a 'tattoo'

als I and II. In the analysis of samples there mainly occur elements of bone and clay (Na, Al, Mg, Ca, P, S, Si), at times also Fe and Mn, at the same time a lack of significant concentrations derived from iron and manganese, which occur only sporadically in the form of micro-particles (Fig. 3: 3, Fig. 4: 1-4). Phosphates dominate in the majority of samples, while some contain aluminosilicates. One should note that the presence of barium compounds has been confirmed (sulphate, carbonate) in the form of particles of about 10 micrometres in size (Fig. 4: 3, 4; Fig. 5: 1-3).

Fig. 9. Porohy, Yampil Region, barrow 3A, feature 10. Macro- and microscopic examination results: 1 – right ulna with visible decorations and close-up of the decoration; 2 – left ulna with visible decorations and close-up of the decoration. Photo by D. Lorkiewicz-Muszyńska

To clarify the presence of barium, three bone samples without a dye (3-10A, 3-10B and 3-10C; Fig. 3: 4) were subject to analysis. It was confirmed that these contained particles of barium compounds on the surface and in part in the internal sections of the bones analysed (Fig. 6: 3-8; Fig. 7: 1, 2). Such particles do not occur in the surrounding soil (Fig. 7: 3-6) but are however, present in the mat under burial – a "white layer"; sample from around the head (Fig. 7: 7-9).

On the bones (i.e. sample 3-10 A, internal), some isolated particles were also found (5-10 micrometres) containing a significant amount of copper (Fig. 7: 1, 2) as well as (separately) gold (Fig. 6: 3-5), which is in the form of a tiny flake (micrometre size). The former, means of the position would appear to point to its incidental presence. The samples of soil under analysis and mats did not contain this type of addition (in a comparative and even greater context of observation).

2.2. RESEARCH IN ANTHROPOLOGY AND FORENSIC MEDICINE

a. Material and methodology

The subject of the comprehensive interdisciplinary research were human remains in the form of two ulnae from a female skeleton from grave 10 in Porohy 3A site, dated to Early Bronze Age: 2650-2500 BC (Fig. 8: 1, 2).

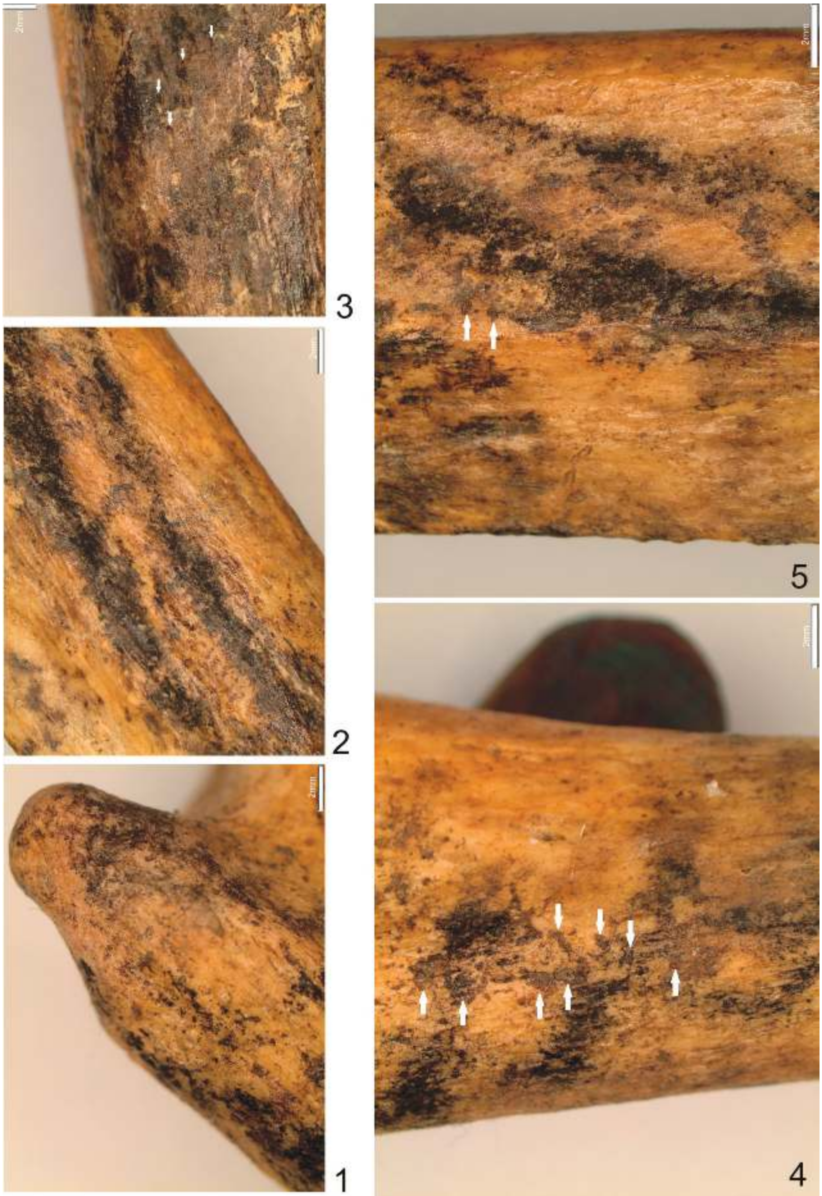
The ulnae were found to contain regular black patterns (Fig. 8: 3, 4), initially described as "tattoos" [Klochko *et al*. 2015: 104]. The detailed research was supposed to explain the mechanism used for their creation. Analyses were conducted as to the character of the decorations, their form, location, degree in which they cover the bone and the anatomic structure of the bones, anatomical attachments in particular segments of bone surface, as well as accounting for histological structure of skin unaffected by postmortem changes, and localization of the tattooing pigment as well as the processes occurring in human skin after death at different stages of postmortem changes.

The patterns on both ulnae were subjected to macro- and microscopic, and physicochemical examination. Observations were made using a stereoscopic microscope Olympus SZ61 to make a series of photographs. Additionally, photographic documentation was created using a digital reflex camera Pentax K30.

b. Macro- and microscopic examination results

Decorations on both ulnae are characterized by a high degree of regularity, maintaining continuity on the right ulna. In the case of the left ulna, the pattern is continuous over a considerable part of the bone, with signs of fading on approximately 1/3 of the shaft. The patterns on the right ulna are arranged into alternating longer parallel stripes in the shape of arches, with single, shorter stripes interlaced between them, similarly in the shape of arches (Fig. 9: 1). The patterns are located on the posterior bone shaft surface, between the posterior and exterior edge (interosseous crest). In some places, the patterns extend to the interosseous crest. The patterns stretch regularly over the interior and exterior part of the posterior surface of the bone shaft and the line formed between them, including the areas of attachment of the following muscles: the externsor carpi ulnaris muscle, the abductor pollicis longus muscle, the extensor pollicis longus muscle, the extensor indicis muscle [Senelnikov, Senelnikov 1996]. The decorations on the left ulna assume the shape of interlacing alternating lines forming a chain pattern (Fig. 9: 2). In the mid-section, they are shaped to resemble diamonds or triangles. Towards the top, they reassume the shape of a chain. Approaching the proximal end of the bone, the pattern is faded and hardly visible. Moreover, the damage suffered by the bone narrows the possibilities to assess the shape. The decorations cover a significant portion of the styloid process surface (Fig. 10: 1), which is the place of attachment of three ligaments, including its apex, to which the ulnar collateral ligament of the wrist is attached. Subsequently, the patterns run slightly upwards in a spiral fashion, and laterally along the bone shaft, covering, as in the case of the right bone, the posterior surface of the shaft. The pigment covers both the interior and exterior surface, as well as the linea between them.

Of particular interest is the location of the decorations on the analysed bones, i.e. their presence on the posterior shaft surface of both ulnae, oriented towards the back and laterally, on the side of the radius. Moreover, regularity and continuity



F i g . 1 0 . Porohy, Yampil Region, barrow 3A, feature 10. Stereoscopic microscope image: 1 – of a decoration fragment on the surface of the styloid process (left ulna), which is an attachment point for numerous anatomical structures; 2 – of a section of the pattern (right ulna) – visible regular patterns evenly covering the surface of the bone; 3 – of a section of the pattern (right ulna) – visible accumulation of the pigment in the natural openings in the cortical bone; 4, 5 – of pattern fragments (4 – left ulna, 5 – right ulna) – visible regular chain (4) and arc (5) patterns evenly covering the surface of the bone. Arrows indicate the presence of the pigment in openings resulting from natural erosion (4 and 5) of the patterns over the muscle, ligament, tendon and the interosseous membrane attachment points can be observed (Fig. 9).

The aspect of natural roughness and porosity of the bone and the manner in which the pigment was applied are of significance. Closer observation under the stereoscopic microscope revealed a high degree of regularity and good coverage of even surfaces of the bones. Absence of pigment was observed in some cavities where the surface of the bone was uneven (Fig. 10: 2), while on the edges of natural openings (i.a. *foramen nutricium*) a greater accumulation of the pigment was observed on one of the edges, consequently on the same side of each opening (Fig. 10: 3). Pigment accumulation on the edges was observed in the lateral part of the openings, considering the placement of the bones *in situ*. Pigment accumulation contrary to the forces of gravity may indicate the direction of pigment application and the force and pressure of the tool used to spread the pigment on the bone (Fig. 10: 3).

Considering the issue of time and technique used for applying the pigment, one must take notice of the parts of the bone affected by natural postmortem changes (decline) in the bone and the pigment it contains. During the microscopic analysis, pigment application to the cavities in the cortical bone occurring due to natural postmortem erosion of bone was observed (Fig. 10: 4, 5).

c. Skin structure

The histological structure of skin determines its ability to preserve the traces of dye used for tattooing. Skin is made up of two layers: the epidermis and dermis, with the hypodermis underneath (Fig. 11: 1). The photograph below illustrates the proper histological structure of skin unaffected by postmortem changes.

The main functions of the epidermis are isolation and protection. Over a human lifetime, the epidermis is subject to a continuous renewal process, and therefore regenerates constantly. Any damage to the epidermis does not lead to permanent changes – scars, and dye applied to the epidermis only cannot be sustained for longer than approximately one month.

The dermis contains numerous fibres of dense connective tissue which provide the skin with flexibility. They contain receptors, nerves, blood vessels, glands and hair roots [Bochenek, Reicher 2007; Senelnikov, Senelnikov 1996]. This layer performs the nutritive and protective function. Damage to the dermis, which is 1 mm to 3 mm thick, leads to scarring. In the process of tattooing, the dye is deposited in the upper layer of the dermis. The large amount of dense connective tissue present in this layer allows for maintaining the specific shape of the tattooed image for many years, while the inflammatory reaction which develops in response to insertion of needles and dye into the skin, as the dye is perceived as a foreign substance by the human body, leads to changes in the colour of the tattoo.

Under the dermis there is the hypodermis, built of loose connective tissue and numerous adipocytes, where receptors, blood vessels, lower sections of hair roots and glands lie.

1 2 3 4 5 6 7 8

F i g . 1 1 . Postmortem changes and skin structure: 1 – histological structure of skin unaffected by postmortem changes: A – epidermis; B – dermis (x100) HE colouring; 2 – postmortem changes due to putrefaction; 3 – numerous blisters visible postmortem changes followed by exfoliation of the epidermis; 4 – postmortem changes in the histological structure of the dermis – putrefaction (x100)1 – damaged structure of connective tissue elastic fibres; 5 – postmortem changes due to putrefaction. Numerous insect larvae visible; 6 – postmortem changes due to putrefaction and desiccation, partial skeletonisation. Further postmortem changes are those of preservative character. This indicates that late, long-term postmortem changes lead to the preservation of all or most of soft tissues along with the skeleton, for years or even centuries; 7 – a mummified corpse. Disintegration of desiccated skin visible on the back. Underneath, crumbling deeper layers of desiccated soft tissue; 8 – tattoos on corpses demonstrating late postmortem changes (putrefaction)

d. Postmortem changes

From the point of view of the broad interdisciplinary analysis of 'tattoos' (decorations) on bones, the postmortem changes occurring in the soft tissues of the body after death deserve particular attention. All the postmortem changes in the body can be divided into two groups: early and late [DiMaio *et al.*1993; Raszeja 2013]. The early changes include: pale appearance; cooling; rigor mortis; livor mortis and desiccation, with livor mortis and desiccation worthy of particular attention. As an early postmortem change, desiccation is a symptom of progressive loss of water resulting from evaporation through the skin tissue deprived of the *stratum corneum* – vermilion zone, conjunctiva, cornea and labia. As an early postmortem change, it does not lead to prolonged preservation of desiccated tissues for years after the death. Livor mortis occurs as a consequence of blood pooling in the lowest situated capillaries after circulation has stopped.

Shortly after death, the process of autolysis begins – spontaneous decomposition of tissues or cells of the body under the influence of its own enzymes, in aseptic conditions. Autolysis first begins in the organs rich in enzymes and sensitive to the lack of oxygen, such as the pancreas, the mucous membrane of the digestive system, the brain and the adrenal glands.

Late postmortem changes include putrefaction, skeletonization, adipocerous formation, peat bog transformation and mummification. Putrefaction refers to disintegration of tissues due to the activity of bacteria in the body after death. Under the influence of the enzymes produced by bacteria, complex organic compounds disintegrate into simple organic and inorganic compounds. Protein, carbohydrates and fats cleavage causes the production of gases with high concentrations of ammonia, carbon dioxide, hydrogen sulfide and methane. As a result of haemoglobin reacting with hydrogen sulfide, sulfhemoglobin and verdoglobin are formed, which explains the change of colour (green colouration) of the body.

Putrefaction spreads along the vessels as a result of the pressure of putrid gases inside the circulatory system and body cavities. Due to the pressure, displacement of tissue fluids in the skin occurs, followed by formation of liquid-filled blisters, detachment of the epidermis (Fig. 11: 2), and eventually exfoliation of the epidermis (Fig. 11: 3). As a result of putrefaction and the presence of large amounts of gases, internal organs and muscles become foam-like. The microscopic picture shows absence of the epidermis due to its complete detachment, thinning and fragmentation of dermal elastic fibres, as well as destruction of skin structure [Mills 2007]. Numerous spaces between particular bundles of elastic fibres of the dermis can be seen (Fig. 11: 4).

In periods of insect activity (spring-summer-autumn), corpses buried in relatively open conditions (similar to those discussed in the present study, such as pit graves, catacomb graves), may become the feeding grounds for insects in various stages of development (Fig. 11: 5), as well as for rodents, which significantly accelerates destruction of soft tissue.

The final result of putrefaction and decomposition of a corpse is its complete skeletonisation. One should, however, note that the postmortem changes in question do not occur equally throughout the entire body, but rather particular parts become skeletonised quickly as compared to other parts of the body (Fig. 11: 6).

Mummification occurs when a corpse is left in a very dry and airy environment, in relatively high or very low temperature (Fig. 11: 7). It should be noted that as a result of mummification all layers of soft tissue are preserved, including skin, muscles and tendons. Due to desiccation, numerous wrinkles and creases appear on the surface. These tissues, however, shrink and break with the use of even very little pressure, both on the skin surface and in the deeper layers. As a consequence of climatic changes (temperature, humidity) and the impact of insects and animals (e.g. rodents), postmortem destruction of the body may be accompanied by considerable loss of desiccated soft tissue (Fig. 11: 7), subsequently leading to complete disintegration of soft tissue and complete skeletonisation.

Adipocerous formation occurs in an extremely humid environment in the absence of oxygen. The process is based on the transformation of adipose tissue into adipocerous mass. It begins with hydrolysis and fat liquefaction, which leads to tissues soaking in and absorbing the above mentioned liquefied fatty substance. Due to the activity of anaerobic bacteria, a greater amount of saturated fatty acids are produced, together with grey-white tissue mass, initially semi-solid, which subsequently hardens because of predominance of saturated fatty acids over unsaturated ones. Soft tissues are preserved in its entirety, though they are rather fragile.

Peat bog transformation occurs when the corpse is interred in a peat bog. As a result of the presence of acids and tannin in this type of soil, the activity of bacteria is suspended and skin becomes tanned, muscles and internal organs decompose and bones decalcify. Postmortem changes of adipocerous and peat bog type should be excluded on account of the absence of conditions necessary for their occurrence, because of access to oxygen and the fact that the grave pit is not located in a highly humid environment or indeed in a peat bog.

Tattooing is based upon repeated breakage in skin continuity and contact with a needle, used to apply the dye to the surface layer of the dermis, containing a large number of elastic fibres of connective tissue. Currently, specialists use sophisticated devices allowing them to apply the dye into the skin at consistent depth, to the connective tissue in the upper layer of the dermis. In the past, when tattoos were applied manually using needles made out of a bone or wood, it was impossible to apply the dye each time to the same level of the dermis, and its application to the subcutaneous tissue resulted in complete absorption, due to the inflammation arising around it.

In the case of death and postmortem decomposition process, gradual destruction of soft tissue occurs, including the skin surface, resulting in deformation and destruction of tattoos (Fig. 11: 8), as the dye becomes homogenous with the elastic tissue of the dermis after the tattoo is made (Fig. 11: 4). The thickness of the dermis, where the ink accumulates, and the amount of ink applied to the upper layers of the dermis, need to be taken into account as well.

Discussion

The conclusions presented in chapter 2 make it impossible to qualify the *symbolic* decorations of interest, documented on the ulnae of the deceased female from grave 10 as tattoos. The complex analysis conducted on the bones indicates the application of a dye, most likely tree tar, posthumously onto the bones at the skeletonised stage, with minor damage from natural erosive changes already present.

Moving the application of symbolic decorations (‘tattoo’) to the post-skeletonisation stage of the interred creates new opportunities for cultural and thanathological interpretation: studies of the sequence and techniques of funerary rites and the attempts at placing them within the hypothetical concept of death theory, respected and observed by YC (or, more broadly speaking, YC/CC) communities.

The innovative nature of the above mentioned conclusions, resulting from the application of specialist analytical techniques, justifies, in our opinion, further discussion of the presented hypothesis in respect to the direction of future research as a means of its verification.

The deep pit grave in which the corpse had been placed (*see* Chapter 1) was situated in a steppe environment [Jankowski *et al*. 2017] and covered with oak planks [*see* Stępnik *et al*. 2017]. It is therefore likely that the ‘chamber’ remained accessible to air, insects and rodents and that postmortem changes happened rapidly in comparison to the changes in a corpse placed in an earth-filled grave. The sequence of changes in the above mentioned conditions could have happened in two possible ways:

– the most likely scenario is that the corpse was subject to progressive decomposition up to the point of complete skeletonisation within the period of approximately two years;

– mummification and further skeletonisation cannot be excluded, though the duration of such changes, from the theoretical point of view, cannot be predicted.

If one were to accept the most likely character of postmortem changes, that is putrefaction, it ought to be emphasised that penetration and multiplication of bacterial colonies took place within the skin and soft tissues, as well as between the clusters of elastic tissue of the dermis, where the decorative dye is deposited, and in the remaining layers of soft tissue. The activity of bacteria led to tissue degradation and its separation due to the production of gases and gradual liquefaction. These changes resulted in complete degradation of soft tissue structure, also visible in the histological picture of the skin (Fig. 11: 4). Such changes first lead to deformation of the decorative image and subsequently to its liquefaction along with soft tissue succumbing to the forces of gravity. It is therefore impossible for patterns applied to the skin (tattoos) to be imprinted onto bones after complete destruction of soft tissue. The tattoo dye cannot separate itself from soft tissue and remain on the bone, as it becomes homogenous with the elastic tissue of the dermis after the tattoo is made. The activity of insects (Fig. 11: 5) or rodents in this process, which can significantly accelerate postmortem changes and enhance the degradation of soft tissues along with the tattoo, cannot be ruled out.

In a variety of postmortem processes in a corpse leading in effect to its skeletonisation, the soft tissue degrades at different rates in different parts of the body. Such changes never occur in the same way throughout the entire body, as illustrated in Fig. 11: 6.

In case of mummification, however, soft tissues desiccate and wrinkle, while tattoos are deformed. It is often difficult to reconstruct precisely the design of patterns on desiccated, deformed and wrinkled hard tissue of mummified corpses. Barkova and Pankova [2005] point to the difficulties tied to discovery of tattoos on certain areas of skin surface on mummified corpses. In their research programme, infrared lamps were used in order to reveal all of the tattoos. Moreover, it was noted that the majority of the tattoos revealed were deformed due to the wrinkling of dried skin. For the purpose of revealing the complete outlines of the tattoos, it was necessary to illuminate and photograph the tattoos from various angles. Despite the application of a variety of reconstruction methods, small deficiencies were noted in specific fragments of these outlines.

In 2004 Russian scholars [Kyzlasov, Pankova 2004] published a work in which they detailed the results of research into the mummified remains of three people discovered by archaeologists in 1969. Tattoos were discovered within the skin layers of one of the mummies. Microscopic and macroscopic analysis showed that the black tattoo pigment was soot. The researchers noted that tattoo drawings were only preserved in fragments, while parts were lost along with damaged skin layers. In the photographs accompanying the publication, the shape of the pattern is clearly visible, discontinued at points of tissue damage, with parts of the skeleton and fragments of the crumbling layers of remaining soft tissue, devoid of any patterns whatsoever reminiscent of a tattoo.

Certain researchers of prehistoric graves [Shishlina *et al*. 2013] have analysed cases of decorations revealed on bones discovered in pit and catacomb graves. Shishlina *et al*. [2013] documented several cases of decorations revealed on bones made with a variety of materials (soot, coal and ochre). The researchers proposed a theory on the tattooing of skin, with transfer of dye onto bone after soft tissue disintegration, preserving clear shapes and patterns of the decorations. Their work does not suggest that detailed specialist analyses had been conducted with respect to bones with decorations, taking into account the nature of the decorated bone surface, detailed localisation of the dye with respect to the anatomical structure, nor indeed microscopic and chemical analysis.

The patterns visible in the burial from the Dniester Region, indicate that the dye was applied posthumously, directly onto the bone. These patterns cover both ulnae over a significant part of their length, with significant regularity of decorations and high level of dye coverage on the surface of both ulnae – including the attachment points of numerous anatomical structures (muscles, tendons and ligaments). A substantial amount of dye (most likely tree tar), thoroughly covering the surface of the analysed bones in the sections with visible decorations, should be noted.

Therefore, in the opinion of the authors, translocation of dye from soft tissue onto the ulna of the individual in question – grave no. 10 in Porohy 3A – is not possible, on account of a series of significant factors, such as the nature and course of postmortem processes and changes, the thickness of soft tissue in the area in question, the nature of anatomical structures, the highly regular character of the decorations and finally, the amount of dye applied.

CONCLUSIONS

Based on the anatomical properties of the structure of a human body, the histological structure of the skin and location of the dye used for tattooing, having conducted an analysis of postmortem changes occurring within the skin after death, and having taken into consideration the continuous and regular nature of the pattern on the ulnae of the individual from grave no. 10, an interdisciplinary team of researchers has concluded *that there is no possibility of a transfer of tattoo dye from the skin onto the surface of an individual's bone*.

The analysis of two ulnae documented in this article indicates that the patterns were made using tree tar, postmortem and directly onto the skeletonised human remains. The placement of the individual's ulnae in grave no. 10 (Fig. 10), and the location of patterns on the upper skin surface, that is, on surfaces accessible without changing the arrangement of the body, may suggest that the patterns were created on the skeletonised remains without the need to change their placement in the pit (= *in situ*).

The present conclusions ought to see the beginning of a wider research programme focused on the analysis of the techniques used to create *decorations on bones in "kurgan cultures" communities* in the context of the Pontic-Caspian Region.

Translated by Dorota Lorkiewicz-Muszyńska, Julia Sobol,
Jerzy J. Langer, Piotr T. Żebrowski

REFERENCES

Armelagos J.
1969 Disease in Ancient Nubia. *Science. New Series* 63. No 3864.

Barkova L.L., Pankova S.V.
2005 Tatoo on the mummies from large Pazyrik kurgans (new data). *Archeology, etnography and antropology,* 2 (22): 48-59.

Bochenek A., Reicher M.
2007 *Anatomia człowieka, vol.* 1. Warszawa.

Dergachev V.A.
1986 *Moldaviya i sosednie territorii v epokhu bronzy.* Kishinev.

Dettmeyer R.B.
2011 *Forensic histopathology.* Berlin-Heidelberg.

DiMaio D.J., DiMaio V.J.M.
1993 *Forensic Pathology.* Boca Raton, Florida.

Goslar T., Kośko A., Razumow S.
2014 Identyfikacja kulturowo-chronologiczna cmentarzysk „wczesnobrązowych" na stanowisku Pidlisiwka 1. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 305-312. Poznań.

Goslar T., Klochko V., Kośko A., Włodarczak P., Żurkiewicz D.
2015 Chronometry of Late Eneolithic and 'Early Bronze' cultures in the Middle Dniester area: investigations of the Yampil Barrow Complex. *Baltic-Pontic Studies* 20: 256-291.

Harat K., Potupczyk M., Razumow S.
2014 Charakterystyka źródeł archeologicznych pozyskanych w latach 1984--1993. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu*

kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie 6, 45-204. Poznań.

Iwanowa S., Kośko A., Włodarczak P.
2014 Komponent tradycji kultur ceramiki sznurowej. Amfory w północno-zachodnio-nadczarnomorskich grobach kultury jamowej. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 351-386. Poznań.

Jankowski M., Dąbrowski M., Jasińska J., Michalski A.
2017 Yampil Barrow Complex: Prydnistryanske 1 and Klembivka 1. Pedological-environmental aspects of location. *Baltic-Pontic Studies* 22: 41-53.

Kałużna-Czaplińska J., Rosiak A., Sikorski A, Żurkiewicz D.
2017 Barrow culture textiles and mats in the Middle Dniester Area. *Baltic-Pontic Studies* 22: 166-190.

Khokhlov V.V., Kuznetsov L.E
1998 *Sudebnaya meditsina.* Rukovodstvo. Smoleńsk.

Kyzlasov L. R., Pankova S.V.
2004 Tatoo of the ancient mummy from Kchakchasia. *Reports of the State Hermitage* 62: 61-67.

Klochko V., Kośko A., Razumov S. Wlodarczak P., Żurkiewicz D
2015 Eneolithic,Yamnaya and Noua culture cemeteries from the first half of the 3rd and the middle of the 2nd millennium BC, Porohy, site 3A, Yampil Region, Vinnitsa Oblast: archaeometric and chronometric description, ritual and taxonomic-topogentic identification. *Baltic-Pontic Studies* 20: 78-141.

Kośko A., Potupczyk M., Razumow S. (Eds)
2014 *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6. Poznań.

Makohonienko M., Hildebrand-Radke I.
2014 Kontekst przyrodniczy i perspektywy studiów paleośrodowiskowych stanowiska kultury jamowej w Pidlisiwce nad Dniestrem, zachodnia Ukra-

ina. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 247-274. Poznań.

Melnik O., Steblina I.
2013 *Yamnaya kultura serednoy techiy Ingultsa.* Kryvyi Rih.

Mills S.E.
2007 *Histology for Pathologists.* 3rd edition. Philadelphia.

Polosmak N.V.
2000 Funeral site of Ak-Alakcha Kurgan 3. Historical – cultural analyses. *Phenomenon of the Altay mummies,* 57-85. Novosibirsk.

Potupczyk M., Razumov S.
2014 Zgrupowanie cmentarzysk kurhanowych w rejonie jampolskim. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 35-39. Poznań.

Pustovalov S.Z
2001 Modeling of the face according to the skull among the population of Ingul Catacomb Culture. *Scientific Notes at UMAA 65 Theory and history of culture* 20-21: 53-65.

Raszeja S.
1993 *Medycyna sądowa.* Warszawa.

Shishlina N.I., Belkevich E,V., Usachuk A.N
2013 Bronze Age Tattoos: Sympathetic Magic or Deceration? *Zurich Studies in Archaelogy* 9: 67-74.

Shmagliy N.M., Cherniakov I.T.
1970 Issledovaniya kurganov v stepnoy chasti mezhdurechia Dunaya i Dnestra. *Materialy po archeologii Severnogo Prichernomoria* 6: 5-90.

Senelnikov R., Senelnikov J.
1996 *Atlas anatomii człowieka.* Vol. 1. Moskva.

Stępnik T., Szmyt M., Danuta Żurkiewicz D.
2017 Use of wood in Yampil Barrow Complex funerary rituals IV-II mill. BC. *Baltic-Pontic Studies* 22: 126-165.

Subbotin L.V.
2003 *Orudiya truda, oruzhiye i ukrasheniya plemen yamnoy kultury Severo-Zapadnogo Prichernomoria.* Odessa.

Szmyt M.
1999 *Between West and East. People of the Globular Amphora Culture in Eastern Europe. Baltic-Pontic Studies* 8.

Teslenko D.L.
1996 Ritual covering of sculls in the Yamnaya culture graves. In: *North – East Asov coastline area in the System of Eurasian Antiquity (Eneolith – Bronze Age).* Part 1, 28-30. Donetsk.

Wiślański T
1966 *Kultura amfor kulistych w Polsce Północno-Zachodniej.* Wrocław-Warszawa-Kraków.

Yarovoy E.V.
1985 *Drevneyshie skotovodcheskie plemena yugo-zapada SSSR (klassifikatsiya pogrebalnogo obriada).* Kishinev.

Baltic-Pontic Studies
vol. 22: 2017, 91-125
ISSN 1231-0344
DOI 10.1515/bps-2017-0023

Tomasz Goslar*, Michał Jankowski, Aleksander Kośko***, Maria Lityńska-Zając****, Piotr Włodarczak****, Danuta Żurkiewicz***

BUILDERS AND USERS OF RITUAL CENTRES, YAMPIL BARROW COMPLEX: STUDIES OF DIET BASED ON STABLE CARBON AND NITROGEN ISOTOPE COMPOSITION

ABSTRACT

The paper presents $\delta^{13}C$ and $\delta^{15}N$ isotope content measurements in human bones from 16 graves, being part of the *Yampil Barrow Complex*. From the results, conclusions may be drawn about the diet of barrow builders and users. It was based on vegetable foodstuffs and characterised by a varied share of terrestrial animal meat, depending on the period. High $\delta^{13}C$ values suggest a share of C4-type plants in the diet, possibly millet.

Key words: paleodiet, stable carbon and nitrogen isotopes, barrows, Eneolithic, Early Bronze Age, Middle Dniester

* A. Faculty of Physics, Adam Mickiewicz University, Umultowska 85, 61-614 Poznań, Poland; B. Poznań Radiocarbon Laboratory, Foundation of the Adam Mickiewicz University, Rubież 46, 61-612 Poznań, Poland; tomasz.goslar@radiocarbon.pl

** Department of Soil Science and Landscape Management, Faculty of Earth Sciences, Nicolaus Copernicus University, ul. Lwowska 1, 87-100 Toruń, Poland; mijank@umk.pl

*** Department of Prehistory of Central and Eastern Europe, Institute of Archaeology, Adam Mickiewicz University, Umultowska 89D, 61-614 Poznań, Poland; antokol@amu.edu.pl, danuta@amu.edu.pl

**** Institute of Archaeology and Ethnology of Polish Academy of Sciences, Centre for Mountains and Uplands Archaeology in Kraków; Sławkowska 17, 31-016 Kraków, Poland; marialitynska@gazeta.pl; wlodarczak.piotr@gmail.com

Nutrition strategies of populations identified with the ‘barrow cultures’ of the Northern Pontic Area of the 4th-2nd millennium BC have not been satisfactorily explored, as far as their adaptation picture is concerned, due to two major research limitations. First and foremost, this concerns the clear domination of archaeometric funeral sources in the body of research data, which is true, by the way, for the analytical studies all ‘grave cultures’. The first limitation is worsened by regionally recurrent limitations in the palynological examination of hypothetical economic penetration zones [for the *Yampil Barrow Complex see* Makohonienko, Hildebrandt-Radke 2014].

The selection of ‘terrestrial’ (vegetable or animal) foodstuffs and others procured by exploiting water reservoirs by ‘barrow communities’ both Late Eneolithic ones, for instance, the Tripolye culture – Gordineşti group (TC-G), and Early Bronze ones – the Yamnaya culture (YC), Catacomb culture (CC), Babyno culture (BC) and Noua culture (NC), recorded in the course of the *Yampil Investigation Programme*, has already been reported on and appraised by presenting osteological data and discussed as part of preliminary consolidation treatments sketched against the broader research space of ‘Pontic Archaeology’ [Kośko *et al.* (Ed.) 2014; Harat *et al.* 2014; Kośko (Ed.) 2015].

The present article focuses on a relatively new – known since the 1980s – method of reconstructing the diet of the deceased by determining the composition of stable carbon and nitrogen isotopes in human bones. The analytical material for this article has come from the chronometric programme completed as part of the *Yampil Investigation Programme* in 2011-2016 [Goslar *et al.* 2014; 2015]. An important motive to take up this study was the necessity to confirm/exclude the reservoir effect that could distort the ^{14}C dating of bones. Possible distortions are produced by the share of foodstuffs coming from water reservoirs in the diet.

In the pursued research programme, the set of ‘isotope data’ is going to be discussed against broader identification contexts: (a) archaeological-anthropological ones on the *Yampil Barrow Complex* (YBC) scale (sections 2-4), and (b) archaeobotanical, archaeozoological and historical-ethnographical ones viewed against the broad comparative background of the ‘nomadic societies’ of the Northern Pontic steppe/forest-steppe (sections 5-7).

a. Archaeologically speaking, the investigated burials can be divided into two groups: the *graves of builders* of ritual centres (= barrows and their clusters) and the *graves of users,* i.e. persons buried in or on the mounds of the barrows (= mounds encountered in the cultural landscape, being carriers of certain thanatological or rather mythological beliefs). The communities of builders, in the light of YBC identifications, comprise Eneolithic taxa (or, in more accurate versions, TC-G communities) and others from the transition period of the Eneolithic and Bronze Ages (Eneolithic-’Pre-Yamnaya’ = EN/YC) and of the early YC. The communities of users, in turn, were found to include the populations of the developed YC, CC, BC and NC.

The archaeological contexts mentioned above were broadened by adding anthropological data on sex (including corrections using the DNA method) and age [Litvinova *et al.* 2015].

b. The interpretation of the results of isotope, botanical and achaeozoological studies, describing the potential subsistence means of the nomadic populations under discussion, is consistent with the living they could make out of the soils formed on 'the substratum of typical *chernozem*, exhibiting characteristics found in the transition zone of the subboreal belt and having a temperate climate with marked continental characteristics and steppe vegetation' [Bednarek, Jankowski 2014].

1. STABLE CARBON AND NITROGEN ISOTOPES IN LIVING ORGANISM TISSUES

Since the early 1980s, the measurements of ratios of stable isotopes of carbon ($^{13}C/^{12}C$) and nitrogen ($^{15}N/^{14}N$) in bone collagen have been a useful source of information on the diet of examined individuals, in particular with respect to its protein component [Ambrose 1993; Richards, Hedges 1999; Olsen *et al.* 2010]. The ratio of stable carbon isotopes (expressed as $\delta^{13}C$) is particularly useful in determining the proportion of sea-origin to land-origin diet. This is a result of a very different carbon isotope composition of atmospheric CO_2 ($\delta^{13}C$ – approx. 7‰) and marine carbon HCO_3 ($\delta^{13}C$ – approx. 0‰). However, $\delta^{13}C$ is not very helpful in differentiating between a diet originating on land and that coming from freshwater, because the isotopic composition is often similar in both environments. In the group of foodstuffs originating on land, it is relatively easy to distinguish between plants photosynthesizing according to the so-called C_3 cycle and a smaller group of plants of the C_4 type (such as millet, maize, sugar cane or sorghum), because the $\delta^{13}C$ value ranges of these plant groups (from -20‰ to -35‰ for C_3 plants and from -9‰ to -14‰ for C_4 plants) are completely disjoint [Katzenberg 2000].

The nitrogen isotopic composition, in turn, mainly reflects the place of a consumer in the food (trophic) chain, because $\delta^{15}N$ of the tissues of a higher-order consumer is markedly higher than that of eaten foodstuffs (producer or lower-order consumer). The difference between the values of $\delta^{15}N$ of a consumer and foodstuff, amounting to 3-5‰ [Drucker, Bocherens 2004], usually about 3.5‰ [Richards, Hedges 1999], follows mainly from the preferential degradation (and excretion with urine) of compounds containing a lighter nitrogen isotope ^{14}N [Schoeninger, DeNiro 1984]. For this reason, $\delta^{15}N$ of predators is as a rule higher than that of herbivores. Moreover, since the food chains in an aquatic environment are longer than those in a terrestrial environment, aquatic organisms (marine or freshwater) usually have $\delta^{15}N$ markedly higher than that of terrestrial organisms. Whereas, the length of a food chain is poorly reflected in $\delta^{13}C$ values, because $\delta^{13}C$ of a consumer is, admittedly, sometimes 5‰ higher than that of eaten plants, but only 1‰ higher than $\delta^{13}C$ of eaten animals [DeNiro, Epstein 1978; Van der Merwe, Vogel 1978].

The measurements of the composition of stable carbon and nitrogen isotopes have been often used in relation to the radiocarbon dating of human and animal remains, the ^{14}C ages of which could be distorted by the reservoir effect [Cook *et al.* 2001; Eriksson 2004; Olsen *et al.* 2010; Shishlina *et al.* 2009; 2014], provided that the share of aquatic-origin foodstuffs (fish, molluscs) in their diet was considerable. Even more often, $\delta^{13}C$ and $\delta^{15}N$ measurements are used in the studies of the diet of our ancestors, independently of its impact on ^{14}C dating. For instance, in Poland, such studies were conducted, regarding human and animal bones from the medieval cemetery in Giecz [Reitsema *et al.* 2010] or the Przeworsk culture cemetery in Karczyn [Pospieszny, Bełka 2015]. In both cases, it was concluded that the individuals in question subsisted mainly (or exclusively) on terrestrial-origin foodstuffs ($\delta^{15}N$ of 8-10‰), while the diet of men was richer in meat than that of women ($\delta^{15}N$ of the collagen of men's bones was on average 1‰ higher than $\delta^{15}N$ of women's bones).

The carbon and nitrogen isotopic composition in examined bones is usually hard to interpret due to its high variability caused by many additional factors, even when there were no aquatic organisms in the food chain. For instance, $\delta^{13}C$ of plants growing in open spaces is usually higher than $\delta^{13}C$ of those growing in a forest environment, where CO_2 produced by breathing plants locally influences the carbon isotopic composition of CO_2 available for photosynthesis [Drucker *et al.* 2008; Reitsema *et al.* 2013] and where there is less light available [Farquhar *et al.* 1982]. Furthermore, the composition of carbon and nitrogen isotopes (in plants, and the tissues of people and animals eating them) depends on the intensity of fertilization of fields and pastures [Bogaard *et al.* 2007]. The complexity of factors determining the isotopic composition of nitrogen and carbon in human and animal tissues makes the values of $\delta^{13}C$ and $\delta^{15}N$ differ greatly between individuals. For this reason, any conclusions about the dietary customs of a given community usually require examining a large number of individuals and taking a statistical approach.

The isotopic composition of carbon and nitrogen depends also on the climate. The mechanisms of this interdependence are known rather well in the case of carbon so much so that the studies of $\delta^{13}C$ of plant remains serve the purpose of quantitative palaeoclimatic reconstructions [McCarroll, Loader 2004; Loader *et al.* 2013]. In contrast, a clear regional differentiation of the isotopic composition of nitrogen seems to be related to the correlation between $\delta^{15}N$ and the precipitation total, but the mechanism of this correlation is not completely clear.

The studies of isotopic composition of nitrogen in animal tissues from South Africa [Heaton *et al.* 1986] and Kenya [Ambrose, DeNiro 1986] show that the values of $\delta^{15}N$ have a very broad range (from 2‰ with the annual precipitation of about 1,000 mm to 12‰ with the annual precipitation of about 100 mm). Schwarcz *et al.* [1999] showed that under extremely dry climatic conditions, $\delta^{15}N$ of plants, animals and people (whose diet comprised foodstuffs of exclusively terrestrial origin) might reach 14, 16 and 18‰, respectively, and observed that the value of $\delta^{15}N$ was not directly dependent on the availability of drinking water (thus, it is not dependent on mainly physiological factors). As the mechanism of observed relationships, he suggested the precipitation-dependent volatilization of ammonia enriched by a lighter nitrogen isotope (^{14}N) and its production by bacteria in soil. Whatever the mechanism is, the difference in the value of $\delta^{15}N$ of animals feeding on the same food may be many times higher than the difference between $\delta^{15}N$ of a consumer and food as well as the difference between $\delta^{15}N$ of aquatic and terrestrial organisms from the same region. This makes it highly desirable, when drawing conclusions on the diet of humans in the remains of which the isotopic composition of nitrogen is studied, to determine $\delta^{15}N$ of the animals that at the same time and in the same region fed on food of terrestrial origin (herbivores and carnivores) as well as of aquatic animals.

2. MEASUREMENTS OF $\delta^{13}C$ AND $\delta^{15}N$ IN HUMAN BONES FROM THE YBC

The study comprised 16 results (Tab. 1) of analyses of human bones from ritual centres in Pidlisivka, site 1, Porohy, site 3A, Klembivka, site 1, and Prydnistryanske, site 1, situated in Yampil Region, Vinnytsia *Oblast,* on the left bank of the Middle Dniester [Klochko *et al.* 2015; 2015a; 2015b; 2015c].

The composition of the stable isotopes of carbon and nitrogen was studied in collagen extracted from certain bones ^{14}C dated in the Poznań Radiocarbon Laboratory [Goslar *et al.* 2014; 2015]. Collagen extracted from the bones [Longin 1971; Piotrowska, Goslar 2002] was subjected to ultrafiltration on the Vivaspin 15 MWCO 30 kD filters [Bronk Ramsey *et al.* 2004]. The measure of the quality of collagen obtained in this manner was the extraction yield (determined as the ratio of obtained collagen to original bone mass) and the ratio of C/N in the collagen measured with a Thermo Flash EA 1112 analyzer. The measurements of $\delta^{13}C$ and $\delta^{15}N$ were made in the Laboratory of Isotope Dating and Environmental Research, PAN Institute of Geological Sciences, Warsaw, Poland, using a Thermo Flash 1112 HT analyzer coupled with a Thermo Delta V Advantage mass spectrometer. To calibrate the instrument, USGS 40, USGS 41and IAEA 600 standards were used. The standard uncertainty of $\delta^{13}C$ and $\delta^{15}N$ was 0.33‰ and 0.43‰, respectively.

Table 1

Results of $\delta^{13}C$ and $\delta^{15}N$ analyses of human bones from the Yampil Barrow Complex. Archaeological dates are based on source publication [Klochko *et al.* 2015; 2015a; 2015b; 2015c] allowing for sex determination corrections relying on DNA analyses [Chyleński *et al.* 2017]

Taxon – Feature Sex – Age	Sample no.	^{14}C Age	% coll	$\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)
Pidlisivka 1 **builders: late 4th – 3rd millennia BC (EN – EN/YC)**					
No data					
Pidlisivka 1 **users: 2800-2700 BC (YC); 2850-2600 BC (CC?); 1850-1700 BC (BC)**					
YC – 1A ?/Male – 7-8 years/30-40 years	Poz-38529 Poz-39214	4195±35 4080±40	??	-19.3	10.6
CC? – 7 Male – 25-30 years	Poz-38531	4120±35	??	-18.9	11.3
BC – 5 Male – 30-35 years	Poz-38530	3430±35	??	-19.5	11.2
Porohy 3A **builders: late 4th –early 3rd millennia BC (Eneolithic/YC?)**					
No data					
Porohy 3A **users: 2760-2515 BC(YC); 1713-1464 BC (NC)**					
YC – 11 Male – 25-30 years	Poz-47741	4075±35	1.1	-19.1	10.3
YC – 17 Male – 30-35 years	Poz-47743	4050±35	1.0	-19.4	11.4
YC – 20 Male – 50-55 skeleton 1	Poz-47744	4190±35	1.4	-19.2	10.9
Klembivka 1 **builders: 3005-2720 BC(EN – EN/YC)**					
EN/YC – 14 Male – 25-30 years	Poz-52605	4135±35	1.9	-18.8	8.9
Klembivka 1 **users: 19th–18th BC (BC);15th–14th BC (NC)**					
No data					
Prydnistryanske 1 **builders: 3350-3150 BC (KT-H); 3100/3000-2550 BC (YC)**					
TC-G – III/1 ? – 20+ years	Poz- 66224	4540±35	11.8	-18.4	9.0
TC-G – III/2 20+ years	Poz-66225	4530±35	14.0	-18.6	9.3
TC-G – IV/10 ? – 20 years (adultus)	Poz- 66234	4520±40	7.4	-18.8	8.9
YC – V/4 Male – 35-50 years (adultus'maturus)	Poz-66230	4455±35	1.5	-18.0	10.3
YC – IV/3 ? – 40+ years (maturus'senilis)	Poz-66228	4090±35	4.6	-18.7	9.2
YC – IV/8 Male – 35-50 (maturus)	Poz-66232	4090±35	9,0	-17.9	9.4
YC – IV/9 Male – 25-35 (adultus)	Poz-66233	4120±35	8,0	-18.1	8.2
Prydnistryanske 1 **users: CC 2700–2400 BC; EŻ = AD**					
CC – I/4 skeleton W = 2 [BPS 20: 192=1] Male – 35-50 years	Poz-66219	4070±35	13.6	-18.3	8.4
CC- I/4 skeleton E – 1 [BPS 20: 192=2] Female – 15 years	Poz-66220 Poz-66732	3940±40 3940±35	11.0	-18.2	10.9

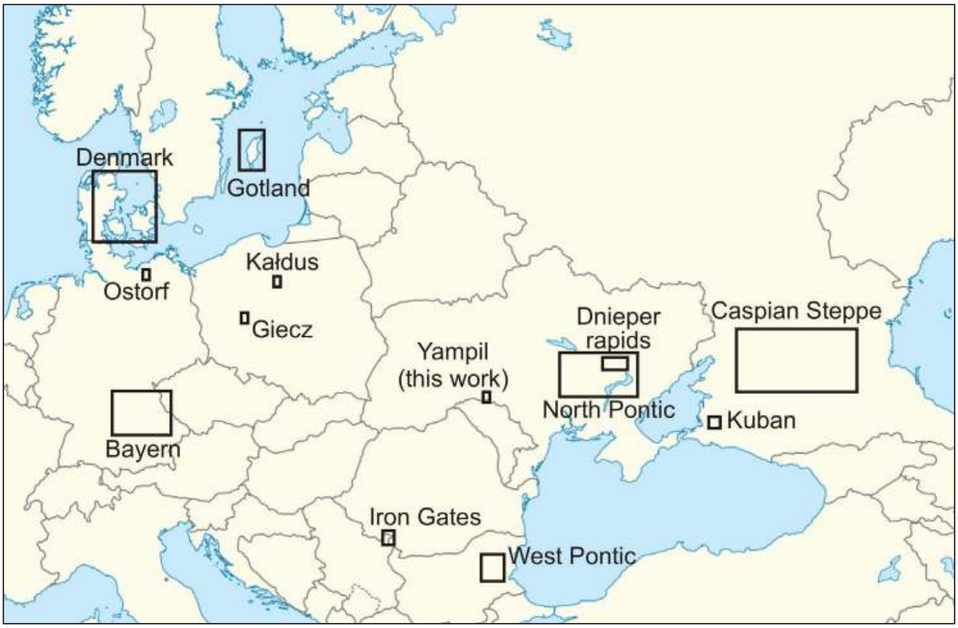
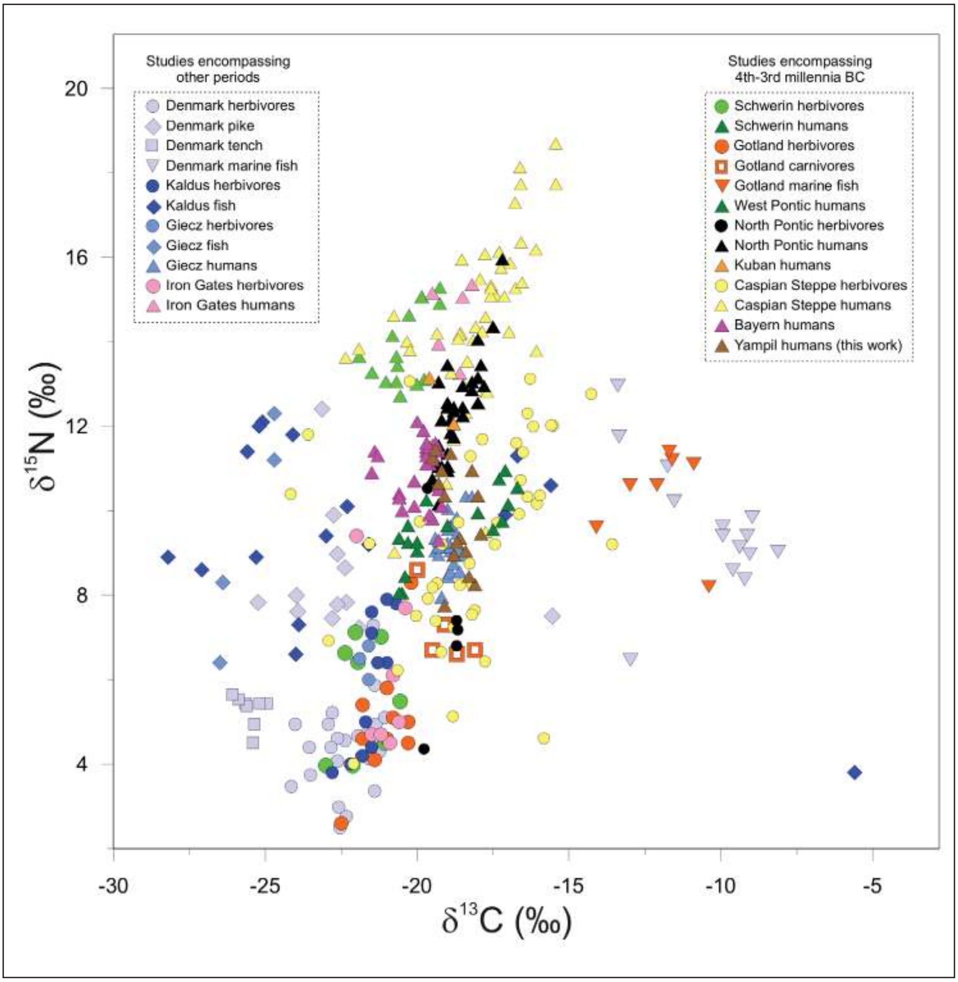


Fig. 1. Regions of origin of individuals whose isotopic composition of carbon and nitrogen is discussed in the text

3. INTERPRETATION OF RESULTS

The interpretation of the isotopic composition of carbon and nitrogen in human bones could concentrate on the general determination of the share of foodstuffs of aquatic origin in the diet of the deceased individuals, the aspect of diet differentiation depending on sex and age, the role of diet in the development of ritual centres (builders→users), and diet changes in time. In most of these aspects, a serious hindrance to interpretation is the unavailability of comparative material, if only herbivorous animal bones from the region and period under investigation.

How important it is to study suitable comparative material is shown in Fig. 2, giving the isotopic composition of human and animal bones. The data come from European regions lying to the west, east and south of the Yampil Region (Fig. 1). What can be clearly seen in Fig. 2 is the geographical differentiation of the $\delta^{15}N$ values of herbivores, with the lowest values (2-7‰) occurring in Denmark and the highest (4-13‰) on the Caspian Steppes. In between lie the values of $\delta^{15}N$ from Gotland (2-8‰), Schwerin (4-7‰), Kałdus (4-8‰), Giecz (6-7‰), Iron Gates (5-10‰) and the Northern Pontic Area (4-10‰). The mean value of $\delta^{15}N$ tends to grow, moving from the west to the east. If there is any relationship between $\delta^{15}N$ and the amount of precipitation (decreasing as one moves from the areas of mari-



F i g . 2 . Composition of stable carbon and nitrogen isotopes in bone collagen from the Yampil Barrow Complex against the background of bone analysis results from selected regions of Europe (Fig. 1). Data from various regions and source publications are colour coded: Denmark – Mesolithic/Eneolithic [Fischer *et al.* 2007], Kałdus – 1200-1300 AD [Reitsema *et al.* 2013], Giecz – 1000--1200 AD [Reitsema *et al.* 2010], Iron Gates – 6200-5500 BC [Cook *et al.* 2001], Schwerin/Ostorf – 3800-2800 BC [Olsen *et al.* 2010], Gotland – 2900-2600 BC [Eriksson 2004], West Pontic, North Pontic, Kuban – ca. 4000-2000 BC [Gerling 2015], Caspian Steppes – 4300-2000 BC [Shishlina *et al.* 2009; 2014], Bayern – 2700-2400 BC [Sjögren *et al*. 2015]. Symbols distinguish data for the bones of terrestrial herbivores, carnivores, freshwater fish, sea fish, and humans. In the group of freshwater fish, tench is distinguished time to continental climate), similar to that exposed in the study of African organisms [Heaton *et al.* 1986; Schwarcz *et al.* 1999], cannot be said beyond doubt, but such a relationship cannot be ruled out either.

3.1. DIET SHARE OF FOODSTUFFS ORIGINATING FROM AN AQUATIC ENVIRONMENT

Fig. 2 illustrates differences between $\delta^{15}N$-$\delta^{13}C$ of terrestrial herbivores and freshwater fish (on the example of Denmark, Kałdus and Giecz), $\delta^{15}N$- $\delta^{13}C$ of terrestrial herbivores and sea fish (on the example of Denmark and Gotland) or, finally $\delta^{15}N$- $\delta^{13}C$ of herbivores, predators and humans (Schwerin, Gotland, Giecz, Iron Gates, Caspian Steppes). In the last-named aspect, the shift in the $\delta^{15}N$ range for humans from Giecz in respect of such a range for herbivores is consistent with the expected growth in the value of $\delta^{15}N$ along the foodstuff-consumer line. A similar interpretation may also be put on the herbivore-predator differences on Gotland. In turn, markedly higher (than $\delta^{15}N$ of herbivores) values of $\delta^{15}N$ in human bones from Schwerin and Iron Gates undoubtedly reflect a very significant share of fish in the diet of humans from those locations. A high share of fish in the diet was also concluded from the study of $\delta^{15}N$ in humans from the Caspian Steppes. As far as stable carbon isotopes are concerned, $\delta^{13}C$ in the bones of humans from Giecz (without a share of fish in the diet) differs from $\delta^{13}C$ of herbivores too much to permit an interpretation based solely on the foodstuff-consumer isotope shift. The result for the bones from Giecz shows rather that the staple food of local people included C4-type plants (in this case: millet).

When compared with the data from various regions of Europe (Fig. 2), the values of $\delta^{15}N$ for human bones from the YBC are only slightly higher than those for humans from Giecz (eating only foodstuffs of terrestrial origin), markedly lower than those for humans from Schwerin, Iron Gates and the Caspian Steppes, and comparable to those for herbivores from the last-mentioned region. Expecting the values of $\delta^{15}N$ for herbivores from the YBC to be intermediate between those for Giecz and the Caspian Steppes, a claim can be made that $\delta^{15}N$ values for humans buried in the YBC fit into the range expected for individuals eating exclusively (or almost exclusively) foodstuffs of terrestrial origin. This interpretation seems to be consistent with the conclusions from the study of $\delta^{15}N$ in human bones from Early Bronze sites in the Northern Pontic Area and Kuban' (Figs. 1, 2). In the study [Gerling 2015], the values of $\delta^{15}N$ in bones from western Pontic sites, covering a similar range as $\delta^{15}N$ in bones from the YBC, were interpreted as an indicator of a diet based on vegetable foodstuffs with a share of meat of terrestrial animals. Whereas the values of $\delta^{15}N$ in the bones of humans from the Northern Pontic Area and

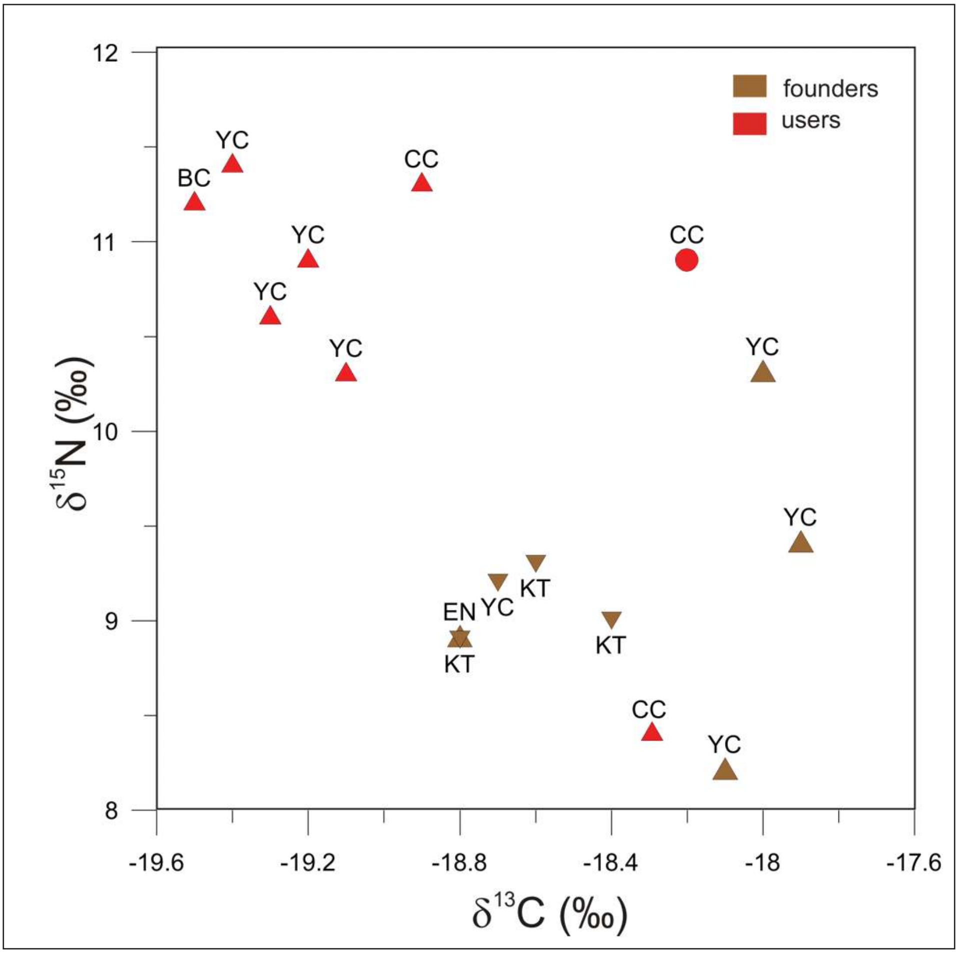


Fig. 3. Composition of stable carbon and nitrogen isotopes in bone collagen from the Yampil Barrow Complex. Isotope data for bones from the graves of builders and users of studied cultural centres are colour coded. Symbols represent data for males (△), females (O) and those whose sex could not be determined (▽). Abbreviations (TC, EN, YC, CC, BC) refer to the cultural attribution of particular graves

Kuban' (Fig. 2), which Gerling [2015] interpreted as an indicator of the significant share of freshwater fish in the diet, are markedly higher than $\delta^{15}N$ in bones from the YBC. The conclusion about the terrestrial character of the diet, showing that no reservoir effect influenced the ^{14}C dating of the bones, is consistent with an earlier suggestion [Goslar *et al.* 2015], following also from the clustering of ^{14}C dates in the plateau sections of the radiocarbon calibration curve. The same conclusion follows from comparing $\delta^{15}N$ values in human bones from the YBC and the bones of people living elsewhere in Europe approximately at the same time (Fig. 2).

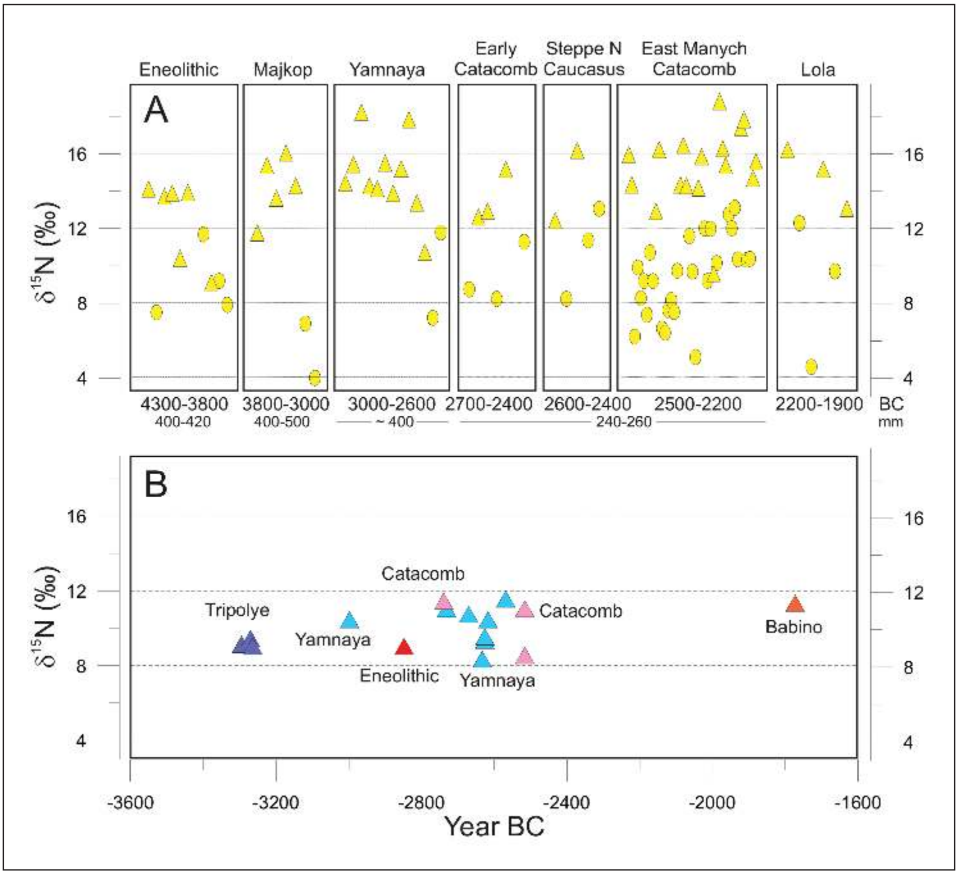


Fig. 4. A – $\delta^{15}N$ values in the bones of herbivores (O) and humans (△) of particular cultures from the 2nd and 3rd millennia BC on the Caspian Steppes [Shishlina *et al.* 2009; 2014]. Since the ^{14}C ages of all individual burials are not known, the points in the drawing are marked along the horizontal axis at random and only grouped in separate boxes, corresponding to particular cultures. The lifetimes of particular cultures and average precipitation totals in these periods are given *after* Shishlina *et al.* 2009; 2014. B – $\delta^{15}N$ values in the bones of people from the Yampil Barrow Complex

The high (> -20‰) values of $\delta^{13}C$ for human bones from the YBC, as for those from Giecz, suggest a share of C4-type plants (most likely millet) in food. Evidence for the cultivation of millet and other cereals in the Northern Pontic Area as early as the Eneolithic includes grain impressions on pottery [Motuzaite-Matuzeviciute *et al.* 2009]. Furthermore, the chief crops on the steppes in the Bronze Age were wheat varieties: emmer, einkorn, bread wheat, as well as rye and millet [Pashkevich 2003]. The isotope studies of human bones from Northern Pontic Early Bronze sites show a relationship between $\delta^{13}C$ and latitude [Gerling 2015] and a positive correlation between the values of $\delta^{13}C$ and $\delta^{15}N$. According to the cited author, this is a result of the fact that the share of C4-type plants falls in higher latitudes. Gerling [2015], however, does not specify which C4-type plants were supposedly part of the diet of the populations she studied.

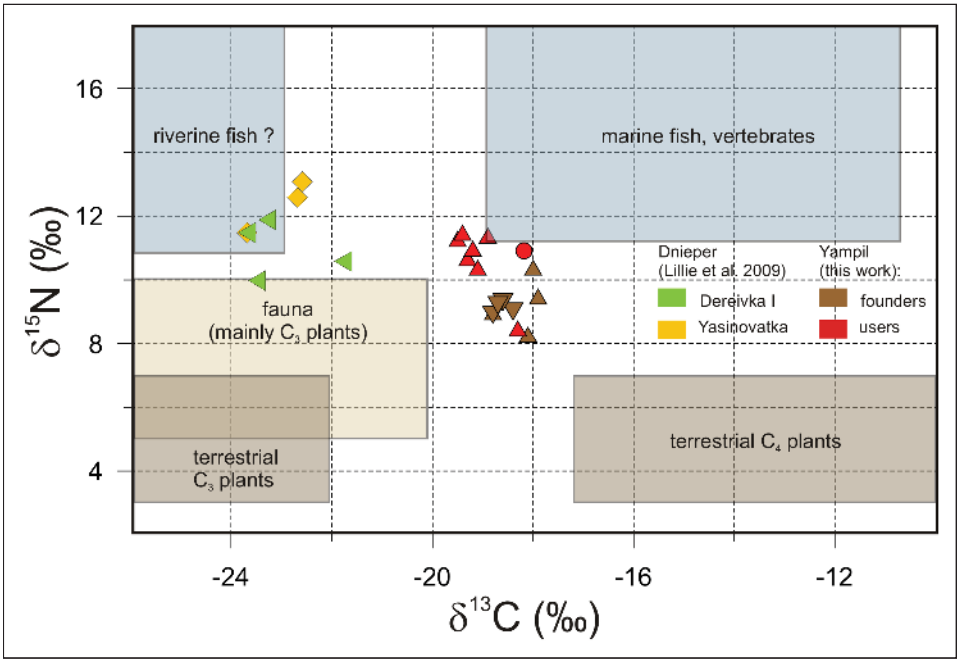
The current state of exploration of millet cultivation on the Middle Dniester is discussed in some detail in section 5. It must be stressed that the question of millet in the YC has not been studied in any greater detail [for a synthesis *see* Milisauskas, Kruk 2002]. This is particularly true for the YBC for which archaeobotanical data is generally scarce [Makohonienko, Hildebrand-Radke 2014].

3.2. DIFFERENCES IN THE DIET OF BUILDERS AND USERS, AND OF MEN AND WOMEN

A comparison of the isotopic composition of bones of the builders and users of investigated cultural centres (Fig. 3) shows the values of $\delta^{15}N$ to be regularly (by 1.5‰ on average) higher in the latter. This regularity could reflect a change in the eating customs of successive generations or, entirely independently of them, follow from climate changes in time. However, in the temporal perspective, no systematic $\delta^{15}N$ trends can be seen (Fig. 4). This may mean that higher $\delta^{15}N$ values for users (in relation to builders) reflect a rise in animal protein consumption, which took place in different centres at different times. Thus, the rise in animal protein consumption resulted rather from the economic stabilization of a particular centre than from regional developments triggered by climatic or cultural changes. Remembering that $\delta^{15}N$ of a consumer is on average 3.5‰ higher than that of a foodstuff, the fact that the value of $\delta^{15}N$ in users' bones is 1.5‰ higher than in builders' could be attributed to the inclusion of animal proteins in the diet up to about 40 per cent.

In the light of this regularity, as an exception – for a user – comes the value of $\delta^{15}N$ (=8.4‰) for a person (skeleton W-2) from grave I/4 of the CC, Prydnistryanske site, which is by 2-3‰ lower than $\delta^{15}N$ in the bones of other users and by 2.5‰ lower than $\delta^{15}N$ for the other person (skeleton E-1) buried in the same grave. Curiously enough, out of all 16 skeletons examined for the composition of carbon and nitrogen isotopes, only skeleton E-1 was positively identified as female. This would show that in this pair of individuals, the diets of an older man (died at the age of 35-50 years, skeleton W-2) and a young woman (died at the age of about 15 years, skeleton E-1) were completely different, while in the group of users, the eating habits of the man buried in grave I/4 were absolutely exceptional.

Among the 16 skeletons whose isotopic composition was determined, only one was identified as female, 11 as male and four (including three from TC graves) were left without sex identification. It needs to be emphasized, however, that if the



F i g . 5. Composition of stable carbon and nitrogen isotopes in bone collagen from the Yampil Barrow Complex against the ranges of isotopic composition expected for various diet components [*after* Gerling 2015: Fig. 6.16]. The meaning of colours and symbols concerning the Yampil Barrow Complex is the same as in Fig. 3. For the sake of comparison, the isotopic composition in human bones from two sites on the Dnieper (ca. 5200-5000 BC) is given, in which the share of freshwater fish in the diet was confirmed by the measurements of the reservoir effect [Lillie *et al.* 2009]

sex of these four individuals is identified, it will not alter the finding that the values of $\delta^{15}N$ in the bones of users are generally higher than in those of builders.

In the studied skeletons, a negative correlation is observed between the values of $\delta^{15}N$ and $\delta^{13}C$ (Fig. 3). The correlation coefficient ($r = -0.575$), significant at $p = 0.02$, makes one believe that the correlation is not merely accidental. The relationship between the isotopic composition of carbon and nitrogen may be related to the share of millet in the diet mentioned already earlier. The consumption of millet, whose $\delta^{13}C$ (between -14‰ and -9‰) is much higher than that of most other plants ($\delta^{13}C < -20$‰) may explain the generally high values of $\delta^{13}C$ in the bones of humans buried in the YBC. If, however, animals (whose meat and milk had an ever-greater share in the diet of users) did not feed on millet, the consumption of animal proteins by humans brought down the average value of $\delta^{13}C$ of the whole diet. In other words, a growth in the consumption of foodstuffs of animal origin entailed a lowering of the share of millet in the diet of humans. Interestingly enough, the correlation between the values of $\delta^{15}N$ and $\delta^{13}C$ was also observed in the assemblage of male skeletons from the medieval cemetery in Giecz [Reitsema *et al.* 2010]. Unlike in the YBC, however, in the medieval society of Giecz, a growth in $\delta^{15}N$ was accompanied by a growth in $\delta^{13}C$ (positive correlation), which was explained by the greater consumption of meat being accompanied by the greater consumption of blood sausage (*farcimina*), with grits made from millet, or alcohol produced by fermenting millet. In the light of the Giecz situation, the cause of the relationship between $\delta^{15}N$ and $\delta^{13}C$ in the YBC seems to be much simpler.

3.3. POSSIBLE SHARE OF FRESHWATER FISH IN THE DIET

An alternative cause of correlation between the values of $\delta^{15}N$ and $\delta^{13}C$, and differences between the isotopic composition in the bones of the builders and users of the YBC could be the inclusion of freshwater fish in the diet, with their share being higher in the diet of users. The share of fish in the diet seems to be attested by the comparison of the absolute values of $\delta^{15}N$ and $\delta^{13}C$ with the ranges expected of various diet components (Fig. 5). It follows from Fig. 5 that fish could represent as much as 20-30 per cent of the diet of YBC builders, with the share going up by another 20-30 percent in the diet of users. It must be noted, however, that the values of $\delta^{15}N$ for terrestrial plants and herbivores in some regions and periods may be higher than shown in Fig. 5. By the way, Gerling [2015] herself, from whose publication the ranges of expected isotopic compositions were taken (Fig. 5), interpreted $\delta^{15}N$ values from the Western Pontic Area similar to Yampil ones as the reflection of a diet of terrestrial origin. Undoubtedly, any final settlement of the question of diet composition of individuals buried in the YBC would first require to determine the isotopic composition of plants or herbivores from the same period and region.

A considerable share of freshwater fish in the diet affects the ^{14}C age of consumer remains (in this case: human) with the reservoir effect. The distortions it causes depend on the reservoir effect in a given body of water (which differs from one water body to another) and the percentage share of foodstuffs of aquatic origin in the diet. To measure the impact of the reservoir effect, it is necessary to compare the results of ^{14}C dating of human remains with that of the remains of organisms that died at the same time and had fed on foodstuffs of terrestrial origin. Such a comparison is only very rarely possible. In East-Central Europe, such studies were made while investigating Eneolithic sites around the Iron Gates on the Danube [Cook *et al.* 2001] and Mesolithic, Neolithic and Eneolithic sites located close to the Dniester Rapids [Lillie *et al.* 2009]. These publications claim that the average reservoir age of people from the area of the Iron Gates is 425 ^{14}C years and the reservoir ages of people from two Eneolithic sites on the Dnieper (Dereivka and Yasinovatka) are 250 and 450 ^{14}C years, respectively. Judging by the value of $\delta^{15}N$ in human and animal bones, the share of freshwater fish in the diet of the Iron

Gates communities was estimated at 80 per cent. This indirectly allowed setting the reservoir age of Danube waters at ca. 550 ^{14}C years [Cook *et al.* 2001]. A more accurate determination of the reservoir age of waters (at ca. 750 ^{14}C years) was possible in the investigation of the Dnieper sites, owing to the radiocarbon dating of fish remains contemporaneous with human and herbivore remains [Lillie *et al.* 2009]. By comparing the reservoir age in water and human bones, the share of fish in the diet of people from Dereivka and Yasinovatka may be estimated at about 30 and 60 per cent, respectively. In this context, taking into account rather broad ranges of $\delta^{13}C$ and $\delta^{15}N$ values characteristic of various environments (Fig. 5), the stable isotopic assessment of fish share in the diet appears less certain and accurate. This is best seen in the investigation results of the Dereivka and Yasinovatka sites [Lillie *et al.* 2009], where, relying on $\delta^{13}C$ and $\delta^{15}N$ values (Fig. 5), the authors could only claim that the share of fish in the diet was significant (Dereivka) or dominant (Yasinovatka).

As far as we can tell, the radiocarbon reservoir effect in the waters of the Dniester (whence fish being a possible diet component of individuals buried in the YBC could come) has never been measured, but it can hardly be expected to be significantly lower than in the Danube or the Dnieper. For this reason, already a 20‰-share of fish in the diet of YBC populations would make ^{14}C dating results of human bones older by 100 years. Such an effect is contradicted by the difference in ^{14}C ages of the bones of a woman (Poz-66220 and Poz-66732, ca. 3940 BP) and a man (Poz-66219, ca. 4070 BP), identified in grave I/4, Prydnistryanske site, as a set of coherent funerary behaviour. The difference, being too large to be a probable effect of only a statistical dispersion of measurement results, could be explained by a considerable age difference between the two individuals at the time of death (the woman was much younger than the man) and the effect of carbon accumulation in the bones of the man over several decades prior to his death [Goslar *et al.* 2015: Fig. 4]. If, however, a significant element in the diet of YBC users were fish, of the two individuals buried in grave I/4, a greater (or the sole) consumer of fish would be the woman (her bones had a much higher value of $\delta^{15}N$). Allowing for the reservoir effect (about 100 years) in her radiocarbon age would prevent the dating results from being reconciled with the coherence of both burials. In addition, making the ^{14}C dates of a considerable number of examined individuals older by 100 years or more due to the reservoir effect would greatly weaken the effect of their clustering in the plateaux of the calibration curve [observed by Goslar *et al.* 2015]. To the insignificant share of fish (in relation to the share of milk and meat of terrestrial animals) in the diet of YBC users, a very small shift of $\delta^{13}C$ values with respect to those in the bones of builders seems to testify, whereas the inclusion of fish (whose $\delta^{13}C$ values are usually very low – Fig. 5) in the diet should considerably lower the value of $\delta^{13}C$ in a consumer's organism.

3.4. VARIATION OF NITROGEN ISOTOPIC COMPOSITION IN TIME

Keeping in mind the considerable interregional differentiation of nitrogen isotopic composition (probably having climate differences as its reason, Fig. 2) and the relationship between the value of $\delta^{15}N$ and precipitation total, found to exist in some regions, one may wonder whether the differences in $\delta^{15}N$ in the bones of people buried in the YBC over a period exceeding a millennium are not a result of general climate changes in the region in question.

Detailed information on climate changes in the Yampil Region in the period in question, unfortunately, is not known to the present authors. Data on precipitation total changes in the 3rd and 2nd millennia BC and a rich set of isotope examination results for this period were presented for the Caspian Steppes [Shishlina *et al.* 2009; 2014]. There, precipitation was the greatest in the lifetime of the Maikop culture (3800-3000 BC) only to fall gradually, making the climate increasingly drier. Annual precipitation totals in the period of 2700-2200 BC were lower by as much as 150 mm than in the time of the Maikop culture. These climate changes are in a way reflected in the nitrogen isotopic composition in the bones of herbivores, because the lowest values of $\delta^{15}N$ were recorded in the lifetime of the Maikop culture. It must be noted, however, that the set of isotope data in this case is very meagre (only two samples). Obviously, no clear reflection of climate changes in isotopic composition in human bones can be expected if only because far greater differences in $\delta^{15}N$ are in this case related to differences in the share of foodstuffs of aquatic origin in the diet.

The values of $\delta^{15}N$ in YBC bones (Fig. 4) seem to show a slight increase between 3300 and 2800-2400 BC, but if one takes into account considerable dispersion of $\delta^{15}N$ ca. 2600 BC, undoubtedly connected with changes in eating habits along the builders-users line, and the fact that all isotope data for 3300 BC concern builders, attributing this increase to the impact of climate appears to be risky.

4. ISOTOPIC PICTURE OF YBC POPULATION DIET: SUMMARY

The composition of stable carbon and nitrogen isotopes in the bones of 16 individuals buried in the YBC show that they ate foodstuffs of terrestrial origin, with the share of foodstuffs of aquatic origin being insignificant. Furthermore, the isotopic data show that in relation to the builders of particular centres, the diet of centre users was several dozen per cent richer in animal proteins and that eating habits changed in various centres at various times. The relatively high values of $\delta^{13}C$ and the negative correlation between the isotopic composition of carbon and nitrogen suggest that millet was a major component of vegetable food eaten by people in the region under discussion and the rise in the consumption of animal food entailed a drop in the share of millet in the diet. Chronologically speaking, the average values of $\delta^{15}N$ in the oldest studied period (ca. 3300 BC) appear to be slightly lower than in later periods, possibly due to climate changes or – which is far more probable – a change in the diet of examined individuals.

5. MILLET: A BRIEF ARCHAEOBOTANICAL CLASSIFICATION COMPLEMENTING ISOTOPIC IDENTIFICATION

As already mentioned, a plant eaten by YBC populations – having a strong impact on the local diet – could have been millet. To avoid any terminological confusion, it must be explained that under the popular name millet, a number of genera are understood, belonging to the family Poaceae (syn. Gramineae) [Madella *et al.* 2016]. Relevant for the discussion at hand are two species: (a) broomcorn millet, *Panicum miliaceum* L. and (b) foxtail millet, *Setaria italica* (L) P. Beauv. The first is a tetraploid plant (2n=36) and one of the earliest domesticated and most important cereals [Zohary *et al.* 2012: 69]. Its origin is not entirely clear, because ‘neither a wild ancestor nor the place of domestication is known’ [Lityńska-Zając, Wasylikowa 2005: 107]. One of the species that was until recently considered its wild progenitor is *P. miliaceum* subsp. *ruderale* (Kitag.) Tzvelev (syn. *P. ruderale* (Kitag.) Lysov). It grows, however, ‘in secondary habitats, which justifies a presumption that it is a mutant that has developed from cultivated millet’ [Lityńska-Zając, Wasylikowa 2005: 107; Zohary *et al.* 2012: 69]. More recent phylogenetic studies of tetraploid and diploid species from the genus *Panicum* show, to put it simply, the origin of *P. miliaceum* to be allotetraploid, with its maternal ancestor possibly being *P. capillare* (or its close relative) and the other genome being shared with *P. repens*. It is also suggested that further search for parent forms be continued in Asia [Hunt *et al.* 2014]. The oldest archaeological finds of broomcorn millet come from northern China, which may suggest the location where the species was domesticated. Most likely, it is from there that it migrated west as is shown by the successive finds of *Panicum miliceum* remains in Georgia (ca. 8000-7150 cal BP) and Moldova (ca. 7600-7400 cal BP) [Zohary *et al.* 2012: 70]. However, millet caryopses extracted from the Bronze Age cemetery in Xinjiang, China, having different genetic characteristics from early cultivated forms, shed a new light on the questions of domestication and migration routes of this species [Li *et al.* 2016].

Archaeobotanical finds of this species have only relatively recently been reviewed [Hunt *et al.* 2008; Conolly *et al.* 2008; Colledge, Conolly 2007 (Eds)]. As already mentioned, the oldest finds come from China and are dated to 7600-7610 cal BP and 8060-7750 cal BP. It was not recorded in the Balkans in the Early Eneolithic, while in the materials of the Linear Pottery culture, it was found at over a dozen sites [Conolly *et al.* 2008]. Some of these finds, in the light of ^{14}C AMS determinations, do not necessarily have to reflect the connection between the plant material and archaeological context [Motuzaite-Matuzeviciute *et al.* 2013]. Nevertheless – generally speaking – it can be assumed that broomcorn millet appeared in Europe in Eneolithic subfossil materials, but always in small amounts, indicating that it was not an important cereal at that time. Its importance markedly grew, beginning with the Late Bronze Age [Lityńska-Zając, Wasylikowa 2005; Hajnalová 2012; Stika, Heiss 2013; Moskal-del Hoyo *et al.* 2015].

The other species – foxtail millet (*Setaria italica*) – is a diploid plant (2n = 8) [Zohary *et al.* 2012: 71]. Its wild ancestor is green millet *Setaria viridis* (L.) P. Beauv., a species very similar to foxtail millet and producing with it fertile hybrids. *S. viridis* grows wild in Eurasia and northern Africa, often as a common weed of spring cereal and root crops [Zohary *et al.* 2012: 71; Lityńska-Zając, Wasylikowa 2005: 109; Lityńska-Zając 2005: 70, 71]. Most likely it was domesticated in China [Zohary *et al.* 2012: 71; Le Thierry d'Ennequin *et al.* 2000], but this 'could have happened anywhere within the entire range of *Setaria viridis*, possibly in several places independently of one another' [Lityńska-Zając, Wasylikowa 2005: 109]. The oldest archaeological finds of *Setaria italica* come from China. In Europe, burnt foxtail millet caryopses are recorded beginning from the Bronze Age [Zohary *et al.* 2012: 71, 72].

Foxtail millet (*Setaria italica*) has two varieties (or subspecies): convar. *moharia* (Alef.) Körn. with loose panicles and smaller caryopses and convar. *italica* (syn. convar. *maxima* (Alef.) Körn.) with compact panicles and land larger grains. The varieties differ in the relief of glumes. *Setaria italica*, similar to millet, has a short vegetation season, is resistant to drought and adapted to the climate of the temperate zone of Eurasia. To grow, it calls for similar cultivation as is required in the case of broomcorn millet [Lityńska-Zając, Wasylikowa 2005: 108, 109]. These properties allow farmers to grow both species together, i.e. broomcorn millet and foxtail millet, which is done for instance in Afghanistan [Sakamoto 1987]. Both species are grown together with other millet grasses, e.g. barnyard grass *Echinochloa* in China, sorghum in Africa and India, and pearl millet (*Pennisetum glaucum*) in Africa [Körber-Grohne 1988].

6. PICTURE OF DNIESTER NORTHERN PONTIC AREA COMMUNITY DIET, 4TH/3RD-2ND MILLENNIUM BC: COMPARISON OF ISOTOPIC, ARCHAEOBOTANIC AND ARCHEOZOOLOGICAL DATA

Among currently used identification methods of prehistoric eating habits, the study of stable carbon and nitrogen isotopes preserved in bones has a special place as it provides a synthesis on adaptation strategies: proportion of nutrition ecotypes (aquatic vs. terrestrial) and plant or animals species found in each. In the case under discussion, the strategy involved the domination of millet consumption combined with increasing consumption of herbivore meat (*see* section 1). The latter indication calls for a comparison of the isotope findings with (a) archaeobotanical and (b) archaeozoological evidence available until now for the Dniester area and the times when the YBC developed. Taxonomically, the above covered three stages:

(1) transition period between the Eneolithic and Bronze Age = TC Gordineşti group/YC prologue

(2) early, classic period of the Bronze Age = 'classic' YC, CC

(3) late period of the Bronze Age = BC, NC

From the north-western Pontic forest-steppe, a fragment of which the YBC is, we have only meagre evidence of the economic use of millet (*Panicum miliaceum*) already from the Atlantic Climatic Phase. This is when the oldest early-agrarian colonizers of the Boh-Dniester culture were settling the area (Sokolec phase III, Balkan trend = Starčevo-Körös/Cris) and especially the Linear Pottery culture (early phase, central European trend), i.e. the second half of the 7th and the 6th millennium BC [Pashkevich 2000: Tab. 2, 3; Pashkevich, Videiko 2006: 33]. A similar tendency seems to have prevailed during the 'Eneolithic prologue' – in the first half of the 5th millennium BC – which is shown by archaeobotanical records for period A ('pre-ploshchadka' one) of the TC. Then, millet was shown to represent 13 per cent of sources from Ukraine and 1 per cent of those from Moldova [Pashkevich, Videiko 2006: 74].

Communities settling the Pontic forest-steppe grew more interested in millet in the second half of the 5th millennium BC. This is true of both steppe Eneolithic cultures, corresponding to eastern Eurasian – 'nomadic' – civilization experience (Dereivka and Lower Mikhailovka I cultures), and – being a border case between the mentioned ones – the Tripolye culture of stage B ('ploshchadka' one). In the latter case, millet was found to represent 7 per cent of 'Tripolye' archaeobotanical sources from Ukraine and 19 per cent of those from Moldova [Pashkevich 2000:

410-411, Tab. 5; Pashkevich, Videiko 2006: 77][1]. Interestingly enough, concerning the archaeobotanical identifications of this cereal – taking into account the conventional range of central Europe – it was maintained that: 'particularly large amounts of millet were recorded in TC "ploshchadkas"' [Wiślański 1969: 194]. It is not known, however, if this was true for all the development stages of these structures, in particular those associated with TC stage CI. What catches the eye here is the difference between the incidence of millet remains in stage 'TC C' from Ukraine: 0% and Moldova: 21% [Pashkevich, Videiko 2006: 78].

The first mention of millet domination among cereals concerns the second half of the 4th millennium BC and the Lower Dnieper, 'early barrow', Usatovo group/culture – a steppe offshoot of the TC (stage CII). With regard to Usatovo and Mayaki, it was said that: 'on pottery, millet impressions clearly dominate. It is no accident either that on ritual objects, such as statuettes, on more than 100 occasions, if any plant impressions are recorded, these are exclusively millet impressions. The cultivation of millet must have laid the foundation of Usatovo agriculture, but this claim cannot be proven beyond doubt' [Patokova *et al.* 1989: 118; Patokova 1979; Videiko, Peterenko 2003; Klochko *et al.* 2003]. As a staple crop, millet was known in the Northern Pontic Area beginning from the 2nd millennium BC, for instance in the Timber Grave and Sabatinovka cultures [Pashkevich 2000: Tab. 6].

Broomcorn millet (*Panicum miliaceum*) is not very demanding in terms of edaphic conditions and grows well on various soils including poor ones. Exceptions include very dry sands and waterlogged soils [Dzieżyc 1967: 92-93]. The highest millet yields are obtained on virgin soil, humic soils if additionally fertilized, and on fertile *chernozem* soils [Strzelczyk 2003: 15]. Millet is a short-day, light- and warmth-loving plant, resistant to drought and shortages of soil water, with a short growing season of 60-90 days [Herse 1980]. It ripens unevenly in a field and because its grains easily fall, it needs to be reaped in a specific way. This could have been done by cutting the stalk under the ear, cutting the plant right above the ground or by pulling up entire plants [Strzelczyk 2003: 17]. This crop is hard to cultivate, because its rows need to be earthed up, as many as several times in one growing season, and it has to be weeded and thinned if it grows too dense. This manner of cultivation permits weeds, typical today of root crops communities, to spread across millet fields.

In the YBC area, on the hilltop of a loess plateau, *chernozem* soils, typical of a steppe landscape, dominate. When analyzed by pedological methods, barrow

[1] *See* the historical-ethnographic description of millet origin and growing area from the early 20th century by Moszyński [1967: 224-225]: 'The chief cultivation range of millet proper covers Japan, Korea and northern China, central and southern Asia as far as the Caucasus and countries lying on the Black Sea'. 'Millet is actually grown today or rather has been grown until recently in all Slavic countries, with the exception of the north-western frontier', 'judging by ancient sources, millet used to be one of the most important or the most important cereal across the vast expanses of Slavic countries'. Against this background, *see* also palaeobotanical 'topogenetic doubts' – as formulated by G.A. Pashkevich – concerning the assessment of millet reception by researchers studying the Northern Pontic Area [Pashkevich, Videiko 2006: 33].

mounds and original soils preserved underneath them suggest that a steppe landscape prevailed there when the barrows were being built. Steppe *chernozem* soils, by their nature associated with the continental climate, characterized by high insolation and relatively low climate humidity [Bednarek, Prusinkiewicz 1980], are fully consistent with millet habitat conditions. Furthermore, the habitat conditions are relatively consistent with the several-thousand-year-old nomadic traditions of Eurasian steppes, from northern China and central Asia, believed to be the places of origin of *Panicum miliaceum*, to the Hungarian Plain [Gyulai 2014, Hunt *et al.* 2008, Jones *et al.* 2016]. The transit location of Dniester steppes seems to point to the natural necessity of millet cultivation appearing in this region.

Harvested millet crop should be stored in spikelets as in this form it can last even up to 20 years [Lundstrom-Baudais, Bailly 1995: 190]. This spikelet durability could not only save people from famine in time of war and crop failure [Mueller-Bieniek 2012: 76], but also allow the crop to be transported over long distances. Whereas, a naked caryopsis decays soon, even in two days only. That is why, millet was roasted or thrashed in small portions immediately prior to consumption [Strzelczyk 2003: 18; Lityńska-Zając, Wasylikowa 2005: 106].

It seems, thus, right to believe that from the transition from the Pontic Eneolithic to the prologue of the Bronze Age, ca. 3300-2800 BC, millet was a permanent part of the economic-subsistence strategy on the Middle Dniester, of the oldest *Yampil barrow communities* – the TC Gordineşti group or early YC – which corresponds well with the isotope data. This hypothesis is supported by millet impressions recorded on YC pottery on the Lower Dnieper steppe [Kuzminova 1990: 261]. They dominate among the impressions of crop plants, albeit the source base is rather small. More evidence of millet presence is related to the CC horizon [Bunyatyan 2003: 274], while a major quantitative increase is recorded in the Late Bronze Age.

It remains an open question, however, how nomadic peoples procured grain. Possibly, broomcorn millet was permanently present in agriculture and, therefore, played a dominant (significant) role in the crop structure (?). Such situations were observed in some pastoral peoples on the Eurasian steppe [Zhang *et al.* 2017]. It cannot be ruled out, however, because of spikelet durability (*see* above), that it was procured in other ways: by exchange or trade with farmers [Spengler *et al.* 2014].

The continuous record of millet presence (*Panicum* and *Setaria*) – beginning with the second half of the 4th millennium BC – underscored the role of steppe communities in spreading the cultivation of these plants across Eurasia [Pashkevich 2003: 292]. In Sherratt's model [2003: 235], millet cultivation was part of a cultural behaviour characteristic of steppe peoples and had an impact on neighbouring areas.

The fact that evidence for 'Yampil' taxa comes only from funerary sources rules out practical – direct – documentation of plant remains such as caryopses or their impressions in available YBC archaeometric sources. For reasons of the poor production and meagre dispersion as an autogamous (self-pollinated) plant of very fine and difficult to identify pollen grains of broomcorn millet [Milecka *et al.* 2004: 263], as well as 'post-deposition distortions', we do not have any palynological data, either [Makohonienko, Hildebrandt-Radke 2014]. Perhaps, some positive results could be produced by analyzing phytoliths or starch grains. This has been done for various grass species of the millet group [Madella *et al.* 2016; Lu *et al.* 2009]. Taking the palaeopaedological and palaeoenvironmental perspective quoted earlier, one may assume that around Yampil, on the Middle Dniester, millet could have been grown on 'the substratum of typical *chernozem*, exhibiting characteristics found in the transition zone of the subboreal belt and having a temperate climate with marked continental characteristics and steppe vegetation' [Bednarek, Jankowski 2014: 279]. Specifically, it is expected that millet could have been cultivated on the Dniester – in areas that had been exploited earlier by TC communities[2].

From the *Yampil Barrow Complex*, 13 grave features are known in which 'animal deposits' were recorded in the course of excavations in 2010-2014 [Marciniak *et al.* 2017: Tab. 1]. All the deposits were found in the context of Eneolithic taxa: YC, CC, BC and NC. This list is complemented by the finds of animal bones, being remains of funeral feasts; it is not possible, however, to date them more or less accurately [Klochko *et al.* 2015; 2015a; 2015b; 2015c]. In terms of species, the deposits represent five wild animals (red deer – 4, fox – 1), three sheep/goats–goats, two instances of cattle and two of the horse. The domination of the former category in animal deposits can be explained by primarily ritual reasons. Interestingly enough, the image of a golden deer appears on a 'Usatovo' symbolic 'tombstone' or a stela from Usatovo, barrow I-3 [Patokova 1979: 46-49, Fig. 19: 7]. The meaning of the other deposits combines a ritual message (related to occasional life) with a pragmatic one: arguments in favour of the position of a given species in everyday life, including the diet. The high position of sheep/goat on the list is borne out by the herding profile of 'early barrow' communities on the Lower Dniester and on the steppe recorded on Usatovo group/culture settlements [Patokova *et al.* 1989: 119, Tab. 4]. On the eponymous site, in Usatovo, the position of sheep/goat was documented by 70.0% of bone fragments and 58.7% of individuals, against 20.2% of cattle bones and 22.2% of individuals, and 9.8% of horse bones and 19.1% of individuals. Similarly organized data for Mayaki are: sheep/goat: 78.4% of bones and 70.0% of individuals, cattle: 12.0% of bones and 16.6% of individuals and horse: 9.6% of bones and 13.4% of individuals. These quantitative data, in herds, when converted into meat production adjust the above percentages for Usatovo as follows: cattle: 49.1%, sheep/goat: 17.5%, horse: 33.4% and for Mayaki: cattle: 54.2%, sheep/goat: 25.8%, horse: 29.0%.

Bringing together both bodies of information on the nutritive use – by 'Usatovo' and *Yampil populations* – of millet, cattle, sheep/goat and horse does not allow us to redraw them as a dynamic picture of the diet before *ca*. 2800 BC

[2] For experience from later times *see* Wyczański [1969: 28].

(= stage 1) and after that time (= stages 2 and 3). The perspective of the 'Usatovo point of view' applies to the first of the named development stages: 'early barrow diet' (=Gordineşti group TC/prologue of YC). The data is insufficient to make the picture of stage 2 more specific: growth in meat consumption in relation to the consumption of processed millet. As far as 'Yampil' data is concerned, evidence for the consumption of horse meat (?) should be noted but only in archaeometric records relating to the 2nd millennium BC and the NC. This may be another argument for treating this period separately: as a hypothetical third stage.

7. AN ATTEMPT TO CONCRETIZE THE DIET PICTURE – SUBSISTENCE STRATEGY – OF DNIESTER COMMUNITIES IN THE 4TH/3RD-2ND MILLENNIUM BC

Millet caryopses were used in various ways. In Europe, they were usually eaten as groats (millet groats), but Columella and Pliny write that [quoted after Körber-Grohne 1988] in the past both millet groats and millet bread were eaten. 'In Asia, besides groats, broomcorn millet and foxtail millet flour are used to make a special dish with milk or fat, while gluten-rich varieties are used to bake bread' [Lityńska-Zając, Wasylikowa 2005: 106]. In addition, millet grains were fed to fowl and poultry, and used to make beer (*braga* in Romania, *bosa* in some Asian countries) and vodka [Hanelt 2001 (Ed.); Podbielkowski 1985: 298]. Various examples of millet (groats) dishes in Slavic countries are discussed by Maurizio [1926] and H. Lis and P. Lis [2009].

Foxtail millet caryopses are used to make primarily flour, groats and pancakes [Lityńska-Zając, Wasylikowa 2005: 109]. Grains and flour are easily digestible and as such, they are recommended to infants and the elderly. Grains are also fed to fowl and poultry. In Asia, foxtail millet is used to make beer and wine, while in China it is also used for medicinal purposes [Hanelt 2001 (Ed.)]. Various dishes and beverages made from broomcorn and foxtail millet caryopses in Eurasia are listed by Sakamoto [1987a]. Detailed ethnobotanical studies of the cultivation, crop processing and food preparation in the Iberian Peninsula were presented by Moreno-Larrazabal *et al.* [2015].

The geographical area under discussion can be related to historical and ethnographic data indicating the use of grits and groats in the diet. They had been known in the menus of European societies since the 'pre-agrarian' times. The isotope finding of millet domination in the diet of Middle Dniester *Yampil Barrow Complex*, complemented by bioarchaeological data from the upper steppe Dniester area (from the similarly 'early-barrow' Usatovo group/culture with strongly marked 'eastern' civilization influences), makes it reasonable to consider the possibility that already in the prologue of Late Eneolithic-Early Bronze barrow culture (3300-2800 BC) development there was a clear dividing line of millet groats use – or millet presence – that is, so-called *yagla* groats (*yagla, yagly* = millet in Old Slavic languages).

An 'attempt to concretize' may be based – preliminarily – on historical and ethnographic data, i.e. by referring to the everyday practices of Iron Age Northern Pontic 'nomadic' communities. In this context it should be observed that the oldest – potentially of great significance – record by Herodotus [1959], concerning the Scythians, does not bring any information of note that may further the discussion of staple diets on the part of Pontic prehistoric communities.

The first more detailed information on the diet of 'Pontic nomads' – 17th-century Crimean Tatars – we owe to Wilhelm Beauplan [1972]. He writes: 'their staple food is millet, and barley and buckwheat groats; their common beverage is *braha* made of cooked millet'. *Braha* is thicker than milk but does not intoxicate'. 'They eat mutton and goat meat: when they roast meat, they put a whole sheep on the spit' [Beauplan 1972: 130]. These observations apply also, as it seems, to the steppe between the estuaries of the Dniester and Danube, known as *Budzhak*: 'where rebels hide, who recognize neither the Khan nor the Turks (*see Orda Budziacka*) [Beauplan 1972: 92, 123].

In Feliks Berdau's 1865 'encyclopaedic' description of the decline stage of the Sarmatian culture, millet is referred to as a cereal plant 'differing greatly from all other cereals', 'it grows best on virgin soils after clearing a pine forest,' 'it is usually sowed in mid-May. The harvest is frequently unusually bountiful'. 'Millet grains thrashed in mill crushers to remove outer glumes produce so-called *yagly* or millet groats, which is very nourishing but less easily digestible' [Berdau 1865: 608].

* * *

The effects of the studies raised in this article set new – of major importance for the *Yampil Programme* – trends in the study of the culture-formation role of the YBC in relation to the settlement environments of the 4th/3rd and the first half of the 3rd millennium BC in the Baltic drainage basin, chiefly the 'Vistula-Oder' groups of the Corded Ware culture. The 'Yampil diet' record poses questions about the scale of its 'Corded' reception. The reception marker could be evidence for the share of millet in 'Corded diet'[3]. This is especially true for the CWC eastern segment – 'Central European Corded Ware culture', and within it, the Małopolska and Kujawy-Wielkopolska groups. In the areas occupied by these communities, in funerary assemblages from the first half of the 3rd millennium BC, YC or YC/CC components have already been identified in rituals and the topogenesis of object sources identified as exogenous [Włodarczak 2014; Kośko 2014; Kośko *et al.* 2017]. The determination of the isotopic composition of such selected exogenous objects should initiate conceptually an extensive study, taking advantage of the research vistas opened up by the *Yampil Programme* [Ivanova *et al.* 2015].

Translated by Piotr T. Żebrowski

[3] *See* a parallel trend of bioarchaeological, isotope and aDNA studies focusing on the bio-cultural borderland between the West and East on the taxonomic scale of the Corded Ware and Yamnaya cultures (diets, settlement mobility, social structure …), pursued as part of programmes developed in West-Central Europe: Sjögren *et al.* 2016;

REFERENCES

Ambrose S.H.
1993 Isotopic analysis of paleodiets: methodological aspects and interpretative considerations. In: M.K. Sandford (Ed.) *Investigations of Ancient Human Tissue,* 59-130. Philadelphia.

Ambrose S.H., DeNiro M.J.
1986 Reconstruction of African human diet using bone collagen carbon and nitrogen isotope rations. *Nature* 319: 321-324.

Bednarek R., Jankowski M.
2014 Charakterystyka gleboznawcza materiału budującego nasyp kurhanu 1 w Pidlisiwce. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 275-280. Poznań.

Bednarek R., Prusinkiewicz Z.
1980 *Geografia gleb.* Warszawa.

Beauplan W.
1972 *Eryka Lassoty i Wilhelma Beauplana opisy Ukrainy.* Warszawa.

Berdau F.
1865 Proso. In: *Encyklopedia Powszechna,* vol. 21, 608. Warszawa.

Bogaard A., Heaton T.H.E., Poulton P., Merbach I.
2007 The impact of manuring on nitrogen isotope rations in cereals: archaeological implications for reconstruction of diet and crop management practices. *Journal of Archaeological Science* 34: 335-343.

Bronk Ramsey C., Higham T., Bowles A., Hedges R.
2004 Improvements to the pretreatment of bone at Oxford. *Radiocarbon* 46: 155-163.

Bunyatyan K.P.
2003 Correlations between Agriculture and Pastoralism in the Northern Pontic Steppe Area during the Bronze Age. In: M. Levine, C. Renfrew, K. Boyle (Eds) *Prehistoric steppe adaptation and the horse,* 269-286. Cambridge.

Chyleński M., Juras A., Żurkiewicz D., Jankowski M., Włodarczak P.
2017 Preservation of ancient DNA in human bones from Bronze Age Ukraine. *Baltic-Pontic Studies* 22: 54-63.

Colledge, S., Conolly, J. (Eds)
2007 *The Origins and Spread of Domestic Plants in Southwest Asia and Europe*. Walnut Creek.

Conolly J., Colledge S., Shennan S.
2008 Founder effect, drift, and adaptive change in domestic crop use in early Neolithic Europe. *Journal of Archaeological Science* 35: 2797-2804.

Cook G.T., Bonsall C., Hedges R.E.M., Mc Sweeney K., Boronean V., Pettitt P.
2001 A freshwater diet-derived ^{14}C reservoir effect at the stone age sites in the Iron Gates gorge. *Radiocarbon* 43: 453-460.

DeNiro M.J., Epstein S.
1978 Influence of diet on the distribution of carbon isotopes in animals. *Geochimica et Cosmochimica Acta* 42: 495-506.

Drucker D., Bocherens H.
2004 Carbon and nitrogen isotopes as tracers of change in diet breadth during Middle and Upper Paleolithic in Europe. *International Journal of Osteoarchaeology* 14: 162-177.

Drucker D.G., Bridault A., Hobson K.A., Szuma E., Bocherens H.
2008 Can carbon-13 in large herbivores reflect the canopy effect in temperate and boreal ecosystems? Evidence from modern and ancient ungulates. *Paleogeography, Palaeoclimatology, Palaeoecology* 266: 69-82.

Dzieżyc J.
1967 *Podstawy rolnictwa.* Warszawa.

Eriksson G.
2004 Part-time farmers or hard-core sealers? Västerbjers studied by means of stable isotope analysis. *Journal of Anthropological Archaeology* 24: 135--162.

Farquhar G.C., O'Leary M.H., Berry J.A.
1982 On the relationship between carbon isotope discrimination and the intercellular carbon dioxide concentration in leaves. *Australian Journal of Plant Physiology,* 9: 121-137.

Fischer A., Olsen J., Richards M., Heinemeier J., Sveinbjörnsdöttir A.E., Bennike P.
2007 Coast-inland mobility and diet in the Danish Mesolithic and Neolithic: evi-

dence from stable isotope values of humans and dogs. *Journal of Archaeological Science* 34: 2125-2150.

Gerling C.
2015 *Prehistoric mobility and diet in the West Eurasian steppes 3500 to 300 BC.* Berlin.

Goslar T., Kośko A., Razumow S.
2014 Identyfikacja kulturowo-chronologiczna cmentarzysk „wczesnobrązowych" na stanowisku Pidlisiwka 1. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 305-312. Poznań.

Goslar T., Klochko V.I., Kośko A., Włodarczak P., Żurkiewicz D.
2015 Chronometry of Late Eneolithic and Early Bronze cultures in the middle Dniester area: investigations of the Yampil barrow complex. *Baltic-Pontic Studies* 20: 256-291.

Gyulai F.
2014 The history of broomcorn millet (*Panicum miliaceum* L.) in the Carpathian-Basin in the mirror of archaeobotanical remains from the Roman Age until the Late Medieval Age. Columella. *Journal of Agricultural and Environmental Sciences* 1: 39-47.

Hajnalová M.
2012 *Archeobotanika doby bronzovej na Slovensku. Stúdie ku klíme, prírodnému prostrediu, pol'nohospodárstvu a paleoekonómii. Univerzita Konstantína Filozofa v Nitre, Filozofivcká fakulta.* Nitra.

Hanelt P. (Ed.)
2001 *Mansfeld's encyclopedia of agricultural and horticultural crops. 1-6. Institute of Plant Genetics and Crop Plant Research.* Berlin.

Harat K., Potupczyk M., Razumov S.
2014 Charakterystyka źródeł archeologicznych pozyskanych w latach 1984-1993. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 45-204. Poznań.

Heaton T.H.E., Vogel J.C., von la Chevallerie G., Collet G.
1986 Climatic influence on the isotopic composition of bone nitrogen. *Nature* 322: 822-823.

Herodotus
1959 *Dzieje*. Tłumaczenie i opracowanie S. Hammera. Warszawa.

Herse J. (Ed.)
1980 *Szczegółowa uprawa roślin*. Warszawa.

Hunt H. V., Badakshi F., Romanova O., Howe C. J.; Jones M. K., Heslop-Harrison J. S.
2014 Reticulate evolution in Panicum (Poaceae): the origin of tetraploid broomcorn millet, P. miliaceum. *Journal of Experimental Botany,* 65 (12): 3165--3175.

Hunt H., Vander Linden M. Liu X., Motuzaite-Matuzeviciute G., Colledge S., Jones M.
2008 Millets across Eurasia: chronology and context of early records of the genera Panicum and Setaria from archaeological sites in the Old World. *Vegetation History and Archaeobotany* 17 (Suppl 1): 5-18.

Jones M., Hunt H., Kneale C., Lightfoot E., Lister D., Liu X., Motuzaite-Matuzeviciute G.
2016 Food globalisation in prehistory: The agrarian foundations of an interconnected continent. *Journal of the British Academy* 4: 73-87.

Katzenberg A.M.
2000 Stable isotope analysis: a tool for studying past diet, demography, and life history. In: Katzenberg A.M., Saunders S.R. (Eds) *Biological Anthropology of the Human Skeleton*. New York.

Klochko V.I. Kośko A., Razumow S.M., Włodarczak P., Żurkiewicz D.
2015 Eneolithic, Yamnaya, Catacomb and Babyno culture cemeteries, Pidlisivka, Barrow 1, Yampil Region, Vinnitsa Oblast: archaeometry, chronometry and taxonomy. *Baltic-Pontic Studies* 20: 40-77.
2015a Eneolithic, Yamnaya, and Noua culture cemeteries from the first half of the 3rd and the middle of the 2nd millennium BC, Porohy, site 3A, Yampil Region, Vinnitsa Oblast: archaeometric and chronometric description, ritual and taxonomic-topogenic identification. *Baltic-Pontic Studies* 20: 78-141.
2015b Eneolithic, Babyno and Noua culture cemeteries, Klembivka site 1, Yampil Region, Vinnitsa Oblast: archaeometry, taxonomy and topogenetics. *Baltic-Pontic Studies* 20: 142-182.

Klochko V.I. Kośko A., Razumow S.M., Potupczyk M.V., Włodarczak P., Żurkiewicz D.

2015c Tripolye (Gordinesti group), Yamnaya and Catacomb culture cemeteries, Prydnistryanske, site 1, Yampil Region, Vinnitsa Oblast: An archaeometric and chronometric description and a taxonomic and topogenetic discussion. *Baltic-Pontic Studies* 20: 183-255.

Klochko V.I. Kośko A., Szmyt M.

2003 A comparative chronology of the prehistory of the area between the Vistula and Dnieper: 4000-1000 BC. *Baltic-Pontic Studies* 12: 396-414.

Kośko A. (Ed.)

2015 *Podolia as a cultural contact area in the 4th/3rd-2nd millennium BC. Baltic-Pontic Studies* 20.

Kośko A., Potupczyk M.V., Razumov S.M. (Eds)

2014 *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6. Poznań.

Körber-Grohne U.

1988 *Nutzpflanzen in Deutschland. Kulturgeschichte und Biologie.* Stuttgart.

Kuzminova N.N.

1990 Paleoetnobotanicheskiy i palinologicheskiy analizy materialov iz kurganov nizhnego Podnestrovia. In: E.V. Yarovoi (Ed.) *Kurgany eneolita-epokhi bronzy Nizhnego Podniestrov'ya.* 259-265. Kishinev.

Le Thierry D' Ennequin M., Penaud O., Toupance B., Sarr A.

2000 Assessment of genetic relationships between Setaria italica and its wild relative S. viridis using AFLP markers. *Theoretical and Applied Genetics* 100: 1061-1066.

Li C., Dong Y., Liu M., Lu P., Li W., Wang Y., Cui X., Zhou H., Xu Z.,

2016 Ancient DNA analysis of Panicum miliaceum (broomcorn millet) from a Bronze Age cemetery in Xinjiang, China. *Vegetation History and Archaeobotany* 25: 469-477.

Lillie M., Budd C., Potekhina I., Hedges R.

2009 The radiocarbon reservoir effect: new evidence from the cemeteries of the middle and lower Dnieper basin, Ukraine. *Journal of Archaeological Science* 36: 256-264.

Lis H., Lis P.
2009 *Kuchnia Słowian. O żywności, potrawach i nie tylko...* Kraków.

Litvinova L., Łukasik S., Żurkiewicz D., Gwizdała M., Chyleński M., Malmström H., Jakobsson M., Juras A.
2015 Anthropological description of skeletal material from the Dniester Barrow-Cemetery Complex, Yampil Region, Vinnitsa Oblast (Ukraine). *Baltic-Pontic Studies* 20: 292-335.

Lityńska-Zając M.
2005 *Chwasty w uprawach roślinnych w pradziejach i wczesnym średniowieczu.* Kraków.

Lityńska-Zając M., Wasylikowa K.
2005 Przewodnik do badań archeobotanicznych. In: J.B. Faliński (Ed.) *Vademecum Geobotanicum.* Poznań.

Loader N.J., Young G.H.F., McCarroll D., Wilson R.J.S.
2013 Quantifying uncertainty in isotope dendroclimatology. *The Holocene* 23: 1221-1226.

Longin R.
1971 New method of collagen extraction for radiocarbon dating. *Nature* 230: 241-242.

Lu H., Zhang J., Liu K.-B., Wu N., Zhou K., Ye M., Zhang T., Zhang H., Yang X., Shen L., Xu D., Li Q.
2009 Earliest domestication of broomcorn millet (Panicum miliaceum) in East Asia extended to 10,000 years ago. *Proceedings of the National Academy of Sciences, USA* 106: 7367-7372. DOI:10.1073/pnas.0900158106.

Lundstrom-Baudais K., Bailly G.
1995 In cellar of a wine-maker during the 14th century: the archaeobotanical study of IlôtVignier, Besançon (France). In: H. Kroll, R. Pasternak (Eds) *Res archaeobotanicae, 9th Symposium IWGP,* 165-193. Kiel.

Madella M., Lancelotti C., García-Granero J.J.
2016 Millet microremains – an alternative approach to understand cultivation and use of critical crops in Prehistory. *Archaeological and Anthropological Sciences* 8 (1): 17-28. https://link.springer.com/journal/12520/8/1/page/1.

Makohonienko M., Hildebrand-Radke I.
2014 Kontekst przyrodniczy i perspektywy studiów paleośrodowiskowych stanowiska kultury jamowej w Pidlisiwce nad Dniestrem, zachodnia Ukraina. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej*

połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie 6, 247-274. Poznań.

Marciniak A., Yanish Y.Y., Zhuravlov O., Kośko A., Włodarczak P., Żurkiewicz D.
2017 Status of animals in funerary rituals of founders and users of ceremonial centres of the Yampil Barrow Cemetery Complex (4th/3rd-2nd millenium BC). A zooarchaeological perspective. Status of animals in YBC funerary rituals: Zooarchaeological analysis (4th/3rd-2nd mill. BC). *Baltic-Pontic Studies* 22: 191-225.

Maurizio A.
1926 *Pożywienie roślinne i rolnictwo w rozwoju dziejowym.* Warszawa.

McCarroll D., Loader N.J.
2004 Stable isotopes in tree-rings. *Quaternary Science Reviews* 23: 765-778.

Milecka K., Makohonienko M., Okuniewska-Nowaczyk I., Nalepka D.
2004 Cerealia (Secale cereale L. excluded) – *Cereals.* In: M. Ralska-Jasiewiczowa, M. Latałowa, K. Wasylikowa, K. Tobolski, E. Madejska, H.E. Jr. Wright, C. Turner (Eds) *Late Glacial and Holocene history of vegetation in Poland based on isopollen maps,* 263-271. Kraków.

Milisauskas S., Kruk J.
2002 Late Neolithic, Crises, Collapse, New Ideologies, and Economies, 3500/3000-2200/2000 BC. In: S. Milisauskas (Ed.) *European Prehistory. A Survey,* 249-270. New York.

Moreno-Larrazabal A., Teira-Brión A., Sopelana-Salcedo I., Arranz-Otaegui A., Zapata L.
2015 Ethnobotany of millet cultivation in the north of the Iberian Peninsula. *Vegetation History and Archaeobotany* 24: 541-554.

Moskal-del Hoyo M., Lityńska-Zając M., Korczyńska M., Cywa K., Kienlin T. L., Cappenberg K.
2015 Plants and environment: results of archaeobotanical research of the Bronze Age settlements in the Carpathian Foothills in Poland. *Journal of Archaeological Sciences* 53: 426-444.

Mueller-Bieniek A.
2012 *Rośliny w życiu codziennym mieszkańców średniowiecznego Krakowa.* Kraków.

Moszyński K.
1967 *Kultura ludowa Słowian, vol. I. Kultura materialna*. Warszawa.

Motuzaite-Matuzeviciute G., Hunt V.H., Jones M.K.
2009 Multiple sources for Neolithic European agriculture: Geographical origins of early domesticates in Moldova and Ukraine. In: P.M. Dolukhanov, G.R. Sarson, A.M. Shukurov (Eds) *The East European Plain on the eve of agriculture. BAR International Series* 1964, 45-51. Oxford.

Motuzaite-Matuzeviciute G., Staff R.A., Hunt H.V., Liu X., Jones M.K.
2013 The early chronology of broomcorn millet (Panicum miliaceum) in Europe. *Antiquity* 87: 1073-1085.

Olsen J., Heinemeier J., Lübke H., Lüth F., Terberger T.
2010 Dietary habits and freshwater reservoir effects in bones from a Neolithic ME Germany cemetery. *Radiocarbon* 53: 635-644.

Pashkievich G.A.
2000 Zemledelie v stepi i lasostepi vostochnoy Evropy v neolite – bronzovom veke (paleoetnobotanicheskie svidetelstva). *Stratum plus* 2: 404-418.
2003 Palaeoethnobotanical evidence of agriculture in the steppe and forest-steppe of east Europe in the late Neolithic and Bronze Age. In: Levine M., Renfrew C., Boyle K. (Eds) *Prehistoric steppe adaptation and the horse,* 287-298. Cambridge.

Pashkievich G.A., Videiko M.
2006 *Rilnitstvo plemen tripilskoy kultury.* Kyev.

Patokova E.F.
1979 *Usatovskoe poselenie i mogilniki.* Kyev.

Patokova E.F., Petrenko V.N., Polishchuk, Burdo N.B.
1989 *Pamyatniki tripolskoy kultury v Severo-Zapadnom Prichernomore.* Kyiv.

Piotrowska N., Goslar T.
2002 Preparation of bone samples in the Gliwice Radiocarbon Laboratory for AMS radiocarbon dating. *Isotopes in Environmental and Health Studies* 38: 1-9.

Podbielkowski Z.
1985 *Słownik roślin użytkowych.* Warszawa.

Pospieszny Ł., Bełka Z.
2015 Dieta i mobilność u schyłku starożytności. Szczątki ludzkie z cmentarzyska w Karczynie/Witowach stan 21/22 w świetle badań izotopowych. In: Bednarczyk J., Romańska A. (Eds) *Karczyn/Witowy stan.* 21/22. *Birytualne cmentarzysko kultury przeworskiej z Kujaw. Studia i Materiały do Dziejów Kujaw* 12, 197-218. Poznań-Inowrocław.

Reitsema L.J., Crews D.E., Polcyn M.
2010 Preliminary evidence for medieval Polish diet from carbon and nitrogen stable isotopes. *Journal of Archaeological Science* 37: 1413-1423.

Reitsema L.J., Kozłowski T., Makowiecki D.
2013 Human-environment interactions in medieval Poland: a perspective form the analysis of faunal stable isotope ratios. *Journal of Archaeological Science* 40: 3636-3646.

Richards M.P., Hedges R.E.M.
1999 Stable isotope evidence for similarities in the types of marine foods used by Late Mesolithic humans at sites along the Atlantic coast of Europe. *Journal of Archaeological Science* 26 (6): 717-722.

Sakamoto S.
1987 Origin and phylogenetic differentiation of cereals in southwest Eurasia. In: Y. Tani, S. Sakamoto (Eds) *Domesticated plants and animals of the southwest Eurasian agro-pastoral culture complex. I. Cereals.* 1-45. Kyoto.
1987a Origin and Dispersal of Common Millet and Foxtail Millet. *Japan Agricultural Research Quarterly* 21 (2): 84-89.

Sherratt A.
2003 The horse and the wheel: the dialectics of change in the Circum-Pontic Region and adjacent areas, 4500-1500 BC. In: M. Levine, C. Renfrew, K. Boyle (Eds) *Prehistoric steppe adaptation and the horse,* 233-252. Cambridge.

Shishlina N., Sevastyanov V., Zazovskaya E., van der Plicht J.
2014 Reservoir effect of archaeological samples from steppe bronze age cultures in southern Russia. *Radiocarbon* 56: 767-778.

Shishlina N., Zazovskaya E., van der Plicht J., Hedges R.E.M., Sevastyanov V.S.
2009 Paleoecology, subsistence and ^{14}C chronology of the Eurasian Caspian steppe Bronze age. *Radiocarbon* 51: 481-499.

Schoeninger M.J., DeNiro M.J.
1984 Nitrogen and carbon isotopic composition of bone collagen from marine and terrestrial animals. *Geochimica et Cosmochimica Acta* 48 (4): 625-639.

Schwarcz H.P., Dupras T.L., Fairgrieve S.I.
1999 ^{15}N enrichment in the Sahara: in search of a global relationship. *Journal of Archaeological Science* 26: 629-636.

Sjögren K.G., Price T.D., Kristiansen K.
2015 Diet and mobility in the Corded Ware in Central Europe. *PLOS One* 11.

Spengler R.N., Cerasetti B., Tengberg M., Cattani M., Rouse L. M.
2014 Agriculturalists and pastoralists: Bronze Age economy of the Murghab al-

luvial fan, southern Central Asia. *Vegetation History and Archaeobotany* 23 (6): 805-820. DOI 10.1007/s00334-014-0448-0.

Stika H.-P., Heiss A.G.
2013 Plant cultivation in the Bronze Age. In: Fokkens H., Harding, A. (Eds) *The Oxford Handbook of the European Bronze Age,* 348-369. Oxford.

Strzelczyk J.
2003 Proso zwyczajne (Panicum miliaceum L.) we wczesnym średniowieczu Wielkopolski. *Prace Zakładu Biogeografii i Paleoekologii UAM w Poznaniu* 2, 1-36. Poznań.

Wiślański T.
1969 *Podstawy gospodarcze plemion neolitycznych w Polsce północno-zachodniej.* Wrocław-Warszawa-Kraków.

Włodarczak P.
2014 Sekwencja czynności obrzędowych: problem korespondencji tradycji funeralnych kultury jamowej i kultury ceramiki sznurowej na Wyżynie Podolskiej. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 313-340. Poznań.

Wyczański A.
1969 *Wieś Polskiego Odrodzenia.* Warszawa.

Van der Merwe N.J., Vogel J.C.
1978 ^{13}C content of human collagen as a measure of prehistoric diet in late woodland North America. *Nature* 276: 815-816.

Videiko M., Petrenko V.H.
2003 Radiocarbon Chronology of Complexes of the Eneolithic – Early Bronze Age in the Northern Pontic Region. A Preliminary Report. *Baltic-Pontic Studies 12*: 113-120.

Zhang J., Lu H., Jia P.W., Flad R., Wu N., Betts A.
2017 Cultivation strategies at the ancient Luanzagangzi settlement on the easternmost Eurasian steppe during the late Bronze Age. *Vegetation History and Archaeobotany* 26: 505-512.

Zohary D., Hopf M., Weiss E.
2012 *Domestication of plants in the Old World,* 4rd ed. Oxford.

Baltic-Pontic Studies
vol. 22: 2017, 126-165
ISSN 1231-0344
DOI 10.1515/bps-2017-0024

Tomasz Stępnik[*], Marzena Szmyt[**], Danuta Żurkiewicz[***]

USE OF WOOD IN YAMPIL BARROW COMPLEX FUNERARY RITUALS IV-II MILL. BC

ABSTRACT

This article presents the results of analyses of relics made out of wood that were discovered during the investigation of the *Yampil Barrow Complex* (Ukraine, Vinnitsa *Oblast*) in the period 2010-2015 in respect to the graves of Eneolithic communities, Yamnaya culture, Catacomb culture, Noua culture and the Iron Age. The research has documented a process of the selection of wood used in funerary rituals in the 4th to 2nd mill. BC and the choice of tree species present in stenothermal climax forests (*Quercus* sp., *Fraxinus* sp.).

Key words: kurgan cultures, Late Eneolithic, Early Bronze Age, Middle Dniester Area, wood, charcoal

This article aims to present the research results of wood relics unveiled during investigation of the *Yampil Barrow Complex* in 2010-2015 and advance arguments of interpretation in respect to three matters: (a) reference to hitherto knowledge on the creators and users of Dniester Region ritual centres in the IV-II millennium BC, (b) the context of correspondingly chronological barrow complexes from the Pontic forest-steppe and steppe and (c) the broader context of Indo-European communities.

[*] UNI-ART Archaeological Laboratory, Św. Czesława 17a/24, 61-583 Poznań, Poland; stepnik.t@wp.pl

[**] Institute of Eastern Studies, Adam Mickiewicz University, Umultowska 89D, 61-614 Poznań, Poland; marzena@amu.edu.pl

[***] Department of Prehistory of Central and Eastern Europe, Institute of Archaeology, Adam Mickiewicz University, Umultowska 89D, 61-614 Poznań, Poland; danuta@amu.edu.pl

1. SOURCES, METHODS AND RESEARCH RESULTS

Some 89 samples of organic substance (wood, charcoal and others), were taken during exploration of barrows in the following: Klembivka, barrow 1 (2 samples), Pidlisivka, barrow 1 (8 samples), Porohy, barrow 3A (24 samples), Prydnistryanske, site 1, four barrows (barrow I – 13 samples, barrow II – 6 samples, barrow III – 1 sample, barrow IV – 35 samples). The samples were gained by manual extraction of carbon or wood fragment visible in the profile or in the layer. The loci of sample extraction are marked on Figs. 1-13.

Dr. Tomasz Stępnik identified the contents of the samples under study and the details of analysis can be seen in Tab. 1.

The main research method in respect to charcoal was the observation of fractures under a binocular magnifying glass in reflected light according to various magnifications. The main information usually was gained from the cross section, while for the purposes of the analysis of wood microscopic preparations were made for observation in passing light. So as to gain a reasonable picture various magnifications were made, depending on the sample, most often around 200 times. The preparations were made out of all three sections: transverse, contiguous and radial.

The state of preservation of organic material in the samples was differentiated, which saw proof in the research results. Thus identification of 66 samples was possible at the level of tree species. In the case of 10 samples only a description of their contents was possible in general terms of deciduous wood probably of diffuse-porous origin, while a further 12 samples contained material in a state that did not make identification possible – in one sample it should be noted an organic substance was found other than wood or bark.

In respect of chronology, the majority, as many as 57 samples, had their origin in objects relating to the peoples of the Yamnaya culture (YC), 16 in objects dated to the Late Eneolithic (including 10 qualified to the Gordineşti group of the Late Tripolye culture), 9 from objects dated to the Sarmatian period, 3 from objects of the Noua culture (NC) and 2 from objects of the Catacomb culture (CC). One sample has its origin in an object with chronology dated to modern times and another represents a phase predating the construction of the barrow at site Porohy 3A.

In terms of function these objects are respectively graves, containing 76 samples, hearth (6 samples), pits (3 samples), pit or hearth (1 sample), ritual pit (1 sample) and an excavation dated to modern times (1 sample). Here, one sample was taken under the barrow fill.

In summarising the data presented in Tab. 1 one should note the low level of taxonomic differentiation of the wood under analysis. After eliminating one of the samples, and unidentified organic material (Tab. 1, no. 39), it can be seen that among the remaining 88 samples studied there dominates oak, *Quercus* sp., which was found in 51 samples (58% of all) and noted in all seven barrows. In 15 samples

Table 1

Klembivka, Pidlisivka, Porohy and Prydnistryanske. List of samples and results of wood identification

Site	**Barrow**	**Feature**	**Function**	**Sample no.**	**Location in the feature**	**Content**	**Taxonomic identification**	**Chronology**	**Figure**
Klembivka	1	4	ritual pit	2	ceiling	charcoal (8 fragments)	oak *Quercus* sp.	Eneolithic	–
Klembivka	1	5	grave	43	inside the human skull	charcoal (2 fragments)	decidous	Eneolithic	–
Pidlisivka	1	1Aa	grave	1	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 1: 1-3
Pidlisivka	1	1B	grave	27	roofing	wood	oak *Quercus* sp.	Eneolithic	Fig. 2
Pidlisivka	1	1B	grave	28	roofing	wood	oak *Quercus* sp.	Eneolithic	Fig. 2
Pidlisivka	1	1B	grave	33	roofing	wood	oak *Quercus* sp.	Eneolithic	Fig. 2
Pidlisivka	1	1B	grave	34	roofing	wood	oak *Quercus* sp.	Eneolithic	Fig. 2
Pidlisivka	1	2	trench	2	ceiling	wood	decidous	modern times	–
Pidlisivka	1	4	grave	3	E wall	wood	decidous	Catacomb c.?	–
Pidlisivka	1	11	grave	46	ceiling	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 1: 4
Porohy	3A	1	grave	2	W part	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 3
Porohy	3A	1	grave	9	roofing, NE part	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 3
Porohy	3A	1	grave	19	roofing, NE part	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 3
Porohy	3A	1	grave	20	roofing, E part	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 3
Porohy	3A	1	grave	22	roofing, E part	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 3
Porohy	3A	1	grave	24	N part of wall boarding	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 3

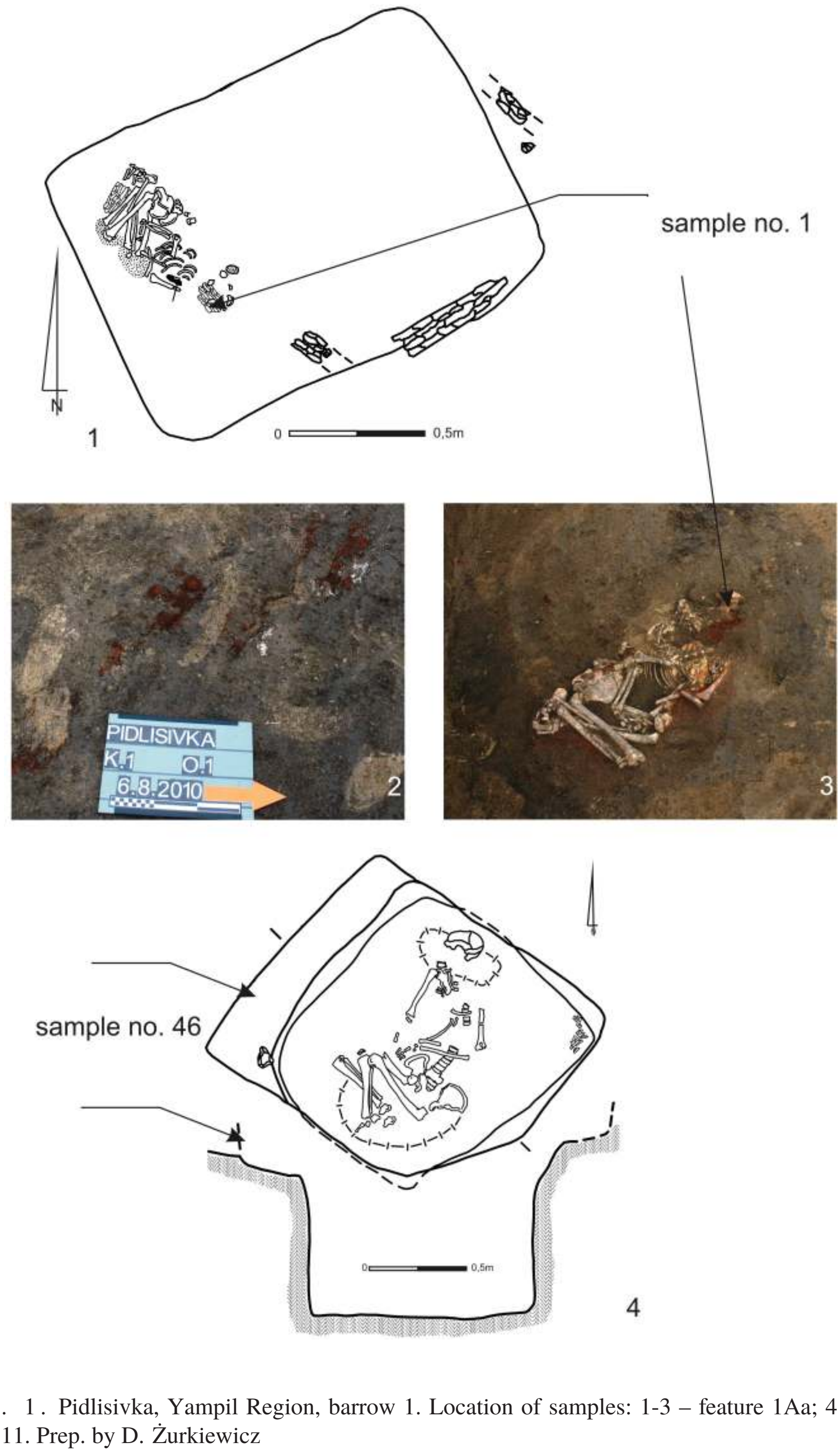
Site	Barrow	Feature	Function	Sample no.	Location in the feature	Content	Taxonomic identification	Chronology	Figure
Porohy	3A	1	grave	35	N part of wall boarding	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 3
Porohy	3A	3	grave	8	ceiling	wood	oak *Quercus* sp.	Noua c.	–
Porohy	3A	5	grave	5	W part of a ceiling	wood	oak *Quercus* sp.	Noua c.	Fig. 4: 1-2
Porohy	3A	7	grave	14	SE part	wood	undefined, de-structed	Noua c.	–
Porohy	3A	10	grave	28	roofing, NW part	wood	deciduous diffuse-porous	Yamnaya c.	Fig. 4: 3-5
Porohy	3A	11	grave	18	inside a grave pit	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 5: 1-2
Porohy	3A	11	grave	30	roofing, NE part	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 5: 1-2
Porohy	3A	12	grave	36	roofing, W part	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 5: 3-4
Porohy	3A	12	grave	37	roofing, W part	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 5: 3-4
Porohy	3A	15	grave	38	roofing, NE part	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 6: 1-3
Porohy	3A	15	grave	47	roofing, N part	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 6: 1-3
Porohy	3A	15	grave	55	roofing, S part	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 6: 1-3
Porohy	3A	16	pit or hearth	54	bottom	wood	undefined, destructed	Yamnaya c.?	–
Porohy	3A	20	grave	57	central part	wood	undefined, destructed	Yamnaya c.	Fig. 6: 4-7
Porohy	3A	20	grave	58	central part	wood	undefined, destructed	Yamnaya c.	Fig. 6: 4-7
Porohy	3A	20	grave	62	E part	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 6: 4-7

Site	Barrow	Feature	Function	Sample no.	Location in the feature	Content	Taxonomic identification	Chronology	Figure
Porohy	3A	20	grave	63	N part	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 6: 4-7
Porohy	3A	–	–	53	–	wood	oak *Quercus* sp.	before the Eneolithic mound	–
Prydnistryanske	I	1	pit	71	bottom	wood	deciduous, destructed	Tripolye c. – Gordineşti g.	Fig. 7: 1-4
Prydnistryanske	I	1	pit	72	bottom	wood	oak *Quercus* sp.	Tripolye c. – Gordineşti g.	Fig. 7: 1-4
Prydnistryanske	I	1	pit	73	bottom	wood	undefined destructed	Tripolye c. – Gordineşti g.	Fig. 7: 1-4
Prydnistryanske	I	2	grave?	5	roofing, SW part	wood	undefined, destructed	Sarmatian period	–
Prydnistryanske	I	2	grave?	74		unidentified organic material		Sarmatian period	–
Prydnistryanske	I	2	grave?	76	roofing, SE part	wood	oak *Quercus* sp.	Sarmatian period	–
Prydnistryanske	I	2	grave?	77	bottom, SW part	wood	undefined, destructed	Sarmatian period	–
Prydnistryanske	I	2	grave?	78	roofing, SE part	wood	oak *Quercus* sp.	Sarmatian period	–
Prydnistryanske	I	3	grave?	17/1	N part	wood	oak *Quercus* sp.	Sarmatian period	–
Prydnistryanske	I	3	grave?	17/2	N part	wood	oak *Quercus* sp.	Sarmatian period	–
Prydnistryanske	I	3	grave?	18/1	S part	wood	undefined, destructed	Sarmatian period	–
Prydnistryanske	I	3	grave?	18/2	S part	wood	undefined, destructed	Sarmatian period	–

Site	**Barrow**	**Feature**	**Function**	**Sample no.**	**Location in the feature**	**Content**	**Taxonomic identification**	**Chronology**	**Figure**
Prydnistryanske	I	4	grave	79	inside a stone mace	wood	deciduous diffuse-porous	Catacomb c.	Fig. 7: 5-8
Prydnistryanske	II	1	hearth	1		charcoal	deciduoud, destructed	Tripolye c. – Gordineşti g.	–
Prydnistryanske	II	1	hearth	2		charcoal	oak *Quercus* sp.	Tripolye c. – Gordineşti g.	–
Prydnistryanske	II	1	hearth	3		charcoal	oak *Quercus* sp.	Tripolye c. – Gordineşti g.	–
Prydnistryanske	II	1	hearth	4		charcoal	oak *Quercus* sp.	Tripolye c. – Gordineşti g.	–
Prydnistryanske	II	1	hearth	6		charcoal	deciduoud, destructed	Tripolye c. – Gordineşti g.	–
Prydnistryanske	II	1	hearth	49		charcoal	deciduoud, destructed	Tripolye c. – Gordineşti g.	–
Prydnistryanske	III	3	grave	7	central part	wood	deciduous diffuse-porous?), destructed	Tripolye c. – Gordineşti g.	Fig. 8
Prydnistryanske	IV	4	grave	19	SW part	wood	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	20	SW part	wood (4 fragments)	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	21	W part	wood	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	22/1	SW part	wood	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	22/2	SW part	wood	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	23	SW part	wood	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	25	SW part	wood	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10

Site	Barrow	Feature	Function	Sample no.	Location in the feature	Content	Taxonomic identification	Chronology	Figure
Prydnistryanske	IV	4	grave	26	S part	wood	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	27/1	central part	wood	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	27/2	central part	wood	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	28	central part	wood	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	29/1	central part	wood	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	29/2	central part	wood	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	30	E part	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	31	E part	wood	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	35	upper part	charcoal	undefined	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	4	grave	89	SE part	wood	ash *Fraxinus* sp.	Yamnaya c.	Fig. 9 – 10
Prydnistryanske	IV	6	grave	50	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 11
Prydnistryanske	IV	6	grave	53	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 11
Prydnistryanske	IV	6	grave	54	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 11
Prydnistryanske	IV	6	grave	55/1	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 11
Prydnistryanske	IV	6	grave	55/2	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 11
Prydnistryanske	IV	6	grave	55/3	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 11

Site	Barrow	Feature	Function	Sample no.	Location in the feature	Content	Taxonomic identification	Chronology	Figure
Prydnistryanske	IV	6	grave	56	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 11
Prydnistryanske	IV	8	grave	51	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 12
Prydnistryanske	IV	8	grave	52	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 12
Prydnistryanske	IV	8	grave	57	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 12
Prydnistryanske	IV	8	grave	58	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 12
Prydnistryanske	IV	8	grave	59	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 12
Prydnistryanske	IV	8	grave	64	roofing	wood	undefined, destructed	Yamnaya c.	Fig. 12
Prydnistryanske	IV	8	grave	94	under a human skull	wood	undefined, destructed	Yamnaya c.	Fig. 12
Prydnistryanske	IV	8	grave	96	on a human skull	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 12
Prydnistryanske	IV	9	grave	66	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 13
Prydnistryanske	IV	9	grave	67	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 13
Prydnistryanske	IV	9	grave	69	roofing	wood	oak *Quercus* sp.	Yamnaya c.	Fig. 13



F i g . 1 . Pidlisivka, Yampil Region, barrow 1. Location of samples: 1-3 – feature 1Aa; 4 – feature 11. Prep. by D. Żurkiewicz

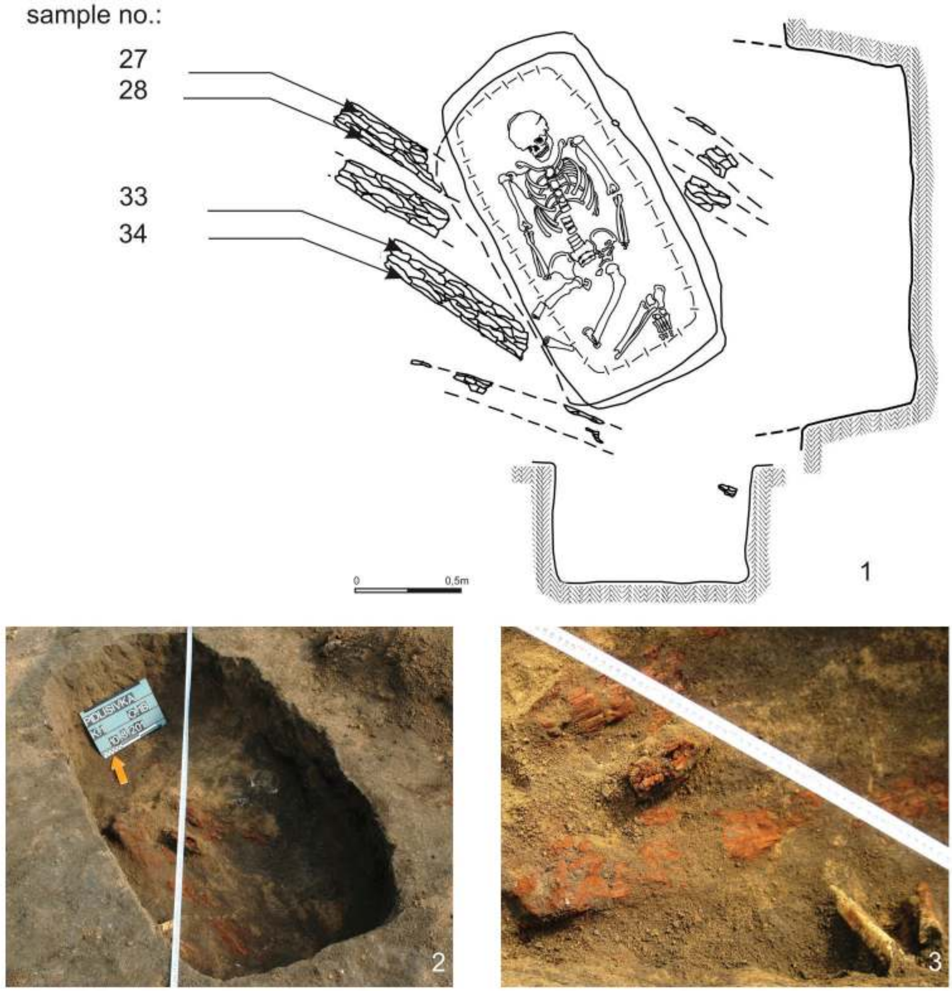


Fig. 2. Pidlisivka, Yampil Region, barrow 1/feature 1B. Location of samples. Prep. by D. Żurkiewicz

(17%) ash wood was identified, *Fraxinus* sp. – though this species occurred only in one barrow and one object, Prydnistryanske barrow IV/feature 4. In a further 10 samples (11%) deciduous wood was identified (diffuse-porous) and – as mentioned above – the identification of the contents of 12 samples was not possible on account of the high level of destruction of their material.

2. INTERPRETATION OF WOOD RELICS IN FEATURES DATED TO THE IV-II MILL. BC

The basis for the interpretation of recorded data for objects dated to the IV-II millennium BC, is the formulation of an appropriate archaeological context of the samples under analysis. For this purpose data from taxonomic and archaeometric analysis is used as well as that of stratigraphic and planimetric, on the basis of sources in the professional literature.

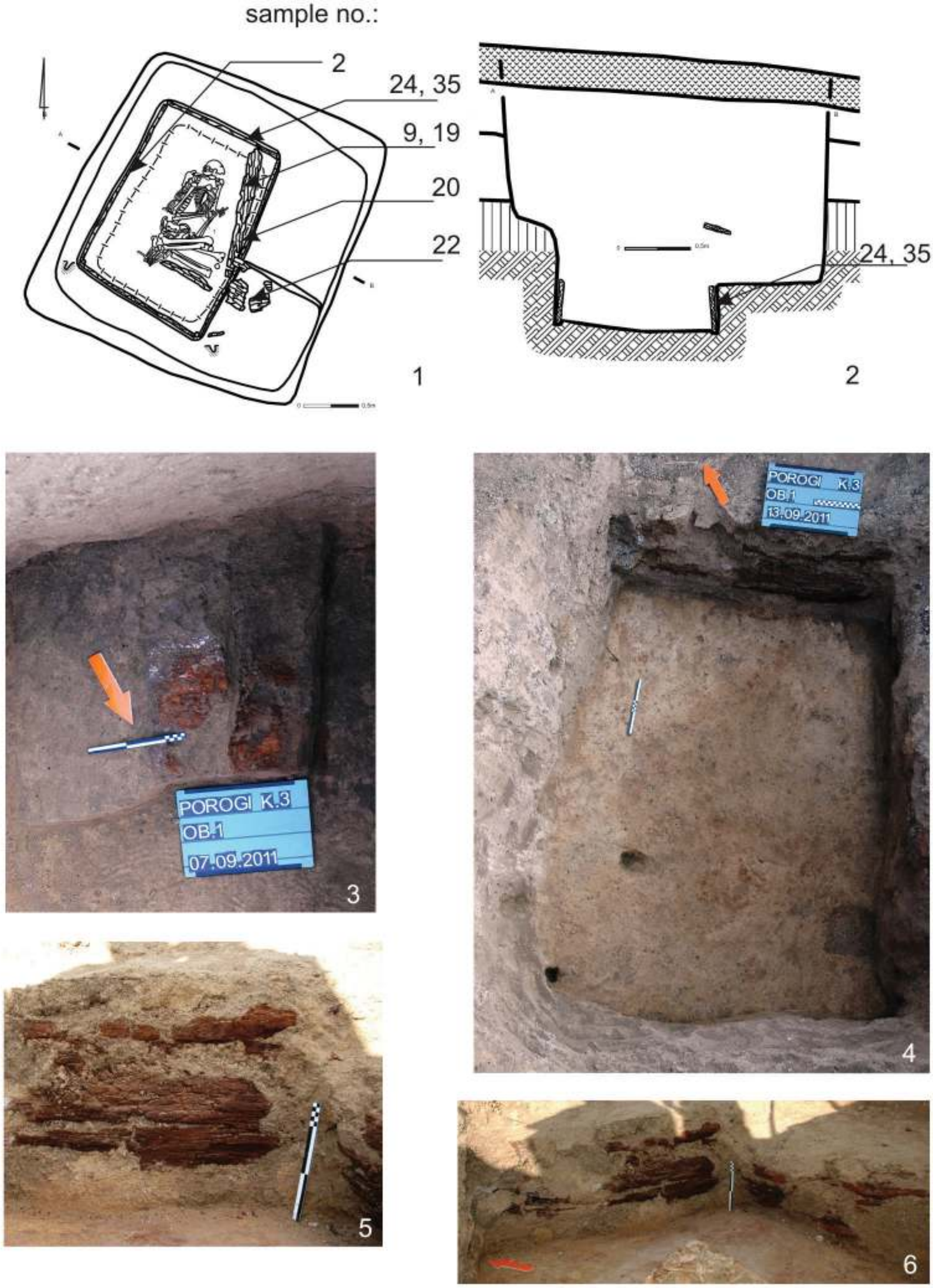
Klembivka barrow 1/feature 4 (further as Klembivka 1/4). A pit, probably ritual, dated to the Late Eneolithic [Klochko *et al*. 2015c: 153-154]. Oak charcoals (sample no. 2) seem to be relics of probable human ritual activity as a result of using fire before the deposition of parts of roe deer into the pit.

Klembivka barrow 1/feature 5. A grave formed by the Late Eneolithic community. Human bone from the grave dated by ^{14}C to 4225±35 BP (Poz-70670) [Goslar *et al*. 2015, Tab. 4; Klochko *et al*. 2015c: 154-155 and Fig. 12]). Charcoals from deciduous wood (sample no. 43) that have been recorded inside the human skull could be a natural and random admixture in the soil that filled the grave pit.

Pidlisivka barrow 1/feature 1A (Fig. 1: 1-3). Probably a central grave of the second (younger) mound built by the Yamnaya culture community [Kośko, Razumow, Żurkiewicz 2014: 214-219; Klochko *et al*. 2015a: 47-49]. Two stratigraphically differentiated human burials have been deposited in two phases: first the lower, no. 1A (male of 30-40 years) and then upper, no. 1Aa (child aged 7-8 years). There are six ^{14}C datings for the grave [*see* discussion in Goslar, Kośko, Razumow 2014: 305-309; Goslar *et al*. 2015: 257-259]. Three such were made for the older burial 1A: 3720±60 BP (Kiev-16673, human bone), 3895±70 BP (Kiev-16892, human bone), 4082±35 BP (Poz-52424, wood). The next three datings refer to the younger burial no. 1Aa: 4195±35 BP (Poz-38529, human bone), 4080±40 BP (Poz-39214, human bone), 4190±35 BP (Poz-52423, wood). The oak wood (sample no. 1) contained part of a plank from the roofing of the younger grave 1Aa.

Pidlisivka barrow 1/feature 1B (Fig. 2). Probably a central grave of the first (older) mound built most likely by the Late Eneolithic circle [Klochko *et al*. 2015a: 49-51].[1] Human bone from the grave gave a ^{14}C dating of 3680±90 BP (Kiev-16674) [*see* discussion in Goslar, Kośko, Razumow 2014: 305-309; Goslar *et al*. 2015: 257-259]. Four oak wood samples were taken from the remains of two planks from the grave roofing: nos. 27 and 28 from the central plank, nos. 33 and 34 from the south-western plank. The planks were placed at an angle or along the longer axis of the grave.

[1] For an earlier interpretation linking the grave with the YC community *see*: Kośko, Razumow, Żurkiewicz 2014: 219-222.



F i g . 3 . Porohy, Yampil Region, barrow 3A/feature 1. Location of samples. Prep. by D. Żurkiewicz

Pidlisivka barrow 1/feature 4. A human grave that can be dated probably to the CC [Klochko *et al*. 2015a: 52-53].[2] There is a ^{14}C dating of human bone of 3810±80 BP (Kiev-16675). Deciduous wood (sample no. 3) has been taken form a plank recorded at the eastern wall of the grave pit. This might have been the remains of grave roofing.[3]

Pidlisivka barrow 1/feature 11 (Fig. 1: 4). A human grave dated to the YC [Kośko, Razumow, Żurkiewicz 2014: 232-234; Klochko *et al*. 2015a: 62-64]. There are two radiocarbon datings of human bones: 3690±80 BP (Kiev-16676), and 4085±30 BP (Poz-81793) [Goslar *et al*. 2015, Tab. 1]. Wood of oak (sample no. 46) has been recorded in the ceiling part of the grave pit. Most probably this is the remainder of the wooden grave cover located on the step, 0.70 m above the bottom of the pit. Roofing elements were laid transversely in relation to the grave axis.

Porohy barrow 3A/feature 1 (Fig. 3). A human grave of the YC [Klochko *et al*. 2015b: 85-89]. Three ^{14}C datings of human bones were made: 3770±170 BP (Kiev-17384), 4430±70 BP (Kiev-17437), 3760±35 BP (Poz-70668) [Goslar *et al*. 2015: 270-274]. Seven samples have been recorded in various parts of the grave fill. Five such (nos. 2, 9, 19, 20, 22) contained oak wood planks used for the grave cover. Elements of the roofing were placed along the longer axis of the grave. Two samples (nos. 24, 35), also of oak wood, came from the boarding of the north wall.

Porohy barrow 3A/feature 3. A human grave belonged to the NC [Klochko *et al*. 2015b: 94-95]. Oak wood (sample no. 8) has been recorded in the ceiling part of the grave pit and came from the grave cover. Elements of roofing were placed transversely in relation to the longer axis of the grave.

Porohy barrow 3A/feature 5 (Fig. 4: 1-2). A human grave that belonged to the NC [Klochko *et al*. 2015b: 95-96]. There is a ^{14}C dating of human bones: 3200±90 BP (Kiev-17440). A sample (no. 5) came from the western part of the pit and contained a fragment of an oak plank from a grave cover. Elements of roofing were placed along the longer axis of the grave.

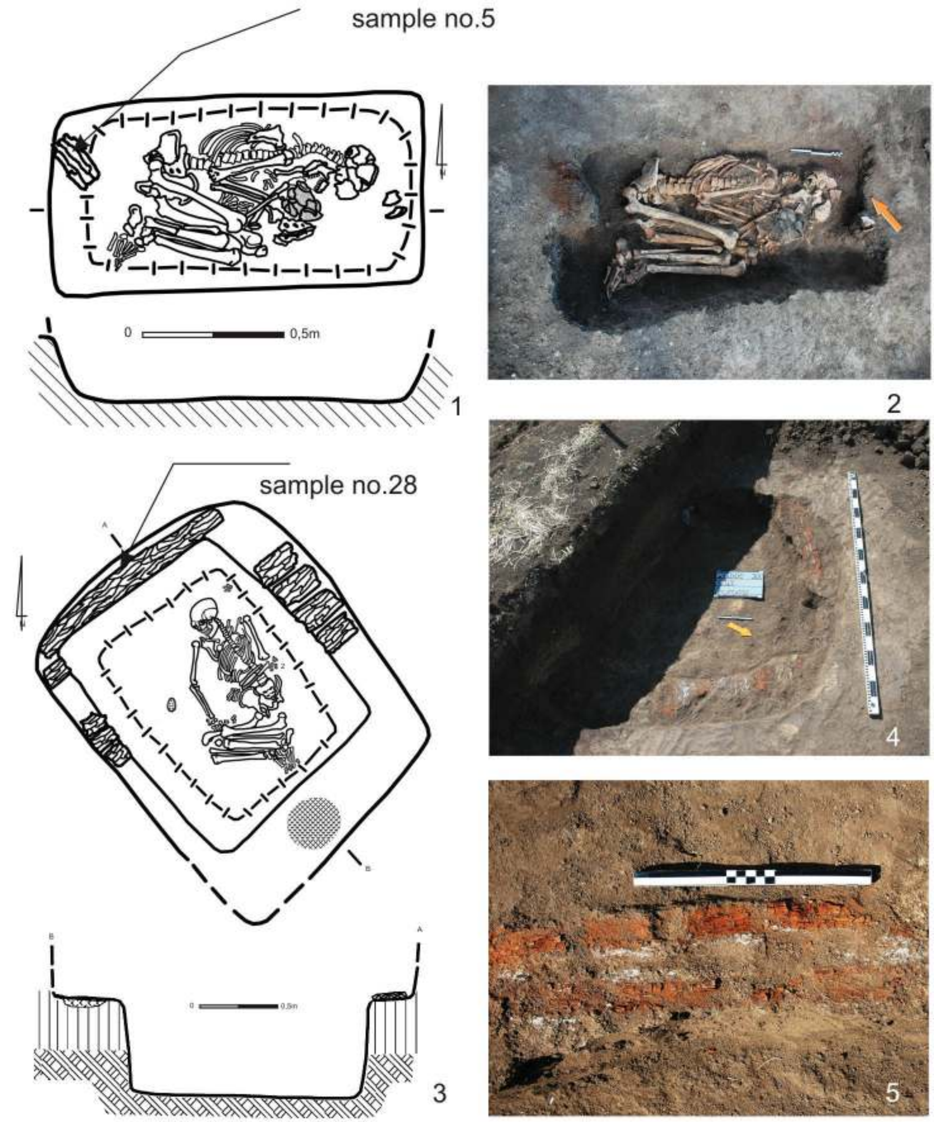
Porohy barrow 3A/feature 7. A human grave that belonged to the NC [Klochko *et al*. 2015b: 98-99]. The ^{14}C dating of human bone is recorded at 4115±35 BP (Poz-70667). A sample (no. 14) was taken in the south-eastern part of the pit and contained a plank made of unidentified wood. Elements of roofing were placed transversely in relation to the longer axis of the grave.[4]

Porohy barrow 3A/feature 10 (Fig. 4: 3-5). A grave of the YC [Klochko *et al*. 2015b: 101-104] that produced five ^{14}C datings of human bones: 3860±160 BP (Kiev-17383), 4370±70 BP (Kiev-17438), 4070±50 BP (Kiev-18928), 4105±35 BP (Poz-74393), 4040±35 BP (Poz-81824). This sample (no. 28) contained decidu-

[2] For earlier considerations *see*: Kośko, Razumow, Żurkiewicz 2014: 222.

[3] Please note that in an earlier publication *Quercus* sp. was mistakenly used here [Kośko, Razumow, Żurkiewicz 2014: 222].

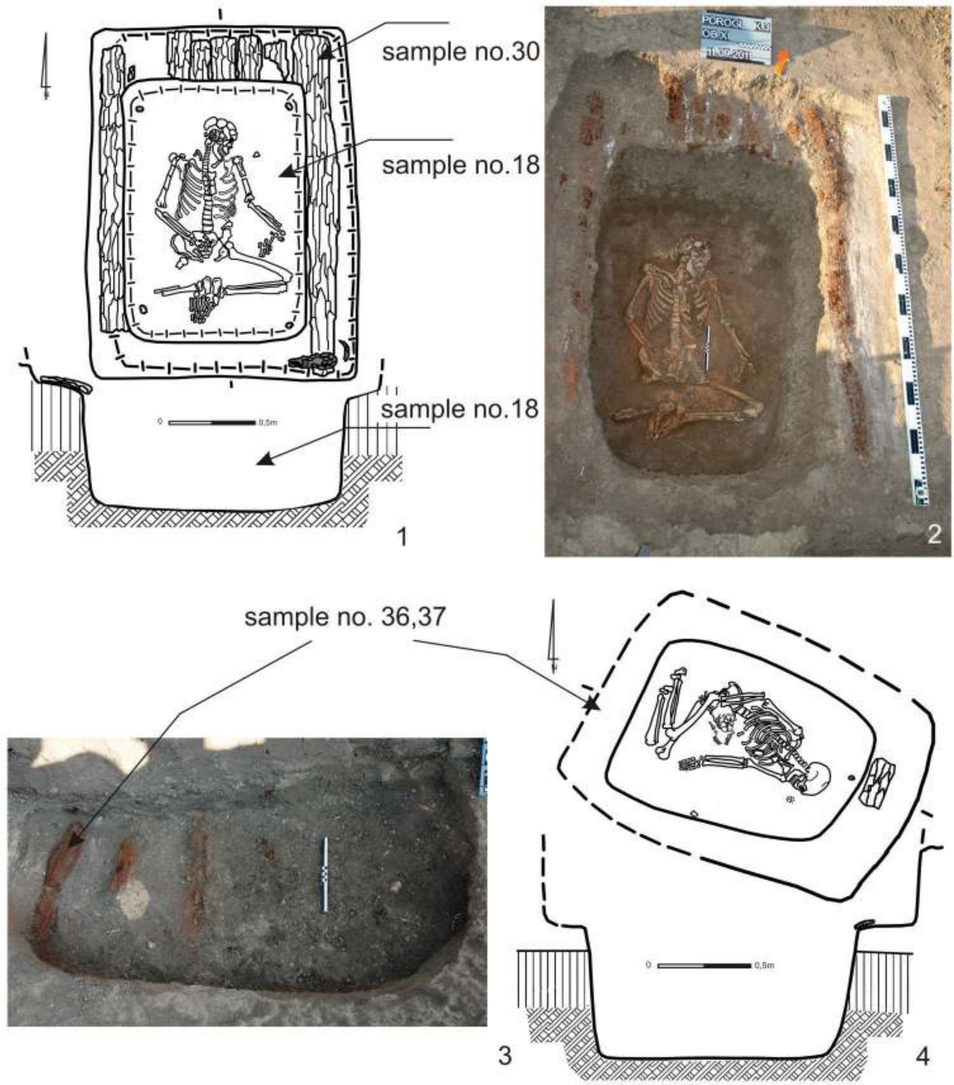
[4] In an earlier publication it was mistakenly written that the remains of wooden roofing were placed in the south-western part of the grave pit [Klochko *et al*. 2015b: 98].



F i g . 4 . Porohy, Yampil Region, barrow 3A. Location of samples: 1-2 – feature 5; 3-5 – feature 10. Prep. by D. Żurkiewicz

ous diffuse-porous wood, out of which a plank forming a grave cover was made. Elements of roofing were placed transversely in relation to the longer axis of the grave.

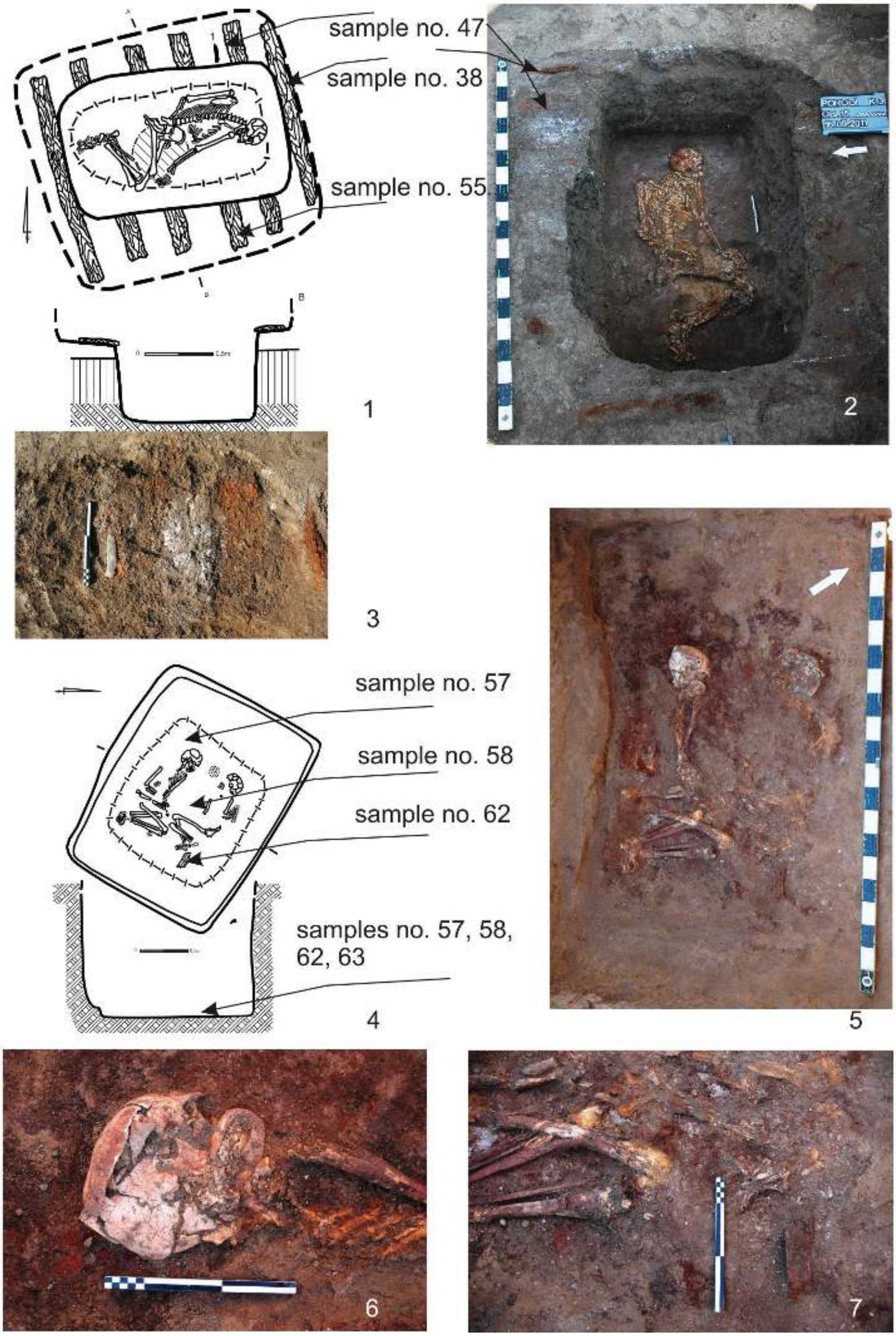
Porohy barrow 3A/feature 11 (Fig. 5: 1-2). The next grave belonging to the YC [Klochko *et al*. 2015b: 105-107] provided a ^{14}C dating of human bones of



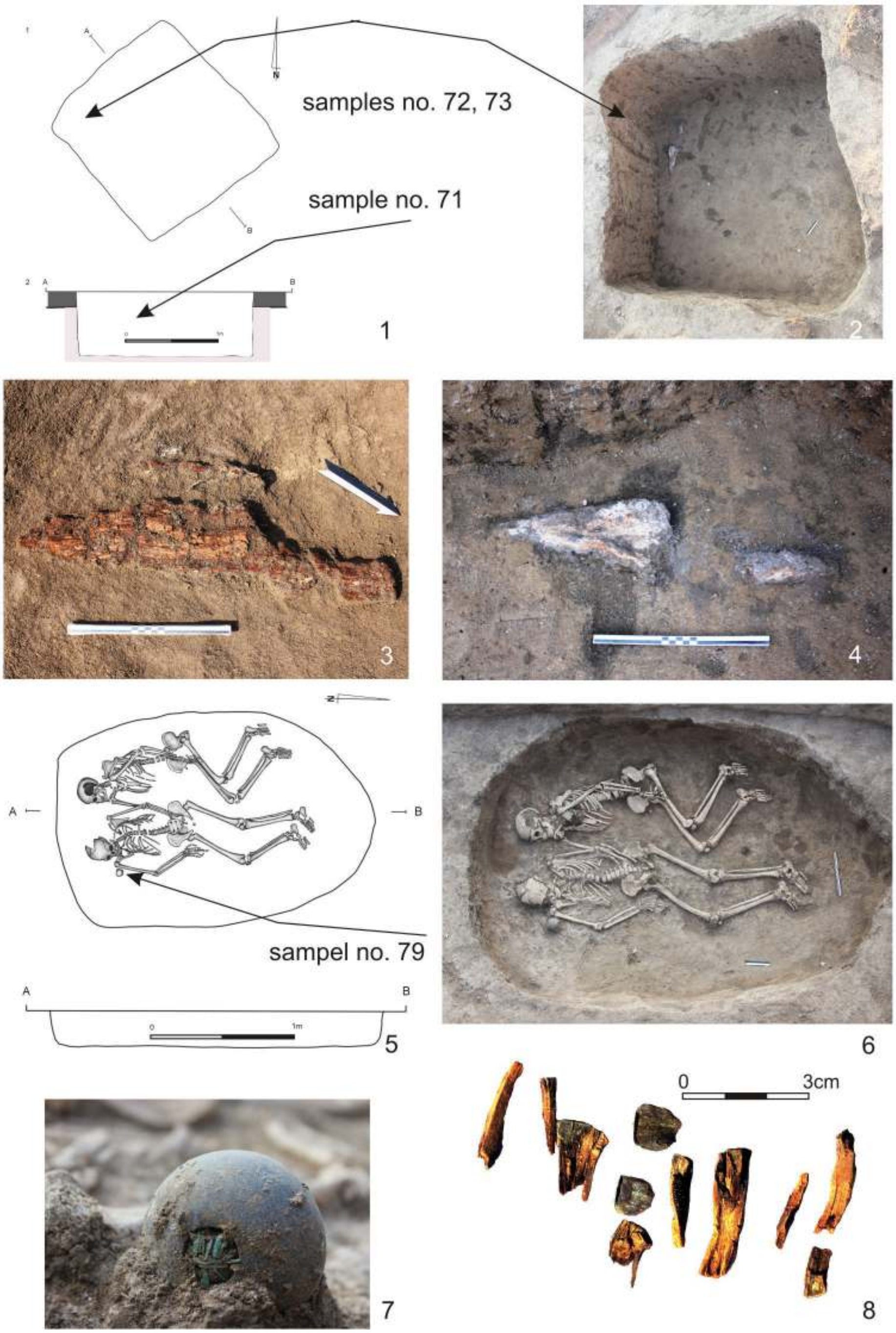
F i g . 5 . Porohy, Yampil Region, barrow 3A. Location of samples: 1-2 – feature 11; 3-4 – feature 12. Prep. by D. Żurkiewicz

4075±35 BP (Poz-47741). Two samples have been taken: no. 18 in the fill of the grave pit and no. 30 from the grave cover in the north-eastern part. In both cases oak was identified – from the cover of the grave. Elements of roofing were placed along the longer axis of the grave.

Porohy barrow 3A/feature 12 (Fig. 5: 3-4). A grave of the YC [Klochko *et al*. 2015b: 108-110] that produced a ^{14}C dating of human bones of 3985±35 BP (Poz-



F i g . 6 . Porohy, Yampil Region, barrow 3A. Location of samples: 1-3 – feature 15; 4-7 – feature 20. Prep. by D. Żurkiewicz



F i g . 7 . Prydnistryanske, Yampil Region, barrow I. Location of samples: 1-4 – pit 1; 5-8 – feature 4. Prep. by D. Żurkiewicz

47742). Both samples (nos. 36 and 37) document the use of oak in the production of planks for the grave cover. Elements of roofing were placed transversely in relation to the longer axis of the grave.

Porohy barrow 3A/feature 15 (Fig. 6: 1-3). A grave of the YC [Klochko *et al*. 2015b: 112-115]. There are two ^{14}C datings of human bones: 3580±90 BP (Kiev-17386), 4010±220 BP (Kiev-17386). Three samples (nos. 38, 47 and 55) document the use of oak in the production of planks for the grave cover. Elements of roofing were placed transversely in relation to the longer axis of the grave.

Porohy barrow 3A/feature 16. This was an unidentified feature – pit or hearth of uncertain chronology (perhaps YC) [Klochko *et al*. 2015b: 115-116]. At the bottom of the object there lay fragments of planks made of unidentified wood. One of them was recorded in sample no. 54.

Porohy barrow 3A/feature 20 (Fig. 6: 4-7). From a human grave of the YC [Klochko *et al*. 2015b: 124-126] there were three ^{14}C datings of human bones: 3820±80 BP (Kiev-17385), 4175±35 BP (Poz-74397), 4190±35 BP (Poz-47744). Four samples were taken in various parts of the grave fill. Two such (nos. 57 and 58) contained unidentified wood and in the next two (nos. 62 and 63) oak wood was found. In every case these are the remains of a cover that fell into the grave pit fill. Elements of roofing were placed along the longer axis of the grave.

Porohy barrow 3A. From the original land level comes sample no. 53, containing oak wood.

Prydnistryanske barrow I/feature 1 (Fig. 7: 1-4). A pit linked to the Gordineşti group of the Late Tripolye culture [Klochko *et al*. 2015d: 189-192]. From two ^{14}C datings of wood one is unreliable (13390±70 BP, Poz-66235) [Goslar *et al*. 2015, Tab. 1] and the second is acceptable: 4700±70 BP (Poz-66214). Three samples were taken in various parts of the fill. They contained deciduous wood (no. 71), a structural element from an oak trunk or a branch (no. 72) and unidentified with remains of lime (?, no. 73). These might be parts of the cover, placed along the longer axis of the object.

Prydnistryanske barrow I/feature 4 (Fig. 7: 5-8). This grave contained two human burials and is linked to the CC [Klochko *et al*. 2015d: 192-195] and has four ^{14}C datings: 4190±80 BP (Poz-66218; wood), 4070±35 BP (Poz-66219; human bone from burial no. 1), 3940±40 BP (Poz-66220; human bone from burial no. 2), 3940±40 BP (Poz-66732; human bone from burial no. 2). Sample (no. 79) contained wood found inside a stone mace, being the remains of a handle made from the branches of deciduous diffuse-porous wood.

Prydnistryanske barrow II/feature 1. A hearth dated to the Gordineşti group of the Late Tripolye culture [Klochko *et al*. 2015d: 197] that is confirmed by a ^{14}C dating of charcoal: 4485±30 BP (Poz-66221). Six samples document the use of oak as firewood (nos. 2, 3, 4) or in general deciduous wood (nos. 1, 6, 49).

Prydnistryanske barrow III/feature 3 (Fig. 8). This human grave is linked to the Gordineşti group of the Late Tripolye culture [Klochko *et al*. 2015d: 207-213]

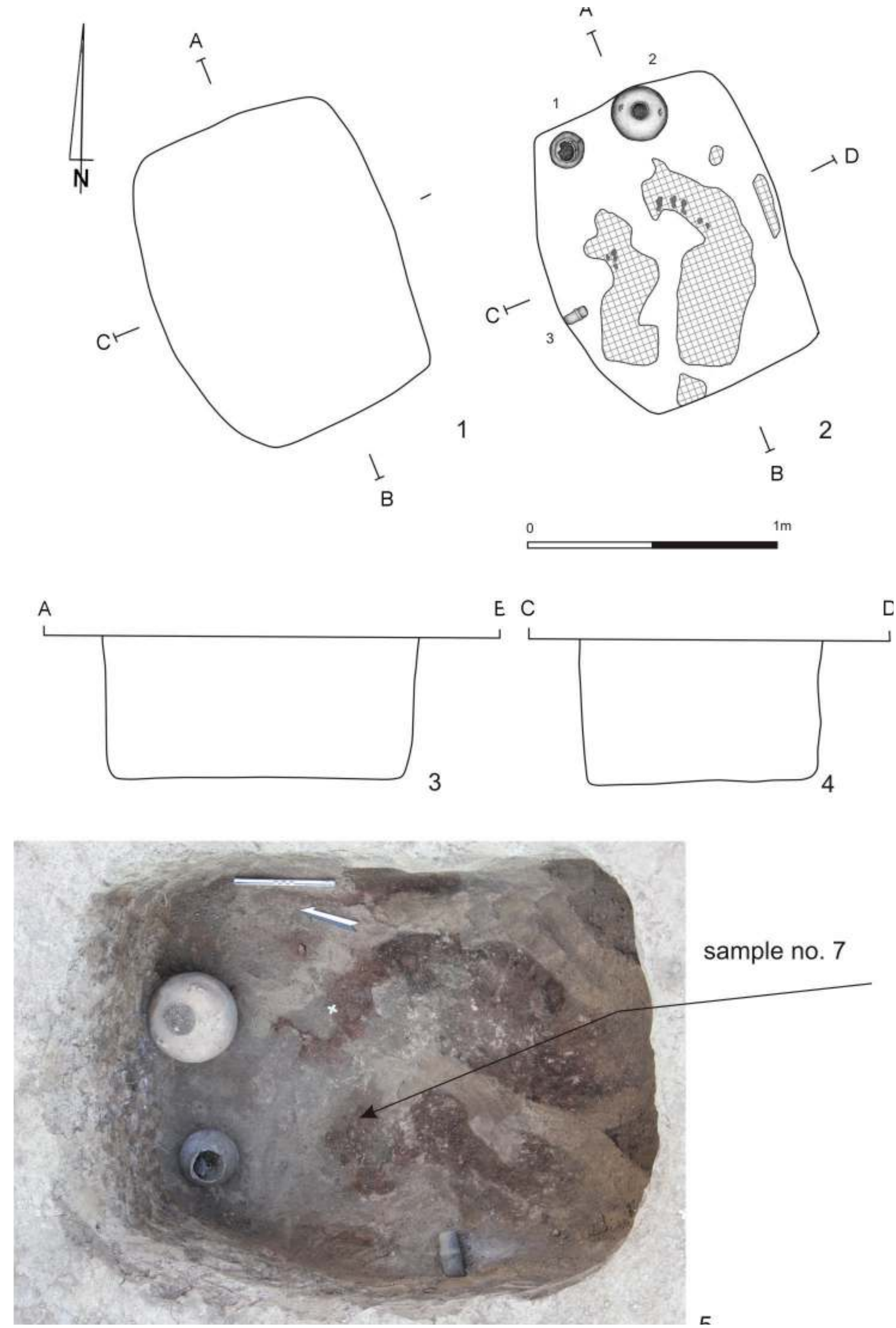
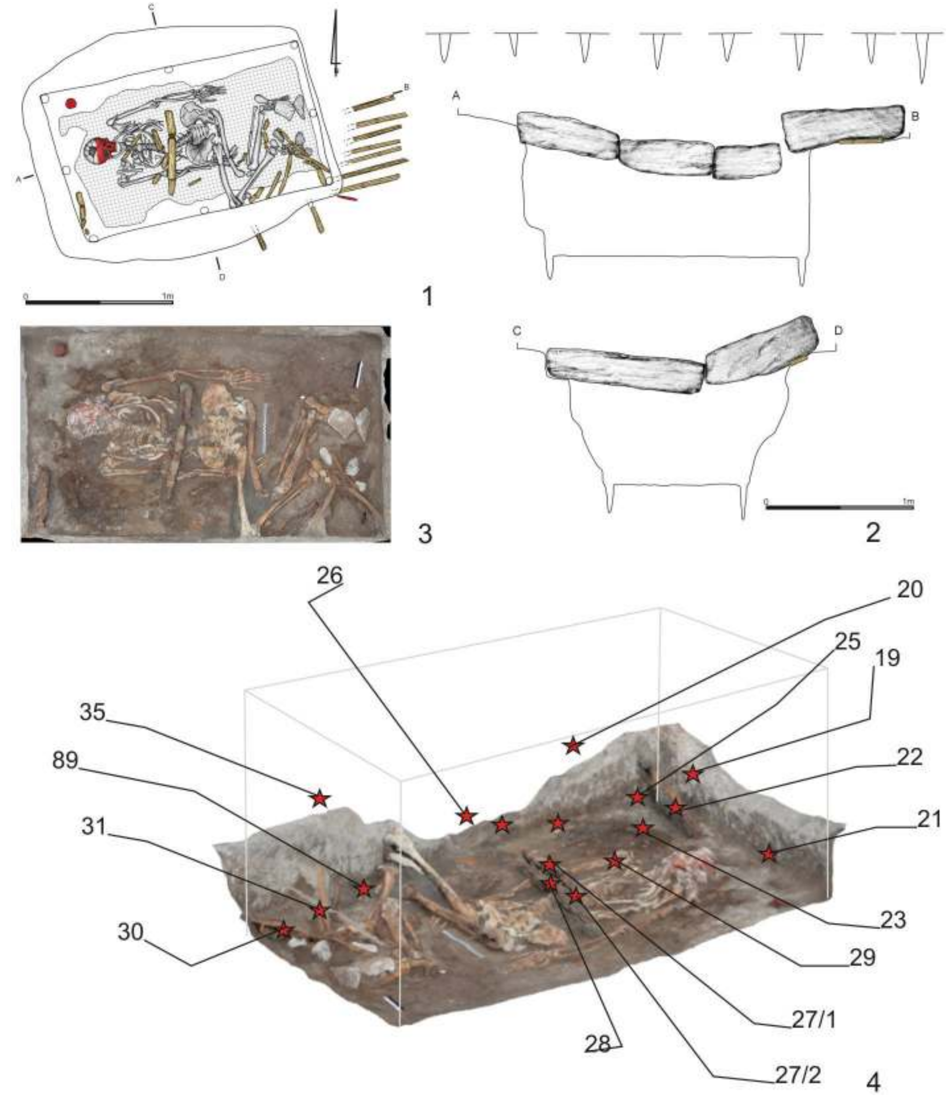


Fig. 8. Prydnistryanske, Yampil Region, barrow III/feature 3. Location of samples. Prep. by D. Żurkiewicz



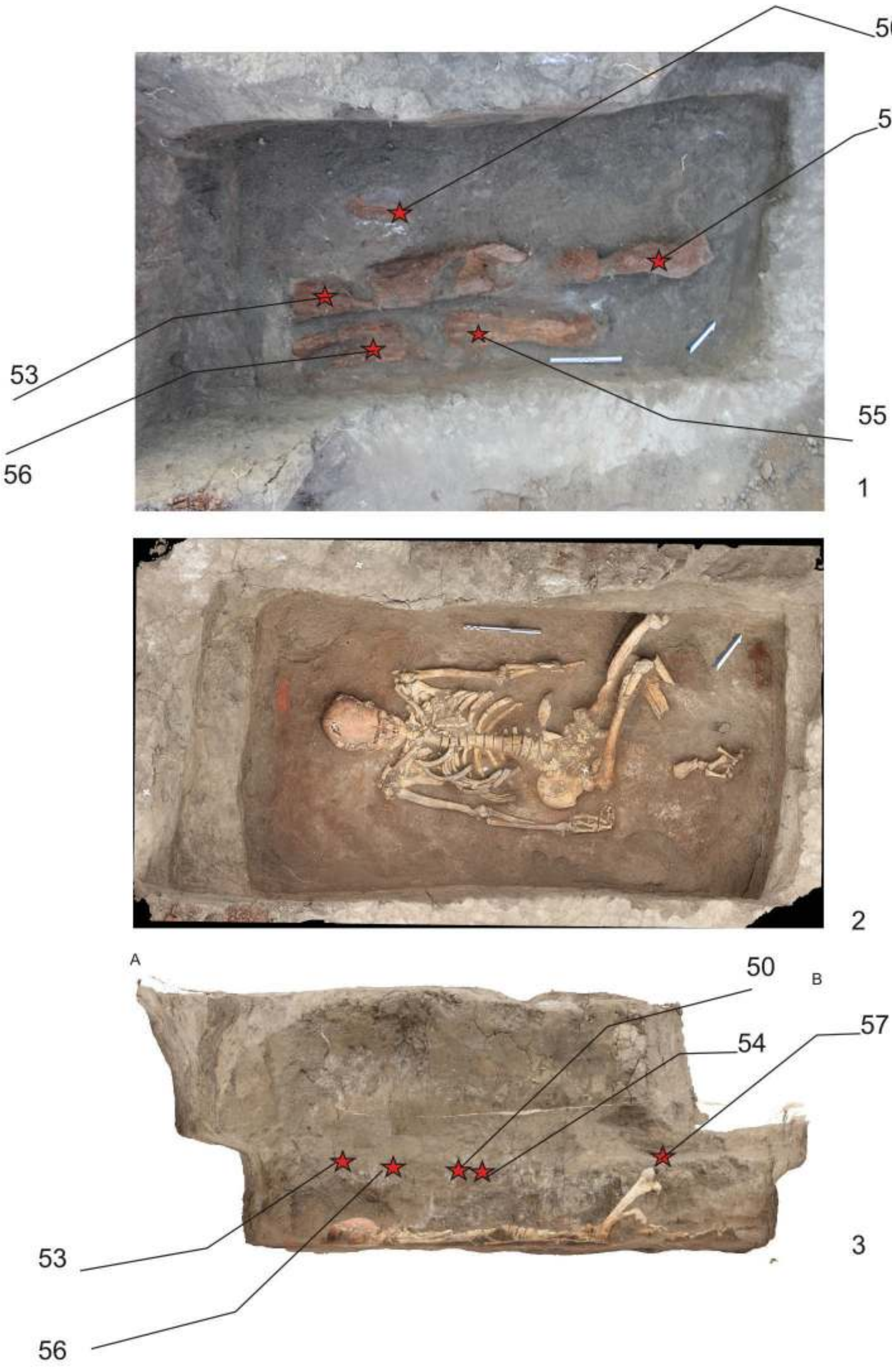
F i g . 9 . Prydnistryanske, Yampil Region, barrow IV/feature 4. Location of samples. Prep. by D. Żurkiewicz

that is confirmed by a ^{14}C dating of wood: 4510±40 BP (Poz-71367). The second dating (9090±50 BP, Poz-66226) is unreliable. Sample (no. 7) was taken from the bottom of the grave, where a rust-brown lining was observed – most likely the remains of a mat. Also deciduous wood was identified, perhaps diffuse-porous.

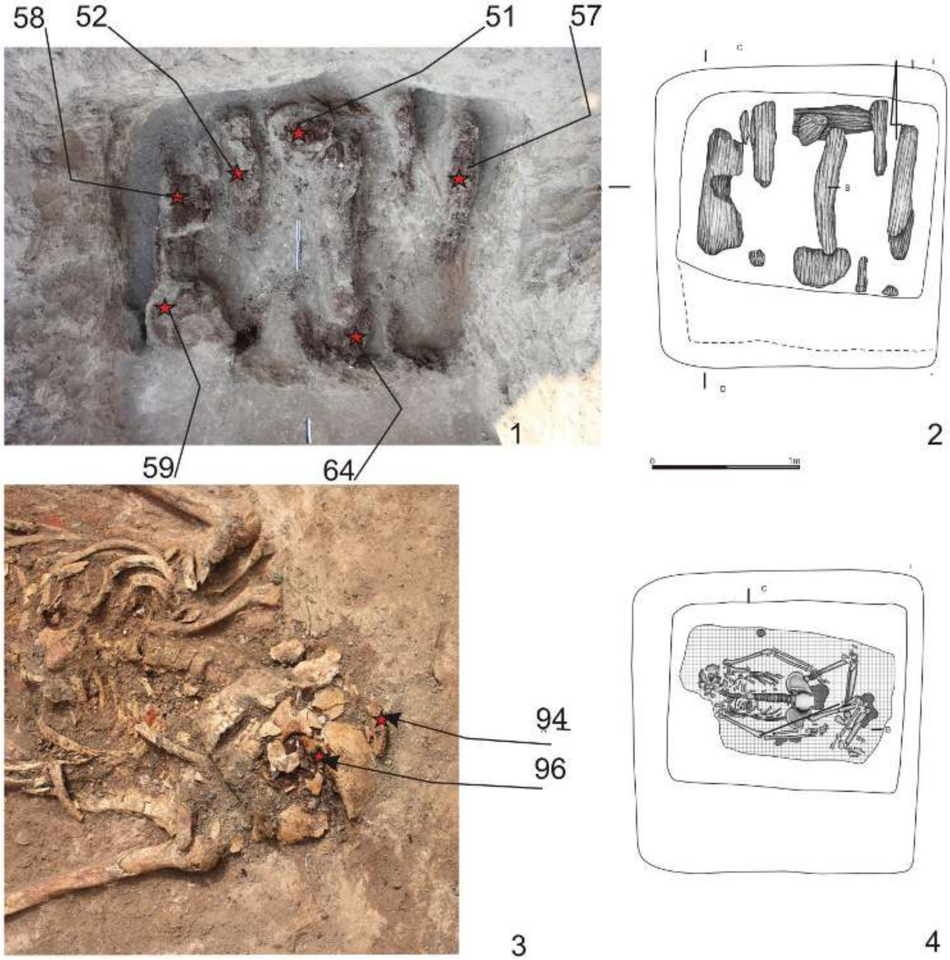
Prydnistryanske barrow IV/feature 4 (Fig. 9 and 10). A grave of the YC [Klochko *et al*. 2015d: 217-222] with two ^{14}C datings: 4455±35 BP (Poz-66230;

F i g . 1 0 . Prydnistryanske, Yampil Region, barrow IV/feature 4. Location of samples. Prep. by D. Żurkiewicz

wood), 4380±35 BP (Poz-66229; human bone). Some 17 samples (nos. 19-23, 25-27, 29-31, 35 and 89) were taken from various parts of the grave pit fill. In 15 of these there was identified the wood of ash from the majority of branches with a diameter from 2 to 4 cm and only in two cases thicker (4.5 cm and 5 cm). There was one case of oak from a branch with a diameter of 2.5 cm and one sample contained unidentified charcoal. The samples document the use of branches for 'grillage woodwork' – a scaffolding on which lay the "stone grave cover, sealed with mats from above and below" [Klochko *et al*. 2015d: 217]. The grillage was supported by eight poles placed vertically along the rectangle of the grave pit.



F i g . 1 1 . Prydnistryanske, Yampil Region, barrow IV/feature 6. Location of samples. Prep. by D. Żurkiewicz



F i g . 1 2 . Prydnistryanske, Yampil Region, barrow IV/feature 8. Location of samples. Prep. by D. Żurkiewicz

Prydnistryanske barrow IV/feature 6 (Fig. 11). The next human grave represented also the YC [Klochko *et al*. 2015d: 222-226] and has two ^{14}C datings: 4185±35 BP (Poz-66231; wood), 4090±40 BP (Poz-70673; human bone). Seven samples were taken from planks forming the grave cover. Oak was identified in all of these. The planks were laid along the longer axis of the grave.

Prydnistryanske barrow IV/feature 8 (Fig. 12). A grave of the YC [Klochko *et al*. 2015d: 227-230] with ^{14}C datings of human bone of 4090±40 BP (Poz-70673). Eight samples were taken: six at the level of the roofing (nos. 51-52, 57-59 and 64) and two from the bottom of the grave, near the skull of the deceased (nos.

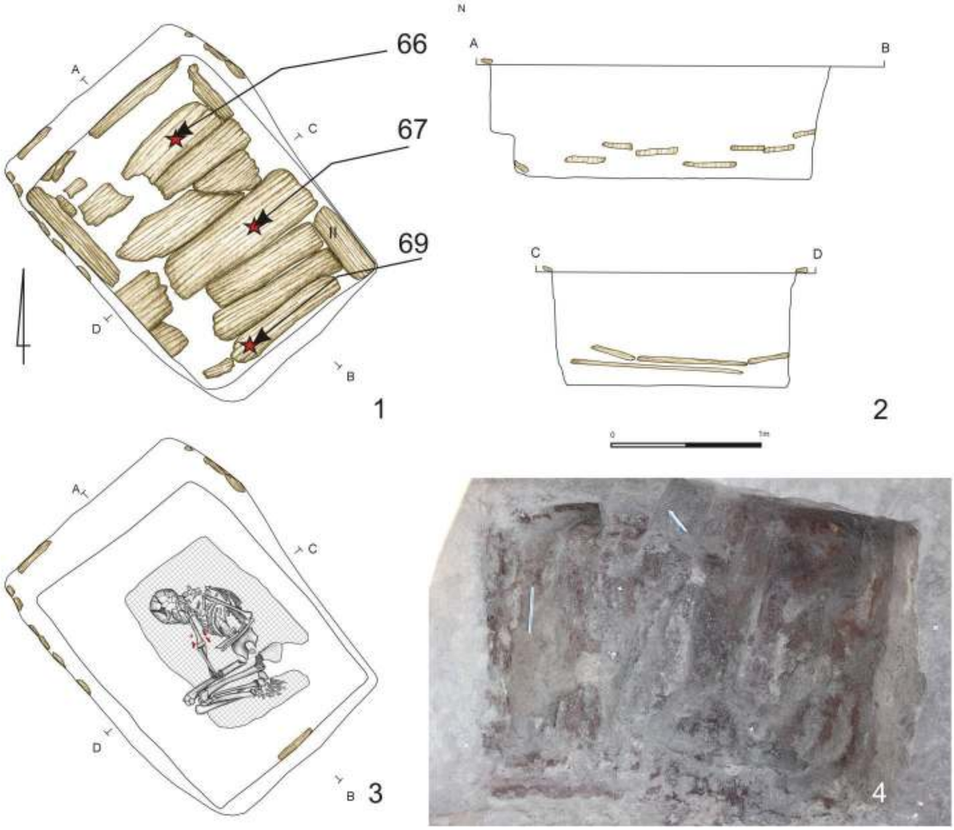


Fig. 13. Prydnistryanske, Yampil Region, barrow IV/feature 9. Location of samples. Prep. by D. Żurkiewicz

94 and 96). Samples from the upper level document the use of oak planks for grave roofing (in one case unidentified), which were placed transversely in relation to the longer axis. On the skull of the deceased a fragment of oak was also found, which most likely fell from the cover. The contents, however, of sample no. 94 taken from under the skull, from the mat it would seem, could not be identified.

Prydnistryanske barrow IV/feature 9 (Fig. 13). This was another grave of the YC [Klochko *et al*. 2015d: 231-234], where one ^{14}C dating of human bone was made, recording 4120±35 BP (Poz-66233). Three samples were taken from planks making up the grave cover. In all of these oak was identified. The planks were placed transversely along the longer axis of the grave and longer walls.

3. WOOD IN THE FUNERARY RITES OF CREATORS AND USERS OF RITUAL CENTRES, YAMPIL BARROW COMPLEX, IV-II MILL. BC

Thus in summarising the results of research conducted and placing it into a wider context, this study has focused on: (3.1) the possibilities of documenting the main species of trees identified in *Yampil Barrow Complex* objects and (3.2) how this wood was exploited in terms of (3.3) differences between the use of wood and the use of stone in grave constructions, and finally (3.4) an outline of the ritual significance of two species of tree identified, oak and ash.

3.1. THE POSSIBILITY OF FINDING WOOD IN THE NATURAL FOREST STEPPE LANDSCAPE ON THE MIDDLE DNIESTER

The above discussion in part two has attested to the widespread use of oak wood. Out of 25 objects where samples were taken, oak was recorded in 17 (graves, hearths and pits). In seven objects deciduous wood was identified and in one, ash. In five objects, however, the wood could not be identified.

In the natural forest steppe landscape of eastern Europe wood was in essence easily accessible because of the characteristic sylvan mosaic in this climate and vegetation zone (mainly stenothermal deciduous forests) and meadow steppe [Sudnik-Wójcikowska, Moysiyenko 2012: 48; Kirleis, Dreibrodt 2016: 172-174]. No doubt this was the same case in the forest steppe of the Middle Dniester [Makohonienko, Hildebrandt-Radke 2014: 262].

At present the prime source of oak wood in eastern Europe are dryland forests – fertile deciduous forests – part of the *Querceto-Carpinetum medioeuropaeum* group. The appropriate environment for these is fertile clayey or clayey-sand soils. Dryland silva are usually multi-species in nature, containing hornbeam and oak, less often lyndon, maple, sometimes elmer, beech and sporadically – in places more damp – ash [Medwecka-Kornaś 1977: 403-405]. In diachronic terms these forests are relatively late, for in the state familiar to modern observation they took form after the expansion of the hornbeam in Europe, dated to c. 2500 BC [4000 BP; Ralska-Jasiewiczowa *et al*. 2004: 72]. In earlier times the place of these silva could have been taken by others, once dominated by the oak [Makohonienko 2008: 367; *see* Kirleis, Dreibrodt 2016: 172].

For the ash the natural environment is a meadow-marsh silva in the valleys of larger rivers (the *Circaeo-Alnetum* group), though this species is also a less important component of highly placed dryland forests (*see* above). The ash prefers wetland environments, remaining under the influence of permeable water or indeed even loci subject to seasonal flooding and is as a rule, associated with silt-mud soils and less often with black soils of the forest [Medwecka-Kornaś 1977: 396-398].

One can therefore sporadically encounter ash in the more damp areas of sylva and at times specimens of oak on wetland meadows. Notwithstanding, both these trees in principle prefer other environments. In the case of oak, dry upland terrain with heavy, fertile clayey soils, while ash prefers wetland terrains of river valleys with their silt-mud soils.

It is difficult to assess to what degree the above described contemporary silva in central Europe correspondent to prehistoric forests in the Pontic forest steppe. At present, because of the very high degree of anthropogenisation, these silva are preserved only in fragments, where there dominates the *Quercus robur* oak. Among the species of trees in the west the ordinary beech prevails (*Fagus sylvatica*), in the centre – the ordinary hornbeam (*Carpinus betulus*). These are accompanied by species of maple (*Acer sp. div.*), ordinary ash (*Fraxinus excelsior*) and small-leaf linden (*Tilia cordata*) [Sudnik-Wójcikowska, Moysiyenko 2012: 48-49; *see* also Kirleis, Dreibrodt 2016: 171-172].

The chronology of the *Yampil Complex* (IV-II mill. BC) corresponds to the second half of the Atlantic period and the first half of the Subboreal. The latter is tied to optimum climate conditions and the dominance of climax deciduous forests. This was a stage of turbulent and dynamic growth, and differentiation in the vegetation profile. The evolution of soils and vegetation took place, taking on the nature of typical progressive growth and developments. This was characterised by a gradual replacement of coniferous silva by deciduous forests typical for the mesocratic stage, where there took place the formation of a balance between climate and vegetation whereby temperatures reach the highest values in all of the cycle.

At that time there dominated deciduous forests largely populated by oak, elm, linden, ash and considerable hazel, ones forming tree species of a different than hitherto ecological scale characterised by a great ability for competition. These populated fertile habitats with humus of the silt type, which they at the same time co-created [Tobolski 1976: 192-194]. Near rivers and backwaters, on alluvial soils that were regularly flooded, forests became widespread as did meadow scrub with a dominating, depending on type, willow, poplar, alder and in somewhat drier parts, elm and ash. From the Atlantic period the anthropogenic factor began to play an increasing role in the shaping of the environment. At the close of the mesocratic stage climax forests began to be subject to successive changes of a regressive nature.

Of the two discussed tree species in stenothermal deciduous forests the oak appeared earlier, and was part of older (boreal) pine-oak woods. The oak heartily withstood climate changes and is still a significant element in contemporary mixed forests [Milecka *et al*. 2004]. Not only did the ash appear significantly later, but also relatively earlier began to lose in significance as a factor in forest creation in the territories of middle Europe [Tobolski, Nalepka 2004]. He was present – and probably in a significant amount – in the fourth mill. BC [Kirleis, Dreibrodt 2016: 173]. This species achieved its greatest dissemination between 4000 and 3000 BC and the clear shrinkage of its radius took place around 2000 BC and from that time the significance and radius of the ash has relatively radically diminished. It is therefore a tree that is very sensitive to climate change and in addition, was subject to significant anthropopressure [Tobolski 1995: 14-15]. At present, the natural radius of ash occurs in east Europe up to the valley of the Volga [Boratyńska 1995: 44, Fig. 18].

The exploitation of ash and oak by inhabitants of the Trypolyean mega-sites attest to the availability of both these trees in the forest-steppe between the Southern Bug and Dnieper [Kirleis, Dreibrodt 2016: 173; Müller *et al*. 2017: 69].

Research from the second half of the 20th century in the Ukraine forest steppe has confirmed among others, the presence of forests containing oak, ash, maple, elm, linden, and hornbeam in the natural landscape of the Dnieper Valley [Chernyakov 1994: 133].

In conclusion, it can be proposed that two species of trees that were identified in samples from the *Yampil Barrow Complex*, oak and ash occurred in the natural landscape of the forest steppe by the Dniester.

3.2. WAYS OF EXPLOITING WOOD IN THE YAMPIL BARROW COMPLEX

In the funerary rite conducted by the creators and users of the *Yampil Barrow Complex* wood was exploited as a fuel and raw material for the production of mats and tool components, foremost as a construction material serving the production of planks out of which subsequently covers and roofing were made, as well as less often the walls of the grave pit.

At least five objects from the *Yampil Barrow Complex* document a differentiation of forms of using wood by Eneolithic communities (including the Gordineşti group of the Late Tripolye culture). Oak was a fuel whose remains were preserved in two hearths (Klembivka 1/4 and Prydnistryanske II/1). Parts of the roofing of one of the graves (Prydnistryanske I/1) was made out of deciduous and unidentified wood, while the planks creating the cover of another grave (Pidlisivka 1/1B) were made out of oak. Deciduous wood in all likelihood served for the production of 'mats' lining the bottom of one of the graves (Prydnistryanske III/3).

The most information gained on the use of wood concerned the peoples of the YC. In the main, these are attestations to the exploitation of planks for the purposes of constructing grave covers. These most often were hewn from oak and were placed over the grave pit according to its longer axis (eg. Porohy 3A/1, 3A/11, 3A/20, Prydnistryanske IV/6) or in transverse fashion (eg. Pidlisivka 1/11, Porohy 3A/12, 3A/15, Prydnistryanske IV/8). In one object (Prydnistryanske IV/9) planks were placed crosswise and in addition, placed along the longer walls of the grave. In one case the transverse placement of planks described in general is that it was made out of deciduous wood (Porohy 3A/10).

In another case, oak plans were used for the casing of a grave pit wall (Porohy 3A/1) and once a mat made out of identified raw material was found (Prydnistryanske III/3).

In the context of all the other objects of the YC the grave in Prydnistryanske IV/4 stands out. Both the form of producing the grave cover (stone blocks placed on grillage made out of branches and placed on a mat that supported vertically wedged poles) and the wooden material used for this purpose – ash, to be precise ash branches with a diameter from 2 to 5 cm [Klochko *et al*. 2015d: 217-222]. Graves with post vertical pole traces placed at the walls of the pit (the so called objects with little pits) also known from other parts of the forest steppe, most broadly identified in the Ingulec basin, where they constituted 3.9% of all YC objects in general [Melnik, Steblina 2013: 20]. Research on these indicates a possible function of strengthening or making the walls of graves and support for roofing [Dergachev 1986: 35].

Objects of the CC community have left traces of using deciduous wood, which was used for making planks for the grave cover in Pidlisivka 1/4. Also, the same wood was used for a handle that held the stone mace in this grave.

The NC used oak to make the covers for graves (Porohy 3A/3 and 3A/5); in one case the wood could not be identified (Porohy 3A/7).

In general, the dendrological identifications for archaeological sites dating to the 4th-2nd mill. BC in the forest steppe and steppe of eastern Europe are still quite few, despite the fact that wooden finds are relatively frequent. The most frequently identified wood is oak, with other species being much rarer, including ash [Chernyakov 1994: 173-173, attachment 1], though the latest research on charcoals in the Trypolyean mega-sites between the Southern Bug and Dnieper have revealed a domination of ash [Kirleis, Dreibrodt 2016: 173-174; Müller *et al*. 2017: 69].

Oak wood was often used for the roofing of Yamnaya graves as in Sadovoje grave 32 [Malyukevich, Agulnikov, Popovich 2017: 26] and in Sugokleja (Sugoklejska Mogila), where the grave covers were made out of logs and half logs as well as oak planks and cart wheels [Heußner 2009; Nikolova, Kaiser 2009; Nikolova 2012]. Wheels made out of wood found at other sites, for example from Bolotnoye, barrow 14, burial 29, in Crimea and from Vertolyetnoye Polye, barrow 1, burial 10 [Shishlina, Kovalev, Ibragimova 2014: 290]. The wood of ash was identified among others in a unique find of a lister in Balki – Vysokaya Mogila, grave 17 [Bidzilya, Yakovenko 1973; Chernyakov (Ed.) 1994: 173-173, attachment 1]. For the production of carts in turn, various species of wood were used, such as oak and ash. For example, wagons from the Ipatovskij barrow were made of *Rosaceae*, ash, maple, durmast oak (*Quercus petraea*), oak (*Quercus robur)*, elm (*Ulmus* gen.) and hornbeam (*Carpinus* gen.), whereas in Ulan IV, barrow 4, elements of the cart placed in grave 15 of the CC were made out of elm, ash, maple and oak [Shishlina, Kovalev, Ibragimova 2014: 284 and 290].

Technical traits may have had an influence on the application of both of the above mentioned types of wood. Oak and ash belong to the same group of diffuse-porous deciduous trees and in part also have similar properties: their wood is hard, heavy, durable, though in the case of the ash it is unusually flexible and pliable. Both, in addition, are relatively difficult to process [Milewski 1965].

Oak is a wood that is widespread in forests, being highly durable, both in environments of constant and changeable dampness, was highly valued. Oak was described as: *'... An underwater building material or for long-serving craft, is one of the best woods'* [Berdau 1890: 151; Nowicki 1913: 149]. Ash on account of its lesser occurrence was less popular and not used as often in production. Nonetheless, its attributes were appreciated: *'... The strongest wood is ash...*[5] ; '*... It is highly resistant and durable, and moreover, is the hardest of woods*'.[6] Thanks to these properties of ash wood, it was used to make spars, such as the Macedonian sarissa [Sekunda 2001: 22-23].

Apart from endurance, and in the case of ash also flexibility, both types of wood have aesthetic attributes thanks to their hue, shine and profile. Oak is a hardwood, possessing a broad hardwood part in its internal section of the trunk and a narrow alburnous section at the external trunk circumference encompassing the remaining several dozen growths.[7] The hardwood parts are yellow-brown to olive-brown in colour and at times turning to dark, whilst the sapwood is much lighter in colour, usually yellow-white [Godet 2008: 58]. In the case of ash it is somewhat lighter in colour – initially after logging, the sapwood and hardwood usually are whitish to yellowish, at times the hardwood darkens and there are even examples of hardwood being dark brown [Godet 2008: 50].

The lustre of the wood in addition, increases the aesthetic attributes and inconsequence light from the smooth surface of the wood. Durable, hardwood deciduous species are characterised by a better lustre such as oak or ash, while much less so, soft non-hardwood and coniferous deciduous species [Krzysik 1978: 315-317]. The effect of the wood's lustre is augmented through additional working of the surface. In the case of grave constructions discovered in barrows there is nothing to suggest the exploitation of this attribute, for example through polishing or burnishing the surface.

Another aesthetic attribute is the profile of the wood, which is influenced by the width of growths and clear boundaries between them. Both oak and ash are charac-

[5] Archive, Chair of Slavic Ethnography, Jagiellonian University, interview no. 22E, Złożna, Żywiec County.

[6] Archive, Chair of Slavic Ethnography, Jagiellonian University, interview no. 3820, Glinka, Żywiec County.

[7] The number of sapwood growths in oak is differentiated and depends on, among others, the species of oak, habitat and individual characteristics.

Table 2

Wood and stone grave construction elements in the Yampil Barrow Complex

Grave construction element		**Late Eneolithic**	**Yamnaya**	**Babyno**	**Noua**	**Sum**
Cover	wood	4	13		3	20
	stone			5		6
	wood and stone	1	2			3
Wall structure	wood		1			1
	stone				1	1

terised by a uniquely clear profile of yearly growths. This is influenced by vessels of a large diameter concentrated in the part of the yearly growths of sapwood that can be seen in the form of rings and additionally, in the case of oak, clearly marked broad radii.

The fundamental characteristic making both these types of wood different is their endurance. In the case of oak in the extremely difficult conditions in the open it is estimated at about 120 years, while that of ash in such conditions, about 10 years and up to 20 in more favourable conditions [Szczuka, Żurowski 1970: 75]. In conditions of constant dampness, as no doubt was the case in barrows, the endurance of wood is significantly extended in period.

3.3. ELEMENTS OF WOOD AND STONE GRAVE CONSTRUCTION IN THE YAMPIL BARROW COMPLEX

Two construction elements in Yampil graves were made out of wood or stone: the cover and the structure of pit grave walls. In this context there are three forms of covers (roofing): wood, stone or wood and stone as well as two forms of wall structure: wood or stone. Their respective numbers are given in the Tab. 2.

From the above table it can be seen that there are differences in the frequency of using wood and stone in respect to chronology and taxonomy. In Eneolithic objects and those tied to the YC and that of Noua, wood dominated and as did much more rarely a combination of wood and stone (or just stone – the case of NC), while stone was used to the greatest extent by the peoples of the Babyno culture.

The above observations may have a vital significance for defining the regional specificity in the context of knowledge on other barrow assemblages, especially those tied to the YC [Shaposhnikova, Fomenko, Dovzhenko 1986: 15]. This is borne out by the more recent research, such as in the basin of the middle Ingulets, where graves with a stone cover constituted 35% as against 23% of objects with roofing of wood [Melnik, Steblina 2013: 11]. The above picture has though, several exceptions, for example the steppe by the Ingul River there are known ritual centres of the 'pit' community that only have covers of wood [Nikolova, Kaiser 2009].

In the Dniester Region the situation is even more complex. On the one hand, research from the 1980s accented the dominance of wooden covers [Yarovoy 1990: 218-219], but in the most recent documentation of the Budzhak culture, the occurrence both of stone and wooden grave covers is emphasised [Ivanova 2013: 108]. Of particular note is the fact that in the Lower Dniester Region one of the concentrations of stone box graves can be found, where a part had covers [Szmyt 2014: 126-134 and Fig. 1]. Hitherto research of *Yampil ritual centres* of the YC has not revealed objects of similar description, while the use of wood in covers or wood and stone would appear to be one of the particular characteristics in the specific nature of the assemblage under research.

3.4. SYMBOLIC MEANING OF OAK AND ASH

In funerary rites of the creators and users of the *Yampil Barrow Complex* wood was used as a raw material out of which grave construction elements were made in the form of roofing made of planks and more rarely, the casing of pit grave walls. From time to time, wood appeared in the form of mats woven out of branches or as an element of a tool. A separate category of sources are charcoals from planks or single fragments – perhaps the remains of a symbolic cleaning of pit graves.

Construction elements in graves were mainly made out of oak planks. In the case of one particular grave the roofing construction was made in the form of a grillage made out of in the main, ash branches with the addition of some oak branches (Prydnistryanske IV/4). In Porohy 3A/10 however, the roofing construction was made out of planks from unidentified deciduous diffuse-porous wood.

In previous sections of this article oak and ash were discussed in terms of their utilisation value (technical and aesthetic properties). It is in particular among the Indo-European peoples that the role of oak and ash was manifested in various ways, finding expression in systems of beliefs, myths and customs, and importantly, the significance of both trees was usually associated with the male element.[8]

Of particular importance for the oak's cultural valorisation was its strength and power, which no doubt arose from its longevity, dimensions and monumental nature, as well as the very good quality of the wood (hardness, durability and endur-

[8] *See*, however, an opinion on the female nature of the ash [Pastoureau 2006: 103].

ance). These characteristics to some extent made the working of this wood more difficult but at the same time, underscored its unique value.

In the mythology of many Indo-European peoples wood had a similar symbolic meaning [Cirlot 2012: 108], being devoted to the deities of the storm: the Greek Zeus, Roman Jupiter, German Tor, Slavonic Perun, Baltic Perkunas [Brückner 1927: 414; Forstner 1990: 160; Szyjewski 2003: 45-46]. The Slavic peoples recognised the cosmogenic significance of oak, which was to have been witness to the beginnings of the world [Karwicka 1970: 296; Ziółkowska 1983: 70]. Large and old oaks according to Slavs gained unique meaning as the centre of pagan deities and as a locus for offering sacrifices [Herbord II, 32, foll. Labuda 1999: 174; Szyjewski 2003: 139; Gieysztor 2006: 89]. Some holy oaks were fenced off, where only those with privileges could enter for the conduct of rituals [Helmold I, 52, foll. Labuda 1999: 176-177].

Also after the Slavs accepted Christianity the oak was held in great respect. Thus it is in fact on this tree that most often wayside shrines were hung, as were crosses and holy images [Moszyński 1967: 527; Karwicka 1970: 291]. Old oaks were not felled, while damage to such a tree was accorded to the appearance of infectious diseases and the breaking of their crown meant death [Biegeleisen 1929: 454; Karwicka 1970: 289; Fischer 1937: 67]. Further, oak branches had a protective function and that is why they were used for decorating homes, stood in fields and used for wedding ceremonies [Fischer 1937: 67; Karwicka 1970: 295]. Oak was also used for healing; it was believed for example that its leaves had the power to resurrect a person [Fischer 1937: 68]. The smoke from oak leaves was seen to have a purgative function and oak wood was considered to be a means of protection against spells [Fischer 1937: 67]. In some graves of the *Yampil Barrow Complex* the presence of oak charcoal was noted, which may be interpreted as a relic of a symbolic cleaning by fire of the grave.

Oak was also associated with the world of the dead. It was believed that it protected against the spirits of the dead and therefore an oak log was placed on the tomb [Moszyński 1928: 163]. In the case of particular individuals such as those who had hung or drowned themselves – having died an unnatural death – the graves were struck through with an oak stake right through to the coffin [Fischer 1937: 67].

Despite the fact that the ash does not occur as often in the belief systems, myths and customs of prehistoric peoples as does the oak, its significance however, was at times elevated. In Scandinavia the huge ash known as the Yggdrasil, constituting the cosmic axis of the world, played the most important role [Słupecki 2006: 51]. In Greek mythology the ash was the wood of the god of war Ares, while Zeus created the generation of 'indomitable people' out of the ash [Hesiod I, 143-145; *see* Hesiod 1999]. A spear made of Pelion ash was a dependable weapon of Achilles [Homer XVI, 142-146; XIX, 389-391; XX, 278; XXII, 225; *see* Homer 1986]. The ash tree moreover, among the Slavic peoples was meant to have a good influence both on the living and the dead. Up until recent times the Polish village believed that to sleep under an ash fortified the mind and at the same time, was a great deal safer than under another tree, for snakes avoided this tree from afar [Fischer 1937: 72; Karwicka 1970: 277-279; Ziółkowska 1983: 133]. Also, the branches of the ash were stuck into thatch so as to protect from demons [Moszyński 1935, Tab. 9-10; Fischer 1937: 72]. In Tatra Mountains ash sticks were used as an apotrope so as to make harmless evil forces [Moszyński 1935, Tab. 9-10; Fischer 1937: 72]. The dead buried in an ash coffin were meant to reach immediate eternal peace and did not wander across the four corners of the world as a spirit [Ziółkowska 1983: 133].

As in the case of the oak there existed a folk custom of placing wayward shrines and holy images on the ash as well as planting ash trees around churches [Ziółkowska 1983: 133], so as to ensure additional protection from evil for a holy place.

In the context outlined above of the symbolic meaning of the oak and ash it is possible to contextualise in this article objects from the *Yampil Barrow Complex*. There is no doubt therefore that the conduct of funerary rituals had a deeply symbolic expression. It would appear highly unlikely therefore that one of the elements of the ritual, such as the choice of wood for grave construction was accidental. The small gamut of marked taxons (only two types of tree: mostly oak and occasionally ash as well as the third – unidentified deciduous diffuse-porous) points to a deliberate choice of wood. The prevalence of oak can only be associated with the presence of oak in the immediate environment, but also because of its symbolic valorisation and technical attributes. Similarly, it is possible to interpret the use of ash branches in the grave Prydnistryanske IV/4.

It would appear therefore that as far as the funerary rite is concerned, the use of an element other than the accepted standard had to have had a clear intentional and highly symbolic meaning for the purposes of emphasising a particular otherness. In Prydnistryanske IV/4 not only were other types of wood used, but also a different roofing construction for the grave. These were not planks made out of the oak trunk, but a type of branch scaffold, mainly ash, on top of which a mat was spread, with stone blocks on top. In this way a type of canopy was made over the grave of the deceased community member [Klochko *et al*. 2015d: 241].

Thus it is difficult at present to claim unreservedly what the above-mentioned otherness possessed in meaning. For example, was it so as to mark the lower status of those interred? Rather not, for ash wood is characterised by equally good properties and visual attractiveness as the oak is – moreover no doubt was less often encountered in forests at that period. Also, the elaborated grave construction containing not only a wooden scaffold but in addition also mats and stone blocks, points to the intention of underscoring a particular difference in this particular grave.

4. SUMMARY

The research conducted indicates the selection of a particular species of wood used in funerary rituals. Traces of other species of wood than oak, are taken from trees being part of stenothermal climax forests in the IV-II mill. BC and no doubt growing in the immediate vicinity, additionally emphasises the deliberate nature of choosing oak as the dominant type of wood.

Both types of wood identified in the *Yampil Barrow Complex* (oak and ash) belong to the same group of deciduous diffuse-porous trees and are characterised by similar properties; the only element that sets them apart is durability. In the case of oak it is very high while in ash significantly lower. Both the wood of oak and ash is recognised as valuable and visually attractive. The fact that they are more difficult for the purposes of working – in comparison to other species of trees – all the more underlines their construction value to which they were used.

The domination of oak among the covers of pit graves may be associated with not only technical and aesthetic properties but also – perhaps in particular – with its symbolic valorisation. This, to an even greater extent, may be related to the unique ash roofing construction in Prydnistryanske IV/4, which in a clear way accents the different nature of this particular grave.

Translated by Piotr T. Żebrowski

REFERENCES

Berdau F.
1890 *Botanika leśna podług kursu wykładowego w Instytucie Rolniczo-Leśnym w Nowej-Aleksandryi (Puławach), Prof. Feliksa Berdau, spisana i wydana staraniem b. uczniów, z licznemi drzeworytami.* Warszawa.

Bidzilya V.I., Yakovenko E.V.
1973 Ralo iz pozdneyamnogo pogrebeniya kontsa III – nachala II tysiacheletiya do n.e. *Sovetskaya arkheologiya* 3: 146-152.

Biegeleisen H.
1929 *Lecznictwo ludu polskiego.* Kraków.

Boratyńska K.
1995 Systematyka i geograficzne rozmieszczenie. In: *Jesion wyniosły Fraxinus excelsior L.* 19-54. Poznań-Kórnik.

Brückner A.
1927 *Słownik etymologiczny języka polskiego.* Kraków.

Chernyakov I.T. (Ed.)
1994 *Remeslo epokhi eneolita – bronzy na Ukraine.* Kiev.

Cirlot J. E.
2012 *Słownik symboli.* Kraków

Dergachev V.A.
1986 *Moldaviya i sosednie territorii v epokhu bronzy.* Kishinev.

Fischer A.
1937 Drzewa w wierzeniach i obrzędach ludu polskiego. *Lud* 35: 60-76.

Forstner D.
1990 *Świat symboliki chrześcijańskiej.* Warszawa.

Gieysztor A.
2006 *Mitologia Słowian.* Ed. III. Warszawa.

Godet J.-D.
2008 *Atlas drewna.* Warszawa.

Goslar T., Klochko V.I., Kośko A., Włodarczak P., Żurkiewicz D.
2015 Chronometry of Late Eneolithic and 'Early Bronze' cultures in the middle Dniester area: investigations of the Yampil barrow complex. *Baltic-Pontic Studies* 20: 256-335.

Goslar T., Kośko A., Razumow S.
2014 Identyfikacja kulturowo-chronologiczna cmentarzysk „wczesnobrązowych” na stanowisku Pidlisiwka 1. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych” strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie 6,* 305-311. Poznań.

Heußner K.-U.
2009 Dendrochronologische Untersuchungen zu den Scheibenrädern aus dem Kurgan “Sugokleja”, Stadt Kirovograd/Ukraine. *Eurasia Antiqua* 15: 235--239.

Hesiod [Hezjod]
1999 *Narodziny bogów (Theogonia). Prace i dni. Tarcza.* Warszawa.

Homer
1986 *Iliada.* Ed. 14. Warszawa.

Ivanova S.V.
2013 *Istoriya naseleniya severo-zapadnogo Prichernomorya v kontse IV-III tys. do n.e.* (habilitation thesis). Kiev.

Karwicka T.
1970 *Drzewa w wierzeniach i praktykach ludu polskiego* (PhD, Archives of Mikołaj Kopernik University in Toruń). Toruń.

Kirleis W., Dreibrodt S.
2016 The Natural Background: Foretsd, Forest Steppe, or Steppe Environment. In: J. Müller, K. Rassmann, M. Videiko (Eds) *Trypillia Mega-Sites and European Prehistory 4100-3400 BC. Themes in Contemporary Archaeology* 2, 170-179. London and New York.

Klochko V.I., Kośko A., Razumov S., Włodarczak P., Żurkiewicz D.
2015a Eneolithic, Yamnaya, Catacomb and Babyno culture cemeteries, Pidlisivka, barrow 1, Yampil Region, Vinnitsa Oblast: archaeometry, chronometry and taxonomy. *Baltic-Pontic Studies* 20: 40-77.

Klochko V.I., Kośko A., Razumov S., Włodarczak P., Żurkiewicz D.
2015b Eneolithic, Yamnaya and Noua culture cemeteries from the first half of the 3rd and the middle of the 2nd millennium BC, Porohy, site 3a, Yampil Region, Vinnitsa Oblast: archaeometric and chronometric description,

ritual and taxonomic-topogenetic identification. *Baltic-Pontic Studies* 20: 78-141.

Klochko V.I., Kośko A., Razumov S., Włodarczak P., Żurkiewicz D.
2015c Eneolithic, Babyno and Noua culture cemeteries, Klembivka, site 1, Yampil Region, Vinnitsa Oblast: archaeometry, taxonomy and topogenetics. *Baltic-Pontic Studies* 20: 142-182.

Klochko V.I., Kośko A., Razumov S., Potupchyk M., Włodarczak P., Żurkiewicz D., Ivanova S.
2015d Tripolye (Gordineşti group), Yamnaya and Catacomb culture cemeteries, Prydnistryanske, site 1, Yampil Region, Vinnitsa Oblast: an archaeometric and chronometric description and a taxonomic and topogenetic discussion. *Baltic-Pontic Studies* 20: 183-255.

Kośko A., Razumow S., Żurkiewicz D.
2014 Cechy formalno-typologiczne obiektów oraz ich wyposażenia. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 213-235. Poznań.

Krzysik F.
1978 *Nauka o drewnie.* Warszawa.

Labuda G.
1999 *Słowiańszczyzna starożytna i wczesnośredniowieczna. Antologia tekstów źródłowych.* Poznań.

Makohonienko M.,
2008 Szata roślinna i etapy rozwoju krajobrazu kulturowego Kujaw w otoczeniu stanowiska Opatowice na Wzgórzu Prokopiaka w okresie neolitu i epoce brązu – podstawy palinologiczne. In: J. Bednarczyk, J. Czebreszuk, P. Makarowicza, M. Szmyt (Eds) *Na pograniczu światów: studia z pradziejów międzymorza bałtycko-pontyjskiego, ofiarowane Profesorowi Aleksandrowi Kośko w 60. rocznicę urodzin,* 353-370. Poznań.

Makohonienko M., Hildebrandt-Radke I.
2014 Kontekst przyrodniczy i perspektywy studiów paleośrodowiskowych stanowiska kultury jamowej w Pidlisiwce nad Dniestrem, zachodnia Ukraina. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki.*

Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie 6, 247-274. Poznań.

Malyukevich A.E., Agulnikov S.M., Popovich S.S.
2017 *Kurgany pravoberezhya Dnestrovskogo limana u s. Mologa*. Odessa – Kishinev.

Medwecka-Kornaś A.
1977 Zespoły leśne i zaroślowe. In: *Szata roślinna Polski,* vol. 1, 383-441. Warszawa.

Melnik O., Steblina I.
2013 *Yamna kultura serednoi techii Ingultsa.* Kriviy Rig.

Milecka K., Kupryjanowicz M., Makohonienko M., Okuniewska-Nowaczyk I., Nalepka D.
2004 Quercus L. – Oak. In: M. Ralska-Jasiewiczowa, M. Latałowa, K. Wasylikowa, K. Tobolski, E. Madeyska, H.E. Wright Jr., C. Turner (Eds) *Late Glacial and Holocene history of vegetation in Poland based on isopollen maps,* 189-197. Kraków.

Milewski A.
1965 *Materiały i wyroby z drewna.* Warszawa.

Moszyński K.
1928 *Polesie Wschodnie.* Warszawa.
1935 *Atlas kultury ludowej w Polsce,* vol. I-II. Kraków.
1967 *Kultura ludowa Słowian,* vol. II. Warszawa.

Müller J., Hofmann R., Kirleis W., Dreibrodt S., Ohlrau R., Brandstätter L., Dal Corso M., Out W., Rassmann K., Burdo N., Videiko M.
2017 *Maidanetske 2013. New Excavations at a Trypillia Mega-site. Studien zur Archäologie in Ostmitteleuropa / Studia nad Pradziejami Europy Środkowej* 16, Kiel – Bonn.

Nikolova A.V.
2012 Absolutna khronologiya yamnoi kulturi pivnichnogo nadchornomorya v svitli dendrodat. *Arkheologiya* 4: 14-31.

Nikolova A.V., Kaiser E.
2009 Die absolute Chronologie der Jamnaja-Kultur im nördlichen Schwarzmeergebiet auf der Grundlage erster dendrochronologischer Daten. *Eurasia Antiqua* 15: 209-239.

Nowicki A.
1913 *Użytkowanie lasów (technologia leśna). Podręcznik dla właścicieli lasów i leśników, podług najlepszych źródeł i praktyki własnej.* Kraków.

Pastoureau M.
2006 *Średniowieczna gra symboli.* Warszawa (trans. *Une histoire symbolique du Moyen Âge occidental*. Paris 2004).

Ralska-Jasiewiczowa M., Miotk-Szpiganowicz G., Zachowicz J., Latałowa M., Nalepka D.
2004 Carpinus betulus L. – Hornbeam. In: M. Ralska-Jasiewiczowa, M. Latałowa, K. Wasylikowa, K. Tobolski, E. Madeyska, H.E. Wright Jr., C. Turner (Eds) *Late Glacial and Holocene history of vegetation in Poland based on isopollen maps,* 69-78. Kraków.

Sekunda N. V.
2001 The Sarissa. *Acta Universitatis Lodziensis. Folia Archeologica* 23 (1): 13-41.

Shaposhnikova O.G., Fomenko V.N., Dovzhenko N.D.
1986 *Yamnaya kulturno-istoricheskaya obshchnost (yuzhnobugskiy variant). Svod arkheologicheskikh istochnikov SSSR* V1-3. Kiev.

Shishlina N.I., Kovalev D.S., Ibragimova E.R.
2014 Catacomb culture wagons of the Eurasian steppes. *Antiquity* 88 (2014): 378-394.

Słupecki L.
2006 *Mitologia skandynawska w epoce Wikingów.* Warszawa.

Sudnik-Wójcikowska B., Moysiyenko I.I.
2012 Polsko-ukraińskie badania flory kurhanów w latach 2004-2011. In: B. Sudnik-Wójcikowska, I.I. Moysiyenko, *Kurhany na „Dzikich Polach" – dziedzictwo kultury i ostoja ukraińskiego stepu*. Warszawa.

Szczuka J., Żurowski J.
1970 *Materiałoznawstwo przemysłu drzewnego.* Warszawa.

Szmyt M.
2014 Fourth-third millennium BC stone cist graves between the Carpathians and Crimea. An outline of issues. *Baltic-Pontic Studies* 19: 108-147.

Szyjewski A.
2003 *Religia Słowian.* Kraków.

Tobolski K

1976 Przemiany klimatyczno-ekologiczne w okresie czwartorzędu a problem zmian we florze. *Phytocoenosis* 5 (3/4): 187-197.

1990 Naturalne i antropogeniczne przemiany szaty leśnej. Pierwotna roślinność leśna Środkowej Wielkopolski i jej antropogeniczne przekształcenia. In: *Paleoekologia i paleolimnologia postglacjału Niżu Polskiego*, 11-20. Warszawa.

1991 Dotychczasowy stan badań paleobotanicznych i biostratygraficznych Lednickiego Parku Krajobrazowego. In: K. Tobolski (Ed.) *Wstęp do paleoekologii Lednickiego Parku Krajobrazowego,* 11-34. Poznań.

1995 Jesion w minionych krajobrazach. In: *Jesion wyniosły Fraxinus excelsior L.*, 7-17. Poznań-Kórnik.

Tobolski K., Nalepka D.

2004 Fraxinus excelsior L. – Ash. In: M. Ralska-Jasiewiczowa, M. Latałowa, K. Wasylikowa, K. Tobolski, E. Madeyska, H.E. Wright Jr., C. Turner (Eds) *Late Glacial and Holocene history of vegetation in Poland based on isopollen maps,* 105-110. Kraków.

Yarovoy E.V.

1990 *Kurgany eneolita – epokhi bronzy nizhnego Podnestroviya.* Kishinev.

Ziółkowska M.

1983 *Gawędy o drzewach.* Warszawa.

Baltic-Pontic Studies
vol. 22: 2017, 166-190
ISSN 1231-0344
DOI 10.1515/bps-2017-0025

Joanna Kałużna-Czaplińska*, Angelina Rosiak*, Andrzej Sikorski, Danuta Żurkiewicz*****

BARROW CULTURE TEXTILES AND MATS IN THE MIDDLE DNIESTER AREA

ABSTRACT

The article describes an attempt to identify the raw material of the organic layers – mats identified within the roofs and floors of the graves in the *Yampil Barrow Cemetery Complex*. The use of gas chromatography and infrared spectroscopy combined with microscopic analysis of the extracted "mat" sections significantly supplements our knowledge in the field of weaving of the studied communities.

Key words: mats, textiles, nomads, Bronze Age, Eurasian steppe

INTRODUCTION

For nomadic societies, we have few sources that could illustrate their economic foundations. The small amount of settlement relics makes us thoroughly analyze the most easily accessible sources, ones from the funeral world of prehistoric societies.

* Institute of General and Ecological Chemistry, Department of Chemistry, Lodz University of Technology, Stefana Żeromskiego 116, 90-924 Łódź, Poland; joanna.kaluzna-czaplinska@p.lodz.pl; angelina.rosiak@gmail.com

** Departament of Iron Age, Institute of Archaeology, Adam Mickiewicz University, Umultowska 89D, 61-614 Poznań, Poland; ands@amu.edu.pl; danuta@amu.edu.pl

*** Department of Prehistory of Central and Eastern Europe, Institute of Archaeology, Adam Mickiewicz University, Umultowska 89D, 61-614 Poznań, Poland; danuta@amu.edu.pl

The study presented below is part of a larger research project focused on Podolia as a context of intercultural contacts in the 4th/3rd–1st millennium BC.[1] To study textiles, a diagnostic area on the middle Dniester was selected, administratively confined to the vicinity of Yampil, Vinnytsia *Oblast* (Ukraine). The choice of this location was determined by the high accumulation of the remains of round barrow mounds, forming the north-western range limit of 'Early Bronze' barrows, associated with the steppe and forest-steppe zones of eastern Europe. Moreover, barrows in this location have been exceptionally well explored by conservators.

The quality of available sources for the study of textiles is closely related to the history of research into the *Yampil Barrow Complex*. This history falls into two distinct periods: one covering archaeological investigations carried out in the vicinity of Yampil prior to 2010 and the other lasting from 2010 to 2014. Intensive work performed there since 1984 left as many as 16 barrows explored, but due to an accident – a fire in the regional storage facility of archaeological collections – all osteological materials and organic samples, produced by investigations prior to 2010, have been destroyed. Discussing organic remains from these sites, we are forced to rely solely on available drawings, photographs and descriptions.

A new class of sources for the study of textiles was provided by the Polish-Ukrainian expedition that investigated altogether 7 more barrows in this area in 2010-2014. Importantly, the investigations were interdisciplinary by assumption and enhanced the cultural and biological image of communities characterized by the barrow funerary rite [Litvinova *et al*. 2015, Juras 2014]. The present paper is one of the results of these investigations.

1. THE HISTORY OF RESEARCH INTO TEXTILES IN THE ENEOLITHIC AND BRONZE CULTURES OF THE STEPPE AND FOREST-STEPPE

Eneolithic and Bronze woven and plaited goods have been discussed so far mainly in relation to the steppes around the Caspian Sea [Shishlina *et al*. 2000: 109] and northern Caucasus [Shishlina *et al*. 2003: 331]. The discussions have relied on artefacts kept in the State Historical Museum in Moscow.

The studies of impressions on pottery conducted so far have supplied information on various textiles used to decorate vessels or incidentally leaving traces on them. These studies embrace such questions as yarn formation techniques, fabric structure and weaving technologies. The major technologies included weaving and

[1] Research financed as part of the projects of the National Science Centre (grant No. 211/01/M/HS3/02142) and National Programme for the Development of the Humanities (No. 108/NPH3/H12/82/2014).

plaiting, with the former supposedly appearing on the steppes already in the Early Eneolithic [Shishlina *et al*. 2000: 112]. The first primitive looms (upright or flat) supposedly appeared there already in the Eneolithic. Classic looms, consisting of a frame, a thread separator and a device for making a second loom shed are associated with the Yamnaya culture, while Catacomb culture looms are believed to have been more diverse.

The determination of raw materials used for making mats has been based so far on examining the samples of well-preserved fragments of goods which permitted a botanical determination of examined remains. For making determinations, palaeo-ecological analyses (of phytoliths, pollen and detritus) have been employed as well. The list of examined materials included various grass varieties, tree and bush branches as well as cereals, sedge and reeds.

The most information was supplied by the study of textile fragments preserved in burials dated to the Bronze Age. Besides identifying the yarn-making and weaving techniques, the major raw materials used for making them were discerned. For the most part, these were fibres designated generally as phytogenic; the use of wool was established as of the second half of the 3rd millennium BC (Middle Bronze Age).

The principal raw materials that were available for making textiles in the area in question were flax and hemp. The wild variety of flax grows in a southern belt from western Europe, across the Mediterranean, Middle East as far as the Caucasus [Chmielewski 2009: 16; Barber 1992: 34]. On the middle Dniester, its occurrence is thus related to the influx of Eneolithic newcomers from the south. That the conditions on the steppes were conducive to the cultivation of flax can be seen in the fact that today Ukraine is the ninth largest producer of this crop in the world.

Hemp is an environmentally flexible plant species whose origin used to be traced to Central Asia, which is not borne out by later findings [Chmielewski 2009: 24]. One of the oldest finds of hemp comes from the context of the Tripolye culture.

2. MATS IN PODOLIA – INCIDENCE, CHRONOLOGY AND CULTURAL IDENTIFICATION

The chronological range of the remains under investigation draws our attention to the final stages of the Neolithic – the Eneolithic and Bronze Age in the studied area. From the archaeometric perspective, this period covers there the lifetime of Eneolithic societies of diverse genetic substrata as well as the Yamnaya, Babyno, Catacomb and Noua cultures. The description of the cultural positions of the features in which the organic remains of mats and textile impressions were recorded are given in Tab. 1.

Table 1

Cultural diversity of burials in the Yampil Region. Red colour shows graves with mat and textile remains

Chronology of objects / Sites	Eneolithic	YC	CC	BC	NC	∑	∑ graves with mats and textile on the site	% graves with mats and textile on the site
Dobrianka 1		4, 5, 6, 7, 8		1, 2, 3, 9, 10, 11		11	2	18%
Klembivka 1	5, 14, 15			1, 2, 3, 6, 8, 10	7, 11, 12, 13	13	3	23%
Pidlisivka 1	1B, 10	1A, 1Aa, 9, 11	4, 7	5, 13		10	7	70%
Porohy 1		1, 2				2	1	50%
Porohy 2		3, 4, 5, 6				4	1	25%
Porohy 3		2, 4		5		3	1	33%
Porohy 3A	14, 18	1, 2, 10, 11, 12, 15, 17, 19, 20			3, 5, 7, 8, 22	16	11	69%
Porohy 4		8		1, 5, 6, 9		5	1	20%
Prydnistryanske I	1		4			2	1	50%
Prydnistryanske III	1, 2, 3					3	1	33%
Prydnistryanske IV	10	3, 4, 6, 8, 9				6	5	83%
Pysarivka 1		1, 2				2	2	100%
Pysarivka 2		3				1	0	0%
Pysarivka 3		1, 2, 3				3	2	67%
Pysarivka 4		1, 2				2	1	50%

Pysarivka 5		1		2		2	2	100%
Pysarivka 6		**1**, **2**, **3**				3	3	100%
Pysarivka 7		2				1	0	0%
Pysarivka 8		2		4		2	1	50%
Pysarivka 9		**2**, 3		1		3	1	33%
Severynivka 1		5		4		2	0	0%
Severynivka 2		1, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13		2		12	5	42%
Σ	12	60	3	24	9	108	51	

So far, in the Yampil Region, 108 features have been recorded that may be classified as graves/burials of which most (60 graves or 56%) have been assigned to the Yamnaya culture. It is also with this community that the greatest number of finds of mat remains is associated. Organic materials or their impressions have been found in 51 burials of which 36 have been assigned to the Yamnaya culture.

The predominance is less pronounced when the frequency of mat identifiability within the studied communities is taken into account. The most numerous organic remains in this context have been found in 56 per cent of all Yamnaya culture burials discovered in the studied area. This percentage is comparably high for earlier cultures – Eneolithic ones – where mats were recorded in 7 out of 12 burials. This sets apart considerably these two from the Catacomb culture, the most proximal chronologically in the vicinity of Yampil, for which mats were recorded in one of three burials.

By way of absolute chronology, we have dates only for 17 features from the second stage of investigations (Fig. 1). The oldest date refers to feature 3 from barrow III in Prydnistryanskie and fits into the interval of 3343-3109 BC (68.2%). It dates, in the context of a hypothetical (child?) burial, wood fragments, forming an irregularly shaped layer on the grave chamber bottom. The youngest date, in turn, 1611-1396 BC (68.2%), refers to remains from a Noua culture grave from site Porohy 3A/5.

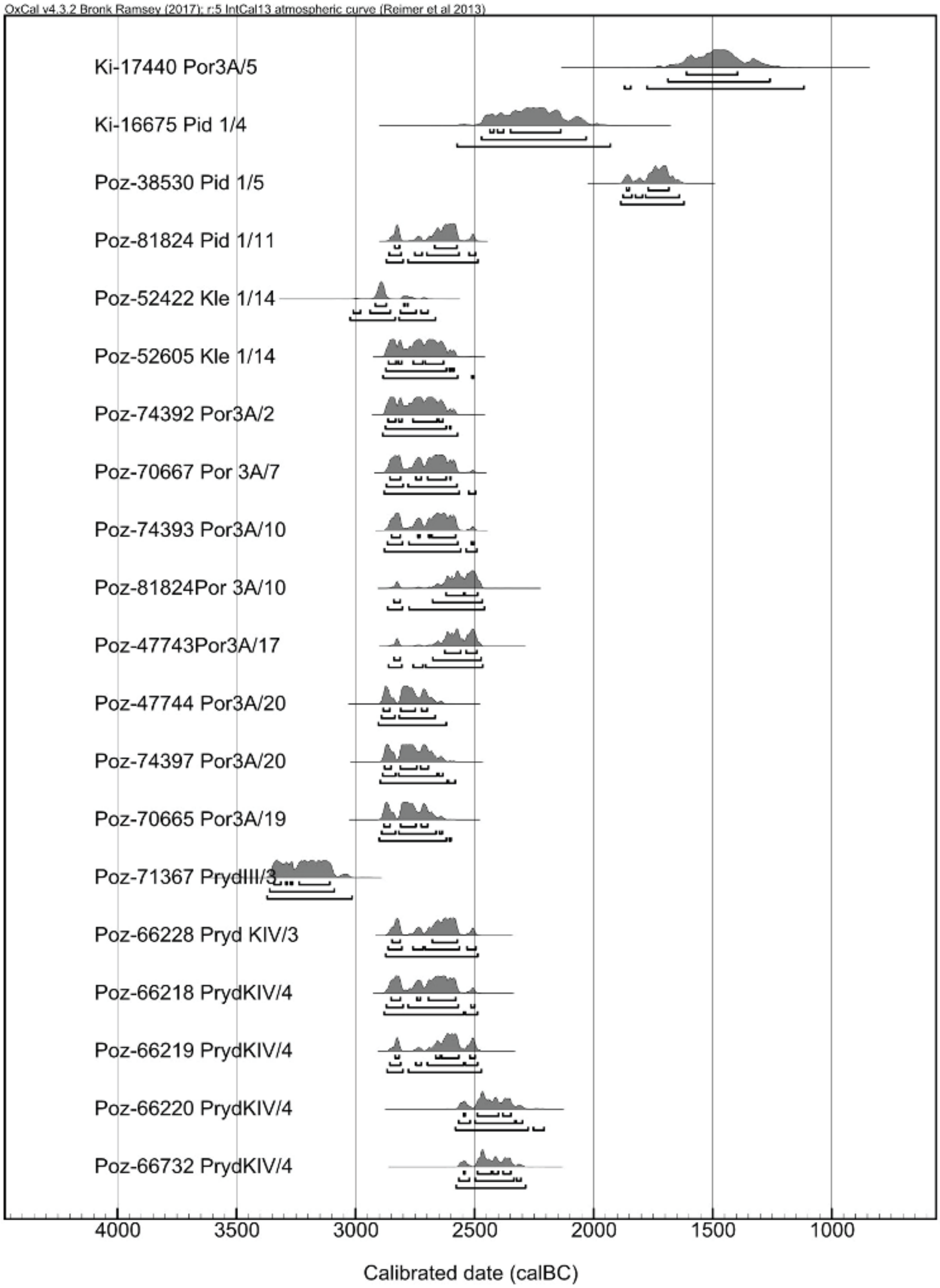


Fig. 1. ^{14}C measurements for Yampil Region graves with mat remains [*after* Goslar *et al.* 2015]

Fig. 2. Porohy, Yampil Region, barrow 3A, feature 17. Grave cover protected by a mat (white remains)

F i g . 3 . Prydnistryanske, Yampil Region, barrow IV, feature 4. Stone grave cover protected by a mat from above

3. ARCHAEOMETRIC MAT DOCUMENTATION

In the *Yampil Barrow Complex*, mat remains were recorded in the form of samples of a geological character collected from the ceilings and bottoms of features. The samples were then studied under a microscope to find and identify any textile impressions [Sikorski, Żurkiewicz 2014].

F i g . 4 . Prydnistryanske, Yampil Region, barrow IV, feature 4. Mat impressions on the bottom side of a stone grave cover

3.1. GRAVE COVERS

This category of finds is related solely to burials classified as Yamnaya culture ones. In their case, the grave chamber was usually rectangular in outline with its design being sometimes enhanced by a step. Furthermore, in most graves, a wooden roofing or cover of the grave could be seen. It was made of planks placed in parallel or perpendicularly to the longer wall of a feature. In selected features, as part of this structure, organic substances were commonly used, probably in the form of

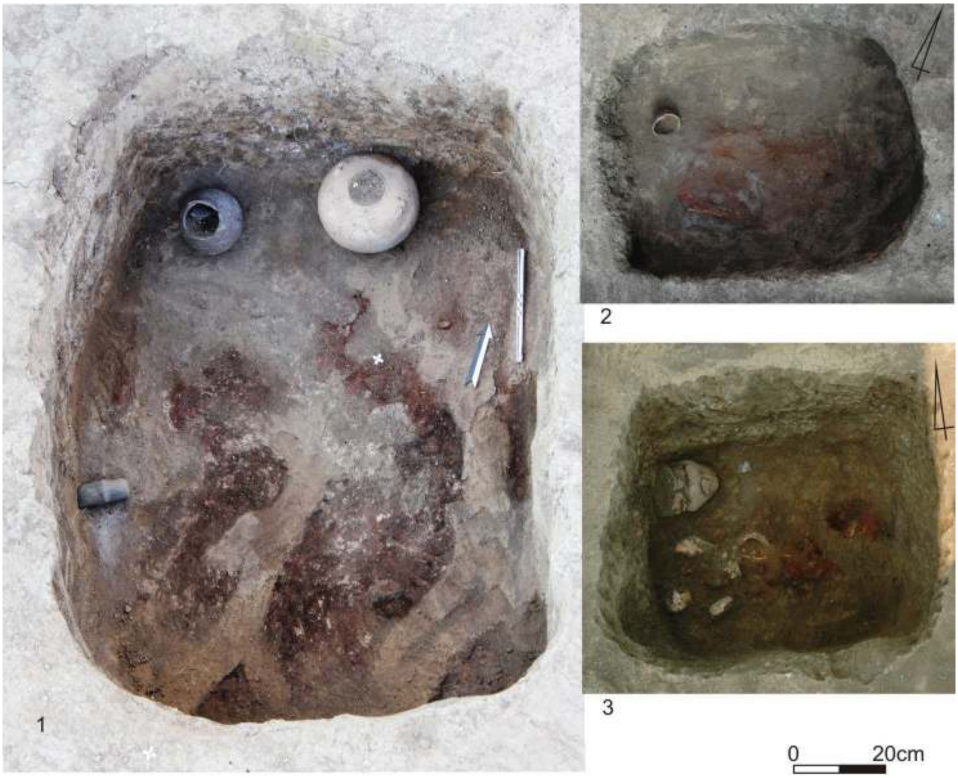


Fig. 5. Mat remains in Eneolithic burials: 1 – Prydnistryanske III/3; 2 – Porohy 3A/18, 3 – Pidlisivka 1/10

mats, to seal the grave roofing surface. In some cases, the considerable distances that separated individual roofing planks indicate that a mat was an important structural element of the ceiling (e.g. Porohy 3A/15). Mats can be seen on the level of discovery as a contrasting white thin layer (Fig. 2). The greatest number was recorded on site Porohy 3A in features 1, 10, 11, 15 and 17. Possibly, the remains of a mat are identifiable too, albeit somewhat less distinctly, in features 3 and 7 on this site and in Prydnistryanske IV/6. From archival data, which do not show this category of remains as a separate entry, relying however on available photographs, it can be concluded that this form of grave sealing was used on sites Porohy 2/6, Porohy 3/2 and Pysarivka 5/1.

The situation in Prydnistryanske, barrow IV, feature 4, differs from the source category described above. There, as a grave cover, stone slabs were used that were protected from above with an organic mat of a rather considerable thickness and pink-white colour. Under the stone cover, plaited branches had been placed which left traces on rock fragments (Figs. 3, 4). A microscopic scrutiny of samples collected from a stone cover (samples nos. 12, 13, 14, 16) reveals that this layer may have been built from reeds, calami (sweet flag) or tree leaves, tightly packed in several layers across the stone structure. Whereas, on boulders, on their bottom side, perpendicular impressions can be seen — traces of wrapping of around sticks placed lengthwise over the grave pit (Fig. 4). The combination of fatty acids determined in a sample collected from a layer recorded on the stone cover (sample 8) reflects their proportion characteristic of such foodstuff residues that are most commonly preserved on pottery. Moreover, the phytogenic origin of the raw material from which the 'mat' had been made was confirmed.

3.2. MATS UNDER A SKELETON

Other examples of the use of textiles come from the level of a burial. In this category, we have samples that have been subjected to physicochemical and microscopic analyses, and on which traces – mat and fabric impressions – have been identified and the type of remains, forming today a 'mat' layer under the skeleton, have been discerned. Organic remains on the level of grave bottom were recorded in Eneolithic and Yamnaya burials and ones dating to the later periods of the Bronze Age.

3.2.1. ENEOLITHIC

In the seven Eneolithic features in which organic substances were recorded at the skeleton, two categories can be seen. The first includes 3 child burials from sites Pidlisivka 1/10, Porohy 3A/18 and Prydnistryanske III/3,[2] in which, on grave chamber bottoms, almost square in shape, organic remains were recorded in various states of preservation and distinctly red in colour, owing probably to the use of a large amount of ochre (Fig. 5).

Out of the features listed above, Prydnistryanske III/3 yielded a mat (sample 13) for which organic compounds were determined, suggesting the plant (most likely grasses) origin of the sample. Furthermore, as many as three biomarkers were identified, indicative of beeswax and a compound found in saffron or flax. No significant differences were found in the content of organic compounds making up the mat in comparison to culturally and chronologically different features subjected to the same examinations.

[2] In this feature, no bone remains have been recorded but relying on feature parameters and analogies, it can be concluded that it was a child burial.

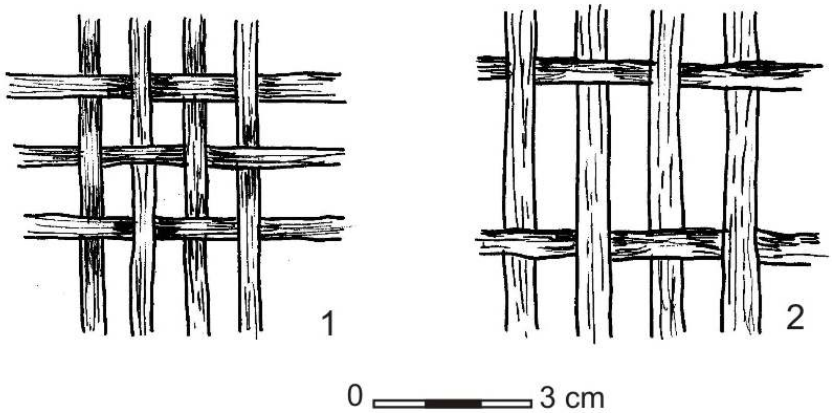


Fig. 6. Pidlisivka, Yampil Region, barrow 1, feature 1B. Drawing reconstruction of mats the impressions of which have survived at the burial level

Fig. 7. Prydnistryanske, Yampil Region, barrow I, feature 1. Remains of an 'object' located on the feature bottom

A microscopic scrutiny of sample no. 48, collected from the bottom of the feature, exposed shallow (2.0-2.3 cm) depressions, left probably by a mat, on the lump surface (max. dimensions: 7.5 × 11.0 × 4.8 cm). Judging by discoloration, mat thickness can be estimated to have been 0.5 cm. On the mat impressions and in gaps between the strips of this artefact, strongly pressed impressions of a thick cloth of 1/1 plain weave, grade IV, were identified.

On a few small lumps (measuring 16 × 13; 12 × 8 mm), collected from the vicinity of the skull from feature 10, site Pidlisivka 1 (sample 18), fabric remains left impressions. The fabric had been woven of unidirectional ZZ yarn with an average warp thread thickness of 0.68 mm (fibre twist angle [fibre thickness of 0.016 mm?]

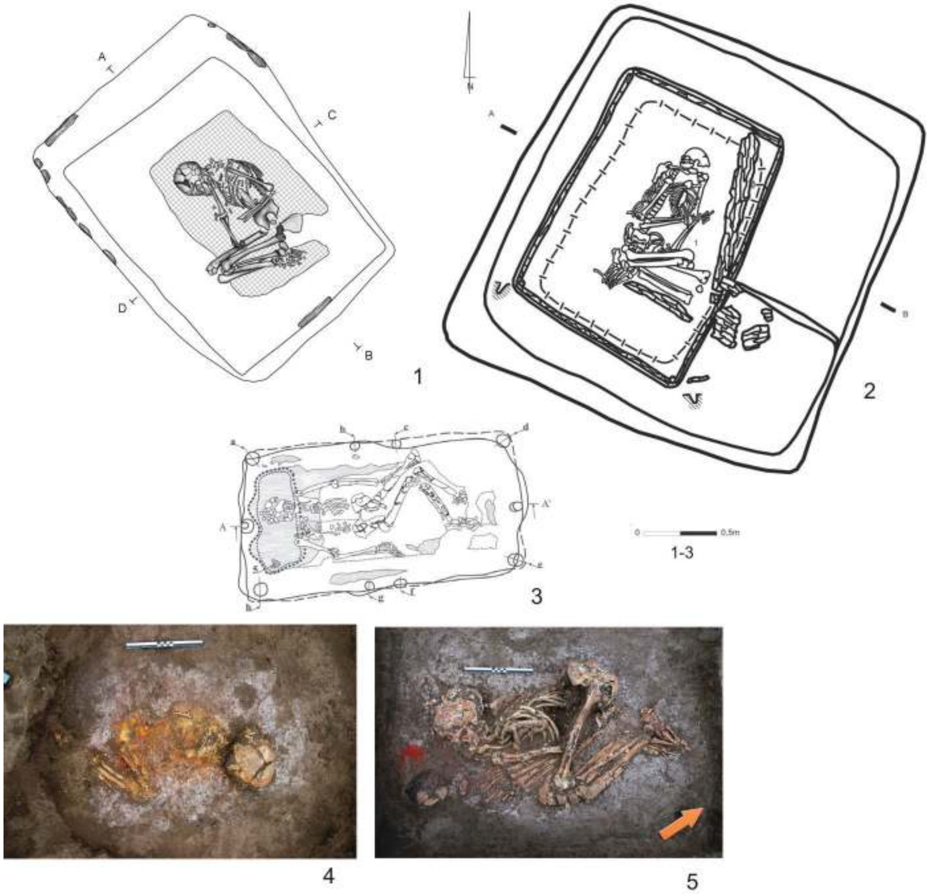
of 32°; [minimum/maximum measurements: 0.57-0.82 mm]); weft – 0.75 mm (26°; [minimum/maximum measurements: 0.57-0.82 mm]). Structure: 1/1 plain weave – baize (3 weft weaves); kind IV (warp – 8 threads/1 cm; weft – 6 threads/1 cm). It appears that in the lumps, two or possibly even three layers of fabric have survived (fold, hood, shroud?).

The second type of Late Eneolithic burials in which mats were recorded is graves of adults (Pidlisivka 1/1B, Klembivka 1/14, 1/15, Prydnistryanske I/1). Mat remains survived best in the feature from Pidlisivka 1/1B (Fig. 6). Sample-sections of a distinct cream-white layer, readily observable in places immediately touching bones, were collected for microscopic analyses. Probably, the fragments of three kinds of goods were identified: two kinds of mats and a fabric.

The first object was plaited of thin twigs or roots (3.28-3.61 mm thick), using the simplest 'criss-cross' weave. This technique 'involves interlacing twigs as in a fabric, that is, at the right angle' [Moszyński 1967: 332]. Importantly, vertically, they were recorded on an average every 0.6-0.7 cm, whereas horizontally spaces were larger: every 1 cm [Podlewski 1960: 495, Fig. 302; Zeylandowa 1963: 281, 282] (Fig. 6: 1). The second mat might have been differently made. It appears that it was made of twigs of a larger diameter (0.6-0.7 cm), arranged in parallel to one another (every 0.8 cm) and joined by horizontal stabilizing elements. It is very likely that it resembled a mat from Bruszczewo [Kneisel 2010: 724, 728, Abb. 4] or another one built making use of 'ribs' 'between which short twigs, sticks or branches are vertically interlaced' [Podlewski 1960: 480, 481] (Fig. 6: 2). Of course, it was stiffer and more durable than the first mat; it was a kind of bier – about 1.0 cm thick – on which a corpse could be carried and/or placed in a grave pit. Thus, the feature held at least two objects that might have served different purposes: the criss-cross plaited object might have covered the head, while the mat could have been a bier. On the traces of the plaited object and mat, pressed negatives of a 'fabric' have survived (clothing or shroud).

In the samples collected from feature 1B (samples 14 and 15), fabric impressions were identified as well. The fabric was made using a 1/1 plain weave with a belt(s) of baize. In addition, the fabric was thick, of kind IV (6-8 threads/1 cm). It could have been made of elementary fibres about 0.016 mm thick (unfortunately, the raw material is not known). Similar fibres may have been used to make right-twisted yarn (ZZ) in both thread systems, that is, warp (Wp) and weft (Wf). From thinner, better twisted Wp threads (average of measurements: 0.63-0.7 mm; elementary fibre twist angle: 35°) and appropriately thicker Wf threads (0.72-0.77 mm), a thick decorative plain 1/1 fabric was woven with baize elements, that is, with perpendicular (weft) sheds, owing to which on the fabric surface, characteristic longitudinal belts are (alternately?) formed [Chmielewski 2009: 233-235, Fig. 129].

It still remains a riddle how to interpret the remains found at the bottom of the Eneolithic feature in Prydnistryanske I/1 (sample 11). A pit of an almost square outline most likely is an excavation, destroying an earlier feature associated with



F i g . 8 . Yampil Region. Examples of mats at the burial levels: 1 – Prydnistryanske IV/9, 2 – Porohy 3A/11, 3 – Pisarivka 6/2, 4 – Porohy 3A/3, 5 – Porohy 3A/7

the Tripolye-Gordineşti culture. The feature fill yielded two Tripolye pottery shards while at the feature bottom, a distinct outline of an object made of an organic substance could be discerned (Fig. 7). It was used to procure a ^{14}C measurement for this feature. The analysis of its organic compound content shows that it closely resembles that of the residues interpreted here as mats.

3.2.2. YAMNAYA CULTURE

Most mat samples from the burial level subjected to analyses are associated with the Yamnaya culture. Their state of preservation varies. In most cases, their colour, varying from cream through white-pink to brown clearly stands out against the loess substratum into which graves had been dug. In some cases, the mat colour changes in the immediate vicinity of the bones of a skeleton and around it (e.g. Porohy 3A/15). Their relatively small thickness of up to a few millimetres contributed to the frequent obliteration of mat outlines by post-depositional processes or in the course of tricky exploration of such features. Nevertheless, the intention of grave builders to cover the entire bottom of a grave chamber with a mat is discernable (e.g. Dobrianka 1/5, Pysarivka 1/2, 3/3, 5/1, Porohy 3A/11 Fig. 8: 2) or the immediate surroundings of the burial itself (e.g. Prydnistryanske IV/9, IV/8) (Fig. 8: 1).

In the reports on older investigations (conducted prior to 2010), the questions of textiles are treated rather descriptively. Finds of a 'plant lining' (Pysarivka 1/2, 3/1, 3/3, 4/1, Porohy 4/8) are mentioned in general terms as are bark mats (Pysarivka 8/2, 9/2) and bark and flax mats (Dobrianka 1/5). To the exceptional complexity of this grave furnishing testifies the description of a burial from Pysarivka 6/2. According to the investigators, a record was made there of a mat constructed from 'reeds sprinkled with ochre of a raspberry colour. On the mat, a layer of bark was spread and sprinkled with the same ochre. In the vicinity of the head, on a burnt bedding, a leather pillow was placed and sprinkled with brown ochre' [Harat *et al.* 2014] (Fig. 8: 3).

Alas, we do not know if the above interpretations were supported by specialist consultations. Due to the misfortune mentioned earlier, these findings cannot be verified.

Below, the results of microscopic and chemical analyses of samples collected from Yamnaya culture features excavated in 2010-2014 shall be presented to explain the questions of raw materials identification and weaving techniques.

The microscopic findings may be illustrated by the study of samples from Pidlisivka 1/11 (sample 19). A sample collected from the bedding underneath the legs showed very shallow depressions (negatives) on three lumps of a dry substratum (measuring 23 × 20; 15 × 12; 11 × 11 mm). The impression survived on darker and brighter surfaces (of a dark red-grey and brown shade – 5YR 4/2 and 10YR 5/3). Most likely, the impressions were left by the remains of clothing (?) or a shroud (?) woven from elementary fibres 0.013-0.016 mm thick (good quality raw material of a plant or animal origin!). The yarn was poorly right-twisted (ZZ) both in the warp (Wp) and weft (Wf) and partially defibrated (elementary fibre twist angle: Wp – 25°, Wf – 21°, it had a similar thickness (Wp – average 0.64 mm [0.57-0.73 mm]; Wf – average 0.67 mm [0.65-0.73 mm]). Structure: 1/1 plain weave – baize (in belts?); kind IV (Wp – 8 threads/1 cm; Wf – 6/8 threads/1 cm).

On site Prydnistryanske IC, on the floor of the grave pit of feature 4, on samples collected from various places within the grave pit (samples 36-39), finds were made of impressions of a cloth of 1/1 plain weave, woven from dextrorotatory yarn in both thread systems (ZZ). As expected, yarn O was thinner (average thickness: 0.9 mm) than yarn W (1.1 mm), Tab. 8-10. These results differ from cloth measurements in barrow III (sample 48) in which traces of a thicker cloth were identified, woven from doubled Z/2S yarn (O density = 8 threads/1 cm; W density = 6 threads/1 cm). The physicochemical examinations of a sample collected from the bottom of this grave (sample 9) left no doubt that the mat was of a phytogenic origin and suggested grasses growing in a waterlogged environment as the raw material. They also showed traces of chemical compounds characteristic of propolis, beeswax and substances found in saffron or flax seed oils on the bottom of the grave.

Porohy 3A. In feature 1, there could have been a mat plaited using the band-cross technique, either straight or diagonal (Pisowicz 2009: 99-102), from bark strips/grass leaves 0.9-1.2 cm wide (samples 3, 15, 31). The small surface of the samples prevents a certain interpretation of the impressions, because the crossing withes/reeds/grass leaves or perhaps calamus (suggestion by Barbara Wielgus, M.A.) – more or less packed – may also result from an alternating arrangement without any stabilizing interweaving element (*see* Prydnistryanske IV/4 ; samples nos. 12, 13, 14, 16). On small sample surfaces, in both cases, similar 'crossings' of bands/grass leaves will be impressed. Similar observations and conclusions apply to samples from feature 10 (sample 26 [bands/stalks/leaves – up to 2 cm]) and feature 17 (sample 48).

Shallow impressions of a 1/1 plain-weave thick cloth of grade IV [Kamińska, Nahlik 1958: 80], were recorded in features 1, 10, and 17 on site Porohy 3A (Tab. 1-6, photo 3a). Although the measurement results – quite understandably – do not reproduce original characteristics [due to sample drying and subsequent shrinkage of negatives – Kaczmarek 2015: 263], permit several observations. The textiles were woven from dextrorotatory yarn (Z), varying in the thickness of warp (O) and weft (W) threads. In each feature, O threads were thinner and more tightly twisted than W ones (average of measurements: feature 1: O – 0.87; W –1.1; feature 10: O – 0.8, W – 0.9; feature 17: O – 0.8, W – 0.95 mm). Generally speaking, these thicknesses are comparable with thread impressions on above all Eneolithic and Early Bronze pottery (sometimes also in the 'ceramic body' – clay, Chmielewski 2009: 232) not only from Poland [Chmielewski 2009: 233; Podkańska 2012: 213; Sikorski 2016: 371, Tab. 12.4, 12.5]. Traces of cloths made using the simplest weave with a relative high incidence of spindle bobs and loom weights show that not only spinning but also weaving were common crafts [Łaszczewska 1966: 26] 1/1 plain weave cloths and their derivatives are considered the most popular in the Eneolithic [Chmielewski 2009: 233-236].

The physicochemical analysis of a mat sample (sample 5, feature 1, sample 4, feature 10) has found the same chemical compounds as those revealed in earlier analyses (*see* part 4).

In a single Catacomb culture feature from Pidlisivka 1/4, hardly noticeable mat remains were found. Under a microscope, traces of animal skin (samples 16, 17) were identified (a fatty darker spot on a lump), as well as those of wool (?), bast and/or grass (?). Of this raw material, lightly right-twisted threads (ZZ) were made. Their average Wp thickness was 0.57-0.69 mm, while the fibre twist angle was about 35°, whereas their Wf thickness was 0.67-0.71 mm and the fibre twist angle was 35-45°. Structure: 1/1 plain weave – baize; kind IV (Wp – 6 threads/1 cm; Wf – 5/6 threads/1 cm). In the lump, at least two layers of fabric were indentified (fold, hood, shroud). In addition, a thin (0.08-0.1 mm) ochre film clearly stood out against the substratum throughout.

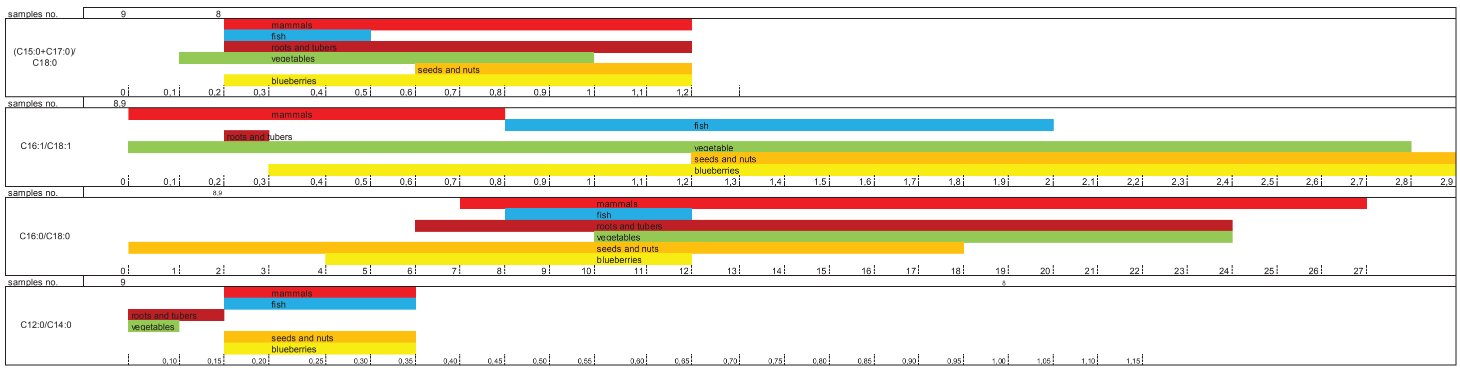
In three Babyno culture features, a record was made of the poorly preserved traces of an organic grave-pit bedding (Dobrianka 1/9, Pysarivka5/2, Pidlisivka 1/5). Due to the poor quality of samples, however, no specialist analyses could be performed.

The youngest of the preserved mats are associated with the Noua culture (Klembivka 1/13, Porohy 3A/3, 3A/5, 3A/7). They were preserved best on the Porohy site where they form a distinct pink-white layer in features 3A/3 and 3A/7 (Fig. 8: 4, 5). The chemical analyses of their samples show them to be very similar in terms of the compound content to such residue samples collected from Eneolithic and Yamnaya culture features in spite of their cultural and chronological differences.

4. CHEMICAL ANALYSES

Thirteen samples from archaeological sites in Porohy and Prydnistryanske were analyzed for fatty acids and compounds characteristic of the lipid profile, and most frequent in mat samples. Moreover, the lipid fraction was examined using infrared spectroscopy.

The determined percentage content of an organic acid is not directly used to make conclusions about the source of organic residues, because the presence of a single acid is not characteristic of a given type of food (of plant or animal origin). The conclusions presented here rely on the proportions of fatty acids proposed by the American archaeologist, Eerkens, from the University of California. Having studied many historical vessels and fresh and decomposed food, and relying on the information obtained by traditional archaeological methods, he found the proportions of selected fatty acids to differ greatly, depending on whether food was of animal or plant origin. It must be kept in mind, however, that he studied



F i g . 9. Fatty acid proportions used to distinguish between food types. Data for decomposed products

Table 2

The most common compounds characteristic of a lipid profile

Name of the chemical compound	Sample no.												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Benzoic acid i pochodne	+	-	-	+	-	+	+	+	+	-	+	+	+
17-Pentatriacontene	+	+	-	+	+	+	+	-	-	+	-	-	+
1-Monolinoleoylglycerol trimethylsilyl ether	+	-	+	+	-	+	+	+	-	-	-	-	-
Hentriacontane	+		+	-	+	+	+	+	+	+	+	+	+
Trilinolein	+	+	+	-	+	+	+	+	+	-	+	+	+
2-Monostearin trimethylsilyl ether	+	+	+	+	+	+	+	+	+	-	+	+	+
9,12,15-Octadecatrienoic acid, 2-[(trimethylsilyl) oxy]-1-[[(trimethylsilyl)oxy] methyl]ethyl ester, (Z,Z,Z)-	-	-	+	+	-	+	+	-	-	-	-	-	-
9,12-Octadecadienoic acid, (2-phenyl-1,3-dioxolan-4-yl) methyl ester, (Z,Z)	+	+	-	-	+	-	+	+	+	-	+	+	+
Tetrapentacontane, 1,54-dibromo-	+	+	-	-	-	+	+	+	-	-	-	-	+

organic residues on pottery. With this reservation, the proportions of appropriate fatty acids in Porohy and Prydnistryanske samples were calculated according to the method suggested by Eerkens [2005] (Fig. 9).

If interpretations are based on fatty acid content proportions, all the samples are in principle of plant origin. However, relying solely on fatty acids, the proportions of which are characteristic of food residues on pottery, it would be difficult to determine the origin of mat samples. Therefore, the most suitable for this purpose compounds known as potential archaeological biomarkers may provide an answer if the mats were made of a plant material (e.g. straw, grass, wicker) or an animal one (e.g. animal skin) [Kałużna-Czaplińska *et al*. 2016]. The concept of archaeological biomarker can be defined as a substance found in analyzed organic residues on, for instance pottery; and which supplies information on past human activity and tradition. Biomarkers are used to determine unequivocally the source or the kind of sources of food kept and/or processed in pottery. For instance, the presence of cholesterol is the positive proof that meat came into contact with the studied object, whereas sitosterol (phytosterols, generally) is a biomarker indicative of plant food.

Tab. 2 shows compounds characteristic of a lipid profile that were the most frequent in the studied mat samples. Relying on chromatographic analyses and infrared examinations; as well as a careful study of relevant scholarly literature, we have found that the examined mats were made of plant raw materials such as, most likely, seaweed or some other water plants (algae). The presence of glycolipids and compounds resulting from the biotransformation of fatty acids, such linoleic and oleic acids, to Octadecatrienoic acid, 2-[(trimethylsilyl)oxy]-1-[[(trimethylsilyl) oxy]methyl] ethyl ester, (Z,Z,Z) and 9,12-Octadecadienoic acid, (2-phenyl-1,3-dioxolan-4-yl) methyl ester, (Z,Z) may potentially indicate seaweed (e.g. *Zostera marina L.*) which even today is found in the Black Sea and is known for its use in plaiting. Examinations have shown the composition of this seaweed species to resemble that of the mats under investigation [Kawasaki *et al*. 1998, Dembitsky *et al*. 1991].

The plant material of which the mats were made was most likely covered by a viscous resinous substance of a plant origin but produced by bees, that is, beeswax (propolis). It could serve as glue but today it is also known for its bactericidal properties. This is evidenced by the presence of two compounds: benzoic acid and 17-Pentatriacontene, which even today are considered ingredients of beeswax characteristic of the Black Sea Region [Erturk *et al*. 2016; Çelemli 2015].

Other compounds such as 1-Monolinoleoylglycerol trimethylsilyl ether or trilinolein (Trilinoleina) are in all likelihood of plant origin. The former is a steroid characteristic of, among others, sea or shore plants [Sheela, Uthayakumari 2013]. The latter is found in saffron and flax seed oils. Hentriacontane, an alkane, found in plants is also present in arabic gum and forms 8-9 per cent of beeswax. Interestingly enough, it is characteristic of specific Black Sea deposits [Sinninghe *et al*. 1995].

The analysis of the lipid fraction using infrared spectroscopy showed only small differences in the spectra of examined samples (Fig. 10). The readings confirm the presence of fatty acids and their derivatives in the mat samples.

5. CONCLUSIONS

Summing up, it should be stressed that mats and textiles were important for ritual scenarios. Statistically, the now observable use of mats and textiles in the burials found in the forest-steppe around Yampil seems to suggest that the practice has been more important for Eneolithic and Yamnaya communities than the taxa associated with the Catacomb, Babyno and Noua cultures.

The study of weaving techniques and materials used indicates considerable continuativeness in these respects shown by communities belonging to various cultures settling the area in question between 3300 and 1300 BC. Moreover, the study supplies palaeo-environmental data, which have been unavailable for this area until now.

The methods that have been applied enabled us to analyze the remains that have not been useful in the study of mats and textiles so far. The microscopic study of fabric and plait impressions observable on organic remains helps draw conclusions on how they were made, without having an access to the woven goods themselves or their impressions left on pottery, and as such is a major development in the methodology of such analyses. Finally, the chemical analyses also point to new ways of studying such remains next to palaeo-ecological ones applied so far.

CATALOGUE OF SAMPLES

Site	**Feature**	**Culture**	**^{14}C dates**	**Impression analyses**	**Chemical analyses**
Pidlisivka 1	1B	Eneolithic	Ki-16674 3680 ± 90 BP	smp 14, smp 15	
Pidlisivka 1	4	CC	Ki-16675 3810±80 2436-2139	smp 16, smp 17	
Pidlisivka 1	10	Eneolithic		smp 18	
Pidlisivka 1	11	YC	Poz-81824 4085±30 2836-2575	smp 19	
Porohy 3A	1	YC		smp 3, 10, 13, 15, 31, 34	smp 5
Porohy 3A	2	YC	Poz-74392 4140±35 2864-2632 2736-2626		smp 1
Porohy 3A	3	NC			smp 2
Porohy 3A	7	NC	Poz-70667 4115±35 2856-2601 2864-2731		smp 3
Porohy 3A	10	YC	Poz-74393 4105±35 2850-2687 2632-2572 4.8 3.19 Poz-81824 4040±35 2619-2490 2632-2572	smp 25, 26	smp 4
Porohy 3A	20	YC	Poz-47744 4190±35 2884-2700 2785-2676 Poz-74397 4175±35 2879-2695 2785-2676		smp 6
Porohy 3A	19				

Site	Feature	Culture	^{14}C dates	Impression analyses	Chemical analyses
Porohy 3A	17			smp 48	
Porohy 3A	15				
Porohy 3A	18				
Prydnistryanske KI	1	Eneolithic	Poz-66235: 13390 ± 70 BP (wood?); Poz-66214: 4700 ± 70 BP (wood)		smp 11
Prydnistryanske KIII	3	Eneolithic	Poz-71367 4510±40 3343-3109 3289-3138	smp 48	smp 13
Prydnistryanske KIV	3	YC	Poz-66228 4090±35 2847-2574 2671-2586		smp 7
Prydnistryanske KIV	4	YC	Poz-66218 4105±40 2851-2580 2621-2489 I/4 (M) Poz-66219 4070±35 2834-2499 2564-2467 13.6 n.m. Poz-66220 3940±40 2548-2348 2564-2467 1 1.0 n.m. I/4 (F?) BIS Poz-66732 3940±35 2548-2348 2564-2467 as above	smp 12, 13, 14, 16, 36, 37, 38, 39	From stone cover smp 8 and grave bottom smp 9
Prydnistryanske KIV	6	YC	Poz-70673 4090±40 2850-2573 2861-2682 7.0 3.07 (wood) Poz-66231 4185±35 2882-2698 2861-2682		smp 10
Prydnistryanske KIV	8	YC	Poz-66232 4090±35 2847-2574 2671-2586		smp 12

Translated by Piotr T. Żebrowski

REFERENCES

Barber J. W.
1992 *Prehistoric textiles.* Princeton.

Chmielewski T.
2009 *Po nitce do kłębka... O przędzalnictwie i tkactwie młodszej epoki kamienia w Europie Środkowej.* Warszawa.

Çelemli Ö.G.
2015 Chemical Classifi cation of Propolis Samples Collected from Different Regions of Turkey in Geographical Region Base. *Hacettepe Journal of Biology and Chemistry* 43 (1): 49-57.

Dembitsky V.; Pechenkina-Shubina E.E.; Rozentsvet O.A.
1991 Glycolipids and fatty acids of some seaweeds and marine grasses from Black Sea. *Phytochemistry* 30: 2279-2283.

Eerkens J.W.
2005 GC–MS analysis and fatty acid ratios of archaeological potsherds from the Western Great Basin of North America. *Archaeometry* 47: 83-102.

Erturk O., Cil E., Yoloğlu N., Yavuz C.
2016 An In vitro Study on Antimicrobial and Antioxidant Activity of Propolis from Rize Province of Turkey. *Mellifera* 16 (1): 4-18.

Goslar T., Klochko V.I., Kośko A. Włodarczak P., Żurkiewicz D.
2015 Chronometry of Late Eneolithic and „Early Bronze" Cultures in the Middle Dniestre Area: Investigations of the Yampil Barrow Complex. *Baltic-Pontic Studies* 20: 256-291.

Harat K., Potupczyk M., Razumow S.
2014 Charakterystyka źródeł archeologicznych pozyskanych w latach 1984-1993. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie 6,* 45-204. Poznań.

Juras A.
2014 Badania kopalnego DNA z cmentarzysk społeczności „wczesnobrązowych" na stanowisku Pidlisiwka 1. In: A. Kośko, M. Potupczyk, S. Razu-

mow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie 6,* 297-300. Poznań.

Kaczmarek M.
2015 Sznur czy tekstylia? Analiza tekstylna ornamentu odciskanego na ceramice funeralnej społeczności niżowych III tysiąclecia przed Chr. *Fontes Archaeologici Posnanienes* 51: 263-281.

Kałużna-Czaplińska J., Rosiak A., Kwapińska M., Kwapiński W.
2016 Different Analytical Procedures for the Study of Organic Residues in Archeological Ceramic Samples with the Use of Gas Chromatography mass Spectrometry. Critical Reviews. *Analytical Chemistry* 46 (1): 67-81.

Kamińska J., Nahlik A.
1958 *Włókiennictwo gdańskie w X-XIII wieku.* Łódź.

Kawasaki W., Matsui K., Akakabe Y., Itai N., Kjiwara T.
1998 Volatiles from Zostera marina. *Phytochemistry* 47 (1): 27-29.

Kneisel J.
2010 Pochówek na osadzie z wczesnej epoki brązu. In: J. Müller, J. Czebreszuk, J. Kneisel (Eds) *Bruszczewo II. Badania mikroregionu osadniczego z terenu Wielkopolski. Studia nad Pradziejami Europy Środkowej* 6.2, 724-729. Bonn.

Litvinova I.V., Łukasik S., Żurkiewicz D., Gwizdała M., Chyleński M., Malmström H., Jakobsson M., Juras A.
2015 Anthropological description of skeletal material from the Dniester Barrow-Cemetery Complex, Yampil Region, Vinnitsa Oblast (Ukraine). *Baltic-Pontic Studies* 20: 292-335.

Łaszczewska T.
1966 Pradzieje włókiennictwa. In: J. Kamińska, I. Turnau (Eds) *Zarys historii włókiennictwa na ziemiach polskich do końca XVIII wieku,* 21-53. Wrocław-Warszawa-Kraków.

Moszyński K.
1967 *Kultura ludowa Słowian. Vol. 1. Kultura materialna*, Warszawa.

Podkańska M.
2012 Odciski tekstylne na ceramice. In: P. Silska (Ed.) *Wczesnobrązowa osada obronna w Bruszczewie. Badania 1964-1968*, 207-213. Poznań.

Podlewski O.
1960 Plecionkarstwo. In: J. Burszta (Ed.) *Kultura ludowa Wielkopolski. Vol. 1.* 471-496. Poznań.

Sheela D., Uthayakumari F.
2013 GC-MS analysis of bioactive constituents from coastal sand dune taxon – Sesuvium portulacastrum (L.*). Bioscience Discovery* 4 (1): 47-53.

Shishlina N., Golikov V., Orfinskaya O.,
2000 Bronze Age Textiles of the Caspian Sea Maritime Steppes. In: J. Davis-Kimball. E.M. Murphy, L. Koryakova, L. Yablonsky (Eds) *Kurgans, Ritual Sites, and Settlements Eurasian Bronze and Iron Age. British Archaeological Reports. International Series* 890, 109-117. Oxford.

Shishlina, N., Orfinskaya, O., Golikov, V.
2003 Bronze Age Textiles from North Caucasus: new evidence of fourth millennium BC fibers and fabrics. *Oxford Journal of Archaeology* 22 (4): 331-344.

Sikorski A.
2016 Wytwarzanie i użytkowanie tekstyliów. In: M. Szmyt (Ed.) *Biały Potok. Materiały z badań Józefa Kostrzewskiego na Podolu,* 365-389. Poznań.

Sikorski A., Żurkiewicz D.
2014 Charakterystyka mat udokumentowanych w pochówkach związanych z karhanem 1 w Pidlisivce. In: A. Kośko, M. Potupczyk, S. Razumov (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie 6,* 281-290. Poznań.

Sinninghe J.S., Erkes A.M. Rijpstra W.I.C., de Leeuw J.W., Wakeham S.G.
1995 C32-C36 polymethyl alkenes in Black Sea sediments. *Geochimica et Cosmochimica Acta* 59 (2): 347-353.

Zeylandowa M.
1963 Osada kultury łużyckiej w Turbi, pow. Tarnobrzeg. *Materiały Archeologiczne* 4: 253-297.

Baltic-Pontic Studies
vol. 22: 2017, 191-225
ISSN 1231-0344
DOI 10.1515/bps-2017-0026

Arkadiusz Marciniak*, Yevheniya Y. Yanish, Oleh Zhuravlov***, Aleksander Kośko****, Piotr Włodarczak*****, Danuta Żurkiewicz****

STATUS OF ANIMALS IN FUNERARY RITUALS OF FOUNDERS AND USERS OF CEREMONIAL CENTRES OF THE YAMPIL BARROW CEMETERY COMPLEX(4TH/3RD-2ND MILLENNIUM BC). A ZOOARCHAEOLOGICAL PERSPECTIVE.

ABSTRACT

This study discusses the issue of 'animal deposits' in funerary practices of early barrow communities settling the Black Sea steppe and forest-steppe in the 4rd/3nd-2nd millennium. The focus of analytical studies is directly on the Yampil Barrow Cemetery Complex situated along the left bank of the Dniester, between the Murafa and Markivka rivers, or what is the Yampil Region (Vinnitsa *Oblast*) now. The chorological system developed by N.Ya. Merpert in his "Yamnaya Cultural-Historical Area" places this area within the Southwestern Variant (between the Southern Bug and Danube rivers) as the Yampil (Podolia) territorial centre. From the perspective of the research programme exploring the 'bio-cultural border land between the West and East of Europe', the Yampil Barrow Cemetery Complex is of special

* Department of Theory and Methods in Archaeology, Institute of Archaeology, Adam Mickiewicz University, Umultowska 89D, 61-614 Poznań, Poland; arekmar@amu.edu.pl
** Shmagayzen Institute of Zoology National Academy of Sciences of Ukraine, Vul. B. Khmelnytskogo15, Kyiv 01030, Ukraine; tinel@ukr.net
*** Institute of Archaeology National Academy of Sciences of Ukraine; Heroyiv Stalingrada 12, 04210 Kyiv, Ukraine
**** Department of Prehistory of Central and Eastern Europe, Institute of Archaeology, Adam Mickiewicz University, Umultowska 89D, 61-614 Poznań, Poland; antokol@amu.edu.pl; danuta@amu.edu.pl
***** Institute of Archaeology and Ethnology of Polish Academy of Sciences, Centre for Mountains and Uplands Archaeology, Sławkowska 17, 31-016 Kraków, Poland; wlodarczak@gmail.com

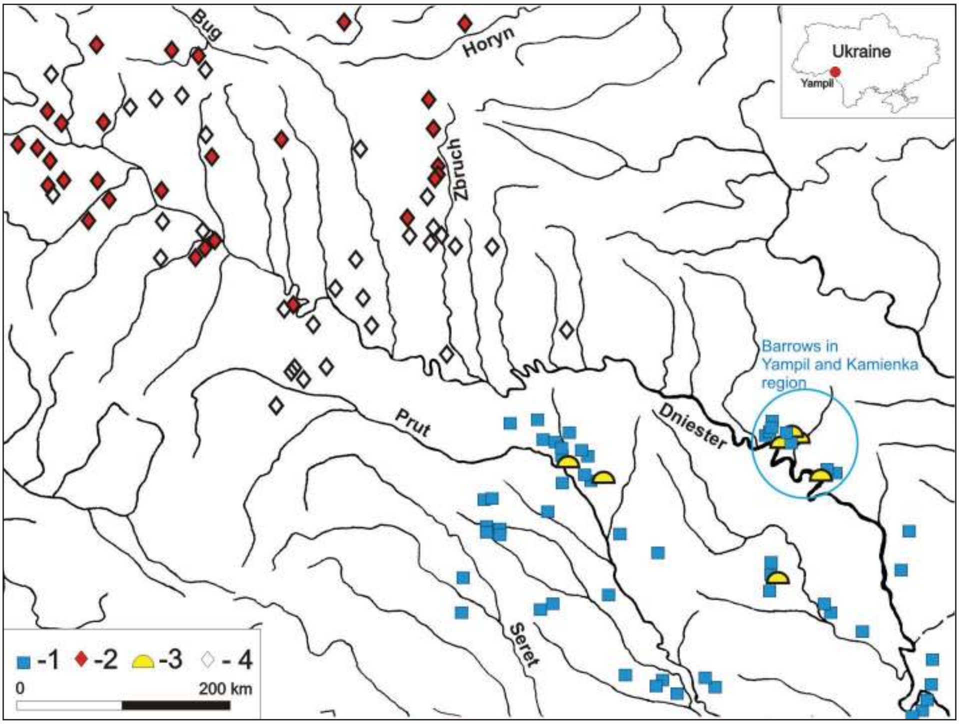


Fig. 1. Location of Yampil and Kamienka ceremonial centres, and barrows of the Yamnaya culture, Corded Ware culture, and Late Eneolithic groups of the Podolia Plateau and adjacent areas. Legend. 1 – barrows and barrow groups of the Yamnaya culture; 2 – barrows and barrow groups of the Corded Ware culture; 3 – Eneolithic barrows; 4 – barrows of undetermined cultural attribution, dated to the 3rd millennium BC [*after* Włodarczak 2014b, revised]

scholarly interest because of its western most location on the Dniester route of exchange for cultural patterns developed by communities settling the drainage basins of the Black and Baltic seas. The investigations followed the excavations of 23 barrows between 1984 and 2014.

Key words: Eneolithic, Yamnaya culture, Catacomb culture, Babyno culture, Noua culture, Globular Amphora culture, Corded Ware culture, barrows, funerary deposits, ‘animal deposits’

INTRODUCTION

The *Yampil Barrow Cemetery Complex* (YBC or YBCC) refers to the area with 'barrow architecture' located along the left bank of the Middle Dniester and its tributaries (between the Murafa and Markivka), or what is the Yampil Region (Vinnitsa *Oblast*) in modern administrative division (Fig. 1). Barrows of this Complex were built on "the substratum of typical *chernozem*, showing characteristics typical of pedogenic conditions prevailing in the transition zone of the subboreal belt with a temperate climate, displaying marked continental characteristics and supporting steppe vegetation" [Bednarek, Jankowski 2014: 279].

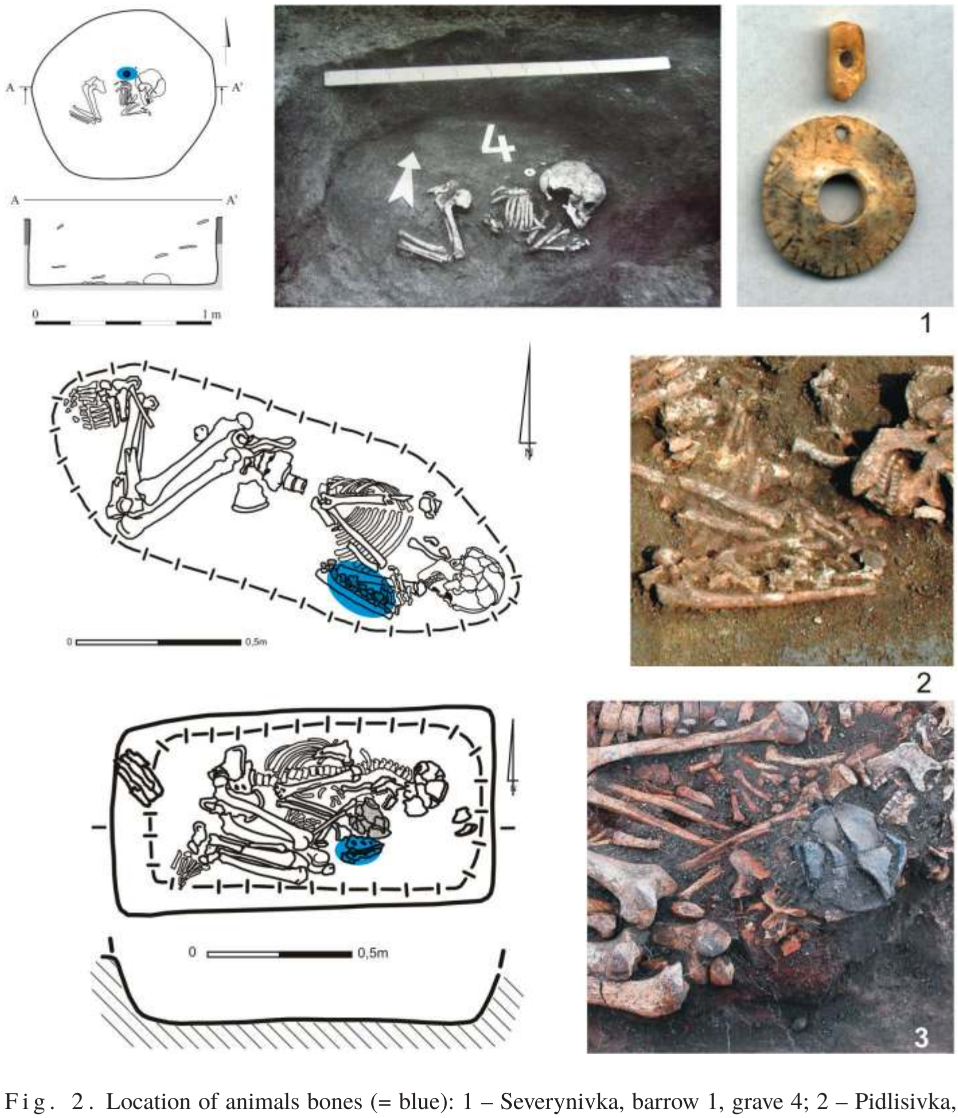
Still used with just minor amendments, N.Ya. Merpert [1974] places the "Yamnaya Cultural-Historical Area", often referred to as the *Yampil (Podolia) territorial centre*, within the *Southwestern Variant* (between the Southern Bug and Danube rivers), which formed the northwest boundary of the Yamnaya culture circle [Merpert 1974; Rassamakin, Nikolova 2008: Fig. 1; Ivanova, Toschev 2015: 378; *see* Heyd 2011].

Until the 1980s, this area remained inaccessible for archaeological reconnaissance. Starting from 1984, during seven fieldwork seasons of field work (1984, 1985, 1986, 1988, 1991, 1992, 1993), 16 barrows were investigated [Potupczyk, Razumow 2014, with references to other literature describing the detailed results]. The results became a baseline for the Polish and Ukrainian *Yampil research project* initiated in 2010, with the focus on the 'Yampil section' of 'the bio-cultural borderland between the West and East of Europe' [Kośko *et al.* 2014][1].

From the perspective of the research programme exploring the 'bio-cultural borderland between the West and East of Europe', the *YBC* is of special scholarly interest because of it western most location on the Dniester route of exchange for cultural patterns developed by communities settling the drainage basins of the Black and Baltic seas. For the 4th/3rd-2nd millennium BC, the research interests remain focused on relationships between the Central European sub-circle of the Corded Ware culture (CWC) and the Black Sea populations of the Late Eneolithic and Early Bronze Age [Włodarczak 2014a; 2014b][2]. In the context of these relationships, study of rituals involving animals, including specifically funerary rituals, are of particular significance. However, the extent to which this specific area of ceremonial and than atological processes has been explored is far from satisfactory (*see* Chapter 1).

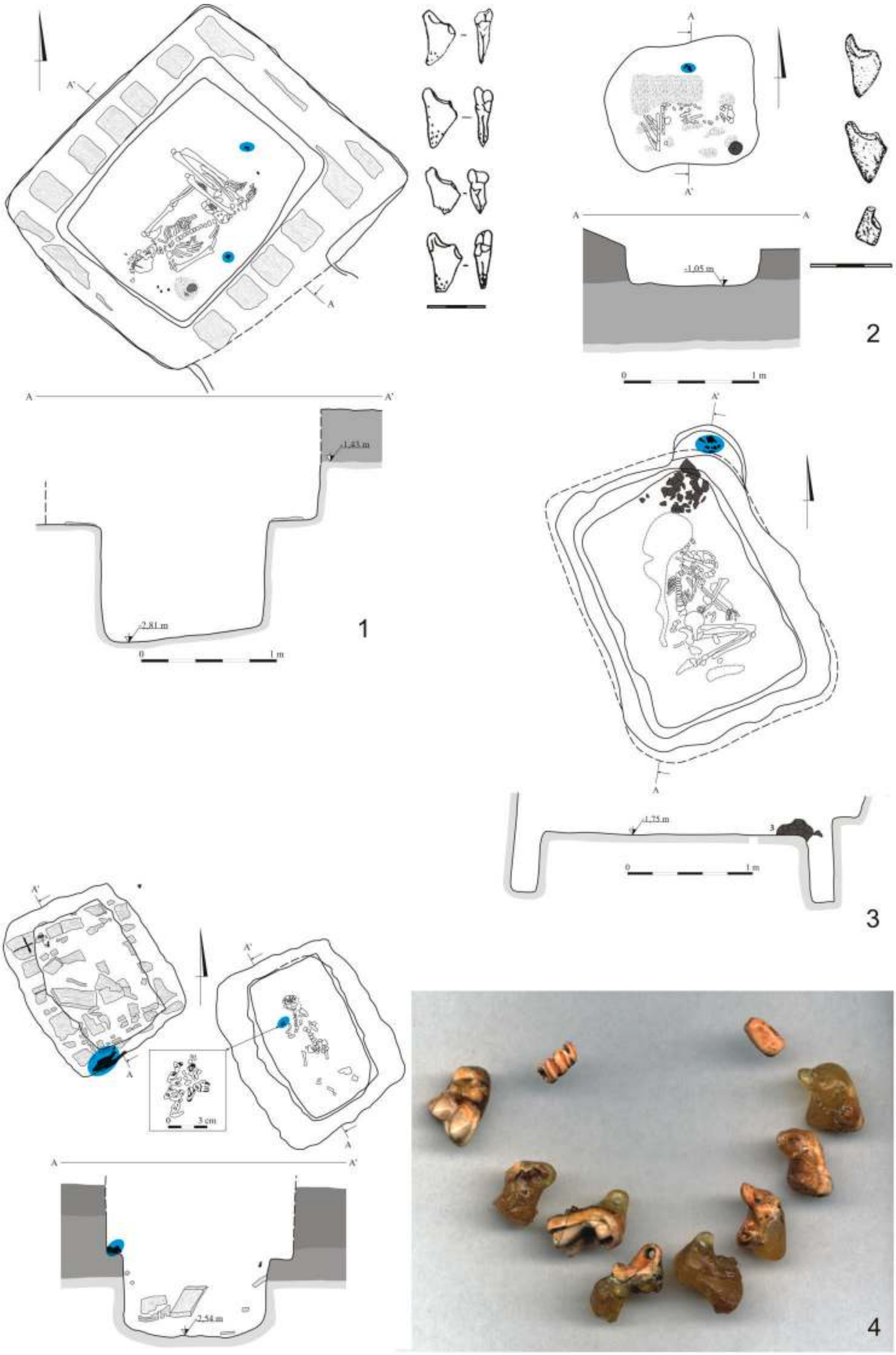
[1] Successive grants awarded by the National Science Centre and current grant no. 0108/NPH3/H12/82/2014 awarded by the National Programme for the Development of Humanities. The grants were, among other things, for scheduled excavation work between 2010 and 2014 (The Yampil Expedition), which covered seven barrow cemeteries and provided a vast body of evidence on burials containing 'animal deposits', as well as for follow-up studies comprising zooarchaeological identification [Zhuravlov 2013; 2014; Yanish 2012]. Fully scoped studies including taphonomic evaluation were, however, prevented for organizational reasons.

[2] *See*: Kośko [2014] for references to extensive literature



F i g . 2 . Location of animals bones (= blue): 1 – Severynivka, barrow 1, grave 4; 2 – Pidlisivka, barrow 1, grave 5; 3 – Porohy, barrow 3A, grave 5

Thirty years of archaeological exploration of the YBC have revealed a number of instances of animal bones having been placed in grave chambers attributed to Eneolithic or ‘Early Bronze’ ‘barrow cultures’ (Late Eneolithic; Yamnaya culture – YC; Catacomb culture – CC; Babyno culture – BC; Noua culture – NC). These discoveries, however, have not triggered to date any interdisciplinary projects. The paper presents the results of first archaeological and zooarchaeological studies of these assemblages (*see* Chapter 2 and 3).



F i g . 3 . Location of animals bones (= blue): 1 – Dobrianka, barrow 1, grave 4; 2 – Dobrianka, barrow 1, grave 6; 3 – Porohy, barrow 4, grave 8; 4 – Pysarivka, barrow 3, grave 2

In case of eight burial chambers (ca. 12% of all of 59 graves), the analysis involved merely a summary of notes from fieldwork carried out in the years 1984--1994[3]. The following materials were recorded: ‘goat cranium’ (Pysarivka 3/2), three instances of animal bones (Dobrianka 1/4; 1/6; 1/8), and three instances of hypothetical ‘animal bones’ (Pysarivka 1/1; 3/1 and Severynivka 2/12). It should be noted that ‘animal deposits’ and ‘animal teeth’ are frequently considered two distinct categories in the literature, including the study referred to above, with the latter being classified as artefacts or components of ‘amulets’ or ‘teeth necklaces’ (Severynivka 1/4, Fig. 2: 1, Pysarivka 3/2 Fig. 3: 4 specimen described as “deer tooth”). Overall, we thus have nine identified uses of ‘animal bones’, which means that 20.5% of the above-mentioned 44 graves from the YBC contained ‘faunal material’ (*see* Chapters 2 and 3). However, although these findings add some insight, they can hardly be deemed to carry any special heuristic value.

Somewhat different evidence was brought to light between 2010 and 2014 as a result of the joint Polish and Ukrainian project investigating 7 barrow cemeteries (*The Yampil Expedition*). It revealed 13 ‘animal deposits’, which were subjected to a zooarchaeological examination [Zhuravlov 2013; 2014; Yanish 2012; Klochko *et al*. 2015a, 2015b, 2015c, 2015d]. However, more comprehensive analysis, including taphonomic studies, has not been completed to date (Chapters 1 and 2).

Despite the limited scale of the hitherto completed studies, it is evident that the YBCC data examined so far offers an opportunity to significantly enhance our understanding of funerary practices, including ‘animal deposits’, of ‘early barrow’ communities (4rd/3rd-2nd millennium BC) or, more specifically, an important group inhabiting the northwest borderland on the Middle Dniester route for transmitting cultural beliefs from the Black Sea Region to the Baltic Sea drainage basin (territory of the Globular Amphora culture – GAC and Corded Ware culture – CWC).

The aim of this study is to explore the nature of the ‘animal component’ in rituals performed by YBCC communities. The focus is on funerary rituals involving animals. A wide range of issues such as animal species preferred for rituals, sex and age of these animals, as well as a number of other variables pertaining to the use of particular animal species, including methods of slaughtering, post-slaughter processing, and practices related to meat preparation, and consumption, are addressed. Special attention is paid to the character of deposition of animals and its fragments. It needs to stressed that the scale of analysis and comparability of the achieved results will depend on the volume and quality of empirical evidence available for analysis. Further, the goal is to identify changes in the above-mentioned practices over time.

Recognizing the origin of ‘animal deposition’ practices (Chapter 4 and 5) remains an important objective of the study from the standpoint of the ‘bio-cultural

[3] Zoo-archaeological analysis was prevented by destruction of the osteological material by fire in the warehouse of the Vinnitsa Regional Museum [Harat *et al.* 2014].

borderland between the West and the East of Europe'. This is particularly so in terms of their reference to the funerary traditions of 'Central European' communities of the Baltic Sea drainage basin, especially GAC groups (*see* Chapter 6).

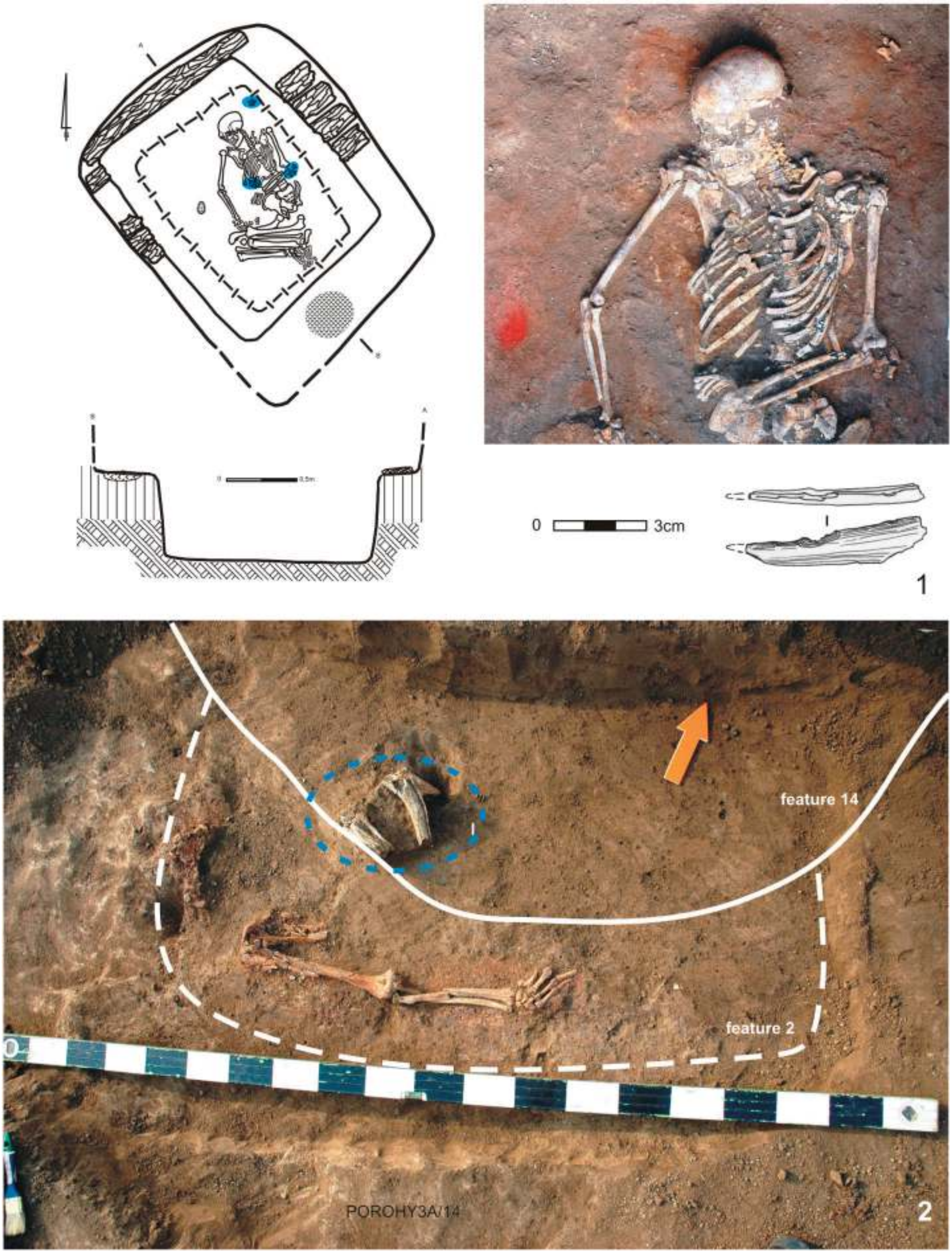
1. 'ANIMAL DEPOSITS' IN 'BARROW CULTURES' OF THE BLACK SEA REGION IN THE 4TH-2ND MILLENNIUM BC. AN OVERVIEW

The overwhelming majority of graves attributable to 'Pontic-Caspian' 'barrow cultures' was investigated in line with a narrowed conception of history as archaeometric measurement, fostered in the 19th and first half of the 20th century, or during conservation campaigns carried out according to Leonid Brezhnev's economic and political plan of transforming steppes into lands with productive agriculture. Both research models did not see osteological evidence as 'particularly preferable'. This does not mean, however, that until the late 1980s or early 1990s, when the 'conservation perspective' prevailed in investigating funerary features of the aforesaid communities, no significant zooarchaeological observations were made as side notes to descriptions of different categories of data, including their typological or taxonomic classification. It should be noted, however, that we are still suffering from glaring gaps in the comprehensive presentations of this research.

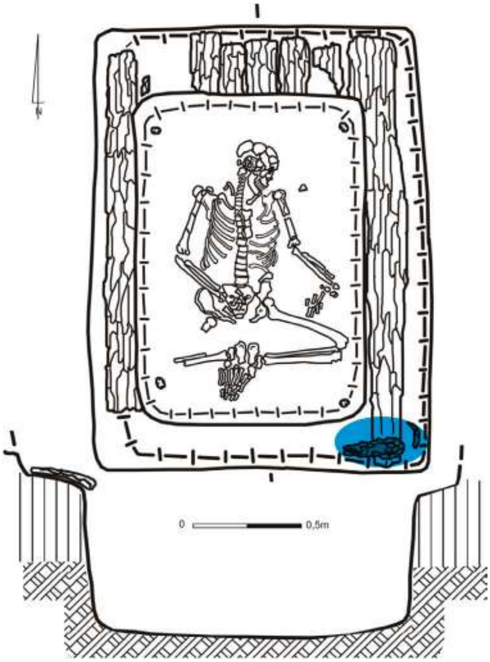
Studies on 'animal deposits' in Late Eneolithic and Early Bronze Age funerary practices in the 'Pontic-Caspian' steppe and forest-steppe(4th-2nd millennium BC) carried out to date may be divided into the following three phases:

(a) Faunal materials gathered as described above were for the first time systemically interpreted from the perspective of Indo-European studies by J.P. Mallory in his *In Search of the Indo-Europeans* programme [1989], which included a series of works on animal, fish, and bird species present in 'Indo-European Mythology'. J.P. Mallory recognized the ritual significance of different animal species. In subsequent studies, he gave the picture of how they manifested themselves in funerary practices of 'barrow communities' of the steppe and forest-steppe of the Black and Caspian seas [Mallory 1981; 1982; 1984; 1989; 1991]. He further attempted to place them in the context of 'Indo-European Mythology'.

(b) L.V. Subbotin in the early 1990s presented an overview of funerary contexts of animals in the Budzhak steppe/forest-steppe zone (Northwest Black Sea Coast, which is particularly close to our area of interest), with reference to studies on "economic and production activity of Yamnaya and Catacomb tribes" [Subbotin 1993]. Subbotin's findings in the Budzhak zone are worth highlighting here in the following three points:



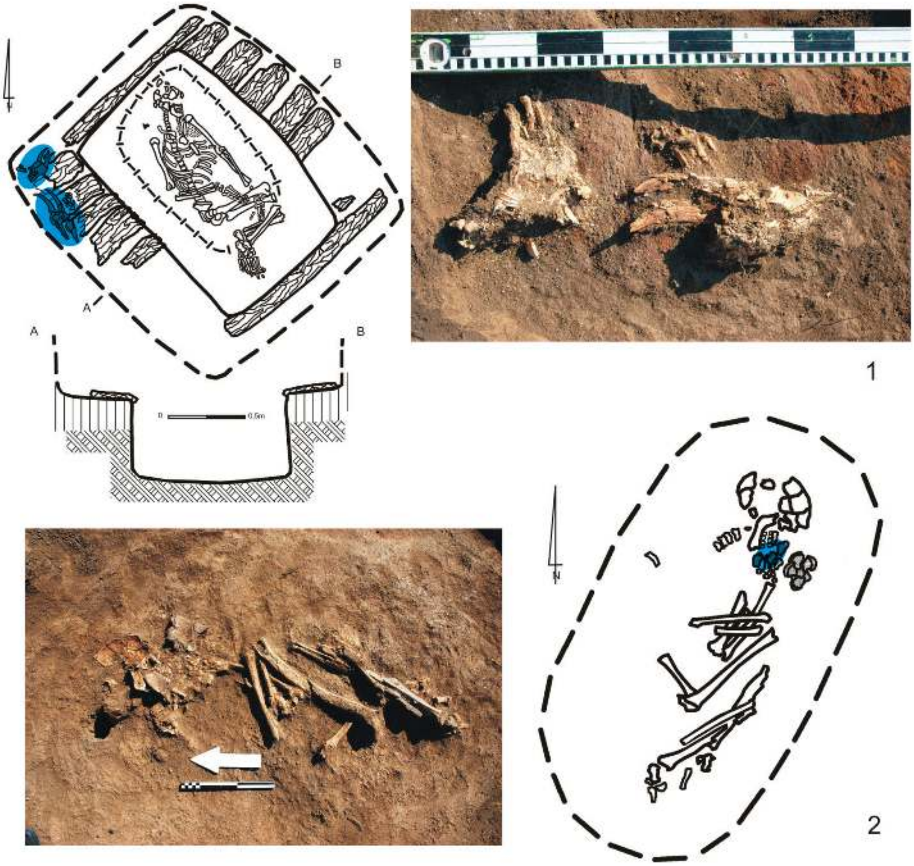
F i g . 4 . Location of animals bones (= blue): 1 – Porohy, barrow 3A, grave 10; 2 – Porohy, barrow 3A, feature 14



F i g . 5 . Location of animals bones (= blue): Porohy, barrow 3A, grave 11

- predominance of 'deposits of domestic animals' such as sheep (14), including 11 *astragali* (ankle bones used for game), cattle (6), horse (5), goat (1);
- a few bones of wild animals red deer (1), aurochs (1) and birds (1);
- no 'fish deposits' [Subbotin 1993: 9-11].

It is worth reiterating that 'animal deposits' and 'animal teeth' were classified as two separate categories, with the latter seen as artefacts or components of 'amulets' or 'teeth necklaces'. The use of 'animal teeth' in funerary rituals of the Northwest Black Sea Coast is clearly detectable already in the Late Eneolithic, when they occur in the association with other groups of 'animal evidence' (deer antler axe-hammers, or deer depictions on tombstones) for funerary rituals [Patokova 1979: 109-110 (wolf and dog teeth pendants), 48, Fig. 19: 7 (stone slab from Usatovo); Patokova *et al.* 1989: 102]. This might justify why this type of evidence is actually an inspiration for a separate sub-programme aimed at investigating 'deposits of animal bone artefacts' (or 'deposits of artefacts made from animal bones'). In this perspective, of particular significance are materials of the *Mamay-Gora Barrow Cemetery Complex*, which yielded 'pendants' made from wolf, red deer and *Rutilus frisii* (fish species, member of the *Cyprinidae family*) teeth [Andrykh, Toschev 2009: 214-216].



F i g . 6 . Location of animals bones (= blue): 1 – Porohy, barrow 3A, grave 17; 2 – Porohy, barrow 3A, grave 22

(c) New phase in studies on ‘animal deposits’ marks the comprehensive archaeological and zooarchaeological research by N.V. Rosiakova, summarized in her PhD dissertation: “Funerary assemblages with animal bones from Timber grave culture cemeteries of the cultural and historical community of the Samara sub-region on the Volga River” [Rosiakova 2015].

In short, as of today there is no comprehensive multi-dimensional analysis of the role of ‘animal deposits’ in funerary practices of ‘early barrow’ communities. The work carried out to date was largely focused upon their economic and adaptive significance rather than the semiotics of rituals, with orthogenetic and topogenetic analysis of the rituals in a broader context of the “Circum-Pontic culture circle“ [Klochko, Kośko 2013; Kośko 2013; 2014; Włodarczak 2014a].

Table 1

A number of identified and unidentified specimens from different cultures and sites of the Yampil barrow cemetery complex

Chronology/ Sites	Eneolithic	Yamnaya culture	Babyno culture	Noua culture	Unidenti-fied	Total	
	NISP	NISP	NISP	NISP	NISP	NISP	%
Dobrianka 1		8				8	2,17%
Klembivka 1			2		40	42	11,38%
Pidlisivka 1	11		28	1		40	10,84%
Porohy 3A	45	206		11		262	71,00%
Porohy 4		1				1	0,27%
Prydnistryanske IV		1				1	0,27%
Prydnistryanske III	1					1	0,27%
Pysarivka 3		12				12	3,25%
Severynivka 1			2			2	0,54%
Total	57	228	32	12	40	369	100,00%
%	15,45%	61,79%	8,67%	3,25%	10,84%	100,00%	

2. MATERIALS AND METHODS

2.1. FAUNAL MATERIALS

Archaeological and faunal data, which form a primary set of evidence to evaluate 'animal deposits' from the YBCC, originate from the following four sites (or, more broadly, from the excavated components of *ceremonial centres*): Pidlisivka 1, Porohy 3A, Klembivka 1, Prydnitryanske 1 [Klochko *et al.* 2015a; 2015b; 2015c; 2015d]. In addition, it is supplemented by 'on-site zooarchaeological observations' recorded in 1984-1993 conservation reports, with their subsequent re-analysis on the basis of available photographic documentation (Dobrianka 1, Porohy 4, Pysarivka 3 and Severynivka 1) [Harat *et al.* 2014; in addition to the analysis by A. Marciniak]

Overall, we examined 22 deposits containing animal remains or grave goods made of animal bones. The deposits originate from the following 11 sites: Dobrianka 1 (Fig. 3: 1, 2), Klembivka 1, Pidlisivka 1 (Fig. 2: 2), Porohy 3A (Fig. 2: 3; 4; 5, 6), Porohy 4 (Fig. 3: 3), Prydnitryanske 1-III, Prydnitryanske1-IV, Pysarivka

1, Pysarivka 3, Severynivka 1, and Severynivka 2. They represent the following cultural units: EN (Late Eneolithic: groups of the Tripolye culture – phase CII), YC, BC and NC (Table 1). The most numerous are materials attributed to the YC. These are 13 deposits of animal bones, accounting for 50% of the entire examined assemblage. Materials representing the other three cultural units are considerably less numerous. Eneolithic and BC sites are represented by three deposits, while the NC attribution is ascertained for just two recorded deposits of animal bones.

Faunal material recovered in 1984-1993 has not been quantitatively examined. Figures describing animal bones are only available for features investigated between 2010 and 2014. The assemblage consists of 369 fragments in total, including 26 fragments originating from the Eneolithic, 57 fragments from the Eneolithic or Yamnaya culture (Porohy 3A, feature no. 2/14- Fig. 4: 2), 228 fragments from the Yamnaya culture, 32 fragments associated from the BC, 12 fragments associated with the NC, and 40 culturally unattributed fragments from Klembivka.

Despite the constraints indicated above, we found that the data so far documented for the YBCC offer an opportunity to significantly advance our understanding of funerary practices, including 'animal deposits' of 'early barrow' communities (4rd/3rd-2nd millennium BC) or, more specifically, the group occupying the northwest borderland situated on the Middle Dniester route for transmitting cultural ideas from the Black Sea Region to the Baltic Sea drainage basin (territory of the GAC and CWC).

2.2. RESEARCH METHODS

The analysed faunal materials have been systematically studied by three researchers.

A majority of the the osteological material has been identified by Ukrainian researchers, Yevheniya Y. Yanish and Oleh Zhuravlov, as a part of inter-institutional cooperation between the Adam Mickiewicz University in Poznań and Institute of Archaeology, National Academy of Sciences of Ukraine [Yanish 2012; Zhuravlov 2013-2014].

For taphonomic analysis, Arkadiusz Marciniak received the faunal material recovered from only four features (2, 11, 14 and 17) at the YC site of Porohy 3A. Other materials presented in this study were not available for taphonomic analysis. In several cases, in addition to systematic taphonomic study, the work by Marciniak resulted in re-examination of earlier findings, including identification of species or anatomical parts. As a result, all faunal materials discussed in this article were systematically examined in terms of a wide range of zooarchaeological and taphonomic variables taking into consideration their fragmentation and generally a bad state of preservation.

The completeness of the material from the aforementioned four YC features was not reliably proven. In case of any discrepancies as to the number of bones between the current study and the Yanish's analysis, it was decided to stay by the results of the latter. This decision was primarily due to very poor condition of the faunal material, as indicated by a considerable degree of its fragmentation. Bone fragmentation is due to an advanced stage of bone mineralization resulting in reduced bone density. Advanced calcification of osteological materials makes any mechanical contact with them during transport, handling, or examination inevitably further exacerbate fragmentation. Furthermore identifications of small ruminant as belonging to goats made by Y.Y. Yanish were adopted without revision, although the material available for re-analysis prevented confirmation of such identifications.

As mentioned above, Arkadiusz Marciniak was provided with an access to faunal materials from only four features at Porohy 3A. They were thoroughly examined for the range of variables, such as species identification, body part distribution age, sex, and taphonomic modifications (cuts, breakages, traces of intentional processing). For identification purposes, every bone fragment was examined for anatomical, taxonomic and taphonomic characteristics, using reference collections of basic domestic species.

In the adopted analytical procedure, studied variables were recorded in the table in the following columns: Species, Age, Sex, Anatomical Part. They were then supplemented by a range of taphonomic observations, such as: Fragmentation, Breakage, Burning, and General Taphonomy.

The primary methods for determining the age at death comprise epiphyseal fusion and dental eruption/wear patterns. In addition, there are also other methods, such as development of horn cores in ruminants or antlers in cervidae. The first method compares the fusion stage and fusion timing determined based on actualistic studies [Silver 1969]. The other method relies on the assumption that, for a specific species and specific teeth (usually molars or premolars), eruption time may be relatively precisely determined [Silver 1969], and that there is a strong correlation between a degree of enamel wear and age of an animal [e.g. Payne 1973; Grant 1982].

Every faunal assemblage from an archaeological site is first of all shaped by taphonomic factors [Lyman 1994]. They include in particular slaughtering process, butchering and subsequent food related practices. They leaves a range of traces attributable to subsequent stages of carcass dismemberment and the meat preparation and consumption. These may include burning, fragmentation caused by carcass processing and marrow/fat extraction, and cut marks [Seetah 2006]. Butchering practices leave numerous traces on bones related to their subsequent stages, such as: skinning, disarticulation, filleting, marrow processing, and consumption [Binford 1981: 106].

The next step in the taphonomic analysis involved the examination of bone fractures. The observable shape and character of fractures, which is an outcome of actualistic studies [Binford 1978; 1981; 1984; Lyman 1994], makes it possible to distinguish their distinct forms indicative of their origin. The analysis also covered taphonomic factors of the biostratinomic stage [Marciniak 1996], including specifically bone weathering [Behrensmeyer 1978].

The following quantitative methods for the analysis of faunal remains were used: NISP (Number of Identified Specimens) and MNE (Minimum Number of Elements) [Grayson 1984; Lyman 1994; 2008; Reitz, Wing 2008]. NISP describes the number of specimens in each assemblage identified to a species, or, if such identification is not possible, to a genus or family and to an anatomical part. NISP values are usually given for particular species or entire animal bone assemblage. NISP is easy to determine as it requires counting bones identified to a particular species. NISP values are cumulative, which means that NISP values determined for various archaeological contexts are adding up and may be examined together. The restrictions of the method involve the interdependence [Grayson 1984, 23-4; Lyman 2008, 36-8]. It rules out a possibility of determining a number of individuals contributing to recorded faunal remains. This is primarily due to the high degree of fragmentation affecting most animal bone assemblages derived from archaeological sites. Moreover, NISP may be affected by the varying number of skeletal elements in different species.

To eliminate irremovable restrictions of the NISP method, MNE was also calculated. MNE is particularly useful for recognizing differences in body parts representation. The MNE method avoids counting the same skeletal element or fragment twice, which means that it is not affected by bone fragmentation. To calculate MNE, remains with the same anatomical and taxonomic identification are compared to find fragments that are known to come from two different skeletal elements/fragments. Such attribution may be made by matching fragments and looking for anatomical overlaps, by comparing age at death, sex, size, etc.

3. ANALYSIS OF ANIMAL DEPOSITS DERIVED FROM CEREMONIAL CENTRES OF THE YAMPIL BARROW CEMETERY COMPLEX

3.1. SUMMARY ANALYSIS

The faunal material subject to analysis comes from the burial contexts of nine sites identified as ceremonial centres of the YBCC (Table 1). It should be noted that it is very unevenly distributed across these cemeteries.

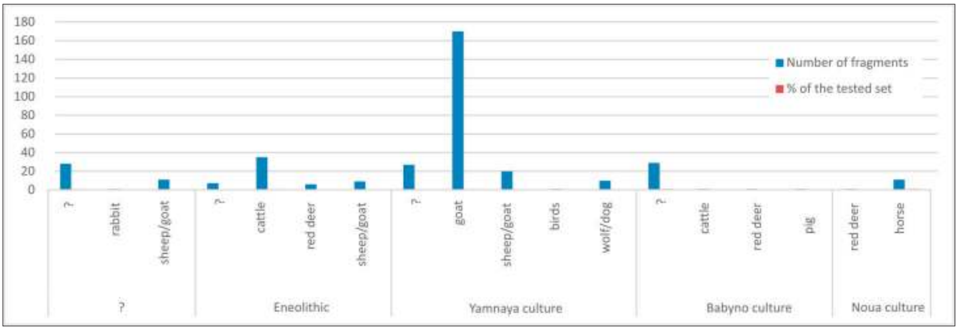


Fig. 7. Species composition at sites of different cultures of the Yampil barrow cemetery complex

The most numerically abundant is osteological material from the site of Porohy 3A, which yielded 262 bone fragments accounting for 71% of the studied assemblage. Faunal material from Klembivka 1 (NISP=42; 11.38%) and Pidlisivka 1 (NISP=40; 10.84%) is also relatively abundant. The other six sites, i.e. Pysarivka 3, Dobrianka 1, Severynivka 1, Porohy 4, Prydnistryanske III and Prydnistryanske IV, yielded 1 to 12 bone fragments each, thereby only slightly contributing to the overall number of bone fragments in the assemblage.

It should be highlighted that 'animal deposits' in the YBCC are not 'ritually extended' to include 'grave goods' made from other raw materials (non-osteological). The only exception is pottery fragments recorded in grave 2 within the *ceremonial centre* of Pysarivka 3.

Material derived from six of the nine examined sites represents just one cultural unit (Table 1). Two sites yielded material attributed to three cultures. As we have already mentioned, the most numerically abundant osteological material was recovered from the site of Porohy 3A, which yielded YC, NC and Eneolithic material, with the YC material predominating. The site of Pidlisivka 1 yielded BC, NC and Eneolithic material, with the BC material being most abundant. The available empirical material has not allowed any cultural attribution of features discovered at Klembivka 1. Material from one of the features has been, however, identified as belonging to the BC.

3.2. ENEOLITHIC

In the studied animal bone assemblage, Eneolithic material i.e. belonging to *founders of Yampil ceremonial centres*, are represented by just 57 bone fragments.

Table 2

Eneolithic features with animal bones at sites of the Yampil barrow cemetery complex. Species composition and body part representation

Species	Cattle					Sheep/Goat				Red deer			Unidentified	Total	
Anatomical part	skull	long bone	horncore	unidentified	Species sub-total	metacarpal	tibia	unidentified	Species sub-total	skull	horncore	Species sub-total	sub-total	NISP	%
Pidisivka 1				11	11				0			0	0	11	19,30%
Porohy 3A	2	5	17		24	1	2	6	9	1	5	6	6	45	78,95%
Prydnistryanske III					0				0			0	1	1	1,75%
NISP					35				9			6	7	57	100,00%
%					61,40%				15,80%			10,50%	12,30%	100,00%	

Table 3

Yamnaya features with animal bones at sites of the Yampil barrow cemetery complex. Species composition and body part representation

Species	Anatomical part/ sites	Dobrianka 1	Porohy 3A	Porohy 4	Prydnistryanske IV	Pysarivka 3	NISP	%
Goat	skull		65				65	
	phalanx I		9				9	
	phalanx II		6				6	
	phalanx III		4				4	
	lower tooth		2				2	
	upper tooth		7				7	
	sacrum		2				2	
	vertebra		1				1	
	horncore		48				48	
	tooth		16				16	
	rib		1				1	
	jaw		1				1	
	unidentified		8				8	
	Sub-total						170	74,56%
Sheep/goat	skull					1	1	
	phalanx II		3				3	
	phalanx III	8	3				11	
	tibia		1				1	
	metacarpal		3				3	
	horncore					1	1	
	Sub-total						20	8,77%
Wolf/ dog	tooth					10	10	
	Sub-total						10	4,39%
Birds	unidentified			1			1	
	Sub-total						1	0,44%
	unidentified		26		1		27	11,84%
	Total		206	1	0	12	228	100,00%

They originate from four features, two of them discovered at Porohy 3A, one at Pidlisivka 1, and one at Prydnitryanske III (Table 2).The overwhelming majority of the faunal material is identified to cattle (NISP=35; 61.4%). In addition, sheep/goat and red deer remains are also recorded (Fig. 7). It is worth noting that the feature at Pidlisivka 1 yielded nothing but cattle bones, while all of the three species were represented in the features at Porohy 3A (Table 2). Our analysis of faunal remains allowed us to recognize anatomical distribution of bones attributed to the three animal species identified in the Eneolithic features (Table 2). What is worth noting is that the anatomical distribution pattern in sheep/goat differs significantly from that in cattle and deer. For sheep/goat, nothing but long bone fragments were present, while for deer and cattle, there were cranial fragments and antler as well as cranial fragments and horncores, respectively. These significant differences should be linked to different ceremonial treatment of the two animal species. These observations should be, however, taken with caution, given the size of bone assemblage available for our analysis.

3.3. YAMNAYA CULTURE

As we have already mentioned, the YC faunal material is most numerically abundant in the group of four cultural units attributable to users of ritual centres of the YBCC. In total, 228 bone fragments from the following five sites (*ceremonial centres*) were recorded: Dobrianka 1, Porohy 3A, Porohy 4, Prydnistryanske IV and Pysarivka 3. The fragments were recovered from nine features, including three from the sites of Dobrianka 1 and Porohy 3A, and one from each of the other sites (Table 3). Most numerous are bones of small ruminants (NISP = 190), accounting for nearly 85% of the animal bone assemblage discussed in this study (Fig. 7).

As far as the five sites are concerned, the most numerically abundant material comes from Porohy 3A, accounting for over 90% of the YC material (Fig. 7; Table 3). Material from the other four sites is considerably less numerous. Porohy 4 and Prydnistryanske IV yielded only single bones. What is worth noting is that bones of small ruminants constitute the largest group within the studied assemblage. Such bones were recognized at three of the five sites under examination. The significant share of goat bones in the Porohy 3A material is remarkable (NISP – 170; 82,52%). Attention should also be paid to the significant share of dog/wolf bones from Pysarivka 3. Two sites with the smallest number of bones yielded bird bones (Porohy 4) and an unidentified bone (Prydnistryanske IV).

Our detailed analysis of the Porohy 3A material allowed us to calculate the Minimum Number of Elements (MNE). Feature 11 contained fragmented maxil-

Table 4

Babyno features with animal bones at sites of the Yampil barrow cemetery complex. Species composition and body part representation

Site / Species	Cattle	Pig	Red deer	Unidentified	NISP	%
Klembivka 1/1	1	1			2	6,25%
Pidlisivka 1/5				28	28	87,50%
Severynivka 1/4			1	1	2	6,25%
NISP	1	1	1	29	32	100%
%	3,13%	3,13%	3,13%	90,63%	100,0%	

lary bones together with a number of caprine mandible teeth. Both the type and number of these bones permitted us to derive the MNE value of 2. Consequently, we were able to recognize that the feature contained remains of at least two individuals. Our analysis of sheep/goat phalanges from feature 17 permitted us to derive the MNE value of 6. A number of right and left phalanges from the north west part of the feature allowed us to determine that the bones belonged to one individual. As far as phalanges discovered elsewhere within the feature are concerned, it is likely that the identified remains belonged to at least two individuals. Furthermore, we were able to determine the MNE value of 1 for both the sheep/goat mandibles and the sheep/goat horncores from the same feature.

Anatomical analysis of 228 osteological remains from the YC features allowed us to reveal a very specific body part distribution pattern (Table 3). For small ruminants (NISP=189), cranial fragments (NISP=65), horncores (NISP=49) and teeth (NISP=25) predominate. These are followed by bones of an axial skeleton, including vertebrae and sacrum. It is worth noting a substantial share of phalanges (NISP=33). Long bones are almost totally missing, except one tibia. It should be underlined that the tibia bears traces of human processing, so it may be considered a finished or semi-finished tool. All of the ten dog/wolf bone fragments recovered from Pysarivka 3 are molars (Fig. 3: 4). One hundred and thirty-two bone fragments from Porohy 3A have been sexed, with a roughly similar number of males and females. Other faunal remains are of indeterminable sex.

The publication of material from conservation work reports ritual remains found in features 4 and 6 at Dobrianka 1 [Harat *et al.* 2014: 61]. Regrettably, the author (Valentina Zahorujko) fails to specify criteria used for such specific identification. The horncore recovered from feature 2-14 at Porohy 3A has traces of human processing and use. It is conceivable that it might have served as a tool. Regrettably, the available archive material does not offer any further details. Feature 2 at Pysarivka 3 yielded sheep/goat cranial and horncore fragments [Harat *et al.* 2014: 118-121]. Both fragments were found in the southern part of the pit. The

Table 5

Noua features with animal bones at sites of the Yampil barrow cemetery complex. Species composition and body part representation

Species / Site	Red deer		Horse			Total	
	humerus	Species subtotal	sacrum	tail vertebrae	Species subtotal	NISP	%
Podlisivka 1	1	1			0	1	8,33%
Porohy 3A		0	6	5	11	11	91,67%
NISP	1	1	6	5	11	12	100,00%
%		8,33%			91,67%	100%	

cranial fragment was found lying face down in such a way that the horns would be pointing northeast. The goods deposited inside the pit included a dog/wolf tooth necklace as an amulet.

3.4. BABYNO CULTURE

The BC materials are represented by as few as 32 bone fragments (Table 4). They were recovered from the following three sites: Klembivka 1, Pidlisivka 1 and Severynivka 1. The material from Pidlisivka 1 (NISP=28; 87.5%) is most numerically abundant. Unfortunately, none of the BC bone fragments from this site has been identified to species (Table 4). Overall, species attribution from this culture was done for just three bone fragments identified as cattle, pig, and red deer. The red deer bone was actually a perforated tooth, accompanied by an oval buckle made of bone unidentifiable to a species.

3.5. NOUA CULTURE

The NC material is least numerically abundant in the group of the four cultural units discussed in this study. The material consists of as few as 12 fragments, accounting for just 3.25% of the studied assemblage. The fragments were recovered from two features at Porohy 3A and one feature at Pidlisivka 1 (Table 5). All bone fragments from Porohy 3A come from horse, while the bone fragment from Pidlisivka 1 comes from red deer (Table 5).The remains of horse consist solely of a sacrum and a caudal vertebra. The preserved fragment of the red deer bone belongs to a humerus (Table 5).

4. 'ANIMAL DEPOSITS' OF THE YAMPIL BARROW CEMETERY COMPLEX FROM THE PERSPECTIVE OF ANALOGOUS MATERIAL AND TOPOGENETIC REFLECTIONS FROM THE NORTHERN BLACK SEA REGION

Our aim in this chapter is to identify a transformation of ritual norms involving 'animal de-posits'(discussed in Chapter 4), which have been documented in the YBCC, and set it in the broader spatial and cultural context. This will primarily include the 'non-Yampil' forest-steppe (Podolia – *see* Chapter 5.1) and steppe (Budzhak steppe – *see* Chapters 5.2 and 5.3) of the Middle Dniester Area, with 'Yamnaya-Catacomb' funerary rituals identified on the North Black Sea Coast or in Ciscaucasia (Chapter 5.4) (Fig. 1).

4.1. DNIESTER FOREST-STEPPE PERSPECTIVE OF PODOLIA BARROWS

As far as YC graves are concerned, which represent a predominant type of *Yampil barrows*, the number of burials containing animal bones (including artefacts made from animal bones) is small: such burials are recorded only in 9 of 76 features (11.8%). A number of such burials for the entire *Podolia zone*, comprising such barrow complexes of the forest-steppe on the left or right bank of the Dniester river as Yampil, Kamienka, Mocra or Tymkove, is even smaller (7.1%).

It is striking that tools are only incidentally recorded: in addition to graves 2 and 3A/10 at Porohy (Fig. 4: 1), tools were present only in barrows at Okniţa, subdistrict of Kamienka (awls from graves 6/5 and 7/8, a pin from grave 4/1, and an object of an unidentified function from grave 4/4 at Okniţa) [Manzura *et al.* 1992: 116, Fig. 14: 5; 117, Fig. 15: 3; 123, Fig. 21: 4; 131, Fig. 29: 7]. When we look at the entire Northwest Black Sea Coast, we see that although bone tools were not an inseparable element of grave goods, they tended to be more frequent and more diversified in the steppe ('Budzhak') zone [Subbotin 2003: 92-102]. A similar incidental occurrence is demonstrated for bone ornaments, which were present only in one grave of the *Yampil-Podolia YC*, i.e. feature 3/2 at Pysarivka (Fig. 3: 4).

They comprised pendants made from dog/wolf molars. Although this specific type of pendant is known from the YC and CC graves [Shaposhnikova *et al.* 1986; Bratchenko 2001: 79, Fig. 5: 7], it does not fall within the category of 'universal' forms (such as dog/wolf canine tooth pendants, or bag- or butterfly-shaped pendants made from deer teeth) widespread across the Eurasian steppe and among Central European cultural groups of the Final Eneolithic.

What is remarkable about the *Yampil burials* attributable to the YC is the presence of small ruminant remains, such as goat crania in the graves at Porohy (features 3A/11, Fig. 5 and 3A/17, Fig. 6: 1) and Pysarivka (feature 3/2, Fig. 3: 4) or the distal limb bones of sheep/goat in the graves at Porohy (feature 10, Fig. 4: 1) and Dobrianka (features 1/4 and 1/6 – Fig. 3: 1,2). As for Dobrianka, these were only third phalanges. In addition to astragali (so far not discovered in any of the *Podolia barrows*), there were caprine limbs in the YC graves of the Ingul zone [Shaposhnikova *et al.* 1986: 21] as well as on the Middle Ingulets [Melnik, Steblina 2013: 49] and in the Lower Dnieper Region [Nikolova *et al*. 2011: 148]. The limb bones were present in graves of the late phase of the YC [Fomenko 2004: 49] and Ingul CC [Fomenko 2005: 51], being particularly numerous east of the Sea of Azov [Andreeva 2009: 109, 110].

In all of the three cases, sheep/goat limb fragments recovered from the *Yampil graves* were deposited on the bottom of burial pits, with two instances having been placed next to the elbow of the deceased. In contrast, goat crania were placed on the pit step, right beneath the timber roof of the burial chamber.

Animal bone deposits (sacrificial meat) occurred rarely in the context of the *Podolia YC graves*: if they did, the bones were placed next to the burial pit (feature 1/8 at Dobrianka) or above the skeleton, within the burial chamber (feature 7/5 at Okniţa; grave 1/13 at Mocra). Animal sacrifices, involving whole or parts of carcasses, were parts of the ritual recorded for Northwest Black Sea Coast in the Eneolithic (Usatovo group of the Tripolye culture) as well as in the Early Bronze Age. The similarity of recorded practices makes some believe that there is a link between the YC customs and the older Eneolithic belief systems [Razumov *et al.* 2016: 190].

The discovery of a pig mandible in grave 3/4 at Mocra is unique [Kashuba *et al.* 2001-2002: 215]. The grave also contained a vessel, which exhibited features typical of the Global Amphora culture [Szmyt 2013: 96], whose communities manifested increased occupational activity also in the Podolia Region. As pig mandibles are a typical element in ritual practices of the GAC [Wiślański 1966: 43], the discovery at Mocra may be indicative of yet another piece of evidence for 'Central European influences' in the YC [Szmyt 1999; 2000; 2009].

It is by no means easy to reveal the meaning or character of the achieved results without reference to 'animal deposits' recorded for the *Budzhak community*, for which the forest-steppe of the Middle Dniester Area is sometimes referred to as the '*specific territorial group*' [Ivanova, Toschev 2015: 362].

This goal cannot be satisfactorily achieved due to a limited number of empirical data, as already indicated in Chapter 2. Just two of the published results of the archaeologically investigated barrows of the *Budzhak zone* present a relatively satisfactory set of archaeological and faunal data comparable to those for the YBCC. These two publications were published Evgenij V. Yarovoy and his associates: *Barrows of the Budzhak Steppe* and *Barrows of the Eneolithic – Bronze Age of the Lower Dniester Area* [Chabotarenko *et al.* 1989; Yarovoy 1990].

The first book published in 1989, reports 'animal deposits' unearthed in 11 graves from the following four *ceremonial centres*:

Balaban (barrows/graves: 13/18=YC; 21/5=YC?);

Ursoaya (barrows/graves: 3/6=YC; 3/11=CC; 3/12=YC);

Kirkaeshty (barrows/graves: 5/2=YC);

Khadzimys (barrows/graves: 2/1=BC; 2/8=BC; 2/12=BC; 2/15=BC; 2/17=YC)

In the *centres* of Balaban, Ursoaya, and Kirkaeshty, 'animal deposits' (N=11) occurred in 21.56% of all investigated graves(N=51 graves from the YC, CC or BC). They appeared pre-dominantly in YC burials (N=6; accounting for 11.76% of the total assemblage) and for 18.75% of all YC graves (N=32). These were followed by BC burials with the share of 7.84% of the total assemblage (N=4), accounting for 30.77% of all BC graves (N=13) and CC burials with the share of 1.96% of the total assemblage (N=1), accounting for 16.67% of all CC graves (N=6).

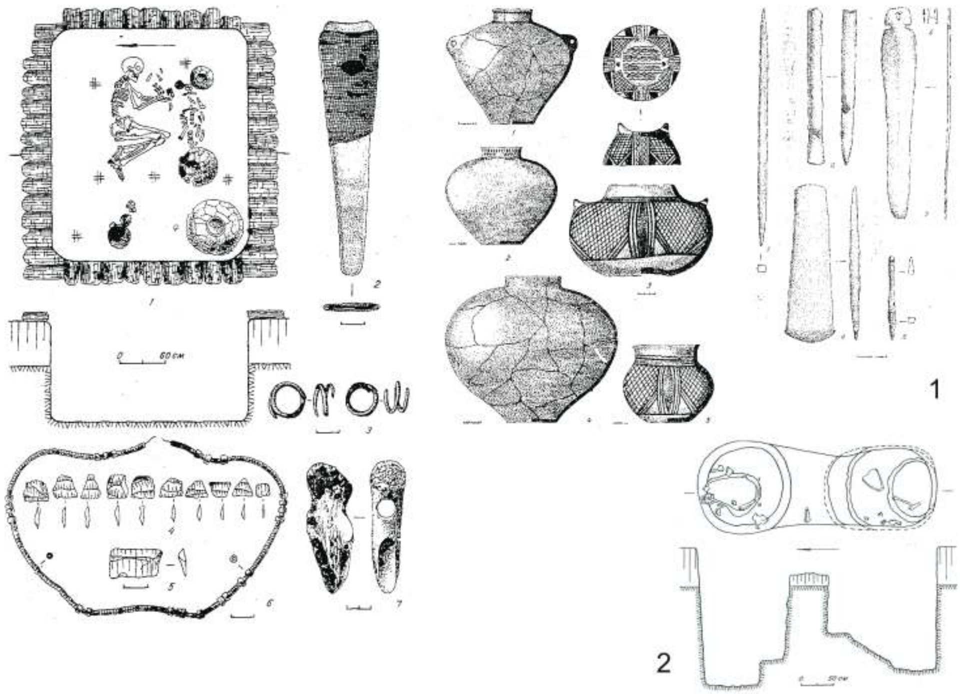
Published in 1990, the second book mentions 'animal deposits' only in one feature with complex 'deposits' and in 19 graves from the following three *ceremonial centres*:

Novye Raskaetsy (barrows/graves: 1/12=CC; 1/27=BC; 1/30=BC; 2/1=YC)

Purcari (barrows/graves: 1/21=EN-Usatovo; 1/27=BC; 2/13=EN-Usatovo; 3/1=EN-Usatovo; 5/7 = BC)

Olaneshty (barrows/graves: 1/4=CC; 1/5=BC; 1/7=BC; 1/17=BC; 1/18=BC; 1/19=BC; 1/32=YC; 4/2=BC; 8/1=BC; 8/7=YC; 14/ =CC).

In the *centres* of Novye Raskaetsy, Purcari and Olaneshty, 'animal deposits' occurred in 22.22% of all investigated graves (90 graves from the EN-Usatovo, YC, CC and BC). Predominant were BC burials with a share of 12.23% of the total assemblage (N=11 graves), accounting for 32.35% of all BC graves (N=34). They are followed by few burials of other cultures (3 graves each); however, they differ in terms of the frequency of 'animal deposits' in each of the cultural units: EN-Usatovo =100% (N=3), YC=9.09% (N=33), CC=15% (N=20).



F i g . 8 . Purcari, barrow 1, grave 21 (Moldova). Usatowo group ceremonial centre with a complex composition of 'animal deposits': 1 – grave 21 and grave goods; 2 – cult feature [*after* Yarovoy 1990]

The comparative analysis of the *Podolia zone* and *Budzhak zone* reveals that the number of 'animal deposits' in funerary contexts is doubled for the Lower Dniester Area, i.e. Budzhak steppe, especially in the BC period. It is worth noting an increased number of grave goods, in particular bone buckles.

4.3. INTERPRETATIVE CONTEXT OF THE BUDZHAK CEREMONIAL CENTRES WITH COMPLEX 'ANIMAL DEPOSITS': PURCARI-GLINOYE TYPE

Of particular significance for the *Budzhak zone*, is the Eneolithic feature from the Usatovo group or phase CII of the Tripolye culture with a *complex 'animal deposits'*. It was recorded as a central (foundation) burial at Purcari, southern Moldova. It is defined as 'ritually atypical' because of the complex character of 'animal deposits' [Yarovoy 1990: 62-70].

What makes the feature distinctive is the fact that the 'animal deposits' originated from a complex ritual cycle that involved (a) burial pit (foundation burial in a barrow of 'an adult' with clearly detectable skeletal pathologies who was accompanied with a very rich array of grave goods; in terms of a social hierarchy, it may be interpreted as 'a princely burial'); and (b) close vicinity of the burial pit (Fig. 8).

a. A complete dog skeleton with its head to the south, was placed on wooden logs of the roof. A caprine articulated skeleton without a cranium was deposited approximately 1 m away from arm bones of the deceased adult, along the longer axis of the burial pit. Next to the left arm of the deceased, there was a hoe made from a young red deer's antler. On the head of the deceased, there were approximately 200 beads made from bird spongy bones (and 25 larger jet beads). Moreover, the deceased was buried with: 8 metal objects made of 'arsenical bronze', including a dagger, a knife, an axe, an awl, a perforator, ornaments and 5 vessels.

b. Approximately 2 m east of the burial pit, a 'ritual pit' was identified. The spectacles-shaped pit included two cavities and contained cranial fragments, limb bones, a pelvis and an astragals of a young horse, large tibias belonging to one young and one old bull, and bones of one sheep/goat, all placed at various depths.

Any in-depth insight into the *ritual cycle* outlined above is prevented by unavailability of (taphonomic and 'isotopic') analysis of the faunal material. What we can say at this stage is that we are dealing here with an *elite ritual* rooted in the Late Eneolithic tradition, involving deposition of birds as well as domesticated and wild mammals in graves, either inside or outside sacrificial pits. Research on the barrow at Glinoye in the Lower Dniester Area carried out by Razumov opens up a new opportunity for studying this type of 'animal deposits' [Razumov *et al.* 2016]. Thus, the *Purcari-Glinoye type* rituals urgently require a dedicated research project.

5. DONETS AND CISCAUCASIAN INSPIRATIONS

Stanislav N. Bratchenko pointed out that the 3rd millennium BC witnessed the practice of depositing distal limb segments and heads of sheep, goat and cows in graves. Such practice is recorded on the Anatolian plateau as well as in features datable to the early phase of the Catacomb culture in the Ciscaucasian, Don and Donets Regions [Bratchenko 2001: 56]. In the Ciscaucasian zone, such practice can be traced back to the Eneolithic, while in the Novotitorovka culture, it manifests itself in nearly 50% of all burial features [Trifonov 1991; Gey 2000]. According to S.N. Bratchenko [2001: 73], the distribution of this particular component of the ritual accompanied the spread of other characteristic traits of the Ciscaucasian zone.

It is also west of the Dnieper where caprine distal limb segments occurred in graves attributed to the Catacomb culture, in particular in its early phase [Kaiser 2003: 228]. Largest concentrations of such deposits come from the Dnieper zone. Animal crania and mandibles are less often deposited in the graves of the western Catacomb culture [Kaiser 2003: 227, Fig. 84: 2]. It was most probably under the influence of this early Catacomb culture that similar elements became present among grave goods of the late phase of the YC in the Lower Dniester and Lower Bug zones, as well as at the Ingulets River, in Crimea and in the Lower Dnieper Area [Shaposhnikova *et al.* 1986: 21]. Associated with the late phase of the YC, the finds from Dobrianka and Porohy are currently regarded as a unequivocal manifestation of the eastern practices in the funerary ritual in the forest-steppe of the Northwest Black Sea Coast. The finds are indicative of relations the YC communities had with the Southern Bug Area [Klochko *et al.* 2015d; Ivanova 2015].

The similar context and possibly roughly the same chronological horizon are shared by animal astragali, which occurred in the graves of the YC and CC of the Northwest Black Sea Coast [Ivanova 2001: 92-93]. Not yet discovered in any Podolia feature, astragali are usually considered to have been used for gaming [Yarovoy 1985] or divination [Ivanova 2001: 92]. They came with the whole set of new elements whose importance in funerary practices grew at the end of the 1st half of the 3rd millennium BC. It is likely that the presence of astragali was also a sign of the aforementioned 'Donets and Ciscaucasian insights'.

6. FUNERARY RITUALS WITH ANIMALS IN THE CONTEXT OF CORDED WARE AND GLOBULAR AMPHORA CULTURES FROM THE BALTIC ZONE

When the above-described uses of animals at funerary rituals are compared with those in the Central European CWC and late phase of the GAC, significant differences become clear. It is particularly in the CWC that the frequency of graves with bone or antler tools is considerable. This is especially evident at the cemeteries of the CWC in Lesser Poland (Małopolska), where bone and antler objects were inseparable elements of the tool inventory present in graves, in particular those of adult males. Such tool types (chisels, awls with preserved hafts, tools made from wild boar tusks, antler wedges, and retouching sticks) are rarely encountered in graves attributed to the Yamnaya culture of the Northwest Black Sea Coast. These comprise major elements of the tool set, being a typical category of grave goods.

The CWC ritual did not see the custom of depositing whole or parts of carcasses. Essential to the GAC rituals, the practice of placing the remains of cattle, pigs and small ruminants next to the remains of the deceased disappeared in the CWC. Moreover, deposition of grave goods became restricted to the bottom of burial pits/ catacombs.

As outlined above, the differences between the zones subject to our comparison appear to be so distinct due to a pronounced dominance of empirical materials datable to the late phase of the CWC. In the earlier phase (marked by the construction of most of the Final Eneolithic barrows: generally from 2800 to 2600 BC), funerary behaviour as regards 'animal deposits' were clearly less standardized. They were also less recognizable, because of the dearth of empirical material. At this stage, the dominant rituals find parallels in the steppe/forest-steppe zone. They were well manifested in barrow 1 at Miernów [Kempisty 1967]. It contained a dog burial placed next to the burial pit[4]. The deceased were accompanied by various bone artefacts, such as tools, ornaments or insignia.

Hence, the differences between the 'Central European' ritual tradition with the use of 'animal deposits' of the early phase of the CWC and the similar ritual practices of the Late Eneolithic and beginning of the Early Bronze Age in the northern Black Sea Area are, therefore, less prominent.

FINAL REMARKS

Funerary practices of the *early barrow Dniester communities* reveal a multidimensional character of animal deposition. They seem to originate from three intertwined distinct traditions:

- 'Post-Eneolithic tradition'– characterized by the deposition of bird remains as well domestic and wild mammals in graves, hearths, or sacrificial pits, or outside thereof within the barrow structure;
- 'Eastern tradition'– deposition of selected anatomical parts of domestic animals (mainly goats and sheep), primarily associated with the late phase of the YC and CC;
- Reception of practices characteristic of the GAC in Central Europe.

In the rituals of the CWC in Central Europe, the use of animal remains in funerary practices does not seem to have played any significantly role, although some elements find surprising parallels in the Baltic Sea zone. Among the parallels, there is a rare custom of depositing dog skeletons in graves (with nearly a total absence of sacrifices of whole carcasses of other animal species), recorded both

[4] For a similar arrangement, *see*: barrow no. 1 at Tudorovo, Budzhak zone [Melnyk, Steblyna 2013].

for the CWC in Lesser Poland (Małopolska) [Włodarczak 2006] and for the early CC [Kaiser 2003: 228]. While the significance of animal use in funerary rituals was considerably less pronounced in the CWC compared to the Black Sea culture circle, a omnipresence of bone objects (mainly ornaments) is noticeable. Artefacts such as pendants made from dog/wolf canine teeth or bag shaped pendants made from deer teeth were present in both cultural zones and seem to prove the existence of shared cultural beliefs.

Translated by Piotr T. Żebrowski

REFERENCES

Andreeva M.V.

2009 Traditsii i novatsii v pogrebalnom obriade katakombnykh plemen severo-vostochnogo Predkavkazia. *Kratkiye Soobschcheniya Instituta Arkheologii* 223: 101-115.

Andrykh S.I,, Toshchev G.N.

2009 *Mogilnik Mamay-Gora. Kniga* IV. Zaporizhzhia.

Bednarek R., Jankowski M.

2014 Charakterystyka gleboznawcza materiału budowlanego kurhanu 1 w Pidlisiwce. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 275-280. Poznań.

Behrensmeyer A. K.

1978 Taphonomic and ecologic information from bone weathering. *Paleobiology* 4: 150-162.

Binford L. R.

1978 *Nunamiut Ethnoarchaeology.* New York.

1981 *Bones: ancient men and modern myths.* New York.

1984 *Faunal remains from Klasies River mouth.* New York.

Bratchenko S.N.

2001 *Donetska katakombna kultura rannioho etapu.* Luhansk.

Chebotarenko G.F., Yarovoy E.V., Telnov N.P.

1989 *Kurgany budzhakskoy stepi.* Kishinev.

Chernykh E.N.

1992 *Ancient Metallurgy in the USSR. The Early Metal Age*. Cambridge.

Fomenko V. M.

2004 Pokhovannia zmishanoho yamno-katakombnoho typu v Buho-Inhuletskomu Mezhyrichchi. In: M.A. Sobutskiy (Ed.) *Naukovi zapysky natsionalnoho uniwersytetu „Kyevo-Mohylianska akademiya"* 24: *Teoriya ta istoriya kultury*, 47-54. Kyiv.

2005 „Rannokatakombni" pokhovannia buho-inhuletskoyi hrupy. In: M.A. Sobutskiy (Ed.) *Naukovi zapysky natsionalnoho uniwersytetu „Kyevo-Mohylianska akademiya"* 40: *Teoriya ta istoriya kultury*, 47-55. Kyiv.

Gey A.N.
2000 *Novotitorovskaya kultura.* Moskva.

Goslar T., Klochko V., Pośko A., Włodarczak P., Żurkiewicz D.
2015 Chronometry of Late Eneolithic and 'Early Bronze' cultures in the Middle Dniester area: investigations of the Yampil Barrow Complex. *Baltic-Pontic Studies* 20: 256-291.

Grant A.
1982 The use of tooth wear as a guide to the age of domestic ungulates. In: B. Wilson, C. Grigson, S. Payne (Eds) *Ageing and sexing animal bones from archaeological sites, BAR British Series* 109, 91-108. Oxford.

Grayson D. K.
1984 *Quantitative zooarchaeology. Topics in the analysis of archaeological faunas*. New York.

Harat K., Potupczyk M., Razumow S.
2014 Charakterystyka źródeł archeologicznych pozyskanych w latach 1984-1993. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 45-204. Poznań.

Heyd V.
2011 Yamnaya Groups and Tumuli West of the Black Sea. In: E. Borgna, S. Műller-Celka (Eds) *Ancestral Landscapes: Burial mounds in the Copper and Bronze Ages,* 529-549. Lyon.

Ivanova S. V.
2001 *Sotsialnaya struktura naseleniya yamnoy kultury severo-zapadnogo Prichernomoria.* Odessa.
2015 „Protobudzhakskiy gorizont" Severo-Zapadnogo Prichernomoria. *Stratum plus* 2(2015): 275-294.

Ivanova S. V., Toshchev G. N.
2015 The Middle-Dniester cultural contact area of early metal age societies. The frontier of Pontic and Baltic drainage basin in the 4th/3rd-2nd millenium BC. *Baltic-Pontic Studies* 20: 336-405.

Kaiser E.
2003 *Studien zur Katakombengrabkultur zwischen Dnepr und Prut. Archäologie in Eurasien,* vol. 14. Mainz am Rhein.

Kempisty A.
1967 Wyniki badań kopca I w Miernowie pow. Pińczów. In: J. Fellmann, A. Kempisty, M. Miśkiewicz, K. Paczek, A. Wiercińska, A. Wierciński (Eds) *Metodyka naukowo-techniczna badań archeologicznych i antropologicznych. Rozprawy Zespołu Badań nad Polskim Średniowieczem Uniwersytetu Warszawskiego i Politechniki Warszawskiej,* 4, 147-175. Warszawa.

Kashuba M.T., Kurchatov S.Y., Shcherbakova T.A.
2001-2002 Kochevniki na zapadnoy granitse Velikoy stepi (po materialam kurganov u s. Mokra). *Stratum plus* 4 (2001-2002): 180-252.

Klochko V.I., Kośko A.
2013 The Baltic Drainage Basin in the Reconstruction of the Mental Map of Central Europe Held in Common by Northern-Pontic Early – Bronze Civilization Communities: 3200-1600 BC. An outline of the research programme. *Baltic-Pontic Studies* 18: 9-20.

Klochko V., Kośko A., Razumov S. Wlodarczak P., Żurkiewicz D.
2015a Eneolithic, Yamnaya and Babyno culture cemeteries, Pidlisivka, site 1, barrow 1, Yampil Region, Vinnitsa Oblast: archaeometric and chronometric description, taxonomic discussion. *Baltic-Pontic Studies* 20: 40-77.
2015b Eneolithic, Yamnaya and Noua culture cemeteries from the first half of the 3rd and the middle of the 2nd millennium BC, Porohy, site 3A, Yampil Region, Vinnitsa Oblast: archaeometric and chronometric description, ritual and taxonomic-topogentic identification. *Baltic-Pontic Studies* 20: 78-141.
2015c Eneolithic, Catacomb, Babyno and Noua culture cemeteries, Klembivka, site 1, Yampil Region, Vinnitsa Oblast: archaeometric, taxonomic and topogenetic description. *Baltic-Pontic Studies* 20: 142-182.

Klochko V., Kośko A., S., Potupczyk M., Włodarczak P., Żurkiewicz D. Ivanova S.
2015d Tripolye (Gordineşti group)*, Yamnaya and Catacomb culture cemeteries, Prydnistrianske, site* 1, Yampil Region, Vinnitsa Oblast: archaeometric, chronometric description and taxonomic, topogenetic discussion. *Baltic--Pontic Studies* 20: 183-255.

Kośko A.
2013 Eastern European Context for Studies on the Use Wagons in the Baltic Sea Catchment Area of the 4th and 3th Millennia BC. In: S. Kadrow, P. Włodarczak (Eds) *Environment and subsistence – forty years after Janusz*

Kruk's „Settlement studies…", Studia nad Pradziejami Europy Środkowej 11, 429-440. Rzeszów.

2014 Traits of „Early Bronze' Pontic Cultures In the Development of Lowland and Eastern European Forest Cultural Environments In the Baltic Soutern Drainage Basin An Outline of the State of Research. *Baltic-Pontic Studies* 19: 53-73.

Kośko A., Potupczyk M., Razumow S. (Eds)

2014 *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6. Poznań.

Lyman R. L.

1994 *Vertebrate taphonomy.* Cambridge.

2008 *Quantitative paleozoology.* Cambridge.

Mallory J.P.

1981 The ritual treatmentof the horse in the early kurgan tradition. *Journal of Indo-European Studies* 9: 205-226.

1982 Indo-European and Kurgan Fauna I: Wild mammals. *Journal of Indo-European Studies* 10: 193-222.

1984 Proto-Indo-European and Kurgan Fauna II: Fish. *TheJournal of Indo-European Studies* 11: 264-279.

1989 *In Search of the Indo-Europeans.* London.

1991 Kurgan and Indo-European Fauna III: Birds. *Journal of Indo-European Studies* 19: 223-234.

Manzura I.V., Klochko E.O, Savva E.N.

1992 *Kamenskie kurgany.* Kishinev.

Marciniak A.

1996 *Archeologia i jej źródła. Materiały faunistyczne w praktyce badawczej archeologii*. Poznań.

Melnyk O., Steblyna I.

2013 *Yamna kultura serednoyi techiyi Inhultsia.* Kryvyi Rih.

Merpert N.Ya.

1974 *Drevneyshye skotovody Volgo-Uralskogo mezhdurechia.* Moskva.

Nikolova A.V., Chernykh L.A., Evdokimov G.L.

2011 Kurgany epokhi bronzy v nizoviakh Dnepra i Ingultsa (po materialam Krasnoznamenskoy ekspeditsii). In: *Materialy ta doslidzhennia z arkheolohiyi Skhidnoyi Ukrayiny,* 96-163. Luhansk.

Patokova E.F.
1979 *Usatovskoe poselenie i mogilniki.* Kiev.

Patokova E.F., Petrenko V.G., Burdo N.B., Polishchuk L.Y.
1989 *Pamiatniki tripolskoy kultury v Severo – Zapadnom Prichernomore.* Kiev.

Payne S.
1973 Kill-off patterns in sheep and goats: the mandibles from Asvan Kale. *Anatolian Studies* 23: 281-303.

Potupczyk M., Razumov S.
2014 Zgrupowanie cmentarzysk kurhanowych w rejonie jampolskim. In: A. Keśko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 35-39. Poznań.

Razumov S., Lysenko S., Sinika V., Telnov N.
2016 Ritualnyi kompleks rannego bronzovogo veka s levoberezhia nizhnego Dnestra. *Tyragetia Serie Nouă* 10/1: 175-194.

Rassamakin Y.Y., Nikolova A.V.
2008 Carpathian imports and imitations in context of the Eneolithic and Early Bronze Age of the Black sea steppe area. In: P.F. Biehl, Y.Y. Rassamakin (Eds) *Import and imitation in archaeology,* 51-87. Langenweißbach.

Reitz, E. J., Wing E. S.
2008 *Zooarchaeology, 2nd edition.* Cambridge.

Rosiakova N.V.
2015 *Pogrebalnye kompleksy s kostiami zhivotnykh iz mogilnikom srubnoy kulturno – istoricheskoy obshchnosti Samarskogo Povolzhiya (Avtoreferat dissertatsii na soiskaniye uchonoy stepeni kandidata istoricheskikh nauk).* Izhevsk.

Seetah K.
2006 *Butchers as an analytical tool: a comparative study of the Romano-British and Medieval periods (held in the archives of University of Cambridge).* Cambridge.

Silver I.
1969 The ageing of domestic animals. In: D. Brothwell, E. Higgs (Eds) *Science in archaeology,* 2nd ed., 283-302. London.

Shaposhnikova O.G, Fomenko V.N., Dovzhenko N.D.
1986 *Yamnaya kulturno-istoricheskaya Oblast (yuzhnobugskiy variant).* Kiev.

Subbotin L.V.
1993 Nekotorye aspekty khoziaystvenno-proizvodstvennoy deyatelnosti yamnykh i katakombnykh plemen stepnoy zony Severo-Zapadnogo Prichernomoria. In: V.P. Vanchugov (Ed.) *Drevnosti prichernomorskikh stepey. Sbornik nauchnykh statey,* 9-21. Kiev.
2003 *Orudiya truda, oruzhie i ukrasheniya plemen yamnoy kultury Severo-Zapadnogo Prichernomoria.* Odessa.

Szmyt M.
1999 *Between West and East. People of the Globular Amphora Culture in Eastern Europe, Baltic-Pontic Studies* 8.
2000 In the Far of Two Worlds. On the Study of Contacts between the Societs of the Globular Amphora and Yamnaya Cultures. In: S. Kadrow (Ed.) *A Turning of Ages/Im Wandel der Zeiten. Jubilee Book Dedicated to Professor Jan Machnik on His 70th Anniversary*, 443-466. Kraków.
2009 Eastern destination of Central European cultural patterns. The case of Globular Amphora Culture (end of the 4th – middle of the 3rd millennium BC). *Baltic-Pontic Studies* 14: 231-250.
2013 View from the Northwest: Interaction Network in the Dnieper-Carpathian Area and the People of the Globular Amphora Culture in the Third Millenium BC. In: V. Heyd, G. Kulcsár, V. Szeverényi (Eds) *Transitioin to Bronze Age. Interregional Interaction and Socio-Cultural Change in the Third Millenium BC. Carpathian Basin and Neighbouring Regions,* 93--111. Budapest.

Trifonov V.A.
1991 Stepnoe Prikubanie v epokhu eneolita – sredney bronzy (periodizatsiya). In: *Drevniye kultury Prikubanya,* 92-166. Leningrad.

Wiślański T.
1966 *Kultura amfor kulistych w Polsce północno-zachodniej.* Wrocław-Warszawa-Kraków.

Włodarczak P.
2006 *Kultura ceramiki sznurowej na Wyżynie Małopolskiej.* Kraków.
2014a The traits of Early-Bronze Pontic cultures in the development of old upland Corded Ware (Małopolska groups) and Złota culture communities. *Baltic-Pontic Studies* 19: 7-52.
2014b Sekwencja czynności obrzędowych: problem korespondencji tradycji funeralnych kultury jamowej i kultury ceramiki sznurowej na Wyżynie Podolskiej. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzań-*

skie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie 6, 313-340. Poznań.

Yanish Y.Y.
2012 Opredelenie osteologicheskikh materialov iz kurgana 3 u s. Porohy. In: Razumov S., Kośko A., Karnaukh E. (Eds) *Otchet o rabote sovmestnoy ukrainsko – polskoy Yampolskoy arkheologicheskoy ekspeditsyi* (held in the archives of IA NANU), 36-41. Kyiv.

Yarovoy E.V.
1985 *Drevneyshie skotovodcheskie plemena yugo-zapada SSSR (klassifikatsiya pogrebalnogo obriada).* Kishinev.
1990 *Kurgany epokhi eneolita-bronzy Nizhnego Podnestrovia.* Kishinev.

Zhuravlov O. (= Żurawlow O.)
2013 *Vyznachennia osteolohichnykh materialiv z Kurhanu 1 bilia s. Klembivka* (held in the archives of IA NANU). Kyiv.
2014 Analiza materiałów kostnych ze stan. Pidlisivka, kurhan 1. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 245-246. Poznań.

Baltic-Pontic Studies
vol. 22: 2017, 226-245
ISSN 1231-0344
DOI 10.1515/bps-2017-0027

Viktor I. Klochko[*]

YAMNAYA CULTURE HOARD OF METAL OBJECTS, IVANIVKA, LOWER MURAFA: AUTOGENESIS OF 'DNIESTER COPPER/BRONZE METALLURGY'

ABSTRACT

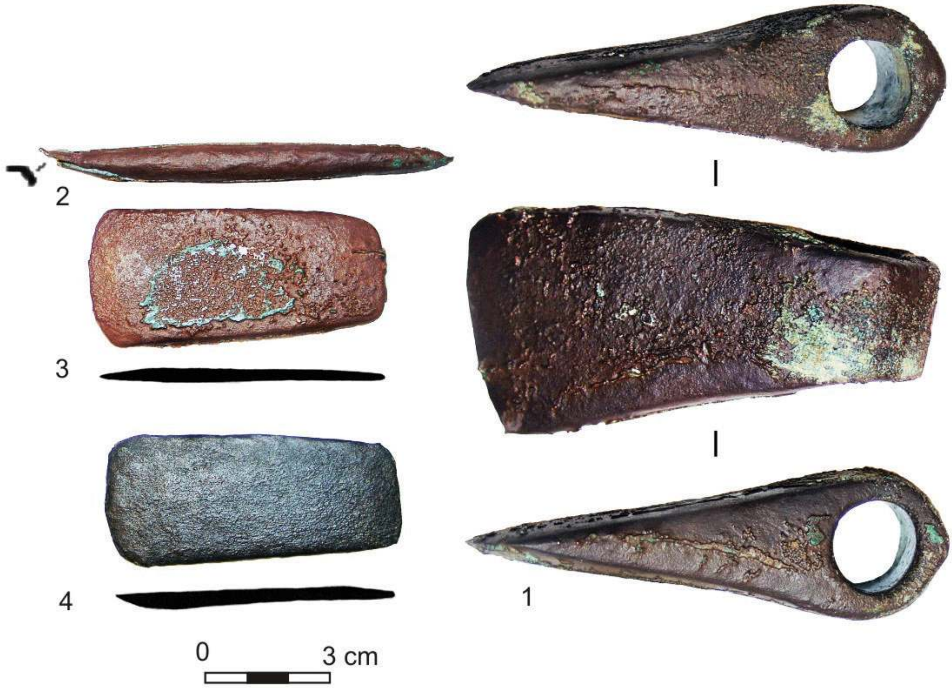
In 2015 near the village of Ivonivka, Mohyliv-Podilskyi Region, Vinnytsia *Oblast*, a hoard of copper objects was found by chance by the River Murafa. The majority of objects belonging to the hoard were fashioned out of a rather pure copper with a combination of admixtures, which can be named 'the Ivonivka group'.

Key words: hoard, yamnaya culture, Middle Dniester Area

Up to only some years ago among the research results of barrow complexes along the Middle Dniester – *Kamenka/Ocniţa and Yampil barrow cemetery complexes* there was a lack of data related to metal objects from the Yamnaya culture (YC) and decline phase of Eneolithic culture [Manzura, Klochko, Savva 1992; Kośko, Potupczyk, Razumow (Eds) 2014; Kośko (Ed.) 2015; Klochko *et al.* 2015]. In this context, the discovery of a hoard of metal goods near the village of Ivonivka in the upper course of the Murafa, has significantly changed our conception of the beginnings of copper metallurgy and early phases of its development in this northern part of the Black Sea Region.

In 2015 near the village of Ivonivka, Mohyliv-Podilskyi Region, Vinnytsia *Oblast*, a hoard of copper objects was found by chance by the River Murafa [Klochko, Kozymenko 2016: 2.1.16]. The circumstances related to the discovery of the hoard, precise localisation and its connection to the settlement or encamp-

[*] Department of Archaeology National University of Kyiv-Mohyla Academy, Skovorody 2, 04665 Kyiv, Ukraine; vklochko@ukr.net



F i g . 1 . Hoard from Ivonivka. Ivonivka, Mohyliv-Podilskyi Region, Vinnytsia *Oblast* [*after* Kolchko, Kozymenko 2016]. *See* Tab. 1: 1 – analysis number 1330. 2 – analysis number 1331, 3 – analysis number 1328, 4 – analysis number 1329

ment, remain unknown. The discovery though, on the western border of the *Yampil barrow cemetery complex* is in a particular way associated with it [Potupczyk, Razumow 2014: Fig. 1.2: 1].

1. DESCRIPTION OF THE IVONIVKA HOARD

The hoard contained: 1. shaft-hole axe, length 11.2 cm, blade width 5.4 cm, butt width 2.8 cm, butt diameter 2.1 and 2.2 cm; 2. bit, length 10.1 cm, diameter 1.0 cm; 3. adze, length 7.6 cm, blade width 3.6 cm, thickness 0.6 cm; 4. adze, length 7.4 cm, blade width 3.2 cm, thickness 0.4 cm (Fig. 1).

A spectral analysis of objects from the hoard was conducted by T.Yu. Goshko at the laboratory of the Institute of Archaeology, NAN Ukraine (Tab. 1).

Table 1

Spectral analysis of objects conducted by T.Yu. Goshko at the laboratory, Institute of Archaeology, NAN Ukraine

Analysis number	1328	1329	1330	1331	1359	1360	1361	1362	1363	1364	1355	1356	1357	1358	1332	1327	1042	1145
Figures	**Fig. 1: 3**	**Fig. 1: 5**	**Fig. 1: 1**	**Fig. 1: 2**	**Fig. 2: 5**	**Fig. 2: 3**	**Fig. 2: 4**	**Fig. 2: 8**	**Fig. 2: 8**	**Fig. 2: 9**	**Fig. 5: 3**	**Fig. 5: 5**	**Fig. 5: 4**	**Fig. 5: 2**	**Fig. 7: 1**	**Fig. 7: 2**	**Fig. 11: 1**	**Fig. 11: 2**
Ag	0,043	0,028	0,045	0,078	0,037	0,043	0,049	0,013	0,036	0,069	0,007	0,007	0,02	0,036	0,011	0,012	0,039	0,033
Al.																		0,117
As		1,187	0,26												1,137	1,443		2,115
Bi	0,002			ves-tigial		ves-tigial		ves-tigial		ves-tigial	ves-tigial					0,009		
Ca	0,006	0,006	0,003		0,029	0,032	0,056	0,294	0,463	0,399	0,015	0,205	0,281	1,414	0,016	0,011	0,408	0,048
Cl	0,024	0,053	0,014	0,043	0,749	1,396	0,66	0,799	0,101	0,244			0,031	0,12		0,036	0,359	0,285
Co	0,035																	
Cr	0,019	0,024	0,025	0,021	0,025	0,023	0,031		0,034						0,029			0,022
Cu	99,04	97,99	99,2	99,41	98,73	97,63	98,18	92,77	96,7	96,62	99,36	97,95	97,88	95,94	96,45	96,84	97,33	96,64
Fe					0,005	0,096	0,014	0,304	0,317	0,039	0,029	0,178	0,062	0,195	0,007	0,008	0,293	0,049
Na																	0,221	
Ni	0,04	0,01	0,03	0,064	0,009										0,04	vesti-gial		
P	0,082	0,055									0,078							0,173
Pb	0,021	0,007		0,038	0,026	0,017	0,024		0,055		0,014	0,02	0,038	0,082	0,019			
S	0,081	0,174	0,071	0,095	0,14	0,139	0,505	3,66	0,539	0,529	0,086	0,091	0,302	0,529	0,446	0,32		0,093
Sb	0,023	0,022	0,03												0,01		0,066	
Si	0,524	0,372	0,254	0,209	0,226	0,588	0,442	2,105	1,334	1,831	0,369	1,526	1,331	1,556	1,804	0,87	1,206	0,355
Sn	0,045	0,034	0,025	0,028	0,031	0,036	0,041	0,052	0,096	0,079	0,035	0,023	0,054	0,126	0,03	0,049	0,077	
Tb		0,024	0,03	0,014														
Te	0,013	0,014	0,013													0,027		
Ti									0,321	0,188								0,072

The majority of objects belonging to the hoard were fashioned out of a rather pure copper with a combination of admixtures, which can be named ‘the Ivonivka group’ (Tab. 1: An. nr. 1328 – 1331), whereby one of the adzes was made out of an arsenic metal alloy from the arsenic group, whose contents is greater than 1% (see below for the chronology of arsenic bronzes appearing in the region).

The shaft-hole axe from the Ivonivka Hoard was cast in a ‘close’ two-part mould (Fig. 1: 1), of a rather advanced technology. This ought to be related to a later chronology, to that of a ‘late pit grave’ phase, which in the middle drainage basin of the Dniester is dated to 2650-2500 BC [*Yampil dating* of the decline YC – Goslar *et al*. 2015: 281-282]. In respect to this axe, in my opinion, the description ‘**Ivonivka type**’ is the best fit, belonging to the decline YC.

The objects from the Ivonivka Hoard (Fig. 1: 2) are one of a kind; it is the first discovery of such a find of a metal tool from the early Bronze Age in the northern Black Sea Region. The artefacts from the hoard (Fig. 1: 3, 4) have a similar form to that of Eneolithic ‘Usatovo’ and ‘Maykop’ flat axe-adzes in the Anatolia tradition, though differing significantly in their smaller dimensions, though among ‘Maykop’ samples there also occur similarly small products (Fig. 12: 4-6; 7).

It is possible to suggest that the ‘Ivonivka Hoard’ reflects the craftwork of a master carpenter, which ought to be dated to the late phase of the YC. It is particularly interesting to find analogies of this with the wooden cart from site 6 in Pysarivka near Yampil [Harat, Potupczyk, Razumow 2014: 142-145] in respect to its possible constructors and place of workshop.

2. THE IVONIVKA HOARD IN THE CONTEXT OF RESEARCH ON THE OLDEST METALLURGY IN THE EASTERN CARPATHIANS, PODOLIA AND VOLHYNIA.

The other signs of metallurgy in the eastern Carpathians, Podolia and Volhynia continue to find little study. The research of N.V. Ryndina on the metallurgy of this region [Ryndina 1971, 1980, 1998] despite everything have left the exploitation of local deposits by the most chronologically distant of regional metallurgists an unresolved question.

Our research, conducted together with geologists and metallurgists have somewhat broadened our concept of copper ores in the region and their exploitation in the period of the Tripolye culture [Klochko *et al*. 2000; Kloczko *et al*. 2003].

Yu.N. Maleev [1976] wrote on the local metallurgy in the decline Bronze Age – on the basis of materials from the Myshkovychi site, Gava-Holihrad culture as did Goshko [2011] – the basis of spectral and metalographic research of objects from the cemetery complex in Hordiyivka (Gordievka).

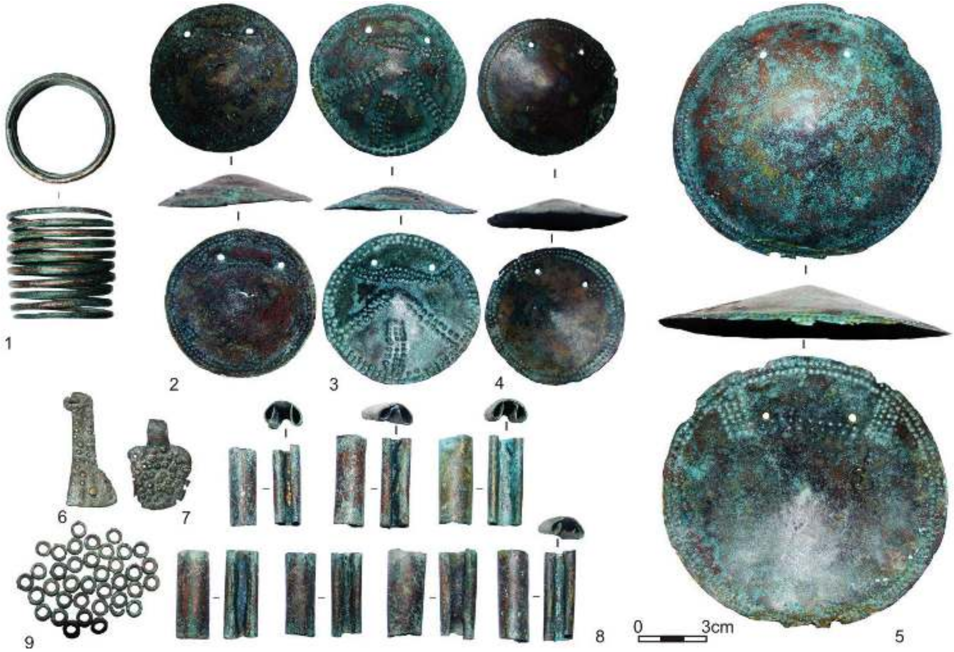


Fig. 2. The hoard from the Velyka Kisnytsia site, Yampil Region, Vinnytsia *Oblast* [*after* Klochko, Kozymenko 2016]. *See* Tab. 1: 3 – analysis number 1360, 4 – analysis number 1361, 5 – analysis number 1359 1361, 8 – analysis number 1362,1363, 9 – analysis number 1364

Fig. 3. Discs from the Velyka Kisnytsia hoard, Yampil Region, Vinnytsia *Oblast*

The above research field gained further perspective in the Carpathian – Volhynia "Willow Leaf" study at the Metallurgy Centre of the 'Circum-Pontic metallurgical province' [Klochko, Klochko 2013: 54-55].

The most recent attempt to use information gained at commercial Internet auctions related to new complexes of the Cucuteni-Tripolye culture, discovered through the use of metal detectors on the Dniester drainage basin and eastern Carpathians undertaken by V. Dergachev [2016], demonstrated the significant potential of this research direction in the context of a total disintegration of relic preservation in post-Soviet Eastern Europe.

The above-mentioned article brings to research practice in particular complexes and objects from a huge collection, studied, investigated and recently published by us [Klochko, Kozymenko 2016], which to a significant degree change our concept of the metallurgy of prehistoric communities in the Eastern Carpathians and Podolia.

2.1. CONTEXT OF THE OLDEST, ENEOLITHIC METALLURGY IN THE MIDDLE DNIESTER DRAINAGE BASIN AND PODOLIA.

First and foremost, four new complexes subject to research have been introduced, discovered both in the area of the (a) *Yampil barrow cemetery complex* and (b) in neighbouring regions, situated more to the west of Chernivtsi *Oblast*, Khmelnytska *Oblast* and Ternopil *Oblast*.

a. The hoard from the *Yampil barrow cemetery complex*: Velyka Kisnytsia Yampil Region, Vinnytsia *Oblast*.

In 2015 a hoard of copper objects was found near the village of Velyka Kisnytsia, at the Tripolye culture settlement, dated to period B [Klochko, Kozymenko 2016: 1.2.48]. The 'Velyka Kisnytsia Hoard' contained: 1. A multi-coil bracelet (?) from a rod with a diameter of 0.3 cm, diameter 15 cm, length 5.2 cm (a second, similar bracelet, damaged by a plough, was not included in the collection); 2. Disc, ornamented punch, diameter 7.8 cm, height of cone 1.3 cm; 3. Disc, ornamented punch, diameter 8.5 cm, height of cone 1.4 cm; 4. Disc, ornamented punch, diameter 7.8 cm, height of cone 1, 1 cm; 5. Disc, ornamented punch, diameter 14 cm, height of cone 2.6 cm; 6. Pendant, measuring in length 4.8 cm; 7. Pendant measuring in length 3.5 cm; 8. Double-twined piped beads measuring in length from 3.7 to 4.4 cm, thickness from 1.5 to 2.0 cm; 9. Round beads with a diameter of 0.6 cm. (Fig. 2).

Of particular note are the discs found in the hoard, ornamented by means of indentation in the form of anthropomorphic figures (?), Similar to Eneolithic goods from the Dunaj Region (Fig. 3).

The 'Velyka Kisnytsia Hoard' is the oldest hoard of copper objects from the Tripolye culture, among those found in Ukraine. On the basis of chronological analysis of ceramic ware from the settlement (conducted by M.Y. Videiko) it can

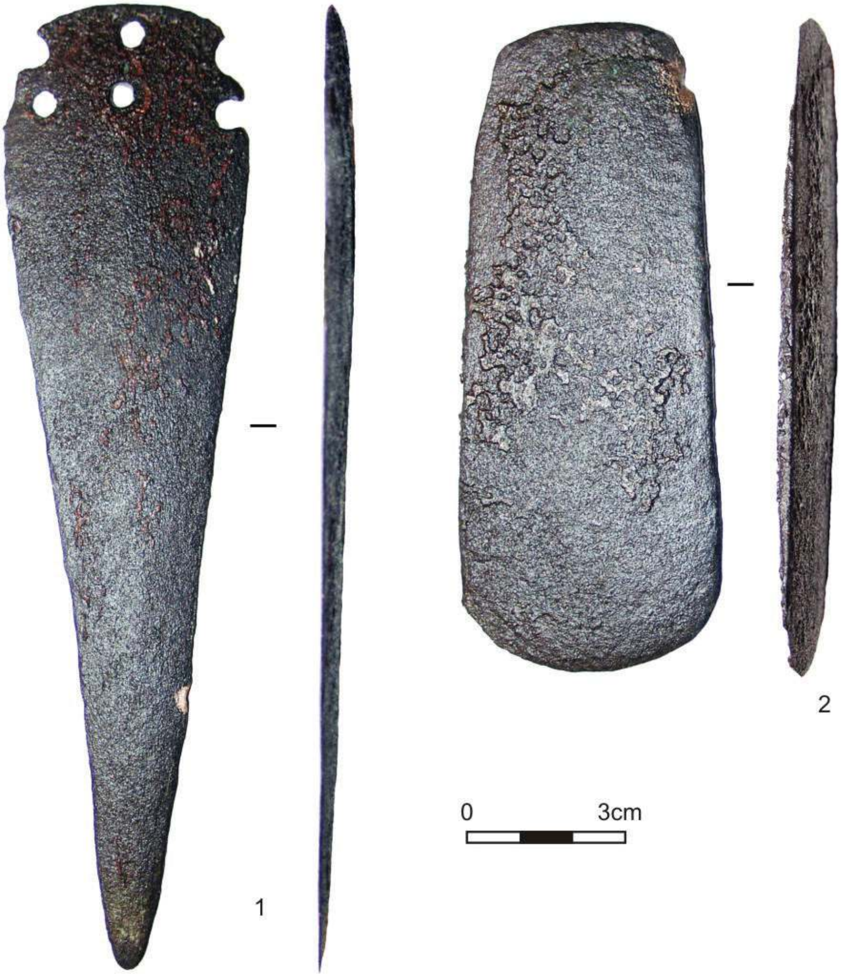
F i g . 4 . Finds from hoards in Romania: Brad (1-3) and Hăbăşeşti (4) [*after* Mareş 2012]

be dated to the BI phase of this culture. Objects from the hoard possess analogies to those from Romania, the Hăbăşeşti settlement and Brad Cucuteni culture, phases A2-B1 [Mareş 2012] (Fig. 4).

The copper in the 'Velyka Kisnytsia Hoard', on the basis of micro-admixtures content, can be divided into two basic groups: An. 1362 – 1364 and An. 1359 – 1361. The latter is similar to the metal from the 'Ivonivka Hoard' (Tab. 1). The similarity of micro-admixtures content in copper from hoards of such diverse chronology points to the one and the same, clearly local, source of raw materials.

F i g . 5 . The Kelmentsi Hoard. Kelmentsi Region, Chernivtsi *Oblast* [*after* Klochko, Kozymenko 2016]. *See* Tab. 1: 2 – analysis number 1358, 3 – analysis number 1355, 4 – analysis number 1357, 5 – analysis number 1356

F i g . 6 . Letychiv Hoard. Letychiv Region, Khmelnytskyi *Oblast* [*after* Klochko, Kozymenko 2016]

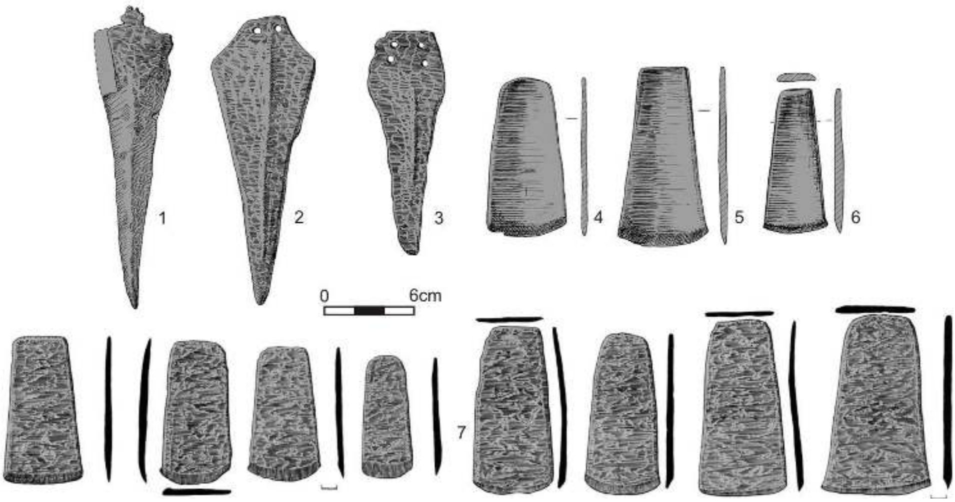


F i g . 7 . The hoard from the Loshniv site, Terebovlia Region, Tarnopil *Oblast* [*after* Klochko, Kozymenko 2016]. *See* Tab. 1: 1 – analysis number 1332, 2 – analysis number 1327

Clearly, these are Dniester copper-bearing sandstones, whose exploitation by Tripolye culture metallurgists has already been recorded [Klochko, *et al*. 2000; Kloczko, *et al*. 2003] on the basis of materials in the Upper Dniester drainage basin.

b. Hoards from the Dniester drainage basin, found beyond the *Yampil barrow cemetery complex*:

(ba) hoard of ornaments, Kelmentsi Region, Chernivtsi *Oblast*, represents the local crafts of several types of ornaments from the decline Tripolye culture, from local raw materials; (bb) assemblage, discovered Letychiv Region, Khmelnytskyi *Oblast* most likely related to the work of ornamentation is of miners, perhaps also



F i g . 8 . Daggers and flat axe-adzes of the Usatovo culture, Odessa *Oblast* and Moldavia: 1. Usatovo 1.1.1; 2. Usatovo 1.3.1; 3. Sucleia 3; 4. Usatovo 1.9.8; 5. Usatovo 1.13; 6. Usatovo 1.12.1. [*after* Klochko 2001]. Flat axe-adzes of the Maykop culture, northern Caucasus: 7 [*after* Chernykh 1966]

miners of ore; (bc) assemblage from the village of Loshniv, Terebovlia Region, Tarnopil *Oblast*, as the first find of arms and work tools belonging to the Gordineşti group, late Tripolye culture.

ba. In 2015, Kelmentsi Region, Chernivtsi *Oblast*, a hoard was found (Fig. 5) [Klochko, Kozymenko 2016: 1.2.49] at the Tripolye culture settlement.

The 'Kelmentsi Hoard' found in a vessel from the CI stage of the Tripolye culture, contained: 1. Vessels; 2. Spiral twined beads; 3. Chisel (length 10 cm; thickness 1 cm; blade width 1.6 cm); 4. Rings; 5. Funnel beaker pendants (Fig. 5). This is the first hoard of a Tripolye master craftsman – of copper ornaments. Metal, from which the goods were made, part of this hoard, is homogenous (Tab. 1: An. 1355 – 1358) and another sample, analogous to the raw material of products from the settlement of Hlybochok [Klochko, *et al*. 2000; Kloczko, *et al*. 2003].

bb. Indirect proof of local copper extraction in the Eneolithic is the hoard, discovered in 2005 Letychiv Region, Khmelnytskyi *Oblast* [Klochko 2016: Drawing 5] (Fig. 6).

The 'Letychiv Hoard' contains four objects: a unique, massive shaft-hole axe-mattock with a long pipe sleeve, measuring in length 15 cm; a miniature axe-adze, measuring in length 11 cm (sceptre head) and two pendants in the form of axe-adze models, measuring in length 5.2 and 3.4 cm (Nicholas elements). In general, these finds as a whole remind us not a hoard, but the grave furnishings of an ore miner (axe-mattock models in the form of a sceptre and pendants can be understood as examples of the secularisation of work tools belonging to ore miners and their work).

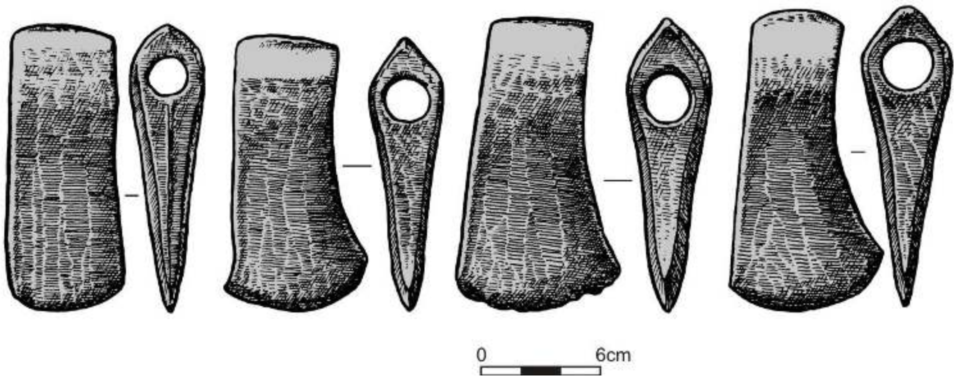


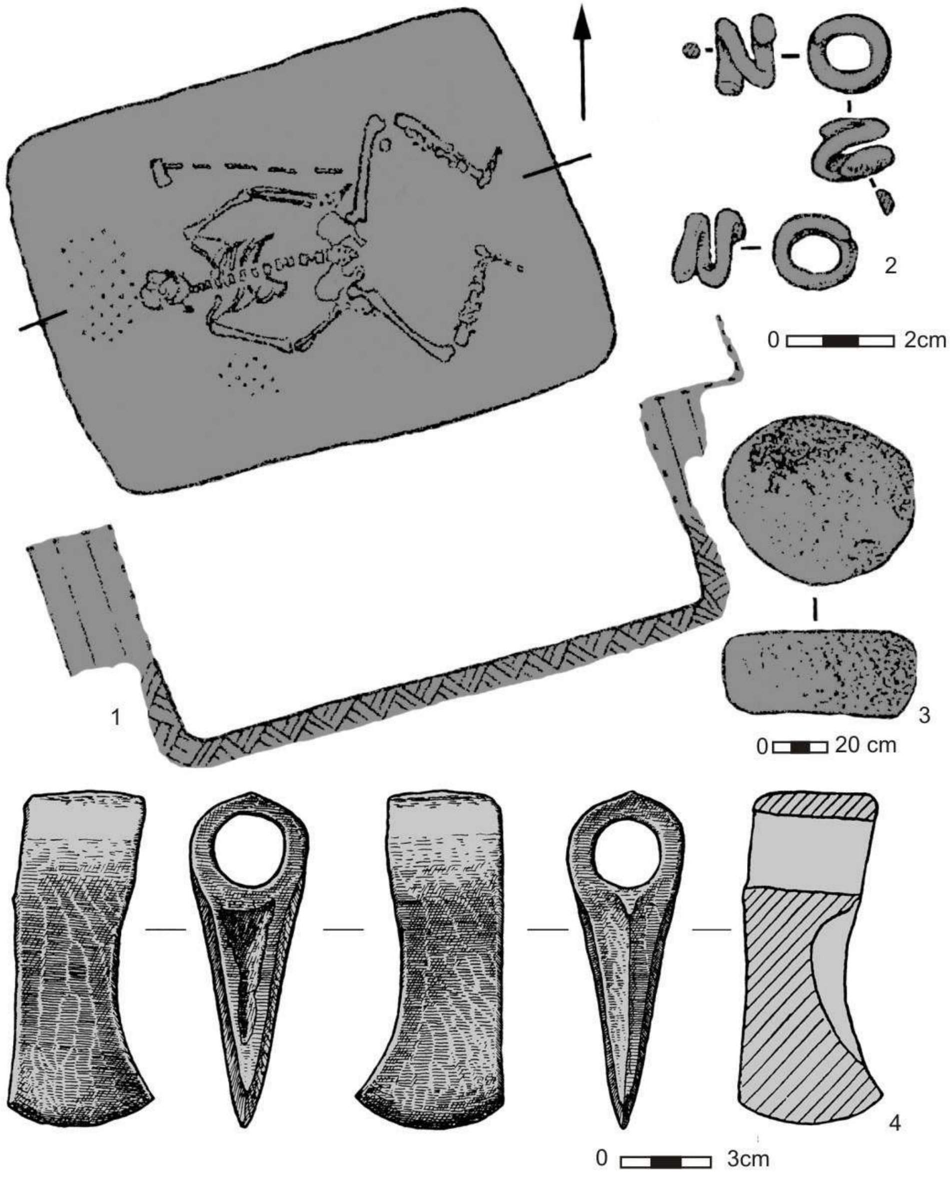
Fig. 9. Main axe types of the hoard from Vîlcele (Baniabic/Bányabükk), Cluj, Transylvania, Romania [*after* Vulpe 1970]

bc. In 2016 a hoard was discovered near the village of Loshniv, Terebovlia Region, Tarnopil *Oblast* (Fig. 7) [Klochko, Kozymenko 2016: 1.3.49].

The hoard from the Loshniv site contains: a Mediterranean dagger (Usatovo), length 20.4 cm, thickness 0.5 cm, handle width 5.2 cm (an. nr 1332) and adze (flat shaft-hole axe) Small-Asian (Usatovo, or also Maykop), length 13.6 cm, thickness 0.5 cm, blade width 5.6 cm (an. nr 1327) (Fig. 7, Tab. 1). Both objects were fashioned out of arsenic bronze. Such an assemblage of objects (dagger and shaft-hole axe) is characteristic for 'Princely' burials of the Usatovo (group), late Tripolye culture [Klochko 2001: 43-49, Fig. Tab. 1, 9; Klochko 2006: 34-37, Drawing 9, 11]. Similar, flat axe-adzes are also known in Maykop culture in the northern Caucasus [Chernykh 1966] (Fig. 8). Usatovo products fashioned out of arsenic bronze, Anatolia type, are considered to be the oldest products fashioned out of bronze in the northern Black Sea area [Ryndina, Konkova 1982]. The hoard from the Loshniv site, which in all probability belongs to the Gordineşti group, late Tripolye culture, demonstrates that arsenic bronzes of the Anatolia type are becoming widespread from the second half of the 4th mill. BC in the entire Dniester drainage basin as far as its northern course.

2.2. THE CONTEXT OF 'EARLY BRONZE' METALLURGY ON THE MIDDLE DNIESTER DRAINAGE BASIN AND PODOLIA.

The 'Ivonivka Hoard'– the first such find in Ukraine and the second after the 'Vîlcele or Baniabic/Bányabükk Hoards', discovered in Romania, Cluj, Transylva-



F i g . 1 0 . The barrow near the village of Pidlissia, Brovary Region, Kiev *Oblast*, Ukraine, burial 1/2 (1); Silver Temple rings (2); shallow navy blue-pestle (3); copper shaft-hole axe (4). [*after* Bratchenko, Klochko, Soltys 2000]

Fig. 11. Metal objects: 1 – ingot of 'raw copper' from the Humentsi site, Kamianets Region, Khmelnytskyi *Oblast* [*after* Klochko, Kozymenko 2016]; 2 – bronze tiles from the inhumation, Prydnistryanske I/4 [*after* Klochko, *et al*. 2015]. *See* Tab. 1: 1 – analysis number 1042

nia [Roska 1933; Vulpe 1970, 27, № 1–32, Taf. 1, Taf. 2, Taf. 3. 25–32] in respect YC hoards. The 'Vîlcele Hoard' contained 32 objects – only axes – whereas the 'Ivonivka Hoard' boasts an entire set of tools for fashioning wood: shaft-hole axe, two adzes and a bit, being the first such hoard of a master-carpenter of the YC.

Despite the fact that the axes from the 'Vîlcele Hoard' are rather differentiated in respect to their form and technology of production (some were cast in open-cast moulds, while others – enclosed two-part moulds, whereby in the latter the respective axe forms of rather differentiated form and technology of production were linked) (Fig. 9). All of these are traditionally recorded as the one type by Vulpe [1970], as Baniabic/Bányabükk, considered to be the oldest type of axe with an opening for a shaft hole, in the Carpathian Basin (shaft-hole axes in the Carpathian Basin) [Dani 2013].

In this context, there has been recent mention on the fact that the evolution of shaft-hole axes began in the northern Black Sea area as early as the Eneolithic from axes of the Sokolov type, which subsequently link axes of the 'Pidlissia and Baniabic/Bányabükk type' [Klochko, Klochko 2013: 54-55].

In earlier literature, based on a new find of an analogous axe, cast in an open mould form, in a YC early pit burial (deceased placed in a supine position with legs

Fig. 12. Casting mould from Zherdenivki, Haisyn Region, Vinnytsia *Oblast* (1); casting mould from Pysarivka, Starokostiantyniv Region, Khmelnytskyi *Oblast* (2) [*after* Klochko, Kozymenko 2016]

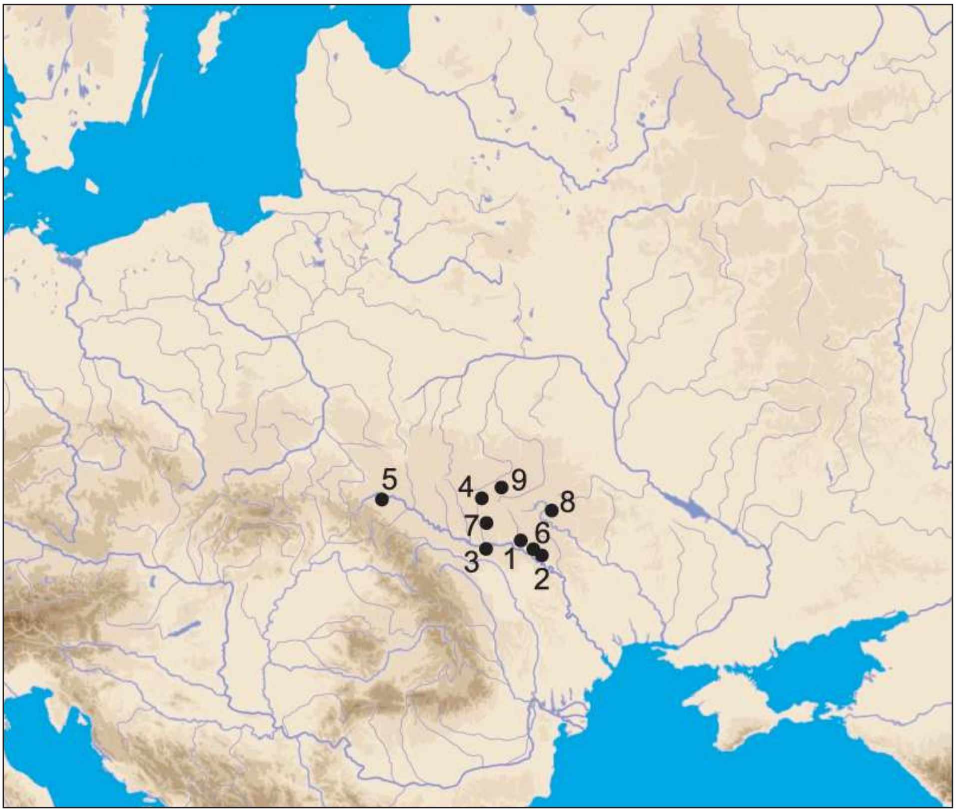
contracted at the knees), Pidlissia site, Brovary Region, Kiev *Oblast*, [Bratchenko, Klochko, Soltys 2000] (Fig. 10: 4), I propose such axes be known as the "Pidlissia variant" of the 'Baniabic/Bányabükk type' [Klochko 2001: 78-83; Klochko 2006: 65-66]. Further, bearing in mind the significant differences in the technology of production, it would be more correct to speak of the 'Pidlissia type', which belongs to the early phase of the YC – dated in the Middle Dniester drainage basin to 2800 – 2350 BC [Klochko 1999: 195].

To this early period of the Bronze Age the ingot of 'raw' copper from the Humentsi site is also dated, Kamianets-Podilskyi Region, Khmelnytskyi *Oblast*, (Fig. 11: 1). Its dimensions are: 12x13x3 cm and correspond to medium-sized so-called 'caste bowls of the early Bronze Age in Europe [Bátora 2006: p. 29; Plates 16, 7]. The metal out of which the ingot is made, is copper of a particularly characteristic (Dniester) composition of micro-admixtures (Tab. 1: an. nr 1042). This testifies to the smelting of copper from a local material in a given region.

The tradition of processing arsenic bronze during the decline Tripolye culture (Usatovo arsenic bronzes and those from the site of the 'Loshniv Hoard') is also continued in the Dniester Region during the early Bronze Age. This is testified to not only by the adze from the 'Ivonivka Hoard' (Fig. 1, 3; an. nr 1329), but also 'guards' serving as reinforcers in the wooden handle of the stone mace from the inhumation grave of the Catacomb culture, Prydnistryanske 1, I/4 near Yampil (Fig. 11: 2, Tab. 1: an nr. 1145) [Klochko, *et al*., 2015: 188-189, Fig. 7], also made out of arsenic bronze. The metal from which these 'guards' are made is entirely analogous to that of the adzes from the 'Ivonivka Hoard', which points to the one and the same source of raw material.

2.3. CONTEXT OF THE CONTINUATION OF METALLURGY TRADITIONS IN THE LATE AND DECLINE BRONZE AGE.

The subject of local metallurgy and its processing in the late Bronze Age has been discussed by Maleev [1976] and Goshko [2011]. New finds of bronze casting forms for Lusation sleeved hammer-axes, related to the early phase of the Chernoles culture [Klochko 2016a; 2016b] from the villages of Zherdenivka, Haisyn Region, Vinnytsia *Oblast* (Fig. 12: 1) and Pysarivka, Starokostiantyniv Region, Khmelnytskyi *Oblast* (Fig. 12: 2) [Klochko, Kozymenko 2016: 4.2.4.2; 4.2.4.3] are broadening the base of information on prehistoric metallurgy in the Dniester drainage basin. There is no doubt that the metallurgy of this region in the Late Bronze Age requires a separate study; nonetheless it is possible to note that also in this period the above-mentioned materials testified to a further exploitation of local copper ores.



F i g . 1 3 . Map of new 'Dniester' finds: 1. Ivonivka; 2. Velyka Kisnytsia; 3. Kelmentsi; 4. Letychiv; 5. Loshniv; 6. Barrow, Prydnistrianske site; 7. Humentsi; 8. Zherdynivka; 9. Pysarivka

3. CONCLUSIONS

The exploitation of Dniester copper bearing sandstone was commenced by Tripolye craftsmen already by the BI phase at the latest. As a result, as in the case of exploiting Volhynia copper, the metallurgy of the middle and late Tripolye culture develops in similar fashion in eastern regions of the Funeral Beaker Culture and Lublin-Volhynia Painted Ceramic Ware culture.

The new materials presented (Fig. 13) show that the earlier presented and subjected to study, *Carpathian Volhynia Early Bronze Age centre of Metallurgy of the Corded Ware culture* [Klochko, Klochko 2013] took shape in the Dniester drainage basin on the basis of Tripolye culture metallurgy, whereas in the Early Bronze Age its south-east part (foremost in the region of the *Yampil Barrow Cemetery Complex*) was exploited by autochthons of the Yamnaya and Catacomb cultures.

Moreover, in the Middle and Late Bronze Age, local metallurgy continued to be developed by the cultures of Babino, Komarov, Noua, Gava-Holihrad and Chernoles. Importantly, Dniester copper was also exploited during the Iron Age and the Middle Ages.

Translated by Piotr T. Żebrowski

REFERENCES

Bátora J.

2006 *Štúdie ku komunikácii medzi strednou a východnou Európou v dobe bronzovej.* Bratislava.

Bratchenko S.N., Klochko V.I., Soltys O.B.

2000 Metalevi sokyry yamnoyi kultury Serdnoyi Naddniprianschyny. *Arkheolohichnyi litopys Livoberezhnoyi Ukrayiny* 1-2: 8-14.

Chernykh E.N.

1966 *Istoriya drevneyshey metallurgii Vostochnoy Evropy.* Moskva.

Dani J.

2013 The Significance of Metallurgy at the Beginning of the Third Millennium BC in the Carpathian Basin. In: V. Heyd, G. Kulcsár, V. Szeverényi (Eds) *Transitions to the Bronze Age. Interregional Interaction and Socio-Cultural Change in the Third Millennium BC Carpathian Basin and Neighbouring Regions,* 203-232. Budapest.

Dergachev V.

2016 Novye klady metallicheskikh izdeliy kultury Kukuten-Tripolie iz Srednego Podneprovia (Ukraina). In: L. Sîrbu, N. Telnov, L. Ciobanu, G. Sîrbu, M. Kaşuba (Eds) *Culturi, Procese şi contexte în Arheologie. Volumul omagial Oleg Leviţki la 60 de ani*, 36-42. Chişinău.

Goshko T.Yu.

2011 Metalevi vyroby z Hordiyivky. In: V.I. Klochko (Ed.) *Hordiyivskyi mohylnyk,* 151-236. Vinnytsia.

Goslar T., Klochko V.I., Kośko A., Włodarczak P., Żurkiewicz D.

2015 Chronometry of Late Eneolithic and "Early Bronze" cultures in the Middle Dniester area: investigations of the Yampil Barrow Complex. In: A. Kośko (Ed.) *Podolia as a cultural contact area in the 4th/3rd-2nd millennium BC. Baltic-Pontic Studies* 20: 256-191.

Harat K., Potupczyk M., Razumov S.

2014 Charakterystyka źródeł archeologicznych pozyskanych w latach 1984-1993. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 45-204. Poznań.

Klochko V.I.
1999 Radiocarbon chronology of the Early and Middle Bronze Age in the Middle Dnieper Region. The Mironivka barrows. *Baltic-Pontic Studies* 7: 163--195.
2001 *Weaponry of Societies of the Northern Pontic Culture Circle: 5000-700 BC. Baltic-Pontic Studies* 10.
2006 *Ozbroyennia ta viyskova sprava davnoho naselennia Ukrayiny*. Kyiv.
2016a Drevneyshye etapy razvitiya metallurgii na Ukraine (Tipokhronologiya drevnikh metallicheskikh izdeliy Ukrainy). In: V.I. Klochko, A.V. Kozymenko*, Drevniy metall Ukrainy,* 285-331. Kiev.
2016b Pro vtulchasti sokyry-kelty Chornoliskoyi kultury. In: *Arkheolohiya i davnia istoriya Ukrayiny* 2(19), 100-102. Kiev.

Klochko V.I., Klochko L.
2013 Complex of Metal Goods between the Vistula and Dnieper rivers at the turn of the 4th/3rd to the 3rd millennium BC. Concept of the Carpathian – Volhynia "Willow Leaf" metallurgy centre. *Baltic-Pontic Studies* 18: 39-71.

Klochko V.I., Kośko A., Potupchyk M.V., Włodarczak P., Żurkiewicz D., Ivanova S. V.
2015 Tripolye (Gordineşti group), Yamnaya and Catcomb culture cemeteries, Prydnistryanske, site 1, Yampil Region, Vinnitsa Oblast: archaeometric and chronometric description and a taxonomic and topogenetic discussion. *Baltic-Pontic Studies* 20: 177-249.

Klochko V.I., Kozymenko A.V.
2016 *Drevniy metall Ukrainy*. Kiev.

Kloczko V.I., Manichev V.I., Kompanec G.S., Kovalchuk M.S.
2003 Wychodnie rud miedzi na terenie Ukrainy zachodniej jako baza surowcowa metalurgii kolorowej w okresie funkcjonowania kultury trypolskiej. *Folia Praehistorica Posnaniensia, X/XI:* 47-78.

Klochko V.I., Manichev V.I., Kvasnitsa V.N., Kozak S.A., Demchenko L.V., Sokhatskiy M.P.
2000 Issues concerning Tripolye metallurgy and the virgin copper of Volhynia. *Baltic-Pontic Studies* 9: 168-186.

Kośko A. (Ed.)
2015 *Podolia as a cultural contact area in the 4th/3rd-2nd millennium BC. Baltic-Pontic Studies* 20.

Kośko A., Potupczyk M., Razumow S. (Eds)
2014 *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych” strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6. Poznań.

Maleev Yu. N.
1976 Liteynye formy s poseleniya Myshkovichi v Podnestrove. In: S.S. Berezanskaya, V.V. Otroschenko, D.Ya. Telegin (Eds) *Eneolit i bronzovyi vek Ukrainy,* 232-239. Kiev.

Manzura I.V., Klochko E.O., Savva E.N.
1992 *Kamenskie Kurgany.* Kishinev.

Mareş I.
2012 *Metalurgia aramei în civilizaţiile Precucuteni şi Cucuteni.* Suceava.

Potupczyk M., Razumow S.
2014 Zgrupowanie cmentarzysk kurhanowych w rejonie jampolskim. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych” strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 35-40. Poznań

Roska M.
1933 Le dépôt de haches en cuivré de Baniabic, département de Turda-Arieş. *Dacia* 3-4: 352-355.

Ryndina N.V.
1971 *Drevneyshee metalloobrabatyvayuschee proizvodstvo Vostochnoy Evropy.* Moskva.
1980 Metall v kulturakh shnurovoy keramiki Ukrainskogo Predkarpatia, Podolii i Volyni. *Sovetskaya arkheologiya* 3: 24-41.
1998 *Drevneyshee metalloobrabatyvayuschee proizvodstvo Yugo-Vostochnoy Evropy.* Moskva.

Ryndina N.V., Konkova L.V.
1982 O proiskhozhdenii bolshykh usatovskikh kinzhalov. *Sovetskaya arkheologiya* 2: 30-42.

Vulpe, A.
1970 *Äxte und Beile in Rumänien I. Prähistorische Bronzefunde IX/2*. München.

Baltic-Pontic Studies
vol. 22: 2017, 246-283
ISSN 1231-0344
DOI 10.1515/bps-2017-0028

Piotr Włodarczak[*]

KURGAN RITES IN THE ENEOLITHIC AND EARLY BRONZE AGE PODOLIA IN LIGHT OF MATERIALS FROM THE FUNERARY-CEREMONIAL CENTRE AT YAMPIL

ABSTRACT

The paper discusses the kurgan burial rites observed by communities inhabiting the eastern part of the Podolie Region in the second half of the 4th and first half of the 3rd millennia BC. The presented data concern finds from four areas: Yampil, Kamienka, Mocra, and Tymkove. The research made it possible to distinguish among the examined material assemblages linked with Late Eneolithic communities. They included graves of the Zhivolitovka-Volchansk type, burials in the extended position, as well as burials representing other cultural traditions (Nizhnaya Mikhailovka, Post-Stog). Materials attributed to the Yamnaya culture prevailed, and their analysis allowed us to trace changes in funeral rituals, reflected in the architecture of graves, arrangement of burials, and grave goods. Materials linked with the late phase of this cultural unit have not been recorded.

Key words: Eneolithic, Early Bronze Age, Yamnaya culture, Podolia, Ukraine, funeral rite

The results of field research carried out by a Polish-Ukrainian expedition investigating kurgans in the middle Dniester basin have already been published [Kośko (Ed.) 2014; 2015; 2017], and many specialist analyses connected with this research have already been concluded as well [apart from the publications quoted above,

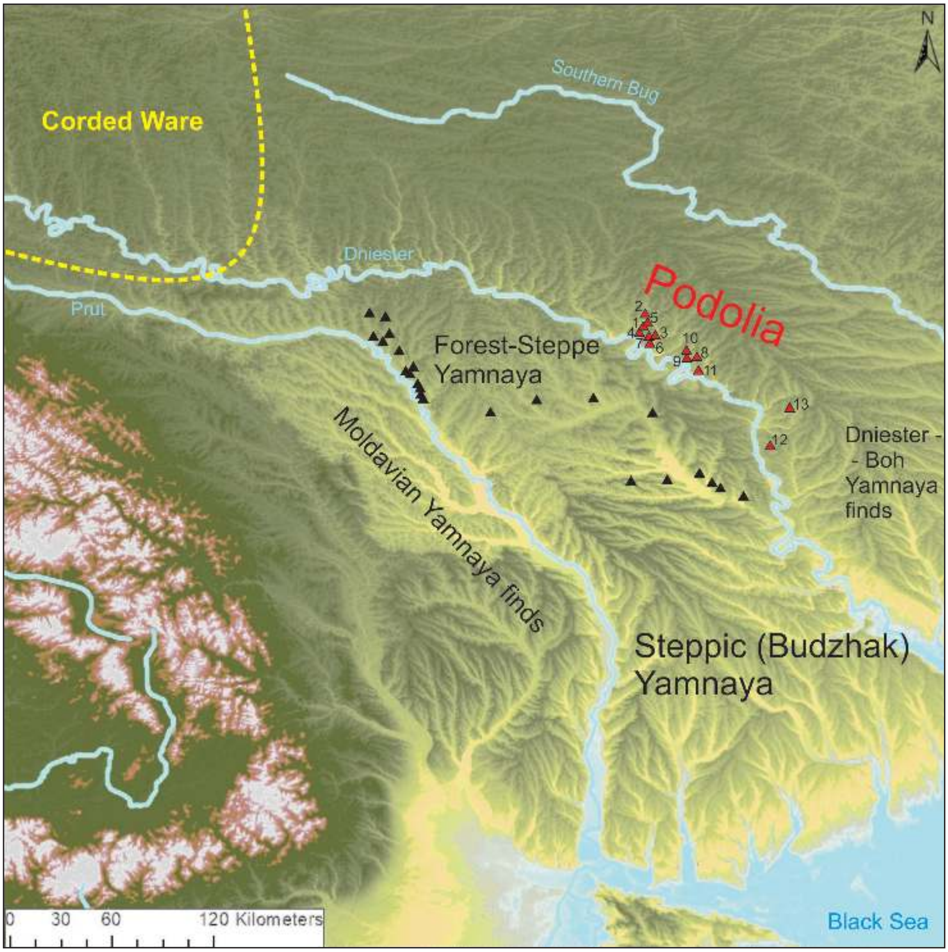
[*] Institute of Archaeology and Ethnology of Polish Academy of Sciences, Centre for Mountains and Uplands Archaeology, Sławkowska 17, 31-016 Kraków, Poland; wlodarczak.piotr@gmail.com

see: Kośko (Ed.) 2017]. The Podolia Region became the focus of our particular interest because the area is believed to have played an important role in contacts between steppe/forest-steppe communities of the North Pontic zone and those inhabiting Central Europe. Changes observable in funerary rites are often regarded as stemming from these contacts. Therefore, the taxonomic and chronological characteristics of kurgan cemeteries on the Dniester River, situated on the fringes of the North Pontic cultural area, were expected to provide a crucial contribution to creating over-regional models for reconstructing processes which took place in the second half of the 4th and first half of the 3rd millennia BC. An efficient tool for performing this task was deemed to be a dialogue among researchers whose areas of interests spanned Central Europe [cf. Kośko 2014; Włodarczak 2014a; 2014b] and the Black Sea coasts [Ivanova 2013; Iwanowa 2014; Ivanova, Toschev 2015a; 2015b; Razumow 2014, among others]. Such a dialog should produce findings allowing for the developing of optimal taxonomic models, in this case related with the funerary sphere.

Studies on kurgan communities of Podolia have become of particular importance in the context of recent archaeogenetic projects [i.a. Haak *et al*. 2015; Allentoft *et al*. 2015; Juras *et al*. forthcoming]. Taxonomic-periodization description of sepulchral rituals is a necessary supplementation to reconstructions of demographic changes. Being a contact zone between the cultural complexes of the steppes and Central Europe, the area in question seems to be of key importance for understanding the transfer of new funerary ideas: the "kurganisation" of Europe.

1. THE YAMPIL GROUP AND THE YAMNAYA CULTURE IN PODOLIA

The field research carried out by the Polish-Ukrainian expedition in 2010-2014 was focused on kurgans situated in the Yampil Region, Vinnitsa *Oblast*' [Klochko *et al*. 2015a; 2015b, 2015c; 2015d]. The particular interest in this group stemmed from its specific location within the "Yamnaya cultural-historical entity": its exposure to Central European Corded Ware culture (further as CWC) on the one hand, and discernible contact with communities representing the Globular Amphorae culture (GAC), expanding to the south-east, on the other [e.g. Szmyt 1999; 2000]. The location on the fringes of the north-western variant of the Yamnaya culture (YC) [acc. to Merpert 1974; cf. Rassamakin 2013a; 2013b; Rassamakin, Nikolova 2008] opened up an interesting perspective for tracing the transfer of Central European cultural patterns to the North Pontic area, and for determining the specificity of the cultural model of steppe communities, which due to their geographic location seemed somehow predestined for westward expansion.



F i g . 1 . Locations of Eneolithic and Early Bronze Age kurgan cemeteries in Podolia. 1-7 – Yampil cluster (1 – Dobrianka, 2 – Klembivka, 3 – Pidlisivka, 4 – Porohy, 5 – Pysarivka, 6 – Prydnistryanske, 7 – Severynivka), 8-11 – Kamienka cluster (8 – Hrustovaia, 9 – Kuzmin, 10 – Ocniţa, 11 – Podoima), 12 – Mocra, 13 – Tymkove

Kurgans linked with YC were first investigated in Podolia as early as the second half of the 19th century. In the Yampil Region, a barrow at Kachkivka was explored at that time, in which graves from the discussed period were found [Sulimirski 1968: 172]. Roughly in the same period, several kurgans in the Kamienka Region were investigated by N.E. Brandenburg [1908: 166-177; Kachalova 1974: 12, 13, 18]. After a long break, Yampil kurgans became the subject of rescue-conservation research carried out by archaeologists from Vinnitsa in the 1980s and 90s [Harat *et al*. 2014]. In 2010-2014, a Polish-Ukrainian expedition excavated another seven barrows. These new materials made it possible to perform many specialist analyses, including archaeogenetic ones and isotope examination of human remsains. A long series of radiocarbon dates were also obtained [Goslar *et al*. 2015], which were distinguished by their very high quality and were therefore very useful in advanced chronometric studies on Eneolithic and Early Bronze Age cultural groups from the north-west Pontic area. The research also brought important discoveries, which allowed an older – Eneolithic – stage in the development of the Yampil ceremonial-funeral centre to be distinguished, not recorded in previous research.

The Podolia variant of YC was distinguished here based on geographic reasons, and also because the significance of the location of the discussed sites on an important route of migration of humans and ideas between the Black and Baltic Seas [Kośko, Klochko 2009]. The analysed kurgan clusters on the left bank of the Dnieper River are part of a larger agglomeration occupying the forest-steppe areas of what is today Ukraine and Moldavia. They constitute the northern, i.e. forest-steppe, part of the above-mentioned north-western variant of YC in N.Y. Merpert's [1974] classification. The latter also includes two other, similar clusters of kurgans: on the upper Prut River [e.g. Dergachev 1982] and between the Dnieper and the Reut Rivers [e.g. the kurgans at Brăviceni and Bursuceni: Larina *et al*. 2008; Yarovoy 1978]. Together with the Podolia kurgans, these two clusters form the forest-steppe part of the North-West Pontic finds [Ivanova, Toschev 2015a: 14, Fig. 2]. In the past, they were discussed jointly with much richer materials – and therefore determining the cultural picture – from the Budzhak Region, from the steppe part of the territory between the Danube and the Dniester [i.a. Dergachev 1986; Ivanova 2001; Yarovoy 1985; 1990].

2. SOURCE BASIS

The analysed sources comprised of materials discovered in kurgans from four regions of Podolia (Fig. 1):

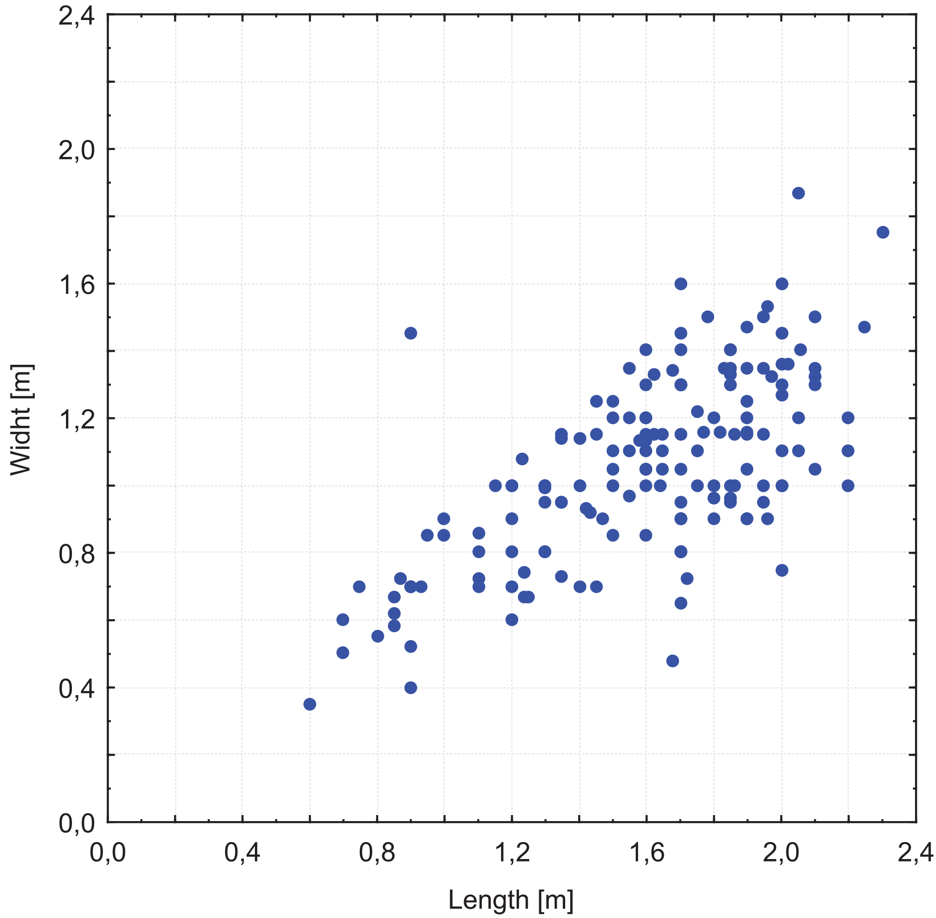
- Yampil: 25 kurgans, 81 graves [Harat *et al*. 2014; Klochko *et al*. 2015a; 2015b; 2015c; 2015d];
- Kamienka: 13 kurgans, 87 graves [Yarovoy 1981; Manzura *et al*. 1992; Bubulich, Khakhey 2001];
- Mocra: 3 kurgans, 17 graves [Kashuba *et al*. 2001-2002];
- Tymkove: 1 kurgan, 5 graves [Subbotin *et al*. 2000].

Thus, the basis for the analysis is a set of 188 graves discovered in 41 kurgans. Although the number is still small as compared with the neighbouring YC regions (including the Budzhak and Lower Dniester), the collected data are sufficient for attempting credible recapitulation, for presenting local characteristics and directions of cultural contacts, and for tracking the chronology of changes.

The materials presented below include Eneolithic/Early Bronze Age features from the Podolia Region, except for Eneolithic graves from the site of Prydnistryanske, which have been radiocarbon dated to around 4300-4100 BC. In some other cases, the chronological and taxonomic attributions (first of all of central burials) are open to doubt. It can only be assumed that the vast majority of them most likely originate from the very close of the 4th millennium and the first half of the 3rd millennium BC. First, particular traits of the kurgan rite in Podolia were analysed jointly (183 graves from 38 kurgans), and then attempts were made at their taxonomic and chronological divisions. According to the rules adopted here, two certain burials of the Catacomb culture (graves 3/5 from Ocniţa and I/4 from Prydnistryanske) were excluded from the analysis, while three other graves probably attributed to this culture were included, because they can possibly be linked with the YC or Eneolithic/Post-Eneolithic traditions as well (burials 1/4 and 1/7 from Pidlisivka and 2/5 from Kuzmin).

3. SPECIFIC TRAITS OF BURIAL RITES OF KURGAN COMMUNITIES IN PODOLIA IN THE FIRST HALF OF THE 3RD MILLENNIUM BC

One specific trait observed among burials dating to the first half of the 3rd millennium BC is a considerable degree of standardisation in terms of the arrangement of burials, contrasting with a higher diversity of funeral behaviours known from the second half of the 4th millennium BC [*see* Rassamakin 2013a; 2013b]. Several previously popular patterns ceased to be used, resulting in the vast majority of YC burials looking very similar: in a pit, with the body lying at the bottom of the pit in the supine position, legs highly contracted with knees up. With respect to central burials, the body orientation was along the E-W axis, with the head pointing to the west [Yarovoy 1985: 52-54; Dergachev 1986: 39; Ivanova, Toschev 2015: 357]. Furthermore, other constant traits of the ritual include rectangular grave pits, the application of ochre in the funerary ritual, the presence of linings of various kinds (e.g. mats) at the bottoms of grave pits, and the use of wooden structures (primarily for roofing the graves). Defined as above, the set of markers of the YC funeral rite was also observed in the Yampil Region and in the entire Podolia cluster, with the vast majority of burials revealing all the above-mentioned traits. The recorded examples of different arrangements should probably be explained in terms of genetic and chronological differences.



F i g . 2 . Dimensions of grave chambers in Podolia kurgans

The bulk of the grave cuts analysed here were rectangular in shape (161). Only in 10 cases were oval or nearly circular pits recorded (Kuzmin, graves 2/5 and 2/6). Oval pits in central graves were recorded three times (Klembivka, grave 1/15, Porohy, grave 3/2, and Severynivka, grave 1/5). As in other regions, grave cuts could be simple (including central burials in all kurgans) or have a step leading down to the grave chamber, which also supported a wooden or stone roofing. Grave chambers differed in size (Fig. 2), which depended primarily on the age of the deceased. Small features designed for children aged *Infans I* are a clearly distinct group, with dimensions of 0.5-1.0 x 0.4-0.75 m. A less clearly discernible group were mid-sized pits, intended primarily for burial of older children and juveniles (approx. 1.2-1.6 x 0.6-1.2 m). The largest group were the largest chambers, made for adult people, with dimensions of approx. 1.7-2.3 x 0.9-1.6 m. These parameters correspond with grave sizes in the neighbouring regions of YC [e.g. Shaposhnikova *et al*. 1986: 14, 15; Dergachev 1986: 34, 35; Melnik, Steblina 2013: 20].

Wooden roofing was recorded in the majority of burials (121 cases, i.e. 66.1%). Boards/laths were placed perpendicularly to the grave's principal axis slightly more often (53 cases) than in parallel arrangement (38 cases). In studies on YC in the North-West Pontic area the orientation of the roofing has sometimes been given a chronological valour [e.g. Manzura *et al*. 1992: 89]. The finds from Podolia support this view and suggest a clear connection of the parallel arrangement of planks with central burials, and with burials dug into the central part of a kurgan during the older phase of YC. Transversal roofing correlates with younger phases of YC, and was recorded for example in series of graves forming characteristic arching arrangements in the marginal parts of kurgan mounds. The presence of transversal roofs in central burials correlated with some other traits atypical of YC, such as oval pits and body orientation other than E-W, which suggests a funeral tradition other than YC (three cases: Hrustovaia, grave 5 and Porohy, graves 1/2 and 3/2).

Nine of the grave pits (4.9%) were covered with stone blocks. This raw material was used only for the cover, while stone boxes, typical of the GAC funerary tradition, have not been recorded. The best-preserved, and at the same time well-documented, feature with stone roofing was grave IV/4 from Prydnistryanske. The cover, built from four large stone blocks, was supplemented with a wooden grate supported by stakes driven into the pit's bottom, and the structure was sealed with two mats. Thus, we are dealing here with a double roof structure, and the same was the case in grave 1/7 from Dobrianka and 2/13 from Severynivka. What was unique for Podolia, however, was the application of well-fitted, slightly dressed slabs resembling schematic stelae, such as those known from the territory between the Boh and Dnieper Rivers, from the Ingul cluster in particular [Rychkov 2001: 45; Ivanova, Toschev 2015b: 357].

The use of stone in Podolie kurgans seems to be a chronologically sensitive trait. Stone was recorded in graves of Eneolithic and early Yamnaya date, including in central burials representing various cultural traditions (grave 2/3 from Pysarivka and 2/5 and 6/24 from Ocniţa). The mentioned grave 1/7 from Dobrianka and grave 2/13 from Severynivka are certainly linked with early YC.

Small stakes driven into the ground at the margins of the pit were recorded in 29 graves (15.8%). Most often (15 cases) there were eight stakes: in the corners and in the middle of each wall. They have typically survived only as impressions a few centimetres in diameter. Large fragments of stakes themselves have survived in grave 4 from the Prydnistryanske kurgan, and they were similar to even bettes-reserved stakes from grave 1/4 from Brînzeni Noi [Agulnicov, Mistreanu 2014: 69, Fig. 7]. The Prydnistryanske grave also yielded transversal stakes, originally probably mounted between the tops of the vertical stakes. Graves with wooden stakes are commonplace and are typical of YC kurgans. They are known both from adult

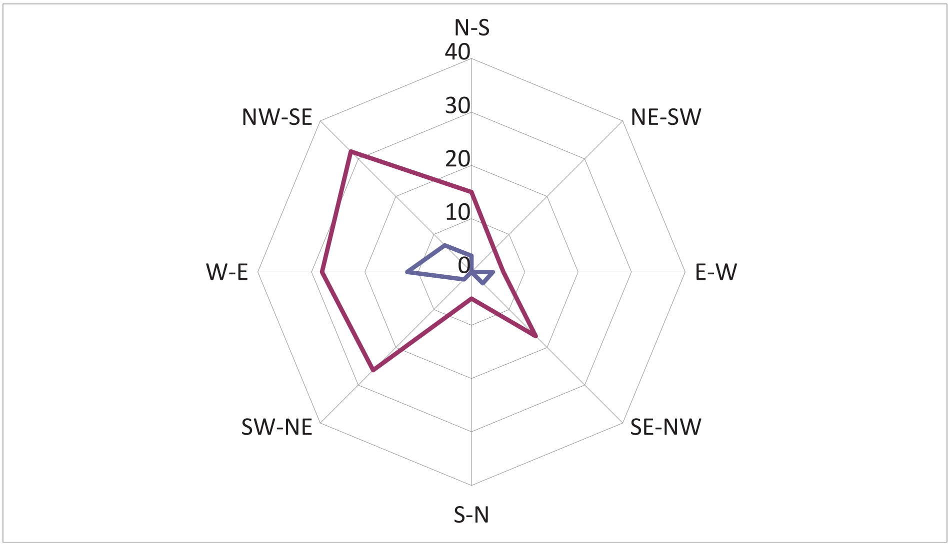


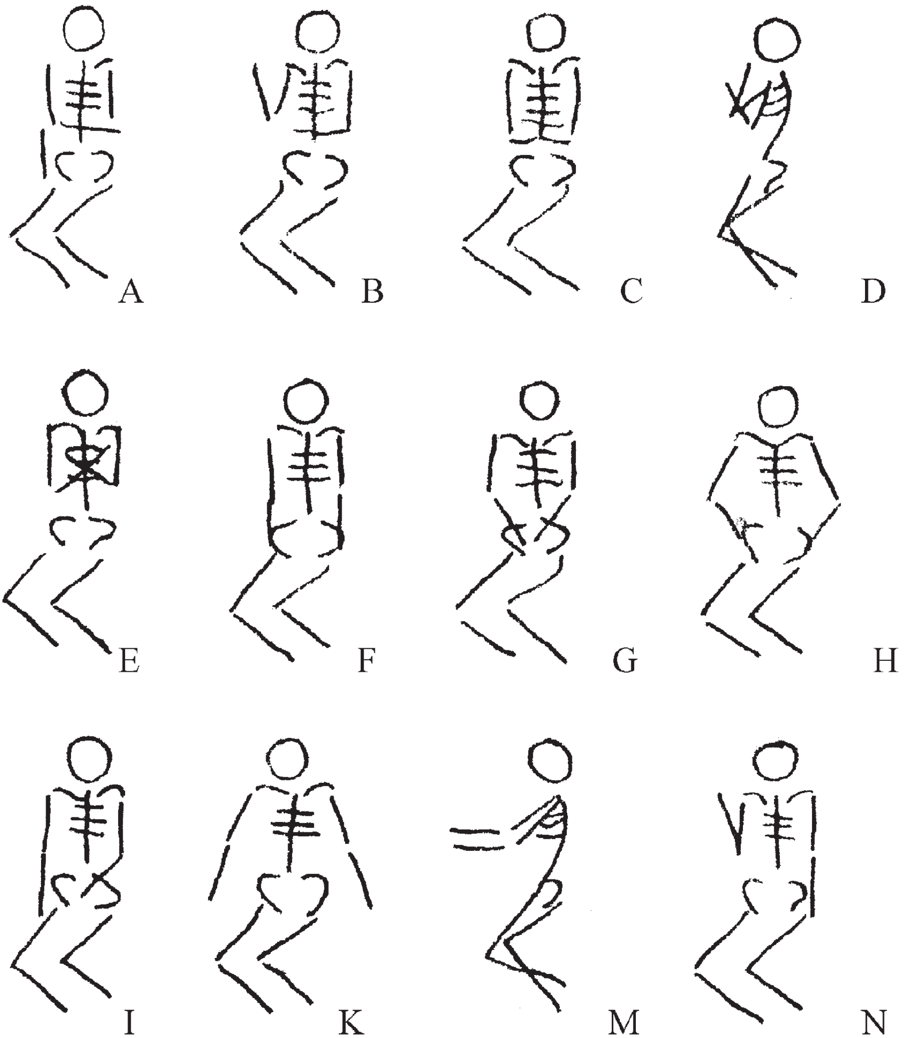
Fig. 3. Orientation of central (blue) and secondary (red) burials in Podolia kurgans

and child burials, and it is worth noting their presence in central burials (8 cases in the Podolia cluster). This constructional element was particularly popular in the kurgan cemetery at Mocra (9 out of 17 graves). The presence of stakes as elements of grave construction is a good indicator of Early Bronze Age rituals of YC, which in the discussed area was absent from Eneolithic funerary traditions.

The connection between the use of stakes along the perimeter of grave pits and the parallel arrangement of wooden roofing is quite clear, although some exceptions to this rule are known (Ocniţa, graves 1/7 and 3/14, Porohy grave 3A/1). This connects with the dating of graves with stakes to the early stages of YC: graves with stakes are usually situated in the central parts of kurgans.

Another typical element of YC grave construction, namely grooves marking the limits of pits, was less often recorded in Podolia kurgans – only in 9 cases, mainly in Ocniţa and Mocra, and only once in the Yampil cluster (Porohy, grave 3A/1). Unlike the stakes discussed above, this element was not recorded in central burials, which means it links with later stages of YC. Grooves have most often been interpreted as elements for setting vertical or horizontal planks or timbers lining grave chambers walls.

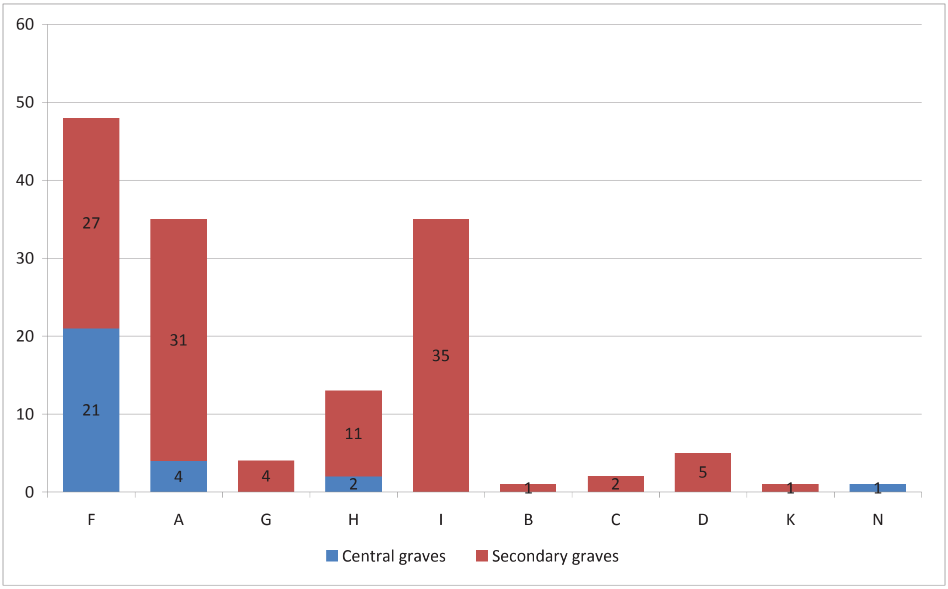
Wooden wall linings made from horizontal timbers were recorded in 11 graves: in the Yampil cluster (Porohy, graves 2/4, 2/6, 3A/1, Prydnistryanske, grave IV/9), the Kamienka cluster (Ocniţa, graves 3/6, 3/12, 3/13, 6/9, 6/13 and 6/27) and in Mocra (grave 1/13). These were graves dug into kurgan mounds, and most of them are linked with younger stages of YC. This element of grave construction can be



F i g . 4 . Types of upper limbs arrangement [Häusler 1974; Włodarczak 2006]

seen as typical of the Podolia Region [Manzura *et al*. 1992: 89; Kashuba *et al*. 2001-2002: 221], although isolated cases are known from other parts of the North-West Pontic area [Yarovoy 1985: 13, 19].

Burial orientation should be discussed separately for central burials and those dug into already existing mounds [e.g. Dergachev 1986: 39-42], although the latter group also include founding burials for successive stages of the kurgan's enlargement, whose orientation was probably established in relation to cardinal directions



F i g . 5 . Types of upper limbs arrangement in graves from Podolia kurgans

rather than the kurgan's centre. However, their objective identification is sometimes impossible. In both groups, the deceased were predominantly buried with their heads to the west (Fig. 3). In the case of central burials, the orientation towards NW was also popular. Graves dug into the existing mounds were oriented in relation to the centre of the kurgan. Additionally, it was observed with respect to Podolia kurgans that subsequent burials were placed according to what is known as the "clock rule", i.e. with the head either in clockwise (in the southern part of the mound) or counter-clockwise direction [Manzura *et al*. 1992: 90, 91; Kashuba *et al*. 2001-2002: 221]. These observations made in the Kamienka cluster and Mocra were confirmed in the Yampil cluster, from where a larger number of graves is known (first of all Dobrianka; Porohy 3A; Severynivka 2). The application of the clock rule for YC graves forming arching arrangements correlates with the preference for burying the dead with the head towards the west (with deviations towards NW and NE – *see* Fig. 3).

The deceased from Podolia kurgans were buried predominantly in the supine position (128 cases, 75.7%), which belong to group II in Y. Rasamakin's classification [2004: 151-168]. This number also includes those cases where the body was lying on the back but slightly leaning to one side, sometimes distinguished as a separate category [e.g. Yarovoy 1985: 38-42; Ivanova 2012: 12, 13]. Such cases are sometimes difficult to objectively distinguish from burials in the typical supine position, and the intentionality of arrangement is difficult to determine due to the

F i g . 6 . The two most characteristic arrangements of YC burials. 1 – Prydnistryanske, grave IV/4, 2 – Porohy, grave 3A/10. Photo by D. Żurkiewicz

operation of post-depositional factors. One can only mention that the supine position with a deviation to one side was recorded primarily in graves dated to later stages of YC in Podolia (e.g. in a group of burials from kurgan 3A at Porohy). The finds from the analysed region confirm the connection of burials in the supine position proper, with legs bent and knees up, with the beginning of the Early Bronze Age – early YC (here belong central burials and burials dug into the central part of a kurgan, linked with the older stages of the mound's enlargement) [Yarovoy 1885: 105-108; Manzura *et al*. 1992: 90].

The position of arms is one of the diagnostic traits in funerary behaviours of Eneolithic and Early Bronze Age communities both in Central Europe (CWC) and in the North-West Pontic area [e.g. Häusler 1974; Yarovoy 1985; Dergachev 1986; Rassamakin 2004]. Some authors have proposed developed typologies in this respect, with dozens of variants [e.g. Yarovoy 1985: 38-49]. For the needs of this study, a generalised classification proposed by A. Häusler [1974: 11, Fig. 1], also applied in the description of funeral rituals of Central European communities (Figs. 4 and 5) [Włodarczak 2006], has been deemed sufficient.

In general, the arrangement particularly typical of YC is with both arms stretched along the body (type F – *see* Fig. 6: 1), sometimes with one or both arms slightly bent at the elbow and hands pointing towards the pelvis (types G, H, and I – *see* Fig. 6: 2). All these four types of arm arrangement have been only incidentally recorded among CWC groups from Central Europe, where the clearly predominant types were A, B, and C: namely with at least one arm sharply bent and placed at the pelvis of the deceased person [Włodarczak 2006; 2014b]. Types B (less common) and C (more widespread) are in particular contrast to the Podolia variant of YC, since they have not been recorded there at all.

During the examination of the materials from kurgan 3A at Porohy, a group of burials situated along an arch around the centre of the kurgan have revealed specific traits in terms of arm arrangements. In each case, one of the arms was bent and placed on the waist or pelvis of the deceased (arrangements A, G, H, or I). An even more telling situation was observed in a kurgan at Hrustovaia (in the Kamienka cluster), where the mentioned arrangement was recorded in all burials forming the arch along the perimeter, and two deceased from the central part (including the central burial) were buried with both arms stretched straight along the body (F). This regularity finds confirmation in other complexes as well (including the kurgans at Ocniţa in the Kamienka cluster and Severynivka in the Yampil cluster). Thus, in the Podolia variant of YC the arrangement of arms is a chronological indicator, with type F characteristic of the older phase and types G, H, I, and A typical of younger stages.

The position of legs is more difficult to be schematically presented due to the operation of post-depositional factors considerably disturbing the original arrangement. With respect to those buried in the supine position, the variant with legs bent and knees up was obviously predominant, although the position would become disturbed due to the decomposition of the body. All that can be concluded is that the deceased buried on their backs usually had their legs bent at the knee joints at a very acute angle.

A specific variant of supine burials was with the rhomboidal arrangement of legs, recorded in 9 cases (the so-called “rider’s position” or “frog position”). In some cases it can be assumed to stem from natural processes of decomposition, with legs falling outwards to the sides (Porohy, grave 3A/11). In most cases, however, the rhomboidal arrangement of legs was mirrored by the same arrangement of arms (type H, 10 cases), which suggests intentional activity. This indicates that this was a specific variant of body position, with knees distinctly spread, most likely applied to males.

The deceased buried on their sides in single graves were twice more often lying on their left side (24 cases) than on the right (12 cases).

Although burials in anatomical positions were by far the predominant group, some proportion of secondarily disturbed graves was recorded as well. The disturbances are interpreted as traces of looting or of ritual behaviour associated with some secondary, post-burial rituals. To the group of 11 burials with clearly disturbed human remains add cenotaphs, graves containing single bones, and those almost totally damaged by secondary pits (e.g. Porohy, grave 3A/14; Mocra, grave 1/15). The tendency to disturb central graves in kurgans finds analogy in customs recorded among North Pontic Eneolithic communities [cf. Larina 2003: 66; Klochko *et al*. 2015d: 240]. For example, none of the five central burials at Prydnistryanske held a skeleton in anatomical position, and in the case of burial III/1 it was confirmed that bones of the deceased had been removed from the bottom of the grave chamber. An analogical situation was recorded in burial 2/12 from Severynivka, linked with YC [Harat *et al*. 2014: 200, Fig. 2.16.4: 23]. This confirms the survival of the Eneolithic tradition into the Early Bronze Age. A new light on the problem of secondary disturbances of grave chambers has been cast by the specialist analysis performed for grave 3A/10 from Porohy. The results show that the chamber was entered again for making paintings on the bones after the body had decomposed [Lorkiewicz-Muszyńska *et al*. 2017].

The use of ochre was confirmed in 148 cases (80.9%), and was recorded slightly later in central burials (61.1%) than in those secondarily dug into the mound (85.5%). The pigment was typically identified on human bones (first of all the skull and limbs), and additionally lumps of bright-red ochre were often found by the head of the deceased. Spilling ochre over the grave's bottom was a rare custom (e.g. Pidlisivka, grave 1A), while grave IV/4 at Prydnistryanske, in which the upper part of the skull of an adult male had been painted with bright-red ochre, is a unique case. Rare examples of such behaviours are known from elite male burials in the steppe part of the North-Pontic area [Shaposhnikova *et al*. 1986: 20].

Ceramic objects were found in only 27 graves (14.8%). Burials were most often furnished with a single vessel, and only in three graves were sets of two pots discovered. S-shaped pots (including "pot-shaped" beakers) were the largest group (15 pcs). Most of them were undecorated, sometimes with notched rims. Another common form were small one-segment beakers with arching walls (6 pcs), typical of the North-West Pontic area [Ivanova 2012: 24]. Amphorae of various types were represented by 7 vessels [*see* Ivanova *et al*. 2014]. They included two GAC amphorae (Ocniţa, grave 3/14 and Mocra, grave 3/4) and one revealing trait of the oldest CWC horizon (Porohy, grave 2/6). The remaining part was made up of amphorae with egg-shaped bodies, some of them adorned with bucranium motifs (Porohy, graves 3/4 and 4/8, Ocniţa, grave 6/18). A bulbous, broad-mouth beaker, a form particularly characteristic of late YC assemblages from the Budzhak area [Ivanova, Toschev 2015c], was found only in one grave (Mocra 1/3).

Among other objects occurring in Podolia graves, flint artefacts were the most common group. These were typically blanks, primarily flakes, from 1 to 4 pieces per grave (31 graves, 16.9%). Single tools were found in only 15 graves, and these were primarily scrapers and retouched flakes, which in terms of typology and technology referred to CWC assemblages from Central Europe.

Bone artefacts were a small group, with tools (awls and perforators) discovered in 6 graves, and ornaments (beads and pendants) in merely two graves. Four graves yielded metal ornaments: silver and bronze earrings (Pysarivka, grave 5/1; Mocra, grave 1/6; Kuzmin, grave 3/2), and beads made of copper/bronze (Ocniţa, grave 3/8).

Table 1

Taxonomic characteristic of the selected Eneolithic/Early YC graves from Podolia

	Region			
	Yampil	**Kamienka**	**Mocra**	**Tymkove**
Type Zhivotilovka-Volchansk	Prydnistryanske, graves: I/1, II/2, III/1-3, IV/10 *Porohy, grave 3A/7?*	*Kuzmin, grave 2/2?*		
Type Kvityana (burials in extended position)	(Pysarivka, grave 2/3)?	Ocniţa, graves 6/24 i 7/14		Tymkove, grave 5
Type Nizhnaya Mikhailovka (Černavoda/ Khadzider?)	Porohy, grave 3/2; Sev-erynivka grave 1/5			
Type „Post-Stog”?/ Early Yamnaya?	Pidlisivka, grave 1/1B; Porohy, grave 2/5 Klembivka 1/15?			
Early Yamnaya	Pysarivka, graves 1/2, 3/1, 4/2, 5/1, 6/2, 7/2, 8/2 i 9/2; Dobrianka, grave 1/5; Severynivka, grave 2/12	Ocniţa, graves1/1, 2/5, 3/1, 3/17, 5/7, 6/11, 6/20; Kuzmin, grave 3/1	Mocra, graves 1/15, 1/2, 3/2, 4/2	Tymkove, grave 4
Early Yamnaya?	Pysarivka, grave 2/3	Ocniţa, graves 1/8, 4/5, 4/7, Kuzmin, grave 2/7		

4. STAGES OF CULTURAL DEVELOPMENT – ATTEMPT AT GENERALISATION

4.1. THE FOUNDERS OF CEREMONIAL-FUNERAL CENTRES – PROBLEM OF IDENTIFICATION

Podolia kurgans originate from various stages of the Eneolithic and Early Bronze Ages, and this chronological diversity is reflected in differences in construction of mounds and central graves for which kurgans were originally built (being burials of the “kurgans’ founders”). These oldest burials link with various Eneolithic and YC communities, and the taxonomic attribution of some of the phenomena discussed here poses difficulties (Tab. 1). This stems from the nature of the finds, which are sometimes only slightly distinctive and often retrieved from contexts difficultt to interpret (e.g. from kurgans damaged to a significant degree). Another reason for the high discordance and ambiguity of opinions lies in the nature of the problem itself, since taxonomic definitions can be no more than proxies for cultural processes which are both fluid and multi-directional. This is particularly evident for phenomena associated with the Eneolithic and the very beginnings of the Bronze Age in steppe and forest-steppe areas [e.g. Rassamakin 2013; Manzura 2016], while later stages (the classic and late YC) are marked by much more regularity in terms of funeral rituals. Funerary behaviours displayed by Eneolithic steppe groups were the outcome of intercultural relationships and often combined elements borrowed from different milieus [e.g. Rassamakin 2008: 215, 216]. One consequence of this is the multitude of approaches to the description of Eneolithic phenomena proposed in the literature, with the controversies the situation creates. This is also true for the Podolia kurgans discussed here, where chronology is relatively easy to interpret while taxonomical attributions are much more difficult. A good example in this context is a recently published complex at Prydnistryanske, which has been linked either with the late Trypilia group of Gordinești [Klochko *et al*. 2015d] or with the Eneolithic steppe formation known as Zhivotilovka-Volchansk [Manzura 2016], or recently with the Bursuceni group [Demcenko 2016].

The stratigraphy of Podolia kurgans poses problems familiar in other regions as well. In some of the mounds, especially those significantly levelled by ploughing, the reconstruction of the chronological sequence of ritual actions is difficult, and sometimes even basic issues such as the identification of the central burial or the linking of particular graves with particular phases of the mound's enlargement create problems. This is well illustrated by examples of kurgans 1 and 2 from Porohy [Harat *et al*. 2014], where central burials can be only hypothetically identified based on constructional traits of graves.

A distinct feature of Podolia kurgans having YC burials is the multi-phase nature of their mounds, a feature recorded throughout the North Pontic area. It is particularly evident in the cases of sequences of burials (typically two burials) placed in the central parts of kurgans and connected with separate stages of the mound's construction. In this context, the temporal and cultural relationship between the older and younger burial becomes a very interesting issue. Younger burials typically revealed traits characteristic of the YC complex, while older ones were often different and distinguished by a different shape of the grave pit and sometimes a different arrangement and orientation of the body as well. In the most evident cases, older pits held a body in the extended position, reminiscent of the Postmariupol/Kvityana tradition. Such a grave was discovered in kurgan 1 at Tymkove [Subbotin *et al*. 2000, 84, ris. 3: 4] beneath grave 4 linked with YC. Kurgans in which two burials in the centre were both laid in rectangular pits and in a contracted position are more difficultt to interpret, with examples known from Hrustovaia [Yarovoy 1981] and Pidlisivka [Klochko *et al*. 2015a]. In such cases, the older grave often stands out with a funerary tradition diverging from model YC behaviours, in terms of orientation, body position, and constructional features.

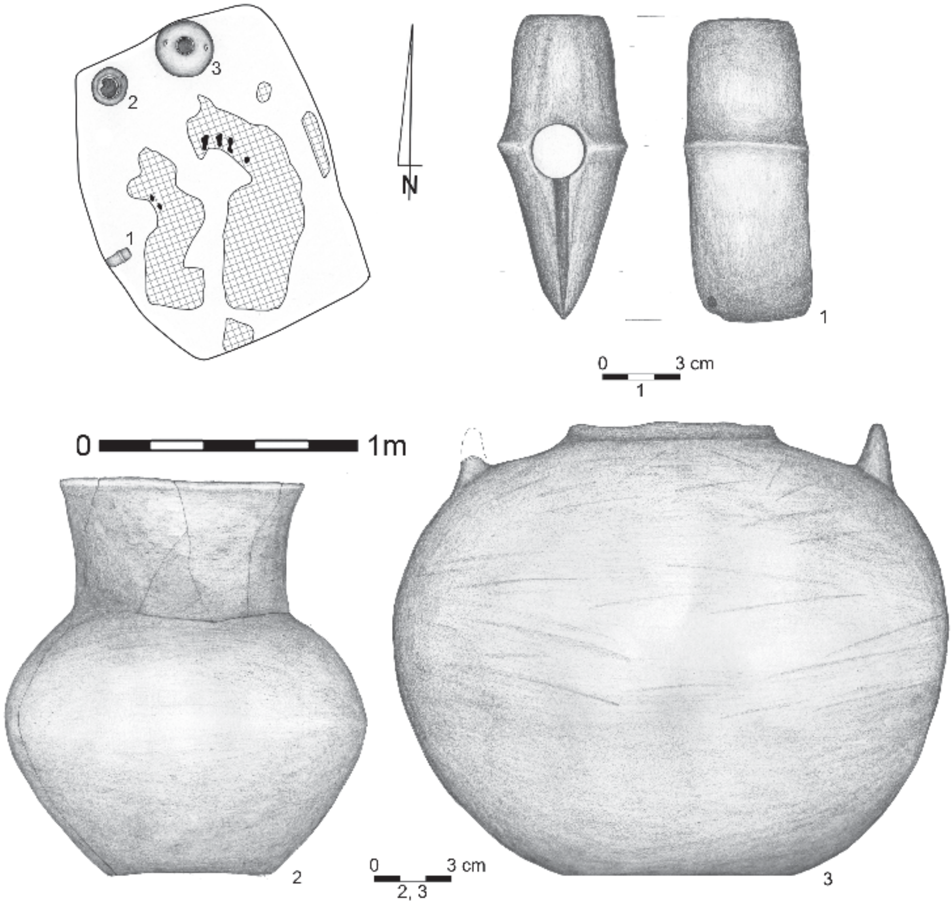


Fig. 7. Grave III/3 from Prydnistryanske, Yampil Region. Drawing by M. Podsiadło

4.2. THE ZHIVOTILOVKA-VOLCHANSK/GORDINEŞTI TYPE

A distinct group among the materials from North-West Pontic kurgans is that of burials with bodies lying on their left or right side with upper limbs sharply bent at the elbows and pointing towards the face, corresponding to group III-C in Y. Rassamakin's classification [2004]. Such a body position finds analogies in "Trypilia" cemeteries from the later stage of phase C/II (the Usatowo and Gordineşti groups), the only difference being much greater freedom in the orientation of burials and a much smaller percentage of bodies buried on the side rather than in the supine

Fig. 8. Klembivka, grave 1/14. Photo D. Żurkiewicz

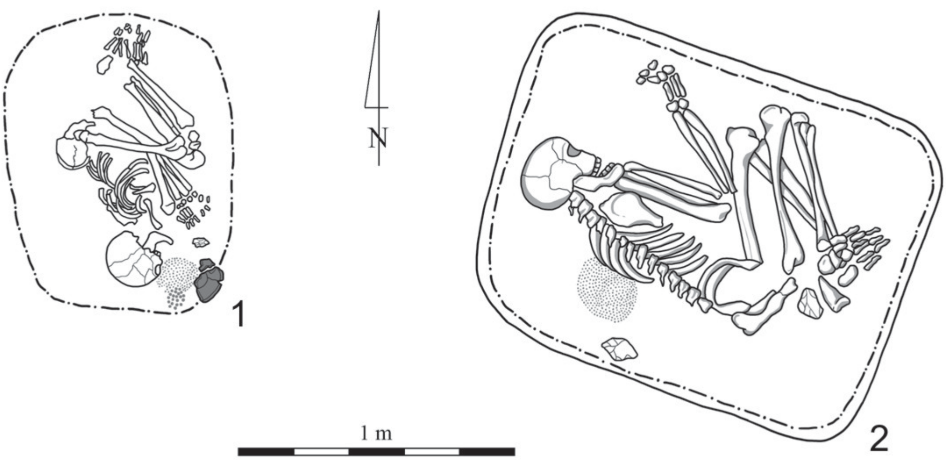


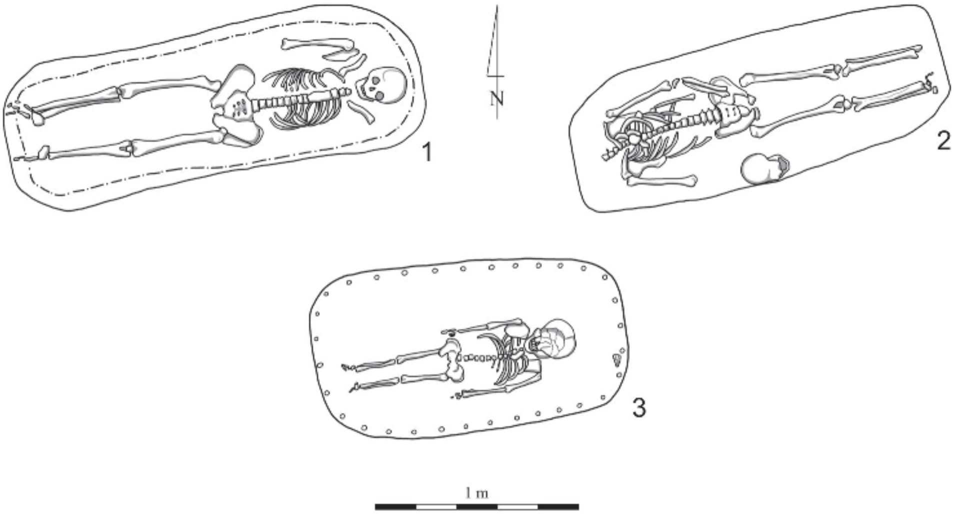
Fig. 9. Burials representing funerary traditions of Zhivotilovka-Volchansk group in Podolie kurgans: 1 – Porohy, grave 3A/7, 2 – Kuzmin, grave 2/2 [*after* Klochko *et al*. 2015b, Bubulich, Khakhey 2001]

position [Manzura 2016: 157]. This similarity results in discrepancies in cultural affiliations given to particular assemblages from the North Pontic area. Some of them have been included either in late Trypilia groups or the Zhivotilovka-Volchansk [Rassamakin 1999; 2004]/Zhivotilovka [Manzura 2016] group, which partly stems from the constant refinement of classification criteria enforcing changes in cultural attribution. How important this distinction is depends on the genetic definition of the discussed group of finds, and may prove to be of no importance if a connection can be confirmed between the Gordineşti group and the Zhivotilovka-Volchansk communities representing the steppe Eneolithic tradition.

In the source publication, the complex of kurgans from Prydnistryanske 1 was attributed to the Gordinești group [Klochko 2015d], which follows the interpretation proposed by O. Larina, who included kurgan burials furnished with characteristic Trypilia pottery into the funeral traditions of this late Trypilia group [Larina 2003]. Undoubtedly, using other criteria the Prydnistryanske complex could be included into the Zhivotilovka-Volchansk group, and the same holds true for burials from kurgan 1 at Bursuceni and assemblages from the upper Prut River basin. The finds from kurgan no. 3 are particularly distinctive. Ceramic vessels from grave 3/3 (amphorae and "pot-shaped" beakers – Fig. 7) represent two leading forms known from Zhivotilovka-Volchansk graves, revealing at the same time traits characteristic of the Gordinești group [cf. Manzura 2016, 160-164]. In turn, a stone battle-axe discovered in the same grave has a good analogy in an artefact from feature 10/17 from Taracila [Dergachev, Manzura 1991, 256, ris. 35: 12].

Comprised of four kurgans, the ceremonial complex at Prydnistryanske is currently one of the most important sources for studies on the mentioned Eneolithic group, and the only one in Podolia. Along with the Bursuceni kurgan and the group of finds from the upper Prut basin [e.g. Dergachev 1982], it forms a group of finds of the Zhivotilovka-Volchansk type in the forest-steppe part of the North-West Pontic area. Non-invasive research carried out in the vicinity of the Prydnistryanske site has demonstrated that the excavated kurgans were part of a larger ceremonial-funerary complex, situated near the edge of the Dniester River valley [Przybyła *et al*. 2017].

Among other Podolia kurgans, it is worth noticing three burials revealing traits of the Zhivotilovka-Volchansk group, discovered at Klembivka, grave 1/14 (Fig. 8) [Klochko *et al*. 2015c: 168, 169], Kuzmin, grave 2/2 (Fig. 9: 2) [Bubulich, Khakhey 2001: 130, 131], and Porohy, grave 3A/7 (Fig. 9: 1) [Klochko *et al*. 2015b: 98, 99]. The deceased were adults, buried on their sides with upper limbs pointing towards the face (type D), in pits having rather irregular shapes. The stratigraphic position was determined with certainty only at Klembivka, where grave 1/14 was the central burial for the second phase of the mound's construction. In Porohy and Kuzmin the discussed graves were situated among YC graves, forming no discernible relations with them. One can either connect them with the Zhivotilovka-Volchansk group (its late and terminal stages) or assume the survival of traits typical of this group

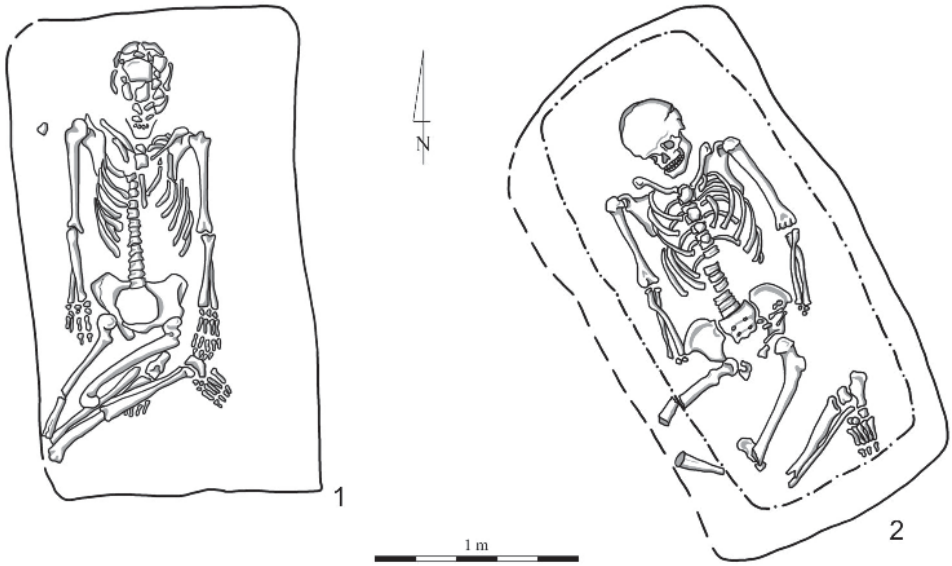


F i g . 1 0 . Eneolithic burials in extended position in Podolia: 1 – Tymkove, grave 5, 2 – Ocniţa, grave 7/14, 3 – Ocniţa, grave 6/24 [*after* Subbotin *et al*. 2000; Manzura *et al*. 1992]

into the Early Bronze Age [cf. Ivanova 2015: 285]. The latter option is suggested by the radiocarbon date obtained for grave 3A/7 from Porohy, which is similar to those obtained for YC burials from that site. It is worth emphasizing, however, the specific features of funerary rituals recorded in these three burials, which clearly diverged from Early Bronze Age patterns. The manner of body deposition represents a tradition unknown from the YC complex [Rassamakin 2013: 127, 130].

In the forest-steppe zone of the North-West Pontic area, important data concerning the chronological position of the Zhivotilovka-Volchansk group have been produced by the exploration of the Bursuceni kurgan, which is still awaiting full publication [Yarovoy 1978; cf. also Demcenko 2016; Manzura 2016]. Burials linked with the mentioned group were stratigraphically the eldest in the kurgan, and pre-dated a burial in the extended position and YC graves. Two of these burials (features 20 and 21) produced radiocarbon dates falling around 3350-3100 BC [Petrenko, Kovaliukh 2003: 108, Tab. 7]. Similar absolute age determinations were obtained for Podolia kurgans at Prydnistryanske [Goslar *et al*. 2015]. These dates, falling within the Late Eneolithic, mark the currently oldest horizon of kurgan burials in the forest-steppe zone of the North-West Pontic area. The Podolia graves linked with other, older traditions of the steppe Eneolithic seem to represent a slightly later horizon dated to the transition between the Late Eneolithic and Early Bronze Age (*see* Chapter 4.3 and 4.4).

The presence on the left bank of the Dniester River of kurgans associated with the Eneolithic tradition, which at the same time reveals connections with the



F i g . 1 1 . Central burials in kurgans from the Yampil cluster (Eneolithic/early phase of YC?): 1 – Porohy, grave 2/5, 2 – Pidlisivka, grave 1B [*after* Klochko *et al*. 2015a; Harat *et al*. 2014]

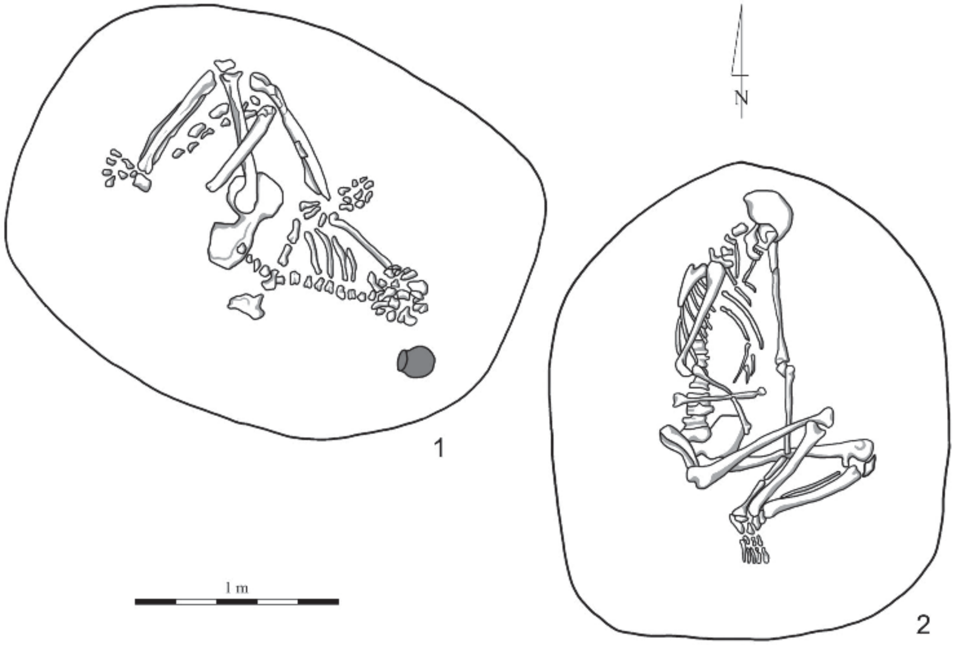
Gordineşti-Kasperovce-Horodiştea complex, raises questions about the western range of the new trend in funerary rituals, and its potential connection with the expansion of the late Trypilia culture to the West Podolia and West Volhynia Regions. The data potentially suggesting the attribution of kurgans from the upper Dniester basin to this period is patchy and difficult to verify [e.g. Liczkowce – *see* Sulimirski 1968: 173]. In this context, the discovery of vessels in the Gordineşti style in a kurgan at Zawisznia near Sokal is inspiring [Antoniewicz 1925].

4.3. BURIALS IN EXTENDED POSITION (OF THE KVITYANA/ POSTMARIUPOL TYPE)

The Pre-Yamnaya (Eneolithic) phase came to be distinguished in kurgan cemeteries from the Podolie Region after the discovery of burials in extended position (i.e. of the Kvityana/Postmariupol type) at Ocniţa (Fig. 10: 2, 3) [kurgans 6 and 7; Manzura *et al*. 1992] and Tymkove (Fig. 10: 1) [Subbotin *et al*. 2000, 84, ris. 3: 4]. In all these three cases the burials marked the oldest phase of mound construction, and later YC burials were dug into the central part of the kurgan, which entailed the remodelling and considerable enlargement of the mound. Both the chronological and taxonomic positions of extended burials in the North Pontic area are subjects of debate [e.g. Manzura 2010; Rassamakin 2013; Ivanova 2015, 280-282]. Their distinct chronological diversity seems likely given constructional differences among the kurgans, and this view is additionally supported by sparse (for the time being) radiocarbon dates [Rassamakin 2013]. Podolia burials or, more generally, sepulchral features discovered throughout the forest-steppe zone of the North-West Pontic area seem to corroborate the opinion positing that burials in narrow rectangular pits represent the youngest variant [cf. Nikolova, Rassamakin 1985; Manzura 2010; Ivanova 2015, 282]. Unfortunately, radiocarbon dates confirming this hypothesis have not yet been obtained. Radiocarbon dates from other regions place burials of the Postmariupol type at the beginning of the first half of the 3rd millennium BC, contemporary with the early YC. They were obtained for graves from Vapniarka and Oleksandrivka in the Pontic steppes [Ivanova 2010; Petrenko, Kovaliukh 2013], at Tiszavasvári-Deákhalom in Hungary [Horváth *et al*. 2013: 157], and Šajkaš "Ciganska humka" in Serbia [Włodarczak *et al*. forthcoming], among other sites. As for the funerary-ceremonial complex at Ocniţa, kurgans 6 and 7, where burials in extended position were found, suggest a late chronology also due to their location among analogical kurgans dated (also in terms of relative chronology) to the turn of the 4th and 3rd millennia BC.

Elements of ritual recorded with burials in extended positions find analogies in the finds representing the Late Eneolithic/early Yamnaya horizon in Podolia. They include irregular, roughly rectangular pits, narrow grave cuts, details of upper limbs arrangement (type F), and manners of ochre application. The graves which reveal these similar traits are feature 1/1B from Pidlisivka (Fig. 11: 2) [Klochko *et al*. 2015a: 49-51] and feature 2/5 from Porohy (Fig. 11: 1) [Harat *et al*. 2014: 82, 83]. Stratigraphic analysis suggests these burials were connected with the first, original phase of respective kurgans, while the position of the body (lying on their backs with legs in type F arrangement) hints at their Post-Stog connotations.

The chronological position of graves with burials in extended position can be narrowed down thanks to stratigraphic observations made in kurgans at Bursuceni, between the Dniester and Prut rivers [Yarovoy 1978]. Graves from this site were younger than the burials representing the Zhivotilovka-Volchansk tradition and older than those linked with the early phase of YC. Based on a relatively compact series of radiocarbon dates obtained for graves of the Zhivotilovka-Volchansk group, the chronology of burials in extended position can be determined as the very close of the 4th – beginning of the 3rd millennia BC (most likely around 3100-2800 BC).



F i g . 1 2 . Central burials representing the Eneolithic tradition in kurgans from the Yampil cluster. 1 – Porohy, grave 3/2, 2 – Severynivka, grave 1/5 [*after* Harat *et al*. 2014]

4.4. BURIALS REPRESENTING OTHER ENEOLITHIC TRADITIONS OR LINKED WITH THE EARLY YAMNAYA PHASE

The investigation of the Yampil kurgans highlighted problems with the interpretation of those central burials in kurgans which were laid in a contracted position and did not reveal the full set of traits typical of the YC ritual. The phenomenon has been given different interpretations, including as a mark of an older, Eneolithic cultural component in the genesis of Early Bronze Age funerary rites ["Protobudzhak component" within YC acc. to Ivanova 2015]. One can also consider a slightly earlier, Eneolithic origin of such burials, pre-dating the appearance of "classic Yamnaya" rites. Yet another possible explanation is the heterogeneity of burials from the very beginnings of the Early Bronze Age – they might blend various traditions, as was the case in the Late Eneolithic. This would imply a considerable diversity of communities who erected Podolia kurgans, of whom only some would represent the tradition linked with the YC proper.

Two central burials in the Yampil cluster, at Porohy grave 3/2 (Fig. 12: 1) and Severynivka grave 1/5 (Fig. 12: 2), were specific, because the deceased were buried

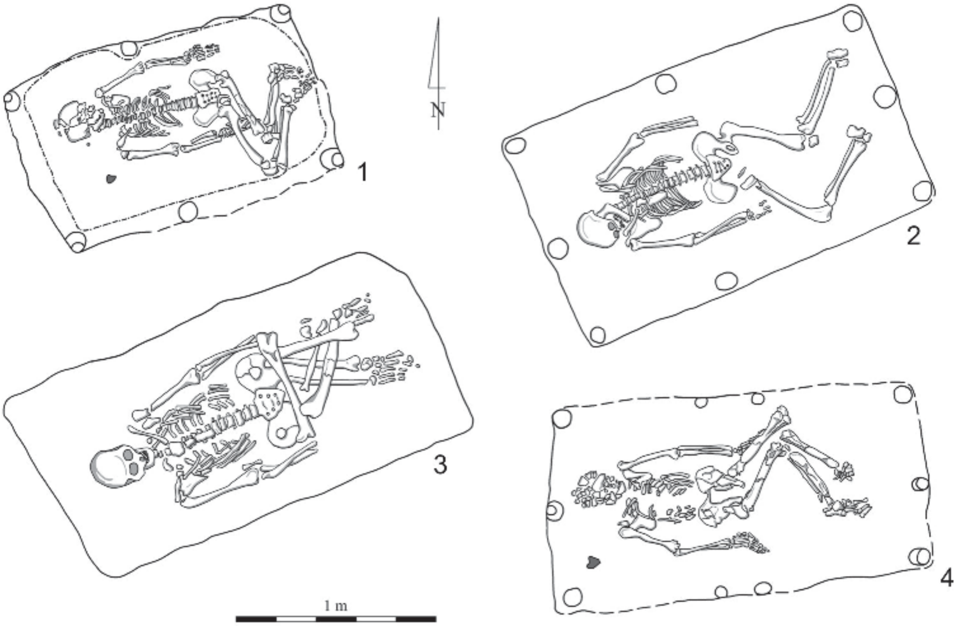


Fig. 13. Central graves in kurgans from Pysarivka, Yampil Region: 1 – grave 5/1, 2 – grave 7/2, 3 – grave 8/2, 4 – grave 6/2 (early phase of YC) [*after* Harat *et al*. 2014]

in a contracted position on their sides, in pits which were oval in plan. These features correspond with the definition of burials of the Nizhnaya Mikhaylovka type according to Y.Y. Rassamakin [e.g. 1997; 2008]. Although burials from the eponymous site date early (first half of the 4th millennium BC) [Kotova 2013], analogical arrangements are known from the Late Eneolithic as well [Rassamakin 1998: 215], representing group III-A in North Pontic funeral traditions [Rassamakin 2004: 51, 52]. The burials from Porohy and Severynivka also correspond with the Bessarabia variant of the Černavoda culture, as understood by I. Manzura [2013, 130, 132]. This variant is distinguished by a specific arrangement of upper limbs, with one arm sharply bent at the elbow and placed at the waist. The deceased from Porohy was laid in a manner specific to this group of burials, namely with the head to the SE [cf. Manzura 2013, 132]. Its Eneolithic origin is also suggested by the transversal arrangement of the wooden roofing, unknown from central graves of YC in Podolia. The deceased from grave 3/2 at Porohy was furnished with a "pot-shaped" beaker [Harat *et al*. 2014, 90, Fig. 2.4.4: 1: 1].

It cannot be ruled out that graves discovered in kurgan 1 at Klembivka (no 5 and possibly also a poorly preserved burial from grave 15) [Klochko *et al*. 2015c] and kurgan 2 at Kuzmin (grave 2/5) [Bubulich, Khakhey 2001] also link with the group of finds discussed here.

Fig. 14. Pysarivka, Yampil Region. Location of kurgans 1-5. Source: archives of the Heritage Protection Office in Vinnitsa

Fig. 15. Prydnistryanske, Yampil Region. Reconstruction of stages of grave IV/4 construction. By M. Podsiadło

The problem with determining the taxonomic and chronological positions of central burials emerges with respect to other kurgans in Podolia as well and has already been addressed in the literature [Manzura *et al*. 1992: 81-92; Kashuba *et al*. 2001-2002: 220, 221]. A good illustration is the situation recorded at Ocniţa in the Kamienka Region, where a group of 7 kurgans were explored and only 3 of the documented burials linked with the earliest phases of the mound construction revealed traits allowing them to be linked with YC (kurgans 2, 3, and 5). The remaining central graves held burials in extended position (kurgans 6 and 7) or burials which due to the characteristics of the ritual (e.g. orientation) can be linked with Eneolithic traditions (kurgans 1 and 4).

Some of the central burials yielded no human remains, or only single bones were found. Sometimes such graves bore clear marks of secondary opening (Porohy, grave 3A/14; Mocra, grave 1/15). The result is that taxonomic-chronological traits cannot be determined with sufficient certainty in five kurgans (Mocra 1; Porohy 3A, Kuzmin 2 and 5, and Podoima). Whether kurgans which revealed traces of sophisticated rituals (such as large postholes, grooves, cromlechs, and sacrificial pits) can be linked with the Late Eneolithic is another issue. Such ritual behaviours were recorded in kurgans at Porohy (3A), Mocra (1), and Klembivka (1).

4.5. GRAVES FROM THE EARLY PHASE OF YC

Among the finds associated with the early phase of YC one should mention first of all burials connected with the construction of the earliest mound (“founder” graves) and some of those dug into the central parts of kurgans during their subsequent enlargements. Graves filling in funerary spaces created by older, Eneolithic communities also belong to this group.

A model ceremonial-funerary complex created by a YC community is a group of kurgans in Pysarivka village [Harat *et al*. 2014: 104-165]. Nine mounds have been explored there, of which eight (1, 3-9) yielded central burials of YC sharing a number of similar features (Fig. 13). The deceased were placed in regular, rectangular pits having vertical walls. Vykids (mounds of soil extracted while digging grave pits) formed regular narrow walls surrounding each grave, and seem to have been integral elements of sepulchral architecture. Chambers were covered with 5-7 timbers/planks arranged parallel to the grave’s longer axis. Another characteristic element was that of wooden stakes driven symmetrically into the bottom along grave chamber edges, recorded in four cases. The deceased were laid on their backs, in a contracted position with the knees up. The head was as a rule turned to W, with possible deflections towards NW or SW. Skeletons bore traces of painting with ochre. Other characteristic elements of YC rituals discovered at this site included silver earrings from grave 5.1 and elements of a wooden wagon from grave 6/2. Unlike kurgan clusters initiated in the Pre-Yamnaya period (in Porohy and Prydnistryanske), kurgans 5-8 at Pysarivka form a regular line along the top of a ridge (Fig. 14). This finds analogies in Central Europe, in CWC barrows. The Pysarivka model of YC kurgans is also followed in nearby complexes at Dobrianka (kurgan 10, with a slightly different body orientation – with the head to E) and Severynivka (kurgan 2) [Harat *et al*. 2014].

Different features, unique in the entire Podolia Region, were recorded in the central burial of kurgan 2 at Pysarivka [Harat *et al*. 2014]. A small pit, oriented N-S, was covered with stone blocks, a construction not typical of the forest-steppe zone of the North-West Pontic area but with analogies further to the east, including in the Boh and Ingul River basins [Shaposhnikova *et al*. 1986: 15] and on the Ingulec River [Melnik, Steblina 2013: 11] – generally between the Dnieper and the Boh. A pot-shaped beaker richly adorned with cord imprints discovered in grave 2/3 at Pysarivka is also atypical for the region. The vessel differs in terms of style from pottery manufactured in the North-West Pontic area, and its ornamentation hints at connections with early Yamnaya materials from the territory between the Dnieper and the Boh.

The role of south-eastern connections at the early stage of YC development can also be seen in grave IV/4 at Prydnistryanske. This is indicated by a combined (wood and stone) roof construction involving stela-like slabs, and by the skull of the deceased characteristically painted with red pigment. The absolute date obtained for grave IV/4 (ca 3100-3000 BC) suggests its early provenance [Goslar *et al*. 2015]. The grave was most likely connected with the oldest stage of enlargement of the Eneolithic barrow [Klochko *et al*. 2015].

The kurgans described above, in which graves connected with the earliest mound reveal set of traits typical of YC, are not in the majority in Podolia. More often, YC graves were secondarily dug into the central part of an earlier kurgan. Such a burial became the new focal point for a cemetery which might comprise graves of different chronology, a “central YC grave”. Thus, a typical behaviour of YC communities was to remodel an “appropriated” Eneolithic kurgan rather than to simply continue using the mound erected by their predecessors [cf. Petrenko 2010: 362]. In such kurgans, the older grave represented a different cultural tradition. It could be a burial in an extended position (as at Ocniţa in kurgans 6 and 7 and at Tymkove) or such in which the body was oriented along an axis other than W-E (e.g. Hrustovaia, Pidlisivka, Ocniţa, kurgans 1, 3, and 4). The younger burial, on the other hand, bore traits typical of the older phase of YC: W-E orientation, wooden roofing parallel with the pit’s axis, a simple pit with no step, the body laid in a contracted position with the knees up and the upper limbs in type F arrangement.

As in other regions, there were single “elite” graves in Podolia, being burials of adult males. To this group belong the central grave from kurgan 6 at Pysarivka, where fragments of a wagon were found, the sophisticated funeral structure from kurgan IV at Prydnistryanske (grave IV/4 – Fig. 15), and the central grave from kurgan 5 at Pysarivka, which yielded silver earrings. In terms of these "elite" markers the Yampil cluster represents a typical ceremonial centre of the North-West Pontic area [Ivanova, Toschev 2015: 378].

4.6. LATER STAGES OF YC

The middle phase of YC is quite clearly evident in Podolia kurgans. It is marked by burials dug into the existing mounds. These are either single burials inserted into different parts of the mounds, or groups of graves forming arches around a central part. Graves with steps leading to the burial chamber are typical of that stage, and they were wider than those in the centres of kurgans. Chambers were typically roofed with planks or timbers placed perpendicularly to the grave's longer axis. Burials on one side and burials on the back but leaning to either side become more numerous, and upper limbs were most often placed in A, G, H, or I arrangements. Ceramic vessels become more common in graves, including forms indicative of contacts with GAC and CWC milieus. Model examples of sepulchral features from that period are kurgans 3, 6, and 7 at Ocniţa and kurgan 3A at Porohy.

Among issues of particular importance one can mention the relationship between the Podolia finds linked with the late phase of YC and materials from the Budzhak Region (i.e. from the Dniester-Danube steppe). Indicating the latter is an original ceramic inventory, combining specific vessel forms with elaborate ornamentation (mainly cord impressions), featuring primarily on broad-mouth one-segment beakers. What is also striking in the materials discussed here is the small number of graves with burials arranged in a manner indicative of a late chronology, i.e. with bodies lying on their sides. This allows for an assumption that only single burials from Podolia (e.g. Mocra, grave 1/3) date to the late phase (in the periodisation used for the Budzhak Region) and, accordingly, that the majority of Podolia kurgans already had ceased to be used as burial grounds before the middle of the 3rd millennium BC.

The succession of the Catacomb culture features poorly in the Podolia materials, with only two burials, of different cultural attributions, standing out: grave 3/5 from Ocniţa, linked with the early Catacomb culture [Klochko 1990] and grave I/4 from Prydnistryanske, revealing inspirations from the Donets or Dnieper (or possibly Ingul) basins [Klochko *et al*. 2015d]. Radiocarbon dates obtained for the latter grave point to about 2600-2500 BC [Goslar *et al*. 2015], which means to the early Catacomb culture. The chronology of these burials does not diverge much from the youngest YC graves in Podolia. This suggests a hiatus of about 500 years in kurgan cemeteries in Podolia between the Yamnaya and Catacomb phase and burials of the Babyno culture, radiocarbon dated to not before circa 2100-2000 BC.

5. SUMMARY

The materials collected during the investigation of the *Yampil kurgans* have made it possible to describe the funerary ritual of local Eneolithic and Early Bronze Age communities, which was a variant of sepulchral rites practiced in the Podolia Region or, more generally, in the forest-steppe part of the North-West Pontic area. The analyses performed have shown distinct similarities in terms of ritual behaviours between this newly investigated group and the communities from the Dniester-Danube area. The majority of kurgan necropolises in question were established in the Late Eneolithic, and this initial period was marked by significant genetic diversity, with rituals indicative of various cultural traditions of the North Pontic area. The oldest – thus far – cemeteries are those associated with the Zhiotilovka-Volchansk group, showing strong links with the Gordineşţi type of the Trypilia culture. Later finds link with the turn of the Eneolithic and Early Bronze Age, and represent a variety of traditions: Early Yamnaya, burials in extended position, Nizhnaya Mikhailovka, and Post-Stog.

The peripheral position of the Yampil cluster within the YC complex favoured contact with Central Europe, which found its reflection in the regional specificity of funerary behaviours. It should be noted, however, that subsequent genetic breakthroughs in funerary rituals in the Podolia cluster were connected primarily with influences from the east and south east. This is indicated by the recorded ritual elements specific to the Early Yamnaya, Late Yamnaya, and Catacomb cultures.

In an overwhelming majority, the Podolia finds represent a local, forest-steppe variant of YC rites from the North-West Pontic area. It shows similar traits with the rituals practiced by North-Pontic communities expanding towards Central and South-Eastern Europe. This expansion resulted in interactions with cultural groups living further to the west. In the forest-steppe zone of the North-West Pontic area there is clear evidence of contact with GAC and CWC communities, while in the Budzhak Region influences from the Balkans and South Carpathians played a more important role. Nevertheless, the impact of these contacts was limited to the adoption and introduction of certain artefacts (pottery, flint tools) into funerary rites of YC communities.

An important task awaiting future researchers is to determine the range and scale to which North Pontic kurgan rituals influenced western Podolia and south-eastern Poland. The findings will be of crucial importance for understanding the genesis of funerary (thanatologic) ideologies of communities inhabiting Central Europe at the close of the Eneolithic. They would also offer valuable supplementation to the results of archaeogenetic studies flourishing in recent years [cf. Chyleński *et al*. 2017; Juras *et al*. forthcoming].

Translated by Piotr Godlewski

REFERENCES

Agulnicov S., Mistreanu E.

2014 Cercetăeile de salvare la tumuli 1 de lângă s. *Brânzenii Noi (r-i Telenești). In: Arheologia preventivă în Republica Moldova, vol. I, nr.*1-2, 63-74.

Allentoft M.E., Sikora M., Sjögren K.-G., Rasmussen S., Rasmussen M., Stenderup J., Damgaard P.B., Schroeder H., Ahlström T., Vinner L., Malaspinas A.-S., Margaryan A., Higham T., Chivall D., Lynnerup N., Harvig L., Baron J., Della Casa P., Dąbrowski P., Duffy P.R., Ebel A.V., Epimakhov A., Frei K., Furmanek M., Gralak T., Gromov A., Gronkiewicz S., Grupe G., Hajdu T., Jarysz R., Khartanovich V., Khokhlov A., Kiss V., Kolář J., Kriiska A., Lasak I., Longhi C., McGlynn G., Merkevicius A., Merkyte I., Metspalu M., Mkrtchyan R., Moiseyev V., Paja L., Pálfi G., Pokutta D., Pospieszny Ł., Price T.D., Saag L., Sablin M., Shishlina N., Smrčka V., Soenov V. I., Szeverényi V., Tóth G., Trifanova S.V., Varul L., Vicze M., Yepiskoposyan L., Zhitenev V., Orlando L., Sicheritz-Pontén T., Brunak S., Nielsen R., Kristiansen K., Willerslev E.

2015 Population genomics of Bronze Age Eurasia. *Nature* 522: 167-173.

Antoniewicz W.

1925 Eneolityczne groby szkieletowe we wsi Złota w pow. Sandomierskim. *Wiadomości Archeologiczne* 9: 191-242.

Brandenburg N.E.

1908 *Zhurnal raskopok N.E. Brandenburga 1888-1902 gg.* Sankt-Peterburg.

Bubulich V., Khakheu V.

2001 Issledovaniya kurganov v Kamenskom rayone na levoberezhe Srednego Dnestra. In: N.A. Ketraru (Ed.) *Severnoe Prichernomore ot eneolita k antichnosti,* 112-148. Tiraspol.

Chyleński M., Juras A., Żurkiewicz D., Jankowski M., Włodarczak P.

2017 Preservation of ancient DNA in human bones from Bronze Age Ukraine. *Baltic-Pontic Studies* 22: 54-63.

Demcenko T.I.

2016 K voprosu o vydelenii kulturnoy grupy Bursuceni v ramkakh grodineshtskogo-pozdnemaykopskogo fenomena In: L. *Sîrbu, N. Telnov, L. Ciobanu, G. Sîrbu, M. Kaşuba (Eds) Culturi, Procese şi contexte în Arheologie. Volumul omagial Oleg Leviţki la 60 de ani*, 84-99. Chişinău.

Dergachev V.A.
1982 *Materialy raskopok arkheologicheskoy ekspeditsii na Srednem Prute (1975-1976 gg.).* Kishinev.
1986 *Moldaviya i sosednie territorii v epokhu bronzy.* Kishinev.

Dergachev V.A., Manzura I.V.
1991 *Pogrebalnye kompleksy pozdnego Tripolia.* Kishinev.

Goslar T., Klochko V.I., Keśko A., Włodarczak P., Żurkiewicz D.
2015 Chronometry of Late Eneolithic and "Early Bronze" cultures in the Middle Dniester area: investigations of the Yampil Barrow Complex. *Baltic-Pontic Studies* 20: 256-191.

Haak W., Lazaridis I., Patterson N., Rohland N., Mallick S., Llamas B., Brandt G., Nordenfelt S., Harney E., Stewardson K., Fu Q., Mittnik A., Bánffy E., Economou C., Francken M., Friederich S., Garrido Pena R., Hallgren F., Khartanovich V., Khokhlov A., Kunst M., Kuznetsov P., Meller H., Mochalov O., Moiseyev V., Nicklisch N., Pichler S.L., Risch R., Rojo Guerra M.A., Roth C., Szécsényi-Nagy A., Wahl J., Meyer M., Krause J., Brown D., Anthony D., Cooper A., Alt K.W., Reich D.
2015 Massive migration from the steppe was a source for Indo-European languages in Europe. *Nature* 522: 207-211.

Harat K., Potupczyk M., Razumov S.
2014 Charakterystyka źródeł archeologicznych pozyskanych w latach 1984-1993. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 45-204. Poznań.

Häusler A.
1974 *Die Gräber der älteren Ockergrabkultur zwischen Ural und Dnepr.* Berlin.

Horváth T., Dani J., Pető Á., Pospieszny Ł., Svingor É.
2013 Multidisciplinary contributions to the study of Pit Grave Culture kurgans of the Great Hungarian Plain. In: V. Heyd, G. Kulcsár, V. Szeverényi (Eds) *Transition to the Bronze Age. Interregional interaction and socio-cultural change in the Third Millennium BC Carpathian Basin and neighbouring regions,* 153-179. Budapest.

Ivanova S.V. [=Iwanowa S.]
2001 *Sotsialnaya struktura naseleniya yamnoy kultury severo-zapadnogo Prichernomoria.* Odessa.
2012 Ob istokakh formirovaniya Budzhakskoy kultury. *Starozhytnosti stepovoho Prychornomoria i Krymu* 16: 18-62.
2013 Connections between the Budzhak culture and central European groups of the Corded Ware culture. *Baltic-Pontic Studies* 18: 86-120.
2014 Stan badań nad osadnictwem kultur jamowej i katakumbowej w zlewni dolnego Dniestru. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 17-33. Poznań.
2015 „Protobudzhakskiy gorizont" Severo-Zapadnogo Prichernomoria. *Stratum plus* 2 (2015): 275-294.

Ivanova S.V., Toshchev G.I.
2015a Late Eneolithic and Bronze Age prologue Pontic societies. Forest-steppe middle Dniester and Prut drainage basins in the 4th/3rd-2nd millenium BC: a history of investigations. *Baltic-Pontic Studies* 20: 7-39.
2015b The Middle-Dniester cultural contact area of early metal age societies. The frontier of Pontic and Baltic drainage basin in the 4th/3rd-2nd millenium BC. *Baltic-Pontic Studies* 20: 336-405.
2015c Budzhakskiye banki kak markery: transkulturnyi i transterritorialnyi aspekt. *Starozhytnosti stepovoho Prychornomoria i Krymu* 18: 17-36.

Iwanowa S., Kośko A., Włodarczak P.
2014 Komponent tradycji kultur ceramiki sznurowej. Amfory w północno-zachodnio-nadczarnomorskich grobach kultury jamowej. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 351-386. Poznań.

Juras A., Chyleński M., Ehler E., Malmström H., Żurkiewicz D., Włodarczak P., Wilk S., Peška J., Fojtík P., Králík M., Libera J., Bagińska J., Tunia K., Klochko V., Dabert M., Jakobsson M., Kośko A.
forthcoming Ancient mitochondrial genome data support the participation of females in the Yamnaya migration into Central Europe.

Kachalova N. K.
1974 Ermitazhnaya kollektsiya N.E. Brandenburga. In: *Svod arkheologicheskikh istochnikov V,* 4-12. Moskva.

Kashuba M.T., Kurchatov S.Y., Scherbakova T.A.
2001-2002 Kochevniki na zapadnoy granitse Velikoy stepi (po materialam kurganov u s. Mocra)*, Stratum plus* 4 (2001-2002): 180-252.

Klochko V.I. Kośko A., Razumow S.M., Włodarczak P., Żurkiewicz D.
2015a Eneolithic, Yamnaya, Catacomb and Babyno culture cemeteries, Pidlisivka, Barrow 1, Yampil Region, Vinnitsa Oblast: archaeometry, chronometry and taxonomy. *Baltic-Pontic Studies* 20: 40-77.
2015b Eneolithic, Yamnaya, and Noua culture cemeteries from the first half of the 3rd and the middle of the 2nd millennium BC, Porohy, site 3A, Yampil Region, Vinnitsa Oblast: archaeometric and chronometric description, ritual and taxonomic-topogenic identification. *Baltic-Pontic Studies* 20: 78-141.
2015c Eneolithic, Babyno and Noua culture cemeteries, Klembivka site 1, Yampil Region, Vinnitsa Oblast: archaeometry, taxonomy and topogenetics. *Baltic-Pontic Studies* 20: 142-182.

Klochko V.I. Kośko A., Potupchyk M.V., Włodarczak P., Żurkiewicz D., Ivanova S.V.
2015d Tripolye (Gordineşti group), Yamnaya and Catacomb culture cemeteries, Prydnistryanske, site 1, Yampil Region, Vinnitsa Oblast: An archaeometric and chronometric description and a taxonomic and topogenetic discussion. *Baltic-Pontic Studies* 20: 183-255.

Klochko E.O.
1990 Redkiy pogrebalnyi kompleks katakombnoy kultury na Srednom Dnestre. In: O.G. Shaposhnikova, V.V. Otroshchenko, S.Z. Pustovalov, G.N. Toshchev, G.I. Shapovalov (Eds) *Problemy izucheniya katakombnoy kulturno--istoricheskoy obschnosti,* 28-30. Zaporozhe.

Kośko A.
2014 Traits of "Early Bronze" Pontic cultures in the development of lowland and eastern European forest cultural environments in the Baltic southern drainage basin. An outline of the state of research. *Baltic-Pontic Studies* 19: 53-73.

Kośko A. (Ed.)
2015 *Podolia as a cultural contact area in the 4th/3rd-2nd millennium BC. Baltic-Pontic Studies* 20.
2017 *Podolia ‚barrow culture' communities: 4th/3rd–2nd millennium BC. Baltic-Pontic Studies* 22.

Kośko A., Klochko V.I.

2009 Transit routes between the Baltic and Black seas: early development stages – from the 3rd to the middle of the 1st millennium BC. An outline of research project. *Baltic-Pontic Studies* 14: 9-18.

Kośko A., Potupczyk M., Razumow S. (Eds)

2014 *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6. Poznań.

Kotova N.S.

2013 *Dereivskaya kultura i pamiatniki nizhnemikhailovskogo tipa.* Kiev.

Larina O., Manzura I., Khakheu V.

2008 *Brevitchenskiye kurgany.* Kishinev.

Lorkiewicz-Muszyńska D., Sobol J., Langer J.L., Kośko A., Włodarczak P., Żurkiewicz D.

2017 Barrow culture "tattoo" rituals and techniques, Pontic-Caspian Steppe/Forest Steppe, Porohy 3A, Yampil Raion, Vinnytsia Oblast. Specialist research perspectives. *Baltic-Pontic Studies* 22: 64-90.

Manzura I.V.

2010 „Vytianutye" pogrebeniya epokhi eneolita v Karpato-Dnestrovskom Regione. *Tyragetia, Serie nouă* 4(1): 35-47.

2016 North Pontic steppes at the oft he 4th millenium BC: the epoch of broken borders. In: A. Zanoci, E. Kaiser, M. Kashuba, E. Izbitser, M. Băţ (Eds) *Man, culture and society from the Copper Age until the Early Iron Age in northern Eurasia (Contributions in honour of the 60th anniversary of Eugen Sava). Tyragetia International* 1, 149-171. Chisinău.

Manzura I.V., Klochko E.O, Savva E.N.

1992 *Kamenskie kurgany.* Kishinev.

Melnik O.,Steblina I.

2013 *Yamnaya kultura serednoyi techiyi Inhultsia.* Kryvyi Rih.

Merpert N.Y.

1974 *Drevneyshiye skotovody Volzhsko-Uralskogo mezhdurechia.* Moskva.

Nikolova A.V., Rassamakin Y.Ya.

1985 O pozdneeneoliticheskikh pamiatnikakh Pravoberezhia Dnepra. *Sovetskaya Arkheologiya* 3: 37-56.

Petrenko V.G.

2010 Kurgan epokhi paleometalla na poberezhe Khadzhibeyskogo limana. In: *Materialy po arkheologii Severnogo Prichernomoria* 11, 303-368. Odessa.

Petrenko V.G., Kovaliukh N.N.

2003 Novye dannye po radiouglerodnoy khronologii eneolita Severo-Zapadnogo Prichernomoria. In: O.H. Korvin-Piotrovskyi (Ed.) *Trypilski poselennia-hihanty v Ukraiyini,* 102-110. Talianki, Kyiv.

Przybyła M.M., Podsiadło M., Potupchyk M., Włodarczak P., Żurkiewicz D.

2017 The Eneolithic ritual barrow complex, Prydnistryanske, Vinnytsia Oblast: magnetometric surveys. *Baltic-Pontic Studies* 22: 30-40.

Rassamakin Y.Ya.

1997 Svit skotariv. In: V. Tolochko (Ed.) *Davna istoriya Ukrainy, vol.* 1, 273--301. Kyiv.

2004 *Die nordpontische Steppe in der Kupferzeit Gräber aus der Mitte des* 5. *Jts. bis Ende des* 4. *Jts. v. Chr. Archäologie in Eurasien* 17. Mainz.

2008 Stepy pivnichnoho Prychornomoria za doby midi. In: *Ukrayina – khronologiya rozvytku. Z davnykh chasiv do piznoyi antichnosti,* 202-218. Kyiv.

2013a From the Late Eneolithic period to the Early Bronze Age in the Black Sea steppe: what is the Pit Grave Culture (late fourth to mid-third millenium BC)? In: V. Heyd, G. Kulcsár, V. Szeverényi (Eds) *Transition to the Bronze Age. Interregional interaction and socio-cultural change in the third millenium BC. Carpathian Basin and neighbouring regions,* 113--138. Budapest.

2013b Pokhovannia kvitianskoyi kultury v konteksti absolutnoyi khronolohii. *Arkheolohiya* 4/2013: 17-41.

Rassamakin Y.Ya., Nikolova A.

2008 Carpathian imports and imitations in context of the Eneolithic and Early Bronze Age of the Black Sea steppe area. In: P.F. Biehl, Y.Ya. Rassamakin (Eds) *Import and Imitation in Archaeology,* 51-87. Langenweißbach.

Razumow S.

2014 Kompenent tradycji kultury jamowej. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 341-346. Poznań.

Rychkov N.A.
2001 Ob uslovnykh tsentrakh nositeley Yamnoy kultury. In: N.A. Ketraru (Ed.) *Severnoe Prichernomore ot eneolita k antichnosti,* 42-66. Tiraspol.

Shaposhnikova O.G, Fomenko V.N., Dovzhenko N.D.
1986 *Yamnaya kulturno-istoricheskaya Oblast (yuzhnobugskiy variant).* Kiev.

Subbotin A.V., Subbotin L.V., Ostroverkhov A.S.
2000 Timkovskiy kurgan v svete problem stepnogo eneolita i kultur bronzovogo veka. In: Y.V. Yarovoy (Ed.) *Chobruchskiy arkheologicheskiy kompleks i drevniye kultury Podnestrovia,* 80-95. Tiraspol.

Sulimirski T.
1968 *Corded Ware and Globular Amphorae North-East of the Carpathians.* London.

Szmyt M.
1999 *Between West and East. People of the Globular Amphora Culture in Eastern Europe, Baltic-Pontic Studies* 8.
2000 In the far reaches of two worlds. On the study of contacts between the societies of the Globular Amphora and Yamnaya cultures. In: S. Kadrow (Ed.) *A Turning of Ages/Im Wandel der Zeiten. Jubilee book dedicated to Professor Jan Machnik on His 70th Anniversary*, 443-466. Kraków.

Włodarczak P.
2006 *Kultura ceramiki sznurowej na Wyżynie Małopolskiej.* Kraków.
2014a Sekwencja czynności obrzędowych: problem korespondencji tradycji funeralnych kultury jamowej i kultury ceramiki sznurowej na Wyżynie Podolskiej. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 313-340. Poznań.
2014b The traits of Early-Bronze Pontic cultures in the development of old upland Corded Ware (Małopolska groups) and Złota culture communities. *Baltic-Pontic Studies* 19: 7-52.

Włodarczak P., Bugaj U., Jarosz P., Koledin J., Novak M., Spašić M.
forthcoming *Archaeological investigations of the „Ciganska humka" at Šajkaš, municipality of Titel, Serbia and the question of the Eneolithic/Early Bronze Age barrows in Vojvodina.*

Yarovoy E.V.
1978 *Otchet o polevykh issledovaniakh eneoliticheskoy archeologicheskoy ekspeditsii v 1977 godu.* Kishinev.

1981 *Kurgan yamnoy kultury u s*. Hrustovaya. In: Arkheologicheskiye issledovaniya v Moldavii (1974-1976 gg.), 45-58. Kishinev.
1985 *Drevneyshie skotovodcheskie plemena yugo-zapada SSSR (klassifikatsiya pogrebalnogo obriada).* Kishinev.
1990 *Kurgany epokhi eneolita-bronzy Nizhnego Podnestrovia.* Kishinev.

LIST OF AUTHORS

Maciej Chyleński
Department of Theory and Methods
in Archaeology
Institute of Archaeology
Adam Mickiewicz University
Umultowska 89d
61-614 Poznań, Poland
maciejchylenski@gmail.com

Michał Dąbrowski
Department of Soil Science and Landscape
Management
Faculty of Earth Sciences
Nicolaus Copernicus University in Toruń
ul. Lwowska 1
87-100 Toruń, Poland
michal.dabrowski@op.pl

Tomasz Goslar
A – Faculty of Physics
Adam Mickiewicz University
Umultowska 85
61-614 Poznań, Poland
B – Poznań Radiocarbon Laboratory
Foundation of the Adam Mickiewicz University
Rubież 46
61-612 Poznań, Poland
tomasz.goslar@radiocarbon.pl

Kacper Jachimowicz
k.jachimowicz89@gmail.com

Michał Jankowski
Department of Soil Science and Landscape
Management
Faculty of Earth Sciences
Nicolaus Copernicus University in Toruń
ul. Lwowska 1
87-100 Toruń, Poland
mijank@umk.pl

Justyna Jasińska
Department of Soil Science and Landscape
Management
Faculty of Earth Sciences
Nicolaus Copernicus University in Toruń
ul. Lwowska 1
87-100 Toruń, Poland
justynaj1804@wp.pl

Anna Juras
Department of Human Evolutionary Biology
Institute of Anthropology, Faculty of Biology
Adam Mickiewicz University in Poznań
Umultowska 89d
61-614 Poznań, Poland
ajuras.anthropology@gmail.com

Joanna Kałużna-Czaplińska
Institute of General and Ecological Chemistry
Department of Chemistry
Lodz University of Technology
Stefana Żeromskiego 116
90-924 Łódź, Poland
joanna.kaluzna-czaplinska@p.lodz.pl

Viktor I. Klochko
Department of Archaeology
National University of Kyiv-Mohyla Academy
Skovorody 2
04665 Kyiv, Ukraine
vklochko@ukr.net

Aleksander Kośko
Department of Prehistory of
Central and Eastern Europe
Institute of Archaeology
Adam Mickiewicz University
Umultowska 89d
61-614 Poznań, Poland
antokol@amu.edu.pl

Jerzy J. Langer
Laboratory for Materials Physicochemistry
and Nanotechnology
Faculty of Chemistry
Adam Mickiewicz University
Umultowska 89b
61-614 Poznań, Poland
langer@amu.edu.pl

Maria Lityńska-Zając
Institute of Archaeology and Ethnology
of Polish Academy of Sciences
Centre for Mountains and Uplands
Archaaeology in Kraków
Sławkowska 17
31-016 Kraków, Poland
marialitynska@gazeta.pl

Dorota Lorkiewicz-Muszyńska
Departament of Forensic Antropology
and Odontology
Poznan University of Medical Sciences

Święcickiego 6
60-781 Poznań, Poland
dlorkiew@gmail.com

Arkadiusz Marciniak
Department of Theory and Methods
in Archaeology
Institute of Archaeology
Adam Mickiewicz University
Umultowska 89d
61-614 Poznań, Poland
arekmar@amu.edu.pl

Adam Michalski
Department of Soil Science and Landscape
Management
Faculty of Earth Sciences
Nicolaus Copernicus University in Toruń
ul. Lwowska 1
87-100 Toruń, Poland
adamich@o2.pl

Michał Podsiadło
"Dolmen" S.C.
pl. Emila Serkowskiego 8/3
30-512 Kraków, Poland
thergo@o2.pl

Mykhailo Potupchyk
Department of Culture and Arts
Khmelnytske St. 7
21036 Vinnitsa, Ukraine
m_potupchik@ukr.net

Marcin M. Przybyła
"Dolmen" S.C.
pl. Emila Serkowskiego 8/3
30-512 Kraków, Poland
megzyk@poczta.onet.pl

Angelina Rosiak
Institute of General and Ecological Chemistry
Department of Chemistry
Lodz University of Technology
Stefana Żeromskiego 116
90-924 Łódź, Poland
angelina.rosiak@gmail.com

Andrzej Sikorski
Departament of Iron Age
Institute of Archaeology
Adam Mickiewicz University
Umultowska 89d
61-614 Poznań, Poland,
ands@amu.edu.pl

Julia Sobol
Department of Pathology and Clinical Genetics
Faculty of Medicine and Health Science
University of Zielona Gora
Zyty 28, 65-046 Zielona Góra, Poland
soboljul@gmail.com

Tomasz Stępnik
UNI-ART Archaeological Laboratory
Świętego Czesława 17a/24
61-583 Poznań, Poland
stepnik.t@wp.pl

Marzena Szmyt
Institute of Eastern Studies
Adam Mickiewicz University
Umultowska 89D
61-614 Poznań, Poland
marzena@amu.edu.pl

Piotr Włodarczak
Institute of Archaeology and Ethnology
of Polish Academy of Sciences
Centre for Mountains and Uplands
Archaeology in Kraków
Sławkowska 17
31-016 Kraków, Poland
wlodarczak.piotr@gmail.com

Yevheniya Y. Yanish
Shmagayzen Institute of Zoology
National Academy of Sciences of Ukraine
Vul. B. Khmelnytskogo15
Kyiv 01030, Ukraine
tinel@ukr.net

Oleh Zhuravlov
Institute of Archaeology
National Academy of Sciences of Ukraine
Heroyiv Stalingrada 12
04210 Kyiv, Ukraine
seretar@iananu.kiev.ua

Danuta Żurkiewicz
Department of Prehistory of
Central and Eastern Europe
Institute of Archaeology
Adam Mickiewicz University
Umultowska 89d
61-614 Poznań, Poland
danuta@amu.edu.pl

Vol. 1: *Weapons of the Tribes of the Northern Pontic Zone in the 16th–10th Centuries BC.*, by Viktor I. Klochko.
Vol. 2: *Nomadism and Pastoralism in the Circle of Baltic–Pontic Early Agrarian Cultures: 5000–1650 BC*, edited by Aleksander Kośko.
Vol. 3: *Cemeteries of the Sofievka type: 2950–2750 BC*, edited by Aleksander Kośko.
Vol. 4: *Eastern Exodus of the Globular Amphora People: 2950–2350 BC*, edited by Aleksander Kośko.
Vol. 5: *Beyond Balkanization*, edited by Lucyna Domańska, Ken Jacobs.
Vol. 6: *The Trzciniec Area of the Early Bronze Age Civilization: 1950–1200 BC*, edited by Aleksander Kośko.
Vol. 7: *The Foundations of Radiocarbon Chronology of Cultures Between the Vistula and Dnieper: 3150–1850 BC,* edited by Aleksander Kośko.
Vol. 8: *Between West And East People of The Globular Amphora Culture in Eastern Europe: 2950–2350 BC*, by Marzena Szmyt.
Vol. 9: *The Western Border Area of the Tripolye Culture,* edited by Aleksander Kośko.
Vol. 10: *Weaponry of Societes of the Northern Pontic Culture Circle: 5000–700 BC*, by Viktor I. Klochko.
Vol. 11: *Fluted Maces in the System of Long-Distance Exchange Trails of the Bronze Age: 2350–800 BC*, edited by Aleksander Kośko.
Vol. 12: *The Foundations of Radiocarbon Chronology of Cultures Between the Vistula and Dnieper: 4000–1000 BC,* edited by Aleksander Kośko and Viktor I. Klochko.
Vol. 13: *Funeral Ries of the Catacomb Community: 2800–1900 BC Ritual, Thanatology and Geographical Origins*, by Katarzyna Ślusarska.
Vol. 14: *Routes between the Seas: Baltic-Bug-Boh-Pont from the 3rd to the Middle of the 1st Millennium BC,* edited by Aleksander Kośko and Viktor I. Klochko.
Vol. 15: *'Cord' Ornaments on Pottery in the Vistula and Dnieper Interfluvial Region: 5th-4th Mill. BC*, edited by Aleksander Kośko and Marzena Szmyt.
Vol. 16: *Flint Atrefacts of Northern Pontic Population of the Early and Middle Bronze Age: 3200–1600 BC*, by Serhiy M. Razumov
Vol. 17: *Wood Tar in the Dnieper and Elbe Communities: VI – II Millenium BC*, by Sławomir Pietrzak
Vol. 18: *The Ingul-Donets Early Bronze Civilization as Springboard for Transmission of Pontic Cultural Patterns to the Baltic Drainage Basin 3200–1750 BC*, edited by Aleksander Kośko and Viktor I. Klochko.
Vol. 19: *Reception Zones of 'Early Bronze Age' Pontic Culture Traditions: Baltic Basin – Baltic and Black Sea Drainage Borderlands, 4/3 Mill. to First Half 2 Mil. BC*, edited by Aleksander Kośko and Viktor I. Klochko.
Vol. 20: *Podolia as a Cultural Contact Area in the 4th/3rd-2nd Millennium BC*, editedy by Aleksander Kośko.
Vol. 21: *Ukrainian Fortresses: a Study of a Strongholds System from the Early Iton Age in Podolia*, edited by Yuriy Boltryk and Marcin Ignaczak

Orders regarding *Baltic-Pontic Studies* should be adressed directly to the Editorial Office (*BPS*, Institute of Prehistory, Umultowska 89D, 61-614 Poznań, Poland). E-mail: iplib@amu.edu.pl; antokol@amu.edu.pl
Moreover, we are pleased to inform that *BPS* volumes currently out of print (1-21) are available online at the Adam Mickiewicz University Repository (AMUR): repozytorium.amu.edu.pl
Starting with volume 20, the BPS is also available on the De Gruyter Open platform.

The project was funded with measures National Science Center awarded by decision numer DEC-2012/07/ B/ HS3/01917. We would like to acknowledge and at the same time express our sincere gratitude for the generosity shown by the following at the Adam Mickiewicz University in making this publication possible: the Dean of the Faculty of History, Institute of Archaeology and Institute of Eastern Studies.

ISSN 1231-0344